Doc no. LEC*-OMY0114

Operation Manual

PRODUCT NAME

AC Servo Motor Driver
(Pulse input type/Positioning type)

MODEL/ Series

LECSB2-T□ Series

SMC Corporation

LECSB2-T☐ 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

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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 brake 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.

LECSB2-T□ 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 and inspections, turn off the power and wait for 15 minutes or more 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, when confirming whether the charge lamp is off or not, always confirm it from the front of the driver. ●Ground the driver and servo motor securely. ●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, it may cause an electric shock. ●Do not operate switches with wet hands. Otherwise, it may cause an electric shock. ●The cables should not be damaged, stressed, loaded, or pinched. Otherwise, it may cause an electric shock. ●During power-on or operation, do not open the front cover of the s driver. Otherwise, it may cause 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 and periodic inspection, do not remove the front cover of the driver even if the power is off. The driver is charged and you may get an electric shock. ●To prevent an electric shock, always connect the protective earth (PE) terminal (marked ⏚) of the driver to the protective earth (PE) of the cabinet. ●When using a residual current device (RCD), select the type B. ●To avoid an electric shock, insulate the connections of the power supply terminals.

2. To prevent fire, note the following

⚠ CAUTION
●Install the driver, servo motor, and regenerative resistor on incombustible material. Installing it directly or close to combustibles will lead to a fire. ●Always connect a magnetic contactor between the power supply and the main circuit power supply (L1, L2, and L3) of the driver, in order to configure a circuit that shuts 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. ●When using the regenerative resistor, switch power off with the alarm signal. Not doing so may cause a fire when a regenerative transistor malfunctions or the like may overheat the regenerative resistor. ●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 molded-case circuit breaker to the power supply of the driver.

3. To prevent injury, note the following

⚠ CAUTION
●Only the voltage specified in the Instruction Manual should be applied to each terminal. Otherwise, a burst, damage, etc. may occur. ●Connect cables to the correct terminals. Otherwise, a burst, damage, etc. may occur. ●Ensure that polarity (+/-) is correct. Otherwise, a burst, damage, etc. may occur. ●The driver heat sink, regenerative resistor, servo motor, etc. may be hot while power is on or for some time after power-off. Take safety measures, e.g. provide covers, to prevent accidental contact of hands and parts (cables, etc.) with them.

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 product packages is not allowed.
- Do not hold the front cover when transporting the driver. Otherwise, it may drop.
- Install the driver and the servo motor in a load-bearing place in accordance with the Instruction Manual.
- Do not get on or put heavy load on the equipment.
- The equipment must be installed in the specified direction.
- Leave specified clearances between the driver and the cabinet walls or other equipment.
- Do not install or operate the driver and servo motor which have been damaged or have any parts missing.
- Do not block the intake and exhaust areas of the driver. Otherwise, it may cause a malfunction.
- Do not drop or strike the driver and servo motor. Isolate them from all impact loads.
- When you keep or use the equipment, please fulfill the following environment.

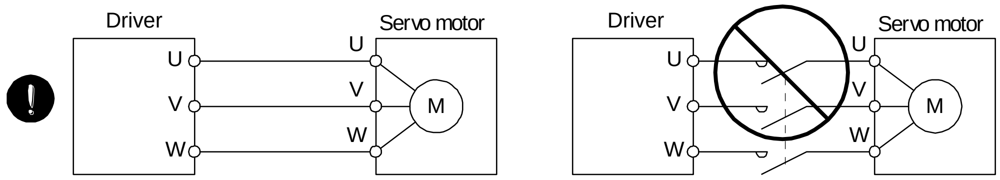
<table>
<tr><th colspan="3" rowspan="2">Environment</th><th colspan="3">Conditions</th></tr>
<tr><th>Driver</th><th colspan="2">Servo motor</th></tr>
<tr><td rowspan="4">Ambient temperature</td><td rowspan="2">In operation</td><td>[°C]</td><td>0 to +55 (non-freezing)</td><td colspan="2">0 to +40 (non-freezing)</td></tr>
<tr><td>[°F]</td><td>32 to 131 (non-freezing)</td><td colspan="2">32 to 104 (non-freezing)</td></tr>
<tr><td rowspan="2">In storage</td><td>[°C]</td><td>−20 to +65 (non-freezing)</td><td colspan="2">−15 to +70 (non-freezing)</td></tr>
<tr><td>[°F]</td><td>−4 to 149 (non-freezing)</td><td colspan="2">5 to 158 (non-freezing)</td></tr>
<tr><td rowspan="2">Ambient humidity</td><td colspan="2">In operation</td><td>90%RH or less (non-condensing)</td><td colspan="2">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. 2000m (6560 ft) above sea level</td></tr>
<tr><td>(Note) Vibration</td><td colspan="2">[m/s²]</td><td>5.9 or less at 10 Hz to 55 Hz (directions of X, Y and Z axes)</td><td>LECSB2-T5
LECSB2-T7
LECSB2-T8
LECSB2-T9
series</td><td>X・Y: 49</td></tr>
</table>

- When handling the driver, be careful about the edged parts such as corners of the driver.
- The driver must be installed in the metal cabinet.

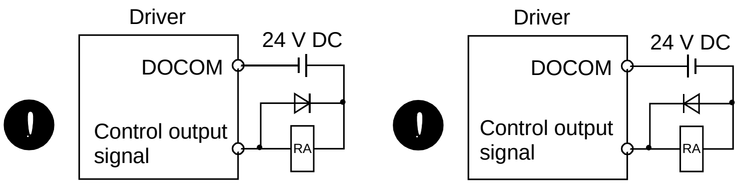
(2) Wiring

⚠ CAUTION

- Perform wiring correctly and securely. It may cause unexpected movement of the servo motor.
- Do not attach a phase-advancing capacitor, surge killer, or radio noise filter (FR-BIF manufactured by Mitsubishi Electric Corporation) to the output side of the driver.
- Connect the driver and servo motor power phases (U, V, W) correctly, as this may cause the servo motor to malfunction.
- Connect the driver power output (U, V, and W) to the servo motor power input (U, V, and W) directly. Do not let a magnetic contactor, etc. intervene. Otherwise, it may cause a malfunction.



- 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, the cable or terminal block may generate heat because of the poor contact. Be sure to tighten the cable with specified torque.
- Connecting a servo motor for different axis to the U, V, W, or CN2 may cause a malfunction.
- Configure a circuit turn off EM2 or EM1 whenthe main circuitpower supply is turned off to prevernt an unexpected restart of the driver
- To prevent malfunction, avoid bundling power lines (input/output) and signal cables together or running them in parallel to each other. Separate the power lines from the signal cables.

(3) Test run and adjustment

⚠ CAUTION

- Before operation, check the parameter settings. Improper settings may cause some machines to perform unexpected operation.
- Never adjust or change the parameter values extremely as it will make operation unstable.
- Do not close to moving parts at servo-on status.

(4) Usage

⚠ CAUTION

- Provide an external emergency stop circuit to ensure that operation can be stopped and power switched off immediately.
- Do not disassemble, repair, or modify the equipment.
- Before resetting an alarm, make sure that the run signal of the driver is off in order to prevent a sudden restart. Otherwise, it may cause an accident.

- Use a noise filter to reduce the effects of electromagnetic interference. Electromagnetic interference may occur on electronic devices used near the driver.
- Do not burn or disassemble the driver, as toxic gas may be generated.

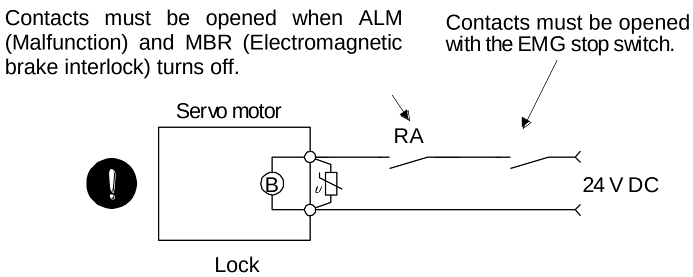
⚠ CAUTION

- Use a noise filter, etc. to minimize the influence of electromagnetic interference. Electromagnetic interference may be given to the electronic equipment used near the driver.
- Burning or breaking a driver may cause a toxic gas. Do not burn or break it.
- 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 occur due to a power failure or product malfunction, use a servo motor with a lock or external lock to prevent the condition.
- **<u>Do not use the 24 V DC interface power supply for the lock.</u>**
  - Configure a lock circuit so that it is activated also by an external EMG stop switch.



Refer to section 3.10.3 when wiring for the circuit configuration.

- When any alarm has occurred, eliminate its cause, ensure safety, and deactivate the alarm before restarting operation.
- Provide an adequate protection to prevent unexpected restart after an instantaneous power failure.

(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 malfunction, it is recommend that the electrolytic capacitor be replaced every 10 years when it is used in general environment. Please contact your local sales office.

(7) General instruction

- To illustrate details, the equipment in the diagrams of this 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. Please display or notify the final product as necessary.

⚠ 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 driver may malfunction when the EEP-ROM reaches the end of its useful life.

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

STO function of the driver

This driver complies with the safety level SIL 3 of the international standard IEC 61508: 2010 for functional safety.
When using the STO function of the driver, refer to chapter 13.

Compliance with global standards

For the compliance with global standards, refer to appendix 4.

«About the manuals»

You must have this Instruction Manual and the following manuals to use this servo. Ensure to prepare them to use the LECSB2-T□ safely.

«Wiring»

Wires mentioned in this Instruction Manual are selected based on the ambient temperature of 40 °C.

«U.S. customary units»

U.S. customary units are not shown in this manual. Convert the values if necessary according to the following table.

Quantity	SI (metric) unit	U.S. customary unit
Mass	1 [kg]	2.2046 [lb]
Length	1 [mm]	0.03937 [in]
Torque	1 [N•m]	141.6 [oz•in]
Moment of inertia	1 [(× 10^{-4} kg•m^2)]	5.4675 [oz•in^2]
Load (thrust load/axial load)	1 [N]	0.2248 [lbf]
Temperature	N [°C] × 9/5 + 32	N [°F]

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1. FUNCTIONS AND CONFIGURATION

1. FUNCTIONS AND CONFIGURATION

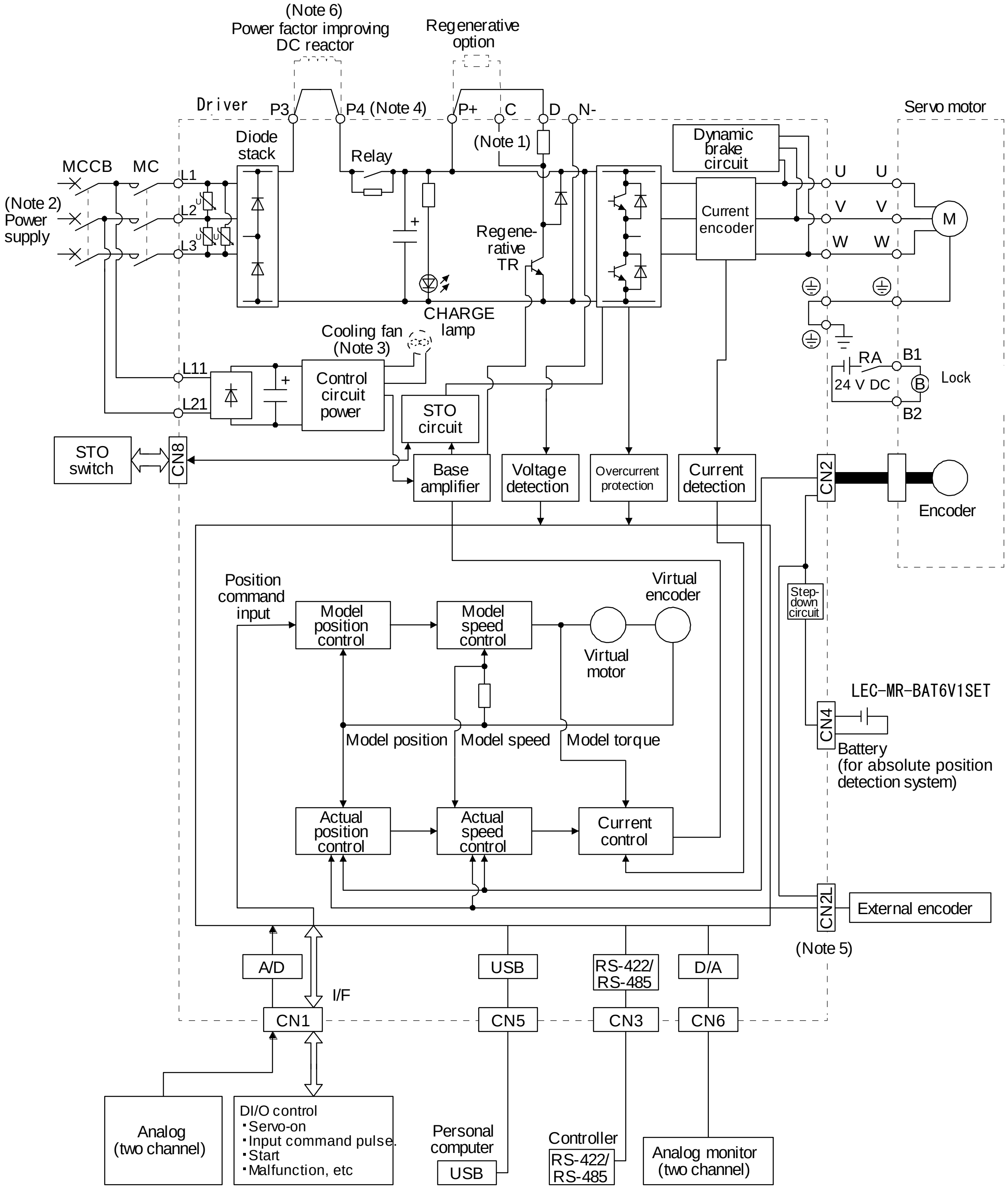
1.1 Summary

The LECSB2-T□ series general-purpose AC servo has further higher performance and higher functions compared to the previous LECSB□-S□ series.
The LECSB2-T□ series compatible rotary servo motor is equipped with 22-bit (4,194,304 pulses/rev) high-resolution absolute encoder. In addition, speed frequency response is increased to 2.5 kHz. Thus, faster and more accurate control is enabled as compared to the LECSB□-S□ series.
The driver has position, speed, and torque control modes. In the position control mode, the maximum pulse train of 4 Mpulses/s is supported. Further, it can perform operation with the control modes switched, 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.
With one-touch tuning and real-time auto tuning, you can automatically adjust the servo gains according to the machine.
The tough drive function and the drive recorder function, which are well-received in the LECSA□-S□ series, have been improved. The driver supports the improved functions. Additionally, the preventive maintenance support function detects an error in the machine parts. This function provides strong support for the machine maintenance and inspection.
The LECSB2-T□ driver supports the STO (Safe Torque Off) function. By combining with optional MR-J3-D05, the driver supports SS1 (Safe Stop 1) function.
The driver has a USB communication interface. Therefore, you can connect the driver to the personal computer with Setup software (MR Configurator2^{TM}) installed to perform the parameter setting, test operation, gain adjustment, and others.

1.2 Function block diagram

The function block diagram of this servo is shown below.

(1) LECSB2-T□



Note 1. The built-in regenerative resistor is not provided for LECSB2-T5.
2. For 1-phase 200 V AC to 240 V AC, connect the power supply to L1 and L3. Leave L2 open. For the power supply specifications, refer to section 1.3.
3. Drivers LECSB2-T9 or more have a cooling fan.
4. The LECSB2-T□driver has P3 and P4 in the upstream of the inrush current suppression circuit. They are different from P1 and P2 of the LECSB□-S□ drivers.
5. CN2L cannot be used. Connect the encoder cable to CN2.
6. short P3 and P4.

1.3 Driver standard specifications

Model: LECSB2-T□		5	7	8	9
Output	Rated voltage	3-phase 170 V AC			
	Rated current [A]	1.1	1.5	2.8	5.8
Main circuit power supply	Voltage/Frequency	3-phase or 1-phase 200 V AC to 240 V AC, 50 Hz/60 Hz			
	Rated current [A]	0.9	1.5	2.6	3.8
	Permissible voltage fluctuation	3-phase or 1-phase 170 V AC to 264 V AC			
	Permissible frequency fluctuation	Within ±5%			
	Power supply capacity [kVA]	Refer to section 10.2.			
	Inrush current [A]	Refer to section 10.5.			
Control circuit power supply	Voltage/Frequency	1-phase 200 V AC to 240 V AC, 50 Hz/60 Hz			
	Rated current [A]	0.2			
	Permissible voltage fluctuation	1-phase 170 V AC to 264 V AC			
	Permissible frequency fluctuation	Within ±5%			
	Power consumption [W]	30			
	Inrush current [A]	Refer to section 10.5.			
Interface power supply	Voltage	24 V DC ± 10%			
	Current capacity [A]	(Note 1) 0.5 (including CN8 connector signals)			
Control method		Sine-wave PWM control, current control method			
Dynamic brake		Built-in			
Communication function		USB: connection to a personal computer or others (setup software (MR Configurator2™)-compatible)			
Encoder output pulses		Compatible (A/B/Z-phase pulse)			
Analog monitor		Two channels			
Position control mode	Max. input pulse frequency	4 Mpulses/s (for differential receiver) (Note 6), 200 kpulses/s (for open collector)			
	Positioning feedback pulse	Encoder resolution (resolution per servo motor revolution): 22 bits			
	Command pulse multiplying factor	Electronic gear A:1 to 16777215, B:1 to 16777215, 1/10 < A/B < 4000			
	In-position range setting	0 pulse to ±65535 pulses (command pulse unit)			
	Error excessive	±3 revolutions			
	Torque limit	Set by parameter setting or external analog input (0 V DC to +10 V DC/maximum torque)			
Speed control mode	Speed control range	Analog speed command 1: 2000, Internal speed command 1: 5000			
	Analog speed command input	0 to ±10 V DC/rated speed (The speed at 10 V is changeable with [Pr. PC12].)			
	Speed fluctuation ratio	±0.01% or less (load fluctuation: 0% to 100%), 0% (power fluctuation: ±10%) ±0.2% or less (ambient temperature: 25 °C ± 10 °C) when using analog speed command			
	Torque limit	Set by parameter setting or external analog input (0 V DC to +10 V DC/maximum torque)			
Torque control mode	Analog torque command input	0 V DC to ±8 V DC/maximum torque (input impedance 10 kΩ to 12 kΩ)			
	Speed limit	Set by parameter setting or external analog input (0 V DC to 10 V DC/rated speed)			
Positioning mode		Refer to Chapter 16.			
Protective functions		Overcurrent shut-off, regenerative overvoltage shut-off, overload shut-off (electronic thermal), servo motor overheat protection, encoder error protection, regenerative error protection, undervoltage protection, instantaneous power failure protection, overspeed protection, error excessive protection			
Safety function		STO (IEC/EN 61800-5-2)			
Safety performance	Standards certified by CB	EN ISO 13849-1 category 3 PL e, EN 61508 SIL 3, EN 62061 SIL CL 3, and EN 61800-5-2			
	Response performance	8 ms or less (STO input off → energy shut off)			

	(Note 3) Test pulse input (STO)		Test pulse interval: 1 Hz to 25 Hz Test pulse off time: Up to 1 ms		
	Mean time to dangerous failure (MTTFd)		MTTFd ≥ 100 [years]		
	Diagnosis coverage (DC)		DC = Medium, 97.6 [%]		
	Average probability of dangerous failures per hour (PFH)		PFH = 6.4 × 10^{-9} [1/h]		
Compliance to global standards	CE marking		LVD: EN 61800-5-1 EMC: EN 61800-3 MD: EN ISO 13849-1, EN 61800-5-2, EN 62061		
	UL standard		UL 508C		
Structure (IP rating)			Natural cooling, open (IP20)		Force cooling, open (IP20)
Close mounting (Note 2)			Possible		
Environment	Ambient temperature	Operation	0 ˚C to 55 ˚C (non-freezing)		
		Storage	-20 ˚C to 65 ˚C (non-freezing)		
	Ambient humidity	Operation	5% to 90 %RH (non-condensing)		
		Storage			
	Ambience		Indoors (no direct sunlight), free from corrosive gas, flammable gas, oil mist, dust, and dirt		
	Altitude		2000 m or less above sea level(note7)		
	Vibration resistance		5.9 m/s^2, at 10 Hz to 55 Hz (directions of X, Y and Z axes)		
Mass [kg]			0.8	1.0	1.4

Note 1. 0.5 A 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 drivers, operate them at the ambient temperature of 0 ˚C to 45 ˚C or at 75% or smaller effective load ratio.
3. Test pulse is a signal which instantaneously turns off a signal to the driver at a constant period for external circuit to self-diagnose.
4. Except for the terminal block.
5. The safety level depends on the setting value of [Pr. PF18 STO diagnosis error detection time] and whether STO input diagnosis by TOFB output is performed or not. For details, refer to the Function column of [Pr. PF18] in section 5.2.6.
6. Follow the restrictions in section 2.6 when using this product at altitude exceeding 1000 m and up to 2000 m above sea level.

1.4 Combinations of driver and servo motors

Driver	Servo motor
	LE-□-□
LECSB2-T5	T5, T6
LECSB2-T7	T7
LECSB2-T8	T8
LECSB2-T9	T9

1.5 Function list

The following table lists the functions of this servo. For details of the functions, refer to each section indicated in the detailed explanation field.

Function	Description	Detailed explanation
Model adaptive control	This realizes a high response and stable control following the ideal model. The two-degrees-of-freedom-model model adaptive control enables you to set a response to the command and response to the disturbance separately. Additionally, this function can be disabled. Refer to section 7.5 for disabling this function.	
Position control mode	This driver is used as a position control servo.	Section 3.2.1 Section 3.6.1 Section 4.2
Speed control mode	This driver is used as a speed control servo.	Section 3.2.2 Section 3.6.2 Section 4.3
Torque control mode	This driver is used as a torque control servo.	Section 3.2.3 Section 3.6.3 Section 4.4
Positioning mode	Used when you use an LECSB2-T□ driver in the positioning mode under the point table/program/indexer method.	Section 16
Position/speed control change mode	Using an input device, control can be switched between position control and speed control.	Section 3.6.4
Speed/torque control change mode	Using an input device, control can be switched between speed control and torque control.	Section 3.6.5
Torque/position control change mode	Using an input device, control can be switched between torque control and position control.	Section 3.6.6
High-resolution encoder	High-resolution encoder of 4,194,304 pulses/rev is used as the encoder of the rotary servo motor compatible with the LECSB2-T□ series.	
Absolute position detection system	Merely setting a home position once makes home position return unnecessary at every power-on.	Chapter 12
Gain switching function	You can switch gains during rotation and during stop, and can use an input device to switch gains during operation.	Section 7.2
Advanced vibration suppression control II	This function suppresses vibration at the arm end or residual vibration.	Section 7.1.5
Machine resonance suppression filter	This is a filter function (notch filter) which decreases the gain of the specific frequency to suppress the resonance of the mechanical system.	Section 7.1.1
Shaft resonance suppression filter	When a load is mounted to the servo motor shaft, resonance by shaft torsion during driving may generate a mechanical vibration at high frequency. The shaft resonance suppression filter suppresses the vibration.	Section 7.1.3
Adaptive filter II	Driver detects mechanical resonance and sets filter characteristics automatically to suppress mechanical vibration.	Section 7.1.2
Low-pass filter	Suppresses high-frequency resonance which occurs as servo system response is increased.	Section 7.1.4
Machine analyzer function	Analyzes the frequency characteristic of the mechanical system by simply connecting an Setup software (MR Configurator2™) installed personal computer and driver. Setup software (MR Configurator2™) is necessary for this function.	
Robust filter	This function provides better disturbance response in case low response level that load to motor inertia ratio is high for such as roll send axis.	[Pr. PE41]
Slight vibration suppression control	Suppresses vibration of ±1 pulse produced at a servo motor stop.	[Pr. PB24]
Electronic gear	Input pulses can be multiplied by 1/10 to 4000.	[Pr. PA06] [Pr. PA07]
S-pattern acceleration/ deceleration time constant	Speed can be increased and decreased smoothly.	[Pr. PC03]

Function	Description	Detailed explanation
Auto tuning	Automatically adjusts the gain to optimum value if load applied to the servo motor shaft varies.	Section 6.3
Brake unit	Used when the regenerative option cannot provide enough regenerative power. Can be used for the 5 kW or more driver.	Section 11.3
Power regeneration converter	Used when the regenerative option cannot provide enough regenerative power. Can be used for the 5 kW or more driver.	Section 11.4
Regenerative option	Used when the built-in regenerative resistor of the driver does not have sufficient regenerative capability for the large regenerative power generated.	Section 11.2
Alarm history clear	Alarm history is cleared.	[Pr. PC18]
Input signal selection (device settings)	ST1 (Forward rotation start), ST2 (Reverse rotation start), and SON (Servo-on) and other input device can be assigned to any pins.	[Pr. PD03] to [Pr. PD22]
Output signal selection (device settings)	The output devices including MBR (Electromagnetic brake interlock) can be assigned to certain pins of the CN1 connector.	[Pr. PD23] to [Pr. PD26] [Pr. PD28] [Pr. PD47]
Output signal (DO) forced output	Output signal can be forced on/off independently of the servo status. Use this function for checking output signal wiring, etc.	Section 4.5.8
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. (available in the future)	
Command pulse selection	Command pulse train form can be selected from among three different types.	[Pr. PA13]
Torque limit	Servo motor torque can be limited to any value.	Section 3.6.1 (5) [Pr. PA11] [Pr. PA12]
Speed limit	Servo motor speed can be limited to any value.	Section 3.6.3 (3) [Pr. PC05] to [Pr. PC11]
Status display	Servo status is shown on the 5-digit, 7-segment LED display	Section 4.5
External I/O signal display	On/off statuses of external I/O signals are shown on the display.	Section 4.5.7
Automatic VC offset	Voltage is automatically offset to stop the servo motor if it does not come to a stop when VC (Analog speed command) or VLA (Analog speed limit) is 0 V.	Section 4.5.4
Alarm code output	If an alarm has occurred, the corresponding alarm number is outputted in 3-bit code.	Chapter 8
Test operation mode	Jog operation, positioning operation, motor-less operation, DO forced output, and program operation can be used. Setup software (MR Configurator2™) is required to perform positioning operation or program operation.	Section 4.5.9
Analog monitor output	Servo status is output in terms of voltage in real time.	[Pr. PC14], [Pr. PC15]
Setup software (MR Configurator2™)	Using a personal computer, you can perform the parameter setting, test operation, monitoring, and others.	Section 11.7
One-touch tuning	Gain adjustment is performed just by one click on a certain button on Setup software (MR Configurator2™) or operation section.	Section 6.2
SEMI-F47 function	Enables to avoid triggering [AL. 10 Undervoltage] using the electrical energy charged in the capacitor in case that an instantaneous power failure occurs during operation. Use a 3-phase for the input power supply of the driver. Using a 1-phase 100 V AC/200 V AC for the input power supply will not comply with SEMI-F47 standard.	[Pr. PA20] [Pr. PE25] Section 7.4
Tough drive function	This function makes the equipment continue operating even under the condition that an alarm occurs. The tough drive function includes two types: the vibration tough drive and the instantaneous power failure tough drive.	Section 7.3

<table>
<tr><th colspan="2">Function</th><th>Description</th><th>Detailed explanation</th></tr>
<tr><td colspan="2">Drive recorder function</td><td>This function continuously monitors the servo status and records the status transition before and after an alarm for a fixed period of time. You can check the recorded data on the drive recorder window on Setup software (MR Configurator2™) by clicking the "Graph" button.
However, the drive recorder will not operate on the following conditions.
1. You are using the graph function of Setup software (MR Configurator2™).
2. You are using the machine analyzer function.
3. [Pr. PF21] is set to "-1".</td><td>[Pr. PA23]</td></tr>
<tr><td colspan="2">STO function</td><td>This function is a functional safety that complies with IEC/EN 61800-5-2. You can create a safety system for the equipment easily.</td><td>Chapter 13</td></tr>
<tr><td colspan="2">Driver life diagnosis function</td><td>You can check the cumulative energization time and the number of on/off times of the inrush relay. This function gives an indication of the replacement time for parts of the driver including a capacitor and a relay before they malfunction.
Setup software (MR Configurator2™) is necessary for this function.</td><td></td></tr>
<tr><td colspan="2">Power monitoring function</td><td>This function calculates the power running energy and the regenerative power from the data in the driver such as speed and current. Power consumption and others are displayed on Setup software (MR Configurator2™).</td><td></td></tr>
<tr><td colspan="2">Machine diagnosis function</td><td>From the data in the driver, this function estimates the friction and vibrational component of the drive system in the equipment and recognizes an error in the machine parts, including a ball screw and bearing.
Setup software (MR Configurator2™) is necessary for this function.</td><td></td></tr>
<tr><td colspan="2">Lost motion compensation function</td><td>This function improves the response delay occurred when the machine moving direction is reversed.</td><td>Section 7.6</td></tr>
<tr><td colspan="2">Super trace control</td><td>This function sets constant and uniform acceleration/deceleration droop pulses to almost 0.</td><td>Section 7.7</td></tr>
<tr><td rowspan="2">Mark detection</td><td>Current position latch function</td><td>When the mark detection signal is turned on, the current position is latched. The latched data can be read with communication commands.</td><td rowspan="2">Section 16</td></tr>
<tr><td>Interrupt positioning function</td><td>When MSD (Mark detection) turns on, this function converts the remaining distance to the travel distance set in [Pr. PT30] and [Pr. PT31] (Mark sensor stop travel distance).</td></tr>
<tr><td colspan="2">High-resolution analog input (VC)</td><td>The analog input resolution can be increased to 16 bits.</td><td>[Pr. PC60]</td></tr>
</table>

1.6 Model designation

(1) Rating plate

LECS B 2 — T5

* If I/O connector(CN1) is required, order the part number "LE-CSNB" separately.
* If I/O cable(CN1) is required, order the part number "LEC-CSNB-1" separately.
(In other than the positioning mode, the electric actuator cannot operate unless the forced stop (EM2) wiring is performed, so an I/O connector or I/O cable is required.)

Driver type

B	Pulse input type /Positioning type (Absolute encoder)

Power supply

2	AC200V～AC240V 50/60Hz

Motor type

	Type	Capacity	Encoder
T5	AC Servo motor (T6) *1	100W	Absolute
T7	AC Servo motor (T7) *1	200W	
T8	AC Servo motor (T8) *1	400W	
T9	AC Servo motor (T9) *1	750W	

*1 This is a symbol of motor type (actuator part).

(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 (For LECSB2-T□)

LE-CSNB

(In other than the positioning mode, the electric actuator cannot operate unless the forced stop (EM2) wiring is performed, so an I/O connector or I/O cable is required.)

Driver Type

B	LECSB2-T

*LE-CSNS is 10126-3000PE (Connector)/ 10320-52F0-008 (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□

Language

NIL	Japanese version
E	English version
C	Chinese version

* SW1DNc-MRC2-J of Mitsubishi Electric Corporation.
Refer to the website of Mitsubishi Electric Corporation for the information of the operating environment and upgrading. Order USB cable separately.
*LECSB2-T□ cannot be used by LEC-MR-SETUP221□.

e) USB cable(3m)

LEC-MR-J3USB

* MR-J3USBCBL3M of Mitsubishi Electric Corporation.

f) Battery

LEC-MR-BAT6V1SET

* MR-BAT6V1SET of Mitsubishi Electric Corporation.
Battery for replacement.
Absolute position data is maintained by installing the battery to the driver.

g) STO cable(3m)

LEC−MR−D05UDL3M

* MR-D05UDL3M of Mitsubishi Electric Corporation.
It is a cable that connects the driver with the equipment when the safety function is used.
Do not use other cables.

h) I/O Connector

LEC-CSNB-1

(In other than the positioning mode, the electric actuator cannot operate unless the forced stop (EM2) wiring is performed, so an I/O connector or I/O cable is required.)

● Cable length(L)[m]

1	1.5

● Driver Type

B	LECSB2-T

*LEC-CSNB-1 is 10120-3000PE (Connector)/ 10320-52F0-008（Shell kit）of Sumitomo 3M Limited or equivalent goods.
*Conductor size:AWG24

Wiring
LEC-CSNB-1: Pin nos. 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

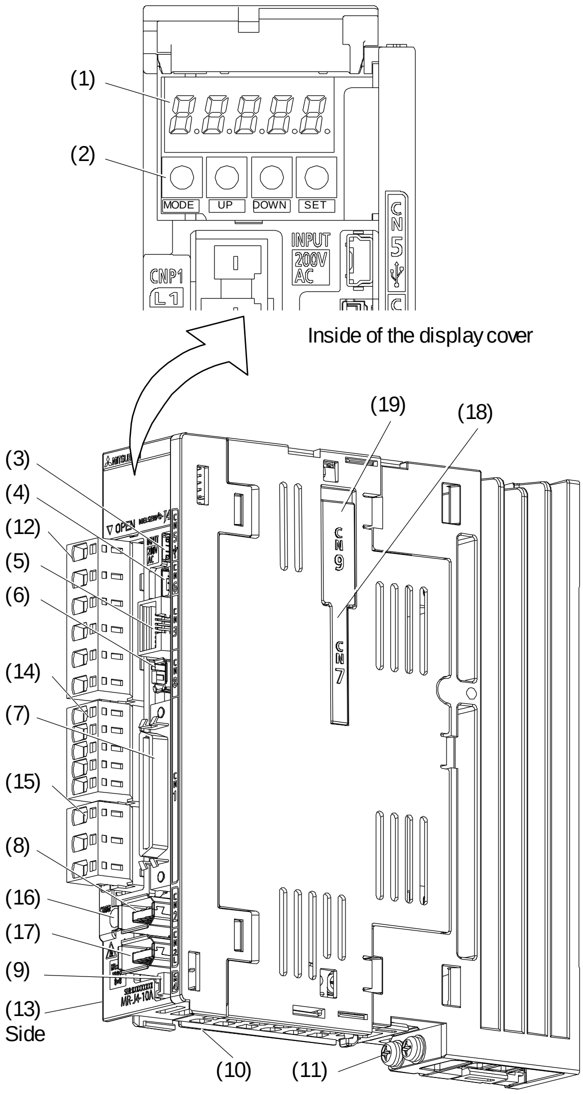
	Connector pin no.	Pair no. of wire	Insulation color	Dot mark	Dot color
A side	19	10	Pink	■ ■	Red
	20			■ ■	Black
	21	11	Orange	■ ■ ■	Red
	22			■ ■ ■	Black
	23	12	Light gray	■ ■ ■	Red
	24			■ ■ ■	Black
	25	13	White	■ ■ ■	Red
	26			■ ■ ■	Black
	27	14	Yellow	■ ■ ■	Red
	28			■ ■ ■	Black
	29	15	Pink	■ ■ ■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

1.7 Structure

1.7.1 Parts identification

(1) LECSB2-T□



No.	Name/Application	Detailed explanation
(1)	Display The 5-digit, 7-segment LED shows the servo status and the alarm number.	Section 4.5
(2)	Operation section Used to perform status display, diagnostic, alarm, and parameter setting operations. Push the "MODE" and "SET" buttons at the same time for 3 s or more to switch to the one-touch tuning mode. MODE UP DOWN SET SET: Used to set data. Push this button together with the "MODE" button for 3 s or more to switch to the one-touch tuning mode. UP/DOWN: Used to change the display or data in each mode. MODE: Used to change the mode Push this button together with the "SET" button for 3 s or more to switch to the one-touch tuning mode.	Section 4.5
(3)	USB communication connector (CN5) Connect with the personal computer.	Section 11.7
(4)	Analog monitor connector (CN6) Outputs the analog monitor.	Section 3.2
(5)	RS-422/RS-485 communication connector (CN3) Connect with the RS-422/RS-485 communication controller, etc.	Chapter 14
(6)	STO input signal connector (CN8) Used to connect the MR-J3-D05 (manufactured by Mitsubishi Electric Corporation) safety logic unit and external safety relay.	Chapter 13 App. 5
(7)	I/O signal connector (CN1) Used to connect digital I/O signals.	Section 3.2 Section 3.4
(8)	Encoder connector (CN2) Used to connect the servo motor encoder or external encoder.	Section 3.4
(9)	Battery connector (CN4) Used to connect the battery for absolute position data backup.	Chapter 12
(10)	Battery holder Install the battery for absolute position data backup.	Section 12.2
(11)	Protective earth (PE) terminal	Section 3.1 Section 3.3
(12)	Main circuit power connector (CNP1) Connect the input power supply.	
(13)	Rating plate	Section 1.6
(14)	Control circuit power connector (CNP2) Connect the control circuit power supply and regenerative option.	Section 3.1 Section 3.3
(15)	Servo motor power output connector (CNP3) Connect the servo motor.	
(16)	Charge lamp When the main circuit is charged, this will light up. While this lamp is lit, do not reconnect the cables.	
(17)	External encoder connector (CN2L) Refer to table 1.1 for the compatible external encoders.	

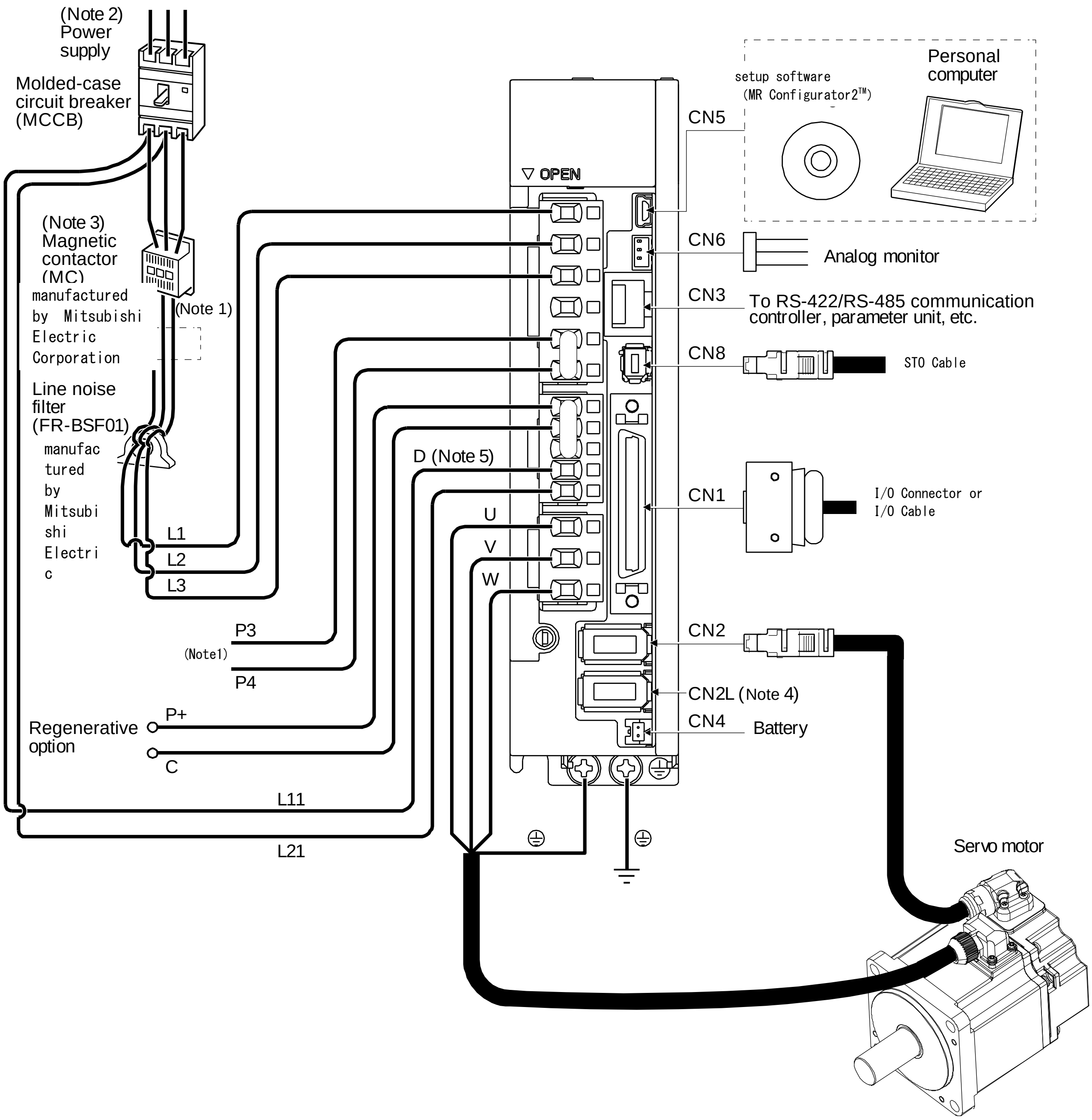
1.8 Configuration including peripheral equipment

⚠CAUTION	●Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the driver may cause a malfunction.

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

(1) LECSB2-T□

The diagram shows LECSB2-T7.



Note 1. The power factor improving AC reactor can also be used.
2. For 1-phase 200 V AC to 240 V AC, connect the power supply to L1 and L3. Leave L2 open. For the power supply specifications, refer to section 1.3.
3. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
4. CN2L can not be used. Connect the encoder cable to CN2.
5. Always connect between P+ and D terminals. When using the regenerative option, refer to section 11.2.

2. INSTALLATION

2. INSTALLATION

⚠WARNING	●To prevent electric shock, ground each equipment securely.

⚠CAUTION	●Stacking in excess of the specified number of product packages is not allowed. ●Do not hold the front cover, cable, or connector when carrying the driver. It may fall. ●Install the equipment on incombustible material. Installing it directly or close to combustibles will lead to a fire. ●Install the driver and the servo motor in a load-bearing place in accordance with this manual. ●Do not get on or put heavy load on the equipment. Otherwise, it may cause injury. ●Use the equipment within the specified environment. For the environment, refer to section 1.3. ●Provide an adequate protection to prevent screws and other conductive matter, oil and other combustible matter from entering the driver. ●Do not block the intake and exhaust areas of the driver. Otherwise, it may cause a malfunction. ●Do not drop or strike the driver. Isolate it from all impact loads. ●Do not install or operate the driver which have been damaged or have any parts missing. ●When the equipment 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 corners of the driver. ●The driver must be installed in the metal cabinet.

POINT

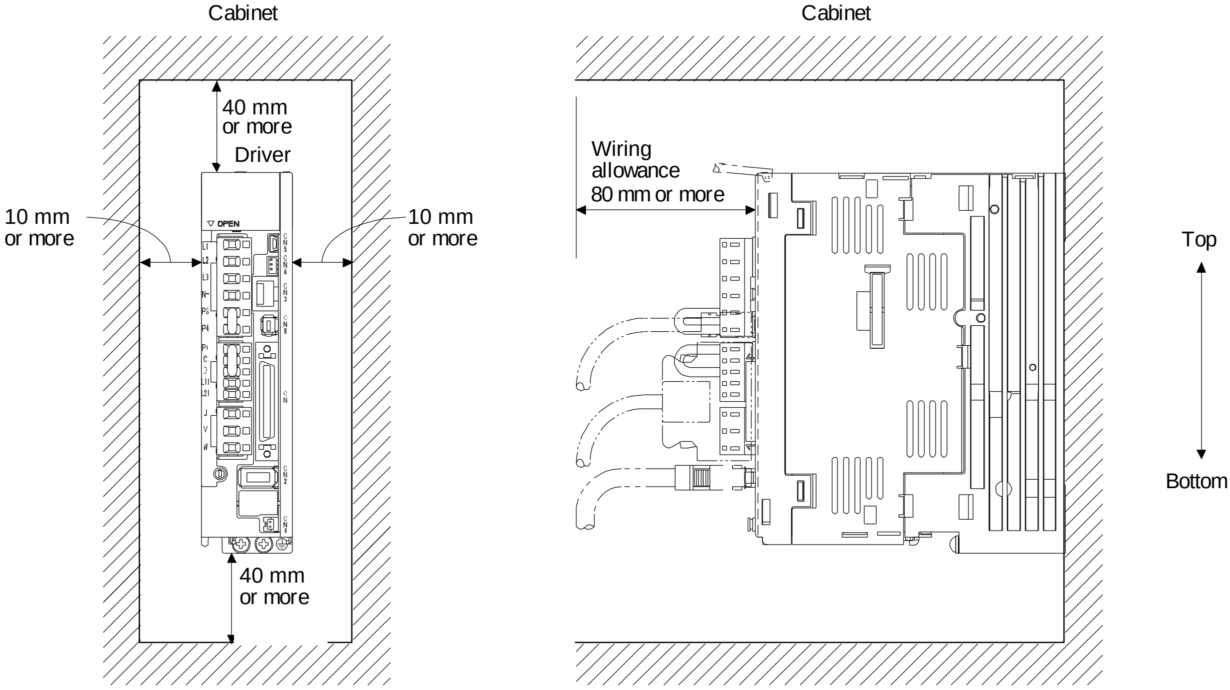
●When pulling out CNP1, CNP2, and CNP3 connectors of LECSB2-T8 or less drivers, pull out CN3 and CN8 connectors beforehand.

2.1 Installation direction and clearances

⚠CAUTION	●The equipment must be installed in the specified direction. Otherwise, it may cause a malfunction. ●Leave specified clearances between the driver and the cabinet walls or other equipment. Otherwise, it may cause a malfunction.

(1) Installation clearances of the driver

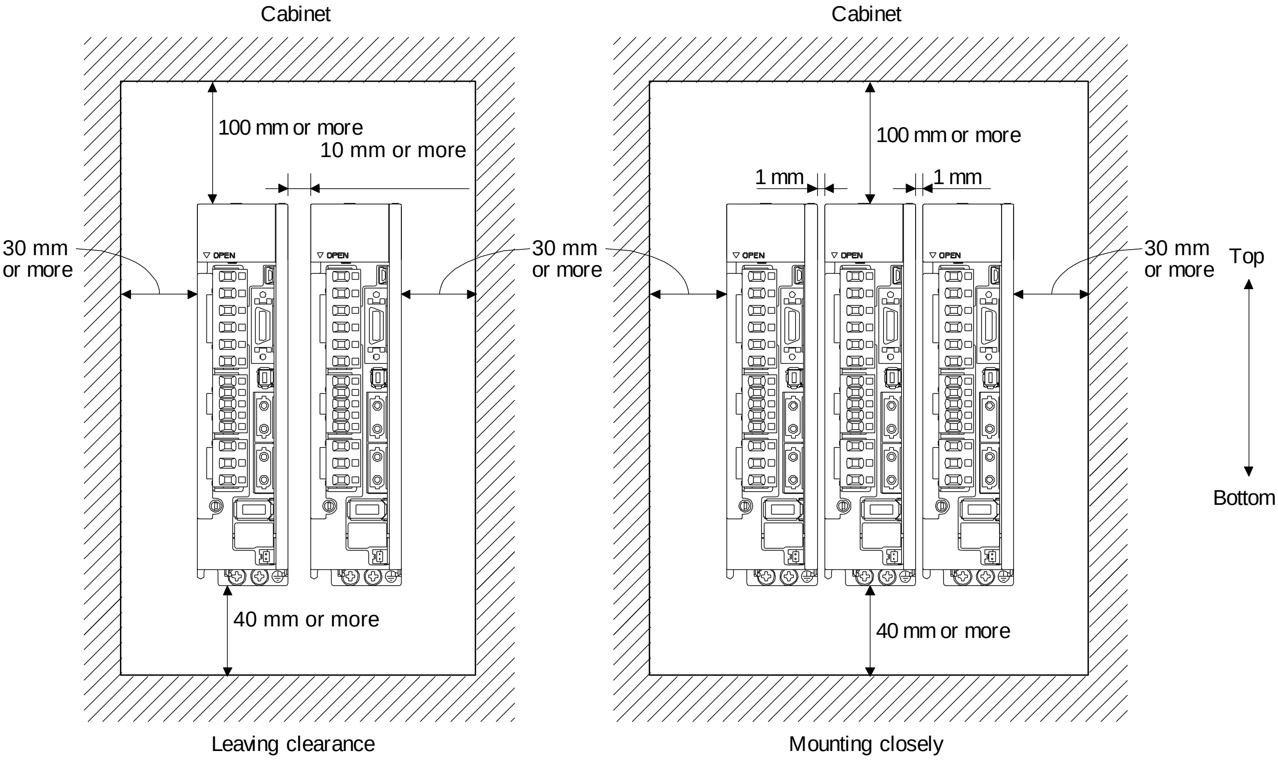
(a) Installation of one driver



(b) Installation of two or more drivers

POINT
●Close mounting is possible depending on the capacity of the driver. Refer to section 1.3 for availability of close mounting. ●When mounting the drivers closely, do not install the driver whose depth is larger than that of the left side driver since CNP1, CNP2, and CNP3 connectors cannot be disconnected.

Leave a large clearance between the top of the driver and the cabinet walls, and install a cooling fan to prevent the internal temperature of the cabinet from exceeding the environment.
When mounting the drivers closely, leave a clearance of 1 mm between the adjacent drivers in consideration of mounting tolerances. In this case, keep the ambient temperature within 0 ˚C to 45 ˚C or use the driver with 75% or less of the effective load ratio.



(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 drilling in the cabinet, 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 cabinet or a cooling fan installed on the ceiling.

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

2.3 Encoder cable stress

(1) The way of clamping the cable must be fully examined so that bending 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, and lock) 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 bending life range. Use the power supply and lock wiring cables within the bending 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 moves, the bending radius should be made as large as possible. Refer to section 10.4 for the bending 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 more 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, when confirming whether the charge lamp is off or not, always confirm it from the front of the driver. ●To avoid an electric shock, only qualified personnel should attempt inspections. For repair and parts replacement, contact your local sales office.

⚠CAUTION	●Do not perform insulation resistance test on the driver. Otherwise, it may cause a malfunction. ●Do not disassemble and/or repair the equipment on customer side.

It is recommended that the following points periodically be checked.

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

(2) Check the cables and the like for scratches or cracks. Inspect them periodically according to operating conditions especially when the servo motor is movable.

(3) Check that the connector is securely connected to the driver.

(4) Check that the wires are not coming out from the connector.

(5) Check for dust accumulation on the driver.

(6) Check for unusual noise generated from the driver.

2.5 Parts having service lives

Service lives of the following parts are listed below. However, the service lives vary depending on operation and environment. If any fault is found in the parts, they must be replaced immediately regardless of their service lives.

Part name	Life guideline
Smoothing capacitor	10 years
Relay	Number of power-on, forced stop by EM1 (Forced stop 1), and PC or PLC…etc forced stop times: 100,000 times Number of on and off for STO: 1,000,000 times
Cooling fan	10,000 hours to 30,000 hours (2 years to 3 years)
Absolute position battery	Refer to section 12.2.

(1) Smoothing capacitor

The characteristic of smoothing capacitor is deteriorated due to ripple currents, etc. 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 ˚C surrounding air temperature or less).

(2) Relays

Contact faults will occur due to contact wear arisen from switching currents. Relays reach the end of their lives when the power has been turned on, forced stop by EM1 (Forced stop 1) has occurred, and PC or PLC…etc forced stop has occurred 100,000 times in total, or when the STO has been turned on and off 1,000,000 times while the servo motor is stopped under servo-off state. However, the lives of relays may depend on the power supply capacity.

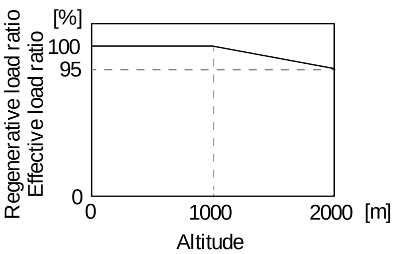
(3) Driver cooling fan

The cooling fan bearings reach the end of their life in 10,000 hours to 30,000 hours. Normally, therefore, the cooling fan must be replaced in a few years of continuous operation as a guideline. It must also be changed if unusual noise or vibration is found during inspection.
The life indicates under the yearly average ambient temperature of 40 ˚C, free from corrosive gas, flammable gas, oil mist, dust and dirt.

2.6 Restrictions when using this product at altitude exceeding 1000 m and up to 2000 m above sea level

(1) Effective load ratio and regenerative load ratio

As heat dissipation effects decrease in proportion to the decrease in air density, use the product Within the effective load ratio and regenerative load ratio shown in the following figure.



When closely mounting the drivers, operate them at the ambient temperature of 0 °C to 45 °C or at 75% or smaller effective load ratio. (Refer to section 2.1.)

(2) Input voltage

Generally, a withstand voltage decreases as increasing altitude; however, there is no restriction on the withstand voltage. Use in the same manner as in 1000 m or less. (Refer to section 1.3.)

(3) Parts having service life

(a) Smoothing capacitor

The capacitor will reach the end of its life in 10 years of continuous operation in air-conditioned environment (ambient temperature of 30 °C or less).

(b) Relay

There is no restriction. Use in the same manner as in 1000 m or less. (Refer to section 2.5.)

(c) Driver cooling fan

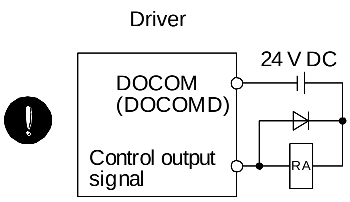
There is no restriction. Use in the same manner as in 1000 m or less. (Refer to section 2.5.)

3. SIGNALS AND WIRING

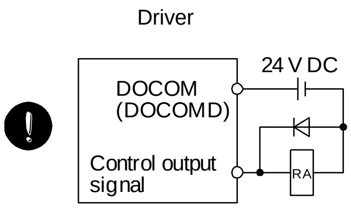
WARNING	
⚠WARNING	●Any person who is involved in wiring should be fully competent to do the work. ●Before wiring, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Then, confirm that the voltage between P+ and N- is safe with a voltage tester and others. Otherwise, an electric shock may occur. In addition, when confirming whether the charge lamp is off or not, always confirm it from the front of the driver. ●Ground the driver and servo motor securely. ●Do not attempt to wire the driver and servo motor until they have been installed. Otherwise, it may cause an electric shock. ●The cables should not be damaged, stressed, loaded, or pinched. Otherwise, it may cause an electric shock. ●To avoid an electric shock, insulate the connections of the power supply terminals.

⚠CAUTION

- ●Wire the equipment correctly and securely. Otherwise, the servo motor may operate unexpectedly, resulting in injury.
- ●Connect cables to the correct terminals. Otherwise, a burst, damage, etc. may occur.
- ●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.

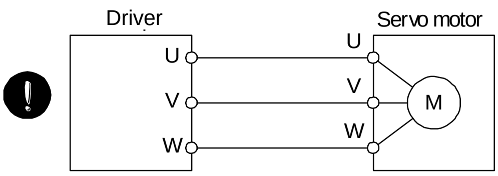


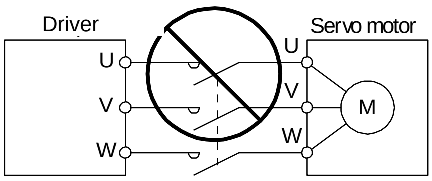
For sink output interface



For source output interface

- ●Use a noise filter, etc. to minimize the influence of electromagnetic interference. Electromagnetic interference may be given to the electronic equipment used near the driver.
- ●Do not install a power capacitor, surge killer or radio noise filter (optional FR-BIF (-H)) 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.
- ●Connect the driver power output (U/V/W) to the servo motor power input (U/V/W) directly. Do not let a magnetic contactor, etc. intervene. Otherwise, it may cause a malfunction.





⚠CAUTION	●Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the driver may cause a malfunction. ●Before wiring, switch operation, etc., eliminate static electricity. Otherwise, it may cause a malfunction.

3.1 Input power supply circuit

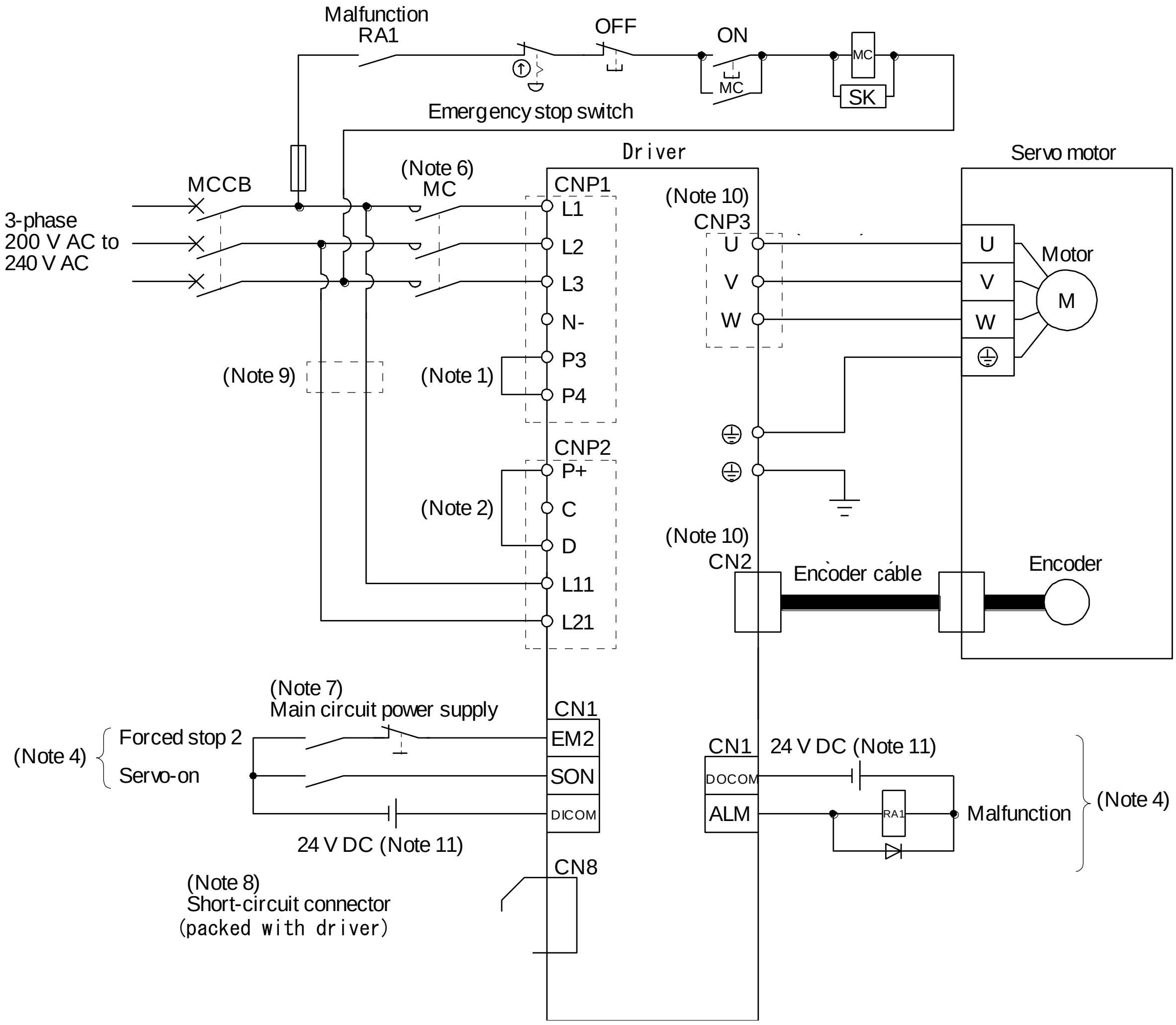
⚠CAUTION	●Always connect a magnetic contactor between the power supply and the main circuit power supply (L1/L2/L3) of the driver, in order to configure a circuit that shuts down the power supply on the side of the driver's power supply. If a magnetic contactor is not connected, continuous flow of a large current may cause a fire when the driver malfunctions. ●Use ALM (Malfunction) to switch main circuit power supply off. Not doing so may cause a fire when a regenerative transistor malfunctions or the like may overheat the regenerative resistor. ●Check the driver model, and then input proper voltage to the driver power supply. If input voltage exceeds the upper limit of the specification, the driver will break down. ●The driver has a built-in surge absorber (varistor) to reduce exogenous noise and to suppress lightning surge. Exogenous noise or lightning surge deteriorates the varistor characteristics, and the varistor may be damaged. To prevent a fire, use a molded-case circuit breaker or fuse for input power supply. ●Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the driver may cause a malfunction. ●The N- terminal is not a neutral point of the power supply. Incorrect wiring will cause a burst, damage, etc.

POINT

- ●EM2 has the same function as EM1 in the torque control mode.
- ●Connect the 1-phase 200 V AC to 240 V AC power supply to L1 and L3. One of the connecting destinations is different from LECSB□-S□ Series Driver's. When using LECSB□-T□ as a replacement for LECSB□-S□, be careful not to connect the power to L2.

Configure the wirings so that the main circuit power supply is shut off and SON (Servo-on) is turned off after deceleration to a stop due to an alarm occurring, enabled servo forced stop, etc. A molded-case circuit breaker (MCCB) must be used with the input cables of the main circuit power supply.

Using 3-phase 200 V AC to 240 V AC power supply for LECSB2-T□

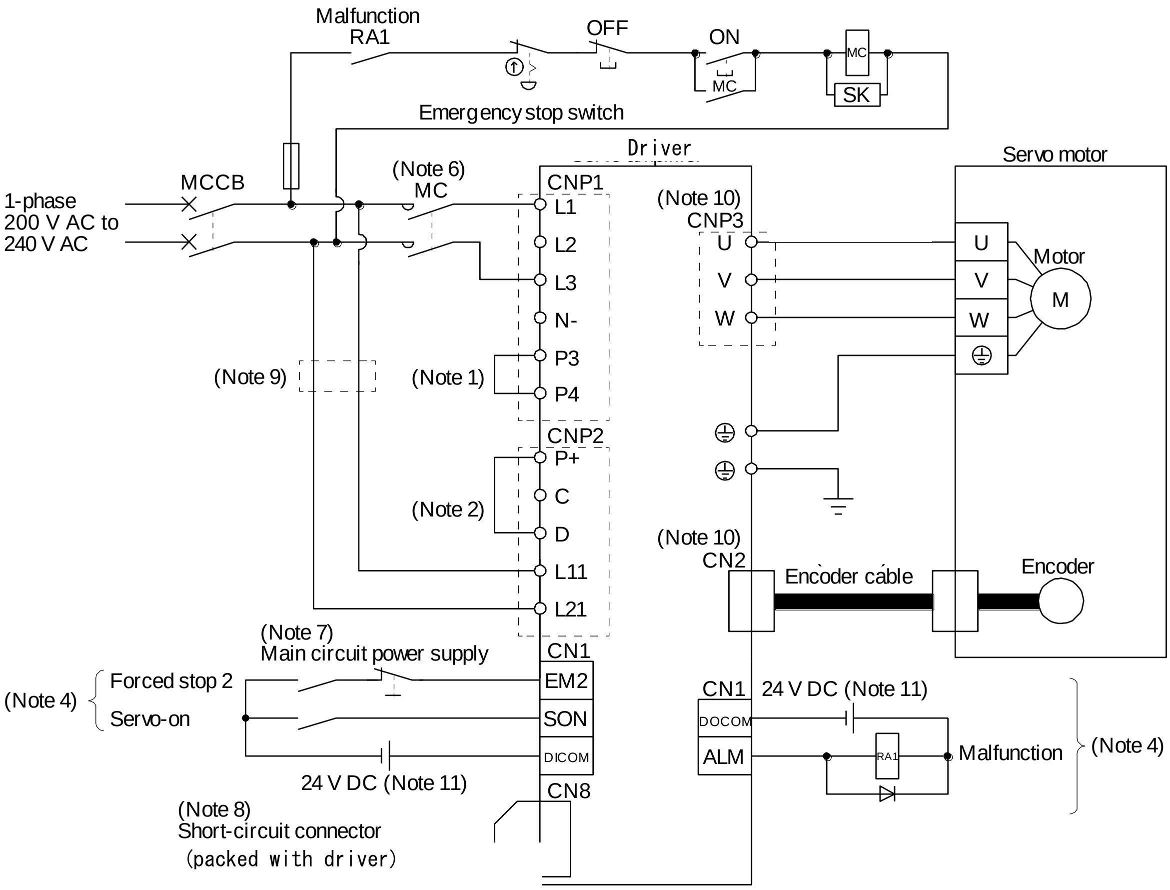


Note 1. Between P3 and P4 is connected by default.

2. Always connect between P+ and D terminals (factory-wired). When using the regenerative option, refer to section 11.2.
4. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.
6. Use a magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
7. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the driver.
8. When not using the STO function, attach the short-circuit connector came with a driver.
9. When wires used for L11 and L21 are thinner than wires used for L1, L2, and L3, use a molded-case circuit breaker. (Refer to section 11.10.)
10. Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the driver may cause a malfunction.
11. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.

(2) Using 1-phase 200 V AC to 240 V AC power supply for LECSB2-T□

POINT
●Connect the 1-phase 200 V AC to 240 V AC power supply to L1 and L3. One of the connecting destinations is different from LECSB□-S□ Series Driver's.

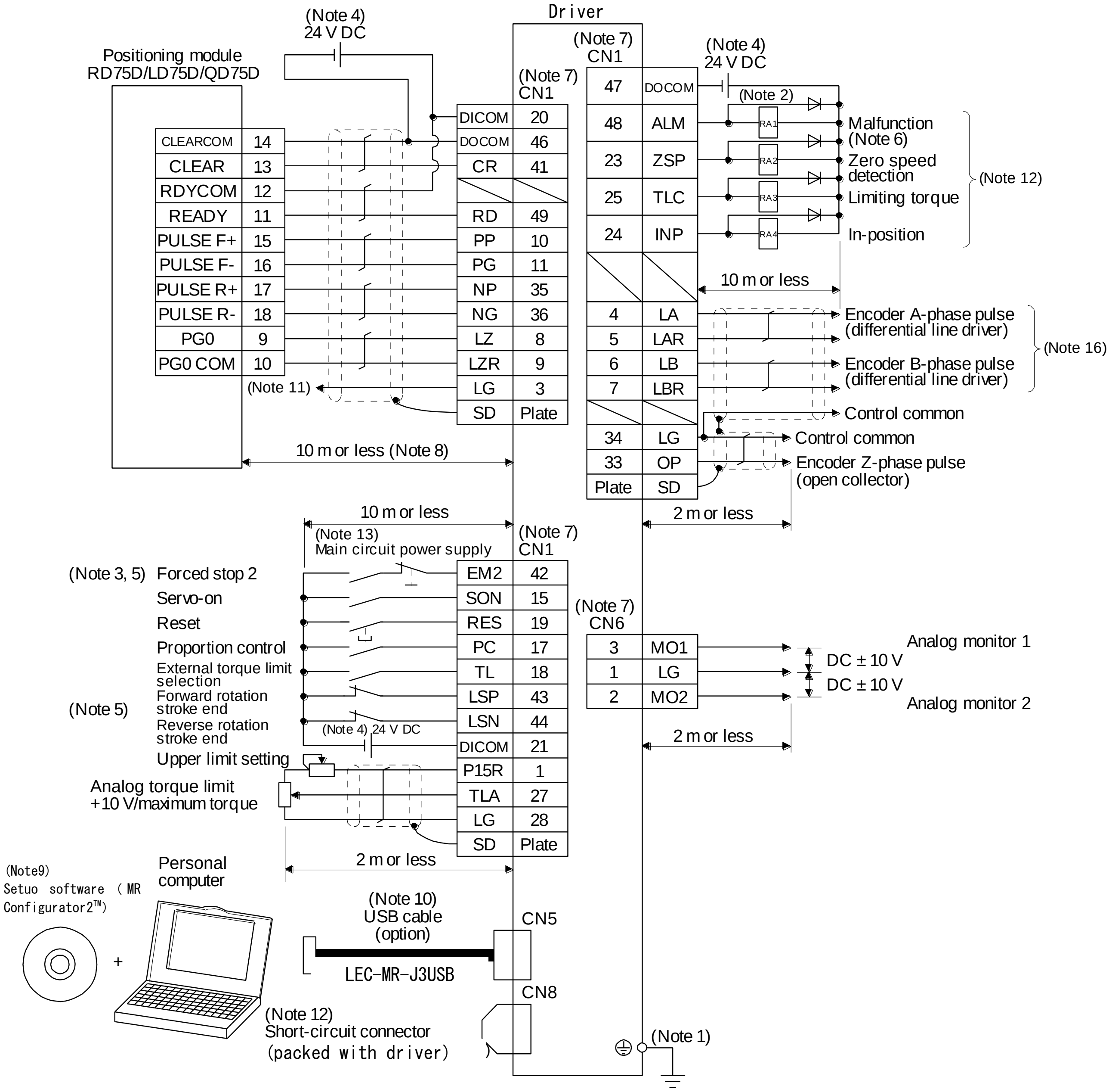


Note 1. Between P3 and P4 is connected by default.
2. Always connect between P+ and D terminals (factory-wired). When using the regenerative option, refer to section 11.2.
4. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.
6. Use a magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
7. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the driver.
8. When not using the STO function, attach the short-circuit connector came with a driver.
9. When wires used for L11 and L21 are thinner than wires used for L1, and L3, use a molded-case circuit breaker. (Refer to section 11.10.)
10. Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the driver may cause a malfunction.
11. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.

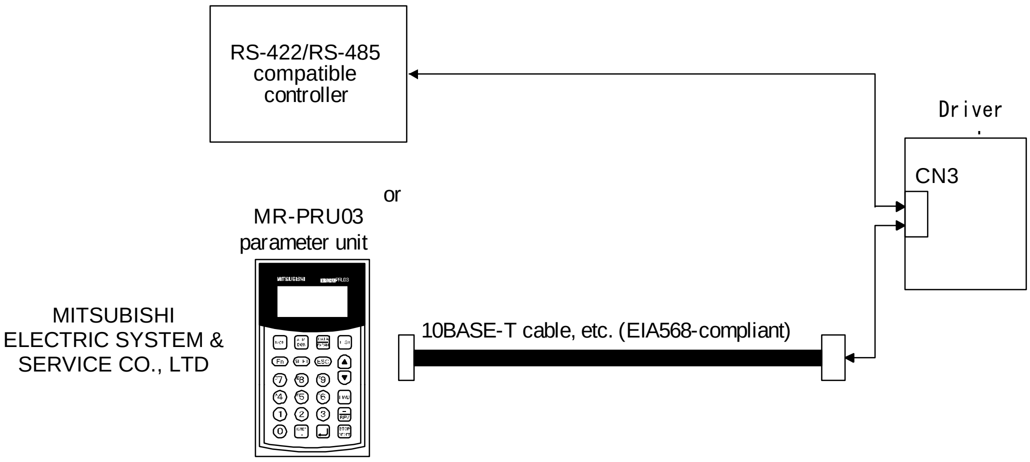
3.2 I/O signal connection example

3.2.1 Position control mode

(1) Sink I/O interface



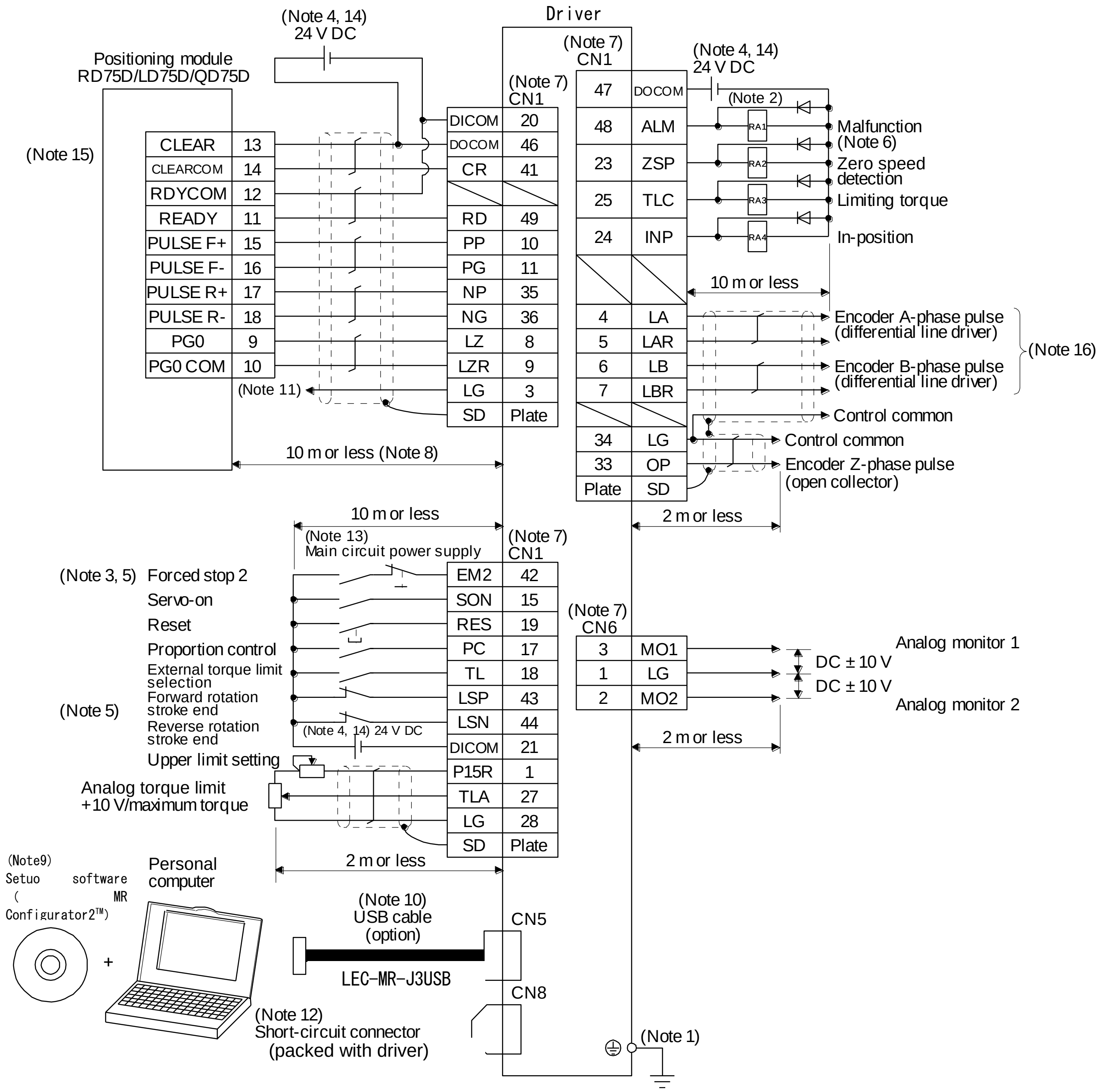
Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal (marked ⏚) of the driver to the protective earth (PE) of the cabinet.
2. Connect the diode in the correct direction. If it is connected reversely, the driver will malfunction and will not output signals, disabling EM2 (Forced stop 2) and other protective circuits.
3. The forced stop switch (normally closed contact) must be installed.
4. Supply 24 V DC ± 10% to interfaces from outside. The total current capacity is up to 500 mA. 500 mA 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 3.9.2 (1) that gives the current value necessary for the interface. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.
5. When starting operation, always turn on EM2 (Forced stop 2), LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end). (Normally closed contact)
6. ALM (Malfunction) turns on in normal alarm-free condition. When this signal (normally closed contact) is switched off (at occurrence of an alarm), the output of the programmable controller 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 type. It is 2 m or less in the open-collector type.
9. Use LEC-MRC2□. (Refer to section 11.3.)
10. Controller or parameter units can also be connected via the CN3 connector, enabling RS-422/RS-485 communication. Note that using the USB communication function (CN5 connector) prevents the RS-422/RS-485 communication function (CN3 connector) from being used, and vice versa. They cannot be used together.



11. This connection is not required for RD75D, LD75D and QD75D. However, to enhance noise tolerance, it is recommended to connect LG of driver and control common depending on the positioning module.
12. When not using the STO function, attach the short-circuit connector came with a driver.
13. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the driver.
14. Plus and minus of the power of source interface are the opposite of those of sink interface.
15. CLEAR and CLEARCOM of source interface are interchanged to sink interface.
16. When a command cable for connection with the controller side malfunctions due to disconnection or noise, a position mismatch can occur. To avoid position mismatch, it is recommended that Encoder A-phase pulse and Encoder B-phase pulse be checked.

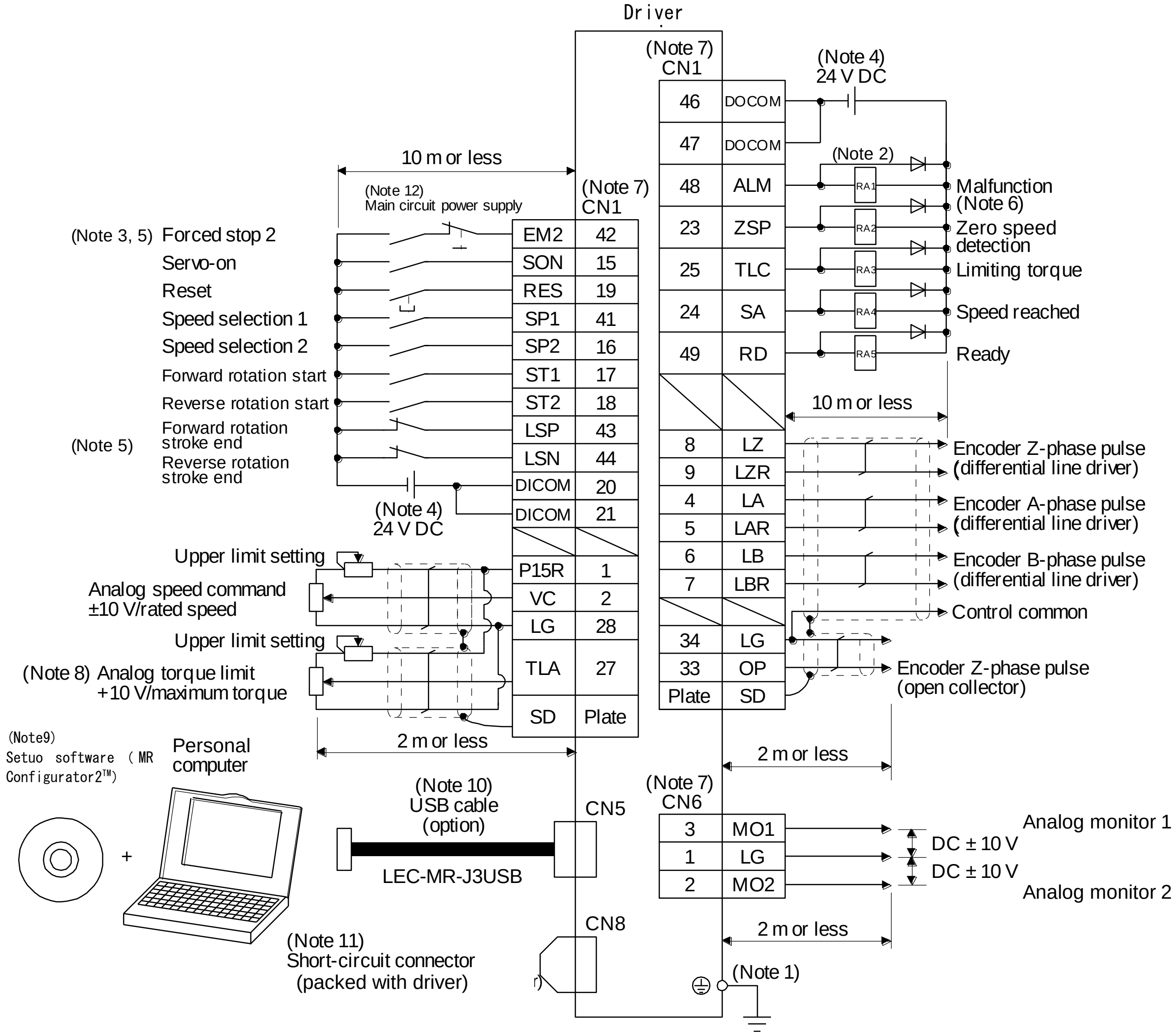
(2) Source I/O interface

POINT
●For notes, refer to (1) in this section.

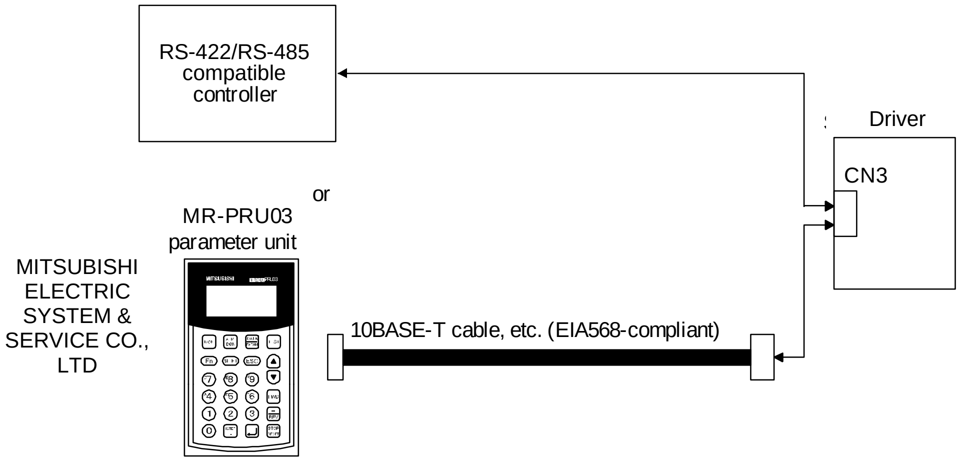


3.2.2 Speed control mode

(1) Sink I/O interface



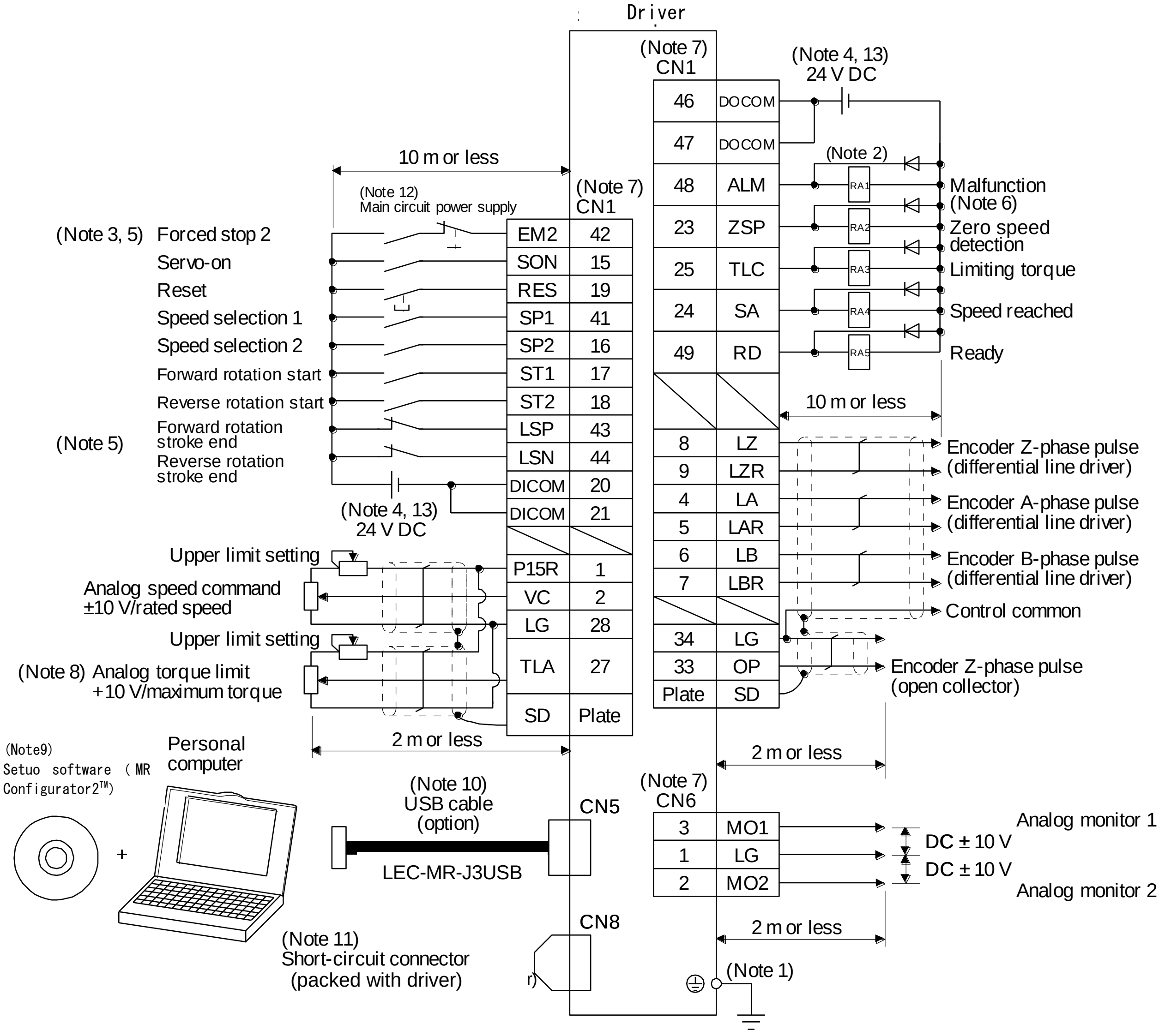
Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal (marked ⏚) of the driver to the protective earth (PE) of the cabinet.
2. Connect the diode in the correct direction. If it is connected reversely, the driver will malfunction and will not output signals, disabling EM2 (Forced stop 2) and other protective circuits.
3. The forced stop switch (normally closed contact) must be installed.
4. Supply 24 V DC ± 10% to interfaces from outside. The total current capacity is up to 500 mA. 500 mA 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 3.9.2 (1) that gives the current value necessary for the interface. The 24 V DC power supply can be used both for input signals and output signals.
5. When starting operation, always turn on EM2 (Forced stop 2), LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end). (Normally closed contact)
6. ALM (Malfunction) turns on in normal alarm-free condition. (Normally closed contact)
7. The pins with the same signal name are connected in the driver.
8. TLA will be available when TL (External torque limit selection) is enabled with [Pr. PD03] to [Pr. PD22]. (Refer to section 3.6.1 (5).)
9. Use LEC-MRC2□. (Refer to section 11.3.)
10. Controller or parameter units can also be connected via the CN3 connector, enabling RS-422/RS-485 communication. Note that using the USB communication function (CN5 connector) prevents the RS-422/RS-485 communication function (CN3 connector) from being used, and vice versa. They cannot be used together.



11. When not using the STO function, attach the short-circuit connector came with a driver.
12. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the driver.
13. Plus and minus of the power of source interface are the opposite of those of sink interface.

(2) Source I/O interface

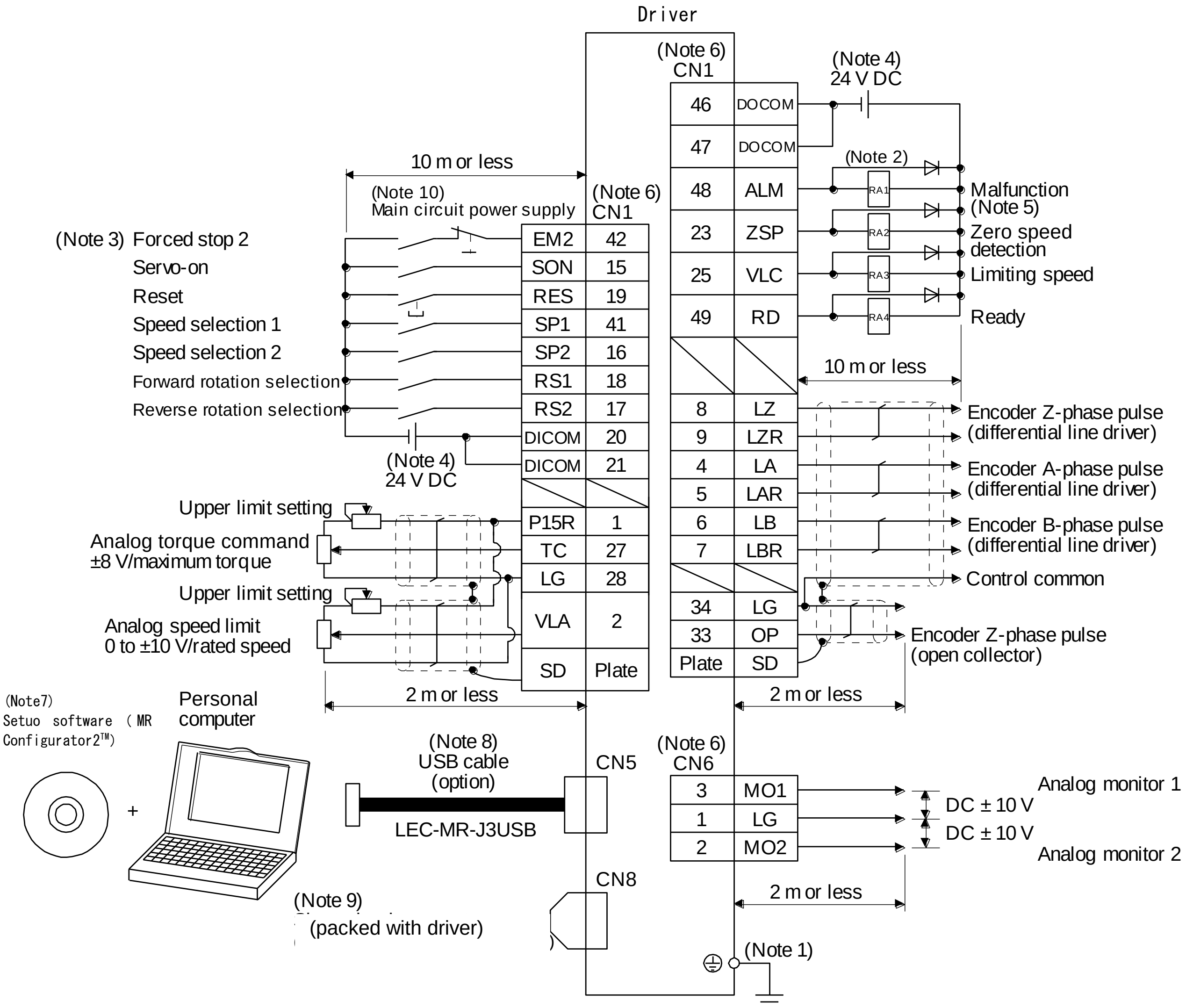
POINT
●For notes, refer to (1) in this section.



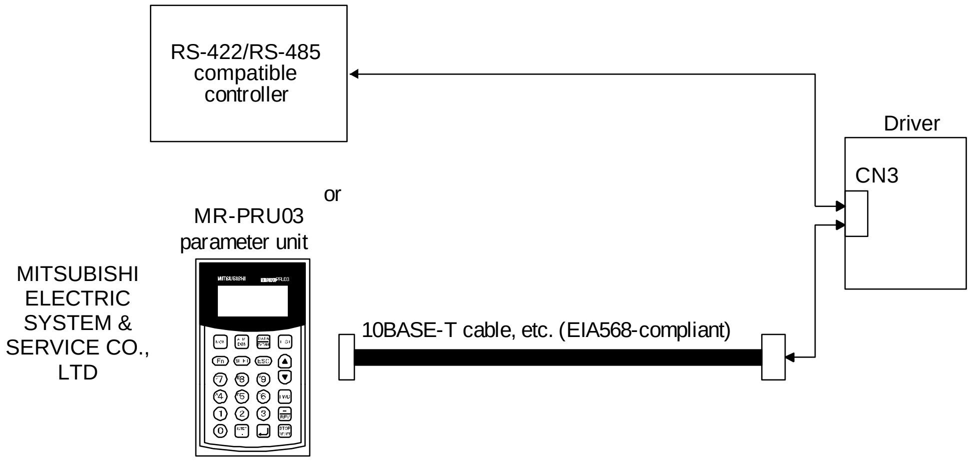
3.2.3 Torque control mode

POINT
●EM2 has the same function as EM1 in the torque control mode.

(1) For sink I/O interface



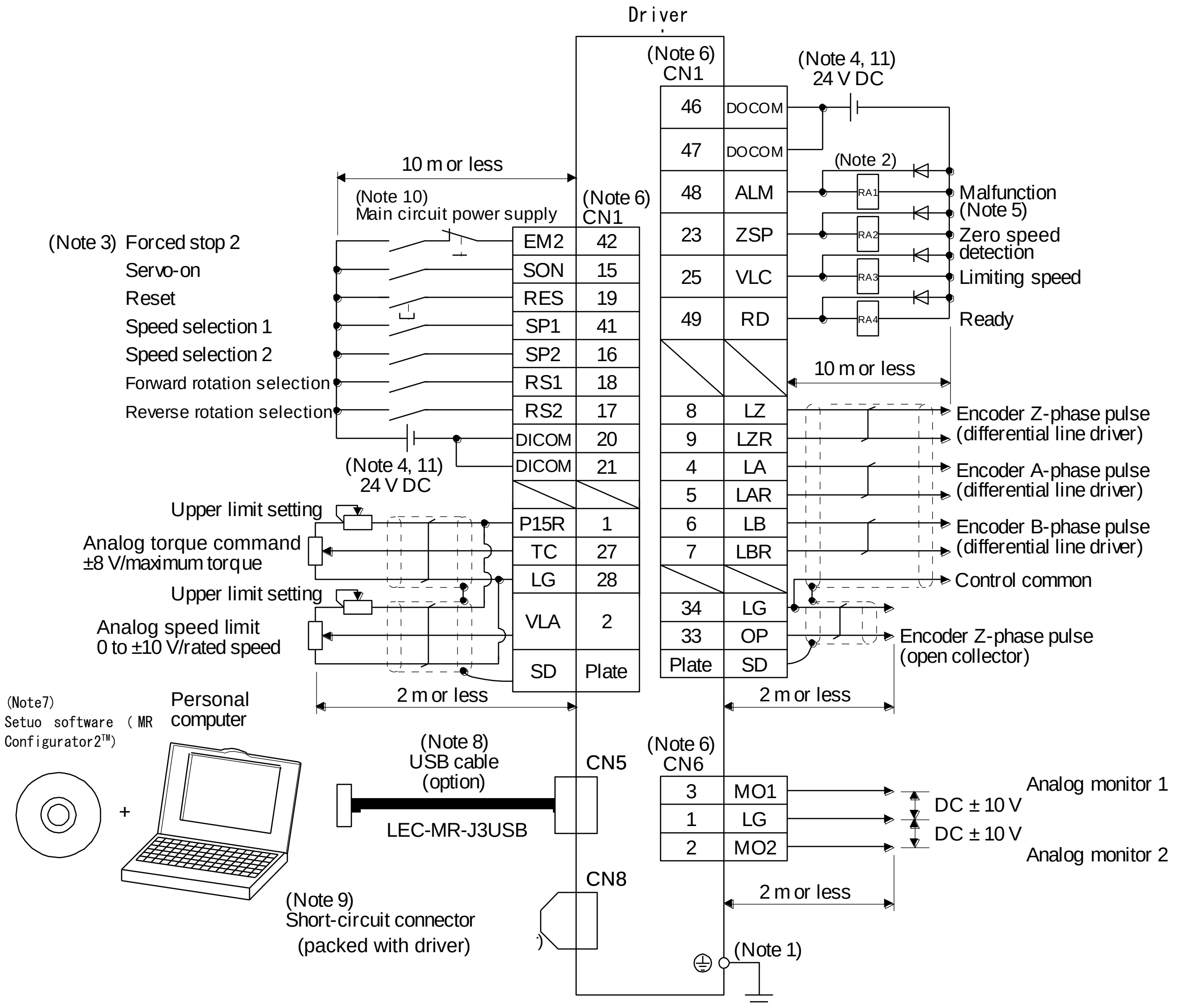
Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal (marked ⏚) of the driver to the protective earth (PE) of the cabinet.
2. Connect the diode in the correct direction. If it is connected reversely, the driver will malfunction and will not output signals, disabling EM2 (Forced stop 2) and other protective circuits.
3. The forced stop switch (normally closed contact) must be installed.
4. Supply 24 V DC ± 10% to interfaces from outside. The total current capacity is up to 500 mA. 500 mA 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 3.9.2 (1) that gives the current value necessary for the interface. The 24 V DC power supply can be used both for input signals and output signals.
5. ALM (Malfunction) turns on in normal alarm-free condition. (Normally closed contact)
6. The pins with the same signal name are connected in the driver.
7. Use LEC-MRC2□. (Refer to section 11.3.)
8. Controller or parameter units can also be connected via the CN3 connector, enabling RS-422/RS-485 communication. Note that using the USB communication function (CN5 connector) prevents the RS-422/RS-485 communication function (CN3 connector) from being used, and vice versa. They cannot be used together.



9. When not using the STO function, attach the short-circuit connector came with a driver.
10. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the driver.
11. Plus and minus of the power of source interface are the opposite of those of sink interface.

(2) For source I/O interface

POINT
●For notes, refer to (1) in this section.



3.3 Explanation of power supply system

3.3.1 Signal explanations

POINT
●For the layout of connector and terminal block, refer to chapter 9 DIMENSIONS.

<table>
<tr><th>Symbol</th><th>Connection target (application)</th><th>Description</th></tr>
<tr><td>L1/L2/L3</td><td>Main circuit power supply</td><td>Supply the following power to L1, L2, and L3. For 1-phase 200 V AC to 240 V AC, connect the power supply to L1 and L3. Leave L2 open.
<table>
<tr><th>Power \ Driver</th><th>LECSB2-T5 to LECSB2-T9</th></tr>
<tr><td>3-phase 200 V AC to 240 V AC, 50 Hz/60 Hz</td><td>L1/L2/L3</td></tr>
<tr><td>1-phase 200 V AC to 240 V AC, 50 Hz/60 Hz</td><td>L1/L3</td></tr>
</table></td></tr>
<tr><td>P3/P4</td><td>-</td><td>Connect P3 and P4. (factory-wired)</td></tr>
<tr><td>P+/C/D</td><td>Regenerative option</td><td>When using a driver built-in regenerative resistor, connect P+ and D. (factory-wired)
When using a regenerative option, disconnect P+ and D, and connect the regenerative option to P+ and C.
Refer to section 11.2 for details.</td></tr>
<tr><td>L11/L21</td><td>Control circuit power supply</td><td>Supply the following power to L11 and L21.
<table>
<tr><th>Power \ Driver</th><th>LECSB2-T5 to LECSB2-T9</th></tr>
<tr><td>1-phase 200 V AC to 240 V AC</td><td>L11/L21</td></tr>
</table></td></tr>
<tr><td>U/V/W</td><td>Servo motor power output</td><td>Connect the driver power output (U/V/W) to the servo motor power input (U/V/W) directly. Do not let a magnetic contactor, etc. intervene. Otherwise, it may cause a malfunction.</td></tr>
<tr><td>N-</td><td>-</td><td>Do not connect to the driver.</td></tr>
<tr><td>⏚</td><td>Protective earth (PE)</td><td>Connect it to the grounding terminal of the servo motor and to the protective earth (PE) of the cabinet for grounding.</td></tr>
</table>

3.3.2 Power-on sequence

POINT
●A voltage, output signal, etc. of analog monitor output may be irregular at power-on.

(1) Power-on procedure

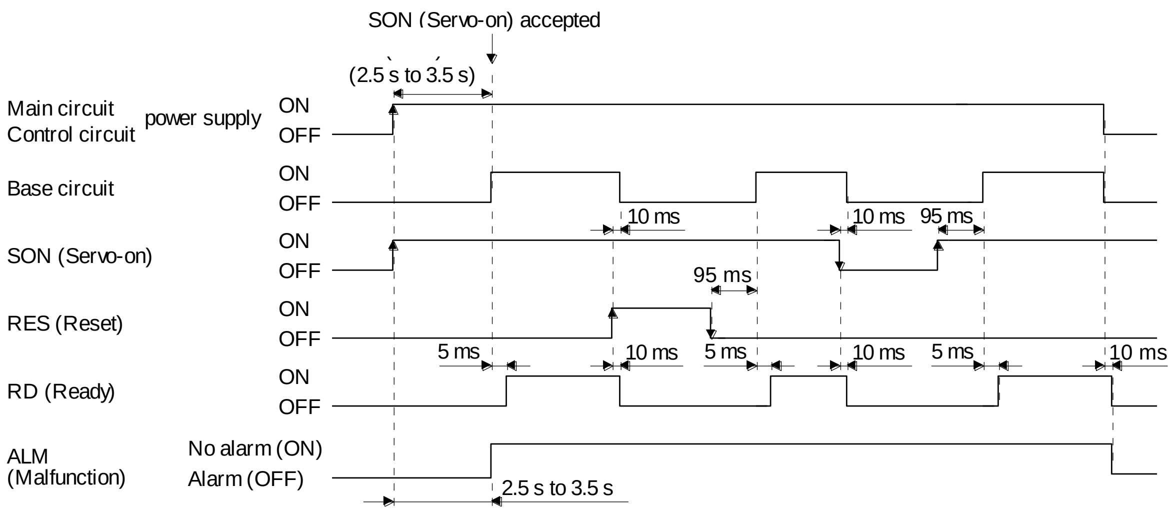
1) Always use a magnetic contactor for the main circuit power supply wiring (L1/L2/L3) as shown in above section 3.1. Configure up an external sequence to switch off the magnetic contactor as soon as an alarm occurs.

2) Switch on the control circuit power supply (L11/L21) 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 receives the SON (Servo-on) 2.5 s to 3.5 s after the main circuit power supply is switched on. Therefore, when SON (Servo-on) is switched on simultaneously with the main circuit power supply, the base circuit will switch on in about 2.5 s to 3.5 s, and the RD (Ready) will switch on in further about 5 ms, making the driver ready to operate. (Refer to (2) in this section.)

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

(2) Timing chart



3.3.3 Wiring CNP1, CNP2, and CNP3

POINT
●For the wire sizes used for wiring, refer to section 11.9. ●When wiring, remove the power connectors from the driver. ●Insert only one wire or ferrule to each wire insertion hole.

Use the driver power supply connector for wiring CNP1, CNP2, and CNP3.

(1) Connector

(a) LECSB2-T□

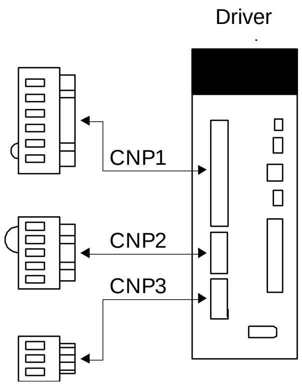


Table 3.1 Connector and applicable wire

Connector	Receptacle assembly	Applicable wire		Stripped length [mm]	Manufacturer	Remarks
		Size	Insulator OD			
CNP1	K05A01490216	AWG 18 to 14	39 mm or shorter	9	MITSUBISHI ELECTRIC SYSTEM & SERVICE CO., LTD (Note)	Open tool comes with.
CNP2	K05A01490209					-
CNP3	K05A01490210					-

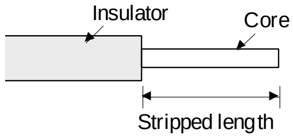
Note. Please purchase from distributor or distributor of Mitsubishi Electric Corporation.

(2) Cable connection procedure

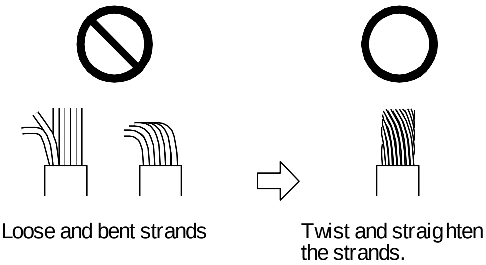
(a) Fabrication on cable insulator

(a) Fabrication on cable insulator

Refer to table 3.1 to 3.4 for stripped length of cable insulator. The appropriate stripped length of cables depends on their type, etc. Set the length considering their status.



Twist strands lightly and straighten them as follows.



You can also use a ferrule to connect with the connectors. The following shows references to select ferrules according to wire sizes.

Driver	Wire size	Ferrule model (Phoenix Contact)		Crimping tool (Phoenix Contact)
		For one	For two	
LECSB2-T5 to LECSB2-T9	AWG 16	AI1.5-10BK	AI-TWIN2×1.5-10BK	CRIMPFOX-ZA3
	AWG 14	AI2.5-10BU		

(b) Inserting wire

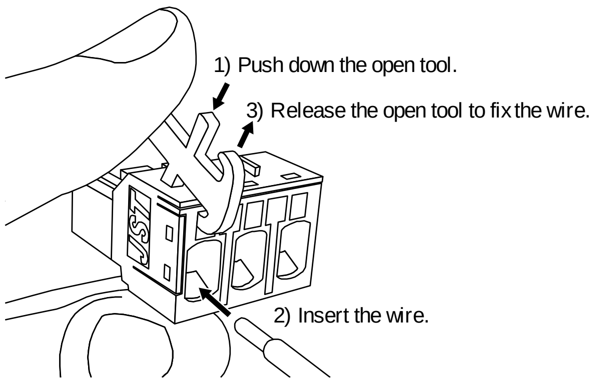
Insert only one wire or ferrule to each wire insertion hole.

Insert the open tool as follows and push it down to open the spring. While the open tool is pushed down, insert the stripped wire into the wire insertion hole. Check the wire insertion depth, and make sure that the cable insulator will not be caught by the spring and that the conductive part of the stripped wire will not be exposed.

Release the open tool to fix the wire. Pull the wire lightly to confirm that the wire is surely connected.

In addition, make sure that no conductor wire sticks out of the connector.

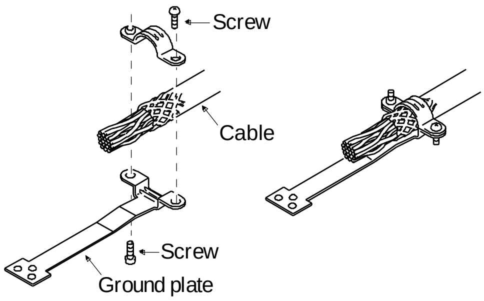
The following shows a connection example of the CNP3 connector.



3.4 Connectors and pin assignment

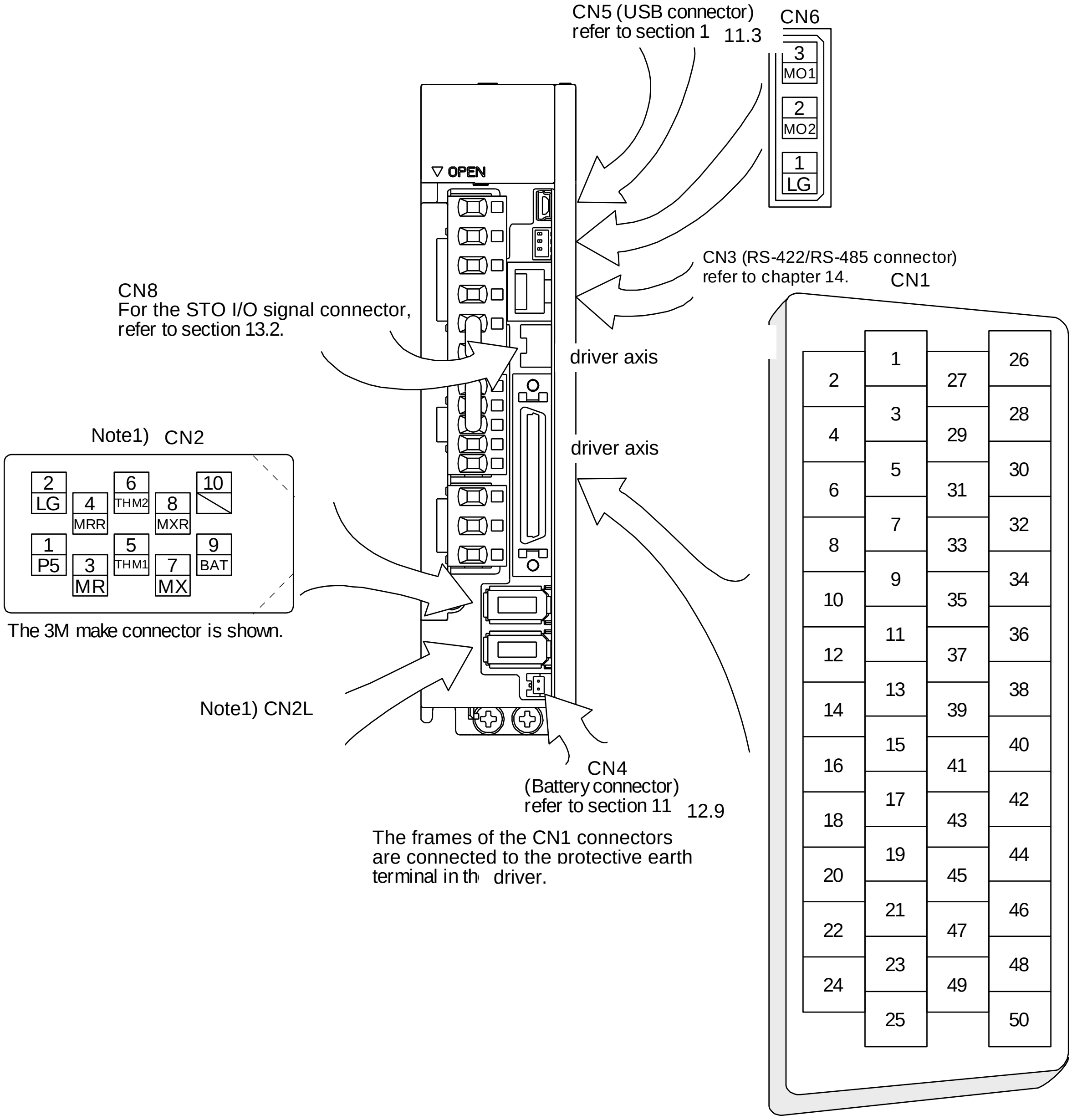
POINT

- The pin assignment of the connectors is as viewed from the cable connector wiring section.
- For the STO I/O signal connector (CN8), refer to chapter 13.
- For the CN1 connector, securely connect the external conductive portion of the shielded cable to the ground plate and fix it to the connector shell.



- PP (CN1-10 pin)/NP (CN1-35 pin) and PP2 (CN1-37 pin)/NP2 (CN1-38 pin) are exclusive. They cannot be used together.

The driver front view shown is that of the LECSB2-T7 or less. Refer to chapter 9 DIMENSIONS for the appearances and connector layouts of the other drivers.



Note 1. CN2L cannot be used. Connect the encoder cable to CN2.

The device assignment of the CN1 connector pins changes depending on the control mode. For the pins which are given parameters in the related parameter column, their devices will be changed using those parameters.

Pin No.	(Note 1) I/O	(Note 2) I/O signals in control modes						Related parameter
		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/-	(Note 6)	(Note 6)	(Note 6)	-/PP	PD43/PD44
11	I	PG	PG/-				-/PG	
12		OPC	OPC/-				-/OPC	
13	O	(Note 4)	(Note 4)	(Note 4)	(Note 4)	(Note 4)	(Note 4)	PD47
14	O	(Note 4)	(Note 4)	(Note 4)	(Note 4)	(Note 4)	(Note 4)	PD47
15	I	SON	SON	SON	SON	SON	SON	PD03/PD04
16	I		-/SP2	SP2	SP2/SP2	SP2	SP2/-	PD05/PD06
17	I	PC	PC/ST1	ST1	ST1/RS2	RS2	RS2/PC	PD07/PD08
18	I	TL	TL/ST2	ST2	ST2/RS1	RS1	RS1/TL	PD09/PD10
19	I	RES	RES	RES	RES	RES	RES	PD11/PD12
20		DICOM	DICOM	DICOM	DICOM	DICOM	DICOM	
21		DICOM	DICOM	DICOM	DICOM	DICOM	DICOM	
22	O	INP	INP/SA	SA	SA/-		-/INP	PD23
23	O	ZSP	ZSP	ZSP	ZSP	ZSP	ZSP	PD24
24	O	INP	INP/SA	SA	SA/-		-/INP	PD25
25	O	TLC	TLC	TLC	TLC/VLC	VLC	VLC/TLC	PD26
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/-	(Note 6)	(Note 6)	(Note 6)	-/NP	PD45/PD46
36	I	NG	NG/-				-/NG	
37	I	PP2	PP2/-	(Note 7)	(Note 7)	(Note 7)	-/PP2	PD43/PD44
38	I	NP2	NP2/-	(Note 7)	(Note 7)	(Note 7)	-/NP2	PD45/PD46
39								
40								
41	I	CR	CR/SP1	SP1	SP1/SP1	SP1	SP1/CR	PD13/PD14
42	I	EM2	EM2	EM2	EM2	EM2	EM2	
43	I	LSP	LSP	LSP	LSP/-		-/LSP	PD17/PD18
44	I	LSN	LSN	LSN	LSN/-		-/LSN	PD19/PD20
45	I	LOP	LOP	LOP	LOP	LOP	LOP	PD21/PD22
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	PD28
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 change mode, S/T: Speed/torque control change mode, T/P: Torque/position control change mode
3. TLA will be available when TL (External torque limit selection) is enabled with [Pr. PD03] to [Pr. PD22].
4. Output devices are not assigned by default. Assign the output devices with [Pr. PD47] as necessary.
6. This is available as an input device of sink interface. Input devices are not assigned by default. Assign the input devices with [Pr. PD43] to [Pr. PD46] as necessary. Supply + of 24 V DC to CN1-12 pin.
7. This is available as an input device of source interface. Input devices are not assigned by default. Assign the input devices with [Pr. PD43] to [Pr. PD46] as necessary.

3.5 Signal (device) explanations

The pin numbers in the connector pin No. column are those in the initial status.

For the I/O interfaces (symbols in I/O division column in the table), refer to section 3.9.2. The symbols in the control mode field of the table shows the followings.

P: Position control mode

S: Speed control mode

T: Torque control mode

"○" and "△" of the table shows the followings.

○: Usable device by default.

△: Usable device by setting the following parameters.

[Pr. PA04], [Pr. PD03] to [Pr. PD26], [Pr. PD28], and [Pr. PD47]

(1) I/O device

(a) Input device

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Function and application</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>Forced stop 2</td><td>EM2</td><td>CN1-42</td><td>Turn off EM2 (open between commons) to decelerate the servo motor to a stop with commands.
Turn EM2 on (short between commons) in the forced stop state to reset that state.
The following shows the setting of [Pr. PA04].
<table>
<tr><th rowspan="2">[Pr. PA04] setting</th><th rowspan="2">EM2/EM1</th><th colspan="2">Deceleration method</th></tr>
<tr><th>EM2 or EM1 is off</th><th>Alarm occurred</th></tr>
<tr><td>0 _ _ _</td><td>EM1</td><td>MBR (Electromagnetic brake interlock) turns off without the forced stop deceleration.</td><td>MBR (Electromagnetic brake interlock) turns off without the forced stop deceleration.</td></tr>
<tr><td>2 _ _ _</td><td>EM2</td><td>MBR (Electromagnetic brake interlock) turns off after the forced stop deceleration.</td><td>MBR (Electromagnetic brake interlock) turns off after the forced stop deceleration.</td></tr>
</table>
EM2 and EM1 are mutually exclusive.
EM2 has the same function as EM1 in the torque control mode.</td><td>DI-1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Forced stop 1</td><td>EM1</td><td>(CN1-42)</td><td>When using EM1, set [Pr. PA04] to "0 _ _ _" to enable EM1.
When EM1 is turned off (open between commons), the base circuit shuts off, and the dynamic brake operates to decelerate the servo motor to a stop.
Turn EM1 on (short between commons) in the forced stop state to reset that state.</td><td>DI-1</td><td>△</td><td>△</td><td>△</td></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 status)
Turn it off to shut off the base circuit and coast the servo motor.
Set "_ _ _ 4" in [Pr. 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 on RES for more than 50 ms to reset the alarm.
Some alarms cannot be deactivated by RES (Reset). Refer to chapter 8.
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 [Pr. PD30].
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>
</table>

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Function and application</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>Forward rotation stroke end</td><td>LSP</td><td>CN1-43</td><td rowspan="2">To start operation, turn on LSP and LSN. Turn it off to bring the motor to a sudden stop and make it servo-locked.
Setting [Pr. PD30] to " _ _ _ 1" will enable a slow stop.
<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
Positive direction</th><th>CW direction
Negative 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 [Pr. PD01] as indicated below to switch on the signals (keep terminals connected) automatically in the driver.
<table>
<tr><th rowspan="2">[Pr. 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 is turned off, [AL. 99 Stroke limit warning] occurs, and WNG (Warning) turns on. When using WNG, enable it by the setting of [Pr. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47].
In the torque control mode, this device cannot be used during normal operation. Also, when the magnetic pole detection in the torque control mode is completed, this signal will be disabled.</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>
<tr><td>External torque limit selection</td><td>TL</td><td>CN1-18</td><td>Turning off TL will enable [Pr. PA11 Forward torque limit] and [Pr. PA12 Reverse torque limit], and turning on it will enable TLA (Analog torque limit). 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>To select [Pr. PC35 Internal torque limit 2/internal thrust limit 2], enable TL1 with [Pr. PD03] to [Pr. PD22]. 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">This is used to start the servo motor.
The following shows the 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 [Pr. PC02] setting and servo-locked.
When " _ _ _1" is set in [Pr. 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>
</table>

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Function and application</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>Forward rotation selection</td><td>RS1</td><td>CN1-18</td><td rowspan="2">This is used to select a servo motor torque generation directions.
The following shows the 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 power running mode/reverse rotation in regenerative mode</td></tr>
<tr><td>1</td><td>0</td><td>Reverse rotation in power running 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>
<tr><td>Speed selection 1</td><td>SP1</td><td>CN1-41</td><td rowspan="3">1. For speed control mode
This is used to select the command speed for operation.
<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>VC (Analog speed command)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Pr. PC05 Internal speed command 1</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Pr. PC06 Internal speed command 2</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Pr. PC07 Internal speed command 3</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Pr. PC08 Internal speed command 4</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Pr. PC09 Internal speed command 5</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Pr. PC10 Internal speed command 6</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Pr. PC11 Internal speed command 7</td></tr>
</table>
Note. 0: Off
1: On

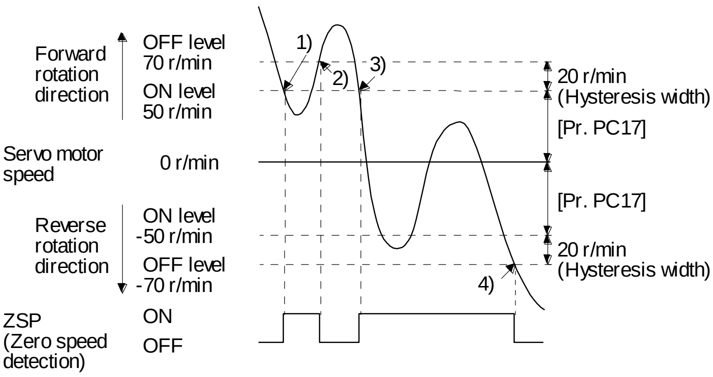
2. For the torque control mode
This is used to select the limit speed for operation.
<table>
<tr><th colspan="3">(Note) Input device</th><th rowspan="2">Speed limit</th></tr>
<tr><th>SP3</th><th>SP2</th><th>SP1</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>VLA (Analog speed limit)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Pr. PC05 Internal speed limit 1</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Pr. PC06 Internal speed limit 2</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Pr. PC07 Internal speed limit 3</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Pr. PC08 Internal speed limit 4</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Pr. PC09 Internal speed limit 5</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Pr. PC10 Internal speed limit 6</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Pr. PC11 Internal speed limit 7</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">Connector pin No.</th><th rowspan="2">Function and application</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 for a 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 PC (Proportion control) 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 PC (Proportion control) and TL (External torque limit selection) at the same time to make the torque less than the rated by TLA (Analog torque limit).
Do not use PC (Proportional control) in the torque control. Doing so may cause the operation to be performed at a speed exceeding the speed limit value.</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 10 ms or longer.
The delay amount set in [Pr. PB03 Position command acceleration/deceleration time constant] is also cleared. When " _ _ _ 1 " is set to [Pr. PD32], 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">The combination of CM1 and CM2 enables you to select 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 numerator</th></tr><tr><th>CM2</th><th>CM1</th></tr><tr><td>0</td><td>0</td><td>Pr. PA06</td></tr><tr><td>0</td><td>1</td><td>Pr. PC32</td></tr><tr><td>1</td><td>0</td><td>Pr. PC33</td></tr><tr><td>1</td><td>1</td><td>Pr. 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 switching</td><td>CDP</td><td></td><td>Turn on CDP to use the values of [Pr. PB29] to [Pr. PB36] and [Pr. PB56] to [Pr. PB60] as the load to motor inertia ratio and gain 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">Connector pin No.</th><th rowspan="2">Function and application</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 switching</td><td>LOP</td><td>CN1-45</td><td>«Position/speed control change mode»
This is used to select the control mode in the position/speed control switching 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»
This is used to select the control mode in the speed/torque control switching 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 change mode»
This is used to select the control mode in the torque/position control switching 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 Function and application.</td></tr>
<tr><td>Second acceleration/deceleration selection</td><td>STAB2</td><td></td><td>The device 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 time constant and deceleration time constant is always uniform.
<table><tr><th>(Note) STAB2</th><th>Acceleration/deceleration time constant</th></tr><tr><td>0</td><td>Pr. PC01 Acceleration time constant
Pr. PC02 Deceleration time constant</td></tr><tr><td>1</td><td>Pr. PC30 Acceleration time constant 2
Pr. PC31 Deceleration time constant 2</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>This is an ABS transfer mode request device.
When "_ _ _ 1" is set in [Pr. PA03] and absolute position detection system by DIO is selected, CN1-17 pin will become ABSM. (Refer to chapter 12.)</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>This is an ABS request device.
When "_ _ _ 1" is set in [Pr. PA03] and absolute position detection system by DIO is selected, CN1-18 pin will become ABSR. (Refer to chapter 12.)</td><td>DI-1</td><td>△</td><td></td><td></td></tr>
<tr><td>-</td><td>CLD</td><td></td><td>Do not use it.</td><td>DI-1</td><td>△</td><td></td><td></td></tr>
<tr><td>-</td><td>MECR</td><td></td><td>Do not use it.</td><td>DI-1</td><td>△</td><td></td><td></td></tr>
</table>

(b) Output device

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
Malfunction	ALM	CN1-48	When an alarm occurs, ALM will turn off. When an alarm does not occur, ALM will turn on after 2.5 s to 3.5 s after power-on. When [Pr. PD34] is "_ _ 1 _", an alarming or warning will turn off ALM.	DO-1	○	○	○
Dynamic brake interlock	DB		Do not need to use this device.	DO-1	○	○	○
Ready	RD	CN1-49	Enabling servo-on to make the driver ready to operate will turn on RD.	DO-1	○	○	○
In-position	INP	CN1-22 CN1-24	When the number of droop pulses is in the preset in-position range, INP will turn on. The in-position range can be changed using [Pr. PA10]. When the in-position range is increased, INP may be on during low-speed rotation. INP turns on when servo-on turns on.	DO-1	○		
Speed reached	SA		When the servo motor speed reaches the following range, SA will turn on. Set speed ± ((Set speed × 0.05) + 20) r/min When the preset speed is 20 r/min or less, SA always turns on. SA does not turn on even when the SON (Servo-on) is turned off or the servo motor speed by the external force reaches the preset speed while both ST1 (Forward rotation start) and ST2 (reverse rotation start) are off.	DO-1		○	
Limiting speed	VLC	CN1-25	VLC turns on when speed reaches a value limited with any of [Pr. PC05 Internal speed limit 1] to [Pr. PC11 Internal speed limit 7] or VLA (Analog speed limit). This turns off when SON (Servo-on) turns off.	DO-1			○
Limiting torque	TLC		TLC turns on when a generated torque reaches a value set with any of [Pr. PA11 Forward torque limit], [Pr. PA12 Reverse torque limit], or TLA (Analog torque limit).	DO-1	○	○	

Device	Symbol	Connector pin No.	Function and application	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 (50 r/min) or less. Zero speed can be changed with [Pr. PC17].  ZSP will turn on when the servo motor is decelerated to 50 r/min (at 1)), and will turn off when the servo motor is accelerated to 70 r/min again (at 2)). ZSP will turn on when the servo motor is decelerated again to 50 r/min (at 3)), and will turn off when the servo motor speed has reached -70 r/min (at 4)). 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 20 r/min for this driver.	DO-1	○	○	○
Electromagnetic brake interlock	MBR		When using the device, set operation delay time of the electromagnetic brake in [Pr. PC16]. When a servo-off status or alarm occurs, MBR will turn off.	DO-1	△	△	△
Warning	WNG		When warning has occurred, WNG turns on. When a warning is not occurring, WNG will turn off in 2.5 s to 3.5 s after power-on.	DO-1	△	△	△
Battery warning	BWNG		BWNG turns on when [AL. 92 Battery cable disconnection warning] or [AL. 9F Battery warning] has occurred. When the battery warning is not occurring, BWNG will turn off in 2.5 s to 3.5 s after power-on.	DO-1	△	△	△
Alarm code	ACD0	(CN1-24)	To use these signals, set " _ _ _ 1" in [Pr. PD34]. This signal is outputted when an alarm occurs. When an alarm is not occurring, respective ordinary signals are outputted. For details of the alarm codes, refer to chapter 8. When [Pr. PD34] is set to "_ _ _ 1", setting the following will trigger [AL. 37 Parameter error]. ・"_ _ _ 1" is set in [Pr. PA03] and the absolute position detection system by DIO is selected. ・MBR, DB, or ALM is assigned to the CN1-22 pin, CN1-23 pin, or CN1-24 pin.	DO-1	△	△	△
	ACD1	(CN1-23)					
	ACD2	(CN1-22)					
Variable gain selection	CDPS		CDPS turns on during gain switching.	DO-1	△	△	△
Absolute position undetermined	ABSV		ABSV turns on when the absolute position is undetermined.	DO-1	△		
ABS transmission data bit 0	ABSB0	(CN1-22)	This is used to output ABS transmission data bit 0. When "Enabled (absolute position detection system by DIO) (_ _ _ 1)" is selected in [Pr. PA03], the CN1-22 pin will become ABSB0 only during ABS transfer mode. (Refer to chapter 12.)	DO-1	△		
ABS transmission data bit 1	ABSB1	(CN1-23)	This is used to output ABS transmission data bit 1. When "Enabled (absolute position detection system by DIO) (_ _ _ 1)" is selected in [Pr. PA03], the CN1-23 pin will become ABSB1 only during ABS transfer mode. (Refer to chapter 12.)	DO-1	△		
ABS transmission data ready	ABST	(CN1-25)	This is used to output ABS transmission data ready. When "Enabled (absolute position detection system by DIO) (_ _ _ 1)" is selected in [Pr. PA03], CN1-25 pin will become ABST only during ABS transfer mode. (Refer to chapter 12.)	DO-1	△		

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode P	Control mode S	Control mode T
During tough drive	MTTR		MTTR turns on when the instantaneous power failure tough drive operates while the tough drive function selection is enabled with [Pr. PA20].	DO-1	△	△	△
-	CLDS		Do not use it.	DO-1	△		

(2) Input signal

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode P	Control mode S	Control mode T
Analog torque limit	TLA	CN1-27	To use the signal in the speed control mode, enable TL (External torque limit selection) with [Pr. PD03] to [Pr. PD22]. When TLA is enabled, torque is limited in the full servo motor output torque range. Apply 0 V to +10 V DC between TLA and LG. Connect the positive terminal of the power supply to TLA. The maximum torque is generated at +10 V. (Refer to section 3.6.1 (5).) If a value equal to or larger than the maximum torque is inputted to TLA, the value is clamped at the maximum torque. Resolution: 10 bits	Analog input	○	△	
Analog torque command	TC		This is used to control torque in the full servo motor output torque range. Apply 0 V to ±8 V DC between TC and LG. The maximum torque is generated at ±8 V. (Refer to section 3.6.3 (1).) The speed at ±8 V can be changed with [Pr. PC13]. If a value equal to or larger than the maximum torque is inputted to TC, the value is clamped at the maximum torque.	Analog input			○
Analog speed command	VC	CN1-2	Apply 0 V to ±10 V DC between VC and LG. Speed set in [Pr. PC12] is provided at ±10 V. (Refer to section 3.6.2 (1).) If a value equal to or larger than the permissible speed is inputted to VC, the value is clamped at the permissible speed. Resolution: 14 bits or equivalent	Analog input		○	
Analog speed limit	VLA		Apply 0 V to ±10 V DC between VLA and LG. Speed set in [Pr. PC12] is provided at ±10 V. (Refer to section 3.6.3 (3).) If a value equal to or larger than the permissible speed is inputted to VLA, the value is clamped at the permissible speed.	Analog input			○
Forward rotation pulse train Reverse rotation pulse train	PP NP PP2 NP2 PG NG	CN1-10 CN1-35 CN1-37 CN1-38 CN1-11 CN1-36	This is used to enter a command pulse train. 1) For open-collector type The maximum input frequency is 200 kpulses/s. For A-phase/B-phase pulse train, 200 kpulses/s will be the frequency after multiplication by four. a) Sink input interface Input the forward rotation pulse train between PP and DOCOM. Input the reverse rotation pulse train between NP and DOCOM. b) Source input interface Input the forward rotation pulse train between PP2 and PG. Input the reverse rotation pulse train between NP2 and NG. 2) For differential receiver type (max. input frequency: 4 Mpulses/s) The maximum input frequency is 4 Mpulses/s. For A-phase/B-phase pulse train, 4 Mpulses/s will be the frequency after multiplication by four. Input the forward rotation pulse train between PG and PP. Input the reverse rotation pulse train between NG and NP. The command input pulse train form, pulse train logic, and command input pulse train filter are changed in [Pr. PA13]. When the command pulse train is over 1 Mpulse/s and lower than 4 Mpulse/s, set [Pr. PA13] to "_ 0 _ _".	DI-2	○		

(3) Output signal

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
Encoder A-phase pulse (differential line driver)	LA LAR	CN1-4 CN1-5	The encoder output pulses set in [Pr. PA15] are outputted in the differential line driver type. 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 relation between rotation direction and phase difference of the A-phase and B-phase pulses can be changed with [Pr. 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 encoder zero-point signal is outputted in the differential line driver type. One pulse is outputted per servo motor revolution. This turns on when the zero-point position is reached. (negative logic) The minimum pulse width is about 400 μs. For home position return using this pulse, set the creep speed to 100 r/min or less.	DO-2	○	○	○
Encoder Z-phase pulse (open-collector)	OP	CN1-33	The encoder zero-point signal is outputted in the open-collector type.	DO-2	○	○	○
Analog monitor 1	MO1	CN6-3	This is used to output the data set in [Pr. PC14] to between MO1 and LG in terms of voltage. Output voltage: ±10 V Resolution: 10 bits or equivalent	Analog output	○	○	○
Analog monitor 2	MO2	CN6-2	This signal outputs the data set in [Pr. PC15] to between MO2 and LG in terms of voltage. Output voltage: ±10 V Resolution: 10 bits or equivalent	Analog output	○	○	○

(4) Communication

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
RS-422/RS-485 I/F	SDP SDN RDP RDN	CN3-5 CN3-4 CN3-3 CN3-6	These are terminals for RS-422/RS-485 communication.		○	○	○

(5) Power supply

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					P	S	T
Digital I/F power supply input	DICOM	CN1-20 CN1-21	Input 24 V DC (24 V DC ± 10% 500 mA) to I/O interface. The power supply capacity changes depending on the number of I/O interface points to be used. For sink interface, connect + of 24 V DC external power supply. For source interface, connect - of 24 V DC external power supply.		○	○	○
Power input for open-collector sink interface	OPC	CN1-12	When inputting a pulse train in the open-collector type with sink interface, supply this terminal with the positive (+) power of 24 V DC.		○		
			Supply + of 24 V DC to this terminal when using CN1-10 pin and CN1-35 pin by DI.			○	○
Digital I/F common	DOCOM	CN1-46 CN1-47	Common terminal of input signal such as EM2 of the driver. This is separated from LG. For sink interface, connect - of 24 V DC external power supply. For source interface, connect + of 24 V DC external power supply.		○	○	○
15 V DC power supply	P15R	CN1-1	This outputs 15 V DC to between P15R and LG. This is available as power for TC, TLA, VC, or VLA. Permissible current: 30 mA		○	○	○
Control common	LG	CN1-3 CN1-28 CN1-30 CN1-34 CN3-1 CN3-7 CN6-1	This is a common terminal for TLA, TC, VC, VLA, FPA, FPB, OP ,MO1, MO2, and P15R. Pins are connected internally.		○	○	○
Shield	SD	Plate	Connect the external conductive portion of the shielded cable.		○	○	○

3.6 Detailed explanation of signals

3.6.1 Position control mode

POINT

●Adjust the logic of a positioning module and command pulse as follows.

・ MITSUBISHI ELECTRIC SYSTEM & SERVICE CO., LTD MELSEC iQ-R series/MELSEC-Q series/MELSEC-L series positioning module

Signal type	Command pulse logic setting	
	Positioning module Pr. 23 setting	LECSB2-T□driver [Pr. PA13] setting
Open-collector type	Positive logic	Positive logic (_ _ 0 _)
	Negative logic	Negative logic (_ _ 1 _)
Differential line driver type	Positive logic (Note)	Negative logic (_ _ 1 _)
	Negative logic (Note)	Positive logic (_ _ 0 _)

Note. For MITSUBISHI ELECTRIC SYSTEM & SERVICE CO., LTD MELSEC iQ-R series, MELSEC-Q series and MELSEC-L series, the logic means N-side waveform. Therefore, reverse the input pulse logic of the driver.

・ MITSUBISHI ELECTRIC SYSTEM & SERVICE CO., LTD MELSEC-F series positioning module

Signal type	Command pulse logic setting	
	Positioning module (fixed)	LECSB2-T□ driver [Pr. PA13] setting
Open-collector Differential line driver	Negative logic	Negative logic (_ _ 1 _)

(1) Pulse train input

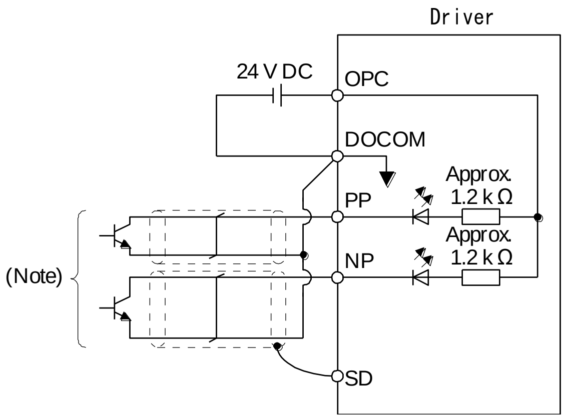
(a) Input pulse waveform selection

You can input command pulses in any of three different forms, and can choose positive or negative logic. Set the command pulse train form in [Pr. PA13]. Refer to section 5.2.1 for details.

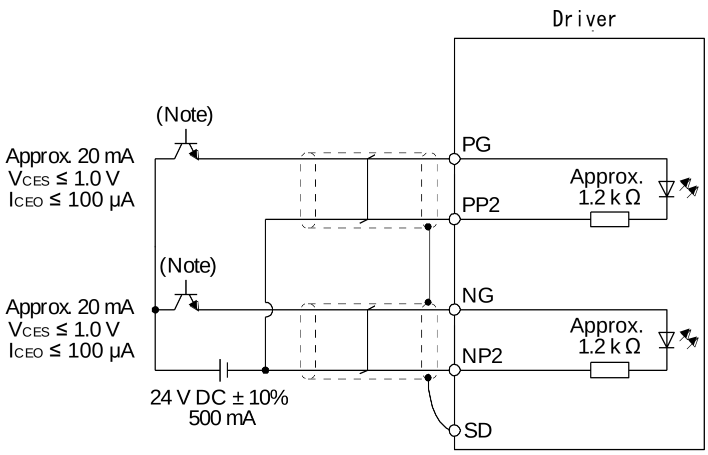
(b) Connection and waveform

1) Open-collector type

Connect as follows.



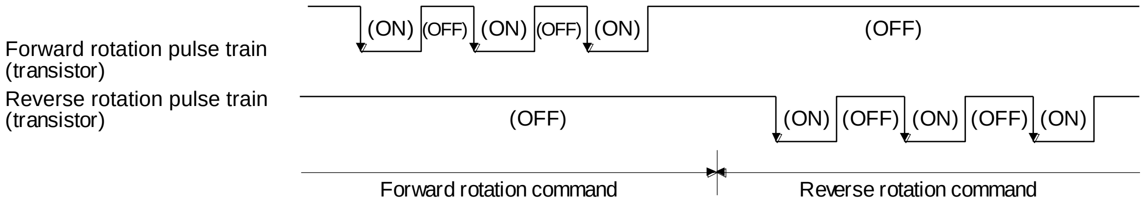
For sink input interface



For source input interface

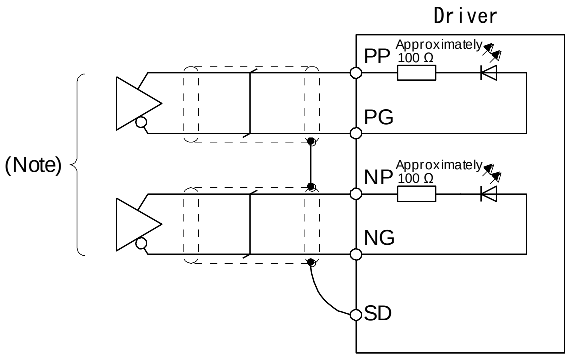
Note. Pulse train input interface is comprised of a photocoupler.
If a resistor is connected to the pulse train signal line, it may malfunction due to reduction in current.

The following section explains about the case where the negative logic and the forward/reverse rotation pulse trains are set to "_ _ 1 0" in [Pr. PA13].



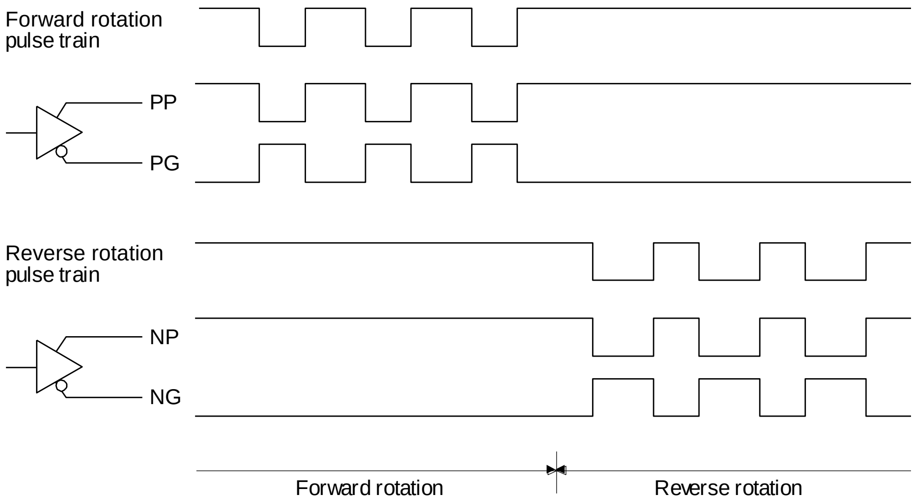
2) Differential line driver type

Connect as follows.



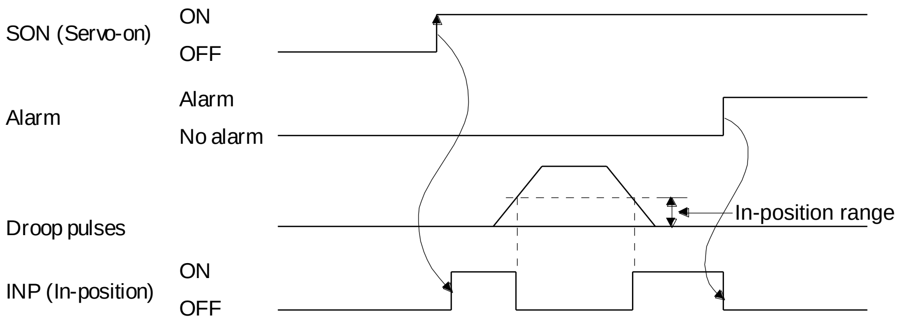
Note. Pulse train input interface is comprised of a photocoupler.
If a resistor is connected to the pulse train signal line, it may malfunction due to reduction in current.

The following section explains about the case where the negative logic and the forward/reverse rotation pulse trains are set to "_ _ 1 0" in [Pr. PA13]. The waveforms of PP, PG, NP, and NG are based on LG.

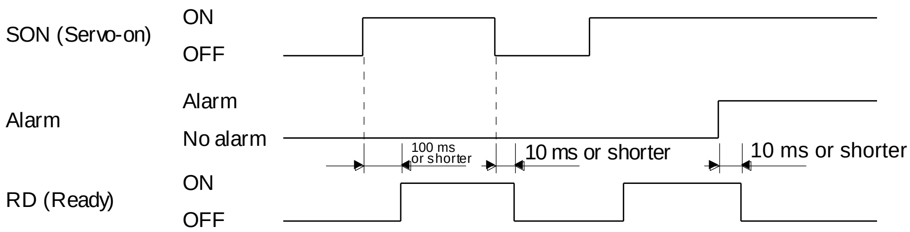


(2) INP (In-position)

INP turns on when the number of droop pulses in the deviation counter falls within the preset in-position range ([Pr. PA10]). INP may turn on continuously during a low-speed operation with a large value set as the in-position range.



(3) RD (Ready)



(4) Electronic gear switching

The combination of CM1 and CM2 enables you to select four different electronic gear numerators set in the parameters.

As soon as CM1/CM2 is turned on or off, the numerator of the electronic gear changes. Therefore, if a shock occurs at switching, use the position smoothing ([Pr. PB03]) to relieve the shock.

(Note) Input device		Electronic gear numerator
CM2	CM1	
0	0	Pr. PA06
0	1	Pr. PC32
1	0	Pr. PC33
1	1	Pr. PC34

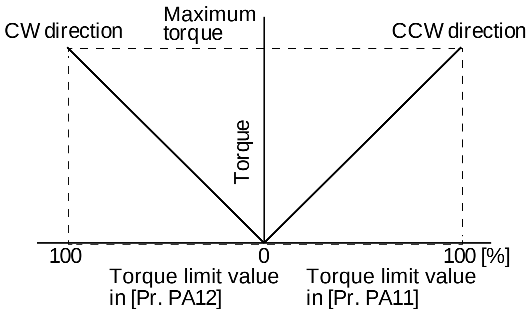
Note. 0: Off
1: On

(5) Torque limit

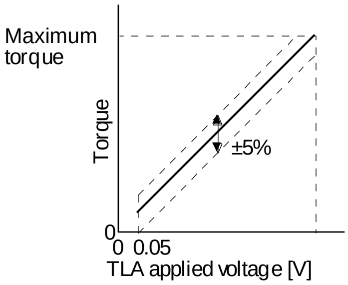
⚠CAUTION	●If the torque limit is canceled during servo-lock, the servo motor may suddenly rotate according to position deviation in respect to the command position. ●When using the torque limit, check that [Pr. PB06 Load to motor inertia ratio/load to motor mass ratio] is set properly. Improper settings may cause an unexpected operation such as an overshoot.

(a) Torque limit and torque

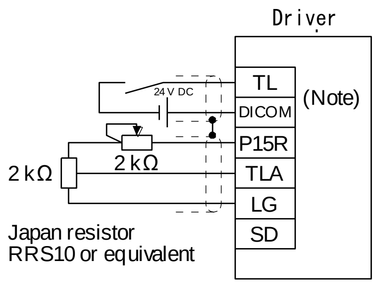
By setting [Pr. PA11 Forward rotation torque limit] or [Pr. PA12 Reverse rotation torque limit], torque is always limited to the maximum value during operation. A relation between the limit value and servo motor torque is as follows.



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



TLA applied voltage vs. torque limit value



Connection example

Note. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.

(b) Torque limit value selection

The following shows how to select a torque limit using TL (External torque limit selection) from [Pr. PA11 Forward torque limit] or [Pr. PA12 Reverse torque limit] and TLA (Analog torque limit).

When TL1 (Internal torque limit selection) is enabled with [Pr. PD03] to [Pr. PD22], you can select [Pr. PC35 Internal torque limit 2/internal thrust limit 2].

However, if [Pr. PA11] and [Pr. PA12] value is less than the limit value selected by TL/TL1, [Pr. PA11] and [Pr. PA12] value will be enabled.

Input device (Note 1)		Limit value status	Enabled torque limit value	
TL1	TL		CCW power running/CW regeneration	CW power running/CCW regeneration
0	0		Pr. PA11	Pr .PA12
0	1	TLA > Pr. PA11 Pr. PA12	Pr. PA11	Pr. PA12
		TLA < Pr. PA11 Pr. PA12	TLA (Note 2)	TLA (Note 3)
1	0	Pr. PC35 > Pr. PA11 Pr. PA12	Pr. PA11	Pr. PA12
		Pr. PC35 < Pr. PA11 Pr. PA12	Pr. PC35 (Note 2)	Pr. PC35 (Note 3)
1	1	TLA > Pr. PC35	Pr. PC35 (Note 2)	Pr. PC35 (Note 3)
		TLA < Pr. PC35	TLA (Note 2)	TLA (Note 3)

Note 1. 0: Off
1: On
2. When "_ 2 _ _" is set in [Pr. PD33], the value set in [Pr. PA11] is applied.
3. When "_ 1 _ _" is set in [Pr. PD33], the value set in [Pr. PA12] is applied.

(c) TLC (Limiting torque)
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.

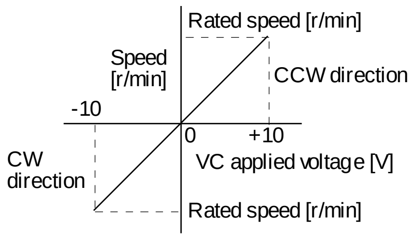
3.6.2 Speed control mode

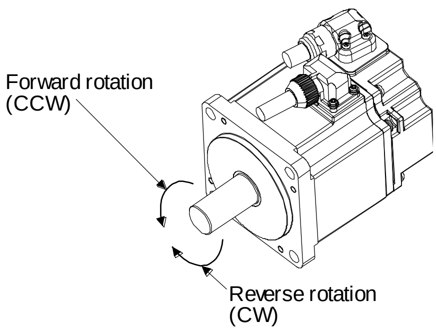
(1) Speed setting

(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 VC (Analog speed command). A relation between VC (Analog speed command) applied voltage and the servo motor speed is as follows.

Rated speed is achieved at ±10 V with initial setting. The speed at ±10 V can be changed with [Pr. PC12].



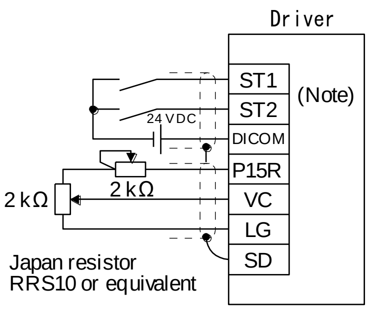


The following table indicates the rotation direction according to ST1 (Forward rotation start) and ST2 (Reverse rotation start) combination.

<table>
<tr><th colspan="2">(Note 1) Input device</th><th colspan="4">(Note 2) Rotation direction</th></tr>
<tr><th rowspan="2">ST2</th><th rowspan="2">ST1</th><th colspan="3">VC (Analog speed command)</th><th rowspan="2">Internal speed command</th></tr>
<tr><th>Polarity: +</th><th>0 V</th><th>Polarity: -</th></tr>
<tr><td>0</td><td>0</td><td>Stop
(servo-lock)</td><td>Stop
(servo-lock)</td><td>Stop
(servo-lock)</td><td>Stop
(servo-lock)</td></tr>
<tr><td>0</td><td>1</td><td>CCW</td><td rowspan="2">Stop
(no servo-lock)</td><td>CW</td><td>CCW</td></tr>
<tr><td>1</td><td>0</td><td>CW</td><td>CCW</td><td>CW</td></tr>
<tr><td>1</td><td>1</td><td>Stop
(servo-lock)</td><td>Stop
(servo-lock)</td><td>Stop
(servo-lock)</td><td>Stop
(servo-lock)</td></tr>
</table>

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.

Normally, connect as follows.



Note. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.

(b) SP1 (Speed selection 1), SP2 (Speed selection 2), and speed command value
Select any of the speed settings by the internal speed commands 1 to 3 and by VC (Analog speed command) using SP1 (Speed selection 1) and SP2 (Speed selection 2) as follows.

(Note) Input device		Speed command value
SP2	SP1	
0	0	VC (Analog speed command)
0	1	Pr. PC05 Internal speed command 1
1	0	Pr. PC06 Internal speed command 2
1	1	Pr. PC07 Internal speed command 3

Note. 0: Off
1: On

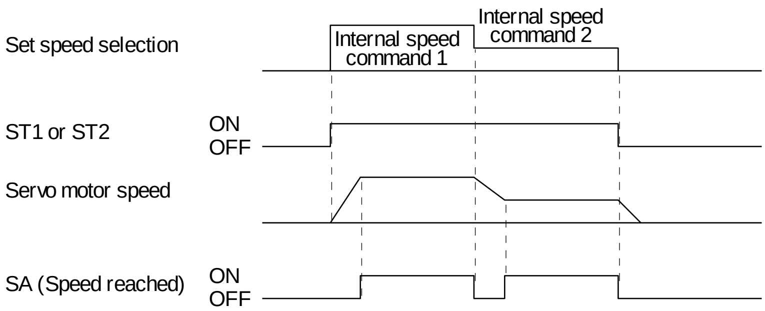
To select VC (Analog speed command) and a speed command value of internal speed commands 1 to 7, enable SP3 (Speed selection 3) with [Pr. PD03] to [Pr. PD22].

(Note) Input device			Speed command value
SP3	SP2	SP1	
0	0	0	VC (Analog speed command)
0	0	1	Pr. PC05 Internal speed command 1
0	1	0	Pr. PC06 Internal speed command 2
0	1	1	Pr. PC07 Internal speed command 3
1	0	0	Pr. PC08 Internal speed command 4
1	0	1	Pr. PC09 Internal speed command 5
1	1	0	Pr. PC10 Internal speed command 6
1	1	1	Pr. PC11 Internal speed command 7

Note. 0: Off
1: On

You can change the speed during rotation. To accelerate/decelerate, set acceleration/deceleration time constant in [Pr. PC01] or [Pr. PC02].
When the internal speed commands are used to command a speed, the speed does not vary with the ambient temperature.

(2) SA (Speed reached)
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)

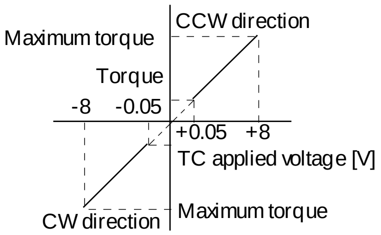
3.6.3 Torque control mode

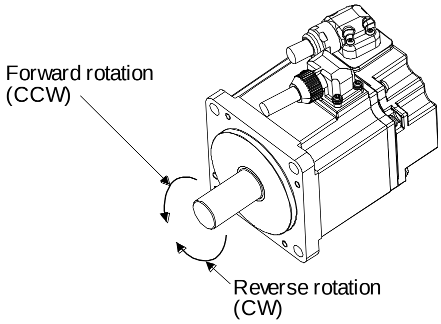
(1) Torque limit

(a) Torque command and torque

The following shows a relation between the applied voltage of TC (Analog torque command) and the torque by the servo motor.

The maximum torque is generated at ±8 V. The speed at ±8 V can be changed with [Pr. PC13].



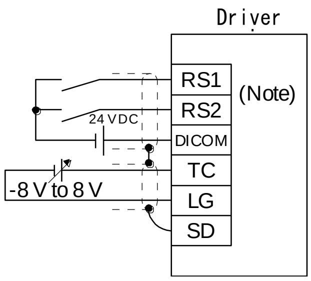


Generated torque command values will vary about 5% relative to the voltage depending on products.
The torque may vary if the voltage is low (-0.05 V to 0.05 V) and the actual speed is close to the limit value. In such a case, increase the speed limit value.
The following table indicates the torque generation directions determined by RS1 (Forward rotation selection) and RS2 (Reverse rotation selection) when TC (Analog torque command) is used.

(Note) Input device		Rotation direction		
		TC (Analog torque command)		
RS2	RS1	Polarity: +	0 V	Polarity: -
0	0	Torque is not generated.	Torque is not generated.	Torque is not generated.
0	1	CCW (Forward rotation in power running mode/reverse rotation in regenerative mode)		CW (Reverse rotation in power running mode/forward rotation in regenerative mode)
1	0	CW (Reverse rotation in power running mode/forward rotation in regenerative mode)		CCW (Forward rotation in power running mode/reverse rotation in regenerative mode)
1	1	Torque is not generated.		Torque is not generated.

Note. 0: Off
1: On

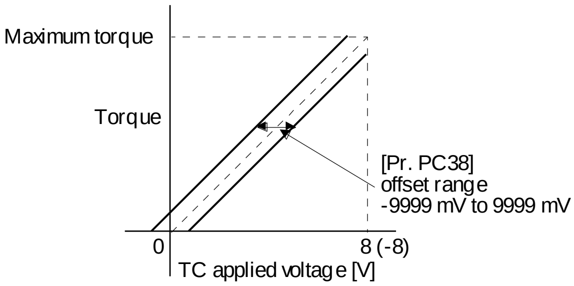
Normally, connect as follows.



Note. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.

(b) Analog torque command offset

Using [Pr. PC38], the offset voltage of -9999 mV to 9999 mV can be added to the TC applied voltage as follows.



(2) Torque limit

By setting [Pr. PA11 Forward rotation torque limit] or [Pr. PA12 Reverse rotation torque limit], torque is always limited to the maximum value during operation. A relation between limit value and servo motor torque is as in section 3.6.1 (5).

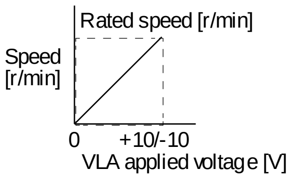
Note that TLA (Analog torque limit) is unavailable.

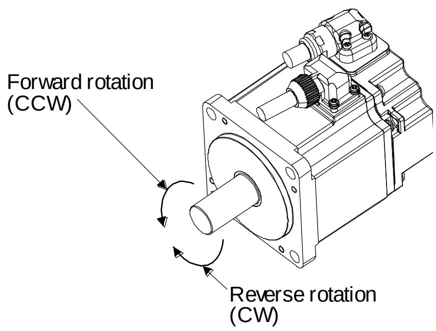
(3) Speed limit

(a) Speed limit value and speed

The speed is limited to the values set with [Pr. PC05 Internal speed limit 0] to [Pr. PC11 Internal speed limit 7] or the value set in the applied voltage of VLA (Analog speed limit). A relation between VLA (Analog speed limit) applied voltage and the servo motor speed is as follows. The speed limit direction and torque command direction are the same direction.

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



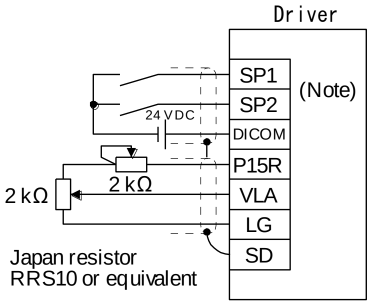


The following table indicates the limit direction according to RS1 (Forward rotation selection) and RS2 (Reverse rotation selection) combination.

(Note) Input device		TC (Analog torque command)		Speed limit direction		
				VLA (Analog speed limit)		
RS1	RS2	Voltage polarity	Torque command direction	Polarity: +	Polarity: -	Internal speed limit
1	0	Polarity: +	CCW	CCW	CCW	CCW
		Polarity: -	CW	CW	CW	CW
0	1	Polarity: +	CW	CW	CW	CW
		Polarity: -	CCW	CCW	CCW	CCW

Note. 0: Off
1: On

Normally, connect as follows.



Note. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.

(b) Speed limit value selection

Select any of the speed settings by the internal speed limits 1 to 7 and by VLA (Analog speed limit) using SP1 (Speed selection 1), SP2 (Speed selection 2), and SP3 (Speed selection 3) as follows.

(Note) Input device			Speed limit
SP3	SP2	SP1	
0	0	0	VLA (Analog speed limit)
0	0	1	Pr. PC05 Internal speed limit 1
0	1	0	Pr. PC06 Internal speed limit 2
0	1	1	Pr. PC07 Internal speed limit 3
1	0	0	Pr. PC08 Internal speed limit 4
1	0	1	Pr. PC09 Internal speed limit 5
1	1	0	Pr. PC10 Internal speed limit 6
1	1	1	Pr. PC11 Internal speed limit 7

Note. 0: Off
1: On

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

(c) VLC (Limiting speed)

VLC turns on when the servo motor speed reaches a speed limited with internal speed limits 1 to 7 or analog speed limit.

3.6.4 Position/speed control switching mode

Set " _ _ _ 1" in [Pr. PA01] to switch to the position/speed control switching mode. This function is not available in the absolute position detection system.

(1) LOP (control switching)

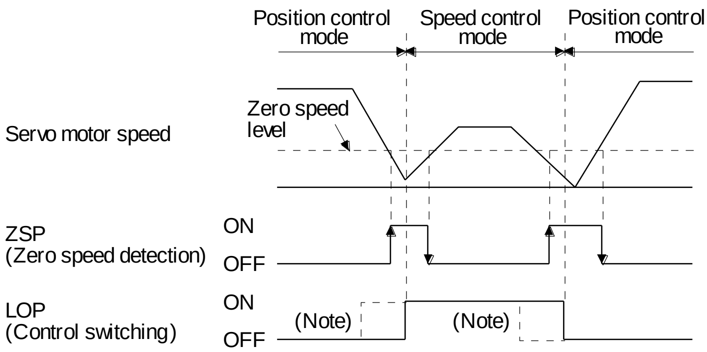
Use LOP (Control switching) to switch between the position control mode and the speed control mode with an external contact. The following shows a relation between LOP and control modes.

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

Note. 0: Off
1: On

You can switch the control mode in the zero speed status. To ensure safety, switch modes after the servo motor has stopped. When position control mode is switched to speed control mode, droop pulses will be reset.

If LOP is switched on/off at the speed higher than the zero speed, the control mode cannot be changed regardless of the speed. The following shows a switching timing chart.



Note. When ZSP is not turned on, the control mode is not switched even if LOP is turned on/off. After LOP is turned on/off, even if ZSP is turned on, the control mode is not switched.

(2) Torque limit in position control mode

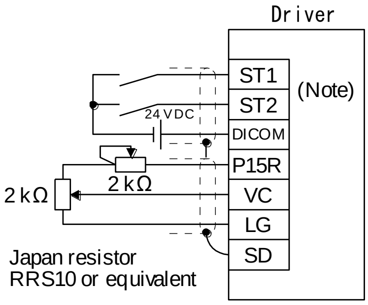
As in section 3.6.1 (5)

(3) Speed setting in speed control mode

(a) Speed command and speed

The servo motor is run at the speeds set in the parameters or at the speed set in the applied voltage of VC (Analog speed command). The relation between an applied voltage of VC (Analog speed command) and servo motor speed, and the rotation direction with turning on ST1/ST2 are the same as section 3.6.2 (1) (a).

Normally, connect as follows.



Note. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.

(b) Speed command value selection

Select any of the speed settings by the internal speed commands 1 to 3 and by VC (Analog speed command) using SP1 (Speed selection 1) and SP2 (Speed selection 2) as follows.

(Note) Input device		Speed command value
SP2	SP1	
0	0	VC (Analog speed command)
0	1	Pr. PC05 Internal speed command 1
1	0	Pr. PC06 Internal speed command 2
1	1	Pr. PC07 Internal speed command 3

Note. 0: Off
1: On

To select VC (Analog speed command) and a speed command value of internal speed commands 1 to 7, enable SP3 (Speed selection 3) with [Pr. PD03] to [Pr. PD22].

(Note) Input device			Speed command value
SP3	SP2	SP1	
0	0	0	VC (Analog speed command)
0	0	1	Pr. PC05 Internal speed command 1
0	1	0	Pr. PC06 Internal speed command 2
0	1	1	Pr. PC07 Internal speed command 3
1	0	0	Pr. PC08 Internal speed command 4
1	0	1	Pr. PC09 Internal speed command 5
1	1	0	Pr. PC10 Internal speed command 6
1	1	1	Pr. PC11 Internal speed command 7

Note. 0: Off
1: On

You can change the speed during rotation. Acceleration/deceleration is performed with the setting values of [Pr. PC01] and [Pr. PC02].

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

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

3.6.5 Speed/torque control switching mode

Set " _ _ _ 3" in [Pr. PA01] to switch to the speed/torque control switching mode.

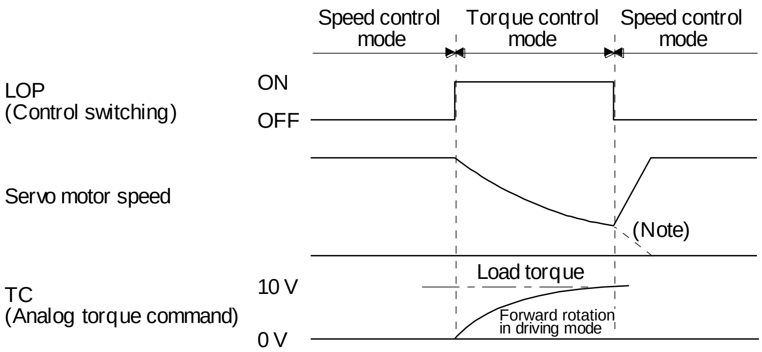
(1) LOP (control switching)

Use LOP (Control switching) to switch between the speed control mode and the torque control mode with an external contact. The following shows a relation between LOP and control modes.

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

Note. 0: Off
1: On

The control mode may be switched at any time. The following shows a switching timing chart.



Note. When ST1 (Forward rotation start) and ST2 (Reverse rotation start) are switched off as soon as a mode is switched to the speed control, the servo motor comes to a stop according to the deceleration time constant. A shock may occur at switching control modes.

(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)

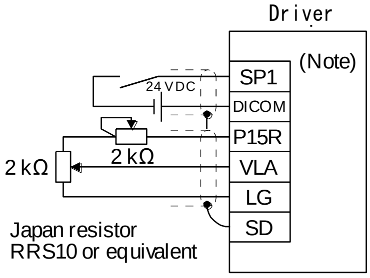
(4) Speed limit in torque control mode

(a) Speed limit value and speed

The speed is limited to the limit value of the parameter or the value set in the applied voltage of VLA (Analog speed limit).

A relation between the VLA (Analog speed limit) applied voltage and the limit value is as in section 3.6.3 (3) (a).

Normally, connect as follows.



Note. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.

(b) Speed limit value selection
Select any of the speed settings by the internal speed limit 1 and by VLA (Analog speed limit) using SP1 (Speed selection 1) as follows.

(Note) Input device	Speed command value
SP1	
0	VLA (Analog speed limit)
1	Pr. PC05 Internal speed limit 1

Note. 0: Off
1: On

You can change the speed during rotation. To accelerate/decelerate, set acceleration/deceleration time constant in [Pr. PC01] or [Pr. PC02].
When the internal speed limit 1 is used to command a speed, the speed does not vary with the ambient temperature.

(c) VLC (Limiting speed)
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 switching mode

Set " _ _ _ 5" in [Pr. PA01] to switch to the torque/position control switching mode.

(1) LOP (control switching)

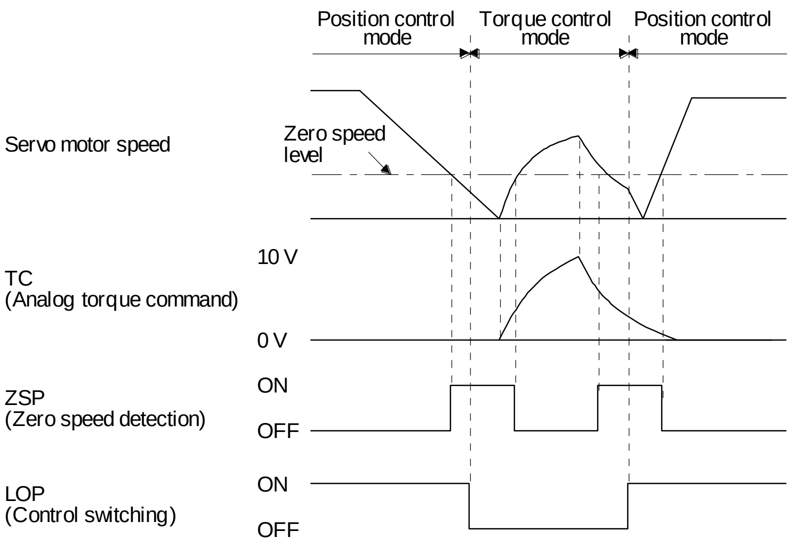
Use LOP (Control switching) to switch between the torque control mode and the position control mode with an external contact. The following shows a relation between LOP and control modes.

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

Note. 0: Off
1: On

You can switch the control mode in the zero speed status. To ensure safety, switch modes after the servo motor has stopped. When position control mode is switched to torque control mode, droop pulses will be reset.

If LOP is switched on/off at the speed higher than the zero speed, the control mode cannot be changed regardless of the speed. The following shows a switching timing chart.



Note. When ZSP is not turned on, the control mode is not switched even if LOP is turned on/off. After LOP is turned on/off, even if ZSP is turned on, the control mode is not switched.

(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 Forced stop deceleration function

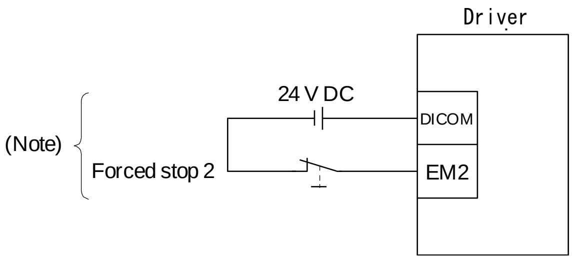
POINT
●When alarms not related to the forced stop function occur, control of motor deceleration cannot be guaranteed. (Refer to chapter 8.) ●In the torque control mode, the forced stop deceleration function is not available. ●If an alarm occurs with the forced stop deceleration function disabled, the servo motor will stop with the dynamic brake. ●Keep SON (Servo-on) on while EM2 (Forced stop 2) is off. If SON (Servo-on) is off, forced stop deceleration, base circuit shut-off delay time, and vertical axis freefall prevention do not function.

3.7.1 Forced stop deceleration function

When EM2 is turned off, dynamic brake will start to stop the servo motor after forced stop deceleration. During this sequence, the display shows [AL. E6 Servo forced stop warning].

During normal operation, do not use EM2 (Forced stop 2) to alternate stop and drive. The driver life may be shortened.

(1) Connection diagram



Note. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.

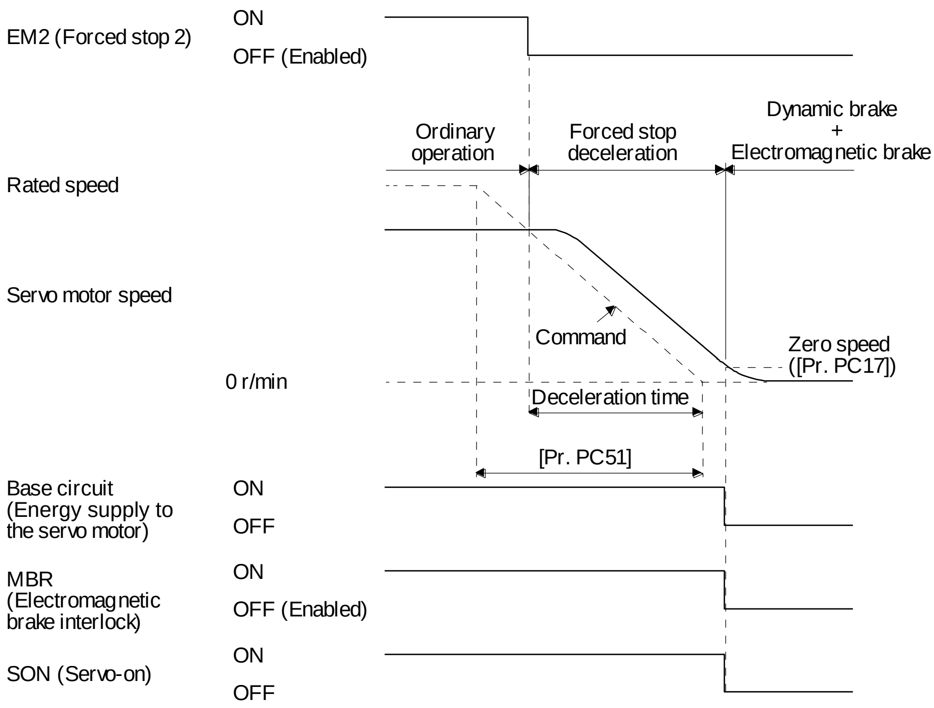
(2) Timing chart

POINT

- When LSP/LSN is turned on during a forced stop deceleration, the motor will stop depending on the setting of [Pr. PD30] as follows.

[Pr. PD30]	Stop system
_ _ _ 0	Switching to sudden stop
_ _ _ 1	Continuing forced stop deceleration

When EM2 (Forced stop 2) is turned off, the motor will decelerate according to [Pr. PC51 Forced stop deceleration time constant]. Once the motor speed is below [Pr. PC17 Zero speed] after completion of the deceleration command, base power is cut and the dynamic brake activates.

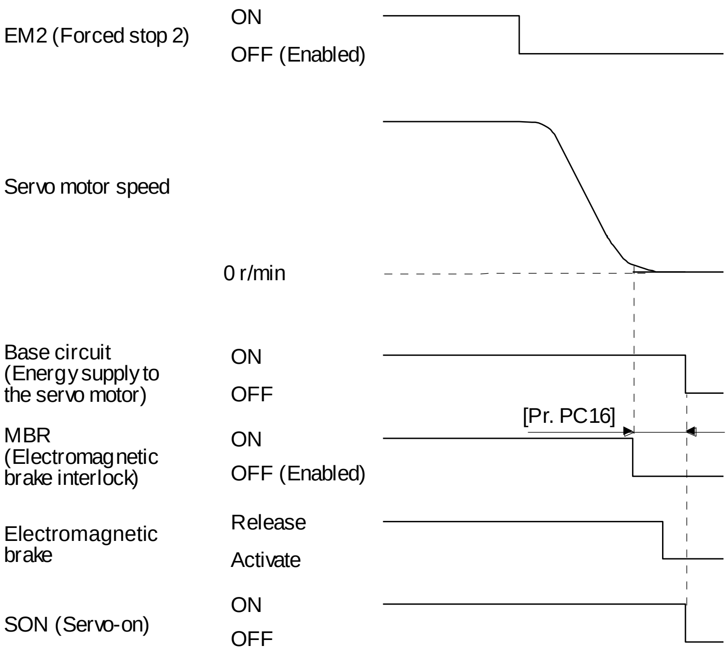


3.7.2 Base circuit shut-off delay time function

The base circuit shut-off delay time function is used to prevent vertical axis from dropping at a forced stop (EM2 goes off) or alarm occurrence due to delay time of the electromagnetic brake. Use [Pr. PC16] to set the delay time between completion of EM2 (Forced stop 2) or activation of MBR (Electromagnetic brake interlock) due to an alarm occurrence, and shut-off of the base circuit.

(1) Timing chart

When EM2 (Forced stop 2) turns off or an alarm occurs during driving, the servo motor will decelerate based on the deceleration time constant. MBR (Electromagnetic brake interlock) will turn off, and then after the delay time set in [Pr. PC16], the driver will be base circuit shut-off status.



(2) Adjustment

While the servo motor is stopped, turn off EM2 (Forced stop 2), adjust the base circuit shut-off delay time in [Pr. PC16], and set the value to approximately 1.5 times of the smallest delay time in which the servo motor shaft does not freefall.

3.7.3 Vertical axis freefall prevention function

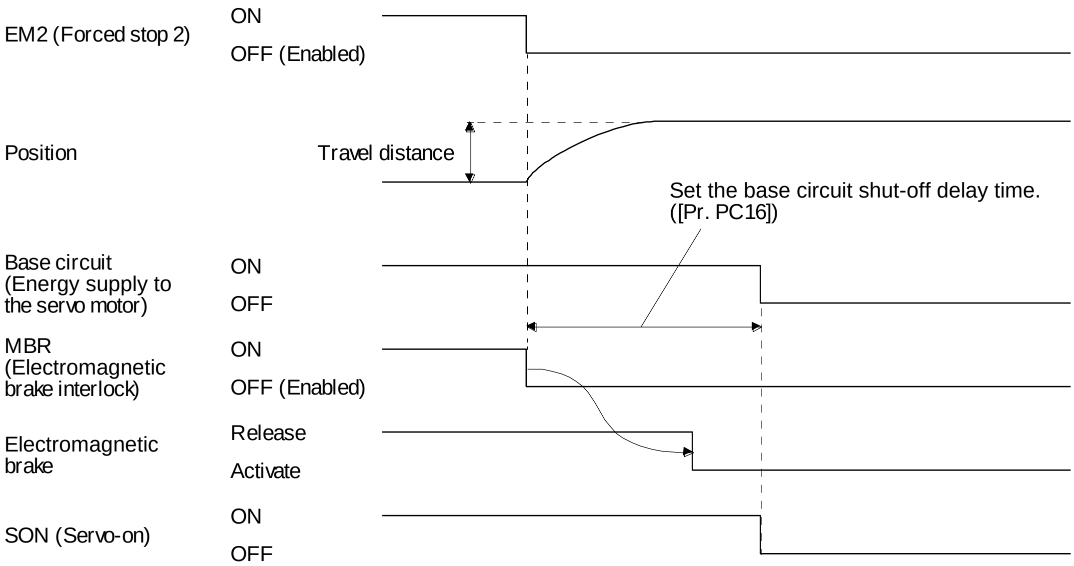
The vertical axis freefall prevention function avoids machine damage by pulling up the shaft slightly like the following case.

When the servo motor is used for operating vertical axis, the servo motor electromagnetic brake and the base circuit shut-off delay time function avoid dropping axis at forced stop. However, those functions may not avoid dropping axis a few μm due to the backlash of the servo motor electromagnetic brake.

The vertical axis freefall prevention function is enabled with the following conditions.

- Other than "0" is set to [Pr. PC54 Vertical axis freefall prevention compensation amount].
- The servo motor speed decelerates lower than the value of zero speed by turning off EM2 (Forced stop 2) or by an alarm occurrence.
- The base circuit shut-off delay time function is enabled.
- EM2 (Forced stop 2) turned off or an alarm occurred while the servo motor speed is zero speed or less.

(1) Timing chart



(2) Adjustment

- Set the freefall prevention compensation amount in [Pr. PC54].
- While the servo motor is stopped, turn off the EM2 (Forced stop 2). Adjust the base circuit shut-off delay time in [Pr. PC16] in accordance with the travel distance ([Pr. PC54). Adjust it considering the freefall prevention compensation amount by checking the servo motor speed, torque ripple, etc.

3.7.4 Residual risks of the forced stop function (EM2)

(1) The forced stop function is not available for alarms that activate the dynamic brake when the alarms occur.

(2) When an alarm that activates the dynamic brake during forced stop deceleration occurs, the braking distance until the servo motor stops will be longer than that of normal forced stop deceleration without the dynamic brake.

(3) If STO is turned off during forced stop deceleration, [AL. 63 STO timing error] will occur.

3.8 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.

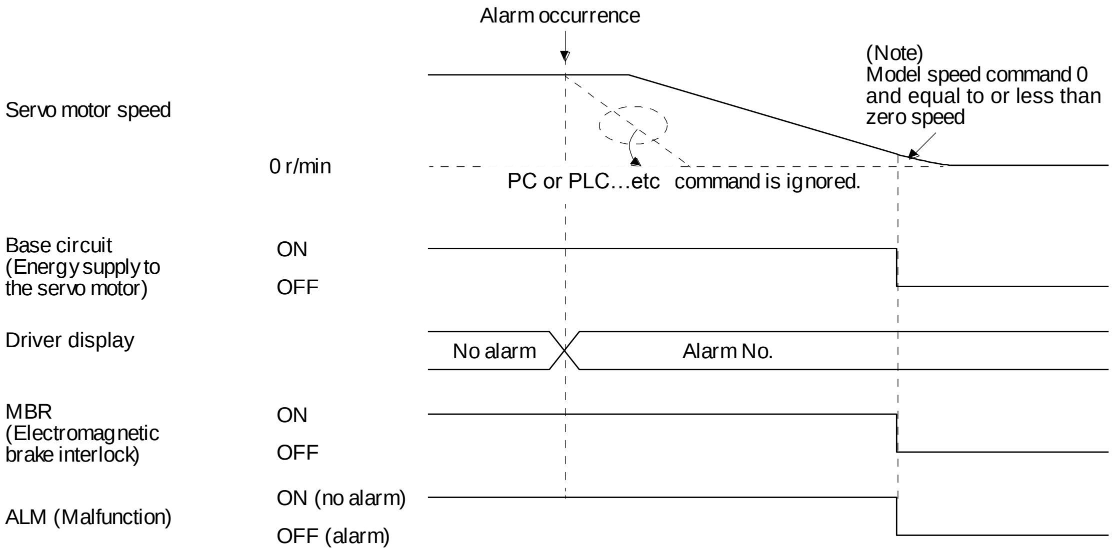
POINT
●In the torque control mode, the forced stop deceleration function is not available.

To deactivate an alarm, cycle the control circuit power, push the "SET" button in the current alarm window, or cycle the RES (Reset) However, the alarm cannot be deactivated unless its cause is removed.

3.8.1 When you use the forced stop deceleration function

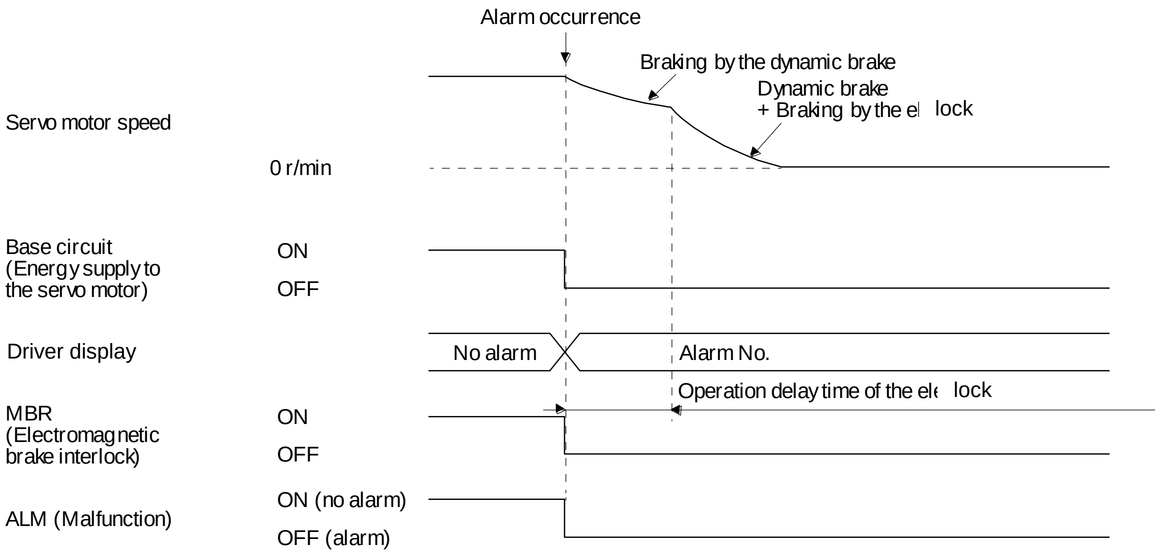
POINT
●To enable the function, set "2 _ _ _ (initial value)" in [Pr. PA04]. ●If an alarm occurs with the forced stop deceleration function disabled, the servo motor will stop with the dynamic brake.

(1) When the forced stop deceleration function is enabled



Note. The model speed command is a speed command generated in the driver for forced stop deceleration of the servo motor.

(2) When the forced stop deceleration function is not enabled



3.8.2 When you do not use the forced stop deceleration function

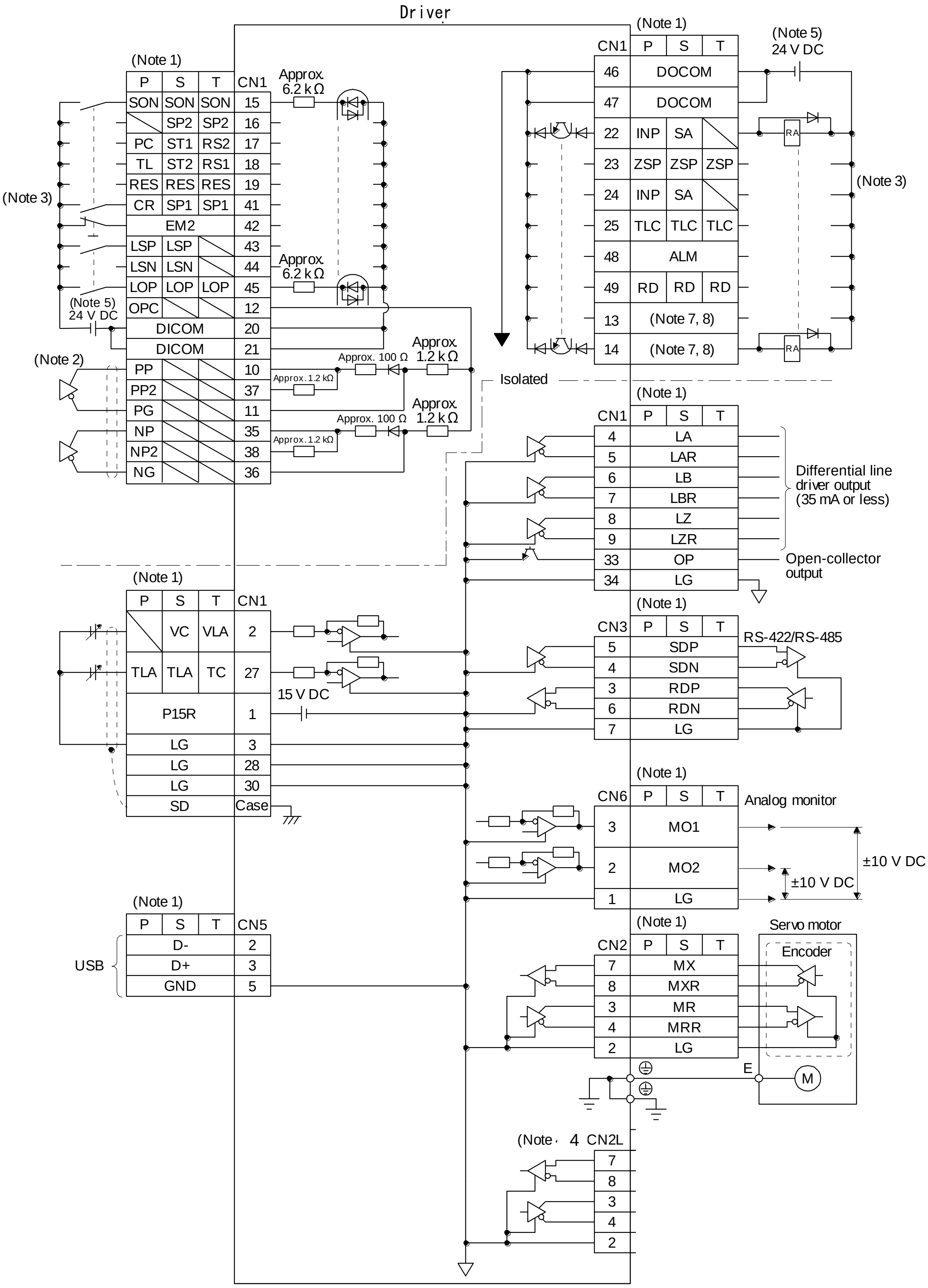
POINT
●To disable the function, set "0 _ _ _" in [Pr. PA04].

The operation status during an alarm is the same as section 3.8.1 (2).

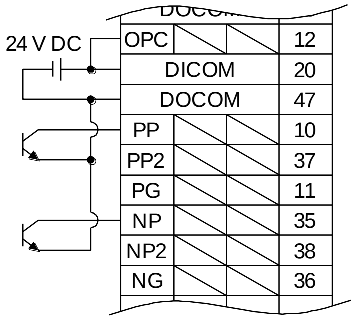
3.9 Interfaces

3.9.1 Internal connection diagram

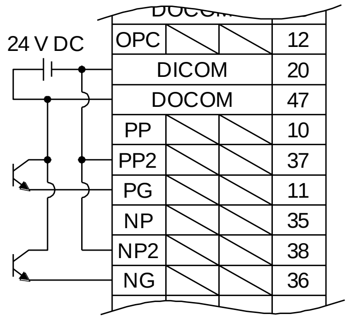
POINT
●Refer to section 13.3.1 for the CN8 connector.



Note 1. P: Position control mode, S: Speed control mode, T: Torque control mode
2. This is for the differential line driver pulse train input. For the open-collector pulse train input, connect as follows.



For sink input interface



For source input interface

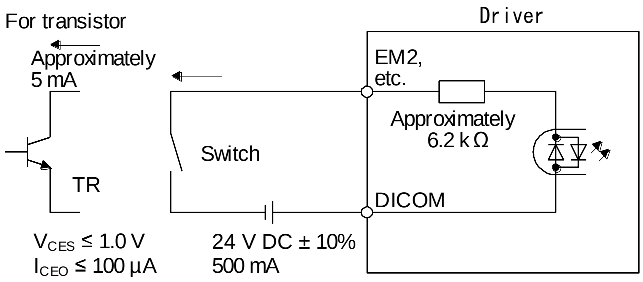
3. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.
4. CN2L can not be used. Connect the encoder cable to CN2.
5. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.
7. Output devices are not assigned by default. Assign the output devices with [Pr. PD47] as necessary.

3.9.2 Detailed explanation of interfaces

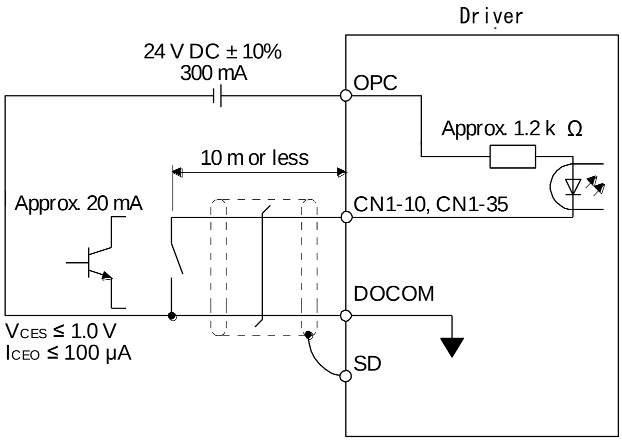
This section provides the details of the I/O signal interfaces (refer to the I/O division in the table) given in section 3.5. Refer to this section and make connection with the external device.

(1) Digital input interface DI-1

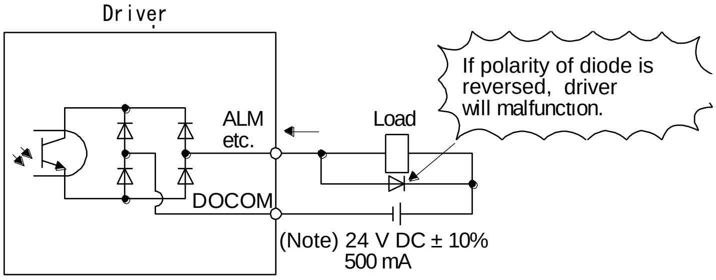
This is an input circuit whose photocoupler cathode side is the input terminal. Transmit signals from sink (open-collector) type transistor output, relay switch, etc. The following is a connection diagram for sink input. Refer to section 3.9.3 for source input.



The following is for when CN1-10 pin and CN1-35 pin are used as digital input interfaces.



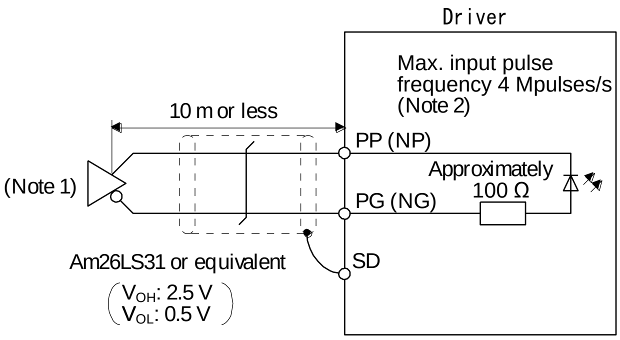
(2) Digital output interface DO-1
This is a circuit in which the collector of the output transistor is the output terminal. When the output transistor is turned on, the current will flow to the collector terminal.
A lamp, relay or photocoupler can be driven. Install a diode (D) for an inductive load, or install an inrush current suppressing resistor (R) for a lamp load.
(Rated current: 40 mA or less, maximum current: 50 mA or less, inrush current: 100 mA or less) A maximum of 2.6 V voltage drop occurs in the driver.
The following shows a connection diagram for sink output. Refer to section 3.9.3 for source output.



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

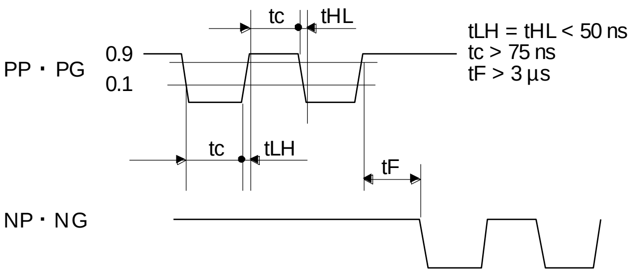
(3) Pulse train input interface DI-2
Give a pulse train signal in the differential line driver type or open-collector type.

(a) Differential line driver type
1) Interface



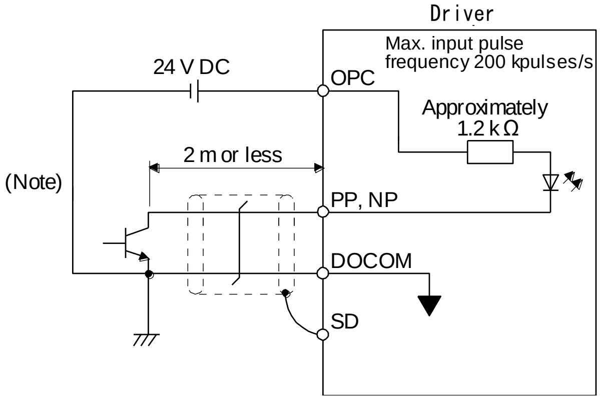
Note 1. Pulse train input interface is comprised of a photocoupler.
If a resistor is connected to the pulse train signal line, it may malfunction due to reduction in current.
2. When the input pulse frequency is 4 Mpulses/s, set [Pr. PA13] to "_ 0 _ _".

2) Input pulse condition



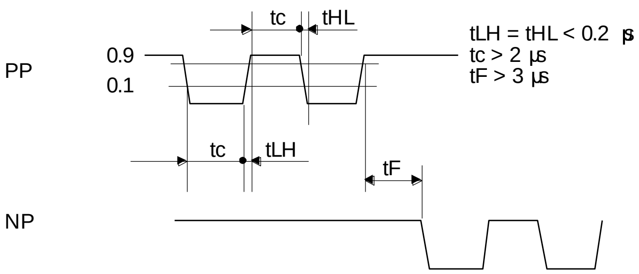
(b) Open-collector type

1) Interface



Note. Pulse train input interface is comprised of a photocoupler.
If a resistor is connected to the pulse train signal line, it may malfunction due to reduction in current.

2) Input pulse condition

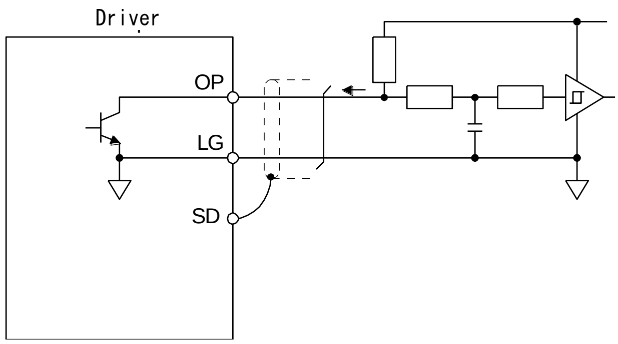


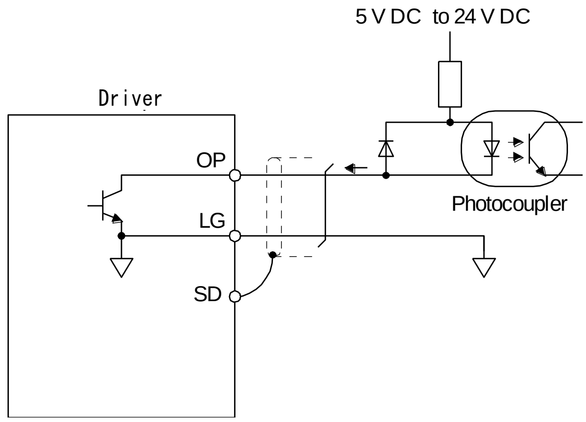
(4) Encoder output pulse DO-2

(a) Open-collector type

Interface

Maximum sink current: 35 mA

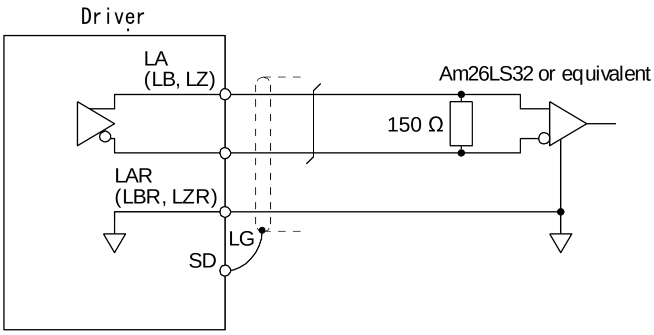


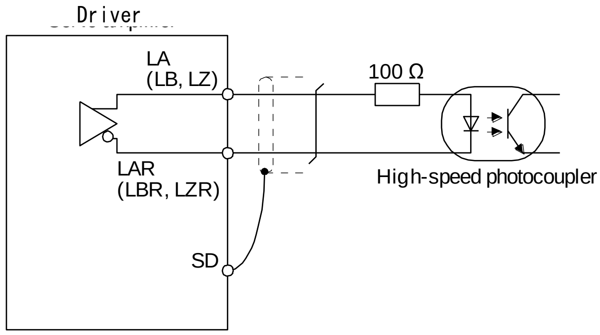


(b) Differential line driver type

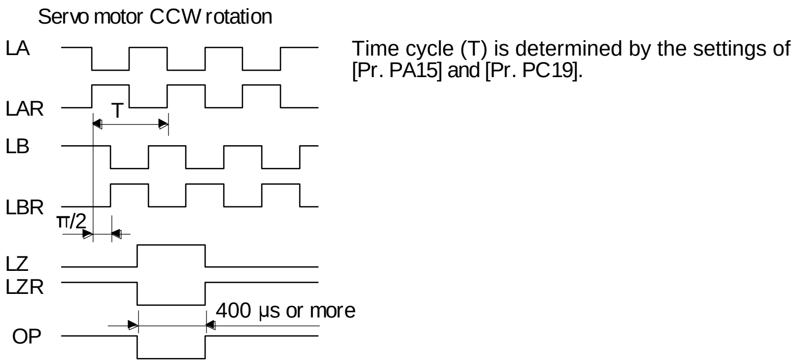
1) Interface

Maximum output current: 35 mA





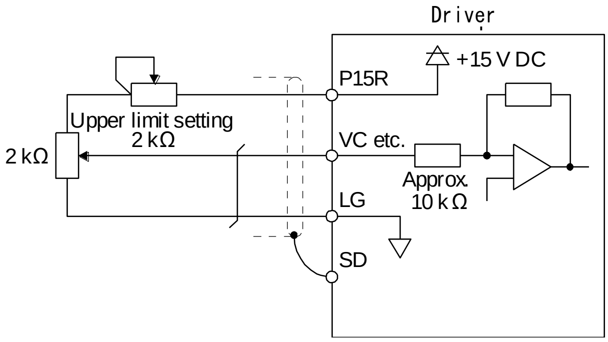
2) Output pulse



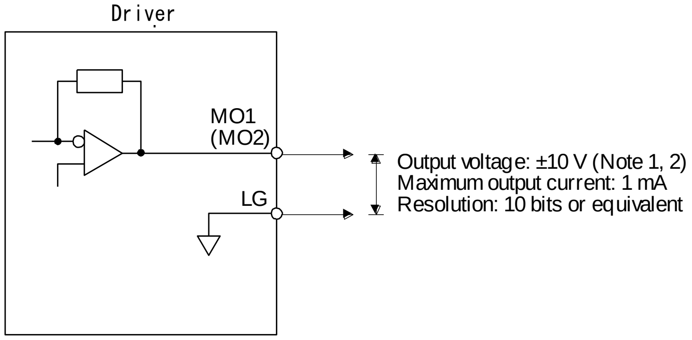
(5) Analog input

Input impedance

10 kΩ to 12 kΩ



(6) Analog output



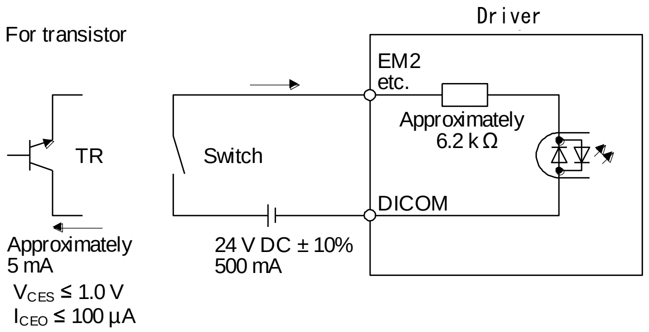
Note 1. Output voltage range varies depending on the monitored signal.

3.9.3 Source I/O interfaces

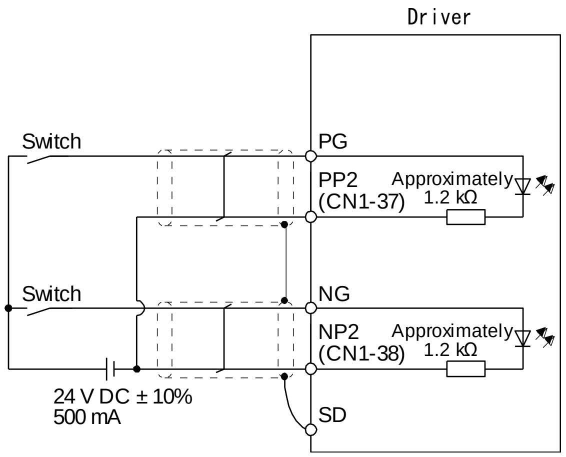
In this driver, source type I/O interfaces can be used.

(1) Digital input interface DI-1

This is an input circuit whose photocoupler anode side is the input terminal. Transmit signals using source (open-collector) type transistor output, relay switch, etc. Additionally, the CN1-10 and CN1-35 pins cannot be used for source inputs.



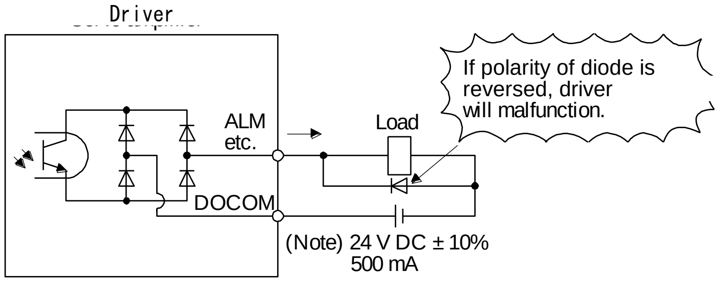
The following shows when the CN1-37 pin and the CN1-38 pin are used as digital input interface:



(2) Digital output interface DO-1

This is a circuit in which the emitter side of the output transistor is the output terminal. When the output transistor is turned on, the current flows from the output terminal to a load.

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

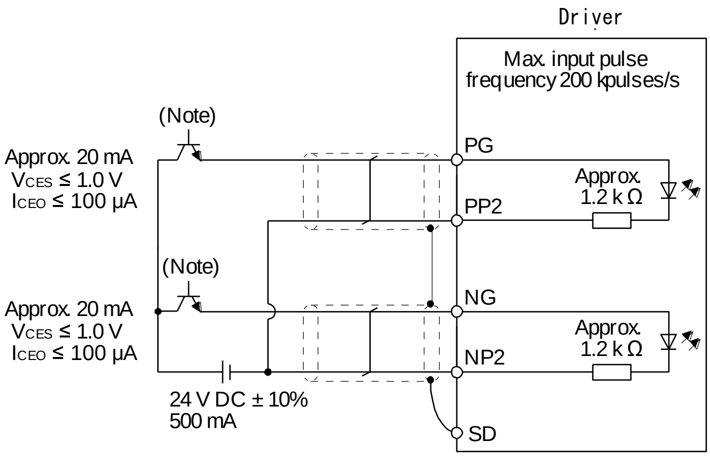


Note. If the voltage drop (maximum of 2.6 V) interferes with the relay operation, apply high voltage (maximum of 26.4 V) from external source.

(3) Pulse train input interface DI-2

Give a pulse train signal in the open-collector type.

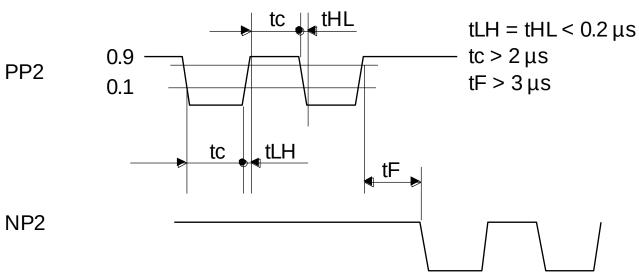
1) Interface



Note. Pulse train input interface is comprised of a photocoupler.

If a resistor is connected to the pulse train signal line, it may malfunction due to reduction in current.

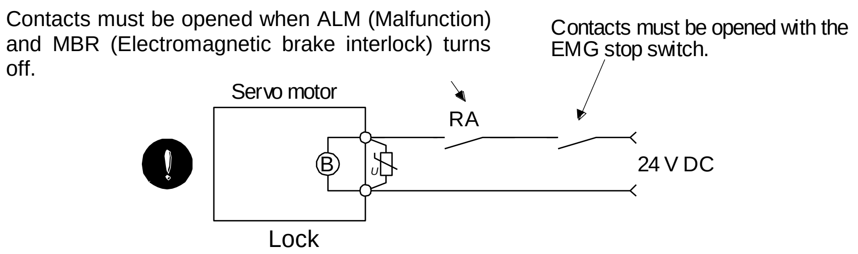
2) Input pulse condition



3.10 Servo motor with a lock
3.10.1 Safety precautions

⚠CAUTION

- Configure an electromagnetic brake circuit which is interlocked with an external emergency stop switch.



Refer to section 3.10.3 when wiring for the circuit configuration.

- The electromagnetic brake is provided for holding purpose and must not be used for ordinary braking.
- Before operating the servo motor, be sure to confirm that the electromagnetic brake operates properly.
- Do not use the 24 V DC interface power supply for the electromagnetic brake. Always use the power supply designed exclusively for the electromagnetic brake. Otherwise, it may cause a malfunction.
- When using EM2 (Forced stop 2), use MBR (Electromagnetic brake interlock) for operating the electromagnetic brake. Operating the electromagnetic brake without using MBR during deceleration to a stop will saturate servo motor torques at the maximum value due to brake torque of the electromagnetic brake. This can result in delay of the deceleration to a stop from a set value.

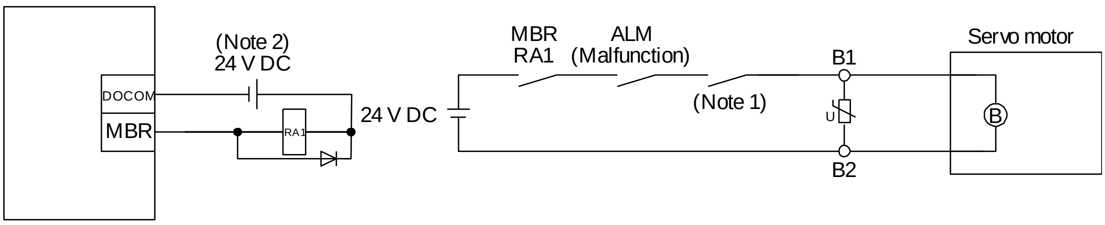
POINT

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

Note the following when the servo motor with an electromagnetic brake is used.

1) The electromagnetic brake will operate when the power (24 V DC) turns off.
2) The status is base circuit shut-off during RES (Reset) on. When you use the motor in vertical axis system, use MBR (Electromagnetic brake interlock).
3) Turn off SON (Servo-on) after the servo motor stopped.

(1) Connection diagram



Note 1. Create the circuit in order to shut off by interlocking with the emergency stop switch.
2. Do not use the 24 V DC interface power supply for the electromagnetic brake.

(2) Setting

(a) Enable MBR (Electromagnetic brake interlock) with [Pr. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47].

(b) In [Pr. PC16 Electromagnetic brake sequence output], set a delay time (Tb) from MBR (Electromagnetic brake interlock) off to base circuit shut-off at a servo-off as in the timing chart in section 3.10.2 (1).

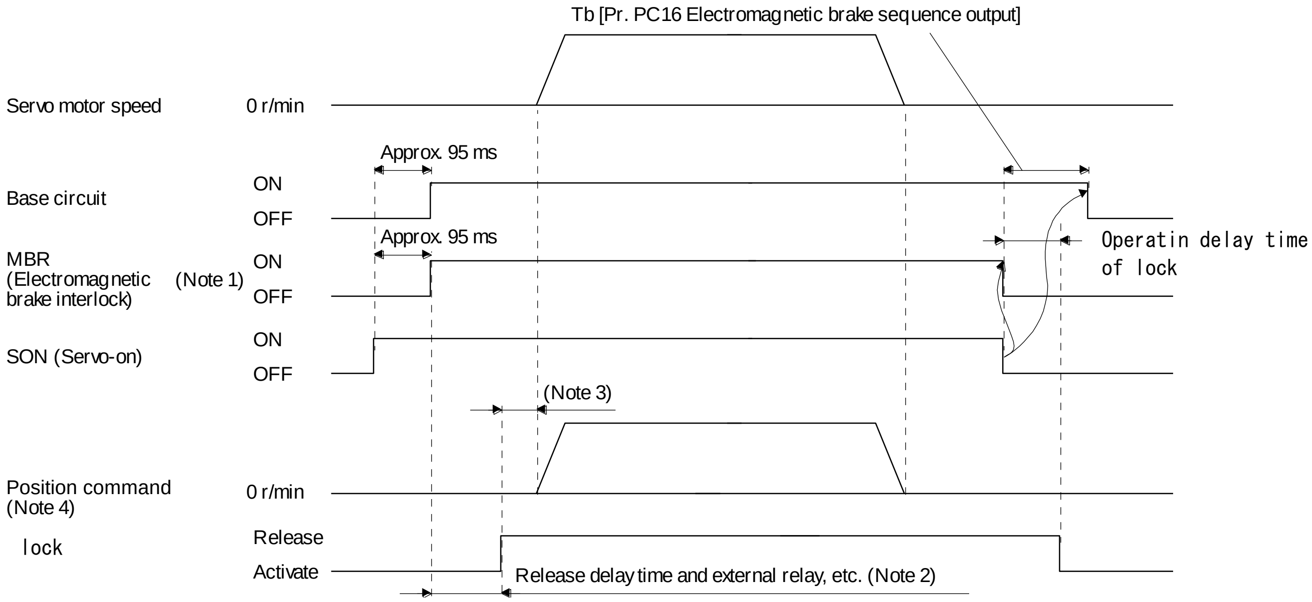
3.10.2 Timing chart

(1) When you use the forced stop deceleration function

POINT
●To enable the function, set "2 _ _ _ (initial value)" in [Pr. PA04].

(a) Servo-on command (from PC or PLC…etc) on/off

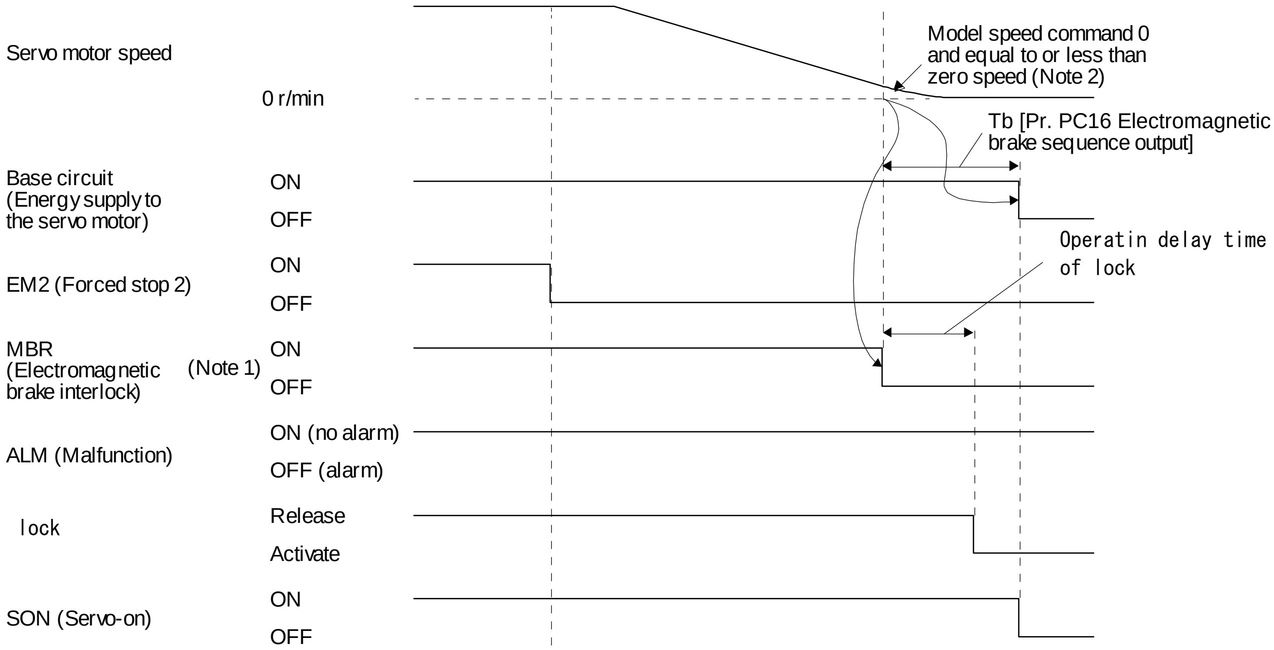
When SON (Servo-on) is turned off, the servo lock will be released after Tb [ms], and the servo motor will coast. If the electromagnetic brake is enabled during servo-lock, the lock life may be shorter. Therefore, set Tb about 1.5 times of the minimum delay time where the moving part will not drop down for a vertical axis system, etc.



Note 1. ON:lock is not activated.
OFF: Electromagnetic brake has been activated.
2. Electromagnetic brake is released after delaying for the release delay time of electromagnetic brake and operation time of external circuit relay. For the release delay time of electromagnetic brake, refer to Chapter 15.
3. Give a position command after the electromagnetic brake is released.
4. This is in position control mode.

(b) Forced stop 2 on/off

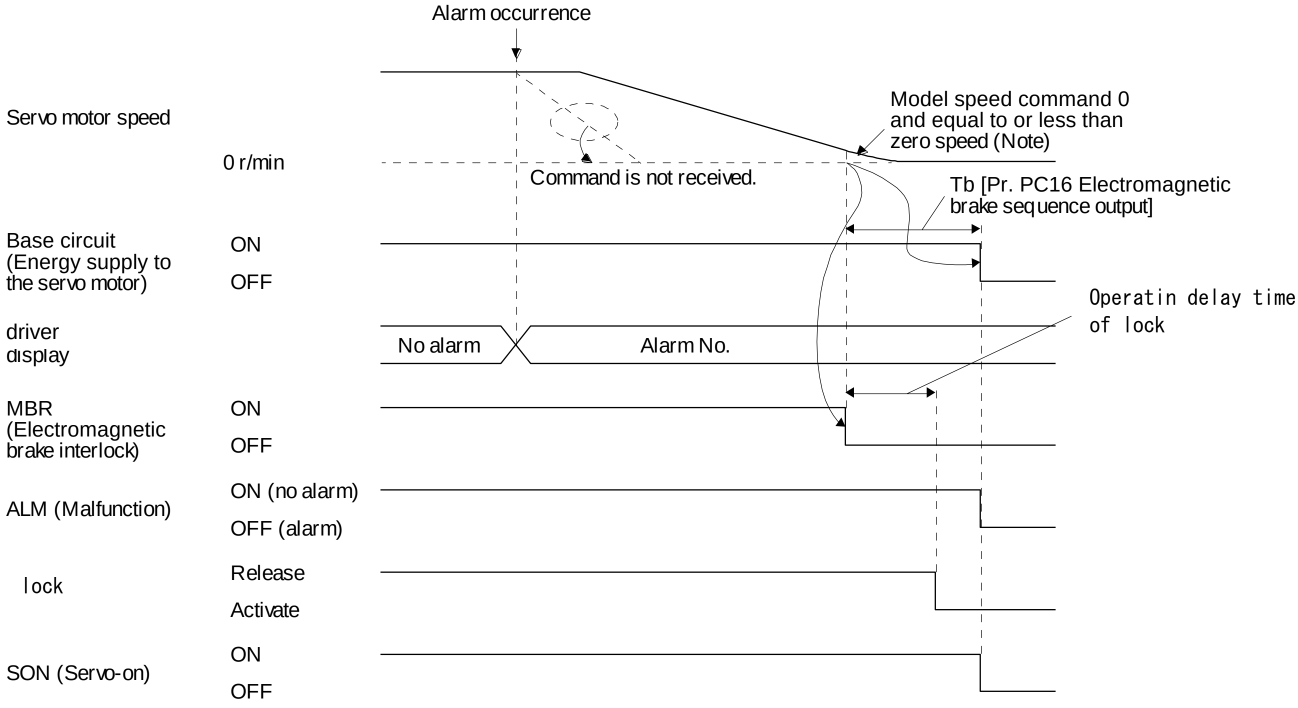
POINT
●In the torque control mode, the forced stop deceleration function is not available. ●Keep SON (Servo-on) on while EM2 (Forced stop 2) is off. If SON (Servo-on) is turned off earlier than EM2 (Forced stop 2), the driver operates in the same way as (1) (a) in this section.



Note 1. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake has been activated.
2. The model speed command is a speed command generated in the driver for forced stop deceleration of the servo motor.

(c) Alarm occurrence

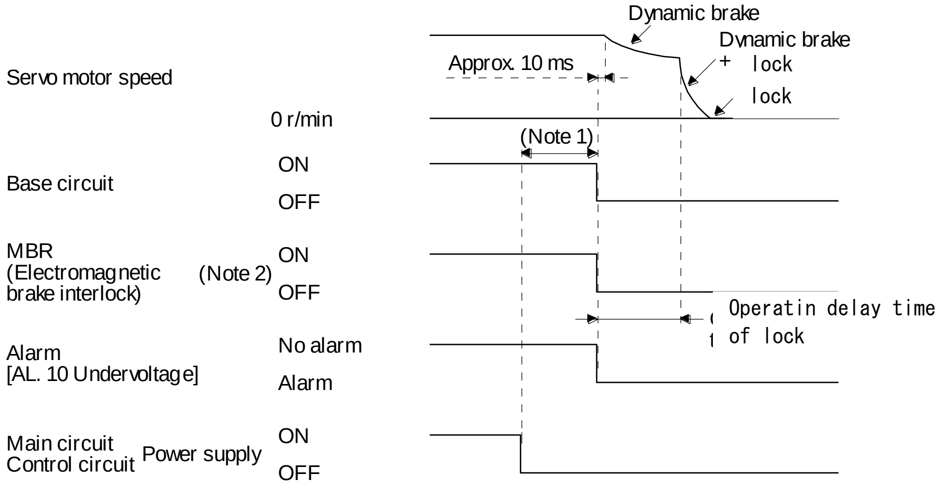
1) When the forced stop deceleration function is enabled



Note. The model speed command is a speed command generated in the driver for forced stop deceleration of the servo motor.

2) When the forced stop deceleration function is disabled
The operation status is the same as section 3.8.1 (2).

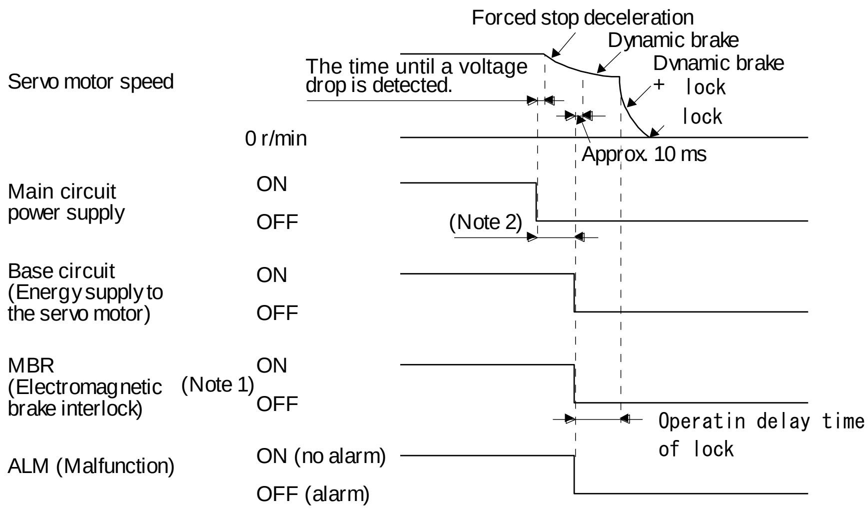
(d) Both main and control circuit power supplies off



Note 1. Variable according to the operation status.
2. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake has been activated.

(e) Main circuit power supply off during control circuit power supply on

POINT
●In the torque control mode, the forced stop deceleration function is not available.



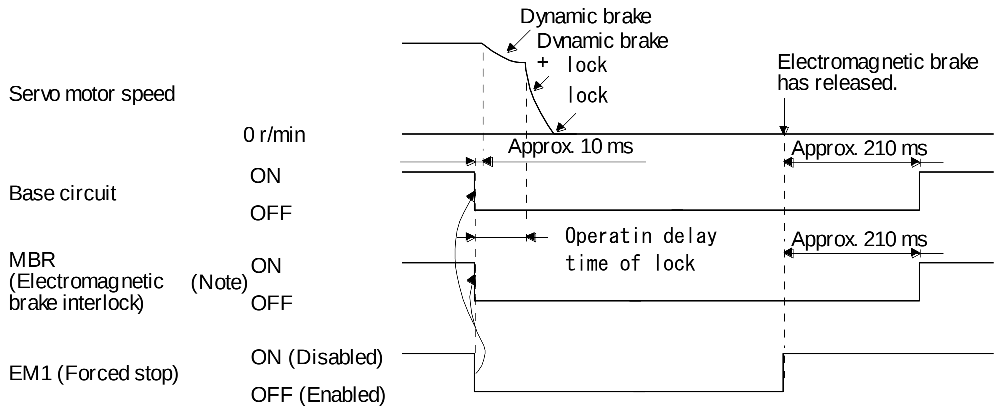
Note 1. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake has been activated.
2. Variable according to the operation status.

(2) When you do not use the forced stop deceleration function

POINT
●To disable the function, set "0 _ _ _" in [Pr. PA04].

(a) SON (Servo-on) on/off
It is the same as (1) (a) in this section.

(b) EM1 (Forced stop 1) on/off

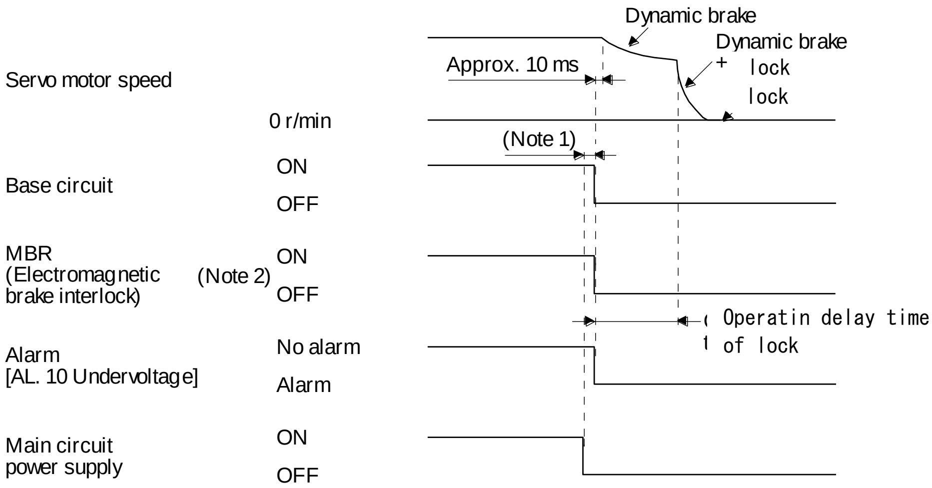


Note. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake has been activated.

(c) Alarm occurrence
The operation status during an alarm is the same as section 3.8.2.

(d) Both main and control circuit power supplies off
It is the same as (1) (d) in this section.

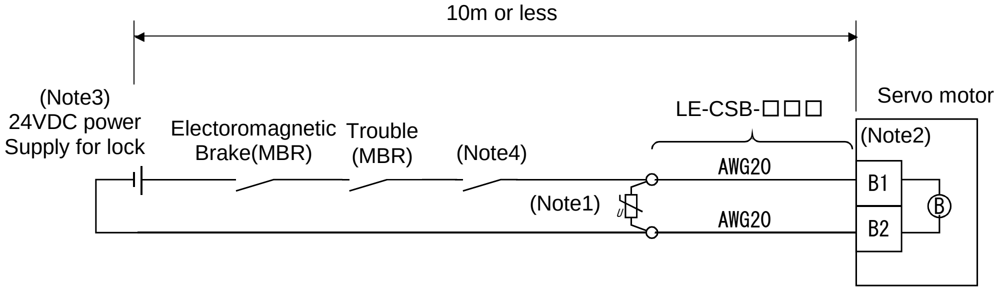
(e) Main circuit power supply off during control circuit power supply on



Note 1. Variable according to the operation status.
2. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake has been activated.

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

(1) When cable length is 10m or less



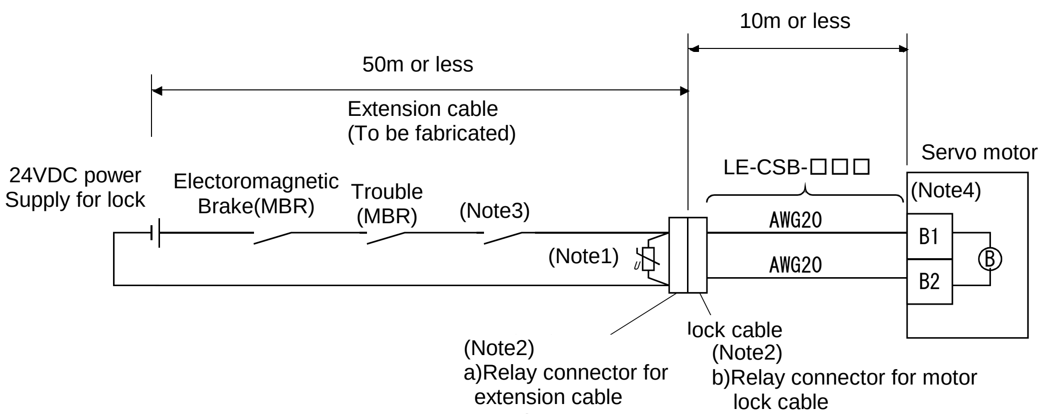
Note 1. Connect a surge absorber as close to the servo motor as possible.
2. There is no polarity in lock terminals (B1 and B2).
3. Do not share the lock power supply with the interface 24VDC power supply.
4. Shut off the circuit in conjunction with the emergency stop switch.

When fabricating the lock cable LE-CSB-R□□, refer to section 11.1.6.

(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 11.5 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.

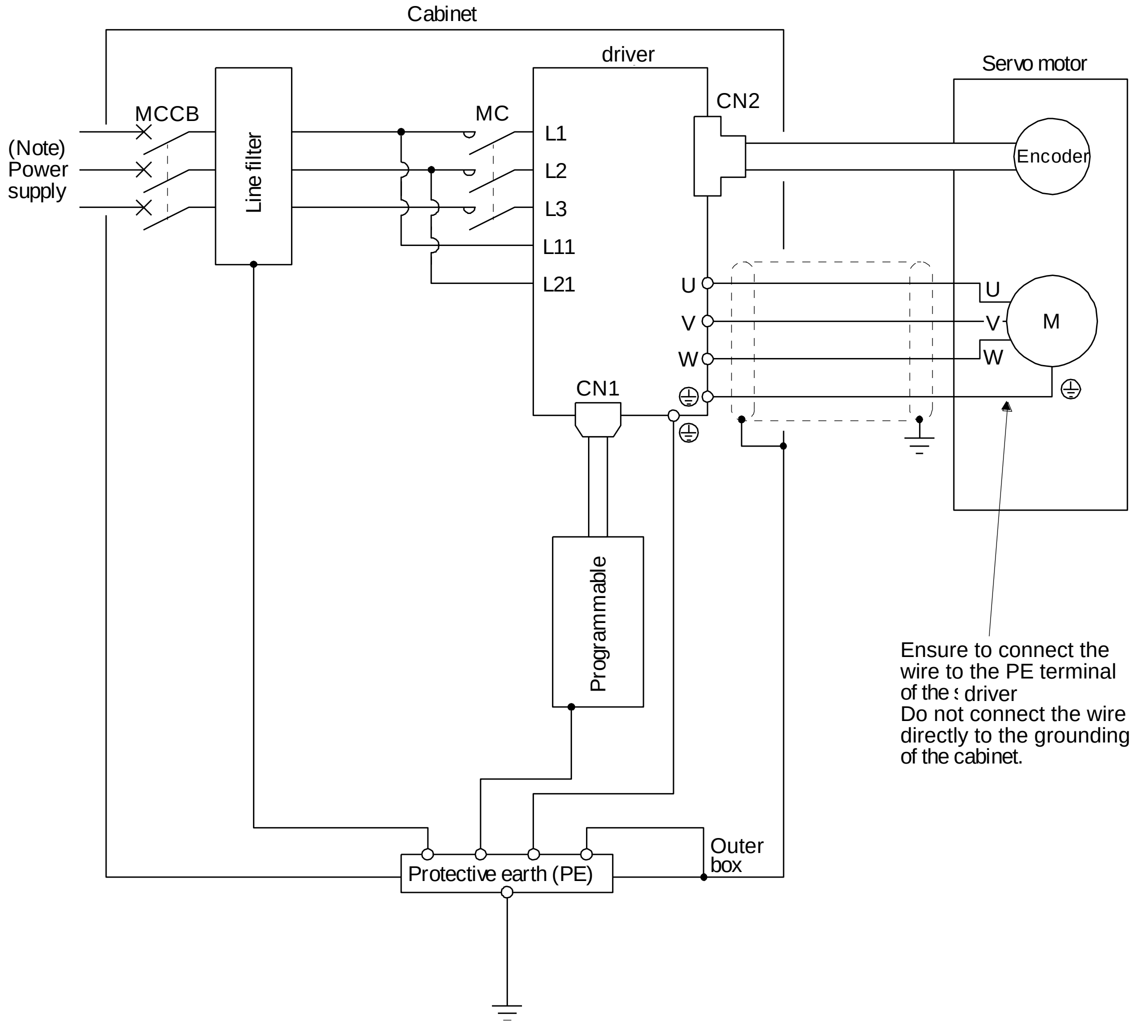
Relay connector	Description	Protective structure
a) Relay connector for extension cable	CM10-CR2P-∗ (DDK) Wire size: S, M, L	IP65
b) Relay connector for motor lock cable	CM10-SP2S-∗ (DDK) Wire size: S, M, L	IP65

3. Shut off the circuit in conjunction with the emergency stop switch.
4. There is no polarity in lock terminals (B1 and B2).
5. Do not share the lock power supply with the interface 24VDC power supply.

3.11 Grounding

⚠WARNING	●Ground the driver and servo motor securely. ●To prevent an electric shock, always connect the protective earth (PE) terminal (marked ⏚) of the driver to the protective earth (PE) of the cabinet.

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 "EMC Installation Guidelines".



Note. For the power supply specifications, refer to section 1.3.

4. STARTUP

4. STARTUP

⚠WARNING	●When executing a test run, follow the notice and procedures in this instruction manual. Otherwise, it may cause a malfunction, damage to the machine, or injury. ●Do not operate the switches with wet hands. Otherwise, it may cause an electric shock.

⚠CAUTION	●Before starting operation, check the parameters. Improper settings may cause some machines to operate unexpectedly. ●The driver heat sink, regenerative resistor, servo motor, etc., may be hot while the power is on and for some time after power-off. Take safety measures such as providing covers to avoid accidentally touching them by hands and parts such as cables. ●During operation, never touch the rotor of the servo motor. Otherwise, it may cause injury. ●Before wiring, switch operation, etc., eliminate static electricity. Otherwise, it may cause a malfunction.

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, DO forced output function (section 4.5.1), 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.)
↓	
Axis No. settings	Confirm that the control axis No. set with the auxiliary axis number setting switches (SW2-3 and SW2-4) and with the axis selection rotary switch (SW1) match the control axis No. set with the servo system controller. (Refer to section 4.3.1 (3).)
↓	
Parameter setting	Set the parameters as necessary, such as the used operation mode and regenerative option selection. (Refer to chapter 5.)
↓	
Test operation of the 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 section 4.5.)
↓	
Test operation of the 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 the servo motor and machine connected	After connecting the servo motor with the machine, check machine motions with sending operation commands from the PC or PLC…etc.
↓	
Gain adjustment	Make gain adjustment to optimize the machine motions. (Refer to chapter 6.)
↓	
Actual operation	
↓	
Stop	Stop giving commands and stop operation.

4.1.2 Wiring check

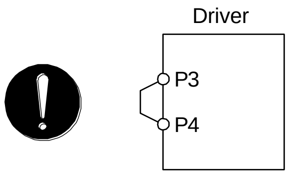
(1) Power supply system wiring

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

(a) Power supply system wiring

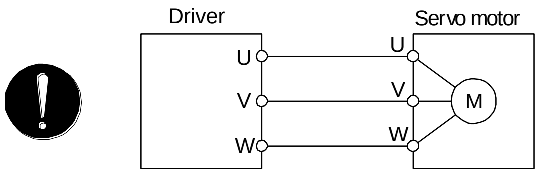
1) The power supplied to the power input terminals (L1/L2/L3/L11/L21) of the driver should satisfy the defined specifications. (Refer to section 1.3.)

2) Between P3 and P4 should be connected.

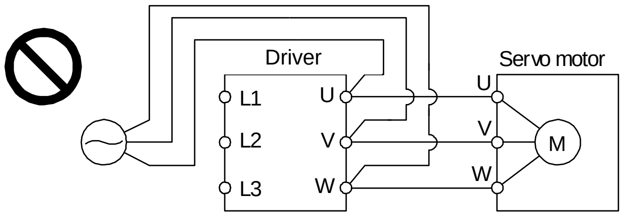


(b) Connection of driver and servo motor

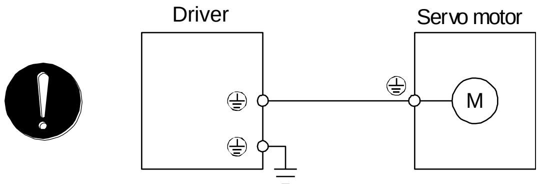
1) The driver power output (U/V/W) should match in phase with the servo motor power input terminals (U/V/W).



2) The power supplied to the driver should not be connected to the power outputs (U/V/W). Otherwise, the driver and servo motor will malfunction.



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



4) The CN2 connector of the driver should be connected to the encoder of the servo motor securely using the encoder cable.

(c) When option and auxiliary equipment are used

a) When you use a regenerative option

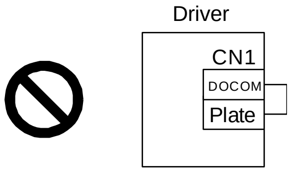
- The lead wire between P+ terminal and D terminal should not be connected.
- The regenerative option should be connected to P+ terminal and C terminal.
- Twisted wires should be used. (Refer to section 11.2.4.)

(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. You can use this function to check the wiring. In this case, switch on the control circuit power supply only.
Refer to section 3.2 for details of I/O signal connection.

(b) 24 V DC or higher voltage is not applied to the pins of the CN1 connector.

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



4.1.3 Surrounding environment

(1) Cable routing

(a) The wiring cables should not be stressed.

(b) The encoder cable should not be used in excess of its bending life. (Refer to section 10.4.)

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

(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 SON (Servo-on).

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

3) Switch on the main circuit power supply and control circuit power supply.
When main circuit power/control circuit power is switched on, the display shows "C (Cumulative feedback pulses)", and in 2 s later, shows data.

In the absolute position detection system, first power-on results in [AL. 25 Absolute position erased] and the servo system cannot be switched on. The alarm can be deactivated by then switching power off once and on again.
Also, if power is switched on at the servo motor speed of 3000 r/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 SON (Servo-on).

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

4.2.2 Stop

Turn off SON (Servo-on) after the servo motor has stopped, and then switch the power off.
If any of the following situations occurs, the driver suspends the running of the servo motor and brings it to a stop. Refer to section 3.10 for the servo motor with an electromagnetic lock.

Operation/command	Stopping condition
Switch of SON (Servo-on).	The base circuit is shut off and the servo motor coasts.
Alarm occurrence	The servo motor decelerates to a stop with the command. With some alarms, however, the dynamic lock operates to bring the servo motor to a stop. (Refer to chapter 8.)
EM2 (Forced stop 2) off	The servo motor decelerates to a stop with the command. [AL. E6 Servo forced stop warning] occurs. EM2 has the same function as EM1 in the torque control mode. Refer to section 3.5 for EM1.
STO (STO1, STO2) off	The base circuit is shut off and the dynamic lock operates to bring the servo motor to a stop.
LSP (Forward rotation stroke end) of LSN (Reverse rotation stroke end) off	It will bring the motor to a sudden stop and make it 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 the 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 4.5.9 for the test operation mode.

Test operation of the servo motor alone by commands

In this step, confirm that the servo motor correctly rotates at the slowest speed under the commands from the PC or PLC...etc.
Make sure that the servo motor rotates in the following procedure.

1) Switch on EM2 (Forced stop 2) and SON (Servo-on). When the driver is put in a servo-on status, RD (Ready) switches on.
2) Switch on LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end).
3) When a pulse train is input from the PC or PLC...etc, the servo motor starts rotating. Give a low speed command at first and check the rotation direction, etc. of the servo motor. If the machine does not operate in the intended direction, check the input signal.

Test operation with the 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 PC or PLC...etc.
Make sure that the servo motor rotates in the following procedure.

1) Switch on EM2 (Forced stop 2) and SON (Servo-on). When the driver is put in a servo-on status, RD (Ready) switches on.
2) Switch on LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end).
3) When a pulse train is input from the PC or PLC...etc, 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, 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 PC or PLC...etc.

4.2.4 Parameter setting

In the position control mode, the driver can be used by merely changing the basic setting parameters ([Pr. PA _ _]) mainly.
As necessary, set other parameters.

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	●Never adjust or change the parameter values extremely as it will make operation unstable.

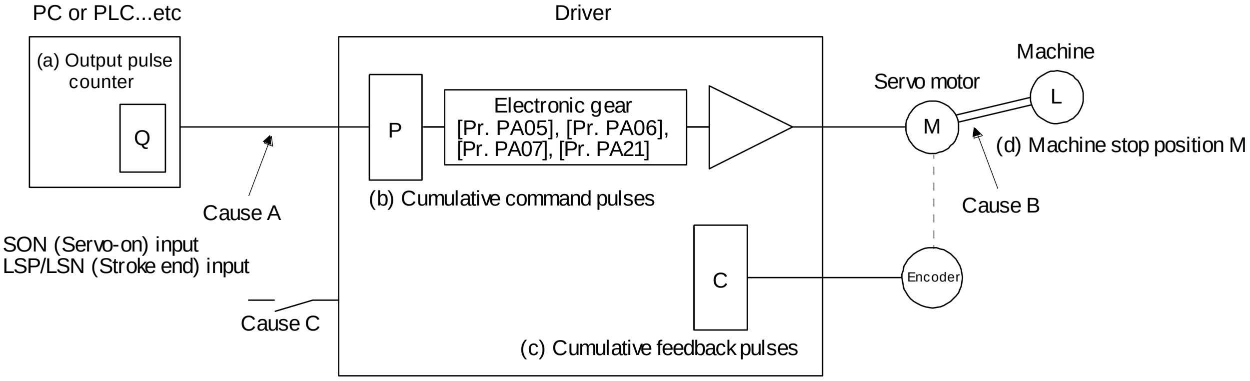
POINT
●Using the optional Setup software (MR Configurator2™), you can refer to reason for rotation failure, etc.

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	▪ The 5-digit, 7-segment LED is not lit. ▪ The 5-digit, 7-segment LED blinks.	Not improved even if CN1, CN2 and CN3 connectors are disconnected.	1. Power supply voltage fault 2. The driver is malfunctioning.	
			Improved when CN1 connector is disconnected.	Power supply of CN1 cabling is shorted.	
			Improved when CN2 connector is disconnected.	1. Power supply of encoder cabling is shorted. 2. Encoder is malfunctioning.	
			Improved when CN3 connector is disconnected.	Power supply of CN3 cabling is shorted.	
		Alarm occurs.	Refer to chapter 8 and remove cause.		Chapter 8
2	Switch on SON (Servo-on).	Alarm occurs.	Refer to chapter 8 and remove cause.		Chapter 8
		Servo motor shaft is not servo-locked. (Servo motor shaft is free.)	1. Check the display to see if the driver is ready to operate. 2. Check the external I/O signal indication (section 4.5.7) to see if SON (Servo-on) is on.	1. SON (Servo-on) is not input. (wiring mistake) 2. 24 V DC power is not supplied to DICOM.	Section 4.5.7
3	Input command pulse. (Test operation)	Servo motor does not rotate.	Check the cumulative command pulse on the status display (section 4.5.3).	1. Wiring mistake (a) For open collector pulse train input, 24 V DC power is not supplied to OPC. (b) LSP and LSN are not on. 2. Pulse is not input from the PC or PLC...etc.	Section 4.5.3
				Mistake in setting of [Pr. PA13].	Chapter 5
		Servo motor run in reverse direction.		1. Mistake in wiring to PC or PLC...etc. 2. Mistake in setting of [Pr. PA14].	
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 three times or more to complete auto tuning.	Gain adjustment fault	Chapter 6
		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 three times or more to complete auto tuning.	Gain adjustment fault	Chapter 6
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 display Q, (b) cumulative command pulse P, (c) cumulative feedback pulse C, and (d) machine stop position M in the above diagram.
Also, Causes A, B, and C indicate the causes of position mismatch. For example, Cause A indicates that noise entered the wiring between the PC or PLC...etc and driver, causing command input pulses to be miscounted.

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

1) Q = P (Output counter = Cumulative command pulses)

2) When [Pr. PA21] is "0 _ _ _"

$P \cdot \frac{\text{CMX [Pr. PA06]}}{\text{CDV [Pr. PA07]}} = C$ (Cumulative command pulses × Electronic gear = Cumulative feedback pulses)

3) When [Pr. PA21] is "1 _ _ _"

$$P \cdot \frac{4194304}{\text{FBP [Pr. PA05]}} = C$$

4) When [Pr. PA21] is "2 _ _ _"

$$P \cdot \frac{\text{CMX [Pr. PA06]}}{\text{CDV [Pr. PA07]}} \times 16 = C$$

5) $C \cdot \Delta\ell = M$ (Cumulative feedback pulses × Travel distance per pulse = Machine position)

Check for a position mismatch in the following sequence.

1) When Q ≠ P
Noise entered the pulse train signal wiring between the PC or PLC...etc and driver, causing command input pulses to be miscounted. (Cause A)
Make the following check or take the following measures.
・Check how the shielding is done.
・Change the open collector type to the differential line driver type.
・Run wiring away from the power circuit.
・Install a data line filter. (Refer to section 11.14 (2) (a).)
・Change the [Pr. PA13 Command pulse input form] setting.

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

During operation, SON (Servo-on), LSP (Forward rotation stroke end), or LSN (Reverse rotation stroke end) was switched off; or CR (Clear) or RES (Reset) was switched on. (Cause C)

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 SON (Servo-on).

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

3) Switch on the main circuit power supply and control circuit power supply.
When main circuit power/control circuit power is switched on, the display shows "r (Servo motor speed)", and in 2 s later, shows data.

(2) Power-off
1) Switch off ST1 (Forward rotation start) and ST2 (Reverse rotation start).

2) Switch off SON (Servo-on).

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

4.3.2 Stop

Turn off SON (Servo-on) after the servo motor has stopped, and then switch the power off.
If any of the following situations occurs, the driver suspends the running of the servo motor and brings it to a stop.
Refer to section 3.10 for the servo motor with an electromagnetic lock.

Operation/command	Stopping condition
Switch of SON (Servo-on).	The base circuit is shut off and the servo motor coasts.
Alarm occurrence	The servo motor decelerates to a stop with the command. With some alarms, however, the dynamic lock operates to bring the servo motor to a stop. (Refer to chapter 8.)
EM2 (Forced stop 2) off	The servo motor decelerates to a stop with the command. [AL. E6 Servo forced stop warning] occurs. EM2 has the same function as EM1 in the torque control mode. Refer to section 3.5 for EM1.
STO (STO1, STO2) off	The base circuit is shut off and the dynamic lock operates to bring the servo motor to a stop.
LSP (Forward rotation stroke end) of LSN (Reverse rotation stroke end) off	It will bring the motor to a sudden stop and make it servo-locked. It can be run in the opposite direction.
Simultaneous on or off of ST1 (Forward rotation start) and ST2 (Reverse rotation start)	The servo motor is decelerated to a stop.

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 the 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 4.5.9 for the test operation mode.

Test operation of the servo motor alone by commands

In this step, confirm that the servo motor correctly rotates at the slowest speed under the commands from the PC or PLC...etc.
Make sure that the servo motor rotates in the following procedure.

1) Switch on EM2 (Forced stop 2) and SON (Servo-on). When the driver is put in a servo-on status, RD (Ready) switches on.
2) Switch on LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end).
3) When VC (Analog speed command) is input from the PC or PLC...etc and ST1 (Forward rotation start) or ST2 (Reverse rotation start) 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 machine does not operate in the intended direction, check the input signal.

Test operation with the 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 PC or PLC...etc.
Make sure that the servo motor rotates in the following procedure.

1) Switch on EM2 (Forced stop 2) and SON (Servo-on). When the driver is put in a servo-on status, RD (Ready) switches on.
2) Switch on LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end).
3) When VC (Analog speed command) is input from the PC or PLC...etc and ST1 (Forward rotation start) or ST2 (Reverse rotation start) 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, check for any problems of the servo motor speed, load ratio, etc.
4) Then, check automatic operation with the program of the PC or PLC...etc.

4.3.4 Parameter setting

When using this servo in the speed control mode, change [Pr. 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 ([Pr. PA _ _]) and extension setting parameters ([Pr. PC _ _]) mainly.
As necessary, set other parameters.

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	●Never adjust or change the parameter values extremely as it will make operation unstable.

POINT
●Using the optional Setup software (MR Configurator2™), you can refer to reason for rotation failure, 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	▪ The 5-digit, 7-segment LED is not lit. ▪ The 5-digit, 7-segment LED blinks.	Not improved even if CN1, CN2, and CN3 connectors are disconnected.	1. Power supply voltage fault 2. The driver is malfunctioning.	
			Improved when CN1 connector is disconnected.	Power supply of CN1 cabling is shorted.	
			Improved when CN2 connector is disconnected.	1. Power supply of encoder cabling is shorted. 2. Encoder is malfunctioning.	
			Improved when CN3 connector is disconnected.	Power supply of CN3 cabling is shorted.	
		Alarm occurs.	Refer to chapter 8 and remove cause.		Chapter 8

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
2	Switch on SON (Servo-on).	Alarm occurs.	Refer to chapter 8 and remove cause.		Chapter 8
		Servo motor shaft is not servo-locked. (Servo motor shaft is free.)	1. Check the display to see if the driver is ready to operate. 2. Check the external I/O signal indication (section 4.5.7) to see if SON (Servo-on) is on.	1. SON (Servo-on) is not input. (wiring mistake) 2. 24 V DC power is not supplied to DICOM.	Section 4.5.7
3	Switch on ST1 (Forward rotation start) or ST2 (Reverse rotation start).	Servo motor does not rotate.	Call the status display (section 4.5.3) and check the input voltage of VC (Analog speed command).	Analog speed command is 0 V.	Section 4.5.3
			Call the external I/O signal display (section 4.5.7) and check the on/off status of the input signal.	LSP, LSN, ST1, and ST2 are off.	Section 4.5.7
			Check the internal speed commands 1 to 7 ([Pr. PC05] to [Pr. PC11]).	Set value is 0.	Section 5.2.3
			Check the forward rotation torque limit ([Pr. PA11]) and the reverse rotation torque limit ([Pr. PA12]).	Torque limit level is too low as compared to the load torque.	Section 5.2.1
			When TLA (Analog torque limit) is usable, check the input voltage on the status display.	Torque limit level is too low as compared to the load torque.	Section 4.5.3
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 three times or more to complete auto tuning.	Gain adjustment fault	Chapter 6
		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 three times or more to complete auto tuning.	Gain adjustment fault	Chapter 6

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 SON (Servo-on).
2) Make sure that RS1 (Forward rotation selection) and RS2 (Reverse rotation selection) are off.
3) Switch on the main circuit power supply and control circuit power supply.
   Data is displayed in 2 s after "U" (Analog torque command) is displayed.

(2) Power-off

1) Switch off RS1 (Forward rotation selection) or RS2 (Reverse rotation selection).
2) Switch off SON (Servo-on).
3) Switch off the main circuit power supply and control circuit power supply.

4.4.2 Stop

Turn off SON (Servo-on) after the servo motor has stopped, and then switch the power off.
If any of the following situations occurs, the driver suspends the running of the servo motor and brings it to a stop. Refer to section 3.10 for the servo motor with an electromagnetic lock.

Operation/command	Stopping condition
Switch off SON (Servo-on).	The base circuit is shut off and the servo motor coasts.
Alarm occurrence	The servo motor decelerates to a stop with the command. With some alarms, however, the dynamic lock operates to bring the servo motor to a stop. (Refer to chapter 8.)
EM2 (Forced stop 2) off	This stops the servo motor with the dynamic lock. [AL. E6 Servo forced stop warning] occurs. EM2 has the same function as EM1 in the torque control mode. Refer to section 3.5 for EM1.
STO (STO1, STO2) off	The base circuit is shut off and the dynamic lock operates to bring the servo motor to a stop.
Simultaneous on or off of RS1 (Forward rotation selection) and RS2 (Reverse rotation selection)	The servo motor coasts.

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.

Test operation of the 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 4.5.9 for the test operation mode.

Test operation of the servo motor alone by commands

In this step, confirm that the servo motor correctly rotates at the slowest speed under the commands from the PC or PLC...etc.
Make sure that the servo motor rotates in the following procedure.

1) Switch on SON (Servo-on). When the driver is put in a servo-on status, RD (Ready) switches on.
2) When TC (Analog speed command) is input from the PC or PLC...etc and RS1 (Forward rotation start) or RS2 (Reverse rotation start) is switched on, the servo motor starts rotating. Give a low torque command at first and check the rotation direction, etc. of the servo motor. If the machine does not operate in the intended direction, check the input signal.

Test operation with the 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 PC or PLC...etc.
Make sure that the servo motor rotates in the following procedure.

1) Switch on SON (Servo-on). When the driver is put in a servo-on status, RD (Ready) switches on.
2) When TC (Analog speed command) is input from the PC or PLC...etc and RS1 (Forward rotation start) or RS2 (Reverse rotation start) is switched on, the servo motor starts rotating. Give a low torque 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, check for any problems of the servo motor speed, load ratio, etc.
3) Then, check automatic operation with the program of the PC or PLC...etc.

4.4.4 Parameter setting

When using this servo in the torque control mode, change [Pr. 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 ([Pr. PA _ _]) and extension setting parameters ([Pr. PC _ _]) mainly.
As necessary, set other parameters.

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	●Never adjust or change the parameter values extremely as it will make unstable movement.

POINT
●Using the optional Setup software (MR Configurator2TM), you can refer to reason for rotation failure, etc.

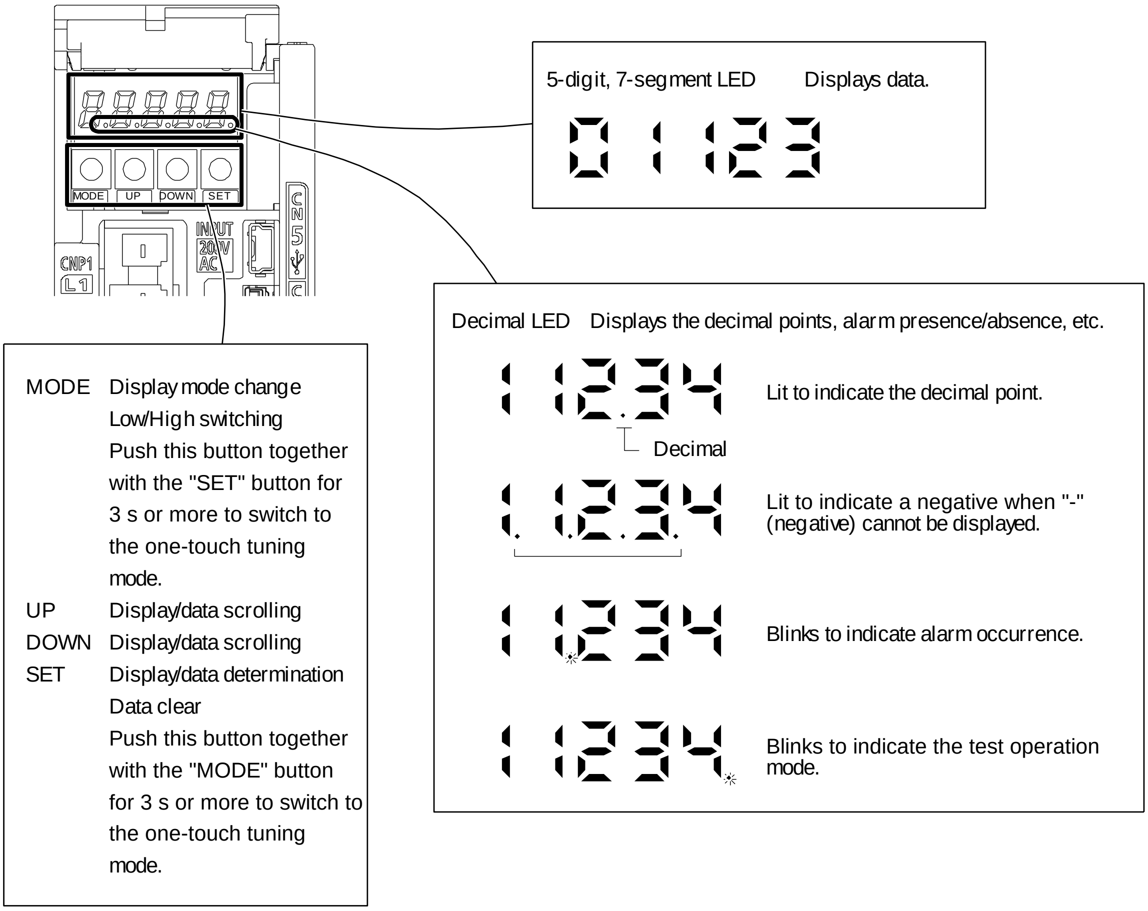
The following faults may occur at start-up. If any of such faults occurs, take the corresponding action.

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
1	Power on	・The 5-digit, 7-segment LED is not lit. ・The 5-digit, 7-segment LED blinks.	Not improved even if CN1, CN2, and CN3 connectors are disconnected.	1. Power supply voltage fault 2. The driver is malfunctioning.	
			Improved when CN1 connector is disconnected.	Power supply of CN1 cabling is shorted.	
			Improved when CN2 connector is disconnected.	1. Power supply of encoder cabling is shorted. 2. Encoder is malfunctioning.	
			Improved when CN3 connector is disconnected.	Power supply of CN3 cabling is shorted.	
		Alarm occurs.	Refer to chapter 8 and remove cause.		Chapter 8
2	Switch on SON (Servo-on).	Alarm occurs.	Refer to chapter 8 and remove cause.		Chapter 8
		(Servo motor shaft is free.)	Call the external I/O signal display (section 4.5.7) and check the on/off status of the input signal.	1. SON (Servo-on) is not input. (wiring mistake) 2. 24 V DC power is not supplied to DICOM.	Section 4.5.7
3	Switch on RS1 (Forward rotation start) or RS2 (Reverse rotation start).	Servo motor does not rotate.	Call the status display (section 4.5.3) and check the input voltage of TC (Analog torque command).	Analog torque command is 0 V.	Section 4.5.3
			Call the external I/O signal display (section 4.5.7) and check the on/off status of the input signal.	RS1 and RS2 are off.	Section 4.5.7
			Check the internal speed limit 1 to 7 ([Pr. PC05] to [Pr. PC11]).	Set value is 0.	Section 5.2.3
			Check the analog torque command maximum output ([Pr. PC13]) value.	Torque command level is too low as compared to the load torque.	Section 5.2.3
			Check the forward rotation torque limit ([Pr. PA11]) and the reverse rotation torque limit ([Pr. PA12]).	Set value is 0.	Section 5.2.1

4.5 Display and operation sections

4.5.1 Summary

The LECSB2-T☐ driver has the display section (5-digit, 7-segment LED) and operation section (4 pushbuttons) for driver status display, alarm display, parameter setting, etc. Also, press the "MODE" and "SET" buttons at the same time for 3 s or more to switch to the one-touch tuning mode.
The operation section and display data are described below.



4.5.2 Display flowchart

Press the "MODE" button once to shift to the next display mode. Refer to section 4.5.3 and later for the description of the corresponding display mode.
To refer to and set the gain/filter parameters, extension setting parameters and I/O setting parameters, enable them with [Pr. PA19 Parameter writing inhibit].

Display mode transition	Initial screen	Function	Reference
Status display	C	Servo status display. "C" appears at power-on. (Note)	Section 4.5.3
One-touch tuning	AUTo	One-touch tuning Select this when performing the one-touch tuning.	Section 6.2
Diagnosis	rd-oF	Sequence display, external signal display, output signal (DO) forced output, test operation, software version display, VC automatic offset, servo motor series ID display, servo motor type ID display, servo motor encoder ID display, drive recorder enabled/disabled display.	Section 4.5.4
Alarms	AL---.	Current alarm display, alarm history display, parameter error number display.	Section 4.5.5
Basic setting parameters	P A01	Display and setting of basic setting parameters.	Section 4.5.6
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.	
Extension setting 2 parameters	P E01	Display and setting of extension setting 2 parameters.	
Extension setting 3 parameters	P F01	Display and setting of extension setting 3 parameters.	
Linear/DD motor setting parameter	P L01	Display and setting of linear/DD motor setting parameters.	

Button MODE

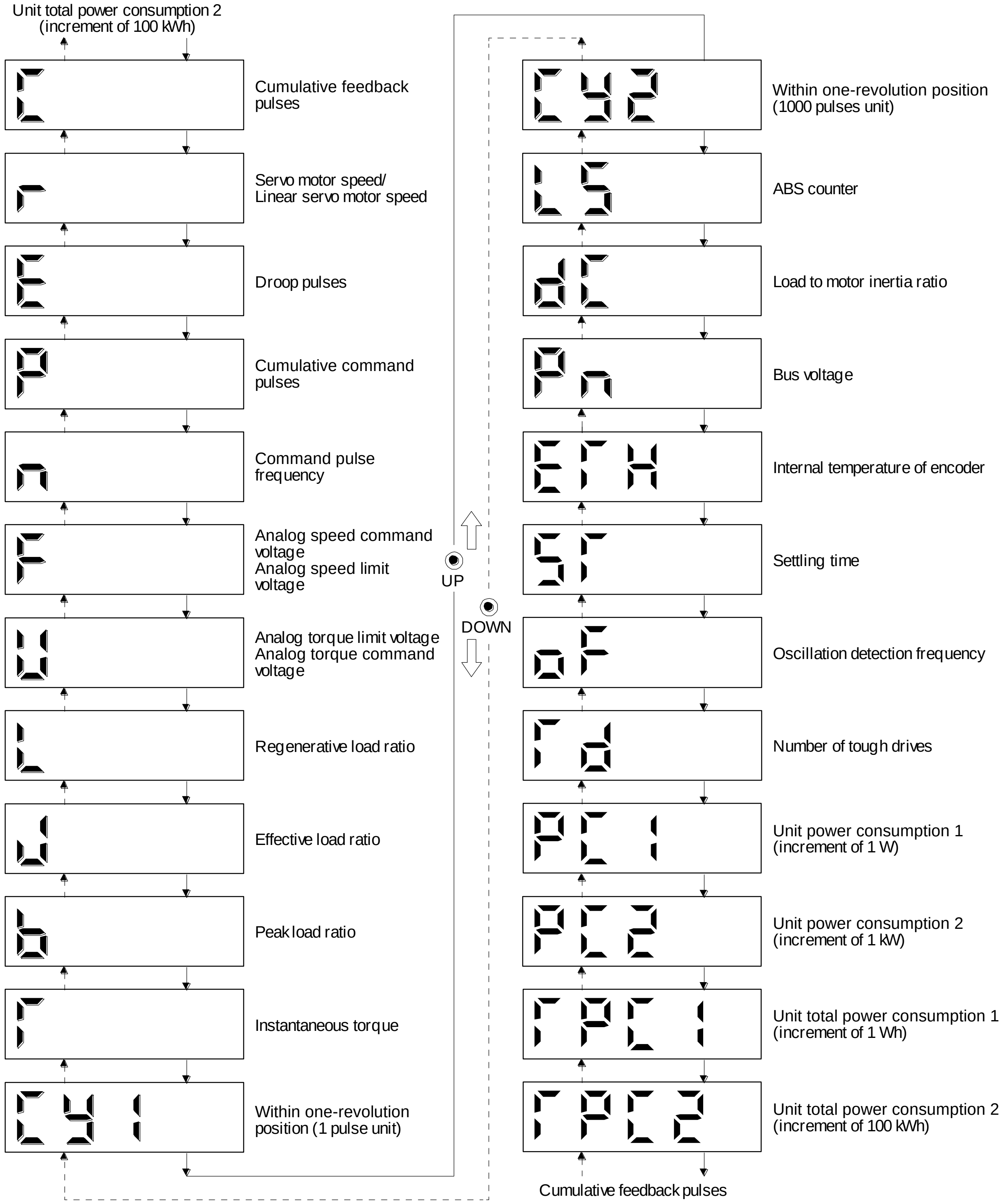
Note. When the axis name is set to the driver with Setup software (MR Configurator2TM), the axis name is displayed and the servo status is then displayed.

4.5.3 Status display mode

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 is displayed. Press the "SET" button to display that data. At only power-on, however, data appears after the symbol of the status display selected in [Pr. PC36] has been shown for 2 s.

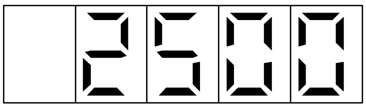
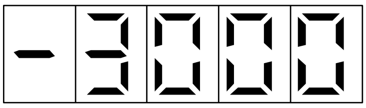
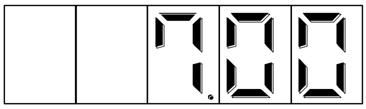
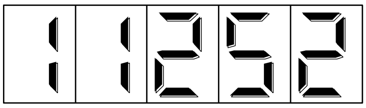
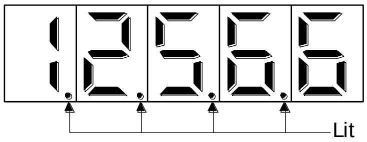
(1) Display transition
After selecting the status display mode with the "MODE" button, pressing the "UP" or "DOWN" button changes the display as shown below.

(a) Standard control mode/DD motor control mode



(2) Display examples

The following table shows the display examples.

Item	State	Displayed data Driver display
Servo motor speed	Forward rotation at 2500 r/min	
	Reverse rotation at 3000 r/min	 Reverse rotation is indicated by "- ".
Load to motor inertia ratio	7.00 times	
ABS counter	11252 rev	
	-12566 rev	 Negative value is indicated by the lit decimal points in the upper four digits.

(3) Status display list

The following table lists the servo statuses that may be shown. Refer to app. 7.3 for the measurement point.

Status display	Symbol	Unit	Description
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.
Servo motor speed	r	r/min	The servo motor speed is displayed. It is displayed rounding off 0.1 r/min (0.1 mm/s) unit.
Droop pulses	E	pulse	The number of droop pulses in the deviation counter is displayed. The decimal points in the upper four digits are lit for reverse rotation 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. The number of pulses displayed is in the encoder pulse unit.
Cumulative command pulses	P	pulse	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.
Command pulse frequency	n	kpulse/s	The frequency of position command input pulses is counted and displayed. The value displayed is not multiplied by the electronic gear (CMX/CDV).
Analog speed command voltage Analog speed limit voltage	F	V	1) Torque control mode Input voltage of VLA (Analog speed limit) voltage is displayed. 2) Speed control mode Input voltage of VC (Analog speed command) voltage is displayed
Analog torque command voltage Analog torque limit voltage	U	V	1) Position control mode and speed control mode Voltage of TLA (Analog torque limit) voltage is displayed. 2) Torque control mode Voltage of TC (Analog torque command) voltage is displayed.
Regenerative load ratio	L	%	The ratio of regenerative power to permissible regenerative power is displayed in %.
Effective load ratio	J	%	The continuous effective load current is displayed. The effective value in the past 15 s is displayed relative to the rated current of 100%.
Peak load ratio	b	%	The maximum occurrence torque is displayed. The highest value in the past 15 s is displayed relative to the rated current of 100%.
Instantaneous torque	T	%	The instantaneous occurrence torque is displayed. The value of torque being occurred is displayed in real time considering a rated torque as 100%.
Within one-revolution position (1 pulse unit)	Cy1	pulse	Position within one revolution is displayed in encoder 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. When the servo motor rotates in the CCW direction, the value is added.
Within one-revolution position (1000 pulses unit)	Cy2	1000 pulses	The within one-revolution position is displayed in 1000 pulse increments of the encoder. When the servo motor rotates in the CCW direction, the value is added.
ABS counter	LS	rev	The travel distance from the home position is displayed as multi-revolution counter value of the absolution position encoder in the absolution position detection system.

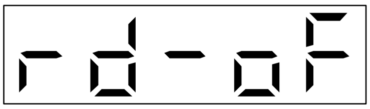
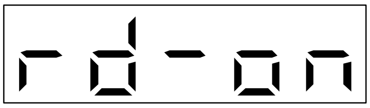
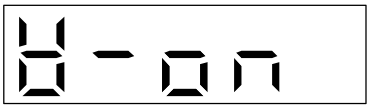
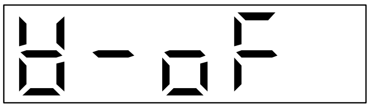
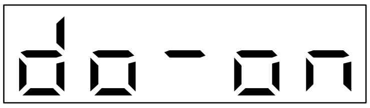
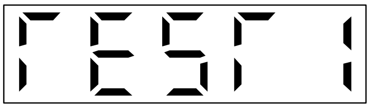
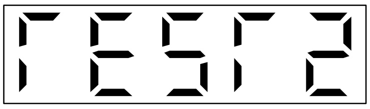
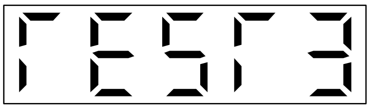
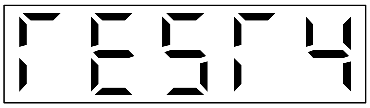
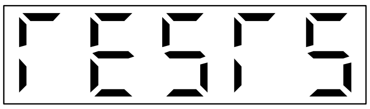
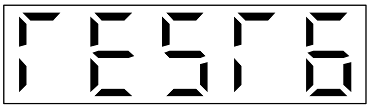
Status display	Symbol	Unit	Description
Load to motor inertia ratio	dC	Multiplier	The estimated ratio of the load inertia moment to the servo motor shaft inertia moment is displayed.
Bus voltage	Pn	V	The voltage of main circuit converter (between P+ and N-) is displayed.
Internal temperature of encoder	ETh	°C	Inside temperature of encoder detected by the encoder is displayed.
Settling time	ST	ms	Settling time is displayed. When it exceeds 1000 ms, "1000" will be displayed.
Oscillation detection frequency	oF	Hz	Frequency at the time of oscillation detection is displayed.
Number of tough operations	Td	times	The number of tough drive functions activated is displayed.
Unit power consumption 1 (increment of 1 W)	PC1	W	Unit power consumption is displayed by increment of 1 W. Positive value indicate power running, and negative value indicate regeneration. 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.
Unit power consumption 2 (increment of 1 kW)	PC2	kW	Unit power consumption is displayed by increment of 1 kW. Positive value indicate power running, and negative value indicate regeneration.
Unit total power consumption 1 (increment of 1 Wh)	TPC1	Wh	Unit total power consumption is displayed by increment of 1 Wh. Positive value is cumulated during power running and negative value during regeneration. 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.
Unit total power consumption 2 (increment of 100 kWh)	TPC2	100 Wh	Unit total power consumption is displayed by increment of 100 kWh. Positive value is cumulated during power running and negative value during regeneration.
-	FC	pulse	Do not use it.
-	FE	pulse	Do not use it.
-	FCY1	pulse	Do not use it.
-	FCY2	100000 pulses	Do not use it.
-	FL5	rev	Do not use it.
Z-phase counter low	FCY1	pulse	The Z-phase counter is displayed in the encoder pulse unit.
Z-phase counter high	FCY2	100000 pulses	The Z-phase counter is displayed by increments of 100000 pulses.
Electrical angle low	ECY1	pulse	The servo motor electrical angle is displayed.
Electrical angle high	ECY2	100000 pulses	The servo motor electrical angle is displayed by increments of 100000 pulses.

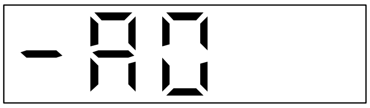
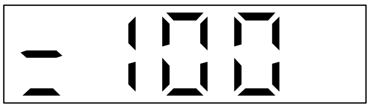
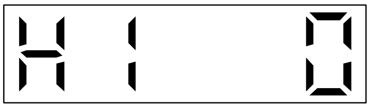
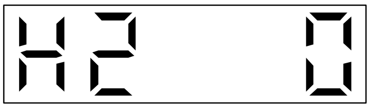
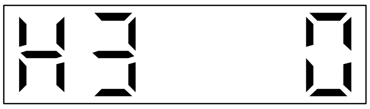
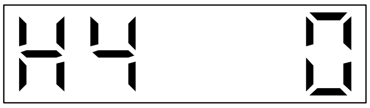
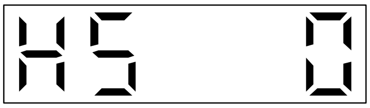
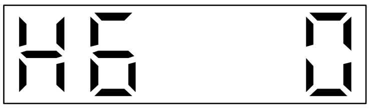
(4) Changing the status display screen

The status display item of the driver display shown at power-on can be changed by changing [Pr. PC36] settings. The item displayed in the initial status changes with the control mode as follows.

Control mode	Status display
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

4.5.4 Diagnostic mode

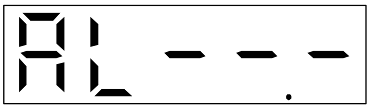
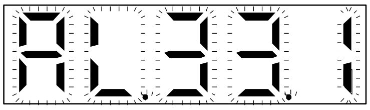
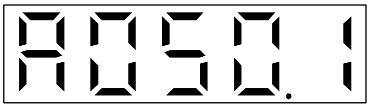
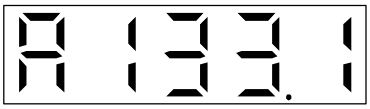
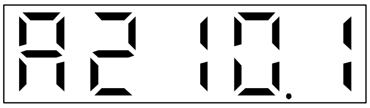
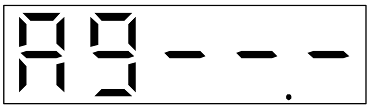
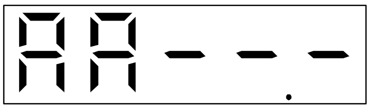
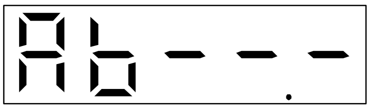
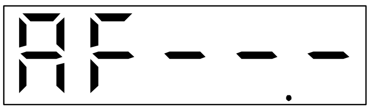
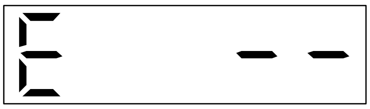
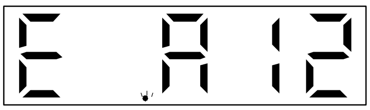
Name		Display	Description
Sequence			Not ready Indicates that the driver is being initialized or an alarm has occurred.
			Ready Indicates that the servo was switched on after completion of initialization and the driver is ready to operate.
Drive recorder enabled/disabled display			Drive recorder enabled When an alarm occurs in the status, the drive recorder will operate and write the status of occurrence.
			Drive recorder enabled The drive recorder will not operate on the following conditions. 1. You are using the graph function of Setup software (MR Configurator2™). 2. You are using the machine analyzer function. 3. [Pr. PF21] is set to "-1".
External I/O signal display		Refer to section 4.5.7.	This Indicates the on/off status of external I/O signal. The upper segments correspond to the input signals and the lower segments to the output signals.
Output signal (DO) forced output			This allows digital output signal to be switched on/off forcibly. For details, refer to section 4.5.8.
Test operation mode	JOG operation		JOG operation can be performed when there is no command from an external PC or PLC...etc. For details, refer to section 4.5.9 (2).
	Positioning operation		Positioning operation can be performed when there is no command from an external PC or PLC...etc. Setup software (MR Configurator2™) is required to perform positioning operation. For details, refer to section 4.5.9 (3).
	Motor-less operation		Without connecting the servo motor, output signals or status display monitoring can be provided in response to the input device as if the servo motor is actually running. For details, refer to section 4.5.9 (4).
	Machine analyzer operation		Merely connecting the driver allows the resonance point of the mechanical system to be measured. Setup software (MR Configurator2™) is required to perform machine analyzer operation. Refer to section 11.7 for details.
	For manufacturer		This is for manufacturer.
	For manufacturer		This is for manufacturer.

Name	Display	Description
Software version – Lower		Indicates the version of the software.
Software version - Upper		Indicates the system number of the software.
Automatic VC offset		If offset voltages in the analog circuits inside and outside the driver cause the servo motor to rotate slowly at VC (Analog speed command) or VLA (Analog speed limit) of 0 V, this function automatically makes zero-adjustment of offset voltages. When using this function, enable the function in the following procedure. When it is enabled, [Pr. PC37] value changes to the automatically adjusted offset voltage. 1) Push "SET" once. 2) Set the number in the first digit to 1 with "UP". 3) Push "SET". This function cannot be used if the input voltage of VC or VLA is - +0.4 V or less, or + 0.4 V or more. (Note)
Servo motor series ID		Push the "SET" button to show the series ID of the servo motor currently connected. For indication details, refer to the Servo Motor Instruction Manual (Vol. 3).
Servo motor type ID		Push the "SET" button to show the type ID of the servo motor currently connected. For indication details, refer to the Servo Motor Instruction Manual (Vol. 3).
Servo motor encoder ID		Push the "SET" button to show the encoder ID of the servo motor currently connected. For indication details, refer to the Servo Motor Instruction Manual (Vol. 3).
For manufacturer		This is for manufacturer.
For manufacturer		This is for manufacturer.

Note. Even if Automatic VC offset is performed and 0 V is input, the servo motor may not completely stop due to an internal error. To completely stop the servo motor, switch off ST1 or ST2.

4.5.5 Alarm mode

The current alarm, past alarm history and parameter error are displayed. The lower 3 digits on the display indicate the alarm number that has occurred or the parameter number in error.

Name	Display	Description
Current alarm		Indicates no occurrence of an alarm.
		Indicates the occurrence of [AL. 33.1 Main circuit voltage error]. Blinks at alarm occurrence.
Alarm history		Indicates that the last alarm is [AL. 50.1 Thermal overload error 1 during operation].
		Indicates the second last alarm is [AL. 33.1 Main circuit voltage error].
		Indicates the third last alarm is [AL. 10.1 Voltage drop in the control circuit power].
		Indicates that there is no tenth alarm in the past.
		Indicates that there is no eleventh alarm in the past.
		Indicates that there is no twelfth alarm in the past.
		Indicates that there is no sixteenth alarm in the past.
Parameter error No.		This indicates no occurrence of [AL. 37 Parameter error].
		The data content error of [Pr. PA12 Reverse rotation torque limit].

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 blinking.

(3) For any alarm, remove its cause and clear it in any of the following methods. (Refer to chapter 8 for the alarms that can be cleared.)

(a) Switch power off, then on.

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

(c) Turn on RES (Reset).

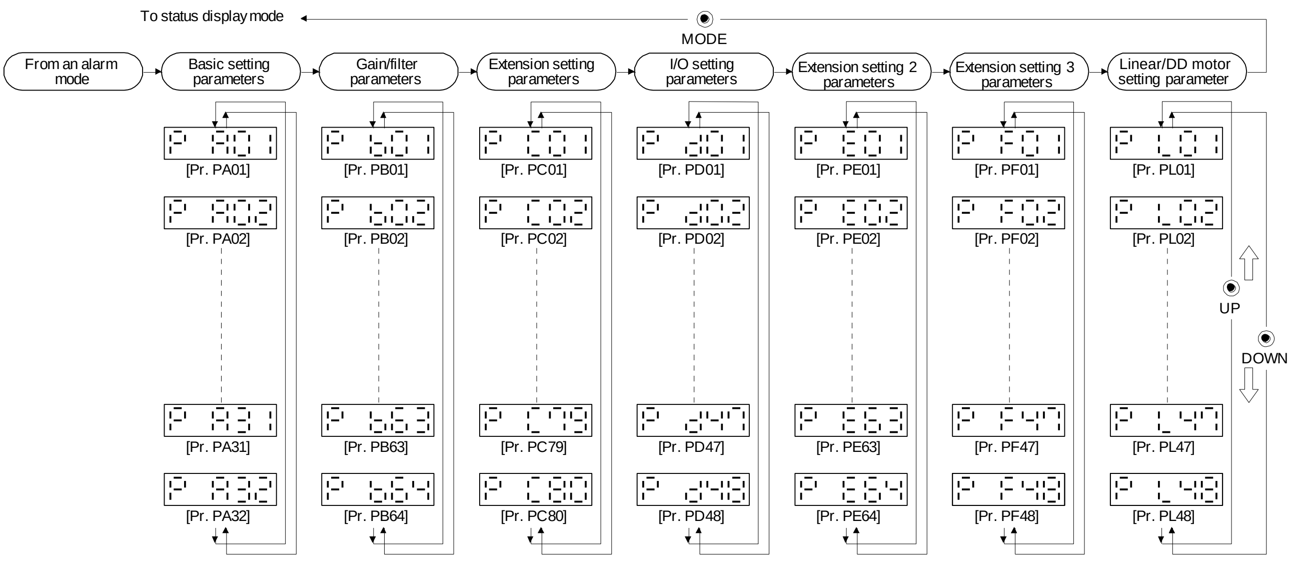
(4) Use [Pr. PC18] to clear the alarm history.

(5) Push "UP" or "DOWN" to move to the next history.

4.5.6 Parameter mode

(1) Parameter mode transition

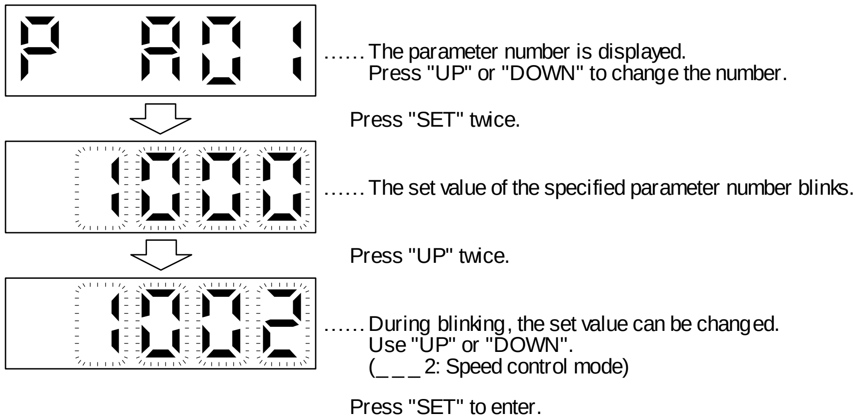
After selecting the corresponding parameter mode with the "MODE" button, pushing the "UP" or "DOWN" button changes the display as shown below.



(2) Operation example

(a) Parameters of 5 or less digits

The following example shows the operation procedure performed after power-on to change the control mode to the speed control mode with [Pr. PA01 Operation mode]. Press "MODE" to switch to the basic setting parameter screen.

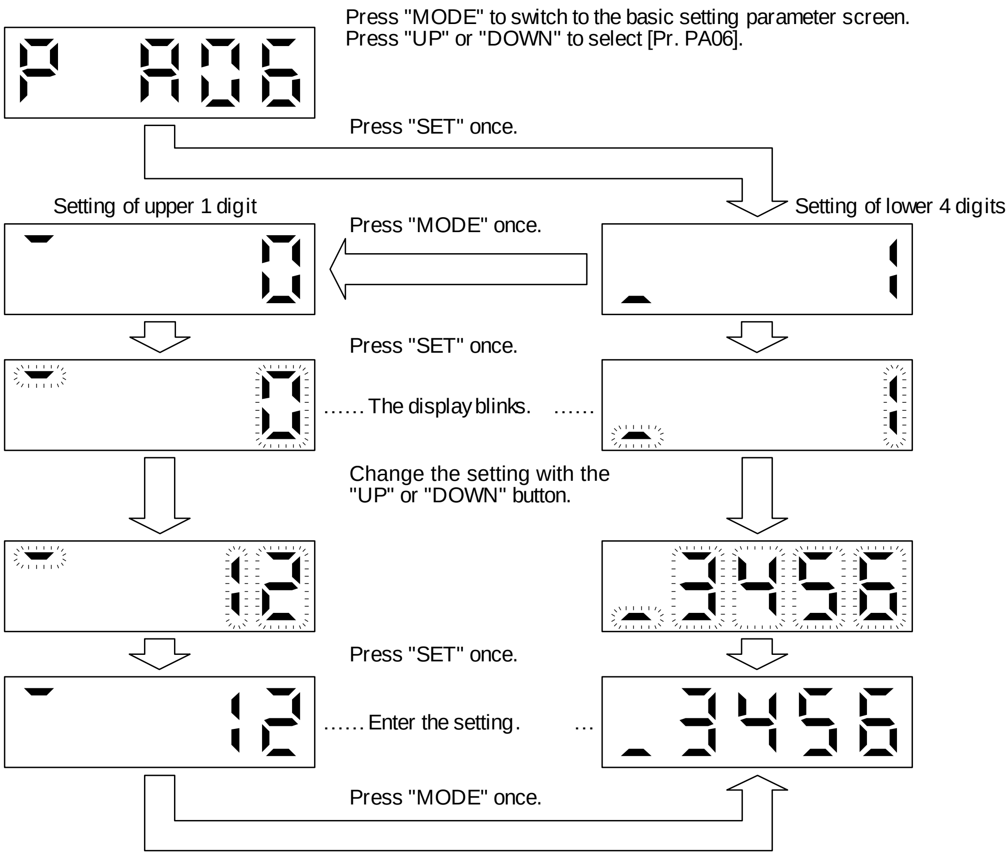


To shift to the next parameter, press the "UP" or "DOWN" button.

When changing the [Pr. PA01] setting, change its set value, then switch power off once and switch it on again to enable the new value.

(b) Parameters of 6 or more digits

The following example gives the operation procedure to change the electronic gear numerator to "123456" with [Pr. PA06 Electronic gear numerator].



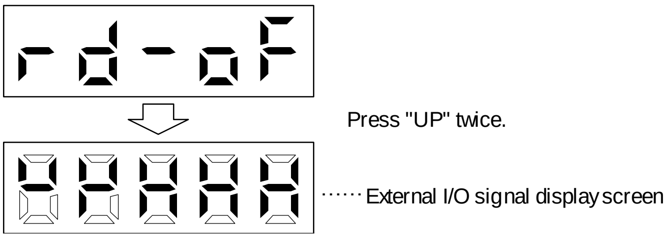
4.5.7 External I/O signal display

POINT
●The I/O signal settings can be changed using the I/O setting parameters [Pr. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47].

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

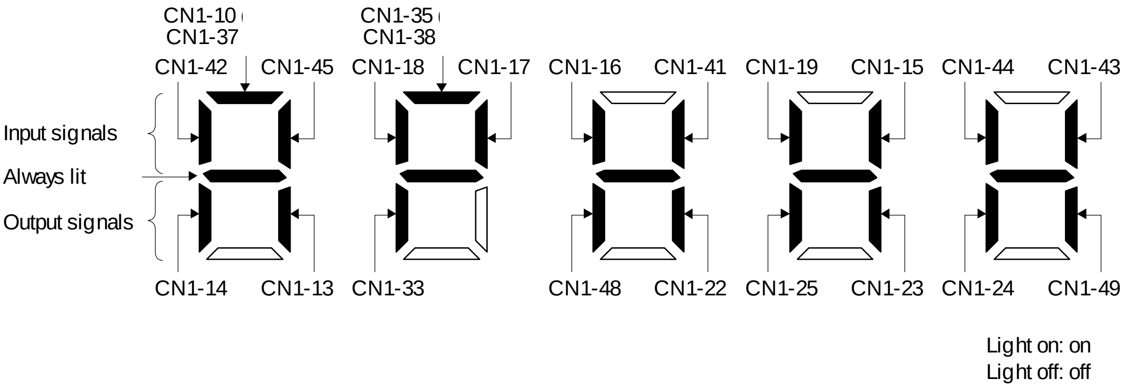
(1) Operation

Call the display screen shown after power-on. Using the "MODE" button, show the diagnostic screen.



(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	10	I	PP	PP/-	(Note 5)	(Note 5)	(Note 5)	-/PP	PD43/PD44
	13	O	(Note 3)	(Note 3)	(Note 3)	(Note 3)	(Note 3)	(Note 3)	PD47
	14	O	(Note 3)	(Note 3)	(Note 3)	(Note 3)	(Note 3)	(Note 3)	PD47
	15	I	SON	SON	SON	SON	SON	SON	PD03/PD04
	16	I		-/SP2	SP2	SP2/SP2	SP2	SP2/-	PD05/PD06
	17	I	PC	PC/ST1	ST1	ST1/RS2	RS2	RS2/PC	PD07/PD08
	18	I	TL	TL/ST2	ST2	ST2/RS1	RS1	RS1/TL	PD09/PD10
	19	I	RES	RES	RES	RES	RES	RES	PD11/PD12
	22	O	INP	INP/SA	SA	SA/-		-/INP	PD23
	23	O	ZSP	ZSP	ZSP	ZSP	ZSP	ZSP	PD24
	24	O	INP	INP/SA	SA	SA/-		-/INP	PD25
	25	O	TLC	TLC	TLC	TLC/VLC	VLC	VLC/TLC	PD26
	33	O	OP	OP	OP	OP	OP	OP	
	35	I	NP	NP/-	(Note 5)	(Note 5)	(Note 5)	-/NP	PD45/PD46
	37 (Note 7)	I	PP2	PP2/-	(Note 6)	(Note 6)	(Note 6)	-/PP2	PD43/PD44
	38 (Note 7)	I	NP2	NP2/-	(Note 6)	(Note 6)	(Note 6)	-/NP2	PD45/PD46
	41	I	CR	CR/SP1	SP1	SP1/SP1	SP1	SP1/CR	PD13/PD14
	42	I	EM2	EM2	EM2	EM2	EM2	EM2	
	43	I	LSP	LSP	LSP	LSP/-		-/LSP	PD17/PD18
	44	I	LSN	LSN	LSN	LSN/-		-/LSN	PD19/PD20
	45	I	LOP	LOP	LOP	LOP	LOP	LOP	PD21/PD22
	48	O	ALM	ALM	ALM	ALM	ALM	ALM	
	49	O	RD	RD	RD	RD	RD	RD	PD28

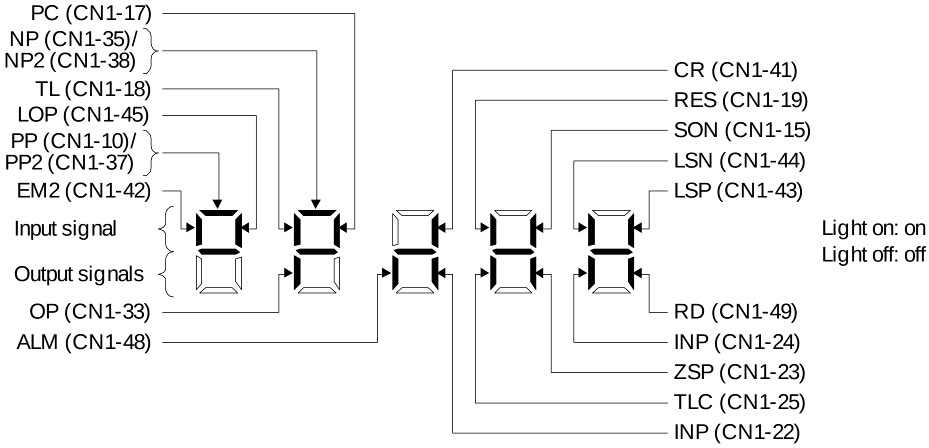
Note 1. I: input signal, O: output signal
2. P: position control mode, S: speed control mode, T: torque control mode
P/S: position/speed control switching mode, S/T: speed/torque control switching mode, T/P: torque/position switching mode
3. Output devices are not assigned by default. Assign the output devices with [Pr. PD47] as necessary.
5. This is available as an input device of sink interface. Input devices are not assigned by default. Assign the input devices with [Pr. PD43] to [Pr. PD46] as necessary. Supply + of 24 V DC to CN1-12 pin.
6. This is available as an input device of source interface. Input devices are not assigned by default. Assign the input devices with [Pr. PD43] to [Pr. PD46] as necessary.

(b) Symbol and signal names

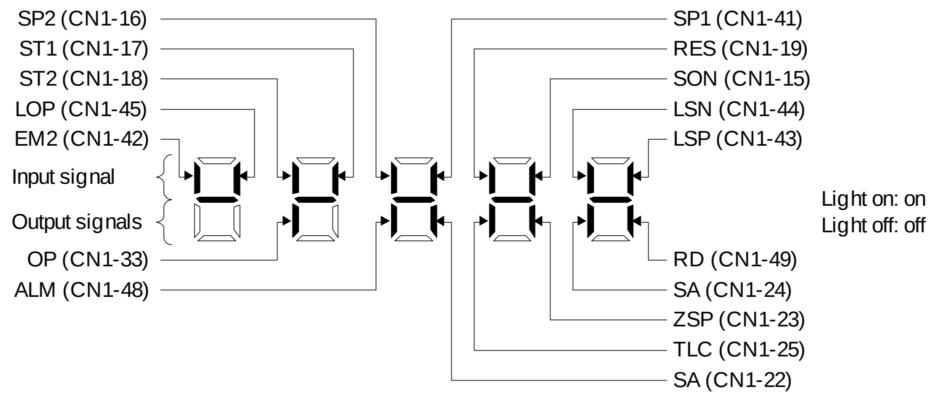
Symbol	Application	Symbol	Application
SON	Servo-on	RES	Reset
LSP	Forward rotation stroke end	EM2	Forced stop 2
LSN	Reverse rotation stroke end	LOP	Control switching
CR	Clear	TLC	Limiting torque
SP1	Speed selection 1	VLC	Limiting speed
SP2	Speed selection 2	RD	Ready
PC	Proportion control	ZSP	Zero speed detection
ST1	Forward rotation start	INP	In-position
ST2	Reverse rotation start	SA	Speed reached
RS1	Forward rotation selection	ALM	Malfunction
RS2	Reverse rotation selection	OP	Encoder Z-phase pulse (open collector)
TL	External torque limit selection		

(3) Display data at initial values

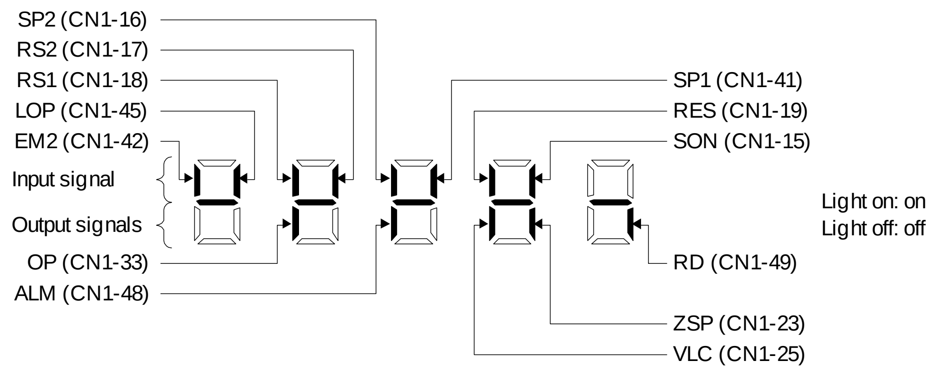
(a) Position control mode



(b) Speed control mode



(c) Torque control mode



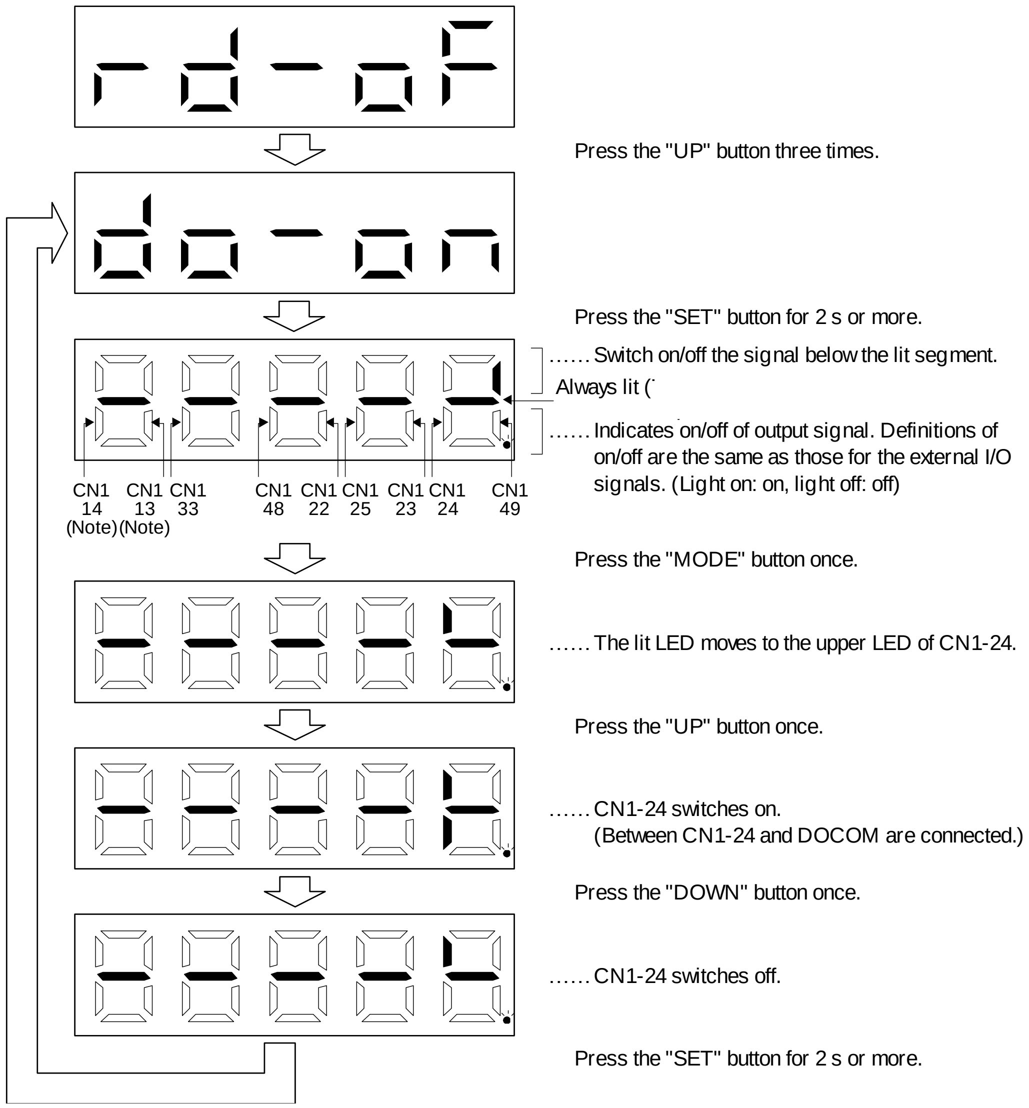
4.5.8 Output signal (DO) forced output

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

Output signals can be switched on/off forcibly 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 SON (Servo-on).

Operation

Call the display screen shown after power-on. Using the "MODE" button, show the diagnostic screen.



4.5.9 Test operation mode

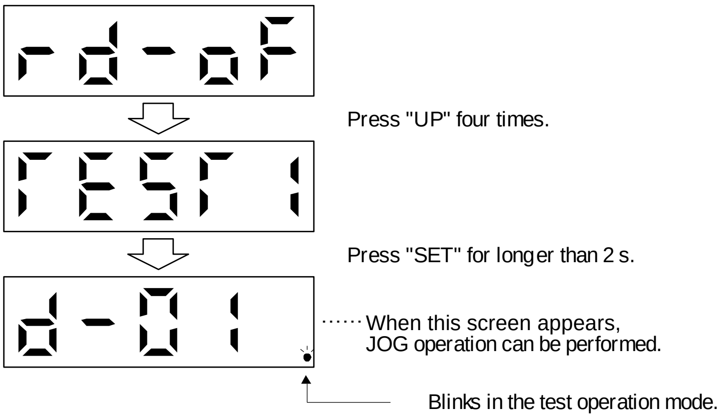
CAUTION	
⚠CAUTION	●The test operation mode is designed for checking servo operation. Do not use it for actual operation. ●If the servo motor operates unexpectedly, use EM2 (Forced stop 2) to stop it.

POINT

- ●The test operation mode cannot be used in the absolute position detection system by DIO ([Pr. PA03: _ _ _ 1]).
- ●Setup software (MR Configurator2™) is required to perform positioning operation.
- ●Test operation cannot be performed if SON (Servo-on) is not turned off.

(1) Mode switching

Call the display screen shown after power-on. Select JOG operation or motor-less operation in the following procedure. Using the "MODE" button, show the diagnostic screen.



(2) JOG operation

POINT
● When performing JOG operation, turn on EM2, LSP and LSN. LSP and LSN can be set to automatic on by setting [Pr. PD01] to " _ C _ _ ".

JOG operation can be performed when there is no command from the PC or PLC...etc.

(a) 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 Setup software (MR Configurator2^{TM}). The initial operation condition and setting range 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

The following table shows how to use the buttons.

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

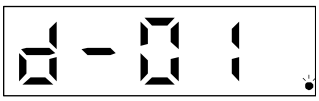
If the USB cable is disconnected during JOG operation using the Setup software (MR Configurator2^{TM}), the servo motor decelerates to a stop.

(b) Status display

Press the "MODE" button in the JOG operation-ready status to call the status display screen. When the JOG operation is performed using the "UP" or "DOWN" button, the servo status is displayed during the JOG operation. Every time the "MODE" button is pushed, the next status display screen appears. When one cycle of the screen display is complete, it returns to the jog operation-ready status screen. Refer to section 4.5.3 for details of status display. Note that the status display screen cannot be changed by the "UP" or "DOWN" button during the JOG operation.

(c) Termination of JOG operation

To end the JOG operation, shut 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.

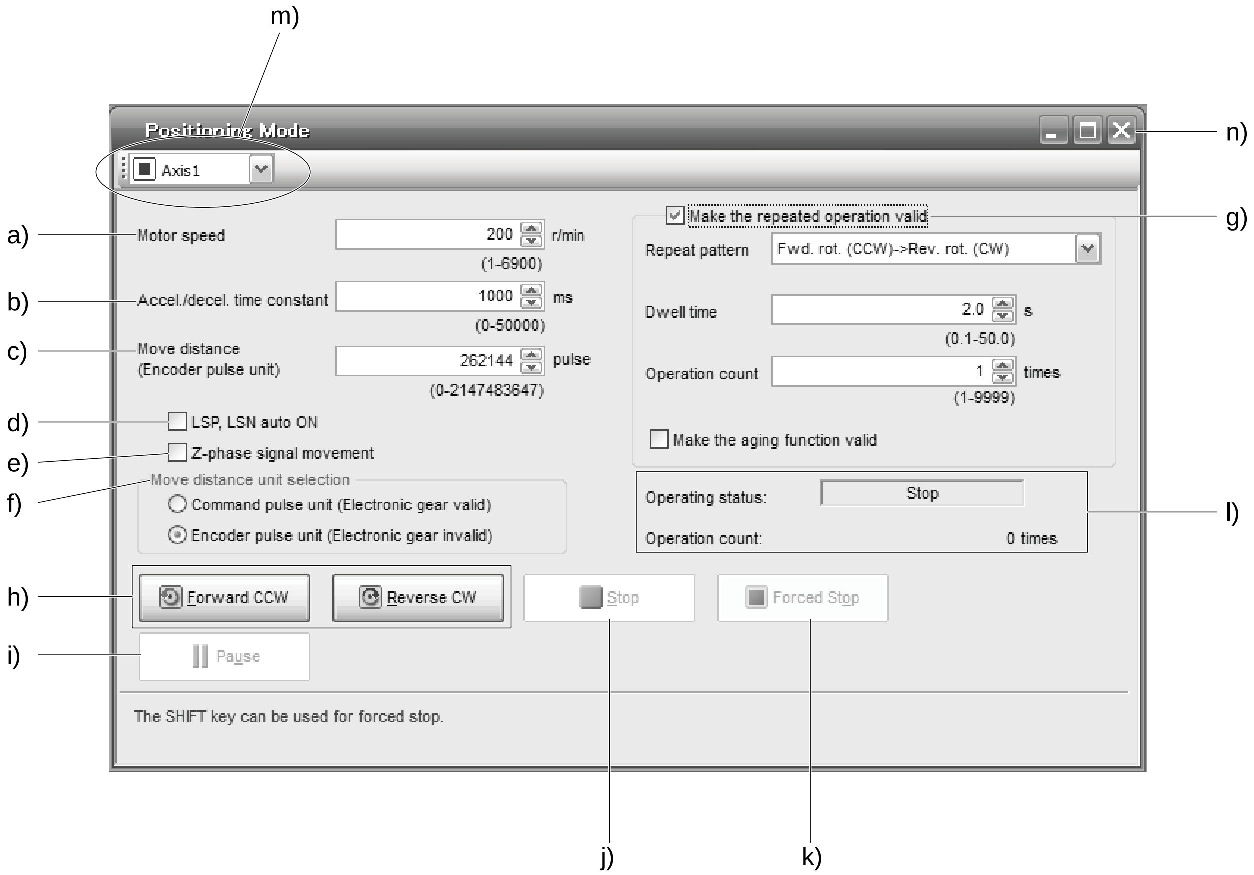


(3) Positioning operation

POINT
●Setup software (MR Configurator2™) is required to perform positioning operation. ●Turn on EM2 (forced stop 2) when performing positioning operation.

Positioning operation can be performed when there is no command from a PC or PLC...etc.

(a) Operation



a) Motor speed [r/min]
Enter the servo motor speed into the "Motor speed" input field.

b) Acceleration/deceleration time constant [ms]
Enter the acceleration/deceleration time constant into the "Accel./decel. time constant" input field.

c) Travel distance [pulse]
Enter the travel distance into the "Travel distance" input field.

d) LSP/LSN are automatically turned on
When setting the external stroke signal to automatic on, click the check box to enable it. When it is not selected, turn on LSP and LSN externally.

e) Move till Z-phase signal
Travel is made until the travel distance is reached and the first Z-phase signal in the travelling direction turns on.

f) Travel distance unit selection
Select with the option buttons whether the travel 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 travel distance multiplied by the electronic gear, will be the command value. When the encoder pulse unit is selected, the travel distance is not multiplied by the electronic gear.

g) Enable repeat operation
To perform repeat operation, click the check. The initial setting and setting range for the repeat operation are listed below.

Item	Initial setting	Setting range
Repeat pattern	Fwd. rot. (CCW) to rev. rot. (CW)	Fwd. rot. (CCW) to rev. rot. (CW) Fwd. rot. (CCW) to fwd. rot. (CCW) Rev. rot. (CW) to fwd. rot. (CCW) Rev. rot. (CW) to rev. rot. (CW)
Dwell time [s]	2.0	0.1 to 50.0
Number of operations [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 enabled".

h) Forward/reverse the servo motor
Click "Forward" to rotate the servo motor in the forward rotation direction.
Click "Reverse" to rotate the servo motor in the reverse rotation direction.

i) Pause the servo motor
Click "Pause" during servo motor rotation to temporarily stop the servo motor.
"Pause" is enabled during servo motor rotation.

j) Stop the servo motor
Click "Stop" during servo motor rotation to stop the servo motor.

k) Forced stop
Click "Forced stop" during servo motor rotation to make a sudden stop.
"Forced stop" is enabled during servo motor rotation.

l) Operation status
The operation status during the repeat operation, and the number of operations are displayed

m) Axis No.
Axis No. in operation is displayed.

n) Termination of positioning operation window
Click "X" to cancel the positioning operation mode and close the window.

(b) Status display
The status display can be monitored during positioning operation.

(4) Motor-less operation
Without connecting the servo motor, output signals or status display can be provided in response to the input device as if the servo motor is actually running. This operation can be used to check the sequence of a PC or PLC...etc or the like.

(a) Start of motor-less operation
After setting "_ _ _ 1" in [Pr. PC60], cycle the power. After that, perform external operation as in ordinary operation.

(b) Termination of motor-less operation
To terminate the motor-less operation, set [Pr. PC60] to "_ _ _ 0" and then turn the power off.

(5) Program operation
Positioning operation can be performed in two or more operation patterns combined, without using a PC or PLC...etc. Use this operation with the forced stop reset. This operation may be used independently of whether servo-on or servo-off and whether a PC or PLC...etc is connected or not.
Exercise control on the program operation screen of Setup software (MR Configurator2TM). For details, refer to Help of Setup software (MR Configurator2TM).

Operation	Screen control
Start	Click "Operation start".
Stop	Click "Stop".
Forced stop	Click "Forced stop".

(6) Output signal (DO) forced output
Output signals can be switched on/off forcibly independently of the servo status. This function is used for output signal wiring check, etc. Exercise control on the DO forced output screen of Setup software (MR Configurator2TM).

5. PARAMETERS

⚠CAUTION	●Never make a drastic adjustment or change to the parameter values as doing so will make the operation unstable. ●If fixed values are written in the digits of a parameter, do not change these values. ●Do not change parameters for manufacturer setting. ●Do not set values other than described values to each parameter.

5.1 Parameter list

POINT

- ●To enable a parameter whose symbol is preceded by *, cycle the power after setting it.
- ●The symbols in the control mode column mean as follows.
  P: Position control mode
  S: Speed control mode
  T: Torque control mode
- ●Setting an out of range value to each parameter will trigger [AL. 37 Parameter error].

5.1.1 Basic setting parameters ([Pr. PA_ _])

No.	Symbol	Name	Initial value	Unit	Operation mode	Control mode		
					Standard	P	S	T
PA01	*STY	Operation mode	1000h		○	○	○	○
PA02	*REG	Regenerative option	0000h		○	○	○	○
PA03	*ABS	Absolute position detection system	0000h		○	○		
PA04	*AOP1	Function selection A-1	2000h		○	○	○	
PA05	*FBP	Number of command input pulses per revolution	10000		○	○		
PA06	CMX	Electronic gear numerator (command pulse multiplication numerator)	1		○	○		
PA07	CDV	Electronic gear denominator (command pulse multiplication denominator)	1		○	○		
PA08	ATU	Auto tuning mode	0001h		○	○	○	
PA09	RSP	Auto tuning response	16		○	○	○	
PA10	INP	In-position range	100	[pulse]	○	○		
PA11	TLP	Forward rotation torque limit/positive direction thrust limit	100.0	[%]	○	○	○	○
PA12	TLN	Reverse rotation torque limit/negative direction thrust limit	100.0	[%]	○	○	○	○
PA13	*PLSS	Command pulse input form	0100h		○	○		
PA14	*POL	Rotation direction selection/travel direction selection	0		○	○		
PA15	*ENR	Encoder output pulses	4000	[pulse/rev]	○	○	○	○
PA16	*ENR2	Encoder output pulses 2	1		○	○	○	○
PA17	*MSR	Servo motor series setting	0000h			○	○	○
PA18	*MTY	Servo motor type setting	0000h			○	○	○
PA19	*BLK	Parameter writing inhibit	00AAh		○	○	○	○
PA20	*TDS	Tough drive setting	0000h		○	○	○	○
PA21	*AOP3	Function selection A-3	0001h		○	○	○	
PA22	*PCS	Position control composition selection	0000h		○	○		
PA23	DRAT	Drive recorder arbitrary alarm trigger setting	0000h		○	○	○	○
PA24	AOP4	Function selection A-4	0000h		○	○	○	
PA25	OTHOV	One-touch tuning - Overshoot permissible level	0	[%]	○	○	○	
PA26	*AOP5	Function selection A-5	0000h		○	○	○	
PA27		For manufacturer setting	0000h					
PA28			0000h					
PA29			0000h					
PA30			0000h					
PA31			0000h					
PA32			0000h					

5.1.2 Gain/filter setting parameters ([Pr. PB_ _])

No.	Symbol	Name	Initial value	Unit	Operation mode	Control mode		
					Standard	P	S	T
PB01	FILT	Adaptive tuning mode (adaptive filter II)	0000h		○	○	○	○
PB02	VRFT	Vibration suppression control tuning mode (advanced vibration suppression control II)	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	Load to motor inertia ratio/load to motor mass ratio	7.00	[Multiplier]	○	○	○	
PB07	PG1	Model loop gain	15.0	[rad/s]	○	○	○	
PB08	PG2	Position loop gain	37.0	[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	NHF	Shaft resonance suppression filter	0000h		○	○	○	○
PB18	LPF	Low-pass filter setting	3141	[rad/s]	○	○	○	
PB19	VRF11	Vibration suppression control 1 - Vibration frequency	100.0	[Hz]	○	○		
PB20	VRF12	Vibration suppression control 1 - Resonance frequency	100.0	[Hz]	○	○		
PB21	VRF13	Vibration suppression control 1 - Vibration frequency damping	0.00		○	○		
PB22	VRF14	Vibration suppression control 1 - Resonance frequency damping	0.00		○	○		
PB23	VFBF	Low-pass filter selection	0000h		○	○	○	○
PB24	*MVS	Slight vibration suppression control	0000h		○	○		
PB25	*BOP1	Function selection B-1	0000h		○	○	○	
PB26	*CDP	Gain switching function	0000h		○	○	○	
PB27	CDL	Gain switching condition	10	[kpulse/s]/ [pulse]/ [r/min]	○	○	○	
PB28	CDT	Gain switching time constant	1	[ms]	○	○	○	
PB29	GD2B	Load to motor inertia ratio/load to motor mass ratio after gain switching	7.00	[Multiplier]	○	○	○	

No.	Symbol	Name	Initial value	Unit	Operation mode	Control mode		
					Standard	P	S	T
PB30	PG2B	Position loop gain after gain switching	0.0	[rad/s]	○	○		
PB31	VG2B	Speed loop gain after gain switching	0	[rad/s]	○	○	○	
PB32	VICB	Speed integral compensation after gain switching	0.0	[ms]	○	○	○	
PB33	VRF1B	Vibration suppression control 1 - Vibration frequency after gain switching	0.0	[Hz]	○	○		
PB34	VRF2B	Vibration suppression control 1 - Resonance frequency after gain switching	0.0	[Hz]	○	○		
PB35	VRF3B	Vibration suppression control 1 - Vibration frequency damping after gain switching	0.00		○	○		
PB36	VRF4B	Vibration suppression control 1 - Resonance frequency damping after gain switching	0.00		○	○		
PB37		For manufacturer setting	1600					
PB38			0.00					
PB39			0.00					
PB40			0.00					
PB41			0000h					
PB42			0000h					
PB43			0000h					
PB44			0.00					
PB45	CNHF	Command notch filter	0000h		○	○		
PB46	NH3	Machine resonance suppression filter 3	4500	[Hz]	○	○	○	○
PB47	NHQ3	Notch shape selection 3	0000h		○	○	○	○
PB48	NH4	Machine resonance suppression filter 4	4500	[Hz]	○	○	○	○
PB49	NHQ4	Notch shape selection 4	0000h		○	○	○	○
PB50	NH5	Machine resonance suppression filter 5	4500	[Hz]	○	○	○	○
PB51	NHQ5	Notch shape selection 5	0000h		○	○	○	○
PB52	VRF21	Vibration suppression control 2 - Vibration frequency	100.0	[Hz]	○	○		
PB53	VRF22	Vibration suppression control 2 - Resonance frequency	100.0	[Hz]	○	○		
PB54	VRF23	Vibration suppression control 2 - Vibration frequency damping	0.00		○	○		
PB55	VRF24	Vibration suppression control 2 - Resonance frequency damping	0.00		○	○		
PB56	VRF21B	Vibration suppression control 2 - Vibration frequency after gain switching	0.0	[Hz]	○	○		
PB57	VRF22B	Vibration suppression control 2 - Resonance frequency after gain switching	0.0	[Hz]	○	○		
PB58	VRF23B	Vibration suppression control 2 - Vibration frequency damping after gain switching	0.00		○	○		
PB59	VRF24B	Vibration suppression control 2 - Resonance frequency damping after gain switching	0.00		○	○		
PB60	PG1B	Model loop gain after gain switching	0.0	[rad/s]	○	○	○	
PB61		For manufacturer setting	0.0					
PB62			0000h					
PB63			0000h					
PB64			0000h					

5.1.3 Extension setting parameters ([Pr. PC_ _])

No.	Symbol	Name	Initial value	Unit	Operation mode	Control mode		
					Standard	P	S	T
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/thrust 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/thrust 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	0	[ms]	○	○	○	○
PC17	ZSP	Zero speed	50	[r/min]	○	○	○	○
PC18	*BPS	Alarm history clear	0000h		○	○	○	○
PC19	*ENRS	Encoder output pulse selection	0000h		○	○	○	○
PC20	*SNO	Station No. setting	0	[station]	○	○	○	○
PC21	*SOP	RS-422 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	*COP7	Function selection C-7	0000h			○	○	○
PC29		For manufacturer setting	0000h					
PC30	STA2	Acceleration time constant 2	0	[ms]	○		○	○
PC31	STB2	Deceleration time constant 2	0	[ms]	○		○	○
PC32	CMX2	Command input pulse multiplication numerator 2	1		○	○		
PC33	CMX3	Command input pulse multiplication numerator 3	1		○	○		
PC34	CMX4	Command input pulse multiplication numerator 4	1		○	○		
PC35	TL2	Internal torque limit 2/internal thrust limit 2	100.0	[%]	○	○	○	○
PC36	*DMD	Status display selection	0000h		○	○	○	○
PC37	VCO	Analog speed command offset	0	[mV]	○		○	
		Analog speed limit offset			○			○

No.	Symbol	Name	Initial value	Unit	Operation mode: Standard	Control mode: P	Control mode: S	Control mode: T
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	ERZ	Error excessive alarm detection level	0	[rev]	○	○		
PC44	*COP9	Function selection C-9	0000h			○		
PC45	*COPA	Function selection C-A	0000h			○	○	○
PC46		For manufacturer setting	0					
PC47			0					
PC48			0					
PC49			0					
PC50			0000h					
PC51	RSBR	Forced stop deceleration time constant	100	[ms]	○	○	○	
PC52		For manufacturer setting	0					
PC53			0					
PC54	RSUP1	Vertical axis freefall prevention compensation amount	0	[0.0001 rev]	○	○		
PC55		For manufacturer setting	0					
PC56			100					
PC57			0000h					
PC58			0					
PC59			0000h					
PC60	*COPD	Function selection C-D	0000h		○	○	○	○
PC61		For manufacturer setting	0000h					
PC62			0000h					
PC63			0000h					
PC64			0000h					
PC65			0000h					
PC66			0					
PC67			0					
PC68			0					
PC69			0					
PC70			0					
PC71			0040h					
PC72			0000h					
PC73	ERW	Error excessive warning level	0	[rev]	○	○		
PC74		For manufacturer setting	0000h					
PC75			0000h					
PC76			0000h					
PC77			0000h					
PC78			0000h					
PC79			0000h					
PC80			0000h					

5.1.4 I/O setting parameters ([Pr. PD_ _])

No.	Symbol	Name	Initial value	Unit	Operation mode	Control mode		
					Standard	P	S	T
PD01	*DIA1	Input signal automatic on selection 1	0000h		○	○	○	○
PD02		For manufacturer setting	0000h					
PD03	*DI1L	Input device selection 1L	0202h		○	○	○	
PD04	*DI1H	Input device selection 1H	0202h		○			○
PD05	*DI2L	Input device selection 2L	2100h		○	○	○	
PD06	*DI2H	Input device selection 2H	2021h		○			○
PD07	*DI3L	Input device selection 3L	0704h		○	○	○	
PD08	*DI3H	Input device selection 3H	0707h		○			○
PD09	*DI4L	Input device selection 4L	0805h		○	○	○	
PD10	*DI4H	Input device selection 4H	0808h		○			○
PD11	*DI5L	Input device selection 5L	0303h		○	○	○	
PD12	*DI5H	Input device selection 5H	3803h		○			○
PD13	*DI6L	Input device selection 6L	2006h		○	○	○	
PD14	*DI6H	Input device selection 6H	3920h		○			○
PD15		For manufacturer setting	0000h					
PD16			0000h					
PD17	*DI8L	Input device selection 8L	0A0Ah		○	○	○	
PD18	*DI8H	Input device selection 8H	0A00h		○			○
PD19	*DI9L	Input device selection 9L	0B0Bh		○	○	○	
PD20	*DI9H	Input device selection 9H	0B00h		○			○
PD21	*DI10L	Input device selection 10L	2323h		○	○	○	
PD22	*DI10H	Input device selection 10H	2B23h		○			○
PD23	*DO1	Output device selection 1	0004h		○	○	○	○
PD24	*DO2	Output device selection 2	000Ch		○	○	○	○
PD25	*DO3	Output device selection 3	0004h		○	○	○	○
PD26	*DO4	Output device selection 4	0007h		○	○	○	○
PD27		For manufacturer setting	0003h					
PD28	*DO6	Output device selection 6	0002h		○	○	○	○
PD29	*DIF	Input filter setting	0004h		○	○	○	○
PD30	*DOP1	Function selection D-1	0000h		○	○	○	○
PD31	*DOP2	Function selection D-2	0000h		○	○		
PD32	*DOP3	Function selection D-3	0000h		○	○		
PD33	*DOP4	Function selection D-4	0000h		○	○	○	○
PD34	DOP5	Function selection D-5	0000h		○	○	○	○
PD35		For manufacturer setting	0000h					
PD36			0000h					
PD37			0000h					
PD38			0					
PD39			0					
PD40			0					
PD41			0000h					
PD42			0000h					
PD43	*DI11L	Input device selection 11L	0000h		○	○	○	
PD44	*DI11H	Input device selection 11H	3A00h		○			○
PD45	*DI12L	Input device selection 12L	0000h		○	○	○	
PD46	*DI12H	Input device selection 12H	3B00h		○			○
PD47	*DO7	Output device selection 7	0000h		○	○	○	○
PD48		For manufacturer setting	0000h					

5.1.5 Extension setting 2 parameters ([Pr. PE_ _])

No.	Symbol	Name	Initial value	Unit	Operation mode	Control mode		
					Standard	P	S	T
PE01	*FCT1	Fully closed loop function selection 1	0000h			○		
PE02		For manufacturer setting	0000h					
PE03	*FCT2	Fully closed loop function selection 2	0003h			○		
PE04	*FBN	Fully closed loop control - Feedback pulse electronic gear 1 - Numerator	1			○		
PE05	*FBD	Fully closed loop control - Feedback pulse electronic gear 1 - Denominator	1			○		
PE06	BC1	Fully closed loop control - Speed deviation error detection level	400	[r/min]		○		
PE07	BC2	Fully closed loop control - Position deviation error detection level	100	[kpulse]		○		
PE08	DUF	Fully closed loop dual feedback filter	10	[rad/s]		○		
PE09		For manufacturer setting	0000h					
PE10	FCT3	Fully closed loop function selection 3	0000h			○		
PE11		For manufacturer setting	0000h					
PE12			0000h					
PE13			0000h					
PE14			0111h					
PE15			20					
PE16			0000h					
PE17			0000h					
PE18			0000h					
PE19			0000h					
PE20			0000h					
PE21			0000h					
PE22			0000h					
PE23			0000h					
PE24			0000h					
PE25			0000h					
PE26			0000h					
PE27			0000h					
PE28			0000h					
PE29			0000h					
PE30			0000h					
PE31			0000h					
PE32			0000h					
PE33			0000h					
PE34	*FBN2	Fully closed loop control - Feedback pulse electronic gear 2 - Numerator (Do not change this value)	1			○		
PE35	*FBD2	Fully closed loop control - Feedback pulse electronic gear 2 - Denominator (Do not change this value)	1			○		
PE36		For manufacturer setting	0.0					
PE37			0.00					
PE38			0.00					
PE39			20					
PE40			0000h					
PE41	EOP3	Function selection E-3	0000h		○	○	○	○

No.	Symbol	Name	Initial value	Unit	Operation mode Standard	Control mode P	S	T
PE42		For manufacturer setting	0					
PE43			0.0					
PE44	LMCP	Lost motion compensation positive-side compensation value selection	0	[0.01%]	○	○		
PE45	LMCN	Lost motion compensation negative-side compensation value selection	0	[0.01%]	○	○		
PE46	LMFLT	Lost motion filter setting	0	[0.1 ms]	○	○		
PE47	TOF	Torque offset	0	[0.01%]	○	○	○	○
PE48	*LMOP	Lost motion compensation function selection	0000h		○	○		
PE49	LMCD	Lost motion compensation timing	0	[0.1 ms]	○	○		
PE50	LMCT	Lost motion compensation non-sensitive band	0	[pulse]/ [kpulse]	○	○		
PE51		For manufacturer setting	0000h					
PE52			0000h					
PE53			0000h					
PE54			0000h					
PE55			0000h					
PE56			0000h					
PE57			0000h					
PE58			0000h					
PE59			0000h					
PE60			0000h					
PE61			0.00					
PE62			0.00					
PE63			0.00					
PE64			0.00					

5.1.6 Extension setting 3 parameters ([Pr. PF_ _])

No.	Symbol	Name	Initial value	Unit	Operation mode	Control mode		
					Standard	P	S	T
PF01		For manufacturer setting	0000h					
PF02			0000h					
PF03			0000h					
PF04			0					
PF05			0					
PF06			0000h					
PF07			1					
PF08			1					
PF09	*FOP5	Function selection F-5	0000h		○	○	○	○
PF10		For manufacturer setting	0000h					
PF11			0000h					
PF12			10000					
PF13			100					
PF14			100					
PF15	DBT	Electronic dynamic brake operating time	2000	[ms]	○	○	○	○
PF16		For manufacturer setting	0000h					
PF17			10					
PF18	*STOD	STO diagnosis error detection time	0	[s]	○	○	○	○
PF19		For manufacturer setting	0000h					
PF20			0000h					
PF21	DRT	Drive recorder switching time setting	0	[s]	○	○	○	○
PF22		For manufacturer setting	200					
PF23	OSCL1	Vibration tough drive - Oscillation detection level	50	[%]	○	○	○	
PF24	*OSCL2	Vibration tough drive function selection	0000h		○	○	○	
PF25	CVAT	SEMI-F47 function - Instantaneous power failure detection time	200	[ms]	○	○	○	○
PF26		For manufacturer setting	0					
PF27			0					
PF28			0					
PF29			0000h					
PF30			0					
PF31	FRIC	Machine diagnosis function - Friction judgment speed	0	[r/min]/ [mm/s]	○	○	○	○
PF32		For manufacturer setting	50					
PF33			0000h					
PF34	*SOP3	RS-422 communication function selection 3	0000h		○	○	○	○
PF35		For manufacturer setting	0000h					
PF36			0000h					
PF37			0000h					
PF38			0000h					
PF39			0000h					
PF40			0					
PF41			0					
PF42			0					
PF43			0					
PF44			0					
PF45			0000h					
PF46			0000h					
PF47			0000h					
PF48			0000h					

5.2 Detailed list of parameters

POINT
●Set a value to each "x" in the "Setting digit" columns.

5.2.1 Basic setting parameters ([Pr. PA_ _])

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PA01 *STY Operation mode	_ _ _ x	Control mode selection Select a 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 6: Positioning mode (point table method) (Note 1) 7: Positioning mode (program method) (Note 1) 8: Positioning mode (Equal division indexing method) (Note 1) (Note 1) Used in positioning mode.	0h	○	○	○
	_ _ x _	Do not change this value.	0h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		1h			

<table>
<tr><th rowspan="2">No./symbol/ name</th><th rowspan="2">Setting digit</th><th rowspan="2">Function</th><th rowspan="2">Initial value [unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td rowspan="3">PA02
*REG
Regenerative option</td><td>_ _ x x</td><td>Regenerative option
Select the regenerative option.
Incorrect setting may cause the regenerative option to burn.
If a selected regenerative option is not for use with the driver, [AL. 37 Parameter error] occurs.

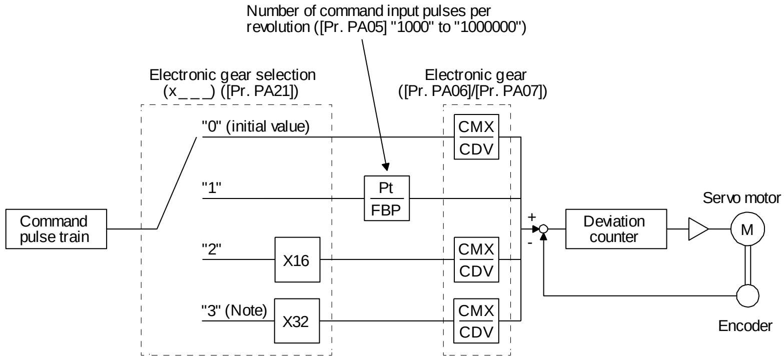
00: Regenerative option is not used.
・For the driver of 100 W, a regenerative resistor is not used.
・For the driver of 200 W to750 W, the built-in regenerative resistor is used.
02: LEC-MR-RB-032
03: LEC-MR-RB-12</td><td>00h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>_ x _ _</td><td rowspan="2">For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>x _ _ _</td><td>0h</td><td></td><td></td><td></td></tr>
</table>

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PA03 *ABS Absolute position detection system	_ _ _ x	Absolute position detection system selection Set this digit when using the absolute position detection system in the position control mode. 0: Disabled (incremental system) 1: Enabled (absolute position detection system by DIO) 2: Enabled (absolute position detection system by communication)	0h	○		
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			
PA04 *AOP1 Function selection A-1	_ _ _ x	For manufacturer setting	0h			
	_ _ x _		0h			
	_ x _ _		0h			
	x _ _ _	Forced stop deceleration function selection 0: Forced stop deceleration function disabled (with EM1) 2: Forced stop deceleration function enabled (with EM2) Refer to table 5.1 for details.	2h	○	○	

Table 5.1 Deceleration method

Setting value	EM2/EM1	Deceleration method: EM2 or EM1 is off	Deceleration method: Alarm occurred
0 _ _ _	EM1	MBR (Electromagnetic brake interlock) turns off without the forced stop deceleration.	MBR (Electromagnetic brake interlock) turns off without the forced stop deceleration.
2 _ _ _	EM2	MBR (Electromagnetic brake interlock) turns off after the forced stop deceleration.	MBR (Electromagnetic brake interlock) turns off after the forced stop deceleration.

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PA05 *FBP Number of command input pulses per revolution		The servo motor rotates based on set command input pulses. To enable the parameter value, set "Electronic gear selection" to "Number of command input pulses per revolution (1 _ _ _)" of in [Pr. PA21]. Setting range: 1000 to 1000000	10000	○		

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode
PA06 CMX Electronic gear numerator (command pulse multiplication numerator)		Set the numerator of the electronic gear. To enable the parameter, set "Electronic gear selection" to "Electronic gear (0 _ _ _)", "J3 electronic gear setting value compatibility mode (2 _ _ _)", or "J2S electronic gear setting value compatibility mode (3 _ _ _)" in [Pr. PA21]. The following shows a standard of the setting range of the electronic gear. $\frac{1}{10} < \frac{CMX}{CDV} < 4000$ 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.  Pt (servo motor resolution): 4194304 pulses/rev Always set the electronic gear with servo-off state to prevent unexpected operation due to improper setting. Setting range: 1 to 16777215	1	○
PA07 CDV Electronic gear denominator (command pulse multiplication denominator)		Set the denominator of the electronic gear. To enable the parameter, set "Electronic gear selection" to "Electronic gear (0 _ _ _)", "J3 electronic gear setting value compatibility mode (2 _ _ _)", or "J2S electronic gear setting value compatibility mode (3 _ _ _)" in [Pr. PA21]. Setting range: 1 to 16777215	1	○

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PA08 ATU Auto tuning mode	_ _ _ x	Gain adjustment mode selection Select the gain adjustment mode. 0: 2 gain adjustment mode 1 (interpolation mode) 1: Auto tuning mode 1 2: Auto tuning mode 2 3: Manual mode 4: 2 gain adjustment mode 2 Refer to table 5.2 for details.	1h	○	○	
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			

Table 5.2 Gain adjustment mode selection

Setting value	Gain adjustment mode	Automatically adjusted parameter
_ _ _ 0	2 gain adjustment mode 1 (interpolation mode)	[Pr. PB06 Load to motor inertia ratio] [Pr. PB08 Position loop gain] [Pr. PB09 Speed loop gain] [Pr. PB10 Speed integral compensation]
_ _ _ 1	Auto tuning mode 1	[Pr. PB06 Load to motor inertia ratio] [Pr. PB07 Model loop gain] [Pr. PB08 Position loop gain] [Pr. PB09 Speed loop gain] [Pr. PB10 Speed integral compensation]
_ _ _ 2	Auto tuning mode 2	[Pr. PB07 Model loop gain] [Pr. PB08 Position loop gain] [Pr. PB09 Speed loop gain] [Pr. PB10 Speed integral compensation]
_ _ _ 3	Manual mode	
_ _ _ 4	2 gain adjustment mode 2	[Pr. PB08 Position loop gain] [Pr. PB09 Speed loop gain] [Pr. PB10 Speed integral compensation]

<table>
<tr><th rowspan="2">No./symbol/ name</th><th rowspan="2">Setting digit</th><th rowspan="2">Function</th><th rowspan="2">Initial value [unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>PA09
RSP
Auto tuning response</td><td colspan="2">Set a response of the auto tuning.
<table>
<tr><th rowspan="2">Setting value</th><th colspan="2">Machine characteristic</th><th rowspan="2">Setting value</th><th colspan="2">Machine characteristic</th></tr>
<tr><th>Response</th><th>Guideline for machine resonance frequency [Hz]</th><th>Response</th><th>Guideline for machine resonance frequency [Hz]</th></tr>
<tr><td>1</td><td rowspan="18">Low response
↑
↓</td><td>2.7</td><td>21</td><td rowspan="18">Middle response
↑
↓</td><td>67.1</td></tr>
<tr><td>2</td><td>3.6</td><td>22</td><td>75.6</td></tr>
<tr><td>3</td><td>4.9</td><td>23</td><td>85.2</td></tr>
<tr><td>4</td><td>6.6</td><td>24</td><td>95.9</td></tr>
<tr><td>5</td><td>10.0</td><td>25</td><td>108.0</td></tr>
<tr><td>6</td><td>11.3</td><td>26</td><td>121.7</td></tr>
<tr><td>7</td><td>12.7</td><td>27</td><td>137.1</td></tr>
<tr><td>8</td><td>14.3</td><td>28</td><td>154.4</td></tr>
<tr><td>9</td><td>16.1</td><td>29</td><td>173.9</td></tr>
<tr><td>10</td><td>18.1</td><td>30</td><td>195.9</td></tr>
<tr><td>11</td><td>20.4</td><td>31</td><td>220.6</td></tr>
<tr><td>12</td><td>23.0</td><td>32</td><td>248.5</td></tr>
<tr><td>13</td><td>25.9</td><td>33</td><td>279.9</td></tr>
<tr><td>14</td><td>29.2</td><td>34</td><td>315.3</td></tr>
<tr><td>15</td><td>32.9</td><td>35</td><td>355.1</td></tr>
<tr><td>16</td><td>37.0</td><td>36</td><td>400.0</td></tr>
<tr><td>17</td><td>41.7</td><td>37</td><td>446.6</td></tr>
<tr><td>18</td><td>47.0</td><td>38</td><td>501.2</td></tr>
<tr><td>19</td><td rowspan="2">Middle response</td><td>52.9</td><td>39</td><td rowspan="2">High response</td><td>571.5</td></tr>
<tr><td>20</td><td>59.6</td><td>40</td><td>642.7</td></tr>
</table>
Setting range: 1 to 40</td><td>16</td><td>○</td><td>○</td><td></td></tr>
<tr><td>PA10
INP
In-position range</td><td></td><td>Set an in-position range per command pulse.
To change it to the servo motor encoder pulse unit, set [Pr. PC24].

Setting range: 0 to 65535</td><td>100
[pulse]</td><td>○</td><td></td><td></td></tr>
<tr><td>PA11
TLP
Forward rotation torque limit/positive direction thrust limit</td><td></td><td>You can limit the torque or thrust generated by the servo motor. Set the parameter referring to section 3.6.1 (5).
When you output torque or thrust as analog monitor output, the larger value of [Pr. PA11 Forward rotation torque limit value] or [Pr. PA12 Reverse rotation torque limit value] will be the maximum output voltage (8 V).
Set the parameter on the assumption that the maximum torque or thrust is 100.0 [%]. The parameter is for limiting the torque of the servo motor in the CCW power running or CW regeneration or negative direction regeneration. Set this parameter to "0.0" to generate no torque or thrust.

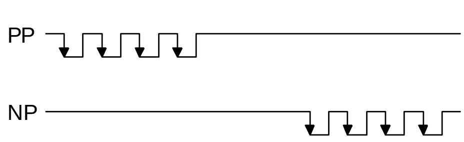
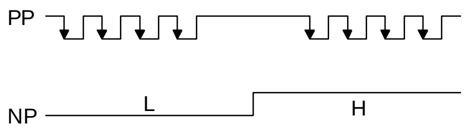
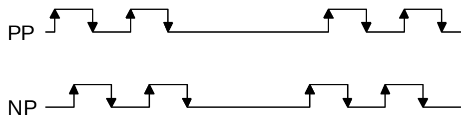
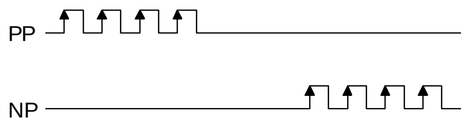
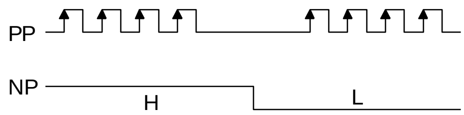
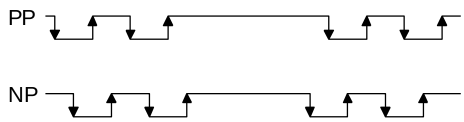
Setting range: 0.0 to 100.0</td><td>100.0
[%]</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PA12
TLN
Reverse rotation torque limit/negative direction thrust limit</td><td></td><td>You can limit the torque generated by the servo motor. Set the parameter referring to section 3.6.1 (5).
When you output torque with analog monitor output, the larger value of [Pr. PA11 Forward rotation torque limit value] or [Pr. PA12 Reverse rotation torque limi value] will be the maximum output voltage (8 V).
Set the parameter on the assumption that the maximum torque is 100.0 [%]. The parameter is for limiting the torque of the servo motor in the CW power running or CCW regeneration, or limiting the thrust of the linear servo motor in the positive direction power running or negative direction regeneration. Set this parameter to "0.0" to generate no torque or thrust.

Setting range: 0.0 to 100.0</td><td>100.0
[%]</td><td>○</td><td>○</td><td>○</td></tr>
</table>

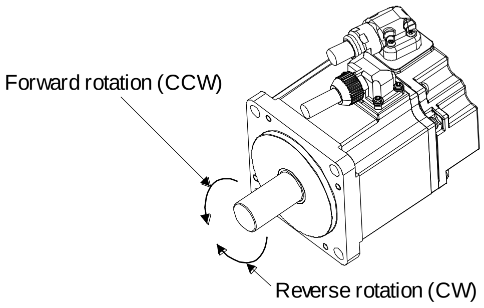
No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PA13 *PLSS Command pulse input form	_ _ _ x	Command input pulse train form selection 0: Forward/reverse rotation pulse train 1: Signed pulse train 2: A-phase/B-phase pulse train (The driver imports input pulses after multiplying by four.) Refer to table 5.3 for settings.	0h	○		
	_ _ x _	Pulse train logic selection 0: Positive logic 1: Negative logic Choose the right parameter to match the logic of the command pulse train received from a connected controller. Refer to POINT of section 3.6.1 for logic of MELSEC iQ-R series/MELSEC-Q series/MELSEC-L series/MELSEC-F series. Refer to table 5.3 for settings.	0h	○		
	_ x _ _	Command input pulse train filter selection Selecting proper filter enables to enhance noise tolerance. 0: Command input pulse train is 4 Mpulses/s or less. 1: Command input pulse train is 1 Mpulse/s or less. 2: Command input pulse train is 500 kpulses/s or less. 3: Command input pulse train is 200 kpulses/s or less 1 Mpulse/s or lower commands are supported by "1". When inputting commands over 1 Mpulse/s and 4 Mpulses/s or lower, set "0". Incorrect setting may cause the following malfunctions. ・Setting a value higher than actual command will lower noise tolerance. ・Setting a value lower than actual command will cause a position mismatch.	1h	○		
	x _ _ _	For manufacturer setting	0h			

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PA13 *PLSS Command pulse input form		Table 5.3 Command input pulse train form selection (see below)				

Table 5.3 Command input pulse train form selection

Setting value		Pulse train form	Forward rotation (positive direction) command	Reverse rotation (negative direction) command
_ _ 1 0	Negative logic	Forward rotation pulse train (positive direction pulse train) Reverse rotation pulse train (negative direction pulse train)		
_ _ 1 1	Negative logic	Signed pulse train		
_ _ 1 2	Negative logic	A-phase pulse train B-phase pulse train		
_ _ 0 0	Positive logic	Forward rotation pulse train (positive direction pulse train) Reverse rotation pulse train (negative direction pulse train)		
_ _ 0 1	Positive logic	Signed pulse train		
_ _ 0 2	Positive logic	A-phase pulse train B-phase pulse train		

Arrows in the table indicate the timing of importing pulse trains. A-phase and B-phase pulse trains are imported after they have been multiplied by 4.

<table>
<tr><th rowspan="2">No./symbol/ name</th><th rowspan="2">Setting digit</th><th rowspan="2">Function</th><th rowspan="2">Initial value [unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>PA14
*POL
Rotation direction selection</td><td></td><td>Select command input pulses of the rotation direction.
<table>
<tr><th rowspan="2">Setting value</th><th colspan="2">Servo motor rotation direction/
linear servo motor travel direction</th></tr>
<tr><th>When forward rotation pulse is input</th><th>When reverse rotation pulse is input</th></tr>
<tr><td>0</td><td>CCW or positive direction</td><td>CW or negative direction</td></tr>
<tr><td>1</td><td>CW or negative direction</td><td>CCW or positive direction</td></tr>
</table>
The following shows the servo motor rotation directions.


Setting range: 0, 1</td><td>0</td><td>○</td><td></td><td></td></tr>
<tr><td>PA15
*ENR
Encoder output pulses</td><td></td><td>Set the encoder output pulses from the driver by using the number of output pulses per revolution, dividing ratio, or electronic gear ratio. (after multiplication by 4)
To set a numerator of the electronic gear, select "A-phase/B-phase pulse electronic gear setting (_ _ 3 _)" of "Encoder output pulse setting selection" in [Pr. PC19].
Refer to app. 15 for details.
The maximum output frequency is 4.6 Mpulses/s. Set the parameter within this range.

Setting range: 1 to 4194304</td><td>4000 [pulse/ rev]</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PA16
*ENR2
Encoder output pulses 2</td><td></td><td>Set a denominator of the electronic gear for the A/B-phase pulse output.
To set a denominator of the electronic gear, select "A-phase/B-phase pulse electronic gear setting (_ _ 3 _)" of "Encoder output pulse setting selection" in [Pr. PC19].
Refer to app. 15 for details.
The maximum output frequency is 4.6 Mpulses/s. Set the parameter within this range.

Setting range: 1 to 4194304</td><td>1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PA17
*MSR
Servo motor series setting</td><td></td><td>Do not change this value.</td><td>0000h</td><td>○</td><td>○</td><td>○</td></tr>
</table>

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PA18 *MTY Servo motor type setting		Do not change this value.	0000h	○	○	○
PA19 *BLK Parameter writing inhibit		Select a reference range and writing range of the parameter. Refer to table 5.4 for settings.	00AAh	○	○	○

Table 5.4 [Pr. PA19] setting value and reading/writing range

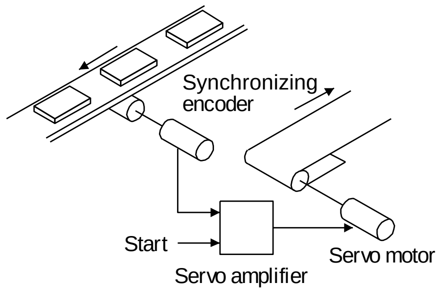
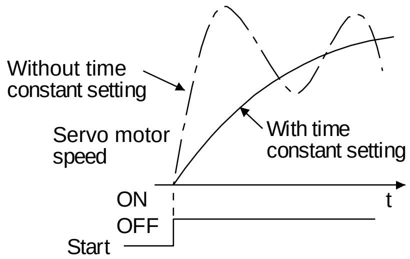
PA19	Setting operation	PA	PB	PC	PD	PE	PF	PL
Other than below	Reading	○						
	Writing	○						
000Ah	Reading	Only 19						
	Writing	Only 19						
000Bh	Reading	○	○	○				
	Writing	○	○	○				
000Ch	Reading	○	○	○	○			
	Writing	○	○	○	○			
00AAh (initial value)	Reading	○	○	○	○	○	○	
	Writing	○	○	○	○	○	○	
00ABh	Reading	○	○	○	○	○	○	○
	Writing	○	○	○	○	○	○	○
100Bh	Reading	○						
	Writing	Only 19						
100Ch	Reading	○	○	○	○			
	Writing	Only 19						
10AAh	Reading	○	○	○	○	○	○	
	Writing	Only 19						
10ABh	Reading	○	○	○	○	○	○	○
	Writing	Only 19						

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PA20 *TDS Tough drive setting		Alarms may not be avoided with the tough drive function depending on the situations of the power supply and load fluctuation. You can assign MTTR (During tough drive) to the pins CN1-22 to CN1-25, CN1-49, CN1-13, and CN1-14 with [Pr. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47].				
	_ _ _ x	For manufacturer setting	0h			
	_ _ x _	Vibration tough drive selection 0: Disabled 1: Enabled Selecting "1" enables to suppress vibrations by automatically changing setting values of [Pr. PB13 Machine resonance suppression filter 1] and [Pr. PB15 Machine resonance suppression filter 2] in case that the vibration exceed the value of the oscillation level set in [Pr. PF23]. To output the oscillation detection alarm as a warning, set [Pr. PF24 Vibration tough drive function selection]. Refer to section 7.3 for details.	0h	○	○	
	_ x _ _	SEMI-F47 function selection 0: Disabled 1: Enabled Selecting "1" enables to avoid occurring [AL. 10 Undervoltage] using the electrical energy charged in the capacitor in case that an instantaneous power failure occurs during operation. In [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time], set the time period until the occurrence of [AL. 10.1 Voltage drop in the control circuit power].	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PA21 *AOP3 Function selection A-3	_ _ _ x	One-touch tuning function selection 0: Disabled 1: Enabled When the digit is "0", the one-touch tuning is not available.	1h	○	○	
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _	Electronic gear selection 0: Electronic gear ([Pr. PA06] and [Pr. PA07]) 1: Number of command input pulses per revolution ([Pr. PA05]) 2: J3 electronic gear setting value compatibility mode (Electronic gear ([Pr. PA06] and [Pr. PA07] × 16)) The electronic gear setting value can be used set with LECSB□-S□.	0h	○		
PA22 *PCS Position control composition selection	_ _ _ x	For manufacturer setting	0h			
	_ _ x _	Super trace control selection 0: Disabled 2: Enabled	0h	○		
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PA23 DRAT Drive recorder arbitrary alarm trigger setting	_ _ x x	Alarm detail No. setting Set the digits when you execute the trigger with arbitrary alarm detail No. for the drive recorder function. When these digits are "0 0", only the arbitrary alarm No. setting will be enabled.	00h	○	○	○
	x x _ _	Alarm No. setting Set the digits when you execute the trigger with arbitrary alarm No. for the drive recorder function. When "0 0" are set, arbitrary alarm trigger of the drive recorder will be disabled.	00h	○	○	○
	Setting example: To activate the drive recorder when [AL. 50 Overload 1] occurs, set "5 0 0 0". To activate the drive recorder when [AL. 50.3 Thermal overload error 4 during operation] occurs, set "5 0 0 3".					
PA24 AOP4 Function selection A-4	_ _ _ x	Vibration suppression mode selection 0: Standard mode 1: 3 inertia mode 2: Low response mode When you select the standard mode or low response mode, "Vibration suppression control 2" is not available. When you select the 3 inertia mode, the feed forward gain is not available. Before changing the control mode during the 3 inertia mode or low response mode, stop the motor.	0h	○	○	
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			
PA25 OTHOV One-touch tuning - Overshoot permissible level		Set a permissible value of overshoot amount for one-touch tuning as a percentage of the in-position range. Setting "0" will be 50%. Setting range: 0 to 100	0 [%]	○	○	
PA26 *AOP5 Function selection A-5	_ _ _ x	Torque limit function selection at instantaneous power failure (instantaneous power failure tough drive selection) 0: Disabled 1: Enabled When an instantaneous power failure occurs during operation, the torque at acceleration is limited to save electric energy charged in the capacitor in the driver and the time until [AL. 10.2 Voltage drop in the main circuit power] occurs is extended with the instantaneous power failure tough drive function. Consequently, you can set a longer time in [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time]. The torque limit function at instantaneous power failure is enabled when "SEMI-F47 function selection" in [Pr. PA20] is "Enabled (_ 1 _ _)".	0h	○	○	
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			

5.2.2 Gain/filter setting parameters ([Pr. PB_ _])

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PB01 FILT Adaptive tuning mode (adaptive filter II)	_ _ _ x	Filter tuning mode selection Set the adaptive tuning. Select the adjustment mode of the machine resonance suppression filter 1. Refer to section 7.1.2 for details. 0: Disabled 1: Automatic setting (Do not use this in the torque control mode.) 2: Manual setting	0h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _	Tuning accuracy selection 0: Standard 1: High accuracy The frequency is estimated more accurately in the high accuracy mode compared to the standard mode. However, the tuning sound may be larger in the high accuracy mode.	0h	○	○	○
PB02 VRFT Vibration suppression control tuning mode (advanced vibration suppression control II)	_ _ _ x	Vibration suppression control 1 tuning mode selection Select the tuning mode of the vibration suppression control 1. Refer to section 7.1.5 for details. 0: Disabled 1: Automatic setting 2: Manual setting	0h	○		
	_ _ x _	Vibration suppression control 2 tuning mode selection Select the tuning mode of the vibration suppression control 2. To enable the setting of this digit, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PA24]. Refer to section 7.1.5 for details. 0: Disabled 1: Automatic setting 2: Manual setting	0h	○		
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PB03 PST Position command acceleration/ deceleration time constant (position smoothing)		Set the constant of a primary delay to the position command. You can select a control method from "Primary delay" or "Linear acceleration/deceleration" of "Position acceleration/deceleration filter type selection" in [Pr. PB25]. When the linear acceleration/deceleration is selected, the setting range is 0 ms to 10 ms. Setting of longer than 10 ms will be recognized as 10 ms. When the linear acceleration/deceleration is selected, do not set the "Control mode selection" ([Pr. PA01]) to the setting other than "_ _ _ 0". Doing so will cause the servo motor or linear servo motor to make a sudden stop at the time of position control mode switching or restart. (Example) When a command is given from a synchronizing encoder, synchronous operation will start smoothly even if it start during line operation.   Setting range: 0 to 65535	0 [ms]	○		
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. When the super trace control is enabled, constant speed and uniform acceleration/deceleration droop pulses will be almost 0. However, sudden acceleration/deceleration will increase the overshoot. As a guideline, when the feed forward gain setting is 100%, set 1 s or more as the acceleration time constant up to the rated speed. Setting range: 0 to 100	0 [%]	○		

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PB06 GD2 Load to motor inertia ratio/ load to motor mass ratio		Set the load to motor inertia ratio or load to motor mass ratio. Setting a value considerably different from the actual load moment of inertia or load mass may cause an unexpected operation such as an overshoot. The setting of the parameter will be the automatic setting or manual setting depending on the [Pr. PA08] setting. Refer to the following table for details. When the parameter is automatic setting, the value will vary between 0.00 and 100.00. Setting range: 0.00 to 300.00	7.00 [Multiplier]	○	○	

Pr. PA08	This parameter
_ _ _ 0 (2 gain adjustment mode 1 (interpolation mode))	Automatic setting
_ _ _ 1: (Auto tuning mode 1)	
_ _ _ 2: (Auto tuning mode 2)	Manual setting
_ _ _ 3 (Manual mode)	
_ _ _ 4: (2 gain adjustment mode 2)	

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PB07 PG1 Model loop gain		Set the response gain up to the target position. Increasing the setting value will also increase the response level to the position command but will be liable to generate vibration and noise. For the vibration suppression control tuning mode, the setting range of [Pr. PB07] is limited. Refer to section 7.1.5 (4) for details. The setting of the parameter will be the automatic setting or manual setting depending on the [Pr. PA08] setting. Refer to the following table for details. Setting range: 1.0 to 2000.0	15.0 [rad/s]	○	○	

Pr. PA08	This parameter
_ _ _ 0 (2 gain adjustment mode 1 (interpolation mode))	Manual setting
_ _ _ 1: (Auto tuning mode 1)	Automatic setting
_ _ _ 2: (Auto tuning mode 2)	
_ _ _ 3 (Manual mode)	Manual setting
_ _ _ 4: (2 gain adjustment mode 2)	

<table>
<tr><th rowspan="2">No./symbol/ name</th><th rowspan="2">Setting digit</th><th rowspan="2">Function</th><th rowspan="2">Initial value [unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td rowspan="2">PB08
PG2
Position loop gain</td><td></td><td>Set the gain of the position loop.
Set this parameter to increase the position response to level load disturbance.
Increasing the setting value will also increase the response level to the load disturbance but will be liable to generate vibration and noise.
The setting of the parameter will be the automatic setting or manual setting depending on the [Pr. PA08] setting. Refer to the following table for details.

Setting range: 1.0 to 2000.0</td><td>37.0
[rad/s]</td><td>○</td><td></td><td></td></tr>
<tr><td colspan="6"><table>
<tr><th>Pr. PA08</th><th>This parameter</th></tr>
<tr><td>_ _ _ 0 (2 gain adjustment mode 1 (interpolation mode))</td><td rowspan="3">Automatic setting</td></tr>
<tr><td>_ _ _ 1: (Auto tuning mode 1)</td></tr>
<tr><td>_ _ _ 2: (Auto tuning mode 2)</td></tr>
<tr><td>_ _ _ 3 (Manual mode)</td><td>Manual setting</td></tr>
<tr><td>_ _ _ 4: (2 gain adjustment mode 2)</td><td>Automatic setting</td></tr>
</table></td></tr>
<tr><td>PB09
VG2
Speed loop gain</td><td></td><td>Set the gain of the speed loop.
Set this parameter when vibration occurs on machines of low rigidity or large backlash. Increasing the setting value will also increase the response level but will be liable to generate vibration and noise.
The setting of the parameter will be the automatic setting or manual setting depending on the [Pr. PA08] setting. Refer to the table of [Pr. PB08] for details.

Setting range: 20 to 65535</td><td>823
[rad/s]</td><td>○</td><td>○</td><td></td></tr>
<tr><td>PB10
VIC
Speed integral compensatio n</td><td></td><td>Set the integral time constant of the speed loop.
Decreasing the setting value will increase the response level but will be liable to generate vibration and noise.
The setting of the parameter will be the automatic setting or manual setting depending on the [Pr. PA08] setting. Refer to the table of [Pr. PB08] for details.

Setting range: 0.1 to 1000.0</td><td>33.7
[ms]</td><td>○</td><td>○</td><td></td></tr>
<tr><td>PB11
VDC
Speed differential compensatio n</td><td></td><td>Set the differential compensation.
To enable the setting value, turn on PC (proportional control).

Setting range: 0 to 1000</td><td>980</td><td>○</td><td>○</td><td></td></tr>
<tr><td>PB12
OVA
Overshoot amount compensatio n</td><td></td><td>Set a viscous friction torque in percentage to the rated torque at servo motor rated speed.
When the response level is low or when the torque/thrust is limited, the efficiency of the parameter may be lower.

Setting range: 0 to 100</td><td>0
[%]</td><td>○</td><td></td><td></td></tr>
<tr><td>PB13
NH1
Machine resonance suppression filter 1</td><td></td><td>Set the notch frequency of the machine resonance suppression filter 1.
When "Filter tuning mode selection" is set to "Automatic setting (_ _ _ 1)" in [Pr. PB01], this parameter will be adjusted automatically by adaptive tuning.
When "Filter tuning mode selection" is set to "Manual setting (_ _ _ 2)" in [Pr. PB01], the setting value will be enabled.

Setting range: 10 to 4500</td><td>4500
[Hz]</td><td>○</td><td>○</td><td>○</td></tr>
</table>

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PB14 NHQ1 Notch shape selection 1		Set the shape of the machine resonance suppression filter 1. When "Filter tuning mode selection" is set to "Automatic setting (_ _ _ 1)" in [Pr. PB01], this parameter will be adjusted automatically by adaptive tuning. When "Filter tuning mode selection" is set to "Manual setting (_ _ _ 2)" in [Pr. PB01], the setting value will be enabled.				
	_ _ _ x	For manufacturer setting	0h			
	_ _ x _	Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB	0h	○	○	○
	_ x _ _	Notch width selection 0: α = 2 1: α = 3 2: α = 4 3: α = 5	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PB15 NH2 Machine resonance suppression filter 2		Set the notch frequency of the machine resonance suppression filter 2. To enable the setting value, set "Machine resonance suppression filter 2 selection" to "Enabled (_ _ _ 1)" in [Pr. PB16]. Setting range: 10 to 4500	4500 [Hz]	○	○	○
PB16 NHQ2 Notch shape selection 2		Set the shape of the machine resonance suppression filter 2.				
	_ _ _ x	Machine resonance suppression filter 2 selection 0: Disabled 1: Enabled	0h	○	○	○
	_ _ x _	Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB	0h	○	○	○
	_ x _ _	Notch width selection 0: α = 2 1: α = 3 2: α = 4 3: α = 5	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PB17 NHF Shaft resonance suppression filter	Set the shaft resonance suppression filter. This is used to suppress a low-frequency machine vibration. When "Shaft resonance suppression filter selection" is set to "Automatic setting (_ _ _ 0)" in [Pr. PB23], the value will be calculated automatically from the servo motor you use and load to motor inertia ratio. It will not be automatically calculated for the linear servo motor. When "Manual setting (_ _ _ 1)" is selected, the value set in this parameter will be used. When "Shaft resonance suppression filter selection" is set to "Disabled (_ _ _ 2)" in [Pr. PB23], the setting value of this parameter will be disabled. When "Machine resonance suppression filter 4 selection" is "Enabled (_ _ _ 1)" in [Pr. PB49], the shaft resonance suppression filter is not available.					
	_ _ x x	Shaft resonance suppression filter setting frequency selection Refer to table 5.5 for settings. Set the value closest to the frequency you need.	00h	○	○	○
	_ x _ _	Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			

Table 5.5 Shaft resonance suppression filter setting frequency selection

Setting value	Frequency [Hz]	Setting value	Frequency [Hz]
_ _ 0 0	Disabled	_ _ 1 0	562
_ _ 0 1	Disabled	_ _ 1 1	529
_ _ 0 2	4500	_ _ 1 2	500
_ _ 0 3	3000	_ _ 1 3	473
_ _ 0 4	2250	_ _ 1 4	450
_ _ 0 5	1800	_ _ 1 5	428
_ _ 0 6	1500	_ _ 1 6	409
_ _ 0 7	1285	_ _ 1 7	391
_ _ 0 8	1125	_ _ 1 8	375
_ _ 0 9	1000	_ _ 1 9	360
_ _ 0 A	900	_ _ 1 A	346
_ _ 0 B	818	_ _ 1 B	333
_ _ 0 C	750	_ _ 1 C	321
_ _ 0 D	692	_ _ 1 D	310
_ _ 0 E	642	_ _ 1 E	300
_ _ 0 F	600	_ _ 1 F	290

No./symbol/ name	Setting digit	Function	Initial value [unit]	P	S	T
PB18 LPF Low-pass filter setting		Set the low-pass filter. The following shows a relation of a required parameter to this parameter. Setting range: 100 to 18000	3141 [rad/s]	○	○	

[Pr. PB23]	[Pr. PB18]
_ _ 0 _ (Initial value)	Automatic setting
_ _ 1 _	Setting value enabled
_ _ 2 _	Setting value disabled

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PB19 VRF11 Vibration suppression control 1 - Vibration frequency		Set the vibration frequency for vibration suppression control 1 to suppress low-frequency machine vibration. When "Vibration suppression control 1 tuning mode selection" is set to "Automatic setting (_ _ _ 1)" in [Pr. PB02], this parameter will be set automatically. When "Manual setting (_ _ _ 2)" is selected, the setting written to the parameter is used. The setting range of this parameter varies, depending on the value in [Pr. PB07]. If a value out of the range is set, the vibration suppression control will be disabled. Refer to section 7.1.5 for details. Setting range: 0.1 to 300.0	100.0 [Hz]	○		
PB20 VRF12 Vibration suppression control 1 - Resonance frequency		Set the resonance frequency for vibration suppression control 1 to suppress low-frequency machine vibration. When "Vibration suppression control 1 tuning mode selection" is set to "Automatic setting (_ _ _ 1)" in [Pr. PB02], this parameter will be set automatically. When "Manual setting (_ _ _ 2)" is selected, the setting written to the parameter is used. The setting range of this parameter varies, depending on the value in [Pr. PB07]. If a value out of the range is set, the vibration suppression control will be disabled. Refer to section 7.1.5 for details. Setting range: 0.1 to 300.0	100.0 [Hz]	○		
PB21 VRF13 Vibration suppression control 1 - Vibration frequency damping		Set a damping of the vibration frequency for vibration suppression control 1 to suppress low-frequency machine vibration. When "Vibration suppression control 1 tuning mode selection" is set to "Automatic setting (_ _ _ 1)" in [Pr. PB02], this parameter will be set automatically. When "Manual setting (_ _ _ 2)" is selected, the setting written to the parameter is used. Refer to section 7.1.5 for details. Setting range: 0.00 to 0.30	0.00	○		
PB22 VRF14 Vibration suppression control 1 - Resonance frequency damping		Set a damping of the resonance frequency for vibration suppression control 1 to suppress low-frequency machine vibration. When "Vibration suppression control 1 tuning mode selection" is set to "Automatic setting (_ _ _ 1)" in [Pr. PB02], this parameter will be set automatically. When "Manual setting (_ _ _ 2)" is selected, the setting written to the parameter is used. Refer to section 7.1.5 for details. Setting range: 0.00 to 0.30	0.00	○		
PB23 VFBF Low-pass filter selection	_ _ _ x	Shaft resonance suppression filter selection Select the shaft resonance suppression filter. 0: Automatic setting 1: Manual setting 2: Disabled When "Machine resonance suppression filter 4 selection" is set to "Enabled (_ _ _ 1)" in [Pr. PB49], the shaft resonance suppression filter is not available.	0h	○	○	○
	_ _ x _	Low-pass filter selection Select the low-pass filter. 0: Automatic setting 1: Manual setting 2: Disabled	0h	○	○	
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PB24 *MVS Slight vibration suppression control	_ _ _ x	Slight vibration suppression control selection Select the slight vibration suppression control. 0: Disabled 1: Enabled To enable the slight vibration suppression control, set "Gain adjustment mode selection" to "Manual mode (_ _ _ 3)" in [Pr. PA08]. Slight vibration suppression control cannot be used in the speed control mode.	0h	○		
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			
PB25 *BOP1 Function selection B-1	_ _ _ x	Model adaptive control selection 0: Enabled (model adaptive control) 2: Disabled (PID control)	0h	○	○	
	_ _ x _	Position acceleration/deceleration filter type selection Select the position acceleration/deceleration filter type. 0: Primary delay 1: Linear acceleration/deceleration When you select "Linear acceleration/deceleration", do not switch the control mode. Doing so will cause the servo motor to make a sudden stop at the time of control mode switching.	0h	○		
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PB26 *CDP Gain switching function	Select the gain switching condition. Set conditions to enable the gain switching values set in [Pr. PB29] to [Pr. PB36] and [Pr. PB56] to [Pr. PB60].					
	_ _ _ x	Gain switching selection 0: Disabled 1: Input device (gain switching (CDP)) 2: Command frequency 3: Droop pulses 4: Servo motor speed	0h	○	○	
	_ _ x _	Gain switching condition selection 0: Gain after switching is enabled with gain switching condition or more 1: Gain after switching is enabled with gain switching condition or less	0h	○	○	
	_ x _ _	Gain switching time constant disabling condition selection 0: Switching time constant enabled 1: Switching time constant disabled 2: Return time constant disabled Refer to section 7.2.4 for details.	0h	○	○	
	x _ _ _	For manufacturer setting	0h			
PB27 CDL Gain switching condition		This is used to set the value of gain switching (command frequency, droop pulses, and servo motor speed) selected in [Pr. PB26]. The set value unit differs depending on the switching condition item. (Refer to section 7.2.3.) Setting range: 0 to 9999	10 [kpulse/s] /[pulse] /[r/min]	○	○	
PB28 CDT Gain switching time constant		This is used to set the time constant until the gains switch in response to the conditions set in [Pr. PB26] and [Pr. PB27]. Setting range: 0 to 100	1 [ms]	○	○	

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PB29 GD2B Load to motor inertia ratio/ load to motor mass ratio after gain switching		This is used to set the load to motor inertia ratio for when gain switching is enabled. This parameter is enabled only when "Gain adjustment mode selection" is "Manual mode (_ _ _ 3)" in [Pr. PA08]. Setting range: 0.00 to 300.00	7.00 [Multiplier]	○	○	
PB30 PG2B Position loop gain after gain switching		Set the position loop gain when the gain switching is enabled. When you set a value less than 1.0 rad/s, the value will be the same as [Pr. PB08]. This parameter is enabled only when "Gain adjustment mode selection" is "Manual mode (_ _ _ 3)" in [Pr. PA08]. Setting range: 0.0 to 2000.0	0.0 [rad/s]	○		
PB31 VG2B Speed loop gain after gain switching		Set the speed loop gain when the gain switching is enabled. When you set a value less than 20 rad/s, the value will be the same as [Pr. PB09]. This parameter is enabled only when "Gain adjustment mode selection" is "Manual mode (_ _ _ 3)" in [Pr. PA08]. Setting range: 0 to 65535	0 [rad/s]	○	○	
PB32 VICB Speed integral compensatio n after gain switching		Set the speed integral compensation when the gain changing is enabled. When you set a value less than 0.1 ms, the value will be the same as [Pr. PB10]. This parameter is enabled only when "Gain adjustment mode selection" is "Manual mode (_ _ _ 3)" in [Pr. PA08]. Setting range: 0.0 to 5000.0	0.0 [ms]	○	○	
PB33 VRF1B Vibration suppression control 1 - Vibration frequency after gain switching		Set the vibration frequency of the vibration suppression control 1 for when the gain switching is enabled. When you set a value less than 0.1 Hz, the value will be the same as [Pr. PB19]. This parameter is enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression control 1 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ _ 2)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.0 to 300.0	0.0 [Hz]	○		
PB34 VRF2B Vibration suppression control 1 - Resonance frequency after gain switching		Set the resonance frequency for vibration suppression control 1 when the gain switching is enabled. When you set a value less than 0.1 Hz, the value will be the same as [Pr. PB20]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression control 1 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ _ 2)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.0 to 300.0	0.0 [Hz]	○		

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PB35 VRF3B Vibration suppression control 1 - Vibration frequency damping after gain switching		Set a damping of the vibration frequency for vibration suppression control 1 when the gain switching is enabled. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression control 1 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ _ 2)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.00 to 0.30	0.00	○		
PB36 VRF4B Vibration suppression control 1 - Resonance frequency damping after gain switching		Set a damping of the resonance frequency for vibration suppression control 1 when the gain switching is enabled. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression control 1 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ _ 2)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.00 to 0.30	0.00	○		

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PB45 CNHF Command notch filter		Set the command notch filter.				
	_ _ x x	Command notch filter setting frequency selection Refer to table 5.6 for the relation of setting values to frequency.	00h	○		
	_ x _ _	Notch depth selection Refer to table 5.7 for details.	0h	○		
	x _ _ _	For manufacturer setting	0h			

Table 5.6 Command notch filter setting frequency selection

Setting value	Frequency [Hz]	Setting value	Frequency [Hz]	Setting value	Frequency [Hz]
_ _ 0 0	Disabled	_ _ 2 0	70	_ _ 4 0	17.6
_ _ 0 1	2250	_ _ 2 1	66	_ _ 4 1	16.5
_ _ 0 2	1125	_ _ 2 2	62	_ _ 4 2	15.6
_ _ 0 3	750	_ _ 2 3	59	_ _ 4 3	14.8
_ _ 0 4	562	_ _ 2 4	56	_ _ 4 4	14.1
_ _ 0 5	450	_ _ 2 5	53	_ _ 4 5	13.4
_ _ 0 6	375	_ _ 2 6	51	_ _ 4 6	12.8
_ _ 0 7	321	_ _ 2 7	48	_ _ 4 7	12.2
_ _ 0 8	281	_ _ 2 8	46	_ _ 4 8	11.7
_ _ 0 9	250	_ _ 2 9	45	_ _ 4 9	11.3
_ _ 0 A	225	_ _ 2 A	43	_ _ 4 A	10.8
_ _ 0 B	204	_ _ 2 B	41	_ _ 4 B	10.4
_ _ 0 C	187	_ _ 2 C	40	_ _ 4 C	10
_ _ 0 D	173	_ _ 2 D	38	_ _ 4 D	9.7
_ _ 0 E	160	_ _ 2 E	37	_ _ 4 E	9.4
_ _ 0 F	150	_ _ 2 F	36	_ _ 4 F	9.1
_ _ 1 0	140	_ _ 3 0	35.2	_ _ 5 0	8.8
_ _ 1 1	132	_ _ 3 1	33.1	_ _ 5 1	8.3
_ _ 1 2	125	_ _ 3 2	31.3	_ _ 5 2	7.8
_ _ 1 3	118	_ _ 3 3	29.6	_ _ 5 3	7.4
_ _ 1 4	112	_ _ 3 4	28.1	_ _ 5 4	7.0
_ _ 1 5	107	_ _ 3 5	26.8	_ _ 5 5	6.7
_ _ 1 6	102	_ _ 3 6	25.6	_ _ 5 6	6.4
_ _ 1 7	97	_ _ 3 7	24.5	_ _ 5 7	6.1
_ _ 1 8	93	_ _ 3 8	23.4	_ _ 5 8	5.9
_ _ 1 9	90	_ _ 3 9	22.5	_ _ 5 9	5.6
_ _ 1 A	86	_ _ 3 A	21.6	_ _ 5 A	5.4
_ _ 1 B	83	_ _ 3 B	20.8	_ _ 5 B	5.2
_ _ 1 C	80	_ _ 3 C	20.1	_ _ 5 C	5.0
_ _ 1 D	77	_ _ 3 D	19.4	_ _ 5 D	4.9
_ _ 1 E	75	_ _ 3 E	18.8	_ _ 5 E	4.7
_ _ 1 F	72	_ _ 3 F	18.2	_ _ 5 F	4.5

Table 5.7 Notch depth selection

Setting value	Depth [dB]	Setting value	Depth [dB]
_ 0 _ _	-40.0	_ 8 _ _	-6.0
_ 1 _ _	-24.1	_ 9 _ _	-5.0
_ 2 _ _	-18.1	_ A _ _	-4.1
_ 3 _ _	-14.5	_ B _ _	-3.3
_ 4 _ _	-12.0	_ C _ _	-2.5
_ 5 _ _	-10.1	_ D _ _	-1.8
_ 6 _ _	-8.5	_ E _ _	-1.2
_ 7 _ _	-7.2	_ F _ _	-0.6

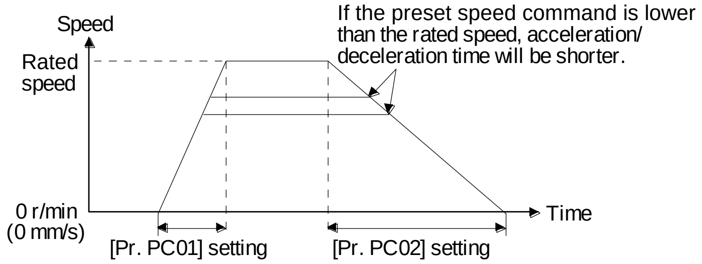
No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PB46 NH3 Machine resonance suppression filter 3		Set the notch frequency of the machine resonance suppression filter 3. To enable the setting value, set "Machine resonance suppression filter 3 selection" to "Enabled (_ _ _ 1)" in [Pr. PB47]. Setting range: 10 to 4500	4500 [Hz]	○	○	○
PB47 NHQ3 Notch shape selection 3	Set the shape of the machine resonance suppression filter 3.					
	_ _ _ x	Machine resonance suppression filter 3 selection 0: Disabled 1: Enabled	0h	○	○	○
	_ _ x _	Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB	0h	○	○	○
	_ x _ _	Notch width selection 0: α = 2 1: α = 3 2: α = 4 3: α = 5	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PB48 NH4 Machine resonance suppression filter 4		Set the notch frequency of the machine resonance suppression filter 4. To enable the setting value, set "Machine resonance suppression filter 4 selection" to "Enabled (_ _ _ 1)" in [Pr. PB49]. Setting range: 10 to 4500	4500 [Hz]	○	○	○
PB49 NHQ4 Notch shape selection 4	Set the shape of the machine resonance suppression filter 4.					
	_ _ _ x	Machine resonance suppression filter 4 selection 0: Disabled 1: Enabled When the setting of this digit is "Enabled", [Pr. PB17 Shaft resonance suppression filter] is not available.	0h	○	○	○
	_ _ x _	Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB	0h	○	○	○
	_ x _ _	Notch width selection 0: α = 2 1: α = 3 2: α = 4 3: α = 5	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PB50 NH5 Machine resonance suppression filter 5		Set the notch frequency of the machine resonance suppression filter 5. To enable the setting value, set "Machine resonance suppression filter 5 selection" to "Enabled (_ _ _ 1)" in [Pr. PB51]. Setting range: 10 to 4500	4500 [Hz]	○	○	○

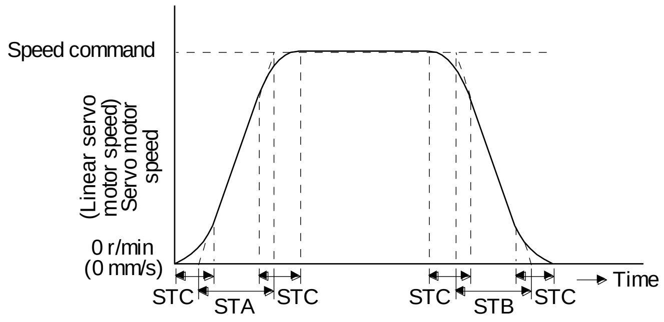
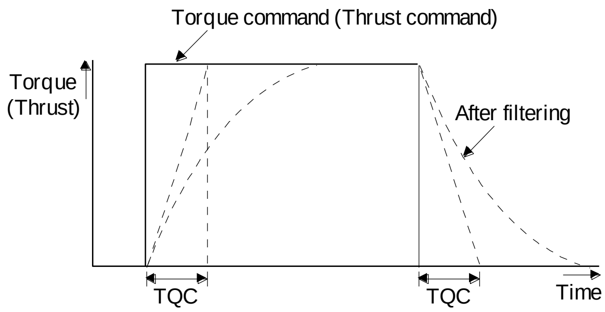
No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PB51 NHQ5 Notch shape selection 5	Set the shape of the machine resonance suppression filter 5. When "Robust filter selection" is "Enabled (_ _ _ 1)" in [Pr. PE41], the machine resonance suppression filter 5 is not available.					
	_ _ _ x	Machine resonance suppression filter 5 selection 0: Disabled 1: Enabled	0h	○	○	○
	_ _ x _	Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB	0h	○	○	○
	_ x _ _	Notch width selection 0: α = 2 1: α = 3 2: α = 4 3: α = 5	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PB52 VRF21 Vibration suppression control 2 - Vibration frequency		Set the vibration frequency for vibration suppression control 2 to suppress low-frequency machine vibration. When "Vibration suppression control 2 tuning mode selection" is set to "Automatic setting (_ _ 1 _)" in [Pr. PB02], this parameter will be set automatically. When "Manual setting (_ _ 2 _)" is selected, the setting written to the parameter is used. To enable the setting value, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PA24]. The setting range of this parameter varies, depending on the value in [Pr. PB07]. If a value out of the range is set, the vibration suppression control will be disabled. Refer to section 7.1.5 for details. Setting range: 0.1 to 300.0	100.0 [Hz]	○		
PB53 VRF22 Vibration suppression control 2 - Resonance frequency		Set the resonance frequency for vibration suppression control 2 to suppress low-frequency machine vibration. When "Vibration suppression control 2 tuning mode selection" is set to "Automatic setting (_ _ 1 _)" in [Pr. PB02], this parameter will be set automatically. When "Manual setting (_ _ 2 _)" is selected, the setting written to the parameter is used. To enable the setting value, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PA24]. The setting range of this parameter varies, depending on the value in [Pr. PB07]. If a value out of the range is set, the vibration suppression control will be disabled. Refer to section 7.1.5 for details. Setting range: 0.1 to 300.0	100.0 [Hz]	○		
PB54 VRF23 Vibration suppression control 2 - Vibration frequency damping		Set a damping of the vibration frequency for vibration suppression control 2 to suppress low-frequency machine vibration. When "Vibration suppression control 2 tuning mode selection" is set to "Automatic setting (_ _ 1 _)" in [Pr. PB02], this parameter will be set automatically. When "Manual setting (_ _ 2 _)" is selected, the setting written to the parameter is used. To enable the setting value, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PA24]. Refer to section 7.1.5 for details. Setting range: 0.00 to 0.30	0.00	○		
PB55 VRF24 Vibration suppression control 2 - Resonance frequency damping		Set a damping of the resonance frequency for vibration suppression control 2 to suppress low-frequency machine vibration. When "Vibration suppression control 2 tuning mode selection" is set to "Automatic setting (_ _ 1 _)" in [Pr. PB02], this parameter will be set automatically. When "Manual setting (_ _ 2 _)" is selected, the setting written to the parameter is used. To enable the setting value, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PA24]. Refer to section 7.1.5 for details. Setting range: 0.00 to 0.30	0.00	○		

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PB56 VRF21B Vibration suppression control 2 - Vibration frequency after gain switching		Set the vibration frequency for vibration suppression control 2 when the gain switching is enabled. When you set a value less than 0.1 Hz, the value will be the same as [Pr. PB52]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression mode selection" in [Pr. PA24] is "3 inertia mode (_ _ _ 1)". ・"Vibration suppression control 2 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ 2 _)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.0 to 300.0	0.0 [Hz]	○		
PB57 VRF22B Vibration suppression control 2 - Resonance frequency after gain switching		Set the resonance frequency for vibration suppression control 2 when the gain switching is enabled. When you set a value less than 0.1 Hz, the value will be the same as [Pr. PB53]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression mode selection" in [Pr. PA24] is "3 inertia mode (_ _ _ 1)". ・"Vibration suppression control 2 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ 2 _)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.0 to 300.0	0.0 [Hz]	○		
PB58 VRF23B Vibration suppression control 2 - Vibration frequency damping after gain switching		Set a damping of the vibration frequency for vibration suppression control 2 when the gain switching is enabled. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression mode selection" in [Pr. PA24] is "3 inertia mode (_ _ _ 1)". ・"Vibration suppression control 2 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ 2 _)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.00 to 0.30	0.00	○		
PB59 VRF24B Vibration suppression control 2 - Resonance frequency damping after gain switching		Set a damping of the resonance frequency for vibration suppression control 2 when the gain switching is enabled. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression mode selection" in [Pr. PA24] is "3 inertia mode (_ _ _ 1)". ・"Vibration suppression control 2 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ 2 _)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.00 to 0.30	0.00	○		

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PB60 PG1B Model loop gain after gain switching		Set the model loop gain when the gain switching is enabled. When you set a value less than 1.0 rad/s, the value will be the same as [Pr. PB07]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.0 to 2000.0	0.0 [rad/s]	○	○	

5.2.3 Extension setting parameters ([Pr. PC_ _])

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PC01 STA Acceleration time constant		Set the acceleration time required to reach the rated speed from 0 r/min or 0 mm/s for VC (Analog speed command) and [Pr. PC05 Internal speed command 1] to [Pr. PC11 Internal speed command 7].  For example for the servo motor of 3000 r/min rated speed, set 3000 (3 s) to increase the speed from 0 r/min to 1000 r/min in 1 second. Setting range: 0 to 50000	0 [ms]		○	○
PC02 STB Deceleration time constant		Set the deceleration time required to reach 0 r/min or 0 mm/s from the rated speed for VC (Analog speed command) and [Pr. PC05 Internal speed command 1] to [Pr. PC11 Internal speed command 7]. Setting range: 0 to 50000	0 [ms]		○	○

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PC03 STC S-pattern acceleration/ deceleration time constant		Start/stop the servo motor smoothly. Set the time of the arc part for S-pattern acceleration/deceleration. Setting "0" will make it linear acceleration/deceleration.  STA: Acceleration time constant ([Pr. PC01]) STB: Deceleration time constant ([Pr. PC02]) STC: S-pattern acceleration/deceleration time constant ([Pr. 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 $\frac{2000000}{STA}$ for acceleration or by $\frac{2000000}{STB}$ for deceleration. (Example) At the setting of STA 20000, STB 5000 and STC 200, the actual arc part times are as follows. Acceleration: 100 ms $\frac{2000000}{20000} = 100\ [ms] < 200\ [ms]$ Therefore, it will be limited to 100 ms. Deceleration: 200 ms $\frac{2000000}{5000} = 400\ [ms] > 200\ [ms]$ Therefore, it will be 200 ms as you set. Setting range: 0 to 5000	0 [ms]		○	○
PC04 TQC Torque/thrust command time constant		Set the constant of a primary delay filter for the torque/thrust command.  TQC: Torque/thrust command time constant Setting range: 0 to 50000	0 [ms]			○
PC05 SC1 Internal speed command 1		Set the speed 1 of internal speed commands. Setting range: 0 to instantaneous permissible speed	100 [r/min]/ [mm/s]		○	
Internal speed limit 1		Set the speed 1 of internal speed limits. Setting range: 0 to instantaneous permissible speed				○

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PC06 SC2 Internal speed command 2 Internal speed limit 2		Set the speed 2 of internal speed commands. Setting range: 0 to instantaneous permissible speed	500 [r/min]/ [mm/s]		○	
		Set the speed 2 of internal speed limits. Setting range: 0 to instantaneous permissible speed				○
PC07 SC3 Internal speed command 3 Internal speed limit 3		Set the speed 3 of internal speed commands. Setting range: 0 to instantaneous permissible speed	1000 [r/min]/ [mm/s]		○	
		Set speed 3 of internal speed limits. Setting range: 0 to instantaneous permissible speed				○
PC08 SC4 Internal speed command 4 Internal speed limit 4		Set the speed 4 of internal speed commands. Setting range: 0 to instantaneous permissible speed	200 [r/min]/ [mm/s]		○	
		Set the speed 4 of internal speed limits. Setting range: 0 to instantaneous permissible speed				○
PC09 SC5 Internal speed command 5 Internal speed limit 5		Set the speed 5 of internal speed commands. Setting range: 0 to instantaneous permissible speed	300 [r/min]/ [mm/s]		○	
		Set the speed 5 of internal speed limits. Setting range: 0 to instantaneous permissible speed				○
PC10 SC6 Internal speed command 6 Internal speed limit 6		Set the speed 6 of internal speed commands. Setting range: 0 to instantaneous permissible speed	500 [r/min]/ [mm/s]		○	
		Set the speed 6 of internal speed limits. Setting range: 0 to instantaneous permissible speed				○
PC11 SC7 Internal speed command 7 Internal speed limit 7		Set the speed 7 of internal speed commands. Setting range: 0 to instantaneous permissible speed	800 [r/min]/ [mm/s]		○	
		Set the speed 7 of internal speed limits. Setting range: 0 to instantaneous permissible speed				○
PC12 VCM Analog speed command - Maximum speed Analog speed limit - Maximum speed		Set the speed of servo motor at the maximum voltage (10 V) input to VC (Analog speed command). When "0" is set, the rated speed of the connected servo motor is used. When you input a command value of the permissible speed or more to VC, the value is clamped at the permissible speed. Setting range: 0 to 50000	0 [r/min]/ [mm/s]		○	
		Set the speed of servo motor at the maximum voltage (10 V) input to VLA (Analog speed limit). When "0" is set, the rated speed of the connected servo motor is used. When you input a limit value of the permissible speed or more to VLA, the value is clamped at the permissible speed. Setting range: 0 to 50000				○

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				P	S	T
PC13 TLC Analog torque/thrust command maximum output		Set the output torque at the analog torque command voltage (TC = ±8 V) of +8 V on the assumption that the maximum torque/thrust is 100.0%. For example, set 50.0. The maximum torque or thrust × $\frac{50.0}{100.0}$ is outputted. When you input a command value of the maximum torque or more to TC, the value is clamped at the maximum torque. Setting range: 0.0 to 1000.0	100.0 [%]			○

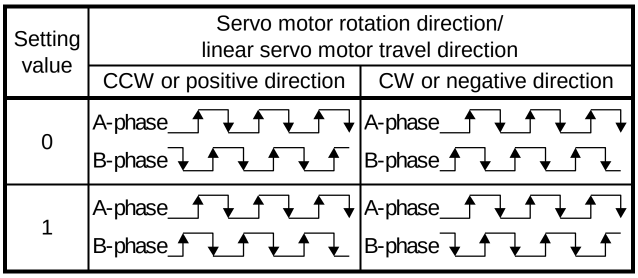
No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PC14 MOD1 Analog monitor 1 output	_ _ x x	Analog monitor 1 output selection Select a signal to output to MO1 (Analog monitor 1). Refer to app. 7.3 for detection point of output selection. Refer to table 5.8 or table 5.9 for settings.	00h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			

Table 5.8 Analog monitor setting value

Setting value	Item	Operation mode Standard
_ _ 0 0	servo motor speed (±8 V/max. speed)	○
_ _ 0 1	Torque or thrust (±8 V/max. torque) (Note 3)	○
_ _ 0 2	servo motor speed (+8 V/max. speed)	○
_ _ 0 3	Torque or thrust (+8 V/max. torque) (Note 3)	○
_ _ 0 4	Current command (±8 V/max. current command)	○
_ _ 0 5	Command pulse frequency (±10 V/±4 Mpulses/s)	○
_ _ 0 6	Servo motor-side droop pulses (±10 V/100 pulses) (Note 2)	○
_ _ 0 7	Servo motor-side droop pulses (±10 V/1000 pulses) (Note 2)	○
_ _ 0 8	Servo motor-side droop pulses (±10 V/10000 pulses) (Note 2)	○
_ _ 0 9	Servo motor-side droop pulses (±10 V/100000 pulses) (Note 2)	○
_ _ 0 A	Feedback position (±10 V/1 Mpulse) (Note 2)	○
_ _ 0 B	Feedback position (±10 V/10 Mpulses) (Note 2)	○
_ _ 0 C	Feedback position (±10 V/100 Mpulses) (Note 2)	○
_ _ 0 D	Bus voltage (200 V class and 100 V class: +8 V/400 V, 400 V class: +8 V/800 V)	○
_ _ 0 E	Speed command 2 (±8 V/max. speed)	○
_ _ 1 0	Load-side droop pulses (±10 V/100 pulses) (Note 2)	
_ _ 1 1	Load-side droop pulses (±10 V/1000 pulses) (Note 2)	
_ _ 1 2	Load-side droop pulses (±10 V/10000 pulses) (Note 2)	
_ _ 1 3	Load-side droop pulses (±10 V/100000 pulses) (Note 2)	
_ _ 1 4	Load-side droop pulses (±10 V/1 Mpulse) (Note 2)	
_ _ 1 5	Servo motor-side/load-side position deviation (±10 V/100000 pulses)	
_ _ 1 6	Servo motor-side/load-side speed deviation (±8 V/max. speed)	
_ _ 1 7	Internal temperature of encoder (±10 V/±128 °C)	○

Note 2. Encoder pulse unit
3. The larger value of [Pr. PA11] or [Pr. PA12] will be the maximum torque or the maximum thrust.

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PC15 MOD2 Analog monitor 2 output	_ _ x x	Analog monitor 2 output selection Select a signal to output to MO2 (Analog monitor 2). Refer to app. 7.3 for detection point of output selection. Refer to [Pr. PC14] for settings.	01h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PC16 MBR Electromagnetic brake sequence output		Set the delay time between MBR (Electromagnetic brake interlock) and the base drive circuit is shut-off. For the timing chart of when the servo motor with an electromagnetic brake is used, refer to section 3.10.2. Setting range: 0 to 1000	0 [ms]	○	○	○
PC17 ZSP Zero speed		Set the output range of ZSP (Zero speed detection). ZSP (Zero speed detection) has hysteresis of 20 r/min or 20 mm/s. Setting range: 0 to 10000	50 [r/min]/ [mm/s]	○	○	○
PC18 *BPS Alarm history clear	_ _ _ x	Alarm history clear selection Clear the alarm history. 0: Disabled 1: Enabled When "Enabled" is set, the alarm history will be cleared at the next power-on. Once the alarm history is cleared, the setting becomes disabled automatically.	0h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			

<table>
<tr><th rowspan="2">No./symbol/ name</th><th rowspan="2">Setting digit</th><th rowspan="2">Function</th><th rowspan="2">Initial value [unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td rowspan="4">PC19
*ENRS
Encoder output pulse selection</td><td>_ _ _ x</td><td>Encoder output pulse phase selection
Select the encoder pulse direction.
0: A-phase 90° shift in CCW
1: A-phase 90° shift in CW
</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>_ _ x _</td><td>Encoder output pulse setting selection
Refer to app. 15 for details.
When you select "1", the setting of [Pr. PA16 Encoder output pulses 2] will be disabled. When you select "2", the settings of [Pr. PA15 Encoder output pulses] and [Pr. PA16 Encoder output pulses 2] will be disabled. When you select the setting, do not change the settings in [Pr. PA06] and [Pr. PA07] after the power-on.
0: Output pulse setting
When "_ 1 0 _" is set to this parameter, [AL. 37 Parameter error] will occur.
1: Dividing ratio setting
2: The same output pulse setting as the command pulse
3: A-phase/B-phase pulse electronic gear setting
4: A/B-phase pulse through output setting</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>_ x _ _</td><td>Do not change this value.</td><td>0h</td><td>○</td><td></td><td></td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>PC20
*SNO
Station No. setting</td><td></td><td>Set a station No. of the driver for RS-422 and USB communication.
Always set one station to one axis of the driver. Setting one station number to two or more stations will disable a normal communication.

Setting range: 0 to 31</td><td>0
[Station]</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td rowspan="5">PC21
*SOP
RS-422 communication function selection</td><td colspan="6">Select the details of RS-422 communication function.</td></tr>
<tr><td>_ _ _ x</td><td>For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ _ x _</td><td>RS-422 communication baud rate selection
When using the parameter unit, set "1 _ _ _" in [Pr. PF34].
0: 9600 [bps]
1: 19200 [bps]
2: 38400 [bps]
3: 57600 [bps]
4: 115200 [bps]</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>_ x _ _</td><td>RS-422 communication response delay time selection
0: Disabled
1: Enabled (responding after 800 μs or longer delay time)</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
</table>

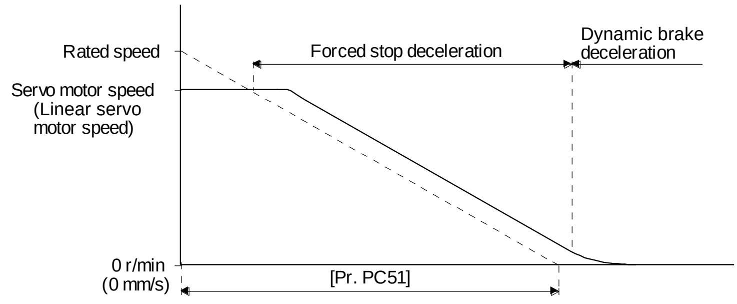
<table>
<tr><th rowspan="2">No./symbol/ name</th><th rowspan="2">Setting digit</th><th rowspan="2">Function</th><th rowspan="2">Initial value [unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td rowspan="4">PC22
*COP1
Function selection C-1</td><td>_ _ _ x</td><td rowspan="3">For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ _ x _</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ x _ _</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>x _ _ _</td><td>Encoder cable communication method selection
(Do not change this value.)</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td rowspan="4">PC23
*COP2
Function selection C-2</td><td>_ _ _ x</td><td>Servo-lock selection at speed control stop
Select the servo-lock selection at speed control stop.
In the speed control mode, the servo motor shaft can be locked to prevent the shaft from being moved by an external force.
0: Enabled (servo-lock)
The operation to maintain the stop position is performed.
1: Disabled (no servo-lock)
The stop position is not maintained.
The control to make the speed 0 r/min or 0 mm/s is performed.</td><td>0h</td><td></td><td>○</td><td></td></tr>
<tr><td>_ _ x _</td><td>For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ x _ _</td><td>VC/VLA voltage averaging selection
Select the VC/VLA voltage average.
Set the filtering time when VC (Analog speed command) or VLA (Analog speed limit) 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>Setting 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>0h</td><td></td><td>○</td><td>○</td></tr>
<tr><td>x _ _ _</td><td>Speed limit selection at torque control
Select the speed limit selection at torque control.
0: Enabled
1: Disabled
Do not use this function except when configuring an external speed loop.</td><td>0h</td><td></td><td></td><td>○</td></tr>
<tr><td rowspan="4">PC24
*COP3
Function selection C-3</td><td>_ _ _ x</td><td>In-position range unit selection
Select a unit of in-position range.
0: Command input pulse unit
1: Servo motor encoder pulse unit</td><td>0h</td><td>○</td><td></td><td></td></tr>
<tr><td>_ _ x _</td><td rowspan="2">For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ x _ _</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>x _ _ _</td><td>Error excessive alarm/error excessive warning level unit selection
Select units for error excessive alarm level setting with [Pr. PC43] and for error excessive warning level setting with [Pr. PC73].
0: Per 1 rev or 1 mm
1: Per 0.1 rev or 0.1 mm
2: Per 0.01 rev or 0.01 mm
3: Per 0.001 rev or 0.001 mm</td><td>0h</td><td>○</td><td></td><td></td></tr>
</table>

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PC26 *COP5 Function selection C-5	_ _ _ x	[AL. 99 Stroke limit warning] selection Enable or disable [AL. 99 Stroke limit warning]. 0: Enabled 1: Disabled	0h	○	○	
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			
PC27 *COP6 Function selection C-6	_ _ _ x	[AL. 10 Undervoltage] detection method selection Set this parameter when [AL. 10 undervoltage] occurs due to power supply voltage distortion while using FR-RC-(H) or FR-CV-(H). 0: When [AL. 10] does not occur 1: When [AL. 10] occurs	0h	○	○	○
	_ _ x _	Do not change this value.	0h	○	○	○
	_ x _ _	Undervoltage alarm selection Select the alarm and warning for when the bus voltage drops to the undervoltage alarm level. 0: [AL. 10.2] regardless of servo motor speed 1: [AL. E9.1] at servo motor speed 50 r/min (50 mm/s) or less, [AL. 10.2] at over 50 r/min (50 mm/s)	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PC28 *COP7 Function selection C-7	_ _ _ x	For manufacturer setting	0h			
	_ _ x _		0h			
	_ x _ _		0h			
	x _ _ _	Do not change this value.	0h	○	○	○
PC30 STA2 Acceleration time constant 2		To enable the parameter, turn on STAB2 (Speed acceleration/deceleration selection). Set the acceleration time required to reach the rated speed from 0 r/min for VC (Analog speed command) and [Pr. PC05 Internal speed command 1] to [Pr. PC11 Internal speed command 7]. Setting range: 0 to 50000	0 [ms]		○	○
PC31 STB2 Deceleration time constant 2		To enable the parameter, turn on STAB2 (Speed acceleration/deceleration selection). Set the deceleration time required to reach 0 r/min from the rated speed for VC (Analog speed command) and [Pr. PC05 Internal speed command 1] to [Pr. PC11 Internal speed command 7]. Setting range: 0 to 50000	0 [ms]		○	○

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PC32 CMX2 Commanded pulse multiplication numerator 2		To enable the parameter, select "Electronic gear (0 _ _ _)", "J3 electronic gear setting value compatibility mode (2 _ _ _)" in [Pr. PA21]. Setting range: 1 to 16777215	1	○		
PC33 CMX3 Commanded pulse multiplication numerator 3		To enable the parameter, select "Electronic gear (0 _ _ _)", "J3 electronic gear setting value compatibility mode (2 _ _ _)" in [Pr. PA21]. Setting range: 1 to 16777215	1	○		
PC34 CMX4 Commanded pulse multiplication numerator 4		To enable the parameter, select "Electronic gear (0 _ _ _)", "J3 electronic gear setting value compatibility mode (2 _ _ _)" in [Pr. PA21]. Setting range: 1 to 16777215	1	○		
PC35 TL2 Internal torque limit 2		Set the parameter on the assumption that the maximum torque is 100.0%. The parameter is for limiting the torque of the servo motor. No torque is generated when this parameter is set to "0.0". When TL1 (Internal torque limit selection) is turned on, Internal torque limits 1 and 2 are compared and the lower value will be enabled. Set the parameter referring to section 3.6.1 (5). Setting range: 0.0 to 100.0	100.0 [%]	○	○	○

<table>
<tr><th rowspan="2">No./symbol/ name</th><th rowspan="2">Setting digit</th><th rowspan="2">Function</th><th rowspan="2">Initial value [unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td rowspan="3">PC36
*DMD
Status display selection</td><td>_ _ x x</td><td>Status display selection at power-on
Select a status display shown at power-on. Setting "21" to "27" will trigger [AL. 37] in the mode other than the positioning mode.
00: Cumulative feedback pulses
01: Servo motor speed
02: Droop pulses
03: Cumulative command pulses
04: Command pulse frequency
05: Analog speed command voltage (Note 1)
06: Analog torque command voltage (Note 2)
07: Regenerative load ratio
08: Effective load ratio
09: Peak load ratio
0A: Instantaneous torque/thrust
0B: Within one-revolution position/within virtual one-revolution position (1 pulse unit)
0C: Within one-revolution position/within virtual one-revolution position (1000 pulses unit)
0D: ABS counter/virtual ABS counter
0E: Load to motor inertia ratio/load to motor mass ratio
0F: Bus voltage
10: Internal temperature of encoder
11: Settling time
12: Oscillation detection frequency
13: Number of tough operations
14: Unit power consumption (increment of 1 W)
15: Unit power consumption (increment of 1 kW)
16: Unit total power consumption (increment of 1 Wh)
17: Unit total power consumption (increment of 100 kWh)
18: Load-side cumulative feedback pulses
19: Load-side droop pulses
1A: Load-side encoder information 1 (1 pulse unit)
1B: Load-side encoder information 1 (100000 pulses unit)
1C: Load-side encoder ABS counter
1D: Z-phase counter (1 pulse unit)
1E: Z-phase counter (100000 pulses unit)
1F: Electrical angle (1 pulse unit)
20: Electrical angle (100000 pulses unit)
Note 1. It is for the speed control mode. It will be the analog speed limit voltage in the torque control mode.
2. It is for the torque control mode. It will be the analog torque limit voltage in the speed control mode and position control mode.</td><td>00h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>_ x _ _</td><td>Status display at power-on in corresponding control mode
0: Depends on the control mode<table><tr><th>Control mode</th><th>Status display at power-on</th></tr><tr><td>Position</td><td>Cumulative feedback pulses</td></tr><tr><td>Position/speed</td><td>Cumulative feedback pulses/servo motor speed</td></tr><tr><td>Speed</td><td>Servo motor speed</td></tr><tr><td>Speed/torque</td><td>Servo motor speed /analog torque command voltage</td></tr><tr><td>Torque</td><td>Analog torque command voltage</td></tr><tr><td>Torque/position</td><td>Analog torque command voltage/cumulative feedback pulses</td></tr></table>1: Depends on the last 2 digits settings of the parameter</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
</table>

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PC37 VCO Analog speed command offset/ Analog speed limit offset		Set the offset voltage of VC (Analog speed command). For example, if CCW rotation or positive direction travel is provided by switching on ST1 (Forward rotation start) while applying 0 V to VC, set a negative value. When automatic VC offset is used, the automatically offset value is set to this parameter. (Refer to section 4.5.4.) The initial value is provided before shipment by the automatic VC offset function on condition that the voltage between VC and LG is 0 V. Setting range: -9999 to 9999	The value differs depending on the driver. [mV]		○	
		Set the offset voltage of VLA (Analog speed limit). For example, if CCW rotation or positive direction travel is provided by switching on RS1 (Forward rotation selection) while applying 0 V to VLA, set a negative value. When automatic VC offset is used, the automatically offset value is set to this parameter. (Refer to section 4.5.4.) The initial value is provided before shipment by the automatic VC offset function on condition that the voltage between VLA and LG is 0 V. Setting range: -9999 to 9999				○
PC38 TPO Analog torque command offset/ Analog torque limit offset		Set the offset voltage of TC (Analog torque command). Setting range: -9999 to 9999	0 [mV]			○
		Set the offset voltage of TLA (Analog torque limit). Setting range: -9999 to 9999			○	
PC39 MO1 Analog monitor 1 offset		Set the offset voltage of MO1 (Analog monitor 1). Setting range: -9999 to 9999	0 [mV]	○	○	○
PC40 MO2 Analog monitor 2 offset		Set the offset voltage of MO2 (Analog monitor 2). Setting range: -9999 to 9999	0 [mV]	○	○	○
PC43 ERZ Error excessive alarm level		Set an error excessive alarm level. You can change the setting unit with "Error excessive alarm/error excessive warning level unit selection" in [Pr. PC24]. Set this per rev. Setting "0" will be "3 rev", and setting over 200 rev will be clamped with 200 rev. Setting range: 0 to 1000	0 [rev]	○		
PC44 *COP9 Function selection C-9	_ _ _ x	For manufacturer setting	0h			
	_ _ x _		0h			
	_ x _ _		0h			
	x _ _ _	Do not change this value.	0h	○		

<table>
<tr><th rowspan="2">No./symbol/ name</th><th rowspan="2">Setting digit</th><th rowspan="2">Function</th><th rowspan="2">Initial value [unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td rowspan="4">PC45
*COPA
Function selection C-A</td><td>_ _ _ X</td><td>Do not change this value.</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ _ X _</td><td>For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ X _ _</td><td>Do not change this value.</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>X _ _ _</td><td>For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>PC51
RSBR
Forced stop deceleration time constant</td><td></td><td>Set deceleration time constant when you use the forced stop deceleration function.
Set the time per ms from the rated speed to 0 r/min or 0 mm/s. Setting "0" will be 100 ms.


[Precautions]
・If the servo motor torque is saturated at the maximum value during forced stop deceleration because the set time is too short, the time to stop will be longer than the set time constant.
・[AL. 50 Overload alarm 1] or [AL. 51 Overload alarm 2] may occur during forced stop deceleration, depending on the set value.
・After an alarm that leads to a forced stop deceleration, if an alarm that does not lead to a forced stop deceleration occurs or if the control circuit power supply is cut, dynamic braking will start regardless of the deceleration time constant setting.

Setting range: 0 to 20000</td><td>100
[ms]</td><td>○</td><td>○</td><td></td></tr>
</table>

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PC54 RSUP1 Vertical axis freefall prevention compensation amount		Set the compensation amount of the vertical axis freefall prevention function. Set it per servo motor rotation amount. When setting a positive value, the servo motor moves in the direction set with [Pr. PA14] for the forward rotation pulse input. When setting a negative value, the servo motor moves in the direction set with [Pr. PA14] for the reverse rotation pulse input. For example, if a positive compensation amount is set when the [Pr. PA14 Rotation direction selection/travel direction selection] setting is "1", compensation will be performed to the CW direction. The vertical axis freefall prevention function is performed when all of the following conditions are met. 1) Position control mode 2) The value of the parameter is other than "0". 3) The forced stop deceleration function is enabled. 4) Alarm occurs or EM2 turns off when the servo motor speed is zero speed or less. 5) MBR (Electromagnetic brake interlock) is enabled with [Pr. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47], and the base circuit shut-off delay time is set in [Pr. PC16]. Setting range: -25000 to 25000	0 [0.0001 rev]	○		
PC60 *COPD Function selection C-D	_ _ _ x	Motor-less operation selection This is used to select the motor-less operation. 0: Disabled 1: Enabled	0h	○	○	○
	_ _ x _	High-resolution analog input selection Select the resolution of VC (analog speed command). When you change parameters, perform offset adjustment with [Pr. PC37 Analog speed command offset]. The offset adjustment can be performed by executing VC automatic offset. 0: Disabled 1: Enabled This digit is available with driver manufactured in November 2014 or later.	0h	○	○	
	_ x _ _	For manufacturer setting	0h			
	x _ _ _	[AL. 9B Error excessive warning] selection 0: [AL. 9B Error excessive warning] disabled 1: [AL. 9B Error excessive warning] enabled	0h	○	○	○
PC73 ERW Error excessive warning level		Set an error excessive warning level. To enable the parameter, select "Enabled (1 _ _ _)" of "[AL. 9B Error excessive warning] selection" in [Pr. PC60]. You can change the setting unit with "Error excessive alarm/error excessive warning level unit selection" in [Pr. PC24]. Set this per rev. Setting "0" will be "1 rev", and setting over 200 rev will be clamped with 200 rev. When an error reaches the set value, [AL. 9B Error excessive warning] will occur. When the error decreases lower than the set value, the warning will be canceled automatically. The minimum pulse width of the warning signal is 100 [ms]. Set as follows.: [Pr. PC73 Error excessive warning level] < [Pr. PC43 Error excessive alarm level] When you set as follows, [AL. 52 Error excessive] will occur earlier than the warning.: [Pr. PC73 Error excessive warning level] ≥ [Pr. PC43 Error excessive alarm level] Setting range: 0 to 1000	0 [rev]	○		

5.2.4 I/O setting parameters ([Pr. PD_ _])

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PD01 *DIA1 Input signal automatic on selection 1		Select input devices to turn on them automatically.				
	_ _ _ x (HEX)	_ _ _ x (BIN): For manufacturer setting	0h			
		_ _ x _ (BIN): For manufacturer setting				
		_ x _ _ (BIN): SON (Servo-on) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)		○	○	○
		x _ _ _ (BIN): For manufacturer setting				
	_ _ x _ (HEX)	_ _ _ x (BIN): PC (Proportional control) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)	0h	○	○	
		_ _ x _ (BIN): TL (External torque/external thrust limit selection) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)		○	○	
		_ x _ _ (BIN): For manufacturer setting				
		x _ _ _ (BIN): For manufacturer setting				
	_ x _ _ (HEX)	_ _ _ x (BIN): For manufacturer setting	0h			
		_ _ x _ (BIN): For manufacturer setting				
		_ x _ _ (BIN): LSP (Forward rotation stroke end) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)		○	○	
		x _ _ _ (BIN): LSN (Reverse rotation stroke end) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)		○	○	
	x _ _ _	For manufacturer setting	0h			

Convert the setting value into hexadecimal as follows.

0

Signal name	Initial value BIN	HEX
	0	0
	0	
SON (Servo-on)	0	
	0	

Signal name	Initial value BIN	HEX
PC (Proportional control)	0	0
TL (External torque/external thrust limit selection)	0	
	0	
	0	

Signal name	Initial value BIN	HEX
	0	0
	0	
LSP (Forward rotation stroke end)	0	
LSN (Reverse rotation stroke end)	0	

BIN 0: Use for an external input signal.
BIN 1: Automatic on

Note EM2 (Forced stop 2) cannot be turned on automatically except in the positioning mode.
In other than the positioning mode, the electric actuator cannot operate unless the EM2 (forced stop 2) wiring is performed, so an I / O connector or I / O cable is required.

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PD03 *DI1L Input device selection 1L	Any input device can be assigned to the CN1-15 pin.					
	_ _ x x	Position control mode - Device selection Refer to table 5.10.	02h	○		
	x x _ _	Speed control mode - Device selection Refer to table 5.10.	02h		○	

Table 5.10 Selectable input devices

Setting value	Input device (Note 1)		
	P	S	T
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	LSP (Note 3)
0B	LSN	LSN	LSN (Note 3)
0D	CDP	CDP	
0E	CLD		
0F	MECR		
20		SP1	SP1
21		SP2	SP2
22		SP3	SP3
23	LOP (Note 2)	LOP (Note 2)	LOP (Note 2)
24	CM1		
25	CM2		
26		STAB2	STAB2

Note 1. P: Position control mode, S: Speed control mode, T: Torque control mode
The diagonal lines indicate manufacturer settings. Never change the setting.
2. When assigning LOP (Control switching), assign it to the same pin in all control modes.
3. In the torque control mode, this device cannot be used during normal operation. Also, when the magnetic pole detection in the torque control mode is completed, this signal will be disabled.

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PD04 *DI1H Input device selection 1H	Any input device can be assigned to the CN1-15 pin.					
	_ _ x x	Torque control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	02h			○
	x x _ _	For manufacturer setting	02h			
PD05 *DI2L Input device selection 2L	Any input device can be assigned to the CN1-16 pin.					
	_ _ x x	Position control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	00h	○		
	x x _ _	Speed control mode - Device selection Refer to table 5.10 for settings.	21h		○	
PD06 *DI2H Input device selection 2H	Any input device can be assigned to the CN1-16 pin.					
	_ _ x x	Torque control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	21h			○
	x x _ _	For manufacturer setting	20h			

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PD07 *DI3L Input device selection 3L		Any input device can be assigned to the CN1-17 pin. When "_ _ _ 1" is set in [Pr. PA03] and absolute position detection system by DIO is selected, the CN1-17 pin will become ABSM (ABS transfer mode).				
	_ _ x x	Position control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	04h	○		
	x x _ _	Speed control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	07h		○	
PD08 *DI3H Input device selection 3H		Any input device can be assigned to the CN1-17 pin.				
	_ _ x x	Torque control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	07h			○
	x x _ _	For manufacturer setting	07h			
PD09 *DI4L Input device selection 4L		Any input device can be assigned to the CN1-18 pin. When "_ _ _ 1" is set in [Pr. PA03] and absolute position detection system by DIO is selected, the CN1-18 pin will become ABSR (ABS transfer request).				
	_ _ x x	Position control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	05h	○		
	x x _ _	Speed control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	08h		○	
PD10 *DI4H Input device selection 4H		Any input device can be assigned to the CN1-18 pin.				
	_ _ x x	Torque control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	08h			○
	x x _ _	For manufacturer setting	08h			
PD11 *DI5L Input device selection 5L		Any input device can be assigned to the CN1-19 pin.				
	_ _ x x	Position control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	03h	○		
	x x _ _	Speed control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	03h		○	
PD12 *DI5H Input device selection 5H		Any input device can be assigned to the CN1-19 pin.				
	_ _ x x	Torque control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	03h			○
	x x _ _	For manufacturer setting	38h			
PD13 *DI6L Input device selection 6L		Any input device can be assigned to the CN1-41 pin.				
	_ _ x x	Position control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	06h	○		
	x x _ _	Speed control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	20h		○	
PD14 *DI6H Input device selection 6H		Any input device can be assigned to the CN1-41 pin.				
	_ _ x x	Torque control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	20h			○
	x x _ _	For manufacturer setting	39h			
PD17 *DI8L Input device selection 8L		Any input device can be assigned to the CN1-43 pin.				
	_ _ x x	Position control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	0Ah	○		
	x x _ _	Speed control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	0Ah		○	
PD18 *DI8H Input device selection 8H		Any input device can be assigned to the CN1-43 pin.				
	_ _ x x	Torque control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	00h			○
	x x _ _	For manufacturer setting	0Ah			
PD19 *DI9L Input device selection 9L		Any input device can be assigned to the CN1-44 pin.				
	_ _ x x	Position control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	0Bh	○		
	x x _ _	Speed control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	0Bh		○	

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PD20 *DI9H Input device selection 9H		Any input device can be assigned to the CN1-44 pin.				
	_ _ x x	Torque control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	00h			○
	x x _ _	For manufacturer setting	0Bh			
PD21 *DI10L Input device selection 10L		Any input device can be assigned to the CN1-45 pin.				
	_ _ x x	Position control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	23h	○		
	x x _ _	Speed control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	23h		○	
PD22 *DI10H Input device selection 10H		Any input device can be assigned to the CN1-45 pin.				
	_ _ x x	Torque control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	23h			○
	x x _ _	For manufacturer setting	2Bh			
PD23 *DO1 Output device selection 1	_ _ x x	Device selection Any output device can be assigned to the CN1-22 pin. When "Enabled (absolute position detection system by DIO) (_ _ _ 1)" is selected in [Pr. PA03], the CN1-22 pin will become ABSB0 (ABS send data bit 0) only during ABS transfer mode. Refer to table 5.11 for settings.	04h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			

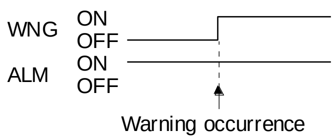
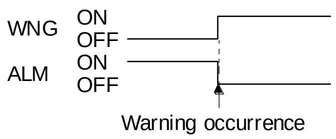
Table 5.11 Selectable output devices

Setting value	Output device (Note 1) P	S	T
_ _ 0 0	Always off	Always off	Always off
_ _ 0 2	RD	RD	RD
_ _ 0 3	ALM	ALM	ALM
_ _ 0 4	INP	SA	Always off
_ _ 0 5	MBR	MBR	MBR
_ _ 0 6	DB	DB	DB
_ _ 0 7	TLC	TLC	VLC
_ _ 0 8	WNG	WNG	WNG
_ _ 0 9	BWNG	BWNG	BWNG
_ _ 0 A	Always off	SA	Always off
_ _ 0 B	Always off	Always off	VLC
_ _ 0 C	ZSP	ZSP	ZSP
_ _ 0 D	MTTR	MTTR	MTTR
_ _ 0 F	CDPS	Always off	Always off
_ _ 1 0	CLDS	Always off	Always off
_ _ 1 1	ABSV	Always off	Always off

Note 1. P: Position control mode, S: Speed control mode, T: Torque control mode

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PD24 *DO2 Output device selection 2	_ _ x x	Device selection Any output device can be assigned to the CN1-23 pin. When "Enabled (absolute position detection system by DIO) (_ _ _ 1)" is selected in [Pr. PA03], the CN1-23 pin will become ABSB1 (ABS send data bit 1) only during ABS transfer mode. Refer to table 5.11 in [Pr. PD23] for settings.	0Ch	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PD25 *DO3 Output device selection 3	_ _ x x	Device selection Any output device can be assigned to the CN1-24 pin. Refer to table 5.11 in [Pr. PD23] for settings.	04h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PD26 *DO4 Output device selection 4	_ _ x x	Device selection Any output device can be assigned to the CN1-25 pin. When "Enabled (absolute position detection system by DIO) (_ _ _ 1)" is selected in [Pr. PA03], the CN1-25 pin will become ABST (ABS send data ready) only during ABS transfer mode. Refer to table 5.11 in [Pr. PD23] for settings.	07h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PD28 *DO6 Output device selection 6	_ _ x x	Device selection Any output device can be assigned to the CN1-49 pin. Refer to table 5.11 in [Pr. PD23] for settings.	02h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PD29 *DIF Input filter setting	Select a filter for the input signal.					
	_ _ _ x	Input signal filter selection If external input signal causes chattering due to noise, etc., input filter is used to suppress it. 0: None 1: 0.888 [ms] 2: 1.777 [ms] 3: 2.666 [ms] 4: 3.555 [ms]	4h	○	○	○
	_ _ x _	RES (Reset) dedicated filter selection 0: Disabled 1: Enabled (50 [ms])	0h	○	○	○
	_ x _ _	CR (Clear) dedicated filter selection 0: Disabled 1: Enabled (50 [ms])	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PD30 *DOP1 Function selection D-1	_ _ _ x	Stop method selection for LSP (Forward rotation stroke end) off and LSN (Reverse rotation stroke end) off Select a stop method for LSP (Forward rotation stroke end) off and LSN (Reverse rotation stroke end) off. Setting "2" or "3" will trigger [AL. 37] in the mode other than the positioning mode. 0: Quick stop 1: Slow stop	0h	○	○	
	_ _ x _	Base circuit status selection for RES (Reset) on 0: Base circuit shut-off 1: No base circuit shut-off	0h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _	Enabled/disabled selection for a thermistor of servo motor. 0: Enabled 1: Disabled The setting in this digit will be disabled when using a servo motor without thermistor.	0h	○	○	○
PD31 *DOP2 Function selection D-2	_ _ _ x	For manufacturer setting	0h			
	_ _ x _		0h			
	_ x _ _	INP (In-position) on condition selection Select a condition that INP (In-position) is turned on. 0: Droop pulses are within the in-position range. 1: The command pulse frequency is 0, and droop pulses are within the in-position range. When the position command is not inputted for about 1 ms, the command pulse frequency is decided as 0.	0h	○		
	x _ _ _	For manufacturer setting	0h			
PD32 *DOP3 Function selection D-3	_ _ _ x	CR (Clear) selection Set CR (Clear). 0: Deleting droop pulses at the leading edge of turning on of CR 1: Continuous deleting of droop pulses while CR is on 2: Disabled	0h	○		
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			
PD33 *DOP4 Function selection D-4	_ _ _ x	For manufacturer setting	0h			
	_ _ x _		0h			
	_ x _ _	Rotation direction selection to enable torque limit. Select a direction which enables internal torque limit 2 or external torque limit. Refer to section 3.6.1 (5) for details. 0: Both of "CCW or positive direction" and "CW or negative direction" are enabled. 1: Enabled with "CCW or positive direction" 2: Enabled with "CW or negative direction"	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			

<table>
<tr><th rowspan="2">No./symbol/ name</th><th rowspan="2">Setting digit</th><th rowspan="2">Function</th><th rowspan="2">Initial value [unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td rowspan="4">PD34
*DOP5
Function selection D-5</td><td>_ _ _ x</td><td>Alarm code output
Select output status of alarm codes.
Alarm codes are outputted to the pins CN1-22, CN1-23, and CN1-24.
0: Disabled
1: Enabled
For details of the alarm codes, refer to chapter 8.
When "1" is set for this digit, setting the following will trigger [AL. 37 Parameter error].
・"_ _ _ 1" is set in [Pr. PA03] and the absolute position detection system by DIO is selected.
・MBR, DB, or ALM is assigned to the CN1-22 pin, CN1-23 pin, or CN1-24 pin.</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>_ _ x _</td><td>Selection of output device at warning occurrence
Select ALM (Malfunction) output status at warning occurrence.
<table>
<tr><th>Setting value</th><th>Device status</th></tr>
<tr><td>0</td><td>
</td></tr>
<tr><td>1</td><td>
</td></tr>
</table></td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>_ x _ _</td><td rowspan="2">For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>x _ _ _</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td rowspan="3">PD43
*DI11L
Input device selection 11L</td><td colspan="6">Any input device can be assigned to the CN1-10 pin/CN1-37 pin.
Setting "00" will assign PP/PP2 (forward rotation pulse).</td></tr>
<tr><td>_ _ x x</td><td>Position control mode - Device selection
The setting is disabled.</td><td>00h</td><td></td><td></td><td></td></tr>
<tr><td>x x _ _</td><td>Speed control mode - Device selection
Refer to table 5.10 in [Pr. PD03] for settings.</td><td>00h</td><td></td><td>○</td><td></td></tr>
<tr><td rowspan="3">PD44
*DI11H
Input device selection 11H</td><td colspan="6">Any input device can be assigned to the CN1-10 pin/CN1-37 pin.
Setting "00" will assign PP/PP2 (forward rotation pulse).</td></tr>
<tr><td>_ _ x x</td><td>Torque control mode - Device selection
Refer to table 5.10 in [Pr. PD03] for settings.</td><td>00h</td><td></td><td></td><td>○</td></tr>
<tr><td>x x _ _</td><td>For manufacturer setting</td><td>3Ah</td><td></td><td></td><td></td></tr>
</table>

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PD45 *DI12L Input device selection 12L	Any input device can be assigned to the CN1-35 pin/CN1-38 pin. Setting "00" will assign NP/NP2 (reverse rotation pulse).					
	_ _ x x	Position control mode - Device selection The setting is disabled.	00h			
	x x _ _	Speed control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	00h		○	
PD46 *DI12H Input device selection 12H	Any input device can be assigned to the CN1-35 pin/CN1-38 pin. Setting "00" will assign NP/NP2 (reverse rotation pulse/manual pulse generator).					
	_ _ x x	Torque control mode - Device selection Refer to table 5.10 in [Pr. PD03] for settings.	00h			○
	x x _ _	For manufacturer setting	3Bh			
PD47 *DO7 Output device selection 7	Any output device can be assigned to the CN1-13 pin and CN1-14 pin.					
	_ _ x x	Device selection Any output device can be assigned to the CN1-13 pin. Refer to table 5.11 in [Pr. PD23] for settings.	00h	○	○	○
	x x _ _	Device selection Any output device can be assigned to the CN1-14 pin. Refer to table 5.11 in [Pr. PD23] for settings.	00h	○	○	○

5.2.5 Extension setting 2 parameters ([Pr. PE_ _])

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PE01 *FCT1	_ _ _ x	Do not change this value.	0h	○		
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			
PE03 *FCT2	_ _ x x	Do not change this value.	03h	○		
	_ x _ _	For manufacturer setting	0h			
	x _ _ _	Do not change this value.	0h	○		
PE04 *FBN		Do not change this value.	1	○		

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PE05 *FBD		Do not change this value.	1	○		
PE06 BC1		Do not change this value.	400 [r/min]	○		
PE07 BC2		Do not change this value.	100 [kpulse]	○		
PE08 DUF		Do not change this value.	10 [rad/s]	○		
PE10 FCT3	_ _ _ x	For manufacturer setting	0h			
	_ _ x _	Do not change this value.	0h	○		
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PE34 *FBN2		Do not change this value.	1	○		
PE35 *FBD2		Do not change this value.	1	○		

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PE41 EOP3 Function selection E-3	_ _ _ x	Robust filter selection 0: Disabled 1: Enabled When you select "Enabled" of this digit, the machine resonance suppression filter 5 set in [Pr. PB51] is not available.	0h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			
PE44 LMCP Lost motion compensation positive-side compensation value selection		Set the lost motion compensation for when reverse rotation (CW) switches to forward rotation (CCW) in increments of 0.01% assuming the rated torque as 100%. Setting range: 0 to 30000	0 [0.01%]	○		
PE45 LMCN Lost motion compensation negative-side compensation value selection		Set the lost motion compensation for when forward rotation (CCW) switches to reverse rotation (CW) in increments of 0.01% assuming the rated torque as 100%. Setting range: 0 to 30000	0 [0.01%]	○		
PE46 LMFLT Lost motion filter setting		Set the time constant of the lost motion compensation filter in increments of 0.1 ms. If the time constant is "0", the torque is compensated with the value set in [Pr. PE44] and [Pr. PE45]. If the time constant is other than "0", the torque is compensated with the high-pass filter output value of the set time constant, and the lost motion compensation will continue. Setting range: 0 to 30000	0 [0.1 ms]	○		
PE47 TOF Torque offset		Set this when canceling unbalanced torque of vertical axis. Set this assuming the rated torque of the servo motor as 100%. The torque offset does not need to be set for a machine not generating unbalanced torque. The torque offset set with this parameter will be enabled in the position control mode, speed control mode, and torque control mode. Input commands assuming torque offset for the torque control mode. Setting range: -10000 to 10000	0 [0.01%]	○	○	○
PE48 *LMOP Lost motion compensation function selection	_ _ _ x	Lost motion compensation selection 0: Disabled 1: Enabled	0h	○		
	_ _ x _	Unit setting of lost motion compensation non-sensitive band 0: 1 pulse unit 1: 1 kpulse unit	0h	○		
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PE49 LMCD Lost motion compensation timing		Set the lost motion compensation timing in increments of 0.1 ms. You can delay the timing to perform the lost motion compensation for the set time. Setting range: 0 to 30000	0 [0.1 ms]	○		

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PE50 LMCT Lost motion compensation non-sensitive band		Set the lost motion compensation non-sensitive band. When the fluctuation of the droop pulse is the setting value or less, the speed will be 0. Setting can be changed in [Pr. PE48]. Set the parameter per encoder unit. Setting range: 0 to 65535	0 [pulse]/ [kpulse]	○		

5.2.6 Extension setting 3 parameters ([Pr. PF_ _])

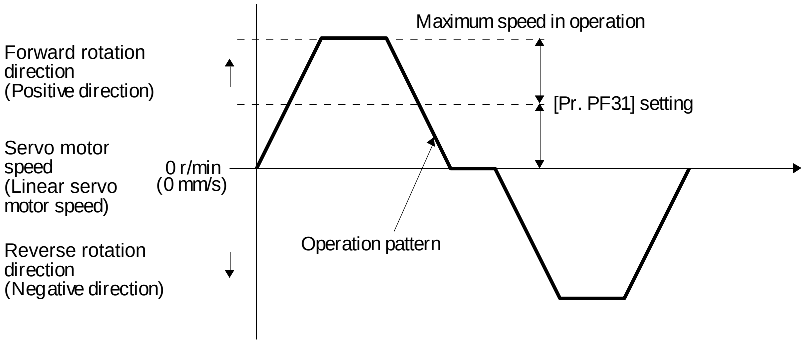
<table>
<tr><th rowspan="2">No./symbol/ name</th><th rowspan="2">Setting digit</th><th rowspan="2">Function</th><th rowspan="2">Initial value [unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td rowspan="4">PF09
*FOP5
Function selection F-5</td><td>_ _ _ x</td><td>Electronic dynamic brake selection
0: Automatic (enabled only for specified servo motors)
2: Disabled
Refer to the following table for the specified servo motors.
<table>
<tr><th>Series</th><th>Servo motor</th></tr>
<tr><td>LE-□-□</td><td>LE-T5-□, LE-T6-□, LE-T7-□, LE-T8-□</td></tr>
</table></td><td>0h</td><td>○</td><td>○</td><td></td></tr>
<tr><td>_ _ x _</td><td rowspan="3">For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ x _ _</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>x _ _ _</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>PF15
DBT
Electronic dynamic brake operating time</td><td></td><td>Set an operating time for the electronic dynamic brake.

Setting range: 0 to 10000</td><td>2000
[ms]</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PF18
*STOD
STO diagnosis error detection time</td><td></td><td>Set the time from when an error occurs in the STO input signal or STO circuit until the detection of [AL. 68.1 Mismatched STO signal error].
When 0 s is set, the detection of [AL. 68.1 Mismatched STO signal error] is not performed.

The following shows safety levels at the time of parameter setting.
<table>
<tr><th>Setting value</th><th>STO input diagnosis by TOFB output</th><th>Safety level</th></tr>
<tr><td rowspan="2">0</td><td>Execute</td><td rowspan="2">EN ISO 13849-1 Category 3 PL d,
IEC 61508 SIL 2,
EN 62061 SIL CL2</td></tr>
<tr><td>Not execute</td></tr>
<tr><td rowspan="2">1 to 60</td><td>Execute</td><td>EN ISO 13849-1 Category 3 PL e,
IEC 61508 SIL 3, EN 62061 SIL CL3</td></tr>
<tr><td>Not execute</td><td>EN ISO 13849-1 Category 3 PL d,
IEC 61508 SIL 2, EN 62061 SIL CL2</td></tr>
</table>
When the short-circuit connector is connected to the CN8 connector, set "0" in the parameter.

Setting range: 0 to 60</td><td>0
[s]</td><td>○</td><td>○</td><td>○</td></tr>
</table>

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	Control mode S	Control mode T
PF21 DRT Drive recorder switching time setting		Set a drive recorder switching time. When a USB communication is cut during using a graph function or a graph function is terminated, the function will be changed to the drive recorder function after the settling time of this parameter. When a value from "1" to "32767" is set, it will switch after the setting value. When "0" is set, it will switch after 600 s. When "-1" is set, the drive recorder function is disabled. Setting range: -1 to 32767	0 [s]	○	○	○
PF23 OSCL1 Vibration tough drive - Oscillation detection level		Set a filter readjustment sensitivity of [Pr. PB13 Machine resonance suppression filter 1] and [Pr. PB15 Machine resonance suppression filter 2] while the vibration tough drive is enabled. However, setting "0" will be 50%. Example: When you set "50" to the parameter, the filter will be readjusted at the time of 50% or more oscillation level. Setting range: 0 to 100	50 [%]	○	○	
PF24 *OSCL2 Vibration tough drive function selection	_ _ _ x	Oscillation detection alarm selection Select alarm or warning when an oscillation continues at a filter readjustment sensitivity level of [Pr. PF23]. The digit is continuously enabled regardless of the vibration tough drive in [Pr. PA20]. 0: [AL. 54 Oscillation detection] will occur at oscillation detection. 1: [AL. F3.1 Oscillation detection warning] will occur at oscillation detection. 2: Oscillation detection function disabled	0h	○	○	
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			
PF25 CVAT SEMI-F47 function - Instantaneous power failure detection time		Set the time of the [AL. 10.1 Voltage drop in the control circuit power] occurrence. To comply with SEMI-F47 standard, it is unnecessary to change the initial value (200 ms). However, when the instantaneous power failure time exceeds 200 ms, and the instantaneous power failure voltage is less than 70% of the rated input voltage, the power may be normally turned off even if a value larger than 200 ms is set in the parameter. To disable the parameter, set "Disabled (_ 0 _ _)" of "SEMI-F47 function selection" in [Pr. PA20]. Setting range: 30 to 500	200 [ms]	○	○	○

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode P	S	T
PF31 FRIC Machine diagnosis function - Friction judgment speed		Set a servo motor speed that divides a friction estimation area into high and low during the friction estimation process of the machine diagnosis. Setting "0" will set a value half of the rated speed. When your operation pattern is under the rated speed, we recommend that you set a half value of the maximum speed.  Setting range: 0 to permissible speed	0 [r/min]/ [mm/s]	○	○	○
PF34 *SOP3 RS-422 communi- cation function selection 3	_ _ _ x	For manufacturer setting	0h			
	_ _ x _		0h			
	_ x _ _		0h			
	x _ _ _	MR-PRU03 selection Select this if using an MR-PRU03. 0: Disabled 1: Enabled	0h	○	○	○

6. NORMAL GAIN ADJUSTMENT

> POINT
>
> ●In the torque control mode, you do not need to make gain adjustment.
>
> ●Before making gain adjustment, check that your machine is not being operated at maximum torque of the servo motor. If operated over maximum torque, the machine may vibrate and may operate unexpectedly. In addition, make gain adjustment with a safety margin considering characteristic differences of each machine. It is recommended that generated torque during operation is under 90% of the maximum torque of the servo motor.
>
> ●For the vibration suppression control tuning mode, the setting range of [Pr. PB07] is limited. For the vibration suppression control tuning mode, the setting range of [Pr. PB07] is limited. Refer to section 7.1.5 (4) for details.

6.1 Different adjustment methods

6.1.1 Adjustment on a single driver

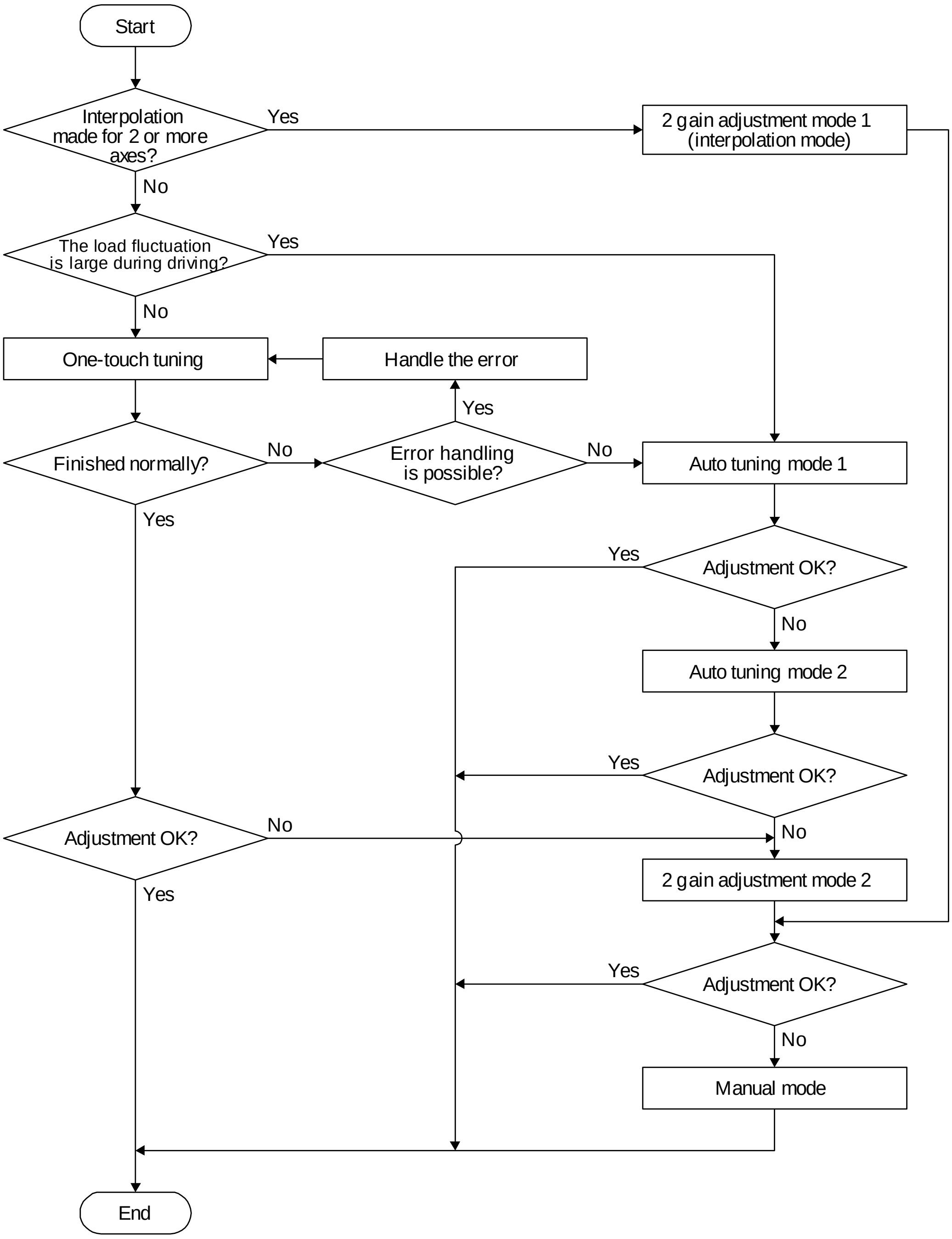
The following table shows the gain adjustment modes that can be set on a single driver. For gain adjustment, first execute "Auto tuning mode 1". If you are not satisfied with the result of the adjustment, execute "Auto tuning mode 2" and "Manual mode" in this order.

.

(1) Gain adjustment mode explanation

Gain adjustment mode	[Pr. PA08] setting	Estimation of load to motor inertia ratio	Automatically set parameters	Manually set parameters
Auto tuning mode 1 (initial value)	_ _ _ 1	Always estimated	GD2 ([Pr. PB06]) PG1 ([Pr. PB07]) PG2 ([Pr. PB08]) VG2 ([Pr. PB09]) VIC ([Pr. PB10])	RSP ([Pr. PA09])
Auto tuning mode 2	_ _ _ 2	Fixed to [Pr. PB06] value	PG1 ([Pr. PB07]) PG2 ([Pr. PB08]) VG2 ([Pr. PB09]) VIC ([Pr. PB10])	GD2 ([Pr. PB06]) RSP ([Pr. PA09])
Manual mode	_ _ _ 3			GD2 ([Pr. PB06]) PG1 ([Pr. PB07]) PG2 ([Pr. PB08]) VG2 ([Pr. PB09]) VIC ([Pr. PB10])
2 gain adjustment mode 1 (interpolation mode)	_ _ _ 0	Always estimated	GD2 ([Pr. PB06]) PG2 ([Pr. PB08]) VG2 ([Pr. PB09]) VIC ([Pr. PB10])	PG1 ([Pr. PB07]) RSP ([Pr. PA09])
2 gain adjustment mode 2	_ _ _ 4	Fixed to [Pr. PB06] value	PG2 ([Pr. PB08]) VG2 ([Pr. PB09]) VIC ([Pr. PB10])	GD2 ([Pr. PB06]) PG1 ([Pr. PB07]) RSP ([Pr. PA09])

(2) Adjustment sequence and mode usage



6.1.2 Adjustment using setup software (MR Configurator2^{TM})

This section explains the functions and adjustment using the driver with setup software (MR Configurator2^{TM}).

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 a 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.

6.2 One-touch tuning

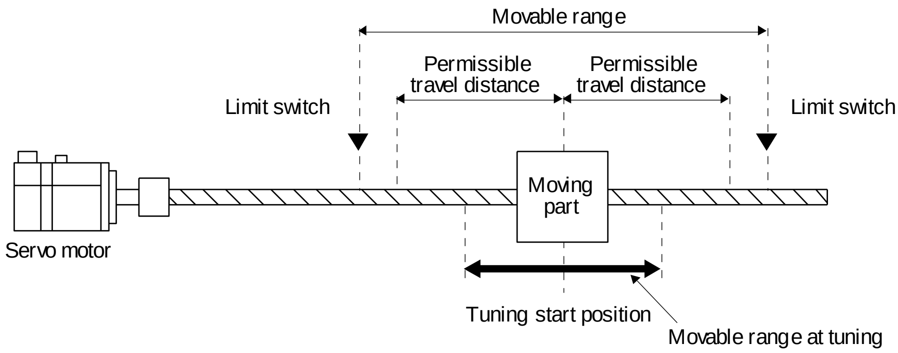
POINT

- After the one-touch tuning is completed, "Gain adjustment mode selection" in [Pr. PA08] will be set to "2 gain adjustment mode 2 (_ _ _ 4)". To estimate [Pr. PB06 Load to motor inertia ratio/load to motor mass ratio], set "Gain adjustment mode selection" in [Pr. PA08] to "Auto tuning mode 1 (_ _ _ 1)".
- When executing the one-touch tuning, check the [Pr. PA21 One-touch tuning function selection] is "_ _ _ 1" (initial value).
- At start of the one-touch tuning, only when "Auto tuning mode 1 (_ _ _ 1)" or "2 gain adjustment mode 1 (interpolation mode) (_ _ _ 0)" of "Gain adjustment mode selection" is selected in [Pr. PA08], [Pr. PB06 Load to motor inertia ratio] will be estimated.
- The driver command method can be used with the setup software (MR Configurator2TM) with software version 1.45X or later.
- When the one-touch tuning is executed in the driver command method, setup software (MR Configurator2TM) is required.

The one-touch tuning includes two methods: the user command method and the driver command method.

(1) User command method
You can execute the one-touch tuning with setup software (MR Configurator2TM) or push buttons. The user command method performs one-touch tuning by inputting commands from outside the driver.

(2) Driver command method
You can execute the one-touch tuning with setup software (MR Configurator2TM). In the driver command method, when you simply input a travel distance (permissible travel distance) that collision against the equipment does not occur during servo motor driving, a command for the optimum tuning will be generated inside the driver to perform one-touch tuning.



The following parameters are set automatically with one-touch tuning. Also, "Gain adjustment mode selection" in [Pr. PA08] will be "2 gain adjustment mode 2 (_ _ _ 4)" automatically. Other parameters will be set to an optimum value depending on the setting of [Pr. PA09 Auto tuning response].

Table 6.1 List of parameters automatically set with one-touch tuning

Parameter	Symbol	Name
PA08	ATU	Auto tuning mode
PA09	RSP	Auto tuning response
PB01	FILT	Adaptive tuning mode (adaptive filter II)
PB02	VRFT	Vibration suppression control tuning mode (advanced vibration suppression control II)
PB03	PST	Position command acceleration/ deceleration time constant (position smoothing)
PB06	GD2	Load to motor inertia ratio
PB07	PG1	Model loop gain
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation
PB12	OVA	Overshoot amount compensation
PB13	NH1	Machine resonance suppression filter 1
PB14	NHQ1	Notch shape selection 1

Parameter	Symbol	Name
PB15	NH2	Machine resonance suppression filter 2
PB16	NHQ2	Notch shape selection 2
PB17	NHF	Shaft resonance suppression filter
PB18	LPF	Low-pass filter setting
PB19	VRF11	Vibration suppression control 1 - Vibration frequency
PB20	VRF12	Vibration suppression control 1 - Resonance frequency
PB21	VRF13	Vibration suppression control 1 - Vibration frequency damping
PB22	VRF14	Vibration suppression control 1 - Resonance frequency damping
PB23	VFBF	Low-pass filter selection
PB46	NH3	Machine resonance suppression filter 3
PB47	NHQ3	Notch shape selection 3
PB48	NH4	Machine resonance suppression filter 4
PB49	NHQ4	Notch shape selection 4
PB51	NHQ5	Notch shape selection 5
PE41	EOP3	Function selection E-3

6.2.1 One-touch tuning flowchart

(1) User command method

(a) When you use setup software (MR Configurator2™)

Make one-touch tuning as follows.

Flowchart	Description
Start	
Startup of the system	Start a system referring to chapter 4.
Operation	Rotate the servo motor by a controller. (In the user command method, the one-touch tuning cannot be executed if the servo motor is not operating.)
One-touch tuning start, mode selection	Start one-touch tuning of setup software (MR Configurator2™), and select "User command method".
Response mode selection	Select a response mode (High mode, Basic mode, and Low mode) in the one-touch tuning window of setup software (MR Configurator2™).
One-touch tuning execution	Click "Start" during servo motor driving to execute one-touch tuning.
One-touch tuning in progress	Gains and filters will be adjusted automatically. During processing of tuning, the tuning progress will be displayed in % in setup software (MR Configurator2™).
One-touch tuning completion	When one-touch tuning is completed normally, the parameters described in table 6.1 will be set automatically. When the tuning is not completed normally, the tuning error will be displayed. (Refer to section 6.2.2 (1) (e).)
Tuning result check	Check the tuning result. When the tuning result is not satisfactory, you can return the parameter to the value before the one-touch tuning or the initial value. (Refer to section 6.2.2 (1) (h).)
End	

(b) When you use push buttons

Make one-touch tuning as follows.

Start	
Startup of the system	Start a system referring to chapter 4.
Operation	Rotate the servo motor by a controller. (In the user command method, the one-touch tuning cannot be executed if the servo motor is not operating.)
One-touch tuning start, mode selection	Push the "MODE" button during motor driving to switch to the initial screen ("AUTO.") of the one-touch tuning. Push the "SET" button for 2 s or more during displaying "AUTO" to switch to the response mode selection ("AUTO.").
Response mode selection	Push the "UP" or "DOWN" button to select a response mode from "AUTO.H" (High mode), "AUTO." (Basic mode), or "AUTO.L" (Low mode).
One-touch tuning execution	Push the "SET" button to start one-touch tuning. Push the "SET" button during servo motor driving.
One-touch tuning in progress	Gains and filters will be adjusted automatically. During processing of tuning, the tuning progress will be displayed in % on the display (five-digit, seven-segment LED).
One-touch tuning completion	When one-touch tuning is completed normally, the parameters described in table 6.1 will be set automatically. When the tuning is not completed normally, the tuning error will be displayed. (Refer to section 6.2.2 (1) (e) and section 6.2.2 (2) (d).)
Tuning result check	Check the tuning result. When the tuning result is not satisfactory, you can return the parameter to the value before the one-touch tuning or the initial value. (Refer to section 6.2.2 (2) (g).)
End	

(2) Driver command method

Make one-touch tuning as follows.

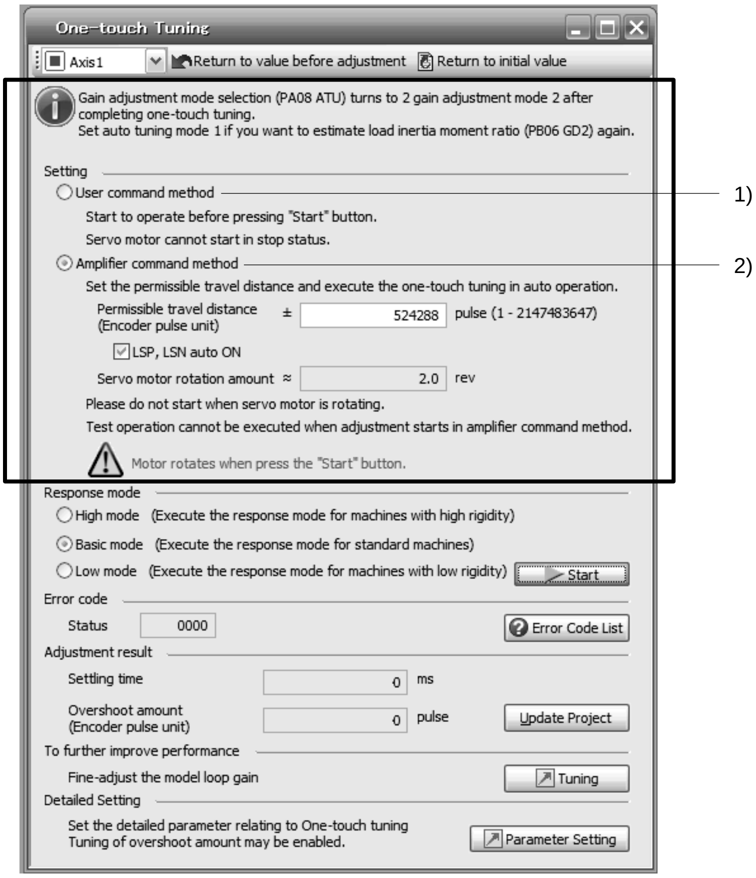
Start	
Startup of the system	Start a system referring to chapter 4.
Movement to tuning start position	Move the moving part to the center of a movable range.
One-touch tuning start, mode selection	Start one-touch tuning of setup software (MR Configurator2TM), and select "Driver command method".
Input of permissible travel distance	In the one-touch tuning window of setup software (MR Configurator2TM), input a maximum travel distance to move the moving part at one-touch tuning.
Response mode selection	Select a response mode (High mode, Basic mode, and Low mode) in the one-touch tuning window of setup software (MR Configurator2TM).
One-touch tuning execution	While the servo motor is stopped, click "Start" to start one-touch tuning. After the tuning is started, the servo motor will reciprocate automatically. Executing one-touch tuning during servo motor rotation will cause an error. After one-touch tuning is executed using the driver command method, control will not be performed by commands from the controller.
One-touch tuning in progress	Gains and filters will be adjusted automatically. During processing of tuning, the tuning progress will be displayed in % in setup software (MR Configurator2TM).
One-touch tuning completion	One-touch tuning will be completed automatically after the tuning. When one-touch tuning is completed normally, the parameters described in table 6.1 will be updated automatically. When the tuning is not completed normally, the tuning error will be displayed. (Refer to section 6.2.2 (1) (e).)
Tuning result check	Check the tuning result. When the tuning result is not satisfactory, you can return the parameter to the value before the one-touch tuning or the initial value. (Refer to section 6.2.2 (1) (h).)
driver power cycling	After executing the one-touch tuning, cycling the power of the driver returns to the state in which control is performed from the controller.
End	

6.2.2 Display transition and operation procedure of one-touch tuning

(1) When you use setup software (MR Configurator2TM)

(a) Command method selection

Select a command method from two methods in the one-touch tuning window of setup software (MR Configurator2TM).



1) User command method
   It is recommended to input commands meeting the following conditions to the driver. If one-touch tuning is executed while commands which do not meet the conditions are inputted to the driver, the one-touch tuning error may occur.

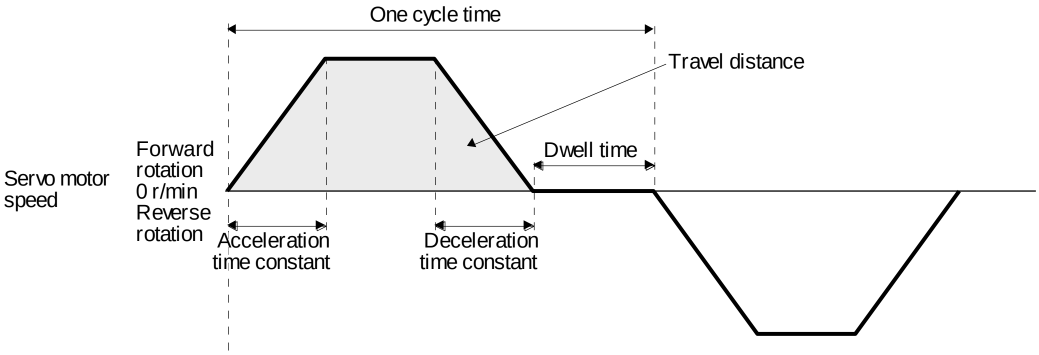


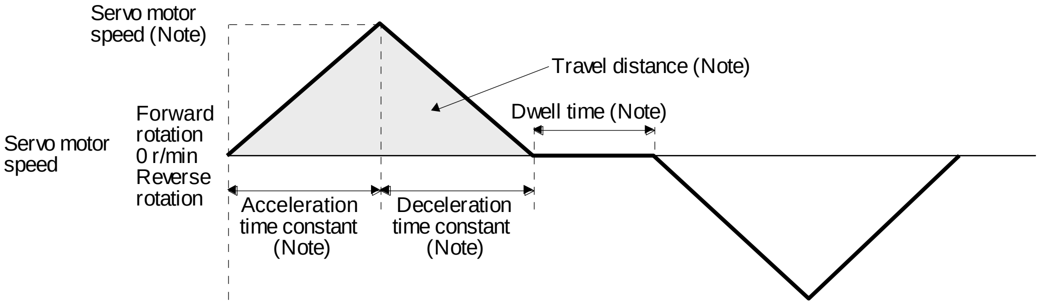
Fig. 6.1 Recommended command for one-touch tuning in the user command method

Item	Description
Travel distance	Set 100 pulses or more in encoder unit. Setting less than 100 pulses will cause the one-touch tuning error "C004".
Servo motor speed	Set 150 r/min (mm/s) or higher. Setting less than 150 r/min may cause the one-touch tuning error "C005".
Acceleration time constant Deceleration time constant	Set the time to reach 2000 r/min (mm/s) to 5 s or less. Set an acceleration time constant/deceleration time constant so that the acceleration/deceleration torque is 10% or more of the rated torque. The estimation accuracy of the load to motor inertia ratio is more improved as the acceleration/deceleration torque is larger, and the one-touch tuning result will be closer to the optimum value.
Dwell time	Set 200 ms or more. Setting a smaller value may cause the one-touch tuning error "C004".
One cycle time	Set 30 s or less. Setting over 30 s will cause the one-touch tuning error "C004".

2) Driver command method

Input a permissible travel distance. Input it in the load-side resolution unit for the fully closed loop control mode, and in the servo motor-side resolution unit for other control modes. In the driver command method, the servo motor will be operated in a range between "current value ± permissible travel distance". Input the permissible travel distance as large as possible within a range that the movable part does not collide against the machine. Inputting a small permissible travel distance decreases the possibility that the moving part will collide against the machine. However, the estimation accuracy of the load to motor inertia ratio may be lower, resulting in improper tuning.

Also, executing the one-touch tuning in the driver command method will generate a command for the following optimum tuning inside the driver to start the tuning.



Note. It will be automatically generated in the driver.

Fig. 6.2 Command generated by one-touch tuning in the driver command method

Item	Description
Travel distance	An optimum travel distance will be automatically set in the range not exceeding the user-inputted permissible travel distance with setup software (MR Configurator2TM).
Servo motor speed	A speed not exceeding 1/2 of the rated speed will be automatically set.
Acceleration time constant Deceleration time constant	An acceleration time constant/deceleration time constant will be automatically set so as not to exceed 60% of the rated torque and the torque limit value set at the start of one-touch tuning in the driver command method.
Dwell time	A dwell time in which the one-touch tuning error "C004" does not occur will be automatically set.

(b) Response mode selection

Select a response mode from 3 modes in the one-touch tuning window of setup software (MR Configurator2™).

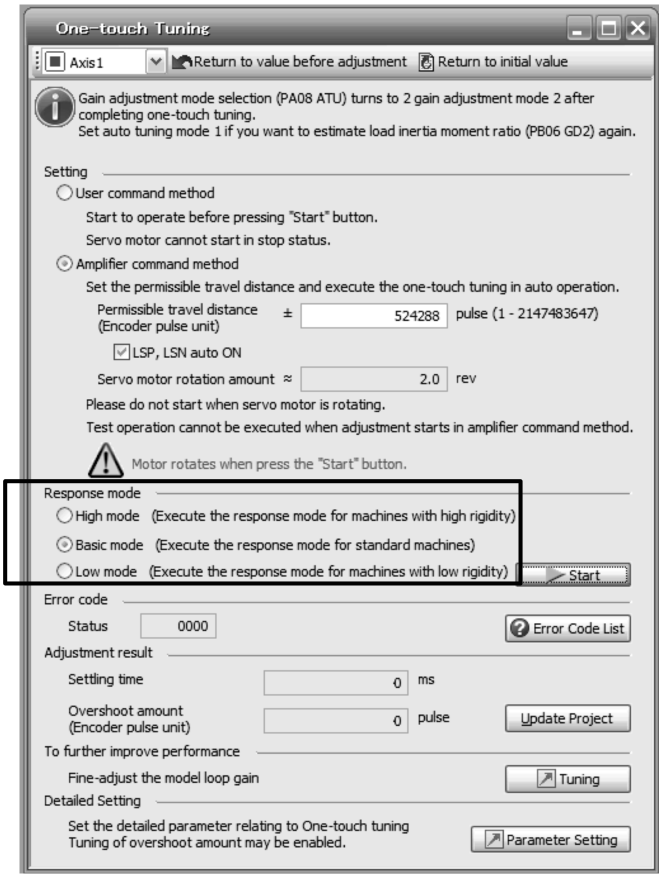
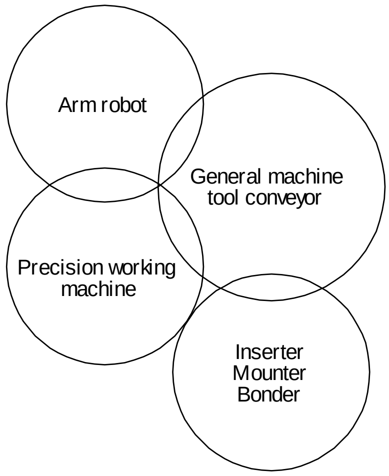


Table 6.2 Response mode explanations

Response mode	Explanation
High mode	This mode is for high-rigid system.
Basic mode	This mode is for standard system.
Low mode	This mode is for low-rigid system.

Refer to the following table for selecting a response mode.

Table 6.3 Guideline for response mode

Response mode			Response	Machine characteristic
Low mode	Basic mode	High mode		Guideline of corresponding machine
↕	↕	↕	Low response ↕ High response	

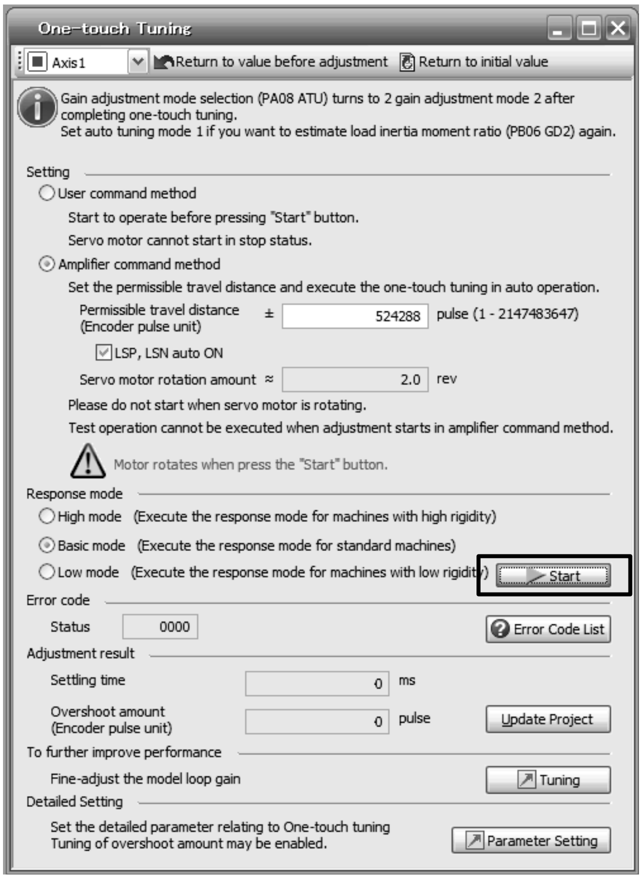
(c) One-touch tuning execution

> **POINT**
> - For equipment in which overshoot during one-touch tuning is in the permissible level of the in-position range, changing the value of [Pr. PA25 One-touch tuning overshoot permissible level] will shorten the settling time and improve the response.
> - When executing one-touch tuning in the driver command method, turn on EM2, LSP, and LSN. When you turn off EM2, LSP, and LSN during one-touch tuning, "C008" will be displayed at status in error code, and the one-touch tuning will be canceled. When setting LSP and LSN to automatic on, enable the check box "LSP, LSN auto ON" in the one-touch tuning window of setup software (MR Configurator2™).
> - When one-touch tuning is executed in the driver command method while magnetic pole detection is not being performed, magnetic pole detection will be performed, and then one-touch tuning will start after the magnetic pole detection is completed.

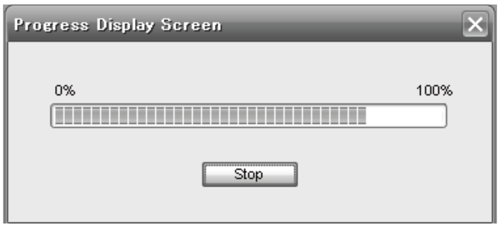
After the response mode is selected in (1) (b) in this section, clicking "Start" will start one-touch tuning. If "Start" is clicked while the servo motor stops, "C002" or "C004" will be displayed at status in error code. (Refer to (1) (e) in this section for error codes.)

Click "Start" with the driver command method selected in the servo-off, the servo-on will be automatically enabled, and the one-touch tuning will start. In the one-touch tuning by the driver command method, an optimum tuning command will be generated in the driver after servo-on. Then, the servo motor will reciprocate, and the one-touch tuning will be executed. After the tuning is completed or canceled, the driver will be the servo-off status. When the servo-on command is inputted from outside, the driver will be the servo-on status.

After one-touch tuning is executed using the driver command method, control will not be performed by commands from the controller. To return to the state in which control is performed from the controller, cycle the power.

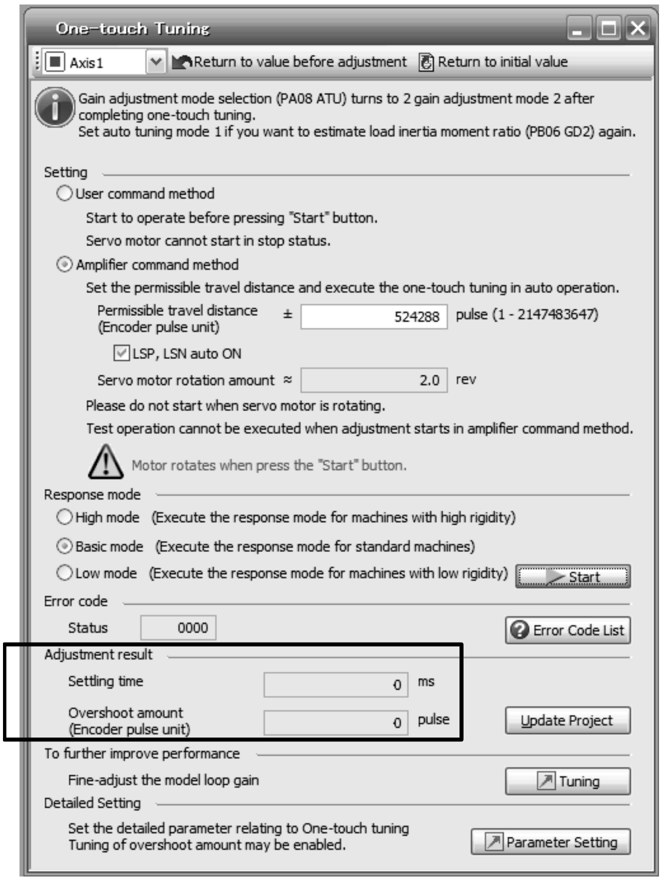


During processing of one-touch tuning, the progress will be displayed as follows. Tuning will be completed at 100%.



Completing the one-touch tuning will start writing tuning parameters to the driver, and the following window will be displayed. Select whether or not to reflect the tuning result in the project.

After the one-touch tuning is completed, "0000" will be displayed at status in error code. In addition, settling time and overshoot amount will be displayed in "Adjustment result".



(d) Stop of one-touch tuning

During one-touch tuning, clicking the stop button stops one-touch tuning. If the one-touch tuning is stopped, "C000" will be displayed at status in error code. After the one-touch tuning is stopped, parameters will return to the values at the start of the one-touch tuning. To stop one-touch tuning, and execute it again, stop the servo motor once. In addition, after returning the moving part to the tuning start position, execute it.

(e) If an error occurs

If a tuning error occurs during the one-touch tuning, the tuning will be stopped. With that, the following error code will be displayed in status. Check the cause of tuning error. When executing one-touch tuning again, stop the servo motor once. In addition, after returning the moving part to the tuning start position, execute it.

Display	Name	Error detail	Corrective action example
C000	Tuning canceled	The stop button was clicked during one-touch tuning.	
C001	Overshoot exceeded	Overshoot amount is a value larger than the one set in [Pr. PA10 In-position range] and [Pr. PA25 One-touch tuning - Overshoot permissible level].	Increase the in-position range or overshoot permissible level.
C002	Servo-off during tuning	The one-touch tuning was attempted in the user command method during servo-off. The driver will be servo-off status during one-touch tuning.	When executing one-touch tuning in the user command method, turn to servo-on, and then execute it. Prevent the driver from being the servo-off status during one-touch tuning.
C003	Control mode error	1. The one-touch tuning was attempted while the torque control mode was selected in the control modes.	Select the position control mode or speed control mode for the control mode, and then execute one-touch tuning. Do not change the control mode during the one-touch tuning.
		2. During one-touch tuning, the control mode was attempted to change from the position control mode to the speed control mode.	
C004	Time-out	1. One cycle time during the operation has been over 30 s.	Set one cycle time during the operation (time from the command start to the next command start) to 30 s or less.
		2. The command speed is slow.	Set the servo motor speed to 100 r/min or higher. Error is less likely to occur as the setting speed is higher. When one-touch tuning by the driver command is used, set a permissible travel distance so that the servo motor speed is 100 r/min or higher. Set a permissible travel distance to two or more revolutions as a guide value to set the servo motor speed to 100 r/min.
		3. The operation interval of the continuous operation is short.	Set the stop interval during operation to 200 ms or more. Error is less likely to occur as the setting time is longer.
C005	Load to motor inertia ratio misestimated	1. The estimation of the load to motor inertia ratio at one-touch tuning was a failure.	Drive the motor with meeting conditions as follows. ・The acceleration time constant/deceleration time constant to reach 2000 r/min (mm/s) is 5 s or less. ・Speed is 150 r/min (mm/s) or higher. ・The load to servo motor (mass of linear servo motor's primary side or direct drive motor) inertia ratio is 100 times or less. ・The acceleration/deceleration torque is 10% or more of the rated torque.
		2. The load to motor inertia ratio was not estimated due to an oscillation or other influences.	Set to the auto tuning mode that does not estimate the load to motor inertia ratio as follows, and then execute the one-touch tuning. ・Select "Auto tuning mode 2 (_ _ _ 2)", "Manual mode (_ _ _ 3)", or "2 gain adjustment mode 2 (_ _ _ 4)" of "Gain adjustment mode selection" in [Pr. PA08]. ・Set [Pr. PB06 Load to motor inertia ratio/load to motor mass ratio] properly with manual setting.

Display	Name	Error detail	Corrective action example
C006	Driver command start error	One-touch tuning was attempted to start in the driver command method under the following speed condition. Servo motor speed: 20 r/min (mm/s) or higher	Execute the one-touch tuning in the driver command method while the servo motor is stopped.
C007	Driver command generation error	1. One-touch tuning was executed in the driver command method when the permissible travel distance is set to 100 pulses or less in the encoder pulse unit, or the distance is set not to increase the servo motor speed to 150 r/min (mm/s) (50 r/min for direct drive motor) or higher at the time of load to motor inertia ratio estimation.	Set a permissible travel distance to 100 pulses or more in the encoder pulse unit, or a distance so as to increase the servo motor speed to 150 r/min (mm/s) (50 r/min for direct drive motor) or higher at the time of load to motor inertia ratio estimation, and then execute the one-touch tuning. Set a permissible travel distance to four or more revolutions as a guide value. Load to motor inertia ratio will be estimated when "0000" or "0001" is set in [Pr. PA08 Auto tuning mode] at the start of one-touch tuning. If the permissible travel distance is short and the servo motor speed cannot be increased to 150 r/min (mm/s) (50 r/min for direct drive motor) or higher, select "Auto tuning mode 2 (_ _ _ 2)", "Manual mode (_ _ _ 3)", or "2 gain adjustment mode 2 (_ _ _ 4)" of "Gain adjustment mode selection" in [Pr. PA08].
		2. The torque limit has been set to 0.	Set the torque limit value to greater than 0.
C008	Stop signal	EM2, LSP, and LSN were turned off during one-touch tuning in the driver command method.	Review the one-touch tuning start position and permissible travel distance for the driver command method. After ensuring safety, turn on EM2, LSP, and LSN.
C009	Parameter	Parameters for manufacturer setting have been changed.	Return the parameters for manufacturer setting to the initial values.
C00A	Alarm	One-touch tuning was attempted to start in the driver command method during alarm or warning. Alarm or warning occurred during one-touch tuning by the driver command method.	Start one-touch tuning when no alarm or warning occurs. Prevent alarm or warning from occurring during one-touch tuning.
C00F	One-touch tuning disabled	"One-touch tuning function selection" in [Pr. PA21] is "Disabled (_ _ _ 0)".	Select "Enabled (_ _ _ 1)".

(f) If an alarm occurs

If an alarm occurs during the one-touch tuning, the tuning will be forcibly terminated. Remove the cause of the alarm and execute one-touch tuning again. When executing one-touch tuning in the driver command method again, return the moving part to the tuning start position.

(g) If a warning occurs

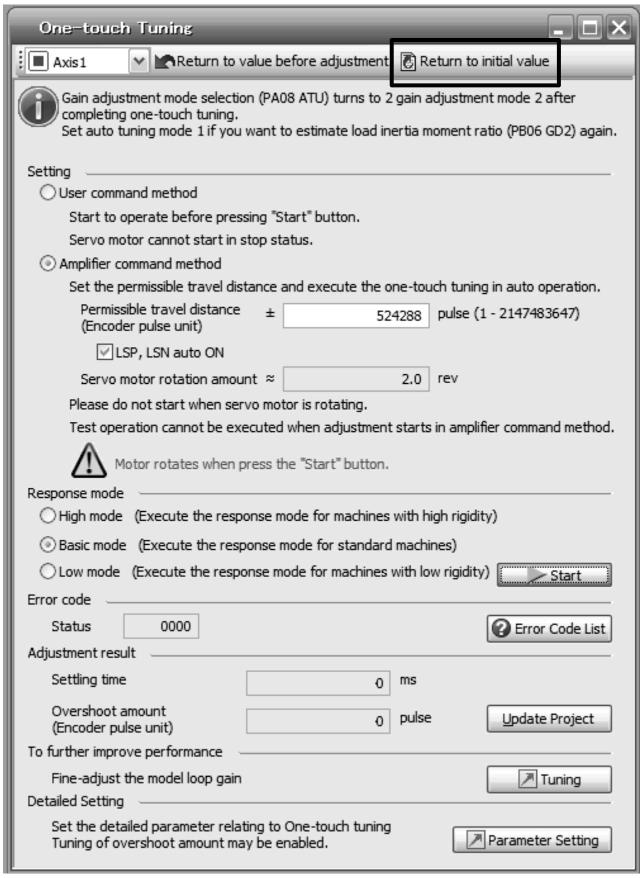
If a warning which continues the motor driving occurs during one-touch tuning by the user command method, the tuning will be continued. If a warning which does not continue the motor driving occurs during the tuning, one-touch tuning will be stopped.

One-touch tuning will be stopped when warning occurs during one-touch tuning by the driver command method regardless of the warning type. Remove the cause of the warning, and return the moving part to the tuning start position. Then, execute the tuning again.

(h) Initializing one-touch tuning

Clicking "Return to initial value" in the one-touch tuning window of setup software (MR Configurator2^{TM}) enables to return the parameter to the initial value. Refer to table 6.1 for the parameters which you can initialize.

Clicking "Return to value before adjustment" in the one-touch tuning window of setup software (MR Configurator2^{TM}) enables to return the parameter to the value before clicking "Start".



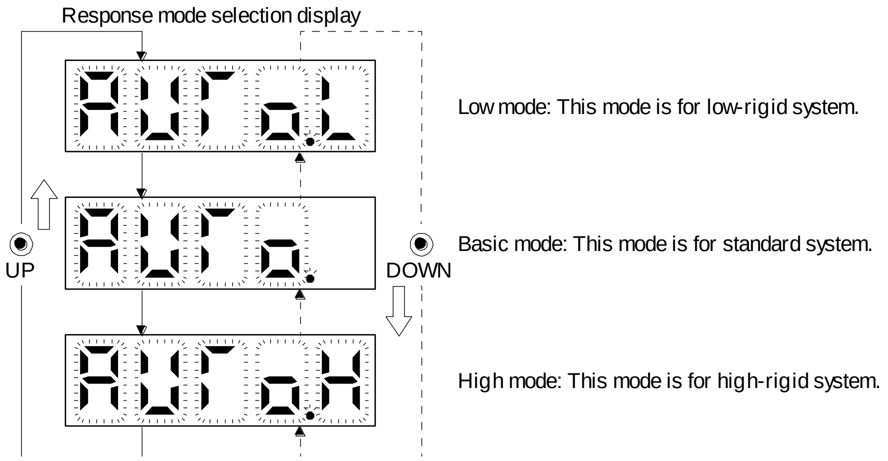
When the initialization of one-touch tuning is completed, the following window will be displayed. (returning to initial value)

(2) When you use push buttons

POINT
●Push the "MODE" and "SET" buttons at the same time for 3 s or more to switch to the response mode selection ("AUTO.") without going through the initial screen of the one-touch tuning ("AUTO").
●When you use push buttons, one-touch tuning can be executed in the user command method only. Tuning cannot be executed in the driver command method with the buttons.

(a) Response mode selection

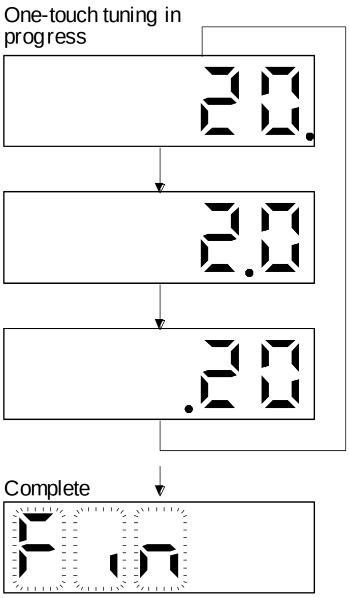
Select a response mode of the one-touch tuning from 3 modes with "UP" or "DOWN". Refer to (1) (b) in this section for a guideline of response mode.



(b) One-touch tuning execution

POINT
●For equipment in which overshoot during one-touch tuning is in the permissible level of the in-position range, changing the value of [Pr. PA25 One-touch tuning - Overshoot permissible level] will shorten the settling time and improve the response.

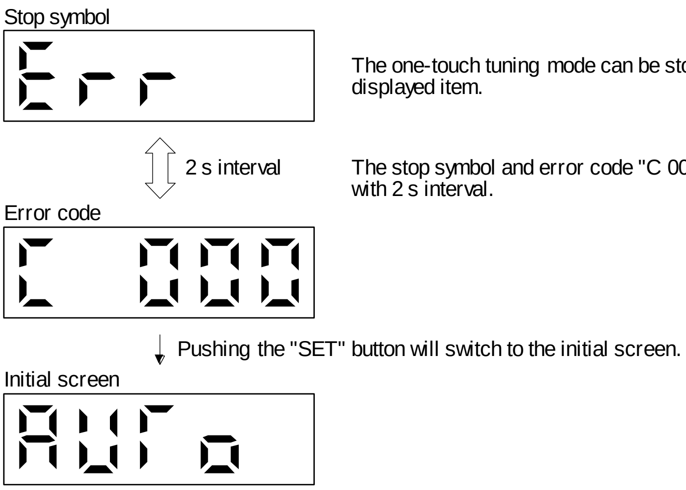
After the response mode is selected in (a), pushing the "SET" button will start one-touch tuning.



The one-touch tuning progress is displayed with 0% to 100%.
The decimal point moves right to left in rotation during the tuning.
To switch the display to the status display during the tuning, push the "MODE" button.

Completing the one-touch tuning will start writing the auto-tuned parameters to the servo driver

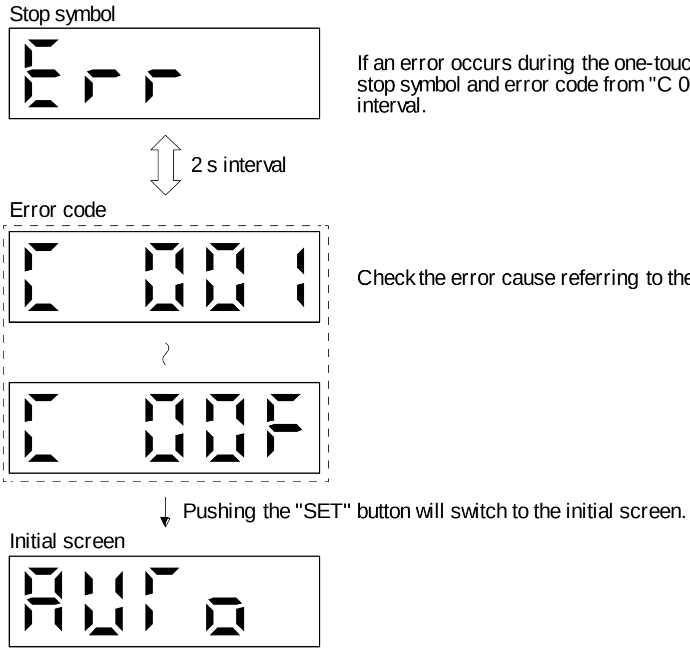
(c) Stop of one-touch tuning



The one-touch tuning mode can be stopped by pushing the "SET" button regardless of displayed item.

The stop symbol and error code "C 000" (cancel during tuning) will be displayed by turns with 2 s interval.

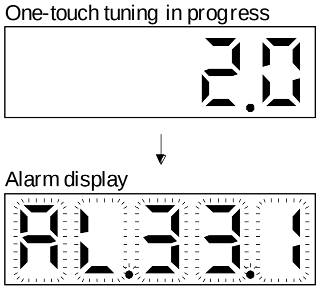
(d) If an error occurs



If an error occurs during the one-touch tuning, the tuning will be forcibly terminated and the stop symbol and error code from "C 001" to "C 00F" will be displayed by turns with 2 s interval.

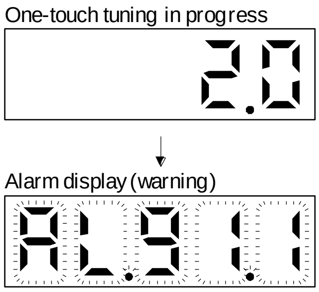
Check the error cause referring to the table 6.2 of (1) (e) in this section.

(e) If an alarm occurs



If an alarm occurs during the one-touch tuning, the tuning will be forcibly terminated and the alarm No. will be displayed.

(f) If a warning occurs



If a warning occurs during the one-touch tuning, the alarm No. of the warning will be displayed.
When the warning is one which continue the motor driving, the one-touch tuning will be continued.

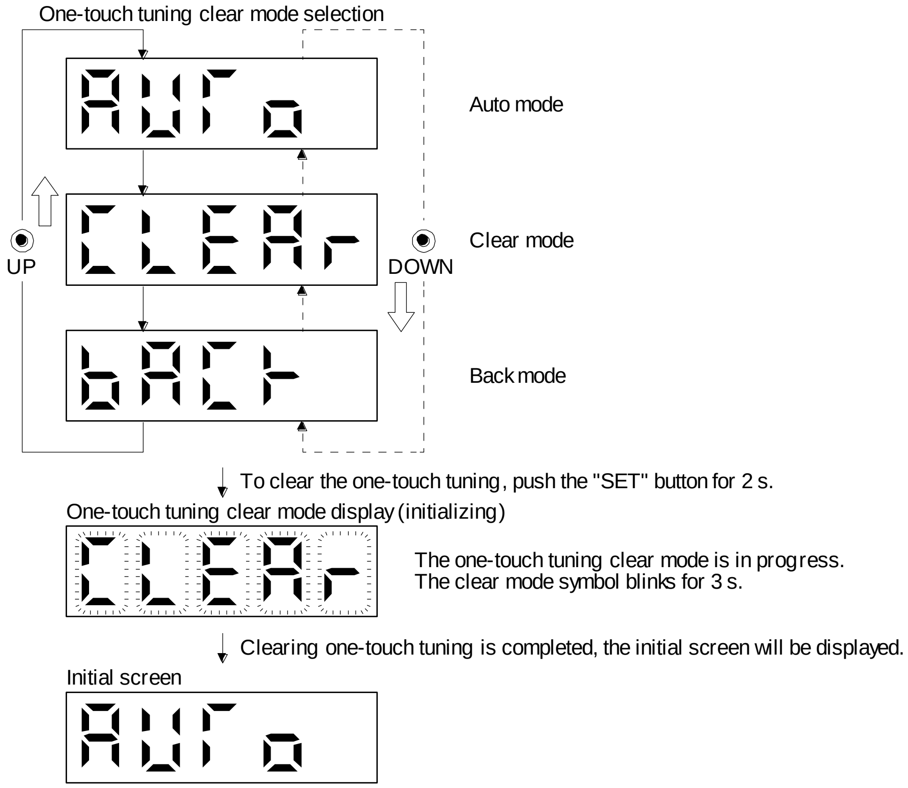
(g) Clearing one-touch tuning

Refer to table 6.1 for the parameters which you can clear.

You can initialize the parameters changed by the one-touch tuning with the clear mode. You can reset the parameters to before tuning with the back mode.

1) Switch to the initial screen "AUTO" of the one-touch tuning with the "MODE" button.

2) Select the clear mode or back mode with the "UP" or "DOWN" button.



6.2.3 Caution for one-touch tuning

(1) Caution common for user command method and driver command method

(a) The tuning is not available in the torque control mode.

(b) The one-touch tuning cannot be executed while an alarm or warning which does not continue the motor driving is occurring.

(c) You can execute the one-touch tuning during the following test operation modes marked by "○".

How to one-touch tuning	Test operation mode				
	Output signal (DO) forced output	JOG operation	Positioning operation	Motor-less operation	Program operation
setup software (MR Configurator2™)		○	○		○
Push buttons					

(d) If one-touch tuning is performed when the gain switching function is enabled, vibration and/or unusual noise may occur during the tuning.

(2) Caution for driver command method

(a) Starting one-touch tuning while the servo motor is rotating displays "C006" at status in error code, and the one-touch tuning cannot be executed.

(b) One-touch tuning is not available during the test operation mode. The following test operation modes cannot be executed during one-touch tuning.

1) Positioning operation

2) JOG operation

3) Program operation

4) Machine analyzer operation

5) Single-step feed

(c) During one-touch tuning, the permissible travel distance may be exceeded due to overshoot, set a value sufficient to prevent machine collision.

(d) When Auto tuning mode 2, Manual mode, or 2 gain adjustment mode 2 is selected in [Pr. PA08 Auto tuning mode], the load to motor inertia ratio will not be estimated. An optimum acceleration/deceleration command will be generated by [Pr. PB06 Load to motor inertia ratio/load to motor mass ratio] at the start of one-touch tuning. When the load to motor inertia ratio is incorrect, the optimum acceleration/deceleration command may not be generated, causing the tuning to fail.

(e) When one-touch tuning is started by using communication, if the communication is interrupted during the tuning, the servo motor will stop, and the tuning will also stop. The parameter will return to the one at the start of the one-touch tuning.

(f) When one-touch tuning is started during the speed control mode, the mode will be switched to the position control mode automatically. The tuning result may differ from the one obtained by executing tuning by using the speed command.

6.3 Auto tuning

6.3.1 Auto tuning mode

The driver has a real-time auto tuning function which estimates the machine characteristic (load to motor inertia 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 to motor inertia 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	Symbol	Name
PB06	GD2	Load to motor inertia ratio
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 all of the following conditions are not satisfied.
  - The acceleration/deceleration time constant to reach 2000 r/min (mm/s) is 5 s or less.
  - Speed is 150 r/min (mm/s) or higher.
  - The load to servo motor (mass of linear servo motor's primary side or direct drive motor) inertia ratio 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

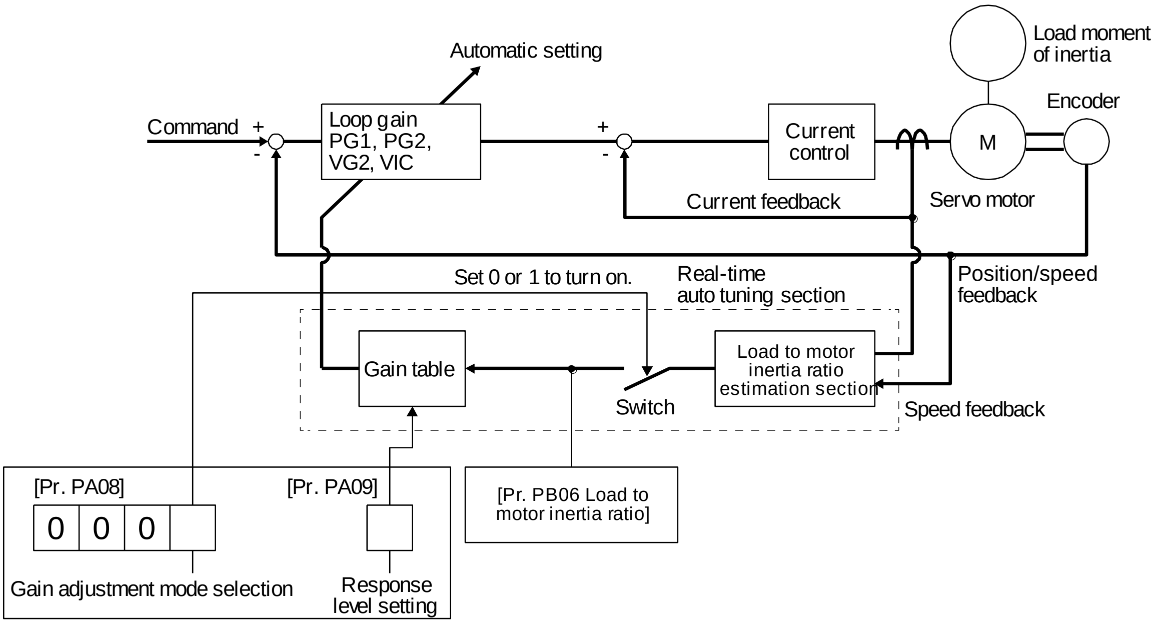
Use the auto tuning mode 2 when proper gain adjustment cannot be made by auto tuning mode 1. Since the load to motor inertia ratio is not estimated in this mode, set the value of a correct load to motor inertia ratio in [Pr. PB06].

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

Parameter	Symbol	Name
PB07	PG1	Model loop gain
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

6.3.2 Auto tuning mode basis

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



When a servo motor is accelerated/decelerated, the load to motor inertia ratio estimation section always estimates the load to motor inertia ratio from the current and speed of the servo motor. The results of estimation are written to [Pr. PB06 Load to motor inertia ratio]. These results can be confirmed on the status display screen of the setup software (MR Configurator2TM).

If you have already known the value of the load to motor inertia ratio or failed to estimate, set "Gain adjustment mode selection" to "Auto tuning mode 2 (_ _ _ 2)" in [Pr. PA08] to stop the estimation (turning off the switch in above diagram), and set the load to motor inertia ratio ([Pr. PB06]) manually.

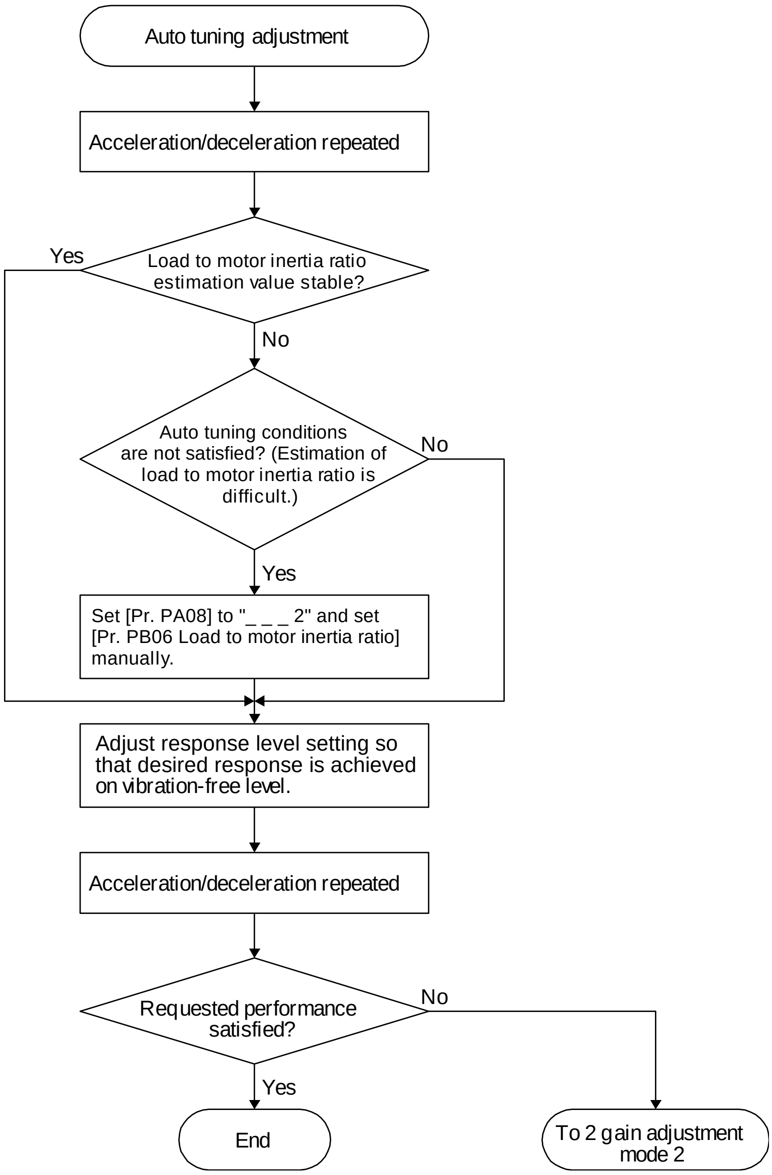
From the preset load to motor inertia ratio ([Pr. PB06]) value and response ([Pr. PA09]), the optimum loop gains are automatically set on the basis of the internal gain table.

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 load to motor inertia ratio may be misestimated temporarily. In such a case, set "Gain adjustment mode selection" to "Auto tuning mode 2 (_ _ _ 2)" in [Pr. PA08] and then set the correct load to motor inertia ratio in [Pr. 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 to motor inertia ratio estimation value are saved in the EEP-ROM.

6.3.3 Adjustment procedure by auto tuning

Since auto tuning is enabled 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.



6.3.4 Response level setting in auto tuning mode

Set the response of the whole servo system by [Pr. PA09]. As the response level setting is increased, trackability to a command improves and settling time decreases, but setting the response level too high will generate vibration.

Set a value to obtain the desired response level within the vibration-free range.

If the response level setting cannot be increased up to the desired response because of machine resonance beyond 100 Hz, filter tuning mode selection in [Pr. PB01] or machine resonance suppression filter in [Pr. PB13] to [Pr. PB16], [Pr. PB46] to [Pr. PB51] may be used to suppress machine resonance. Suppressing machine resonance may allow the response level setting to increase. Refer to section 7.2 and 7.3 for settings of the adaptive tuning mode and machine resonance suppression filter.

[Pr. PA09]

Setting value	Machine characteristic		Reference (setting value of MR-J3)
	Response	Guideline for machine resonance frequency [Hz]	
1	Low response	2.7	
2		3.6	
3		4.9	
4		6.6	
5		10.0	1
6		11.3	2
7		12.7	3
8		14.3	4
9		16.1	5
10		18.1	6
11		20.4	7
12		23.0	8
13		25.9	9
14		29.2	10
15		32.9	11
16		37.0	12
17		41.7	13
18		47.0	14
19	Middle response	52.9	15
20		59.6	16

Setting value	Machine characteristic		Reference (setting value of MR-J3)
	Response	Guideline for machine resonance frequency [Hz]	
21	Middle response	67.1	17
22		75.6	18
23		85.2	19
24		95.9	20
25		108.0	21
26		121.7	22
27		137.1	23
28		154.4	24
29		173.9	25
30		195.9	26
31		220.6	27
32		248.5	28
33		279.9	29
34		315.3	30
35		355.1	31
36		400.0	32
37		446.6	
38		501.2	
39	High response	571.5	
40		642.7	

6.4 Manual mode

If you are not satisfied with the adjustment of auto tuning, you can adjust all gains manually.

POINT
●If machine resonance occurs, filter tuning mode selection in [Pr. PB01] or machine resonance suppression filter in [Pr. PB13] to [Pr. PB16] and [Pr. PB46] to [Pr. PB51] may be used to suppress machine resonance. (Refer to section 7.2 to 7.3.)

(1) For speed control

(a) Parameter

The following parameters are used for gain adjustment.

Parameter	Symbol	Name
PB06	GD2	Load to motor inertia ratio
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 6.2.3.	
2	Change the setting of auto tuning to the manual mode ([Pr. PA08]: _ _ _ 3).	
3	Set the estimated value to the load to motor inertia ratio. (If the estimate value with auto tuning is correct, setting change is not required.)	
4	Set a small value to the model loop gain. Set a large 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 overshoot 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 the adaptive tuning mode or machine resonance suppression filter and then executing steps 3 to 7.	Suppression of machine resonance Refer to section 7.2 and 7.3.
9	While checking the motor status, fine-adjust each gain.	Fine adjustment

(c) Parameter adjustment

1) [Pr. PB09 Speed loop gain]

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.

$$\text{Speed loop response frequency [Hz]} = \frac{\text{Speed loop gain}}{(1 + \text{Load to motor inertia ratio}) \times 2\pi}$$

2) [Pr. PB10 Speed integral compensation]

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 to motor inertia 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.

$$\text{Speed integral compensation setting [ms]} \geq \frac{2000 \text{ to } 3000}{\text{Speed loop gain/(1 + Load to motor inertia rat}}$$

3) [Pr. PB07 Model loop gain]

This parameter determines the response level to a speed command. Increasing the value improves trackability to a speed command, but a too high value will make overshoot liable to occur at settling.

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

(2) For position control

(a) Parameter

The following parameters are used for gain adjustment.

Parameter	Symbol	Name
PB06	GD2	Load to motor inertia ratio
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 6.2.3.	
2	Change the setting of auto tuning to the manual mode ([Pr. PA08]: _ _ _ 3).	
3	Set the estimated value to the load to motor inertia ratio. (If the estimate value with auto tuning is correct, setting change is not required.)	
4	Set a small value to the model loop gain and the position loop gain. Set a large 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 overshoot takes place.	Increase the model 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 the adaptive tuning mode or machine resonance suppression filter and then executing steps 3 to 8.	Suppression of machine resonance Refer to section 7.2 and 7.3.
10	While checking the settling characteristic and motor status, fine-adjust each gain.	Fine adjustment

(c) Parameter adjustment

1) [Pr. PB09 Speed loop gain]

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.

$$\text{Speed loop response frequency [Hz]} = \frac{\text{Speed loop gain}}{(1 + \text{Load to motor inertia ratio}) \times 2\pi}$$

2) [Pr. PB10 Speed integral compensation]

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 to motor inertia 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.

$$\text{Speed integral compensation setting [ms]} \geq \frac{\text{2000 to 3000}}{\text{Speed loop gain/(1 + Load to motor inertia rat}}$$

3) [Pr. PB08 Position loop gain]
This parameter determines the response level to a disturbance to the position control loop. Increasing the value increases the response level to the disturbance, but a too high value will increase vibration of the mechanical system.

$$\text{Position loop gain guideline} \leq \frac{\text{Speed loop gain}}{(1 + \text{Load to motor inertia ratio})} \times \left(\frac{1}{4} \text{ to } \frac{1}{8}\right)$$

4) [Pr. PB07 Model loop gain]
This parameter determines the response level to a position command. Increasing the value improves trackability to a position command, but a too high value will make overshoot liable to occur at settling.

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

6.5 2gain adjustment mode

The 2 gain adjustment 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 trackability. Other parameters for gain adjustment are set automatically.

(1) 2 gain adjustment mode 1 (interpolation mode)
The 2 gain adjustment mode 1 manually set the model loop gain that determines command trackability. The mode constantly estimates the load to motor inertia ratio, and automatically set other parameters for gain adjustment to optimum gains using auto tuning response.
The following parameters are used for 2 gain adjustment mode 1.

(a) Automatically adjusted parameter
The following parameters are automatically adjusted by auto tuning.

Parameter	Symbol	Name
PB06	GD2	Load to motor inertia ratio
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

(b) Manually adjusted parameter
The following parameters are adjustable manually.

Parameter	Symbol	Name
PA09	RSP	Auto tuning response
PB07	PG1	Model loop gain

(2) 2 gain adjustment mode 2
Use 2 gain adjustment mode 2 when proper gain adjustment cannot be made with 2 gain adjustment mode 1. Since the load to motor inertia ratio is not estimated in this mode, set the value of a proper load to motor inertia ratio in [Pr. PB06].
The following parameters are used for 2 gain adjustment mode 2.

(a) Automatically adjusted parameter
The following parameters are automatically adjusted by auto tuning.

Parameter	Symbol	Name
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

(b) Manually adjusted parameter
The following parameters are adjustable manually.

Parameter	Symbol	Name
PA09	RSP	Auto tuning response
PB06	GD2	Load to motor inertia ratio
PB07	PG1	Model loop gain

(3) Adjustment procedure of 2 gain adjustment mode

POINT

●Set the same value in [Pr. PB07 Model loop gain] for the axis used in 2 gain adjustment mode.

Step	Operation	Description
1	Set to the auto tuning mode.	Select the auto tuning mode 1.
2	During operation, increase the response level setting value in [Pr. PA09], and return the setting if vibration occurs.	Adjustment in auto tuning mode 1.
3	Check value of the model loop gain and the load to motor inertia ratio in advance.	Check the upper setting limits.
4	Set the 2 gain adjustment mode 1 ([Pr. PA08]: _ _ _ 0).	Select the 2 gain adjustment mode 1 (interpolation mode).
5	When the load to motor inertia ratio is different from the design value, select the 2 gain adjustment mode 2 ([Pr. PA08]: _ _ _ 4) and then set the load to motor inertia ratio manually in [Pr. PB06].	Check the load to motor inertia ratio.
6	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.
7	Considering the interpolation characteristic and motor status, fine-adjust the model loop gain and response level setting.	Fine adjustment

(4) Parameter adjustment

[Pr. PB07 Model loop gain]

This parameter determines the response level of the position control loop. Increasing the value improves trackability to a position command, but a too high value will make overshoot liable to occur at settling.

Number of droop pulses is determined by the following expression.

$$\text{Number of droop pulses [pulse]} = \frac{\text{Position command frequency [pulse/}}{\text{Model loop gain setting}}$$

Position command frequency differs depending on the operation mode.

Position command frequency

$$= \frac{\text{Speed [r/min}}{60} \times \text{Encoder resolution (number of pulses per servo motor revolution)}$$

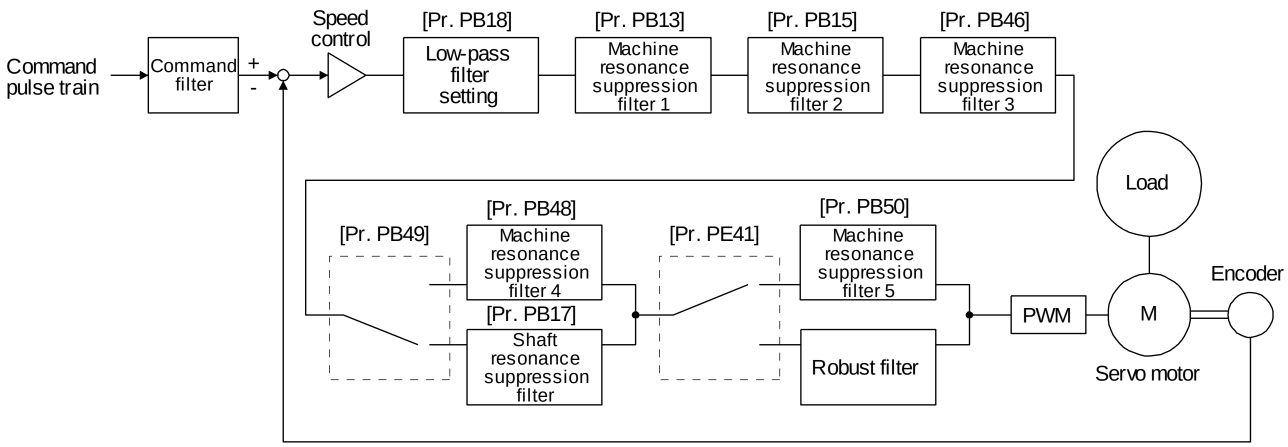
7. SPECIAL ADJUSTMENT FUNCTIONS

7. SPECIAL ADJUSTMENT FUNCTIONS

POINT
●The functions given in this chapter need not be used normally. Use them if you are not satisfied with the machine status after making adjustment in the methods in chapter 6.

7.1 Filter setting

The following filters are available with LECSB2-T□ drivers.



7.1.1 Machine resonance suppression filter

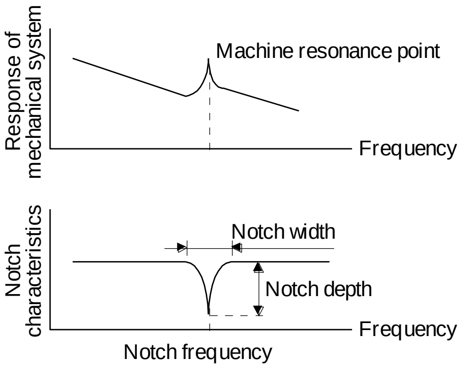
POINT

- The machine resonance suppression filter is a delay factor for the servo system. Therefore, vibration may increase if you set an incorrect resonance frequency or set notch characteristics too deep or too wide.
- 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 deeper 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 setup software (MR Configurator2™). This allows the required notch frequency and notch characteristics to be determined.

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. The setting range is 10 Hz to 4500 Hz.

(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 set five machine resonance suppression filters at most.

Filter	Setting parameter	Precaution	Parameter that is reset with vibration tough drive function	Parameter automatically adjusted with one-touch tuning
Machine resonance suppression filter 1	PB01/PB13/PB14	The filter can be set automatically with "Filter tuning mode selection" in [Pr. PB01].	PB13	PB01/PB13/PB14
Machine resonance suppression filter 2	PB15/PB16		PB15	PB15/PB16
Machine resonance suppression filter 3	PB46/PB47			PB46/PB47
Machine resonance suppression filter 4	PB48/PB49	Enabling the machine resonance suppression filter 4 disables the shaft resonance suppression filter. Using the shaft resonance suppression filter is recommended because it is adjusted properly depending on the usage situation. The shaft resonance suppression filter is enabled for the initial setting.		PB48/PB49
Machine resonance suppression filter 5	PB50/PB51	Enabling the robust filter disables the machine resonance suppression filter 5. The robust filter is disabled for the initial setting.		PB51

(2) Parameter

(a) Machine resonance suppression filter 1 ([Pr. PB13] and [Pr. PB14])

Set the notch frequency, notch depth and notch width of the machine resonance suppression filter 1 ([Pr. PB13] and [Pr. PB14])

When you select "Manual setting (_ _ _ 2)" of "Filter tuning mode selection" in [Pr. PB01], the setting of the machine resonance suppression filter 1 is enabled.

(b) Machine resonance suppression filter 2 ([Pr. PB15] and [Pr. PB16])

To use this filter, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 2 selection" in [Pr. PB16].

How to set the machine resonance suppression filter 2 ([Pr. PB15] and [Pr. PB16]) is the same as for the machine resonance suppression filter 1 ([Pr. PB13] and [Pr. PB14]).

(c) Machine resonance suppression filter 3 ([Pr. PB46] and [Pr. PB47])

To use this filter, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 3 selection" in [Pr. PB47].

How to set the machine resonance suppression filter 3 ([Pr. PB46] and [Pr. PB47]) is the same as for the machine resonance suppression filter 1 ([Pr. PB13] and [Pr. PB14]).

(d) Machine resonance suppression filter 4 ([Pr. PB48] and [Pr. PB49])

To use this filter, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 4 selection" in [Pr. PB49]. However, enabling the machine resonance suppression filter 4 disables the shaft resonance suppression filter.

How to set the machine resonance suppression filter 4 ([Pr. PB48] and [Pr. PB49]) is the same as for the machine resonance suppression filter 1 ([Pr. PB13] and [Pr. PB14]).

(e) Machine resonance suppression filter 5 ([Pr. PB50] and [Pr. PB51])

To use this filter, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 5 selection" in [Pr. PB51]. However, enabling the robust filter ([Pr. PE41: _ _ _ 1]) disables the machine resonance suppression filter 5.

How to set the machine resonance suppression filter 5 ([Pr. PB50] and [Pr. PB51]) is the same as for the machine resonance suppression filter 1 ([Pr. PB13] and [Pr. PB14]).

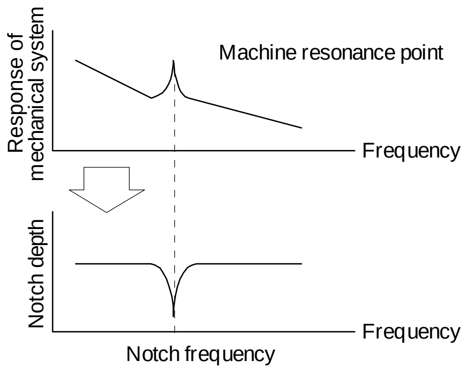
7.1.2 Adaptive filter II

POINT

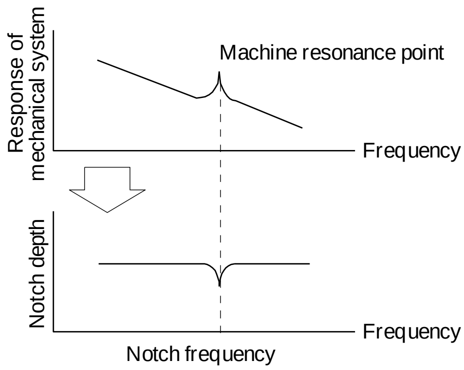
- The machine resonance frequency which adaptive filter II (adaptive tuning) can respond to is about 100 Hz to 2.25 kHz. As for the resonance frequency out of the range, set manually.
- When adaptive tuning is executed, vibration sound increases as an excitation signal is forcibly applied for several 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 setting.
- 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 setting.
- Adaptive vibration suppression control may provide no effect on a mechanical system which has complex resonance characteristics.
- The frequency is estimated more accurately in the high accuracy mode compared to the standard mode. However, the tuning sound may be larger in the high accuracy mode.

(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

(2) Parameter

Select how to set the filter tuning in [Pr. PB01 Adaptive tuning mode (adaptive filter II)].

[Pr. PB01]

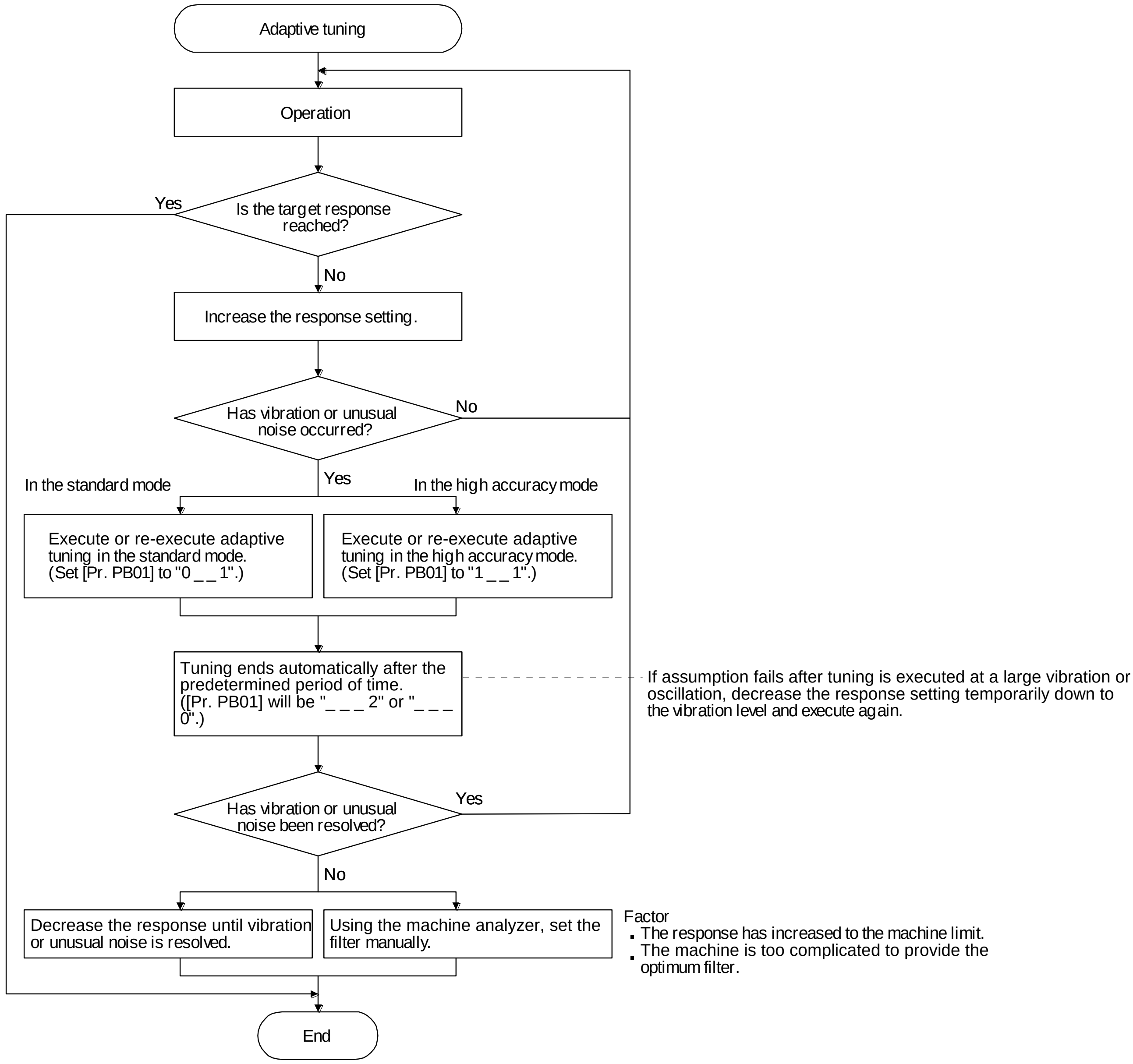
	0	0	

Filter tuning mode selection

Setting value	Filter tuning mode selection	Automatically set parameter
0	Disabled	
1	Automatic setting	PB13/PB14
2	Manual setting	

Tuning accuracy selection (Note)
0: Standard
1: High accuracy

(3) Adaptive tuning mode procedure



7.1.3 Shaft resonance suppression filter

POINT

- This filter is set properly by default according to servo motor you use and load moment of inertia. It is recommended that [Pr. PB23] be set to "_ _ _ 0" (automatic setting) because changing "Shaft resonance suppression filter selection" in [Pr. PB23] or [Pr. PB17 Shaft resonance suppression filter] may lower the performance.

(1) Function

When a load is mounted to the servo motor shaft, resonance by shaft torsion during driving may generate a mechanical vibration at high frequency. The shaft resonance suppression filter suppresses the vibration.

When you select "Automatic setting", the filter will be set automatically on the basis of the motor you use and the load to motor inertia ratio. The disabled setting increases the response of the driver for high resonance frequency.

(2) Parameter

Set "Shaft resonance suppression filter selection" in [Pr. PB23].

[Pr. PB23]

0	0	0	

Shaft resonance suppression filter selection
0: Automatic setting
1: Manual setting
2: Disabled

To set [Pr. PB17 Shaft resonance suppression filter] automatically, select "Automatic setting".

To set [Pr. PB17 Shaft resonance suppression filter] manually, select "Manual setting". The setting values are as follows.

Shaft resonance suppression filter setting frequency selection

Setting value	Frequency [Hz]
_ _ 0 0	Disabled
_ _ 0 1	Disabled
_ _ 0 2	4500
_ _ 0 3	3000
_ _ 0 4	2250
_ _ 0 5	1800
_ _ 0 6	1500
_ _ 0 7	1285
_ _ 0 8	1125
_ _ 0 9	1000
_ _ 0 A	900
_ _ 0 B	818
_ _ 0 C	750
_ _ 0 D	692
_ _ 0 E	642
_ _ 0 F	600

Setting value	Frequency [Hz]
_ _ 1 0	562
_ _ 1 1	529
_ _ 1 2	500
_ _ 1 3	473
_ _ 1 4	450
_ _ 1 5	428
_ _ 1 6	409
_ _ 1 7	391
_ _ 1 8	375
_ _ 1 9	360
_ _ 1 A	346
_ _ 1 B	333
_ _ 1 C	321
_ _ 1 D	310
_ _ 1 E	300
_ _ 1 F	290

7.1.4 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 enabled for a torque command as a default. The filter frequency of the low-pass filter is automatically adjusted to the value in the following equation.

$$\text{Filter frequency ([rad/s])} = \frac{\text{VG2}}{1 + \text{GD2}} \times 10$$

However, when an automatically adjusted value is smaller than VG2, the filter frequency will be the VG2 value.
To set [Pr. PB18] manually, select "Manual setting (_ _ 1 _)" of "Low-pass filter selection" in [Pr. PB23].

(2) Parameter

Set "Low-pass filter selection" in [Pr. PB23].

[Pr. PB23]

0	0		0

Low-pass filter selection
0: Automatic setting
1: Manual setting
2: Disabled

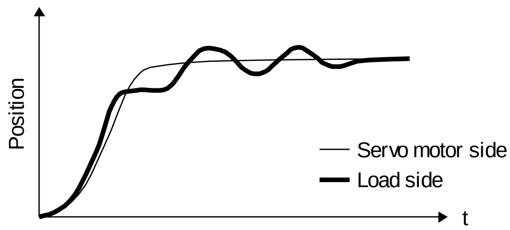
7.1.5 Advanced vibration suppression control II

POINT

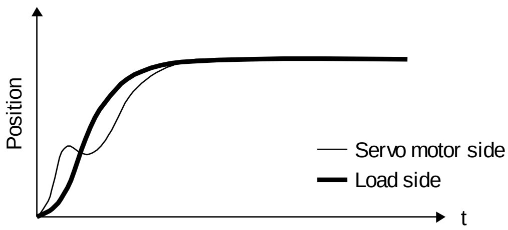
- The function is enabled when "Gain adjustment mode selection" in [Pr. PA08] is "Auto tuning mode 2 (_ _ _ 2)", "Manual mode (_ _ _ 3)", or "2 gain adjustment mode 2 (_ _ _ 4)".
- The machine resonance frequency supported in the vibration suppression control tuning mode is 1.0 Hz to 100.0 Hz. As for the vibration out of the range, set manually.
- Stop the servo motor before changing the vibration suppression control-related parameters. Otherwise, it may cause an unexpected operation.
- For positioning operation during execution of vibration suppression control tuning, provide a stop time to ensure a stop after vibration damping.
- Vibration suppression control tuning may not make normal estimation if the residual vibration at the servo 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.
- When using the vibration suppression control 2, set "_ _ _ 1" in [Pr. PA24].

(1) Function

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



Vibration suppression: off (normal)



Vibration suppression control: on

When the advanced vibration suppression control II ([Pr. PB02 Vibration suppression control tuning mode]) is executed, the vibration frequency at load side is automatically estimated to suppress machine side vibration two times at most.

In the vibration suppression control tuning mode, this mode shifts to the manual setting after the positioning operation is performed the predetermined number of times. For manual setting, adjust the vibration suppression control 1 with [Pr. PB19] to [Pr. PB22] and vibration suppression control 2 with [Pr. PB52] to [Pr. PB55].

(2) Parameter

Set [Pr. PB02 Vibration suppression control tuning mode (advanced vibration suppression control II)]. When you use a vibration suppression control, set "Vibration suppression control 1 tuning mode selection". When you use two vibration suppression controls, set "Vibration suppression control 2 tuning mode selection" in addition.

[Pr. PB02]

0	0		

Vibration suppression control 1 tuning mode

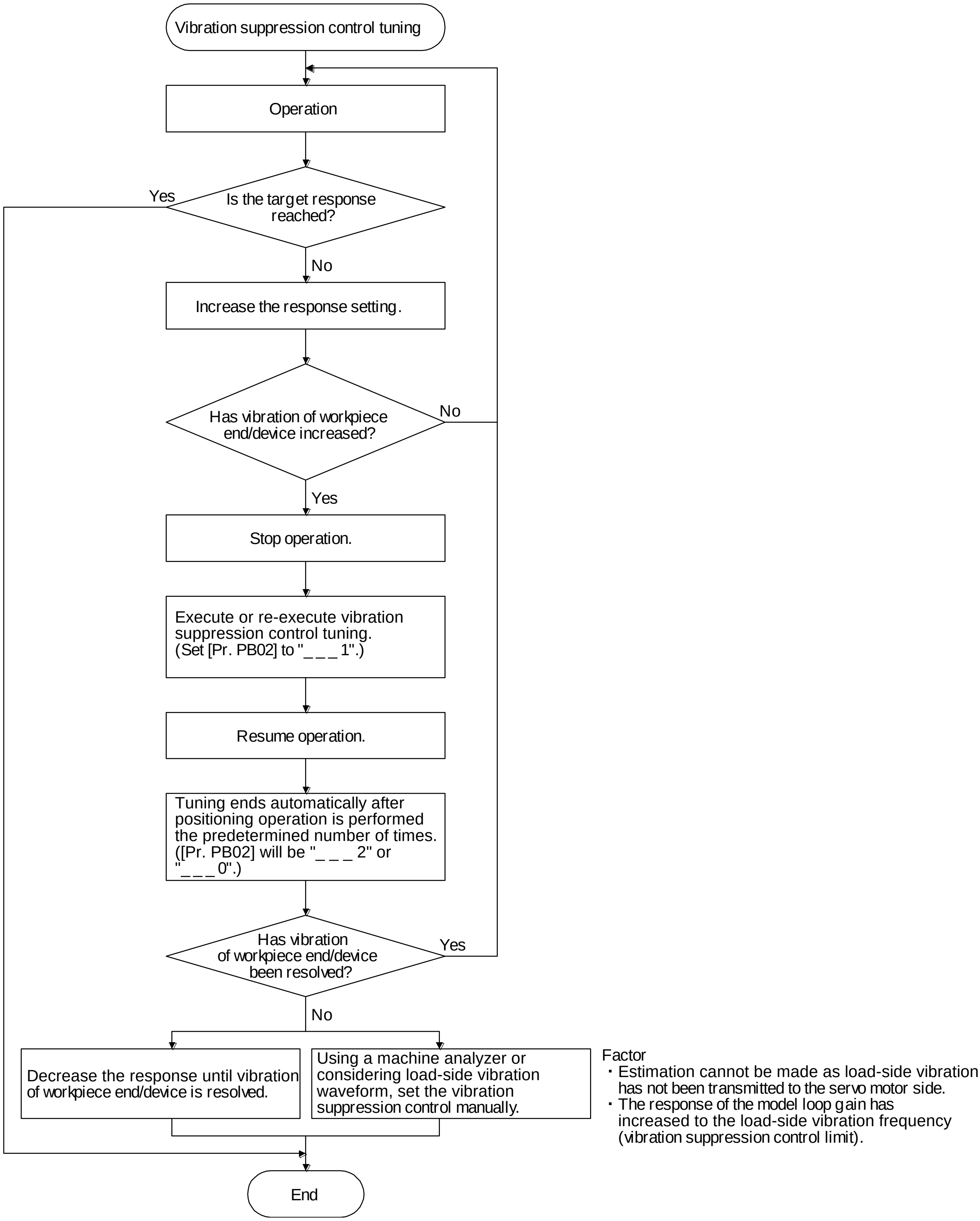
Setting value	Vibration suppression control 1 tuning mode selection	Automatically set parameter
_ _ _ 0	Disabled	
_ _ _ 1	Automatic setting	PB19/PB20/PB21/PB22
_ _ _ 2	Manual setting	

Vibration suppression control 2 tuning mode

Setting value	Vibration suppression control 2 tuning mode selection	Automatically set parameter
_ _ 0 _	Disabled	
_ _ 1 _	Automatic setting	PB52/PB53/PB54/PB55
_ _ 2 _	Manual setting	

(3) Vibration suppression control tuning procedure

The following flow chart is for the vibration suppression control 1. For the vibration suppression control 2, set "_ _ 1 _" in [Pr. PB02] to execute the vibration suppression control tuning.



(4) Vibration suppression control manual mode

POINT

- When load-side vibration does not show up in servo motor-side vibration, the setting of the servo 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 equipment, do not set the same value but set different values to improve the vibration suppression performance.
- The setting range of [Pr. PB19], [Pr. PB20], [Pr. PB52], and [Pr. PB53] varies, depending on the value in [Pr. PB07]. If a value out of the range is set, the vibration suppression control will be disabled.

Measure work-side vibration and device shake with the machine analyzer or external measuring instrument, and set the following parameters to adjust vibration suppression control manually.

Setting item	Vibration suppression control 1	Vibration suppression control 2
Vibration suppression control - Vibration frequency	[Pr. PB19]	[Pr. PB52]
Vibration suppression control - Resonance frequency	[Pr. PB20]	[Pr. PB53]
Vibration suppression control - Vibration frequency damping	[Pr. PB21]	[Pr. PB54]
Vibration suppression control - Resonance frequency damping	[Pr. PB22]	[Pr. PB55]

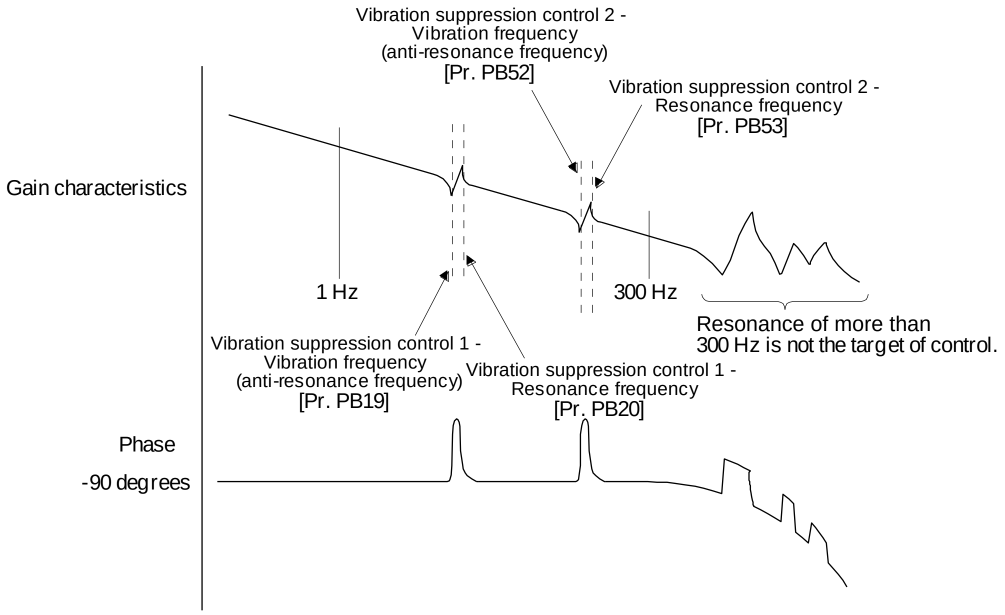
Step 1 Select "Manual setting (_ _ _ 2)" of "Vibration suppression control 1 tuning mode selection" or "Manual setting (_ _ 2 _)" of "Vibration suppression control 2 tuning mode selection" in [Pr. PB02].

Step 2 Set "Vibration suppression control - Vibration frequency" and "Vibration suppression control - Resonance frequency" as follows.

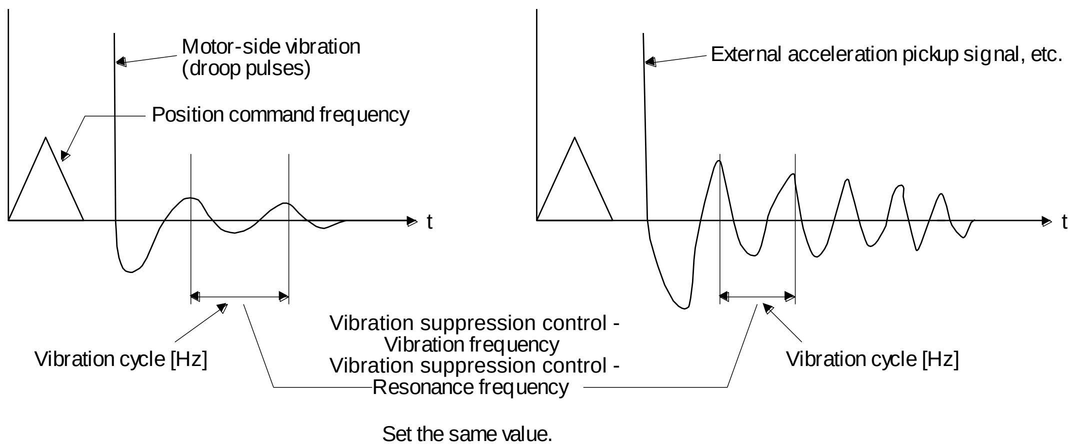
However, the value of [Pr. PB07 Model loop gain], vibration frequency, and resonance frequency have the following usable range and recommended range.

Vibration suppression control	Usable range	Recommended setting range
Vibration suppression control 1	[Pr. PB19] > 1/2π × (0.9 × [Pr. PB07]) [Pr. PB20] > 1/2π × (0.9 × [Pr. PB07])	[Pr. PB19] > 1/2π × (1.5 × [Pr. PB07]) [Pr. PB20] > 1/2π × (1.5 × [Pr. PB07])
Vibration suppression control 2	When [Pr. PB19] < [Pr. PB52], [Pr. PB52] > (5.0 + 0.1 × [Pr. PB07]) [Pr. PB53] > (5.0 + 0.1 × [Pr. PB07]) 1.1 < [Pr. PB52]/[Pr. PB19] < 5.5 [Pr. PB07] < 2π (0.3 × [Pr. PB19] + 1/8 × [Pr. PB52])	When [Pr. PB19] < [Pr. PB52], [Pr. PB52], [Pr. PB53] > 6.25 Hz 1.1 < [Pr. PB52]/[Pr. PB19] < 4 [Pr. PB07] < 1/3 × (4 × [Pr. PB19] + 2 × [Pr. PB52])

(a) When a vibration peak can be confirmed with machine analyzer using setup software (MR Configurator2™), or external equipment.



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



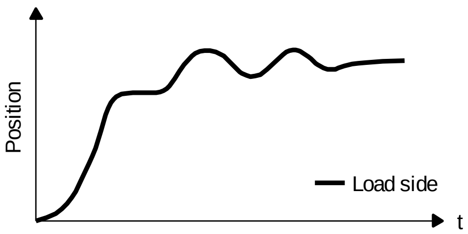
Step 3 Fine-adjust "Vibration suppression control - Vibration frequency damping" and "Vibration suppression control - Resonance frequency damping".

7.1.6 Command notch filter

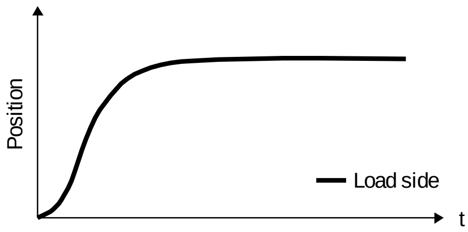
POINT
●By using the advanced vibration suppression control II and the command notch filter, the load-side vibration of three frequencies can be suppressed. ●The frequency range of machine vibration, which can be supported by the command notch filter, is between 4.5 Hz and 2250 Hz. Set a frequency close to the machine vibration frequency and within the range. ●When [Pr. PB45 Command notch filter] is changed during the positioning operation, the changed setting is not reflected. The setting is reflected approximately 150 ms after the servo motor stops (after servo-lock).

(1) Function

Command notch filter has a function that lowers the gain of the specified frequency contained in a position command. By lowering the gain, load-side vibration, such as work-side vibration and base shake, can be suppressed. Which frequency to lower the gain and how deep to lower the gain can be set.



Command notch filter: disabled



Command notch filter: enabled

(2) Parameter

Set [Pr. PB45 Command notch filter] as shown below. For the command notch filter setting frequency, set the closest value to the vibration frequency [Hz] at the load side.

[Pr. PB45]

0 □ □ □

Notch depth

Setting value	Depth [dB]
0	-40.0
1	-24.1
2	-18.1
3	-14.5
4	-12.0
5	-10.1
6	-8.5
7	-7.2
8	-6.0
9	-5.0
A	-4.1
B	-3.3
C	-2.5
D	-1.8
E	-1.2
F	-0.6

Command notch filter setting frequency

Setting value	Frequency [Hz]	Setting value	Frequency [Hz]	Setting value	Frequency [Hz]
00	Disabled	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

7.2 Gain switching function

You can switch gains with the function. You can switch gains during rotation and during stop, and can use an input device to switch gains during operation.

7.2.1 Applications

T The following shows when you use the function.

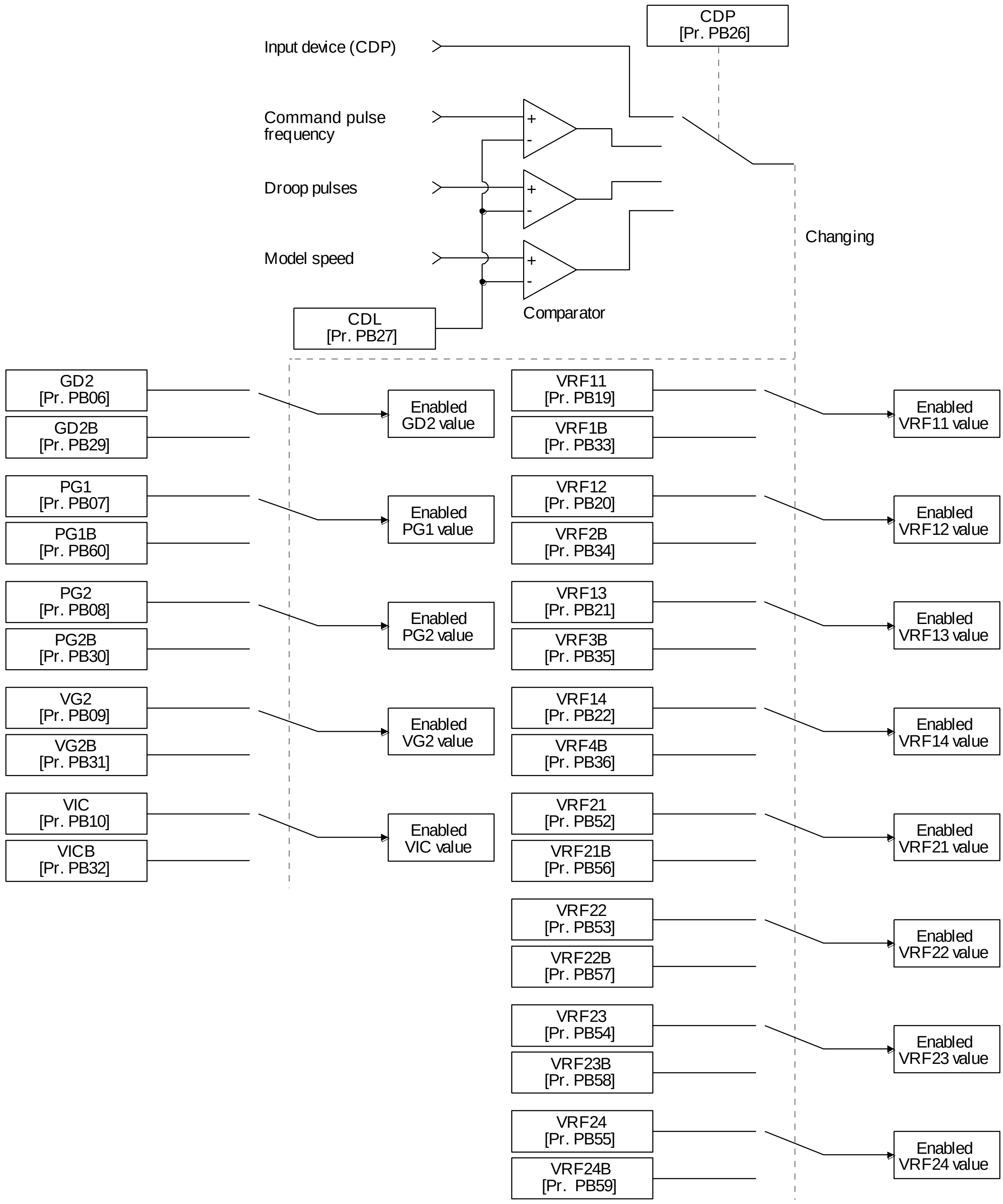
(1) You want to increase the gains during servo-lock but decrease the gains to reduce noise during rotation.

(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 to motor inertia ratio varies greatly during a stop (e.g. a large load is mounted on a carrier).

7.2.2 Function block diagram

The control gains, load to motor inertia ratio, and vibration suppression control settings are changed according to the conditions selected by [Pr. PB26 Gain switching function] and [Pr. PB27 Gain switching condition].



7.2.3 Parameter

When using the gain switching function, always select "Manual mode (_ _ _ 3)" of "Gain adjustment mode selection" in [Pr. PA08 Auto tuning mode]. The gain switching function cannot be used in the auto tuning mode.

(1) Parameter for setting gain switching condition

Parameter	Symbol	Name	Unit	Description
PB26	CDP	Gain switching function		Select a switching condition.
PB27	CDL	Gain switching condition	[kpulse/s] /[pulse] /[r/min]	Set a switching condition values.
PB28	CDT	Gain switching time constant	[ms]	Set the filter time constant for a gain change at switching.

(a) [Pr. PB26 Gain switching function]

Used to set the gain switching condition. Select the switching condition in the first to third digits.

[Pr. PB26]

0			

Gain switching selection
0: Disabled
1: Input device (gain switching (CDP))
2: Command frequency
3: Droop pulses
4: Servo motor speed/linea

Gain switching condition
0: Gain after switching is enabled with gain switching condition or more
1: Gain after switching is enabled with gain switching condition or less

Gain switching time constant disabling condition selection (Note)
0: Switching time constant enabled
1: Switching time constant disabled
2: Return time constant disabled

(b) [Pr. PB27 Gain switching condition]

Set a level to switch gains with [Pr. PB27] after you select "Command frequency", "Droop pulses", or "Servo motor speed" with the gain switching selection in [Pr. PB26 Gain switching function].
The setting unit is as follows.

Gain switching condition	Unit
Command frequency	[kpulse/s]
Droop pulses	[pulse]
Servo motor speed	[r/min]

(c) [Pr. PB28 Gain switching time constant]

You can set the primary delay filter to each gain at gain switching. This parameter is used to suppress shock given to the machine if the gain difference is large at gain switching, for example.

(2) Switchable gain parameter

Loop gain	Before switching			After switching		
	Parameter	Symbol	Name	Parameter	Symbol	Name
Load to motor inertia ratio	PB06	GD2	Load to motor inertia ratio	PB29	GD2B	Load to motor inertia ratio after gain switching
Model loop gain	PB07	PG1	Model loop gain	PB60	PG1B	Model loop gain after gain switching
Position loop gain	PB08	PG2	Position loop gain	PB30	PG2B	Position loop gain after gain switching
Speed loop gain	PB09	VG2	Speed loop gain	PB31	VG2B	Speed loop gain after gain switching
Speed integral compensation	PB10	VIC	Speed integral compensation	PB32	VICB	Speed integral compensation after gain switching
Vibration suppression control 1 - Vibration frequency	PB19	VRF11	Vibration suppression control 1 - Vibration frequency	PB33	VRF11B	Vibration suppression control 1 - Vibration frequency after gain switching
Vibration suppression control 1 - Resonance frequency	PB20	VRF12	Vibration suppression control 1 - Resonance frequency	PB34	VRF12B	Vibration suppression control 1 - Resonance frequency after gain switching
Vibration suppression control 1 - Vibration frequency damping	PB21	VRF13	Vibration suppression control 1 - Vibration frequency damping	PB35	VRF13B	Vibration suppression control 1 - Vibration frequency damping after gain switching
Vibration suppression control 1 - Resonance frequency damping	PB22	VRF14	Vibration suppression control 1 - Resonance frequency damping	PB36	VRF14B	Vibration suppression control 1 - Resonance frequency damping after gain switching
Vibration suppression control 2 - Vibration frequency	PB52	VRF21	Vibration suppression control 2 - Vibration frequency	PB56	VRF21B	Vibration suppression control 2 - Vibration frequency after gain switching
Vibration suppression control 2 - Resonance frequency	PB53	VRF22	Vibration suppression control 2 - Resonance frequency	PB57	VRF22B	Vibration suppression control 2 - Resonance frequency after gain switching
Vibration suppression control 2 - Vibration frequency damping	PB54	VRF23	Vibration suppression control 2 - Vibration frequency damping	PB58	VRF23B	Vibration suppression control 2 - Vibration frequency damping after gain switching
Vibration suppression control 2 - Resonance frequency damping	PB55	VRF24	Vibration suppression control 2 - Resonance frequency damping	PB59	VRF24B	Vibration suppression control 2 - Resonance frequency damping after gain switching

(a) [Pr. PB06] to [Pr. PB10]

These parameters are the same as in ordinary manual adjustment. Gain switching allows the values of load to motor inertia ratio, position loop gain, speed loop gain, and speed integral compensation to be switched.

(b) [Pr. PB19] to [Pr. PB22]/[Pr. PB52] to [Pr. PB55]

These parameters are the same as in ordinary manual adjustment. Executing gain switching while the servo motor stops, You can change vibration frequency, resonance frequency, vibration frequency damping, and resonance frequency damping.

(c) [Pr. PB29 Load to motor inertia ratio after gain switching]

Set the load to motor inertia ratio after gain switching. If the load to motor inertia ratio does not change, set it to the same value as [Pr. PB06 Load to motor inertia ratio].

(d) [Pr. PB30 Position loop gain after gain switching], [Pr. PB31 Speed loop gain after gain switching], and [Pr. PB32 Speed integral compensation after gain switching]

Set the values of after switching position loop gain, speed loop gain and speed integral compensation.

(e) Vibration suppression control after gain switching ([Pr. PB33] to [Pr. PB36]/[Pr. PB56] to [Pr. PB59]), and [Pr. PB60 Model loop gain after gain switching]

The gain switching vibration suppression control and model loop gain are used only with control command from the PC or PLC…etc.

You can switch the vibration frequency, resonance frequency, vibration frequency damping, resonance frequency damping, and model loop gain of the vibration suppression control 1 and vibration suppression control 2.

7.2.4 Gain switching procedure

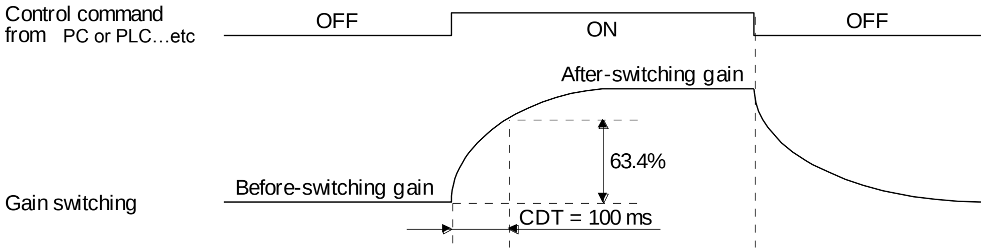
This operation will be described by way of setting examples.

(1) When you choose switching by control command from the PC or PLC…etc

(a) Setting

Parameter	Symbol	Name	Setting value	Unit
PB06	GD2	Load to motor inertia ratio/load to motor mass ratio	4.00	[Multiplier]
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	VRF11	Vibration suppression control 1 - Vibration frequency	50	[Hz]
PB20	VRF12	Vibration suppression control 1 - Resonance frequency	50	[Hz]
PB21	VRF13	Vibration suppression control 1 - Vibration frequency damping	0.20	
PB22	VRF14	Vibration suppression control 1 - Resonance frequency damping	0.20	
PB52	VRF21	Vibration suppression control 2 - Vibration frequency	20	[Hz]
PB53	VRF22	Vibration suppression control 2 - Resonance frequency	20	[Hz]
PB54	VRF23	Vibration suppression control 2 - Vibration frequency damping	0.10	
PB55	VRF24	Vibration suppression control 2 - Resonance frequency damping	0.10	
PB29	GD2B	Load to motor inertia ratio/load to motor mass ratio after gain switching	10.00	[Multiplier]
PB60	PG1B	Model loop gain after gain switching	50	[rad/s]
PB30	PG2B	Position loop gain after gain switching	84	[rad/s]
PB31	VG2B	Speed loop gain after gain switching	4000	[rad/s]
PB32	VICB	Speed integral compensation after gain switching	50	[ms]
PB26	CDP	Gain switching function	0001 (Switch by input device (CDP) on/off.)	
PB28	CDT	Gain switching time constant	100	[ms]
PB33	VRF1B	Vibration suppression control 1 - Vibration frequency after gain switching	60	[Hz]
PB34	VRF2B	Vibration suppression control 1 - Resonance frequency after gain switching	60	[Hz]
PB35	VRF3B	Vibration suppression control 1 - Vibration frequency damping after gain switching	0.15	
PB36	VRF4B	Vibration suppression control 1 - Resonance frequency damping after gain switching	0.15	
PB56	VRF21B	Vibration suppression control 2 - Vibration frequency after gain switching	30	[Hz]
PB57	VRF22B	Vibration suppression control 2 - Resonance frequency after gain switching	30	[Hz]
PB58	VRF23B	Vibration suppression control 2 - Vibration frequency damping after gain switching	0.05	
PB59	VRF24B	Vibration suppression control 2 - Resonance frequency damping after gain switching	0.05	

(b) Switching timing chart



Model loop gain	100	→	50	→	100
Load to motor inertia ratio/load to motor mass ratio	4.00	→	10.00	→	4.00
Position loop gain	120	→	84	→	120
Speed loop gain	3000	→	4000	→	3000
Speed integral compensation	20	→	50	→	20
Vibration suppression control 1 - Vibration frequency	50	→	60	→	50
Vibration suppression control 1 - Resonance frequency	50	→	60	→	50
Vibration suppression control 1 - Vibration frequency damping	0.20	→	0.15	→	0.20
Vibration suppression control 1 - Resonance frequency damping	0.20	→	0.15	→	0.20
Vibration suppression control 2 - Vibration frequency	20	→	30	→	20
Vibration suppression control 2 - Resonance frequency	20	→	30	→	20
Vibration suppression control 2 - Vibration frequency damping	0.10	→	0.05	→	0.10
Vibration suppression control 2 - Resonance frequency damping	0.10	→	0.05	→	0.10

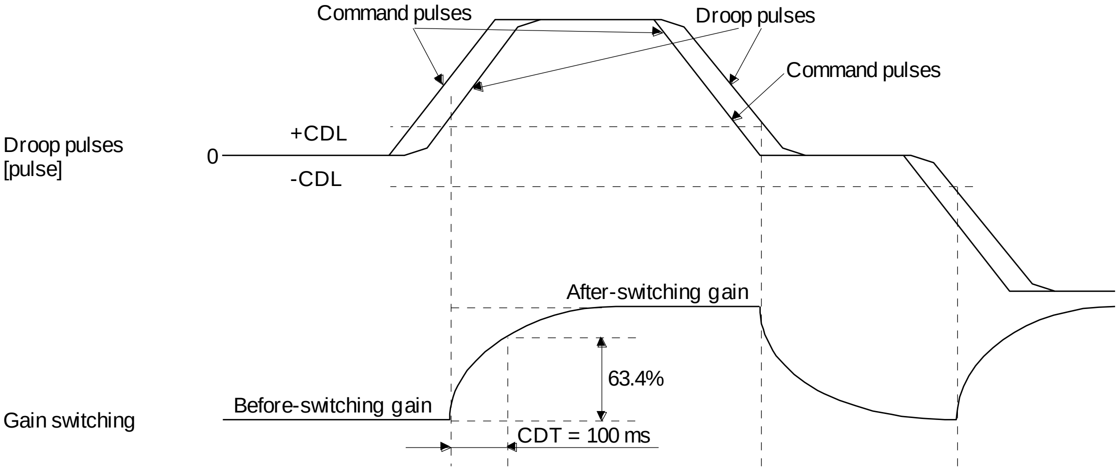
(2) When you choose switching by droop pulses

The vibration suppression control after gain switching and model loop gain after gain switching cannot be used.

(a) Setting

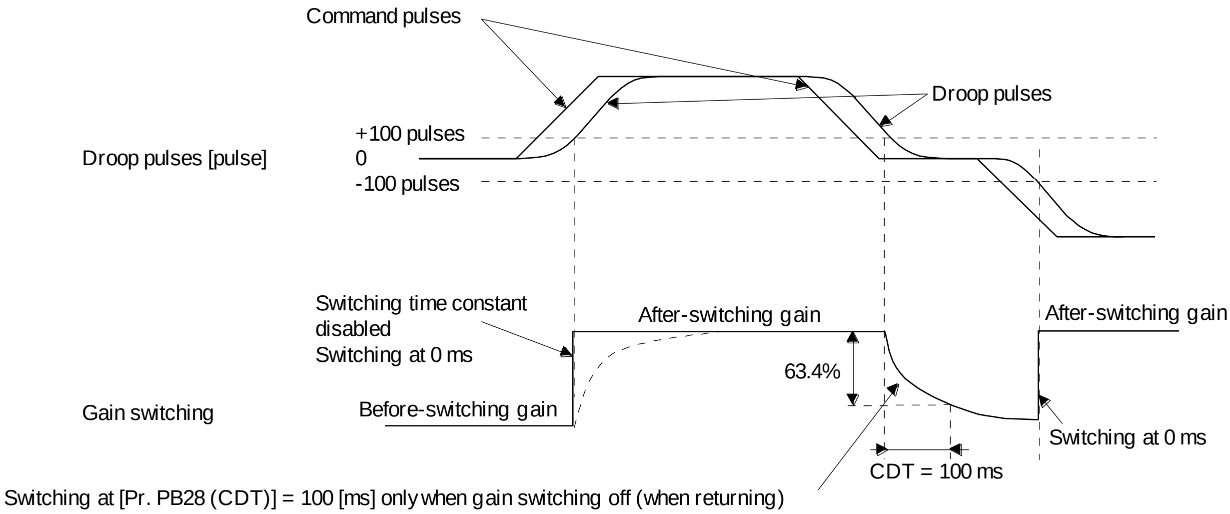
Parameter	Symbol	Name	Setting value	Unit
PB06	GD2	Load to motor inertia ratio/load to motor mass ratio	4.00	[Multiplier]
PB08	PG2	Position loop gain	120	[rad/s]
PB09	VG2	Speed loop gain	3000	[rad/s]
PB10	VIC	Speed integral compensation	20	[ms]
PB29	GD2B	Load to motor inertia ratio/load to motor mass ratio after gain switching	10.00	[Multiplier]
PB30	PG2B	Position loop gain after gain switching	84	[rad/s]
PB31	VG2B	Speed loop gain after gain switching	4000	[rad/s]
PB32	VICB	Speed integral compensation after gain switching	50	[ms]
PB26	CDP	Gain switching selection	0003 (switching by droop pulses)	
PB27	CDL	Gain switching condition	50	[pulse]
PB28	CDT	Gain switching time constant	100	[ms]

(b) Switching timing chart

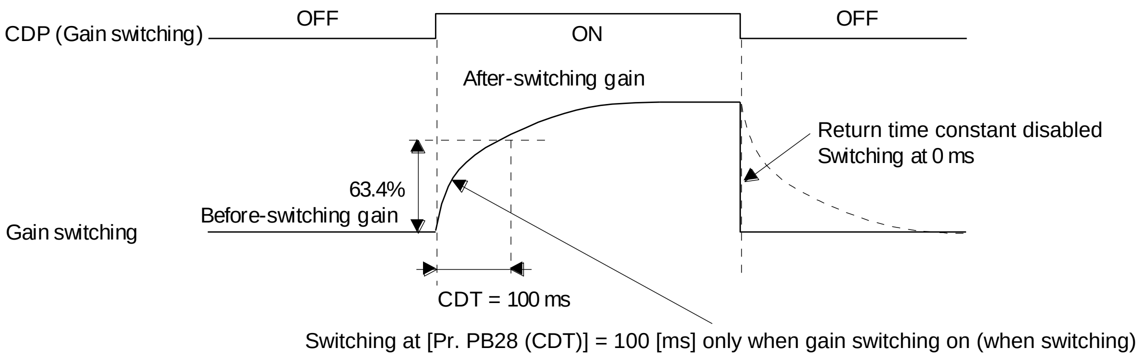


Load to motor inertia ratio	4.00	→	10.00	→	4.00	→	10.00
Position loop gain	120	→	84	→	120	→	84
Speed loop gain	3000	→	4000	→	3000	→	4000
Speed integral compensation	20	→	50	→	20	→	50

3) When the gain switching time constant is disabled
   (a) Switching time constant disabled was selected.
   The gain switching time constant is disabled. The time constant is enabled at gain return.
   The following example shows for [Pr. PB26 (CDP)] = 0103, [Pr. PB27 (CDL)] = 100 [pulse], and [Pr. PB28 (CDT)] = 100 [ms].



(b) Return time constant disabled was selected.
The gain switching time constant is enabled. The time constant is disabled at gain return.
The following example shows for [Pr. PB26 (CDP)] = 0201, [Pr. PB27 (CDL)] = 0, and [Pr. PB28 (CDT)] = 100 [ms].



7.3 Tough drive function

POINT
●Set enable/disable of the tough drive function with [Pr. PA20 Tough drive setting]. (Refer to section 5.2.1.)

This function makes the equipment continue operating even under the condition that an alarm occurs. The tough drive functions are the vibration tough drive and the instantaneous power failure tough drive.

7.3.1 Vibration tough drive function

This function prevents vibration by resetting a filter instantaneously when machine resonance occurs due to varied vibration frequency caused by machine aging.
To reset the machine resonance suppression filters with the function, [Pr. PB13 Machine resonance suppression filter 1] and [Pr. PB15 Machine resonance suppression filter 2] should be set in advance.
Set [Pr. PB13] and [Pr. PB15] as follows.

(1) One-touch tuning execution (section 6.1)

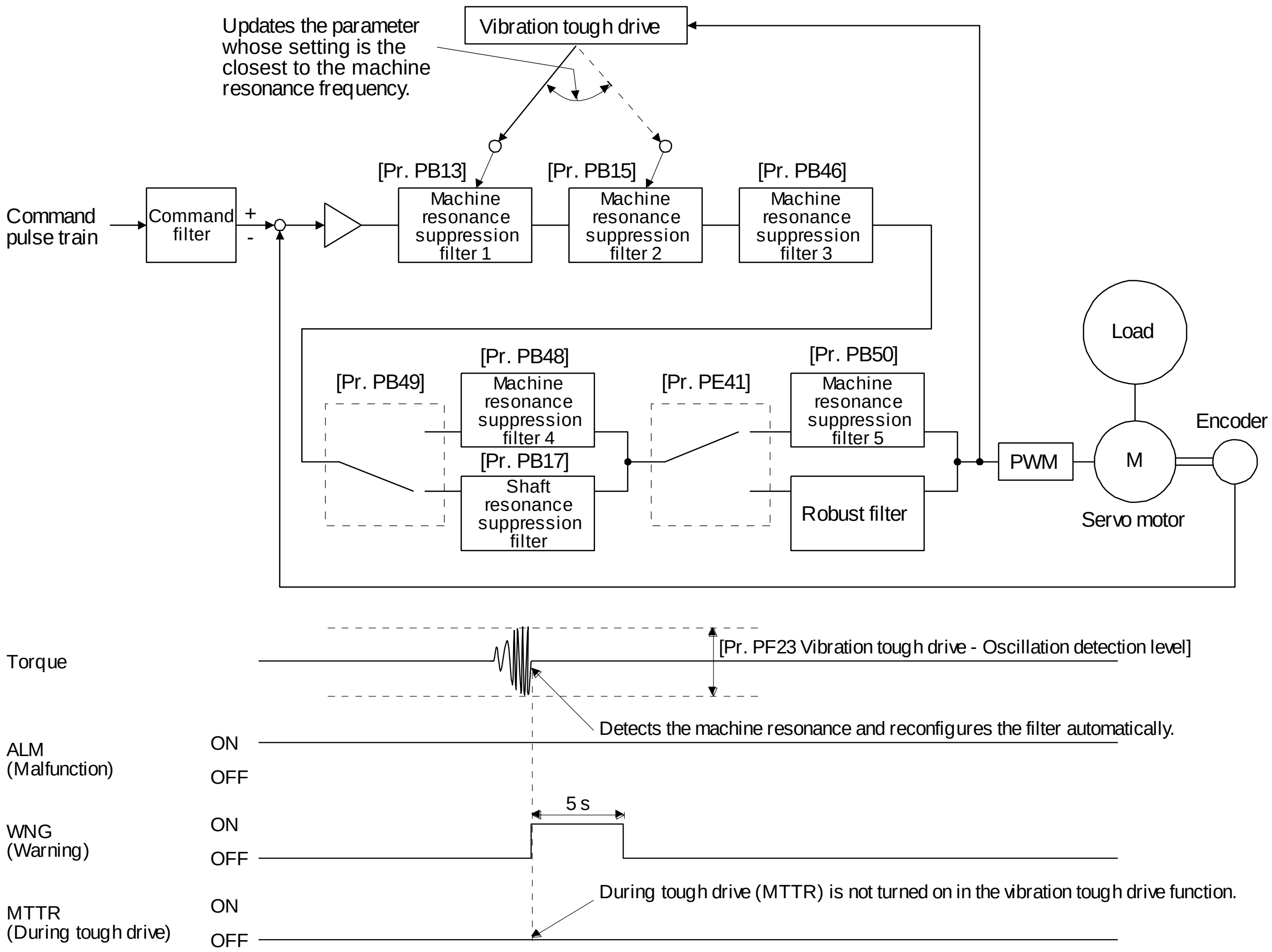
(2) Manual setting (section 4.2.2)

The vibration tough drive function operates when a detected machine resonance frequency is within ±30% for a value set in [Pr. PB13 Machine resonance suppression filter 1] or [Pr. PB15 Machine resonance suppression filter 2].
To set a detection level of the function, set sensitivity in [Pr. PF23 Vibration tough drive - Oscillation detection level].

POINT
●Resetting [Pr. PB13] and [Pr. PB15] by the vibration tough drive function is performed constantly. However, the number of write times to the EEPROM is limited to once per hour. ●The vibration tough drive function does not reset [Pr. PB46 Machine resonance suppression filter 3], [Pr. PB48 Machine resonance suppression filter 4], and [Pr. PB50 Machine resonance suppression filter 5]. ●The vibration tough drive function does not detect a vibration of 100 Hz or less.

The following shows the function block diagram of the vibration tough drive function.
The function detects machine resonance frequency and compare it with [Pr. PB13] and [Pr. PB15], and reset a machine resonance frequency of a parameter whose set value is closer.

Filter	Setting parameter	Precaution	Parameter that is reset with vibration tough drive function
Machine resonance suppression filter 1	PB01/PB13/PB14	The filter can be set automatically with "Filter tuning mode selection" in [Pr. PB01].	PB13
Machine resonance suppression filter 2	PB15/PB16		PB15
Machine resonance suppression filter 3	PB46/PB47		
Machine resonance suppression filter 4	PB48/PB49	Enabling the machine resonance suppression filter 4 disables the shaft resonance suppression filter. Using the shaft resonance suppression filter is recommended because it is adjusted properly depending on the usage situation. The shaft resonance suppression filter is enabled for the initial setting.	
Machine resonance suppression filter 5	PB50/PB51	Enabling the robust filter disables the machine resonance suppression filter 5. The robust filter is disabled for the initial setting.	



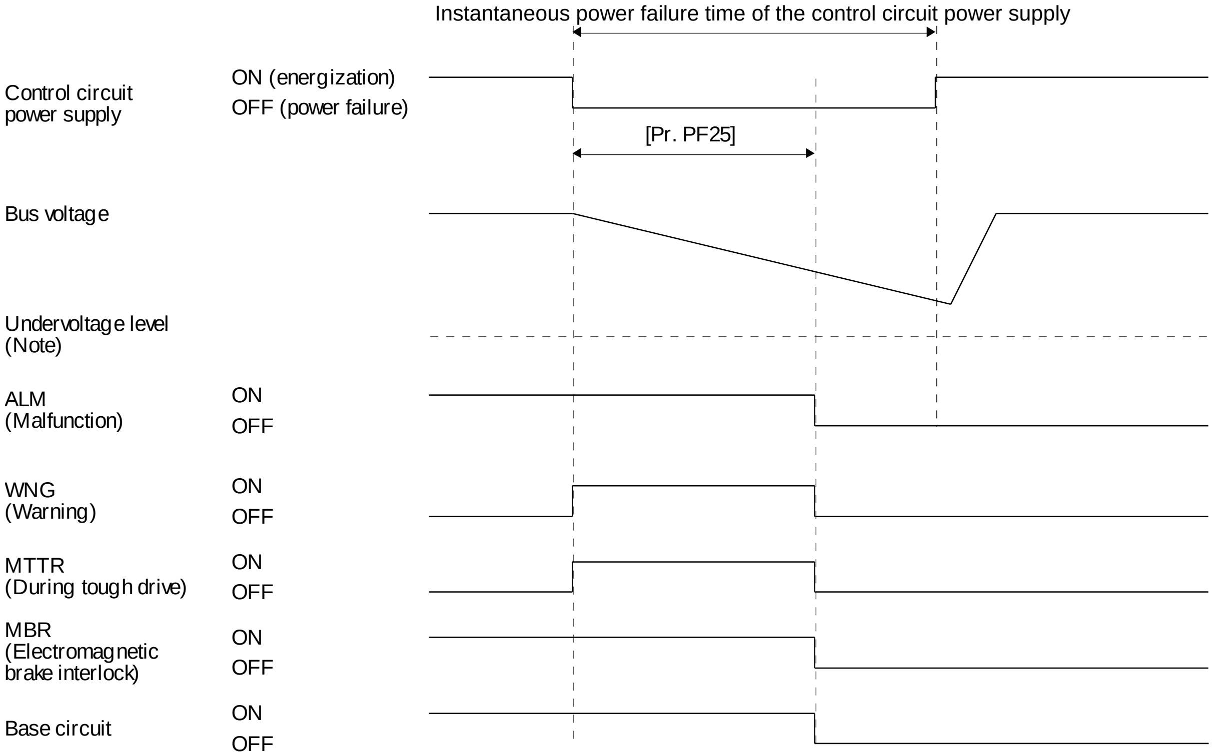
7.3.2 Instantaneous power failure tough drive function

The instantaneous power failure tough drive function avoids [AL. 10 Undervoltage] even when an instantaneous power failure occurs during operation. When the instantaneous power failure tough drive activates, the function will increase the tolerance against instantaneous power failure using the electrical energy charged in the capacitor in the driver and will change an alarm level of [AL. 10 Undervoltage] simultaneously. The [AL. 10.1 Voltage drop in the control circuit power] detection time for the control circuit power supply can be changed by [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time]. In addition, [AL. 10.2 Voltage drop in the main circuit power] detection level for the bus voltage is changed automatically.

POINT

- MBR (Electromagnetic brake interlock) will not turn off during the instantaneous power failure tough drive.
- When selecting "Enabled (_ _ _ 1)" for "Torque limit function selection at instantaneous power failure" in [Pr. PA26], if an instantaneous power failure occurs during operation, you can save electric energy charged in the capacitor in the driver by limiting torque at acceleration. You can also delay the time until the occurrence of [AL. 10.2 Voltage drop in the main circuit power]. Doing this will enable you to set a longer time in [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time].
- When the load of instantaneous power failure is large, [AL. 10.2] caused by the bus voltage drop may occur regardless of the set value of [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time].
- The external dynamic brake cannot be used for compliance with SEMI-F47 standard. Do not assign DB (Dynamic brake interlock) in [Pr. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47]. Failure to do so will cause the driver to become servo-off when an instantaneous power failure occurs.
- To comply with SEMI-F47 standard, it is unnecessary to change the initial value (200 ms). However, when the instantaneous power failure time exceeds 200 ms, and the instantaneous power failure voltage is less than 70% of the rated input voltage, the power may be normally turned off even if a value larger than 200 ms is set in the parameter.

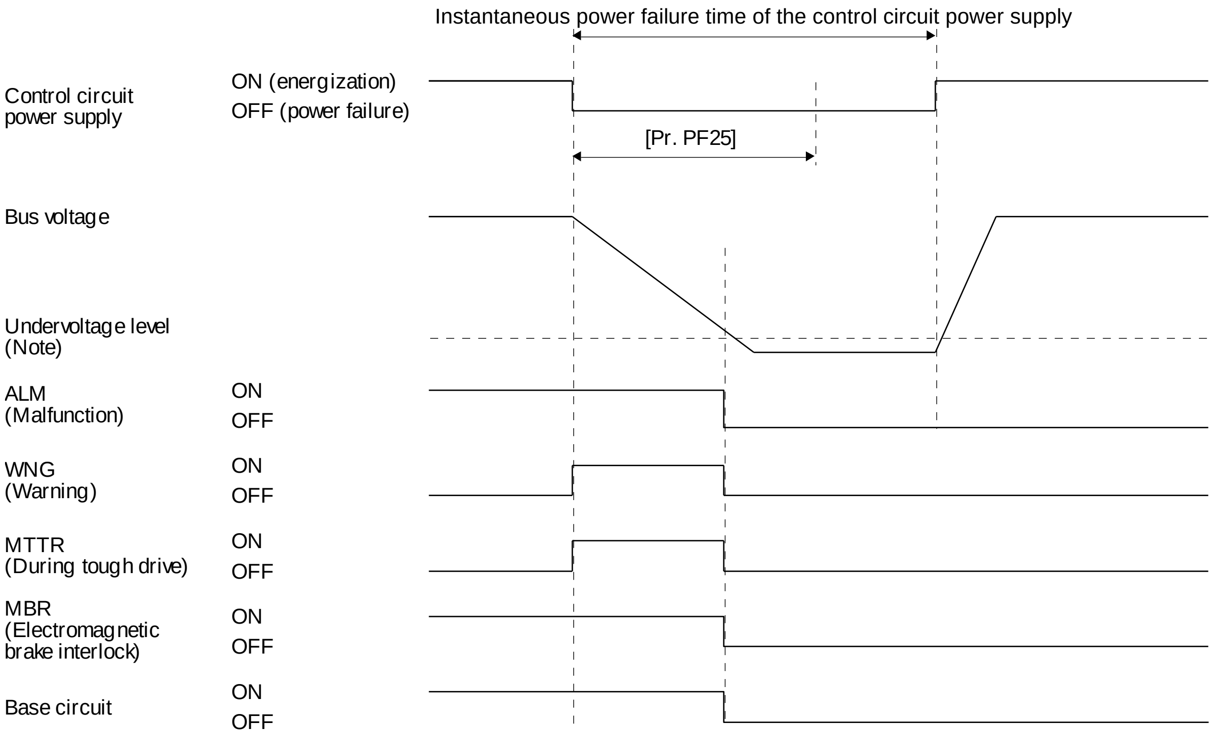
(1) Instantaneous power failure time of the control circuit power supply > [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time]
The alarm occurs when the instantaneous power failure time of the control circuit power supply exceeds [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time].
MTTR (During tough drive) turns on after detecting the instantaneous power failure.
MBR (Electromagnetic brake interlock) turns off when the alarm occurs.



Note. Refer to table 7.1 for the undervoltage level.

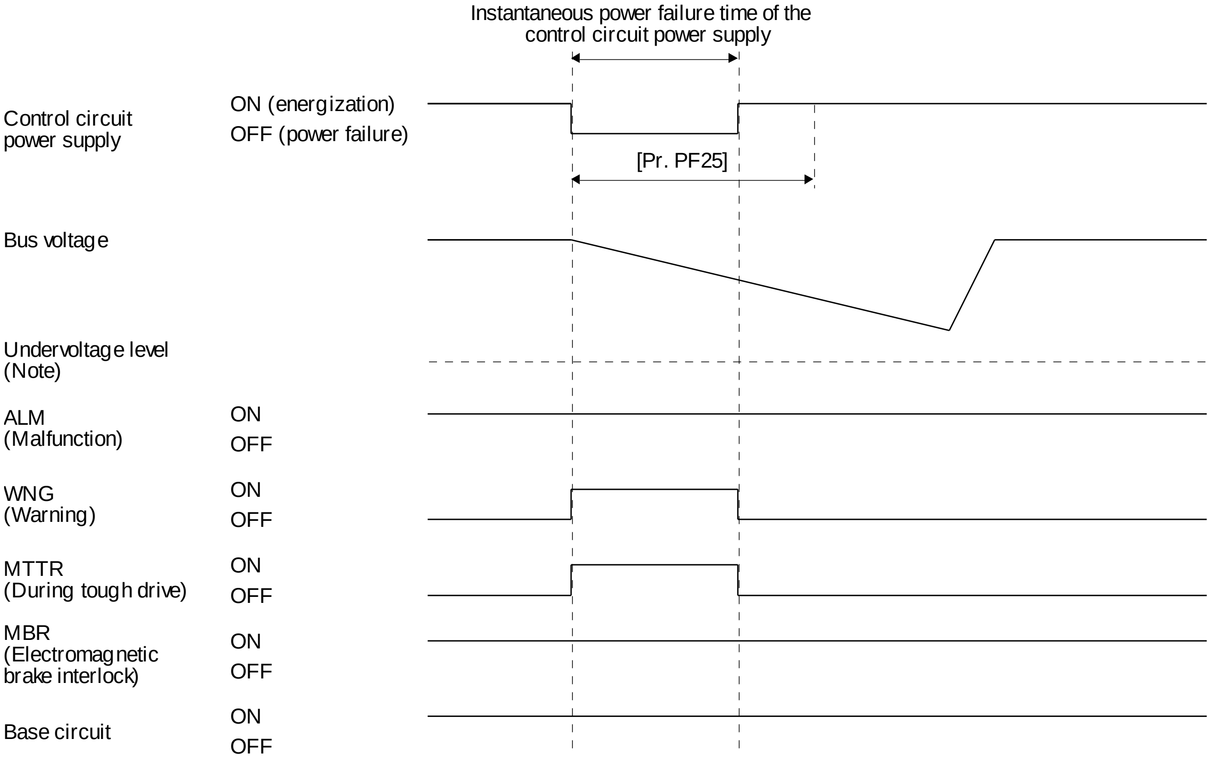
(2) Instantaneous power failure time of the control circuit power supply < [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time]
Operation status differs depending on how bus voltage decrease.

(a) When the bus voltage decrease lower than undervoltage level within the instantaneous power failure time of the control circuit power supply
[AL. 10 Undervoltage] occurs when the bus voltage decrease lower than undervoltage level regardless of the enabled instantaneous power failure tough drive.



Note. Refer to table 7.1 for the undervoltage level.

(b) When the bus voltage does not decrease lower than 158 V DC within the instantaneous power failure time of the control circuit power supply
The operation continues without alarming.



Note. Refer to table 7.1 for the undervoltage level.

7.4 Compliance with SEMI-F47 standard

POINT

- The control circuit power supply of the the driver can comply with SEMI-F47 standard. However, a back-up capacitor may be necessary for instantaneous power failure in the main circuit power supply depending on the power supply impedance and operating situation.
- Use a 3-phase for the input power supply of the driver. Using a 1-phase 100 V AC/200 V AC for the input power supply will not comply with SEMI-F47 standard.
- Be sure to perform actual machine tests and detail checks for power supply instantaneous power failure of SEMI-F47 standard with your equipment.

The following explains the compliance with "SEMI-F47 semiconductor process equipment voltage sag immunity test" of LECSB2-T□ series.

(1) Parameter setting

Setting [Pr. PA20] and [Pr. PF25] as follows will enable SEMI-F47.

Parameter	Setting value	Description
PA20	_ 1 _ _	SEMI-F47 selection
PF25	200	Set the time [ms] of the [AL. 10.1 Voltage drop in the control circuit power] occurrence.

Enabling SEMI-F47 will change operation as follows.

(a) The voltage will drop in the control circuit power at "Rated voltage × 50% or less". After 200 ms, [AL. 10.1 Voltage drop in the control circuit power] will occur.

(b) [AL. 10.2 Voltage drop in the main circuit power] will occur when bus voltage is as follows.

Table 7.1 Voltages which trigger [AL. 10.2 Voltage drop in the main circuit power]

Driver	Bus voltage which triggers alarm
LECSB2-T5 to LECSB2-T9	158 V DC

(c) MBR (Electromagnetic brake interlock) will turn off when [AL. 10.1 Voltage drop in the control circuit power] occurs.

(2) Requirements and recommended conditions of SEMI-F47 standard

Table 7.1 shows the permissible time of instantaneous power failure for instantaneous power failure of SEMI-F47 standard.

Table 7.2 Requirements conditions of SEMI-F47 standard

Instantaneous power failure voltage	Permissible time of instantaneous power failure [s]
Rated voltage × 80%	1
Rated voltage × 70%	0.5
Rated voltage × 50%	0.2

(3) Calculation of tolerance against instantaneous power failure

Table 7.3 shows tolerance against instantaneous power failure when instantaneous power failure voltage is "rated voltage × 50%" and instantaneous power failure time is 200 ms.

Table 7.3 Tolerance against instantaneous power failure (instantaneous power failure voltage = rated voltage × 50%, instantaneous power failure time = 200 ms)

driver	Instantaneous maximum output [W]	Tolerance against instantaneous power failure [W] (voltage drop between lines)
LECSB2-T5	350	250
LECSB2-T7	700	420
LECSB2-T8	1400	630
LECSB2-T9	2625	1150

Instantaneous maximum output means power which driver can output in maximum torque at rated speed. You can examine margins to compare the values of following conditions and instantaneous maximum output.
Even if driving at maximum torque with low speed in actual operation, the motor will not drive with the maximum output. This can be handled as a margin.
The following shows the conditions of tolerance against instantaneous power failure.

(a) Delta connection
For the 3-phase (L1/L2/L3) delta connection, an instantaneous power failure occurs in the voltage between a pair of lines (e.g. between L1 and L2) among voltages between three pairs of lines (between L1 and L2, L2 and L3, or L3 and L1).

(b) Star connection
For the 3-phase (L1/L2/L3/neutral point N) star connection, an instantaneous power failure occurs in the voltage between a pair of lines (e.g. between L1 and N) among voltages at six locations, between three pairs of lines (between L1 and L2, L2 and L3, or L3 and L1) and between one of the lines and the neutral point (between L1 and N, L2 and N, or L3 and N).

7.5 Model adaptive control disabled

POINT
●Change the parameters while the servo motor stops. ●When setting auto tuning response ([Pr. PA09]), change the setting value one by one to adjust it while checking operation status of the servo motor.

(1) Summary

The driver has a model adaptive control. The driver has a virtual motor model and drives the servo motor following the output of the motor model in the model adaptive control. At model adaptive control disabled, the driver drives the motor with PID control without using the model adaptive control.

The following shows the available parameters at model adaptive control disabled.

Parameter	Symbol	Name
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

(2) Parameter setting

Set [Pr. PB25] to "_ _ _ 2".

(3) Restrictions

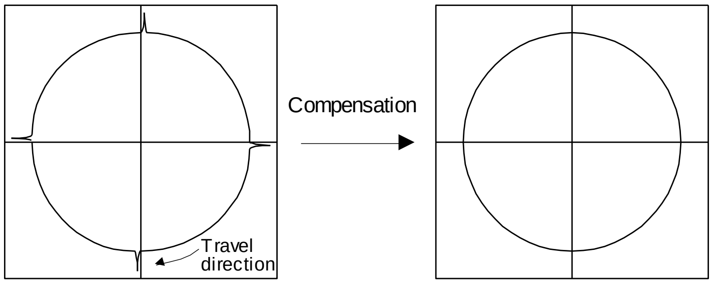
The following functions are not available at model adaptive control disabled.

Function	Explanation
Forced stop deceleration function ([Pr. PA04])	Disabling the model adaptive control while the forced stop deceleration function is enabled, [AL. 37] will occur. The forced stop deceleration function is enabled at factory setting. Set [Pr. PA04] to "0 _ _ _" (Forced stop deceleration function disabled).
Vibration suppression control 1 ([Pr. PB02]/[Pr. PB19]/[Pr. PB20]) Vibration suppression control 2 ([Pr. PB02]/[Pr. PB52]/[Pr. PB53])	The vibration suppression control uses the model adaptive control. Disabling the model adaptive control will also disable the vibration suppression control.
Overshoot amount compensation ([Pr. PB12])	The overshoot amount compensation uses data used by the model adaptive control. Disabling the model adaptive control will also disable the overshoot amount compensation.
Super trace control ([Pr. PA22])	The super trace control uses the model adaptive control. Disabling the model adaptive control will also disable the super trace control.

7.6 Lost motion compensation function

POINT
●The lost motion compensation function is enabled only in the position control mode.

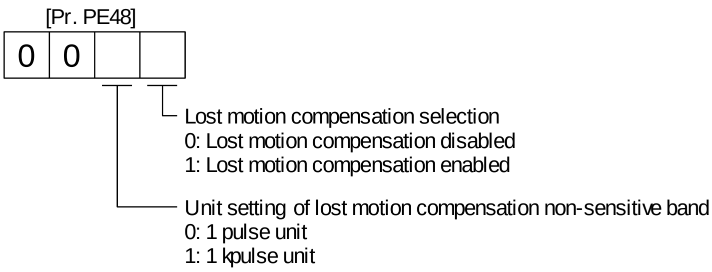
The lost motion compensation function corrects response delays (caused by a non-sensitive band due to friction, twist, expansion, and backlash) caused when the machine travel direction is reversed. This function contributes to improvement for protrusions that occur at a quadrant change and streaks that occur at a quadrant change during circular cutting.
This function is effective when a high follow-up performance is required such as drawing an arc with an X-Y table.



The locus before compensation   The locus after compensation

(1) Parameter setting
Setting [Pr. PE44] to [Pr. PE50] enables the lost motion compensation function.

(a) Lost motion compensation function selection ([Pr. PE48])
Select the lost motion compensation function.



(b) Lost motion compensation ([Pr. PE44]/[Pr. PE45])
Set the same value for the lost motion compensation for each of when the forward rotation switches to the reverse rotation and when the reverse rotation switches to the forward rotation. When the heights of protrusions differ depending on the travel direction, set the different compensation for each travel direction. Set a value twice the usual friction torque and adjust the value while checking protrusions.

(c) Torque offset ([Pr. PE47])
For a vertical axis, unbalanced torque occurs due to the gravity. Although setting the torque offset is usually unnecessary, setting unbalanced torque of a machine as a torque offset cancels the unbalanced torque. The torque offset does not need to be set for a machine not generating unbalanced torque.

(d) Lost motion compensation timing ([Pr. PE49])
You can set the delay time of the lost motion compensation start timing with this parameter. When a protrusion occurs belatedly, set the lost motion compensation timing corresponding to the protrusion occurrence timing.

(e) Lost motion compensation non-sensitive band ([Pr. PE50])
When the travel direction reverses frequently around the zero speed, unnecessary lost motion compensation is triggered by the travel direction switching. By setting the lost motion compensation non-sensitive band, the speed is recognized as 0 when the fluctuation of the droop pulse is the setting value or less. This prevents unnecessary lost motion compensation.
When the value of this parameter is changed, the compensation timing is changed. Adjust the value of Lost motion compensation timing ([Pr. PE49]).

(f) Lost motion filter setting ([Pr. PE46])
Changing the value of this parameter is usually unnecessary. When a value other than 0.0 ms is set in this parameter, the high-pass filter output value of the set time constant is applied to the compensation and lost motion compensation continues.

(2) Adjustment procedure of the lost motion compensation function

(a) Measuring the load current
Measure the load currents during the forward direction feed and reverse direction feed with setup software (MR Configurator2™).

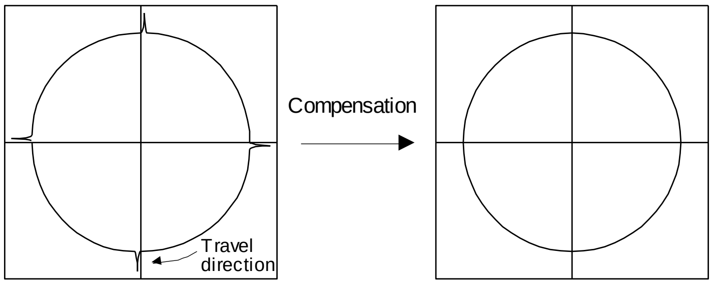
(b) Setting the lost motion compensation
Calculate the friction torque from the measurement result of (2) (a) in this section and set a value twice the friction torque in [Pr. PE44] and [Pr. PE45] as lost motion compensation.

$$\text{Friction torque [\%]} = \frac{|(\text{load current during feed in the forward rotation direction [\%]}) - (\text{load current during feed in the reverse rotation direction [\%}}{2}$$

(c) Checking protrusions
Drive the servo motor and check that the protrusions are corrected.

(d) Adjusting the lost motion compensation

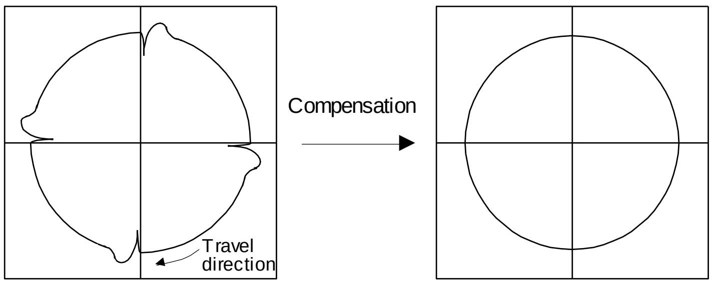
When protrusions still occur, the compensation is insufficient. Increase the lost motion compensation by approximately 0.5% until the protrusions are eliminated. When notches occur, the compensation is excessive. Decrease the lost motion compensation by approximately 0.5% until the notches are eliminated. Different values can be set as the compensation for each of when the forward rotation (CCW) switches to the reverse rotation (CW) and when the reverse rotation (CW) switches to the forward rotation (CCW).



The locus before compensation   The locus after compensation

(e) Adjusting the lost motion compensation timing

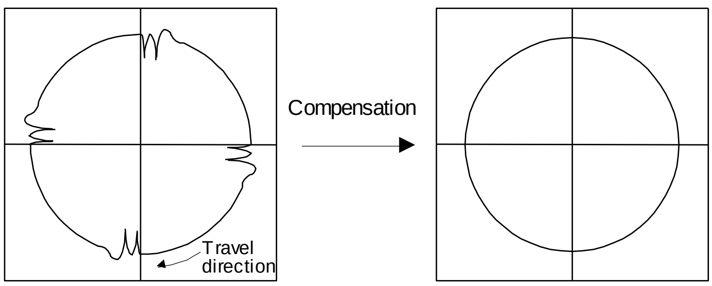
When the machine has low rigidity, the speed loop gain is set lower than the standard setting value, or the servo motor is rotating at high speed, quadrant projections may occur behind the quadrant change points. In this case, you can suppress the quadrant projections by delaying the lost motion compensation timing with [Pr. PE49 Lost motion compensation timing]. Increase the setting value of [Pr. PE49] from 0 ms (initial value) by approximately 0.5 ms to adjust the compensation timing.



Before timing delay compensation   After timing delay compensation

(f) Adjusting the lost motion compensation non-sensitive band

When the lost motion is compensated twice around a quadrant change point, set [Pr. PE50 Lost motion compensation non-sensitive band]. Increase the setting value so that the lost motion is not compensated twice. Setting [Pr. PE50] may change the compensation timing. Adjust the lost motion compensation timing of (2) (e) in this section.

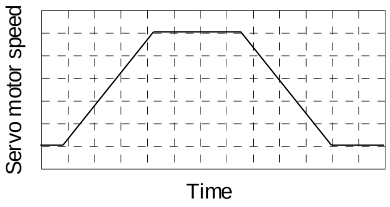
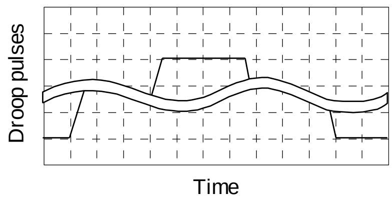
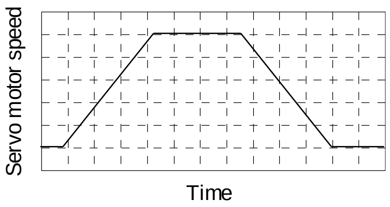
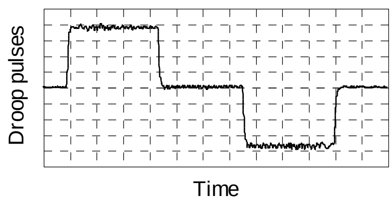
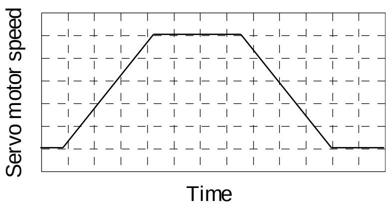
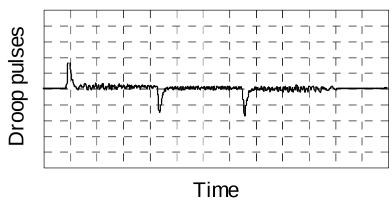


Before timing delay compensation   After timing delay compensation

7.7 Super trace control

(1) Summary

In the normal position control, droop pulses are generated against the position control command from the PC or PLC...etc. Using the feed forward gain sets droop pulses at a constant speed to almost 0. However, droop pulses generated during acceleration/deceleration cannot be suppressed.
With the ideal model in the driver, the super trace control enables to set constant speed and uniform acceleration/deceleration droop pulses to almost 0 that cannot be coped with by the feed forward gain.

Control	Position command (the same command)	Droop pulses
Normal control		 Droop pulses are always generated.
Feed forward gain		 Droop pulses are generated during acceleration/ deceleration.
Super trace control		 Droop pulses are almost 0 including the time of acceleration or deceleration.

(2) Adjustment procedure

POINT

- In the super trace control, droop pulses are near 0 during the servo motor control. Thus, the normal INP (In-position) may always be turned on. Be sure to set "INP (In-position) on condition selection" in [Pr. PD31] to " _ 1 _ _".
- When you use the super trace control, it is recommended that the acceleration time constant up to the rated speed be set to 1 s or more.

The following shows the adjustment procedure.

Step	Operation
1	Execute the gain adjustment with one-touch tuning, auto tuning, etc. Refer to chapter 6 for details.
2	Change the setting of auto tuning mode to the manual mode ([Pr. PA08]: _ _ _ 3).
3	Change the setting of feed forward gain ([Pr. PB04]), and adjust that droop pulses will be 0 at a constant speed.
4	Set the setting of INP (In-position) on condition selection ([Pr. PD31]) to " _ 1 _ _".
5	Enable the super trace control. ([Pr. PA22]: _ _ 2 _)
6	Change the setting of model loop gain ([Pr. PB07]), and adjust droop pulses during acceleration/deceleration.

8. TROUBLESHOOTING

8. TROUBLESHOOTING

POINT
●As soon as an alarm occurs, turn SON (Servo-on) off and interrupt the power. ●[AL. 37 Parameter error] and warnings (except [AL. F0 Tough drive warning]) are not recorded in the alarm history.

When an error occurs during operation, the corresponding alarm and warning are displayed. When an alarm or warning is displayed, remove the failure. When an alarm occurs, ALM will turn off.

8.1 Explanation for the lists

(1) No./Name/Detail No./Detail name
Indicates each No./Name/Detail No./Detail name of alarms or warnings.

(2) Stop method
For the alarms and warnings in which "SD" is written in the stop method column, the servo motor stops with the dynamic lock after forced stop deceleration. For the alarms and warnings in which "DB" or "EDB" is written in the stop method column, the servo motor stops with the dynamic lock without forced stop deceleration.

(3) Alarm deactivation
After the cause of the alarm has been removed, the alarm can be deactivated by any of the methods marked ○ in the alarm deactivation column. Warnings are automatically canceled after the cause of occurrence is removed. Alarms are deactivated with alarm reset or cycling the power.

Alarm deactivation	Explanation
Alarm reset	1. Turning on RES (Reset) with input device 2. Pushing the "SET" button while the display of the driver is the current alarm display status 3. Pushing "Occurring Alarm Reset" in the "Alarm Display" window of Setup software (MR Configurator2™)
Cycling the power	Turning the power off and then turning it on again.

(4) Alarm code
To output alarm codes, set [Pr. PD34] to "_ _ _ 1". Alarm codes are outputted by on/off of bit 0 to bit 2. Warnings ([AL. 91] to [AL. F3]) do not have alarm codes. The alarm codes in the following table will be outputted when they occur. The alarm codes will not be outputted in normal condition.

8.2 Alarm list

	No.	Name	Detail No.	Detail name	Stop Type (Note 2, 3)	Alarm deactivation: Alarm reset	Alarm deactivation: Cycling the power	Alarm code: ACD3 (Bit 3)	Alarm code: ACD2 (Bit 2)	Alarm code: ACD1 (Bit 1)	Alarm code: ACD0 (Bit 0)
Alarm	10	Undervoltage	10.1	Voltage drop in the control circuit power	EDB	○	○	0	0	1	0
			10.2	Voltage drop in the main circuit power	SD	○	○				
	11	Switch setting error	11.1	Axis number setting error/station number setting error	DB		○				
			11.2	Disabling control axis setting error	DB		○				
	12	Memory error 1 (RAM)	12.1	RAM error 1	DB		○	0	0	0	0
			12.2	RAM error 2	DB		○				
			12.3	RAM error 3	DB		○				
			12.4	RAM error 4	DB		○				
			12.5	RAM error 5	DB		○				
			12.6	RAM error 6	DB		○				
	13	Clock error	13.1	Clock error 1	DB		○	0	0	0	0
			13.2	Clock error 2	DB		○				
	14	Control process error	14.1	Control process error 1	DB		○	0	0	0	0
			14.2	Control process error 2	DB		○				
			14.3	Control process error 3	DB		○				
			14.4	Control process error 4	DB		○				
			14.5	Control process error 5	DB		○				
			14.6	Control process error 6	DB		○				
			14.7	Control process error 7	DB		○				
			14.8	Control process error 8	DB		○				
			14.9	Control process error 9	DB		○				
			14.A	Control process error 10	DB		○				
			14.B	Control process error 11	DB		○				
	15	Memory error 2 (EEP-ROM)	15.1	EEP-ROM error at power on	DB		○	0	0	0	0
			15.2	EEP-ROM error during operation	DB		○				
			15.4	Home position information read error	DB		○				
	16	Encoder initial communication error 1	16.1	Encoder initial communication - Receive data error 1	DB		○	0	1	1	0
			16.2	Encoder initial communication - Receive data error 2	DB		○				
			16.3	Encoder initial communication - Receive data error 3	DB		○				
			16.4	Encoder initial communication - Encoder malfunction (Note 6)	DB		○				
			16.5	Encoder initial communication - Transmission data error 1	DB		○				
			16.6	Encoder initial communication - Transmission data error 2	DB		○				
			16.7	Encoder initial communication - Transmission data error 3	DB		○				
			16.8	Encoder initial communication - Incompatible encoder (Note 6)	DB		○				
			16.A	Encoder initial communication - Process error 1	DB		○				
			16.B	Encoder initial communication - Process error 2	DB		○				
			16.C	Encoder initial communication - Process error 3	DB		○				
			16.D	Encoder initial communication - Process error 4	DB		○				
			16.E	Encoder initial communication - Process error 5	DB		○				
			16.F	Encoder initial communication - Process error 6	DB		○				

	No.	Name	Detail No.	Detail name	Stop Type (Note 2, 3)	Alarm deactivation		Alarm code			
						Alarm reset	Cycling the power	ACD3 (Bit 3)	ACD2 (Bit 2)	ACD1 (Bit 1)	ACD0 (Bit 0)
Alarm	17	Board error	17.1	Board error 1	DB		○	0	0	0	0
			17.3	Board error 2	DB		○				
			17.4	Board error 3	DB		○				
			17.5	Board error 4	DB		○				
			17.6	Board error 5	DB		○				
			17.7	Board error 7	DB		○				
			17.8	Board error 6	EDB		○				
			17.9	Board error 8	DB		○				
	19	Memory error 3 (Flash-ROM)	19.1	Flash-ROM error 1	DB		○	0	0	0	0
			19.2	Flash-ROM error 2	DB		○				
			19.3	Flash-ROM error 3	DB		○				
	1A	Servo motor combination error	1A.1	Servo motor combination error 1	DB		○	0	1	1	0
			1A.2	Servo motor control mode combination error	DB		○				
			1A.4	Servo motor combination error 2	DB		○				
	1B	Converter alarm	1B.1	Converter unit error	DB		○	0	0	1	0
	1E	Encoder initial communication error 2	1E.1	Encoder malfunction	DB		○	0	1	1	0
			1E.2	Load-side encoder malfunction	DB		○				
	1F	Encoder initial communication error 3	1F.1	Incompatible encoder	DB		○	0	1	1	0
			1F.2	Incompatible load-side encoder	DB		○				
	20	Encoder normal communication error 1	20.1	Encoder normal communication - Receive data error 1	EDB		○	0	1	1	0
			20.2	Encoder normal communication - Receive data error 2	EDB		○				
			20.3	Encoder normal communication - Receive data error 3	EDB		○				
			20.5	Encoder normal communication - Transmission data error 1	EDB		○				
			20.6	Encoder normal communication - Transmission data error 2	EDB		○				
			20.7	Encoder normal communication - Transmission data error 3	EDB		○				
			20.9	Encoder normal communication - Receive data error 4	EDB		○				
			20.A	Encoder normal communication - Receive data error 5	EDB		○				
	21	Encoder normal communication error 2	21.1	Encoder data error 1	EDB		○	0	1	1	0
			21.2	Encoder data update error	EDB		○				
			21.3	Encoder data waveform error	EDB		○				
			21.4	Encoder non-signal error	EDB		○				
			21.5	Encoder hardware error 1	EDB		○				
			21.6	Encoder hardware error 2	EDB		○				
			21.9	Encoder data error 2	EDB		○				
	24	Main circuit error	24.1	Ground fault detected at hardware detection circuit	DB		○	1	1	0	0
			24.2	Ground fault detected by software detection function	DB	○	○				
	25	Absolute position erased	25.1	Servo motor encoder - Absolute position erased	DB		○	1	1	1	0
			25.2	Scale measurement encoder - Absolute position erased	DB		○				

	No.	Name	Detail No.	Detail name	Stop Type (Note 2, 3)	Alarm deactivation		Alarm code			
						Alarm reset	Cycling the power	ACD3 (Bit 3)	ACD2 (Bit 2)	ACD1 (Bit 1)	ACD0 (Bit 0)
Alarm	27	Initial magnetic pole detection error	27.1	Initial magnetic pole detection - Abnormal termination	DB	○	○	1	1	1	0
			27.2	Initial magnetic pole detection - Time out error	DB	○	○				
			27.3	Initial magnetic pole detection - Limit switch error	DB	○	○				
			27.4	Initial magnetic pole detection - Estimated error	DB	○	○				
			27.5	Initial magnetic pole detection - Position deviation error	DB	○	○				
			27.6	Initial magnetic pole detection - Speed deviation error	DB	○	○				
			27.7	Initial magnetic pole detection - Current error	DB	○	○				
	28	Linear encoder error 2	28.1	Linear encoder - Environment error	EDB		○	0	1	1	0
	2A	Linear encoder error 1	2A.1	Linear encoder error 1-1	EDB		○	0	1	1	0
			2A.2	Linear encoder error 1-2	EDB		○				
			2A.3	Linear encoder error 1-3	EDB		○				
			2A.4	Linear encoder error 1-4	EDB		○				
			2A.5	Linear encoder error 1-5	EDB		○				
			2A.6	Linear encoder error 1-6	EDB		○				
			2A.7	Linear encoder error 1-7	EDB		○				
			2A.8	Linear encoder error 1-8	EDB		○				
	2B	Encoder counter error	2B.1	Encoder counter error 1	EDB		○	1	1	1	0
			2B.2	Encoder counter error 2	EDB		○				
	30	Regenerative error	30.1	Regeneration heat error	DB	○ (Note 1)	○ (Note 1)	0	0	0	1
			30.2	Regeneration signal error	DB	○ (Note 1)	○ (Note 1)				
			30.3	Regeneration feedback signal error	DB	○ (Note 1)	○ (Note 1)				
	31	Overspeed	31.1	Abnormal motor speed	SD	○	○	0	1	0	1
	32	Overcurrent	32.1	Overcurrent detected at hardware detection circuit (during operation)	DB		○	0	1	0	0
			32.2	Overcurrent detected at software detection function (during operation)	DB	○	○				
			32.3	Overcurrent detected at hardware detection circuit (during a stop)	DB		○				
			32.4	Overcurrent detected at software detection function (during a stop)	DB	○	○				
	33	Overvoltage	33.1	Main circuit voltage error	EDB	○	○	1	0	0	1
	34	SSCNET receive error 1	34.1	SSCNET receive data error	SD	○	○				
			34.2	SSCNET connector connection error	SD	○	○				
			34.3	SSCNET communication data error	SD	○	○				
			34.4	Hardware error signal detection	SD	○	○				
			34.5	SSCNET receive data error (safety observation function)	SD	○	○				
			34.6	SSCNET communication data error (safety observation function)	SD	○	○				
	35	Command frequency error	35.1	Command frequency error	SD	○	○	1	1	0	1
	36	SSCNET receive error 2	36.1	Continuous communication data error	SD	○	○				
			36.2	Continuous communication data error (safety observation function)	SD	○	○				

	No.	Name	Detail No.	Detail name	Stop Type (Note 2, 3)	Alarm deactivation		Alarm code			
						Alarm reset	Cycling the power	ACD3 (Bit 3)	ACD2 (Bit 2)	ACD1 (Bit 1)	ACD0 (Bit 0)
Alarm	37	Parameter error	37.1	Parameter setting range error	DB		○	1	0	0	0
			37.2	Parameter combination error	DB		○				
			37.3	Point table setting error	DB		○				
	39	Program error	39.1	Program error	DB		○	0	0	0	0
			39.2	Instruction argument external error	DB		○				
			39.3	Register No. error	DB		○				
			39.4	Non-correspondence instruction error	DB		○				
	3A	Inrush current suppression circuit error	3A.1	Inrush current suppression circuit error	EDB		○	0	0	0	0
	3D	Parameter setting error for driver communication	3D.1	Parameter combination error for driver communication on slave	DB		○				
			3D.2	Parameter combination error for driver communication on master	DB		○				
	3E	Operation mode error	3E.1	Operation mode error	DB		○				
			3E.6	Operation mode switch error	DB		○	1	0	0	0
	42	Servo control error	42.1	Servo control error by position deviation	EDB	(Note 4)	○	0	1	1	0
			42.2	Servo control error by speed deviation	EDB	(Note 4)	○				
			42.3	Servo control error by torque/ thrust deviation	EDB	(Note 4)	○				
		Fully closed loop control error	42.8	Fully closed loop control error by position deviation	EDB	(Note 4)	○				
			42.9	Fully closed loop control error by speed deviation	EDB	(Note 4)	○				
			42.A	Fully closed loop control error by position deviation during command stop	EDB	(Note 4)	○				
	45	Main circuit device overheat	45.1	Main circuit device overheat error 1	SD	○ (Note 1)	○ (Note 1)	0	0	1	1
			45.2	Main circuit device overheat error 2	SD	○ (Note 1)	○ (Note 1)				
	46	Servo motor overheat	46.1	Abnormal temperature of servo motor 1	SD	○ (Note 1)	○ (Note 1)	0	0	1	1
			46.2	Abnormal temperature of servo motor 2	SD	○ (Note 1)	○ (Note 1)				
			46.3	Thermistor disconnected error	SD	○ (Note 1)	○ (Note 1)				
			46.4	Thermistor circuit error	SD	○ (Note 1)	○ (Note 1)				
			46.5	Abnormal temperature of servo motor 3	DB	○ (Note 1)	○ (Note 1)				
			46.6	Abnormal temperature of servo motor 4	DB	○ (Note 1)	○ (Note 1)				
	47	Cooling fan error	47.1	Cooling fan stop error	SD		○	0	0	1	1
			47.2	Cooling fan speed reduction error	SD		○				
	50	Overload 1	50.1	Thermal overload error 1 during operation	SD	○ (Note 1)	○ (Note 1)	0	0	1	1
			50.2	Thermal overload error 2 during operation	SD	○ (Note 1)	○ (Note 1)				
			50.3	Thermal overload error 4 during operation	SD	○ (Note 1)	○ (Note 1)				
			50.4	Thermal overload error 1 during a stop	SD	○ (Note 1)	○ (Note 1)				
			50.5	Thermal overload error 2 during a stop	SD	○ (Note 1)	○ (Note 1)				
			50.6	Thermal overload error 4 during a stop	SD	○ (Note 1)	○ (Note 1)				

	No.	Name	Detail No.	Detail name	Stop Type (Note 2, 3)	Alarm deactivation		Alarm code			
						Alarm reset	Cycling the power	ACD3 (Bit 3)	ACD2 (Bit 2)	ACD1 (Bit 1)	ACD0 (Bit 0)
Alarm	51	Overload 2	51.1	Thermal overload error 3 during operation	DB	○ (Note 1)	○ (Note 1)	0	0	1	1
			51.2	Thermal overload error 3 during a stop	DB	○ (Note 1)	○ (Note 1)				
	52	Error excessive	52.1	Excess droop pulse 1	SD	○	○	0	1	0	1
			52.3	Excess droop pulse 2	SD	○	○				
			52.4	Error excessive during 0 torque limit	SD	○	○				
			52.5	Excess droop pulse 3	EDB	○	○				
	54	Oscillation detection	54.1	Oscillation detection error	EDB	○	○	0	0	1	1
	56	Forced stop error	56.2	Over speed during forced stop	EDB	○	○	0	1	1	0
			56.3	Estimated distance over during forced stop	EDB	○	○				
	61	Operation error	61.1	Point table setting error	DB	○	○	0	1	0	1
	63	STO timing error	63.1	STO1 off	DB	○	○	0	1	1	0
			63.2	STO2 off	DB	○	○				
			63.5	STO by functional safety unit	DB	○	○				
	64	Functional safety unit setting error	64.1	STO input error	DB		○	1	0	0	0
			64.2	Compatibility mode setting error	DB		○				
			64.3	Operation mode setting error	DB		○				
	65	Functional safety unit connection error	65.1	Functional safety unit communication error 1	SD		○	0	0	0	0
			65.2	Functional safety unit communication error 2	SD		○				
			65.3	Functional safety unit communication error 3	SD		○				
			65.4	Functional safety unit communication error 4	SD		○				
			65.5	Functional safety unit communication error 5	SD		○				
			65.6	Functional safety unit communication error 6	SD		○				
			65.7	Functional safety unit communication error 7	SD		○				
			65.8	Functional safety unit shut-off signal error 1	DB		○				
			65.9	Functional safety unit shut-off signal error 2	DB		○				
	66	Encoder initial communication error (safety observation function)	66.1	Encoder initial communication - Receive data error 1 (safety observation function)	DB		○	0	1	1	0
			66.2	Encoder initial communication - Receive data error 2 (safety observation function)	DB		○				
			66.3	Encoder initial communication - Receive data error 3 (safety observation function)	DB		○				
			66.7	Encoder initial communication - Transmission data error 1 (safety observation function)	DB		○				
			66.9	Encoder initial communication - Process error 1 (safety observation function)	DB		○				

	No.	Name	Detail No.	Detail name	Stop Type (Note 2, 3)	Alarm deactivation		Alarm code			
						Alarm reset	Cycling the power	ACD3 (Bit 3)	ACD2 (Bit 2)	ACD1 (Bit 1)	ACD0 (Bit 0)
Alarm	67	Encoder normal communication error 1 (safety observation function)	67.1	Encoder normal communication - Receive data error 1 (safety observation function)	DB		○	0	1	1	0
			67.2	Encoder normal communication - Receive data error 2 (safety observation function)	DB		○				
			67.3	Encoder normal communication - Receive data error 3 (safety observation function)	DB		○				
			67.4	Encoder normal communication - Receive data error 4 (safety observation function)	DB		○				
			67.7	Encoder normal communication - Transmission data error 1 (safety observation function)	DB		○				
	68	STO diagnosis error	68.1	Mismatched STO signal error	DB		○	0	0	0	0
	69	Command error	69.1	Forward rotation-side software limit detection - Command excess error	SD	○	○				
			69.2	Reverse rotation-side software limit detection - Command excess error	SD	○	○				
			69.3	Forward rotation stroke end detection - Command excess error	SD	○	○				
			69.4	Reverse rotation stroke end detection - Command excess error	SD	○	○				
			69.5	Upper stroke limit detection - Command excess error	SD	○	○				
			69.6	Lower stroke limit detection - Command excess error	SD	○	○				
	70	Load-side encoder initial communication error 1	70.1	Load-side encoder initial communication - Receive data error 1	DB		○	0	1	1	0
			70.2	Load-side encoder initial communication - Receive data error 2	DB		○				
			70.3	Load-side encoder initial communication - Receive data error 3	DB		○				
			70.4	Load-side encoder initial communication - Encoder malfunction (Note 6)	DB		○				
			70.5	Load-side encoder initial communication - Transmission data error 1	DB		○				
			70.6	Load-side encoder initial communication - Transmission data error 2	DB		○				
			70.7	Load-side encoder initial communication - Transmission data error 3	DB		○				
			70.8	Load-side encoder initial communication - Incompatible encoder (Note 6)	DB		○				
			70.A	Load-side encoder initial communication - Process error 1	DB		○				
			70.B	Load-side encoder initial communication - Process error 2	DB		○				
			70.C	Load-side encoder initial communication - Process error 3	DB		○				
			70.D	Load-side encoder initial communication - Process error 4	DB		○				
			70.E	Load-side encoder initial communication - Process error 5	DB		○				
			70.F	Load-side encoder initial communication - Process error 6	DB		○				

	No.	Name	Detail No.	Detail name	Stop Type (Note 2, 3)	Alarm deactivation		Alarm code			
						Alarm reset	Cycling the power	ACD3 (Bit 3)	ACD2 (Bit 2)	ACD1 (Bit 1)	ACD0 (Bit 0)
Alarm	71	Load-side encoder normal communication error 1	71.1	Load-side encoder normal communication - Receive data error 1	EDB		○	0	1	1	0
			71.2	Load-side encoder normal communication - Receive data error 2	EDB		○				
			71.3	Load-side encoder normal communication - Receive data error 3	EDB		○				
			71.5	Load-side encoder normal communication - Transmission data error 1	EDB		○				
			71.6	Load-side encoder normal communication - Transmission data error 2	EDB		○				
			71.7	Load-side encoder normal communication - Transmission data error 3	EDB		○				
			71.9	Load-side encoder normal communication - Receive data error 4	EDB		○				
			71.A	Load-side encoder normal communication - Receive data error 5	EDB		○				
	72	Load-side encoder normal communication error 2	72.1	Load-side encoder data error 1	EDB		○	0	1	1	0
			72.2	Load-side encoder data update error	EDB		○				
			72.3	Load-side encoder data waveform error	EDB		○				
			72.4	Load-side encoder non-signal error	EDB		○				
			72.5	Load-side encoder hardware error 1	EDB		○				
			72.6	Load-side encoder hardware error 2	EDB		○				
			72.9	Load-side encoder data error 2	EDB		○				
	74	Option card error 1	74.1	Option card error 1	DB		○				
			74.2	Option card error 2	DB		○				
			74.3	Option card error 3	DB		○				
			74.4	Option card error 4	DB		○				
			74.5	Option card error 5	DB		○				
	75	Option card error 2	75.3	Option card connection error	EDB		○				
			75.4	Option card disconnected	DB		○				
	79	Functional safety unit diagnosis error	79.1	Functional safety unit power voltage error	DB	○ (Note 5)	○	1	1	1	1
			79.2	Functional safety unit internal error	DB		○				
			79.3	Abnormal temperature of functional safety unit	SD	○ (Note 5)	○				
			79.4	Driver error	SD		○				
			79.5	Input device error	SD		○				
			79.6	Output device error	SD		○				
			79.7	Mismatched input signal error	SD		○				
			79.8	Position feedback fixing error	DB		○				
	7A	Parameter setting error (safety observation function)	7A.1	Parameter verification error (safety observation function)	DB		○	1	0	0	0
			7A.2	Parameter setting range error (safety observation function)	DB		○				
			7A.3	Parameter combination error (safety observation function)	DB		○				
			7A.4	Functional safety unit combination error (safety observation function)	DB		○				

	No.	Name	Detail No.	Detail name	Stop Type (Note 2, 3)	Alarm deactivation: Alarm reset	Alarm deactivation: Cycling the power	Alarm code: ACD3 (Bit 3)	Alarm code: ACD2 (Bit 2)	Alarm code: ACD1 (Bit 1)	Alarm code: ACD0 (Bit 0)
Alarm	7B	Encoder diagnosis error (safety observation function)	7B.1	Encoder diagnosis error 1 (safety observation function)	DB		○	0	1	1	0
			7B.2	Encoder diagnosis error 2 (safety observation function)	DB		○				
			7B.3	Encoder diagnosis error 3 (safety observation function)	DB		○				
			7B.4	Encoder diagnosis error 4 (safety observation function)	DB		○				
	7C	Functional safety unit communication diagnosis error (safety observation function)	7C.1	Functional safety unit communication setting error (safety observation function)	SD	○ (Note 5)	○	0	0	0	0
			7C.2	Functional safety unit communication data error (safety observation function)	SD	○ (Note 5)	○				
	7D	Safety observation error	7D.1	Stop observation error	DB	○ (Note 3)	○	1	1	1	1
			7D.2	Speed observation error	DB	○ (Note 5)	○				
	7F	Pushing error (Note6)	7F. 1	Missed swing error	DB	○	○	1	1	0	1
			7F. 2	Push back error		○	○	1	1	0	1
			7F. 3	Pushing direction error		○	○	1	1	0	1
			7F. 4	Start pushing error		○	○	1	1	0	1
	82	Master-slave operation error 1	82.1	Master-slave operation error 1	EDB	○	○				
	84	Network module initialization error	84.1	Network module undetected error	DB		○				
			84.2	Network module initialization error 1	DB		○				
			84.3	Network module initialization error 2	DB		○				
	85	Network module error	85.1	Network module error 1	SD		○				
			85.2	Network module error 2	SD		○				
			85.3	Network module error 3	SD		○				
	86	Network communication error	86.1	Network communication error 1	SD	○	○				
			86.2	Network communication error 2	SD	○	○				
			86.3	Network communication error 3	SD	○	○				
	8A	USB communication time-out error/serial communication time-out error/Modbus RTU communication time-out error	8A.1	USB communication time-out error/Serial communication time-out error	SD	○	○	0	0	0	0
			8A.2	Modbus RTU communication time-out error	SD	○	○				
	8D	CC-Link IE communication error	8D.1	CC-Link IE communication error 1	SD	○	○				
			8D.2	CC-Link IE communication error 2	SD	○	○				
			8D.3	Master station setting error 1	DB	○	○				
			8D.5	Master station setting error 2	DB		○				
			8D.6	CC-Link IE communication error 3	SD	○	○				
			8D.7	CC-Link IE communication error 4	SD	○	○				
			8D.8	CC-Link IE communication error 5	SD	○	○				
			8D.9	Synchronization error 1	SD		○				
			8D.A	Synchronization error 2	SD		○				

	No.	Name	Detail No.	Detail name	Stop Type (Note 2, 3)	Alarm deactivation		Alarm code			
						Alarm reset	Cycling the power	ACD3 (Bit 3)	ACD2 (Bit 2)	ACD1 (Bit 1)	ACD0 (Bit 0)
Alarm	8E	USB communication error/serial communication error/Modbus RTU communication error	8E.1	USB communication receive error/Serial communication receive error	SD	○	○	0	0	0	0
			8E.2	USB communication checksum error/Serial communication checksum error	SD	○	○				
			8E.3	USB communication character error/serial communication character error	SD	○	○				
			8E.4	USB communication command error/Serial communication command error	SD	○	○				
			8E.5	USB communication data number error/Serial communication data number error	SD	○	○				
			8E.6	Modbus RTU communication receive error	SD	○	○				
			8E.7	Modbus RTU communication message frame error	SD	○	○				
			8E.8	Modbus RTU communication CRC error	SD	○	○				
	88888	Watchdog	8888._	Watchdog	DB		○				

Note 1. After resolving the source of trouble, cool the equipment for approximately 30 minutes.
2. The following shows three stop methods of DB, EDB, and SD.
DB: Stops with dynamic lock. (Coasts for the driver without dynamic lock.)
EDB: Electronic dynamic lock stop (available with specified servo motors)
Refer to the following table for the specified servo motors. The stop method for other than the specified servo motors will be DB.

Series	Servo motor
LE-□-□	LE-T5-□, LE-T6-□, LE-T7-□, LE-T8-□

SD: Forced stop deceleration
3. This is applicable when [Pr. PA04] is set to the initial value. The stop system of SD can be changed to DB using [Pr. PA04].
5. Reset this while all the safety observation functions are stopped.
6. This alarm will occur only in the J3 compatibility mode.

8.3 Warning list

	No.	Name	Detail No.	Detail name	Stop method (Note 2, 3)
Warning	90	Home position return incomplete warning	90.1	Home position return incomplete	
			90.2	Home position return abnormal termination	
			90.5	Z-phase unpassed	
	91	Driver overheat warning (Note 1)	91.1	Main circuit device overheat warning	
	92	Battery cable disconnection warning	92.1	Encoder battery cable disconnection warning	
			92.3	Battery degradation	
	93	ABS data transfer warning	93.1	Magnetic pole detection incomplete warning at ABS data transfer request	
	95	STO warning	95.1	STO1 off detection	DB
			95.2	STO2 off detection	DB
			95.3	STO warning 1 (safety observation function)	DB
			95.4	STO warning 2 (safety observation function)	DB
			95.5	STO warning 3 (safety observation function)	DB
	96	Home position setting warning	96.1	In-position warning at home positioning	
			96.2	Command input warning at home positioning	
			96.3	Servo off warning at home positioning	
			96.4	Magnetic pole detection incomplete warning at home positioning	
	97	Positioning specification warning	97.1	Program operation disabled warning	
			97.2	Next station position warning	
	98	Software limit warning	98.1	Forward rotation-side software stroke limit reached	
			98.2	Reverse rotation-side software stroke limit reached	
	99	Stroke limit warning	99.1	Forward rotation stroke end off	(Note 4)
			99.2	Reverse rotation stroke end off	(Note 4)
			99.4	Upper stroke limit off	
			99.5	Lower stroke limit off	
	9A	Optional unit input data error warning	9A.1	Optional unit input data sign error	
			9A.2	Optional unit BCD input data error	
	9B	Error excessive warning	9B.1	Excess droop pulse 1 warning	
			9B.3	Excess droop pulse 2 warning	
			9B.4	Error excessive warning during 0 torque limit	
	9C	Converter warning	9C.1	Converter unit warning	
	9D	CC-Link IE warning 1	9D.1	Station number switch change warning	
			9D.2	Master station setting warning	
			9D.3	Overlapping station number warning	
			9D.4	Mismatched station number warning	
	9E	CC-Link IE warning 2	9E.1	CC-Link IE communication warning	
	9F	Battery warning	9F.1	Low battery	
			9F.2	Battery degradation warning	

	No.	Name	Detail No.	Detail name	Stop method (Note 2, 3)
Warning	E0	Excessive regeneration warning	E0.1	Excessive regeneration warning	
	E1	Overload warning 1	E1.1	Thermal overload warning 1 during operation	
			E1.2	Thermal overload warning 2 during operation	
			E1.3	Thermal overload warning 3 during operation	
			E1.4	Thermal overload warning 4 during operation	
			E1.5	Thermal overload warning 1 during a stop	
			E1.6	Thermal overload warning 2 during a stop	
			E1.7	Thermal overload warning 3 during a stop	
			E1.8	Thermal overload warning 4 during a stop	
	E2	Servo motor overheat warning	E2.1	Servo motor temperature warning	
	E3	Absolute position counter warning	E3.1	Multi-revolution counter travel distance excess warning	
			E3.2	Absolute position counter warning	
			E3.4	Absolute positioning counter EEP-ROM writing frequency warning	
			E3.5	Encoder absolute positioning counter warning	
	E4	Parameter warning	E4.1	Parameter setting range error warning	
	E5	ABS time-out warning	E5.1	Time-out during ABS data transfer	
			E5.2	ABSM off during ABS data transfer	
			E5.3	SON off during ABS data transfer	
	E6	Servo forced stop warning	E6.1	Forced stop warning	SD
			E6.2	SS1 forced stop warning 1 (safety observation function)	SD
			E6.3	SS1 forced stop warning 2 (safety observation function)	SD
	E7	Controller forced stop warning	E7.1	Controller forced stop input warning	SD
	E8	Cooling fan speed reduction warning	E8.1	Decreased cooling fan speed warning	
			E8.2	Cooling fan stop	
	E9	Main circuit off warning	E9.1	Servo-on signal on during main circuit off	DB
			E9.2	Bus voltage drop during low speed operation	DB
			E9.3	Ready-on signal on during main circuit off	DB
			E9.4	Converter unit forced stop	DB
	EA	ABS servo-on warning	EA.1	ABS servo-on warning	
	EB	The other axis error warning	EB.1	The other axis error warning	DB
	EC	Overload warning 2	EC.1	Overload warning 2	
	ED	Output watt excess warning	ED.1	Output watt excess warning	
	F0	Tough drive warning	F0.1	Instantaneous power failure tough drive warning	
			F0.3	Vibration tough drive warning	

	No.	Name	Detail No.	Detail name	Stop method (Note 2, 3)
Warning	F2	Drive recorder - Miswriting warning	F2.1	Drive recorder - Area writing time-out warning	
			F2.2	Drive recorder - Data miswriting warning	
	F3	Oscillation detection warning	F3.1	Oscillation detection warning	
	F4	Positioning warning	F4.4	Target position setting range error warning	
			F4.6	Acceleration time constant setting range error warning	
			F4.7	Deceleration time constant setting range error warning	
			F4.9	Home position return type error warning	
	F5	Simple cam function - Cam data miswriting warning	F5.1	Cam data - Area writing time-out warning	
			F5.2	Cam data - Area miswriting warning	
			F5.3	Cam data checksum error	
	F6	Simple cam function - Cam control warning	F6.1	Cam axis one cycle current value restoration failed	
			F6.2	Cam axis feed current value restoration failed	
			F6.3	Cam unregistered error	
			F6.4	Cam control data setting range error	
			F6.5	Cam No. external error	
			F6.6	Cam control inactive	
	F7	Machine diagnosis warning	F7.1	Vibration failure prediction warning	
			F7.2	Friction failure prediction warning	
			F7.3	Total travel distance failure prediction warning	

Note 1. After resolving the source of trouble, cool the equipment for approximately 30 minutes.
2. The following shows two stop methods of DB and SD.
DB: Stops with dynamic lock. (Coasts for the driver without dynamic lock.)
SD: Forced stop deceleration
3. This is applicable when [Pr. PA04] is set to the initial value. The stop system of SD can be changed to DB using [Pr. PA04].
4. Quick stop or slow stop can be selected using [Pr. PD30].

8.4 Remedies for alarms

CAUTION	
⚠CAUTION	●When any alarm has occurred, eliminate its cause, ensure safety, and deactivate the alarm before restarting operation. Otherwise, it may cause injury. ●If [AL. 25 Absolute position erased] occurs, always make home position setting again. Otherwise, it may cause an unexpected operation. ●As soon as an alarm occurs, make the Servo-off status and interrupt the main circuit power.

POINT

●When any of the following alarms has occurred, do not cycle the power repeatedly to restart. Doing so will cause a malfunction of the driver and the servo motor. Remove its cause and allow about 30 minutes for cooling before resuming the operation.
- [AL. 30 Regenerative error]
- [AL. 45 Main circuit device overheat]
- [AL. 46 Servo motor overheat]
- [AL. 50 Overload 1]
- [AL. 51 Overload 2]

Remove the cause of the alarm in accordance with this section. Use setup software (MR Configurator2™) to refer to a factor of alarm occurrence.

Alarm No.: 10		Name: Undervoltage			
Alarm content		The voltage of the control circuit power supply has dropped. The voltage of the main circuit power supply has dropped.			
Detail No.	Detail name	Cause	Check method	Check result	Action
10.1	Voltage drop in the control circuit power	(1) The control circuit power supply connection is incorrect.	Check the connection of the control circuit power supply.	It has a failure.	Connect it correctly.
				It has no failure.	Check (2).
		(2) The voltage of the control circuit power supply is low.	Check if the voltage of the control circuit power supply is lower than prescribed value. 160 V AC	The voltage is the prescribed value or lower.	Review the voltage of the control circuit power supply.
				The voltage is higher than the prescribed value.	Check (3).
		(3) The power was cycled before the internal control circuit power supply stopped.	Check if the power has a problem.	It has a problem.	Cycle the power after the seven-segment LED of the driver is turned off.
				It has no problem.	Check (4).
		(4) An instantaneous power failure has occurred for longer time than the specified time. The time will be 60 ms when [Pr. PA20] is "_ 0 _ _". The time will be the value set in [Pr. PF25] when [Pr. PA20] is "_ 1 _ _". The time will be 60 ms when [Pr. PX25] is "_ 0 _ _" and the J3 extension function is used. The time will be the value set in [Pr. PX28] when [Pr. PX25] is "_ 1 _ _".	Check if the power has a problem.	It has a problem.	Review the power.
				It has no problem.	Check (5).
		(5) When a power regeneration converter is used, the voltage of the control circuit power supply is distorted.	Check if the power has a problem. When power supply impedance is high, power supply voltage will be distorted due to current at power regeneration, and it may be recognized as undervoltage.	It has no problem.	Review the setting of "[AL. 10 Undervoltage] detection method selection" with the following parameters. [Pr. PC27]
10.2	Voltage drop in the main circuit power	(1) The main circuit power supply wiring was disconnected. For the drive unit, the main circuit power supply wiring of the converter unit was disconnected.	Check the main circuit power supply wiring. Check the main circuit power supply wiring of the converter unit.	It is disconnected.	Connect it correctly
				It is connected.	Check (2).
		(2) The wiring between P3 and P4 was disconnected. For the drive unit, the wiring between P1 and P2 of the converter unit was disconnected.	Check the wiring between P3 and P4. Check the wiring between P1 and P2 of the converter unit.	It is disconnected.	Connect it correctly.
				It is connected.	Check (3).
		(3) For the drive unit, the	Check the magnetic	It is disconnected.	Connect it correctly.

			magnetic contactor control connector of the converter unit was disconnected.	contactor control connector of the converter unit.	It has no failure.	It is disconnected.
		(4)	For the drive unit, the bus bar between the converter unit and drive unit was disconnected	Check the bus bar between the converter unit and drive unit.	It is disconnected.	Connect it correctly.
					It has no failure.	Check (5).
		(5)	The voltage of the main circuit power supply is low.	Check if the voltage of the main circuit power supply is the prescribed value or lower. 160 V AC	The voltage is the prescribed value or lower.	Increase the voltage of the main circuit power supply.
					The voltage is higher than the prescribed value.	Check (6).
		(6)	The alarm has occurred during acceleration.	Check if the bus voltage during acceleration is lower than the prescribed value. 200 V DC	The voltage is lower than the prescribed value.	Increase the acceleration time constant. Or increase the power supply capacity.
					The voltage is equal to or higher than the prescribed value.	Check (7).

Alarm No.: 12		Name: Memory error 1 (RAM)				
Alarm content		・ A part (RAM) in the driver is failure.				
Detail No.	Detail name	Cause		Check method	Check result	Action
12.1	RAM error 1	(1)	A part in the driver is failure.	Disconnect the cables except for the control circuit power supply, and then check the repeatability	It is repeatable.	Replace the driver.
					It is not repeatable	Check (2).
		(2)	Something near the device caused it.	Check the power supply for noise.	There is a problem in the surrounding	Take countermeasures against its cause.
12.2	RAM error 2	Check it with the check method for [AL. 12.1].				
12.3	RAM error 3					
12.4	RAM error 4					
12.5	RAM error 5					
12.6	RAM error 6					

Alarm No.: 13		**Name: Clock error**				
Alarm content		**A part in the servo driver.** **・A clock error transmitted from the controller occurred.**				
Detail No.	**Detail name**	**Cause**		**Check method**	**Check result**	**Action**
13.1	Clock error 1	(1)	A part in the driver is failure.	Disconnect the cables except for the control circuit power supply, and then check the repeatability.	It is occurring.	Replace the driver.
		(2)	Something near the device caused it.	Check the power supply for noise. Check if the connector is shorted.	There is a problem in the surrounding.	Take ountermeasures against its cause.
13.2	Clock error 2	Check it with the check method for [AL. 13.1].				

Alarm No.: 14		Name: Control process error					
Alarm content		・The process did not complete within the specified time.					
Detail No.	Detail name	Cause		Check method	Check result	Action	
14.1	Control process error 1	(1)	The parameter setting is incorrect.	Check if the parameter setting is incorrect.	It is incorrect.	Set it correctly.	
					It is correct.	Check (3).	
		(2)	Something near the device caused it.	Check the power supply for noise. Check if the connector is shorted	There is a problem in the surrounding.	Take countermeasures against its cause.	
					There is no problem in the surrounding.	Check (4).	
		(3)	The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.	
14.2	Control process error 2	(1)	The parameter setting is incorrect.	Check if the parameter setting is incorrect.	It is incorrect.	Set it correctly.	
					It is correct.	Check (5).	
		(2)	Something near the device caused it.	Check the power supply for noise. Check if the connector is shorted.	There is a problem in the surrounding.	Take countermeasures against its cause.	
					There is no problem in the surrounding.	Check (6).	
		(3)	The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.	
14.3	Control process error 3	Check it with the check method for [AL. 14.1].					
14.4	Control process error 4						
14.5	Control process error 5						
14.6	Control process error 6						
14.7	Control process error 7						
14.8	Control process error 8						
14.9	Control process error 9						
14.A	Control process error 10						
14.B	Control process error 11	(1)	The parameter setting is incorrect.	Check if the parameter setting is incorrect.	It is incorrect.	Set it correctly.	
					It is correct.	Check (3).	
		(2)	Something near the device caused it.	Check the power supply for noise. Check if the connector is shorted.	It has a failure.	Take countermeasures against its cause.	
					It has no failure.	Check (4).	
		(3)	The driver is malfunctioning	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.	
14.C	Control process error 12	Check it with the check method for [AL. 14.B].					
14.D	Control process error 13						

Alarm No.: 15		Name: Memory error 2 (EEP-ROM)				
Alarm content		A part (EEP-ROM) in the driver is failure.				
Detail No.	Detail name	Cause		Check method	Check result	Action
15.1	EEP-ROM error at power on	(1)	EEP-ROM is malfunctioning at power on.	Disconnect the cables except for the control circuit power supply, and then check the repeatability.	It is repeatable.	Replace the driver.
					It is not repeatable.	Check (2).
		(2)	Something near the device caused it.	Check the power supply for noise. Check if the connector is shorted	There is a problem in the surrounding.	Take countermeasures against its cause.
					There is no problem in the surrounding.	Check (3).
		(3)	The number of write times exceeded 100,000.	Check if parameters, point tables, or programs are changed very frequently.	It was changed.	Replace the driver. Change the process to use parameters, point tables, and programs less frequently after replacement.
15.2	EEP-ROM error During operation	(1)	EEP-ROM is malfunctioning during normal operation.	Check if the error occurs when you change parameters during normal operation.	It occurs.	Replace the driver.
					It does not occur.	Check (3).
		(2)	A write error occurred while adjustment results were processed.	Check if the alarm occurs after an hour from power on.	It takes an hour or more	Replace the driver.
					It takes less than an hour.	Check (4).
		(3)	Something near the device caused it.	Check the power supply for noise. Check if the connector is shorted.	There is a problem in the surrounding.	Take countermeasures against its cause.
15.4	Home position information read error	(1)	EEP-ROM is malfunctioning at power on.	Disconnect the cables except for the control circuit power supply, and then check the repeatability.	It is repeatable.	Replace the driver.
					It is not repeatable.	Check (2).
		(2)	Multiple rotation data saved as a home position and read from EEP-ROM were failure.	Check if the home position was set correctly.	It is repeatable.	Replace the driver.
					It is not repeatable.	Check (3).
		(3)	Something near the device caused it.	Check the power supply for noise. Check if the connector is shorted.	There is a problem in the surrounding.	Take countermeasures against its cause.
					There is no problem in the surrounding.	Check (4).
		(4)	The number of write times exceeded 100,000.	Check if parameters has been used very frequently.	It was changed.	Replace the driver. Change the process to use parameters less frequently after replacement.

Alarm No.: 16		Name: Encoder initial communication error 1				
Alarm content		**An error occurred in the communication between an encoder and driver.**				
Detail No.	**Detail name**	**Cause**		**Check method**	**Check result**	**Action**
16.1	Encoder initial communication - Receive data error 1	(1)	An encoder cable is malfunctioning.	Check if the encoder cable is disconnected or shorted.	It has a failure.	Replace or repair the cable.
					It has no failure.	Check (2).
		(4)	The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.
					It is repeatable.	Check (5).
		(5)	An encoder is malfunctioning.	Replace the servo motor, and then check the repeatability.	It is not repeatable.	Replace the servo motor
					It is repeatable.	Check (6).
		(6)	Something near the device caused it.	Check the noise, ambient temperature, vibration, etc.	There is a problem in the surrounding.	Take countermeasures against its cause.
16.2	Encoder initial communication - Receive data error 2	Check it with the check method for [AL. 16.1].				

Alarm No.: 16		Name: Encoder initial communication error 1			
Alarm content		An error occurred in the communication between an encoder and driver			
Detail No.	Detail name	Cause	Check method	Check result	Action
16.3	Encoder initial communication - Receive data error 3	(1) An encoder cable was disconnected.	Check if the encoder cable is connected correctly.	It is not connected	Connect it correctly.
				It is connected.	Check (3).
		(2) The parameter setting of communication method is incorrect.	Check the parameter setting.	The setting is incorrect.	Set it correctly.
				The setting is correct.	Check (4).
		(3) An encoder cable is malfunctioning.	Check if the encoder cable is disconnected or shorted.	The setting is incorrect.	Set it correctly.
				The setting is correct.	Check (5).
		(5) The voltage of the control circuit power supply has been unstable.	Check the voltage of the control circuit power supply.	An instantaneous power failure is occurring at the control circuit power supply.	Review the power and related parts
				It has no failure.	Check (8).
		(6) The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace thedriver.
				It is repeatable.	Check (9).
		(7) An encoder is malfunctioning.	Replace the servo motor,and then check the repeatability.	It is not repeatable.	Replace the servo motor
				It is repeatable.	Check (10).
		(8) Something near the device caused it.	Check the noise, ambient temperature, vibration,etc.	There is a problem in the surrounding.	Take countermeasures against its cause.
16.5	Encoder initial communication - Transmission data error 1	Check it with the check method for [AL. 16.1].			
16.6	Encoder initial communication - Transmission data error 2				
16.7	Encoder initial communication - Transmission data error 3				

Alarm No.: 16		Name: Encoder initial communication error 1					
Alarm content		An error occurred in the communication between an encoder and driver.					
Detail No.	Detail name	Cause		Check method	Check result	Action	
16.A	Encoder initial communication - Process error 1	(1)	The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.	
					It is repeatable.	Check (2).	
		(2)	An encoder is malfunctioning.	Replace the servo motor, and then check the repeatability	It is not repeatable.	Replace the driver.	
					It is repeatable.	Check (3).	
		(3)	Something near the device caused it.	Check the noise, ambient temperature, vibration, etc.	There is a problem in the surrounding.	Take countermeasures against its cause.	
16.B	Encoder initial communication - Process error 2	Check it with the check method for [AL. 16.A].					
16.C	Encoder initial communication - Process error 3						
16.D	Encoder initial communication - Process error 4						
16.E	Encoder initial communication - Process error 5						
16.F	Encoder initial communication - Process error 6						

Alarm No.: 17		**Name: Board error**					
Alarm content		**A part in the driver is malfunctioning.**					
Detail No.	**Detail name**	**Cause**		**Check method**	**Check result**	**Action**	
17.1	Board error 1	(1)	A current detection circuit is malfunctioning.	Check if the alarm occurs during the servo-on status.	It occurs.	Replace the driver.	
					It does not occur.	Check (2).	
		(2)	Something near the device caused it.	Check the noise, ambient temperature, etc.	There is a problem in the surrounding.	Take countermeasures against its cause.	
17.3	Board error 2	Check it with the check method for [AL. 17.1].					
17.4	Board error 3	(1)	The driver recognition signal was not read properly.	Disconnect the cables except for the control circuit power supply, and then check the repeatability.	It is repeatable.	Replace the driver.	
					It is not repeatable.	Check (2).	
		(2)	Something near the device caused it.	Check the noise, ambient temperature, etc.	There is a problem in the surrounding.	Take countermeasures against its cause.	
17.7	Board error 7	(1)	Check it with the check method for [AL. 17.4].				

Alarm No.: 19		Name: Memory error 3 (Flash-ROM)				
Alarm content		A part (Flash-ROM) in the driver is failure.				
Detail No.	Detail name	Cause		Check method	Check result	Action
19.1	Flash-ROM error 1	(1)	The Flash-ROM is malfunctioning.	Disconnect the cables except for the control circuit power supply, and then check the repeatability.	It is repeatable.	Replace the driver.
					It is not repeatable.	Check (2).
		(2)	Something near the device caused it.	Check the noise, ambient temperature, etc.	There is a problem in the surrounding.	Take countermeasures against its cause.
19.2	Flash-ROM error 2	Check it with the check method for [AL. 19.1].				
19.3	Flash-ROM error 3					

Alarm No.: 1A		Name: Servo motor combination error				
Alarm content		・The combination of driver and servo motor is incorrect.				
Detail No.	Detail name	Cause		Check method	Check result	Action
1A.1	Servo motor combination error 1	(1)	The driver and the servo motor was connected incorrectly.	Check the model name of the servo motor and corresponding driver.	The combination is incorrect.	Use them in the correct combination.
					The combination is correct.	Check (2).
		(2)	The setting of [Pr. PA01] is not corresponding to the connected servo motor.	Check the [Pr. PA01] setting. Rotary servo motor: "0"	The combination is incorrect.	Set [Pr. PA01] correctly. When using a linear servo motor, also check (3).
					The combination is correct.	Check (3).
		(3)	An encoder is malfunctioning.	Replace the servo motor, and then check the repeatability.	It is not repeatable.	Replace the servo motor
1A.2	Servo motor control mode combination error	(1)	The setting of [Pr. PA01] is not corresponding to the connected servo motor	Check the [Pr. PA01] setting. Rotary servo motor: "0"	The combination is incorrect.	Set [Pr. PA01] correctly.
		(2)	When the fully closed loop control mode is selected, encoders of the servo motor side and the machine side are connected reversely.	Check the connection destination of the encoder.	The connection destination of the encoder is incorrect	Connect it correctly.
1A.4	Servo motor combination error 2	(1)	Thedriver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.

Alarm No.: 1B		Name: Converter alarm				
Alarm content		An alarm occurred in the converter unit during the servo-on.				
Detail No.	Detail name	Cause		Check method	Check result	Action
1B.1	Converter unit error	(1)	The protection coordination cable is not correctly connected	Check the protection coordination cable connection.	It is not connected.	Connect it correctly. It is connected. Check (2).
					It is connected.	Check (2).
		(2)	An alarm occurred in the converter unit during the servo-on.	Check the alarm of the converter unit, and take the action following the remedies for alarms of the converter unit.		

Alarm No.: 1E		Name: Encoder initial communication error 2					
Alarm content		・An encoder is malfunctioning.					
Detail No.	Detail name	Cause		Check method	Check result	Action	
1E.1	Encoder malfunction	(1)	An encoder is malfunctioning.	Replace the servo motor, and then check the repeatability.	It is not repeatable.	Replace the servo motor.	
					It is repeatable.	Check (2).	
		(2)	Something near the device caused it.	Check the noise, ambient temperature, vibration, etc.	There is a problem in the surrounding.	Take countermeasures against its cause.	

Alarm No.: 1F		Name: Encoder initial communication error 3					
Alarm content		The connected encoder is not compatible with the driver.					
Detail No.	Detail name	Cause		Check method	Check result	Action	
1F.1	Incompatible encoder	(1)	A servo motor encoder, which is not compatible with the driver, was connected.	Check the model of the servo motor encoder.	It is not compatible with the driver.	Replace it with a compatible one.	
					It is compatible with the driver.	Check (2).	
		(2)	The software version of the driver does not support the servo motor.	Check if the software version supports the servo motor encoder.	It is not compatible.	Replace the driver to one which software version supports the servo motor encoder	
					It is compatible.	Check (3).	
		(3)	An encoder is malfunctioning.	Replace the servo motor, and then check the repeatability.	It is not repeatable.	Replace the servo motor.	
					It is repeatable	Replace the driver.	

Alarm No.: 20		Name: Encoder normal communication error 1					
Alarm content		An error occurred in the communication between an encoder and driver.					
Detail No.	**Detail name**		**Cause**	**Check method**	**Check result**	**Action**	
20.1	Encoder normal communication - Receive data error 1	(1)	An encoder cable is malfunctioning.	Check if the encoder cable is disconnected or shorted. When you use an A/B/Z-phase differential output linear encoder, check the wiring of the linear encoder.	It has a failure.	Repair or replace the cable.	
					It has no failure.	Check (2).	
		(2)	The external conductor of the encoder cable is not connected to the ground plate of the connector.	Check if it is connected.	It is not connected.	Connect it correctly.	
					It is connected.	Check (3).	
		(3)	The parameter setting of communication method is incorrect. [Pr. PC22]	Check the parameter setting.	The setting is incorrect.	Set it correctly.	
					The setting is correct.	Check (4).	
		(4)	In the parallel drive system, the setting of [Pr. PF40] is incorrect.	Check the parameter setting.	The setting is incorrect.	Set it correctly.	
					The setting is correct.	Check (5).	
		(5)	The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.	
					It is repeatable.	Check (6).	
		(6)	An encoder is malfunctioning.	Replace the servo motor, and then check the repeatability.	It is not repeatable.	Replace the servo motor.	
					It is repeatable.	Check (7).	
		(7)	Something near the device caused it.	Check the noise, ambient temperature, vibration,etc.	There is a problem in the surrounding.	Take countermeasures against its cause.	
20.2	Encoder normal communication - Receive data error 2	Check it with the check method for [AL. 20.1].					
20.3	Encoder normal communication - Receive data error 3						
20.5	Encoder normal communication - Transmission data error 1	(2)	An encoder cable is malfunctioning.	Check it with the check method for [AL. 20.1].			
		(3)	The external conductor of the encoder cable is not connected to the ground plate of the connector.				
		(5)	The driver is malfunctioning.				
		(6)	An encoder is malfunctioning.				
		(7)	Something near the device caused it.				

Alarm No.: 20		Name: Encoder normal communication error 1				
Alarm content		An error occurred in the communication between an encoder and driver.				
Detail No.	Detail name	Cause		Check method	Check result	Action
20.6	Encoder normal communication - Transmission data error 2	(2)	An encoder cable is malfunctioning.	Check it with the check method for [AL. 20.1].		
		(3)	The external conductor of the encoder cable is not connected to the ground plate of the connector.			
		(4)	When you use an A/B/ Z-phase differential output linear encoder, the parameter setting is incorrect.			
		(5)	The driver is malfunctioning.			
		(6)	An encoder is malfunctioning.			
		(7)	Something near the device caused it.			
20.7	Encoder normal communication - Transmission data error 3	Check it with the check method for [AL. 20.1].				
20.9	Encoder normal communication - Receive data error 4					
20.A	Encoder normal communication - Receive data error 5					

Alarm No.: 21		Name: Encoder normal communication error 2				
Alarm content		· The encoder detected an error signal.				
Detail No.	Detail name	Cause		Check method	Check result	Action
21.1	Encoder data error 1	(1)	The encoder detected a high speed/acceleration rate due to an oscillation or other factors.	Decrease the loop gain, and then check the repeatability.	It is not repeatable.	Use the encoder with low loop gain.
					It is repeatable.	Check (2).
		(2)	The external conductor of the encoder cable is not connected to the ground plate of the connector.	Check if it is connected.	It is not connected.	Connect it correctly.
					It is connected.	Check (3).
		(3)	An encoder is malfunctioning.	Replace the servo motor, and then check the repeatability.	It is not repeatable.	Replace the servo motor.
					It is repeatable.	Check (4).
		(4)	Something near the device caused it.	Check the noise, ambient temperature, vibration, etc.	There is a problem in the surrounding.	Take countermeasures against its cause.
21.2	Encoder data update error	(1)	An encoder is malfunctioning.	Replace the servo motor, and then check the repeatability.	It is not repeatable.	Replace the servo motor
					It is repeatable.	Check (2).
		(2)	The external conductor of the encoder cable is not connected to the ground plate of the connector.	Check if it is connected	It is not connected.	Connect it correctly.
					It is connected.	Check (3).
		(3)	Something near the device caused it.	Check the noise, ambient temperature, etc.	There is a problem in the surrounding.	Take countermeasures against its cause
21.3	Encoder data waveform error	Check it with the check method for [AL. 21.2].				
21.4	Encoder nonsignal error	(1)	A signal of the encoder has not been inputted.	Check if the encoder cable is wired correctly	It has a failure.	Review the wiring.
					It has no failure.	Check (2).
		(2)	The external conductor of the encoder cable is not connected to the ground plate of the connector.	Check if it is connected.	It is not connected.	Connect it correctly.
					It is connected.	Check (3).
		(3)	Something near the device caused it.			
21.5	Encoder hardware error 1	Check it with the check method for [AL. 21.2].				
21.6	Encoder hardware error 2					
21.9	Encoder data error 2	Check it with the check method for [AL. 21.1].				

Alarm No.: 24		Name: Main circuit error				
Alarm content		· A ground fault occurred on the servo motor power lines. · A ground fault occurred at the servo motor.				
Detail No.	Detail name	Cause		Check method	Check result	Action
24.1	Ground fault detected by hardware detection circuit	(1)	The driver is malfunctioning.	Disconnect the servo motor power cables (U/V/ W) and check if the alarm occurs.	It occurs.	Replace the driver.
					It does not occur.	Check (2).
		(2)	A ground fault or short occurred at the servo motor power cable.	Check if only the servo motor power cable is shorted.	It is shorted.	Replace the servo motor power cable.
					It is not shorted.	Check (3).
		(3)	A ground fault occurred at the servo motor.	Disconnect the servo motor power cables on motor side, and check insulation of the motor (between U/V/W/).	It is shorted.	Replace the servo motor.
					It is not shorted.	Check (4).
		(4)	The main circuit power supply cable and servo motor power cable were shorted.	Shut off the power, and check if the main circuit power supply cable and servo motor power cable are in contact.	They are in contact.	Correct the wiring.
					They are not in contact.	Check (5).
		(5)	Something near the device caused it.	Check the noise, ambient temperature, etc.	There is a problem in the surrounding.	Take countermeasures against its cause.
24.2	Ground fault detected by software detection function	(1)	The driver is malfunctioning.	Disconnect the servo motor power cable (U/V/W), and check if the alarm occurs.	It occurs.	Replace the driver.
					It does not occur.	Check (3).
		(2)	A ground fault or short occurred at the servo motor power cable.	Check if only the servo motor power cable is shorted.	It is shorted.	Replace the servo motor power cable.
					It is not shorted.	Check (4).
		(3)	A ground fault occurred at the servo motor.	Disconnect the servo motor power cables on motor side, and check insulation between phases (U/V/W/).	It is shorted.	Replace the servo motor.
					It is not shorted.	Check (5).
		(4)	The main circuit power supply cable and servo motor power cable were shorted.	Shut off the power, and check if the main circuit power supply cable and servo motor power cable are in contact.	They are in contact.	Correct the wiring.
					They are not in contact.	Check (6).
		(5)	Something near the device caused it.	Check the noise, ambient temperature, etc.	There is a problem in the surrounding.	

Alarm No.: 25		Name: Absolute position erased					
Alarm content		・The absolute position data is faulty. ・Power was switched on for the first time in the absolute position detection system. ・After the scale measurement encoder was set to the absolute position detection system, the power was switched on for the first time.					
Detail No.	**Detail name**	**Cause**		**Check method**	**Check result**	**Action**	
25.1	Servo motor encoder - Absolute position erased	(1)	Power was switched on for the first time in the absolute position detection system.	Check if this is the first time you switched on the power in the absolute position detection system.	This is the first time.	Check that the battery is mounted correctly, and make home position return.	
					This is not the first time.	Check (2).	
		(2)	1) When a battery Battery case was used, CN4 of the driver was disconnected during control circuit power supply off.	Check if the battery was removed in this way when the control circuit power supply was off.	It was removed.	Check that the battery is mounted correctly, and make home position return.	
		(6)	The battery voltage is low. The battery is consumed.	Check the battery voltage with a tester.	It is less than 3 V DC.	Replace the battery.	
					It is 3 V DC or more.	Check (7).	
		(7)	The voltage has dropped greatly in the encoder cable wired to the battery.	Check if a recommended cable is used for the encoder cable.	It is not used.	Use a recommended wire.	
					It is used.	Check (8).	
		(8)	A battery cable is malfunctioning.	Check for the loose connection with a tester.	It has a failure.	Replace the battery cable.	
					It has no failure.	Check (9).	
		(9)	There is a loose connection of the encoder cable on the servo motor side.	Check for the loose connection with a tester. Measure the voltage on the servo motor side.	It has a failure.	Repair or replace the encoder cable.	
					It has no failure.	Check (10).	
		(11)	The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.	
					It is repeatable.	Check (12).	
		(12)	An encoder is malfunctioning.	Replace the servo motor,and then check the repeatability.	It is not repeatable.	Replace the servo motor	

Alarm No.: 2B		Name: Encoder counter error					
Alarm content		Data which encoder created is failure.					
Detail No.	Detail name	Cause		Check method	Check result	Action	
2B.1	Encoder counter error 1	(1)	An encoder cable is malfunctioning.	Check if the encoder cable is disconnected or shorted.	It has a failure.	Repair or replace the cable.	
					It has no failure.	Check (2).	
		(2)	The external conductor of the encoder cable is not connected to the ground plate of the connector.	Check if it is connected.	It is not connected.	Connect it correctly.	
					It is connected.	Check (3).	
		(3)	Something near the device caused it.	Check the noise, ambient temperature, vibration, etc.	There is a problem in the surrounding.	Take countermeasures against its cause.	
					There is no problem in the surrounding.	Check (4).	
		(4)	An encoder is malfunctioning.	Replace the direct drive motor, and then check the repeatability.	It is not repeatable. Replace	Replace the direct drive motor.	
2B.2	Encoder counter error 2	Check it with the check method for [AL. 2B.1].					

Alarm No.: 30		Name: Regenerative error					
Alarm content		· Permissible regenerative power of the built-in regenerative resistor or regenerative option is exceeded. · A regenerative transistor in the driver is malfunctioning.					
Detail No.	Detail name	Cause		Check method	Check result	Action	
30.1	Regeneration heat error	(1)	The setting of the regenerative resistor (regenerative option) is incorrect.	Check the regenerative resistor (regenerative option) and [Pr. PA02] setting.	The setting value is incorrect.	Set it correctly.	
					It is set correctly.	Check (2).	
		(2)	The regenerative resistor (regenerative option) is not connected.	Check if the regenerative resistor (regenerative option) is connected correctly.	It is not connected correctly.	Connect it correctly	
					It is connected correctly.	Check (3).	
		(3)	The combination of regenerative resistor (regenerative option) and driver is incorrect.	Check if the regenerative resistor (regenerative option) and the driver are connected in the specified combination.	The combination is incorrect.	Use them in the correct combination.	
					The combination is correct.	Check (4).	
		(4)	The power supply voltage is high.	Check if the voltage of the input power supply is over the prescribed value. 264 V AC	It is higher than the prescribed value.	Reduce the power supply voltage.	
					It is at the prescribed value or lower.	Check (5).	

Detail No.	Detail name		Cause	Check method	Check result	Action
		(5)	The regenerative load ratio exceeded 100%.	Check the regenerative load ratio when alarm occurs.	It is 100% or more	Reduce the frequency of positioning. Increase the deceleration time constant. Reduce the load. Use a regenerative option if it is not being used. Review the regenerative option capacity.
30.2	Regeneration signal error	(1)	A detection circuit of the driver is malfunctioning.	Check if the regenerative resistor (regenerative option) is overheating.	It is overheating abnormally.	Replace the driver.
30.3	Regeneration feedback signal error	(1)	A detection circuit of the driver is malfunctioning.	Remove the regenerative option or built-in regenerative resistor, and then check if the alarm occurs at power on.	The alarm occurs.	Replace thedriver.
					The alarm does not occur.	Check (2).
		(2)	Something near the device caused it.	Check the noise, ground fault, ambient temperature, etc.	There is a problem in the surrounding.	Take countermeasures against its cause.

Alarm No.: 31		Name: Overspeed				
Alarm content		**・The servo motor speed has exceeded the instantaneous permissible speed.**				
Detail No.	**Detail name**	**Cause**		**Check method**	**Check result**	**Action**
31.1	Abnormal motor speed	(1)	The command pulse frequency is high.	Check the command pulse frequency.	The command pulse frequency is high.	Check operation pattern.
					The command pulse frequency is low.	Check (2).
		(2)	The settings of the electronic gear are incorrect.	Check the setting value of the electronic gear.	The setting value is incorrect.	Review the settings.
					The setting value is correct.	Check (5).
		(3)	The servo motor was at the maximum torque (maximum thrust) at the time of acceleration.	Check if the torque (thrust) at the time of acceleration is the maximum torque (maximum thrust).	It is the maximum torque (maximum thrust).	Increase the acceleration/deceleration time constant. Or reduce the load.
					It is less than the [GF] maximum torque (maximum thrust).	Check (6).
		(4)	The servo system is unstable and oscillating.	Check if the servo motor is oscillating.	It is oscillating.	Adjust the servo gain. Or reduce the load.
					It is not oscillating.	Check (7).
		(5)	The velocity waveform has overshot.	Check if it is overshooting because the acceleration time constant is too short.	It is overshooting.	Increase the acceleration/deceleration time constant.
					It is not overshooting.	Check (8).
		(7)	The connection of the servo motor is incorrect.	Check the wiring of U/V/W.	It is incorrect.	Set it correctly.
					It is correct.	Check (11).
		(8)	The encoder or linear encoder is malfunctioning.	Check if the alarm is occurring during less than instantaneous permissible speed.	It is occurring during less than instantaneous permissible speed.	Replace the servo motor.

Alarm No.: 32		Name: Overcurrent				
Alarm content		· A current higher than the permissible current was applied to the driver.				
Detail No.	**Detail name**	**Cause**		**Check method**	**Check result**	**Action**
32.1	Overcurrent detected at hardware detection circuit (during operation)	(1)	The driver is malfunctioning.	Disconnect the servo motor power cables (U/V/W) and check if the alarm occurs.	It occurs.	Replace the driver.
					It does not occur.	Check (2).
		(2)	A ground fault or short occurred at the servo motor power cable.	Check if only the servo motor power cable is shorted.	It is shorted.	Replace the servo motor power cable.
					It is not shorted.	Check (3).
		(3)	The servo motor is malfunctioning.	Disconnect the servo motor power cables on motor side, and check insulation of the motor (between U/V/W/ ⏚/—)	A ground fault is occurring.	Replace the servo motor.
					A ground fault is not occurring.	Check (4).
		(4)	The dynamic brake is malfunctioning.	Check if the alarm occurs when you turn on the servo-on command.	It occurs.	Replace the driver.
					It does not occur.	Check (7).
		(5)	Something near the device caused it.	Check the noise, ambient temperature, etc.	There is a problem in the surrounding.	Take countermeasures against its cause.
					There is no problem in the surrounding	Check it with the check method for [AL. 45.1].

Alarm No.: 32		Name: Overcurrent				
Alarm content		· A current higher than the permissible current was applied to the driver.				
Detail No.	**Detail name**	**Cause**		**Check method**	**Check result**	**Action**
32.2	Overcurrent detected at software detection function (during operation)	(1)	The servo gain is high.	Check if an oscillation is occurring.	An oscillation is occurring.	Reduce the speed loop gain ([Pr. PB09]).
					An oscillation is not occurring.	Check (2).
		(2)	The driver is malfunctioning.	Disconnect the servo motor power cables (U/V/W) and check if the alarm occurs.	It occurs.	Replace the driver.
					It does not occur.	Check (3).
		(3)	A ground fault or short occurred at the servo motor power cable.	Check if only the servo motor power cable is shorted.	It is shorted.	Replace the servo motor power cable.
					It is not shorted.	Check (4).
		(4)	The servo motor is malfunctioning.	Disconnect the servo motor power cables on motor side, and check insulation of the motor (between U/V/W/ /).	A ground fault is occurring.	Replace the servo motor.
					A ground fault is not occurring.	Check (5).
		(5)	Something near the device caused it.	Check the noise, ambient temperature, etc.	There is a problem in the surrounding.	Take countermeasures against its cause.
32.3	Overcurrent detected at hardware detection circuit (during a stop)	Check it with the check method for [AL. 32.1].				
32.4	Overcurrent detected at software detection function (during a stop))	Check it with the check method for [AL. 32.2].				

Alarm No.: 33		Name: Overvoltage					
Alarm content		・The value of the bus voltage exceeded the prescribed value.					
Detail No.	Detail name	Cause		Check method	Check result	Action	
33.1	Main circuit voltage error	(1)	The setting of the regenerative resistor (regenerative option) is incorrect.	Check the regenerative resistor (regenerative option) and [Pr. PA02] setting.	The setting value is incorrect.	Set it correctly.	
					It is set correctly.	Check (2).	
		(2)	The regenerative resistor (regenerative option) is not connected.	Check if the regenerative resistor (regenerative option) is connected correctly.	It is not connected correctly.	Connect it correctly.	
					It is connected correctly.	Check (3).	
		(3)	Wire breakage of builtin regenerative resistor or regenerative option	Measure the resistance of the built-in regenerative resistor or regenerative option.	The resistance is abnormal.	When using a built-in regenerative resistor, replace the driver. When using a regenerative option, replace the regenerative option.	
					The resistance is normal.	Check (4).	
		(4)	The regeneration capacity is insufficient.	Set a longer deceleration time constant, and then check the repeatability.	It is not repeatable.	When using a built-in regenerative resistor, use a regenerative option. When using a regenerative option, use a larger capacity one.	
					It is repeatable.	Check (5).	
		(5)	Power supply voltage high.	Check if the voltage of the input power supply is over the prescribed value. 264 V AC	It is higher than the prescribed value.	Reduce the power supply voltage.	
					It is at the prescribed value or lower.	Check (6).	
		(6)	Something near the device caused it.	Check the noise, ambient temperature, etc.	There is a problem in the surrounding.	Take countermeasures against its cause.	

Alarm No.: 35		Name: Command frequency error					
Alarm content		Input pulse frequency of command pulse is too high.					
Detail No.	Detail name	Cause		Check method	Check result	Action	
35.1	Command frequency error	(1)	The command pulse frequency is high.	Check the command pulse frequency.	The command pulse frequency is high.	Check operation pattern.	
					The command pulse frequency is low.	Check (2).	
		(2)	The setting of "Command input pulse train filter selection" in [Pr. PA13] is not correct.	Check if the command pulse frequency is within the setting range of the filter.	It is out of setting range.	Review the filter setting.	
					It is within the setting range.	Check (6).	
		(3)	Inputted frequency with a manual pulse generator is high.	Check the inputted frequency of the manual pulse generator	The command pulse frequency is high.	Reduce the inputted frequency of the manual pulse generator.	
					The command pulse frequency is low.	Check (6).	
		(4)	Something near the device caused it.	Check the noise, ambient temperature, etc.	There is a problem in the surrounding.	Take ountermeasures against its cause.	

Alarm No.: 37	Name: Parameter error					
Alarm content	・Parameter setting is incorrect. ・Point table setting is incorrect.					
Detail No.	**Detail name**	**Cause**		**Check method**	**Check result**	**Action**
37.1	Parameter setting range error	(1)	A parameter was set out of setting range.	Check the parameter error No. and setting value.	It is out of setting range.	Check operation pattern.
					It is within the setting range.	Check (2).
		(2)	A parameter setting contradicts another.	Check the parameter error No. and setting value.	A setting value is incorrect.	Review the filter setting.
					A setting value is correct.	Check (6).
		(3)	The parameter setting has changed due to a driver malfunction.	Replace thedriver, and then check the repeatability.	It is not repeatable.	Replace the driver.
37.2	Parameter combination error	(1)	A parameter setting contradicts another.	Check the parameter error No. and setting value.	A setting value is incorrect.	Correct the setting value. (When the master-slave function is set, also check (2).)
37.3	Point table setting error	(1)	The setting of point tables is incorrect.	Check if the setting of point tables is within the setting range. Check the parameter error No. and point table error No. with the point table error No. display on the display of the driver. Or check the setting value with the point table display of setup software (MR Configurator2™).	A setting value is incorrect.	Correct the setting value.
					A setting value is correct.	Check (2).
		(2)	A point table setting has changed due to a driver malfunction.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.

Alarm No.: 39	**Name: Program error**						
Alarm content	**A program used for the program operation is incorrect.**						
Detail No..	**Detail name**	**Cause**		**Check method**	**Check result**	**Action**	
39.1	Program error	(1)	A checksum of the program did not match at power-on. (The program has an error.)	Check if an error occurred (such as entered noise, power-off) at program write.	It has a failure.	Rewrite the program.	
					It has no failure.	Check (2).	
		(2)	A program has changed due to a driver malfunction.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.	
39.2	Instruction argument external error	(1)	A program has never been written since program initialization.	Check if a program was written.	It was not executed.	Write the program.	
					It was executed.	Check (3).	
		(2)	A command argument is using a value out of specifications.	Check if the command description has a failure.	It has a failure.	Correct the command description.	
					It has no failure.	Check (3).	
		(3)	A program has changed due to a driver malfunction.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.	
39.3	Register No. error	(1)	A specified number of the general purpose register used for a command is a value out of specifications.	Check if the command description has a failure.	It has a failure.	Correct the command description.	
					It has no failure.	Check (2).	
		(2)	A program has changed due to a driver malfunction.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.	
39.4	Noncorrespondence instruction error	(1)	A used command is not correspondent to the program.	Check if the command description has a failure.	It has a failure.	Correct the command description.	
					It has no failure.	Check (2).	
		(2)	A program has changed due to a driver malfunction.	Replace the driver, and then check the repeatability.	It has no failure.	Replace the driver.	

Alarm No.: 3A	**Name: Inrush current suppression circuit error**						
Alarm content	**The inrush current suppression circuit error was detected.**						
Detail No.	**Detail name**	**Cause**		**Check method**	**Check result**	**Action**	
3A.1	Inrush current suppression circuit error	(1)	Inrush current suppressor circuit is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.	

Alarm content	**Name: Operation mode error**						
Alarm content	**· The operation mode setting was changed.**						
Detail No.	**Detail name**	**Cause**		**Check method**	**Check result**	**Action**	
3E.6	Operation mode switch error	(1)	A method of positioning data memorized in the driver (point table method/program method) is different from the actual positioning mode (point table method/program method).	Check if the positioning mode (point table method/program method) was changed. Positioning mode: [Pr. PA01] "_ _ _ x"	It was changed. (with a purpose) After changing the positioning mode, initialize	After changing the positioning mode, initialize the point table method/ program method. (Refer to section 7.2.8 [Pr. PT34] of "MRJ4-_A_-RJ driver Instruction Manual (Positioning Mode)")	
					It was changed by mistake.	Set the positioning mode back to the correct setting.	

Alarm No.: 45		Name: Main circuit device overheat				
Alarm content		· Inside of the driver overheated.				
Detail No.	Detail name	Cause		Check method	Check result	Action
45.1	Main circuit device overheat error 1	(1)	Ambient temperature has exceeded 55 ℃. .	Check the ambient temperature.	It is over 55 ℃.	Lower the ambient temperature.
					It is less than 55℃.	Check (2).
		(2)	The close mounting is out of specifications.	Check the specifications of close mounting.	It is out of specifications.	Use within the range of specifications.
					It is within specifications.	Check (3).
		(3)	Turning on and off were repeated under the overload status.	Check if the overload status occurred many times.	It occurred.	Check operation pattern.
					It did not occur.	Check (4).
		(4)	A cooling fan, heat sink, or openings is clogged with foreign matter.	Clean the cooling fan, heat sink, or openings, and then check the repeatability.	It is not repeatable.	Clean it periodically.
					It is repeatable.	Check (5).
		(5)	The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.
45.2	Main circuit device overheat error 2	(1)	Check it with the check method for [AL. 45.1].			

Alarm No.: 46		Name: Servo motor overheat				
Alarm content		· The servo motor overheated.				
Detail No.	Detail name	Cause		Check method	Check result	Action
46.1	Abnormal temperature of servo motor 1	(1)	Ambient temperature of the servo motor has exceeded 40℃.	Check the ambient temperature of the servomotor.	It is over 40℃	Lower the ambient temperature.
					It is less than 40 ℃	Check (2).
		(2)	Servo motor is overloaded.	Check the effective load ratio.	The effective load ratio is high.	Reduce the load or review the operation pattern.
					The effective load ratio is small.	Check (3).
		(3)	The thermal sensor in the encoder is malfunctioning.	Check the servo motor temperature when the alarm occurs.	The servo motor temperature is low.	Replace the servo motor.
46.3	Thermistor disconnected error	(1)	In the parallel drive system, the parameter settings and the axis number settings are incorrect.	Check the settings of [Pr.PF37 Parallel drive -Encoder ID setting 1]. Check if the setting of [Pr. PF40 Parallel drive -Servo motor side system setting] matches the setting of the axis number set with the combination of SW2-3, SW2-4, and SW1.	It is not set correctly.	Set the parameter and the axis number correctly.
					It is set correctly.	Check (2).
		(2)	In the parallel drive system, the encoder cable from the servo motor is not connected to the encoder master driver.	Check if the encoder cable from the servo motor is connected to the encoder master driver.	It is not connected.	Connect the encoder cable of the servo motor to the encoder master driver.Connect the encoder master driver and the encoder slave driver in the order of the axis number.
					It is connected.	Check (3).
		(3)	A thermistor wire is not connected.	Check the thermistor wire.	It is not connected.	Connect it correctly.
					It is connected.	Check (4).
		(5)	The thermistor wire is disconnected.	Check the thermistor wire.	It is disconnected.	Repair the lead wire.
					It is not disconnected.	Replace the servo motor.
46.4	Thermistor circuit error	(1)	A thermistor circuit of the driver is malfunctioning.	Replace the driver, and then check the repeatability	It is not repeatable.	Replace the driver.
46.5	Abnormal temperature of servo motor 3	Check it with the check method for [AL. 46.1].				
46.6	Abnormal temperature of servo motor 4	(1)	A current was applied to the driver in excess of its continuous output current.	Check the effective load ratio.	The effective load ratio is high.	Reduce the load or review the operation pattern. Or use a larger capacity motor.

Alarm No.: 47		Name: Cooling fan error				
Alarm content		・The speed of the driver cooling fan decreased. ・Or the fan speed decreased to the alarm occurrence level or less.				
Detail No.	Detail name	Cause		Check method	Check result	Action
47.1	Cooling fan stop error	(1)	Foreign matter was caught in the cooling fan.	Check if a foreign matter is caught in the cooling fan.	Something has been caught.	Remove the foreign matter.
					Nothing has been caught.	Check (2).
		(2)	Cooling fan life expired.	Check if the cooling fan is stopping.	It is stopping.	Replace the driver.
47.2	Cooling fan speed reduction error	(1)	Foreign matter was caught in the cooling fan.	Check if a foreign matter is caught in the cooling fan.	Something has been caught.	Remove the foreign matter.
					Nothing has been caught.	Check (2).
		(2)	Cooling fan life expired.	Check the cooling fan speed.	The fan speed is less than the alarm occurrence level.	Replace the driver.

Alarm No.: 50		Name: Overload 1				
Alarm content		Load exceeded overload protection characteristic of driver.				
Detail No.	Detail name	Cause		Check method	Check result	Action
50.1	Thermal overload error 1 during operation	(1)	The servo motor power cable was disconnected.	Check the servo motor power cable.	It is disconnected.	Repair or replace the servo motor power cable.
					It is not isconnected.	Check (2).
		(2)	The connection of the servo motor is incorrect.	Check the wiring of U/V/ W.	It is incorrect.	Connect it correctly.
					It is correct.	Check (3).
		(3)	The electromagnetic brake has not released. (The electromagnetic brake has been activated.)	Check if the electromagnetic brake is released during operation.	It is not released.	Release the electromagnetic brake.
					It is released.	Check (4).
		(5)	A current was applied to the driver in excess of its continuous output current.	Check the effective load ratio.	The effective load ratio is high.	Reduce the load. Or use a larger capacity motor.
					The effective load ratio is small.	Check (6).
		(6)	The servo system is unstable and resonating.	Check if it is resonating	It is resonating.	Adjust gains.
					It is not resonating.	Check (8).
		(7)	The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.
					It is repeatable.	Check (9).
		(8)	The encoder is malfunctioning.	Replace the servo motor encoder, and then check the repeatability.	It is not repeatable.	Replace the servo motor encoder.
50.2	Thermal overload error 2 during operation	Check it with the check method for [AL. 50.1].				
50.3	Thermal overload error 4 during operation					

Alarm No.: 50		Name: Overload 1				
Alarm content		· Load exceeded overload protection characteristic of driver.				
Detail No.	Detail name	Cause		Check method	Check result	Action
50.4	Thermal overload error 1 during a stop	(1)	A moving part collided against the machine.	Check if it collided.	It collided.	Check operation pattern.
					It did not collide.	Check (2).
		(2)	The servo motor power cable was disconnected.	Check the servo motor power cable.	It is disconnected.	Repair or replace the servo motor power cable.
					It is not disconnected.	Check (3).
		(3)	Hunting occurs during servo-lock.	Check if the hunting is occurring.	The hunting is occurring.	Adjust gains.
					The hunting is not occurring.	Check (4).
		(4)	The electromagnetic brake has not released. (The electromagnetic brake has been activated.)	Check if the electromagnetic brake is released.	It is not released.	Release the electromagnetic brake.
					It is released.	Check (5).
		(6)	A current was applied to the driver in excess of its continuous output current.	Check the effective load ratio.	The effective load ratio is high.	Reduce the load. Or use a larger capacity motor.
					The effective load ratio is small.	Check (7).
		(7)	The servo system is unstable and resonating.	Check if it is resonating.	It is resonating.	Adjust gains.
					It is not resonating.	Check (9).
		(8)	The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.
					It is repeatable.	Check (10).
		(9)	The encoder, servo motor, is malfunctioning.	Replace the servo motor, and then check the repeatability.	It is not repeatable.	Replace the servo motor.
50.5	Thermal overload error 2 during a stop	Check it with the check method for [AL. 50.4].				
50.6	Thermal overload error 4 during a stop					

Alarm No.: 51		Name: Overload 2				
Alarm content		・Maximum output current flowed continuously due to machine collision or the like.				
表示	Detail name	Cause		Check method	Action	Action
51.1	Thermal overload error 3 during operation	(1)	The servo motor power cable was disconnected.	Check the servo motor power cable.	It is disconnected.	Repair or replace the servo motor power cable.
					It is not disconnected.	Check (2).
		(2)	The connection of the servo motor is incorrect.	Check the wiring of U/V/W.	It is incorrect.	Connect it correctly.
					It is correct.	(Check (3).
		(3)	The connection of the encoder cable is incorrect.	Check if the encoder cable is connected correctly.	It is incorrect.	Connect it correctly.
					It is correct.	Check (4).
		(5)	The torque is insufficient.	Check the peak load ratio.	The torque is saturated.	Reduce the load or review the operation pattern. Or use a larger capacity motor.
					The torque is not [GF] saturated.	Check (6).
		(6)	The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.
					It is repeatable.	Check (7).
		(7)	An encoder or servo motor is malfunctioning.	Replace the servo motor, and then check the repeatability.	It is not repeatable.	Replace the servo motor.
51.2	Thermal overload error 3 during a stop	(1)	A moving part collided against the machine.	Check if it collided.	It collided.	Check operation pattern.
					It did not collide.	Refer to (2).
		(2)	The servo motor power cable was disconnected.	Check it with the check method for [AL. 51.1].		
		(3)	The connection of the servo motor is incorrect.			
		(4)	The connection of the encoder cable is incorrect.			
		(6)	The torque is saturated.			
		(7)	The driver is malfunctioning			
		(8)	An encoder is malfunctioning.			

Alarm No.: 52		Name: Error excessive					
Alarm content		· Droop pulses have exceeded the alarm occurrence level.					
Detail No.	Detail name	Cause		Check method	Check result	Action	
52.1	Excess droop pulse 1	(1)	The servo motor power cable was disconnected.	Check the servo motor power cable.	It is disconnected.	Repair or replace the servo motor power cable.	
					It is not disconnected.	Check (2).	
		(2)	The connection of the servo motor is incorrect.	Check the wiring of U/V/W.	It is incorrect.	Connect it correctly.	
					It is correct.	Check (3).	
		(3)	The connection of the encoder cable is incorrect.	Check if the encoder cable is connected correctly.	It is incorrect.	Connect it correctly.	
					It is correct.	Check (4).	
		(4)	The torque limit has been enabled.	Check if the limiting torque is in progress.	The limiting torque is in progress.	Increase the torque limit value.	
					The limiting torque is not in progress.	Check (5).	
		(5)	A moving part collided against the machine.	Check if it collided.	It collided.	Check operation pattern.	
					It did not collide.	Check (6).	
		(6)	The electromagnetic brake has not released. (The electromagnetic brake has been activated.)	Check if electromagnetic brake is released.	It is not released.	Release the electromagnetic brake.	
					It is released.	Check (7).	
		(7)	The torque is insufficient.	Check the peak load ratio.	The torque is saturated.	Reduce the load or review the operation pattern. Or use a larger capacity motor.	
					The torque is not saturated.	Check (8).	
		(8)	Power supply voltage dropped.	Check the bus voltage value.	The bus voltage is low.	Check the power supply voltage and power supply capacity.	
					The bus voltage is high.	Check (9).	
		(9)	Acceleration/ deceleration time constant is too short.	Set a longer deceleration time constant, and then check the repeatability	It is not repeatable.	Increase the acceleration/deceleration time constant.	
					It is repeatable.	Check (10).	
		(10)	The position loop gain is small.	Increase the position loop gain, and then check the repeatability.	It is not repeatable.	Increase the position loop gain ([Pr. PB08]).	
					It is repeatable.	Check (11).	
		(11)	The error excessive alarm level was not set correctly.	Check the setting of the error excessive alarm level. [Pr. PC24], [Pr.PC43]	It is not set correctly.	Set it correctly.	
					It is set correctly.	Check (12).	
		(12)	Servo motor shaft was rotated by external force.	Measure the actual position under the servolock status.	It is rotated by external force./ It was moved by external force.	Review the machine.	
					It is not rotated by external force./ It was not moved by external force.	Check (13).	
		(13)	Servo-on was enabled while the servo motor was rotating.	Measure the actual position at servo-on.	Servo is enabled while the servo motor is rotating. Servo-on is enabled while the linear servo motor is moving.	Review the timing of the servo-on.	
					Servo-on is not enabled while the	Check (14).	

					servo motor is rotating Servo-on is not enabled while the linear servo motor is moving.	
		(14)	The encoder or the servo motor is malfunctioning.	Replace the servo motor,and then check the repeatability.	It is not repeatable.	Replace the servo motor.
					It is repeatable.	Check (15).
		(15)	The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.
52.3	Excess droop pulse 2	Check it with the check method for [AL. 52.1].				
52.4	Error excessive during 0 torque limit	(1)	The torque limit has been 0.	Check the torque limit value.	The torque limit has been 0.	Do not input a command while the torque limit value is 0.
52.5	Excess droop pulse 3	Check it with the check method for [AL. 52.1].				

Alarm No.: 52		Name: Error excessive				
Alarm content		**· Droop pulses have exceeded the alarm occurrence level.**				
Detail No.	**Detail name**	**Cause**		**Check result**	**Check result**	**Action**
52.4	Error excessive during 0 torque limit	(1)	The torque limit has been 0.	Check the torque limit value.	The torque limit has been 0.	Do not input a command while the torque limit value is 0.
52.5	Excess droop pulse 3	Check it with the check method for [AL. 52.1].				

Alarm No.: 54		Name: Oscillation detection				
Alarm content		**· An oscillation of the servo motor was detected.**				
Detail No.	**Detail name**	**Cause**		**Check method**	**Check result**	**Action**
54.1	Oscillation detection error	(1)	The servo system is unstable and oscillating.	Check if the servo motor is oscillating. Check the torque ripple with setup software (MR Configurator2™).	The torque ripple is vibrating.	Adjust the servo gain with the auto tuning. Set the machine resonance suppression filter.
					The torque ripple is not vibrating.	Check (2).
		(2)	The resonance frequency has changed due to deterioration.	Measure the resonance frequency of the equipment and compare it with the setting value of the machine resonance suppression filter.	The resonance frequency of the equipment is different from the filter setting value.	Change the setting value of the machine resonance suppression filter.
					The resonance frequency of the equipment is the same as the filter setting value.	Check (3).
		(3)	The encoder is malfunctioning.	Replace the servo motor, and then check the repeatability.	It is not repeatable.	Replace the servo motor.

Alarm No.: 56		Name: Forced stop error				
Alarm content		· The servo motor does not decelerate normally during forced stop deceleration.				
Detail No.	Detail name	Cause		Check method	Check result	Action
56.2	Over speed during forced stop	(1)	The forced stop deceleration time constant is short. [Pr. PC51]	Increase the parameter setting value, and then check the repeatability.	It is not repeatable.	Adjust the deceleration time constant.
					It is repeatable.	Check (2).
		(2)	The torque limit has been enabled.	Check if the limiting torque is in progress.	The limiting torque is in progress.	Review the torque limit value.
					The limiting torque is not in progress.	Check (3).
		(3)	The servo system is unstable and oscillating.	Check if the servo motor is oscillating. Check the torque ripple with setup software (MR Configurator2™).	The torque ripple is vibrating.	Adjust the servo gain. Set the machine resonance suppression filter.
					The torque ripple is not vibrating.	Check (4).
		(4)	The encoder is malfunctioning.	Replace the servo motor, and then check the repeatability.	It is not repeatable.	Replace the servo motor.
56.3	Estimated distance over during forced stop	(1)	The forced stop deceleration time constant is short. [Pr. PC51]	Increase the parameter setting value, and then check the repeatability.	It is not repeatable.	Adjust the deceleration time constant.
					It is repeatable.	Check (2).
		(2)	The torque limit has been enabled.	Check if the limiting torque is in progress.	The limiting torque is in progress.	Review the torque limit value.
					The limiting torque is not in progress.	Check (3).
		(3)	The encoder or linear encoder is malfunctioning.	Replace the servo motor, and then check the repeatability.	It is not repeatable.	Replace the servo motor.

Alarm No.: 61		Name: Operation error				
Alarm content		· An operation of the positioning function failed.				
Detail No.	Detail name	Cause		Check method	Check result	Action
61.1	Point table setting range error	(1)	"1" or "3" was set to the sub function of the last point table (255).	Check if "1" or "3" was set.	It was set.	Review the settings.

Alarm No.: 63		Name: STO timing error				
Alarm content		· STO input signal turns off while the servo motor is rotating.				
Detail No.	Detail name	Cause		Check method	Check result	Action
63.1	STO1 off	(1)	STO1 was turned off (enabled) under the following speed conditions. 1) Servo motor speed: 50 r/min or more	Check if STO1 is off (enabled).	It is off (enabled).	Turn on STO1 (disabled).
63.2	STO2 off	(1)	STO2 was turned off (enabled) under the following speed conditions.	Check if STO2 is off (enabled).	It is off (enabled).	Turn on STO2 (disabled).

Alarm No.: 63		Name: STO timing error					
Alarm content		・STO input signal turns off while the servo motor is rotating.					
Detail No.	**Detail name**	**Cause**		**Check method**	**Check result**	**Action**	
63.2	STO2 off	(1)	Servo motor speed: 50 r/min or more				
63.5	STO by functional safety unit		STO of the functional safety unit was turned off (enabled) under the following speed conditions. 1) Servo motor speed: 50 r/min or more	Check if STO of the functional safety unit is off (enabled).	It is off (enabled).	Turn on STO (disabled).	

Alarm No.: 64		Name: Functional safety unit setting error					
Alarm content		・A setting of the driver or functional safety unit was incorrect.					
Detail No.	**Detail name**	**Cause**		**Check method**	**Check result**	**Action**	
64.1	STO input error	(1)	When a functional safety unit is used, a connector is connected to CN8 of the driver.	Check the connection of the CN8 connector.	It is connected.	Turn off the control circuit power supply of the driver, and then remove the connector of CN8.	

Alarm No.: 65		Name: Functional safety unit connection error					
Alarm content		・Communication or signal between a functional safety unit and driver failed.					
Detail No.	Detail name	Cause		Check method	Check result	Action	
65.1	Functional safety unit communication error 1	(1)	The functional safety unit came off.	Check the installation of the functional safety unit.	It is disconnected.	Turn off the control circuit power supply of the driver, and then connect the functional	
					It is connected.	Check (2).	
		(2)	The functional safety unit is malfunctioning.	Replace the functional safety unit, and then check the repeatability.	It is not repeatable.	Replace the functional safety unit.	
					It is repeatable.	Check (3).	
		(3)	The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.	
					It is repeatable.	Check (4).	
		(4)	Something near the device caused it.	Check the noise, ambient temperature, etc.	There is a problem in the surrounding.	Take countermeasures against its cause.	
65.2	Functional safety unit communication error 2	Check it with the check method for [AL. 65.1].					
65.3	Functional safety unit communication error 3						
65.4	Functional safety unit communication error 4						
65.5	Functional safety unit communication error 5						
65.6	Functional safety unit communication error 6						
65.7	Functional safety unit communication error 7						
65.8	Functional safety unit shutoff						
65.9	Functional safety unit shutoff						

Alarm No.: 66		Name: Encoder initial communication error (safety observation function)				
Alarm content		▪The connected encoder is not compatible with the driver. ▪An error has occurred in the communication between an encoder and driver.				
Detail No.	Detail name	Cause		Check method	Check result	Action
66.1	Encoder initial communication - Receive data error 1 (safety observation function)	(1)	An encoder cable is malfunctioning.	Check if the encoder cable is disconnected or shorted.	It has a failure.	Replace or repair the cable.
					It has no failure.	Check (2).
		(2)	The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.
					It is repeatable.	Check (3).
		(3)	An encoder is malfunctioning.	Replace the servo motor, and then check the repeatability.	It is not repeatable.	Replace the servo motor.
					It is repeatable.	Check (4).
		(4)	Something near the device caused it.	Check the noise, ambient temperature, vibration,etc.	There is a problem in the surrounding.	Take countermeasures against its cause.
66.2	Encoder initial communication - Receive data error 2 (safety observation function)	Check it with the check method for [AL. 66.1].				
66.3	Encoder initial communication - Receive data error 3 (safety observation function)					
66.7	Encoder initial communication - Transmission data error 1 (safety observation function)					

Alarm No.: 66		Name: Encoder initial communication error (safety observation function)				
Alarm content		・The connected encoder is not compatible with the driver. ▪ An error has occurred in the communication between an encoder and driver				
Detail No.	Detail name	Cause		Check method	Check result	Action
66.9	Encoder initial communication - Process error 1 (safety Observation function)	(1)	A servo motor with functional safety is not connected.	Check if a servo motor with functional safety is connected.	It is not a servo motor with functional safety.	Connect a servo motor with functional safety.
					It is a servo motor with functional safety.	lCheck (2).
		(2)	The functional safety unit is malfunctioning.	Replace the functional safety unit, and then check the repeatability.	It is not repeatable.	Replace the functional safety unit.
					It is repeatable.	Check (3).
		(3)	The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.
					It is repeatable.	Check (4).
		(4)	An encoder is malfunctioning.	Replace the servo motor, and then check the	It is not repeatable.	Replace the servo motor.
					It is repeatable.	Check (5).
		(5)	Something near the device caused it.	Check the noise, ambient	There is a problem in the surrounding.	Take countermeasures against its cause.

Alarm No.: 67	Name: Encoder normal communication error 1 (safety observation function)					
Alarm content	・An error has occurred in the communication between an encoder and driver.					
Detail No.	Detail name		Cause	Check method	Check result	Action
67.1	Encoder normal communication - Receive data error 1 (safety observation function)	(1)	An encoder cable is malfunctioning.	Check if the encoder cable is disconnected or shorted.	It has a failure.	Repair or replace the cable.
					It has no failure.	Check (2).
		(2)	The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.
					It is repeatable.	Check (3).
		(3)	An encoder is malfunctioning.	Replace the servo motor,and then check the repeatability.	It is not repeatable.	Replace the servo motor.
					It is repeatable.	Check (4).
		(4)	Something near the device caused it.	Check the noise, ambient temperature, vibration,etc.	There is a problem in thesurrounding.	Take countermeasures against its cause.
67.2	Encoder normal communication - Receive data error 2 (safety observation function)	Check it with the check method for [AL. 67.1].				
67.3	Encoder normal communication - Receive data error 3 (safety observation function)					
67.4	Encoder normal communication - Receive data error 4 (safety observation function)					
67.7	Encoder normal communication - Transmission data error 1 (safety observation function)					

Alarm No.: 68	Name: STO diagnosis error					
Alarm content	・ An error of STO input signal was detected.					
Detail No.	Detail name		Cause	Check method	Check result	Action
68.1	Mismatched STO signal error	(1)	STO1 and STO2 are not inputted correctly.	Check if the STO1 and STO2 of CN8 connector are wired correctly.	It is not wired correctly.	Wire it correctly.
					It is wired correctly.	Check (2).
		(2)	The input states of STO1 and STO2 are different.	Check the on/off states of STO1 and STO2.	The on/off states of STO1 and STO2 are different.	Set STO1 and STO2 to the same input states.
					The on/off states of STO1 and STO2 are the same.	Check (3).
		(3)	The setting of [Pr. PF18 STO diagnosis error detection time] ([Pr. PX43] for when the J3 extension function is used) is incorrect.	Set a longer time in the parameter, and then check the repeatability.	It is not repeatable.	Review the parameter setting.
					It is repeatable.	Check (4).
		(4)	The STO circuit is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.
					It is repeatable.	Check (5).

		(5) Something near the device caused it.	Check the noise, ambient temperature, etc.	There is a problem in the surrounding.	Take countermeasures against its cause

Alarm No.: 79	Name: Functional safety unit diagnosis error				
Alarm content	· A diagnosis of the functional safety unit failed.				
Detail No.	**Detail name**	**Cause**	**Check method**	**Check result**	**Action**
79.1	Functional safety unit power voltage error	(1) The power supply of the functional safety unit is failure.	Check the installation of the functional safety unit.	It has a failure.	Install it correctly.
				It has no failure.	Check (2).
		(2) The functional safety unit is malfunctioning.	Replace the functional safety unit, and then check the repeatability.	It is not repeatable.	Replace the functional safety unit.
				It is repeatable.	Check (3).
		(3) The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.
				It is repeatable.	Check (4).
		(4) Something near the device caused it.	Check the power supply for noise.	There is a problem in the surrounding.	Take countermeasures against its cause.
79.2	Functional safety unit internal error	(1) The functional safety unit is malfunctioning.	Replace the functional safety unit, and then check the repeatability.	It is not repeatable.	Replace the functional safety unit.
				It is repeatable.	Check (2).
		(2) Something near the device caused it.	Check the power supply for noise.	There is a problem in the surrounding.	Take countermeasures against its cause.
79.3	Abnormal temperature of functional safety unit	(1) Ambient temperature has exceeded 55 ℃.	Check the ambient temperature.	It is over 55 ℃	Lower the ambient temperature.
				It is less than 55 ℃	Check (2).
		(2) Ambient temperature is less than 0 ℃.	Check the ambient temperature.	It is less than 0 ℃	Increase the ambient temperature.
				It is 0℃ or more.	Check (3).
		(3) The close mounting is out of specifications.	Check the specifications of close mounting.	It is out of specifications.	Mount it correctly
				It is within specifications.	Check (4).
		(4) An opening is clogged up.	Clean the opening and check the repeatability.	It is not repeatable.	Clean it periodically.
				It is repeatable.	Check (5).
		(5) The functional safety unit is malfunctioning.	Replace the functional safety unit, and then check the repeatability.	It is not repeatable.	Replace the functional safety unit.
				It is repeatable	Check (6).
		(6) Something near the device caused it.	Check the power supply for noise.	There is a problem in the surrounding.	Take countermeasures against its cause.
79.4	Driver error	(1) The functional safety unit came off.	Check the installation of the functional safety unit.	It has a failure.	Install it correctly.
				It has no failure.	Check (2).
		(2) The functional safety unit is malfunctioning.	Replace the functional safety unit, and then check the repeatability.	It is not repeatable.	Replace the functional safety unit.
				It is repeatable.	Check (3).
		(3) The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.
				It is repeatable.	Check (4).
		(4) Something near the device caused it.	Check the noise, ambient temperature, etc.	There is a problem in the surrounding.	Take countermeasures against its cause.

79.5	Input device error	(1)	A signal of input device is not inputted correctly.	Check if the input device cable is wired correctly.	It has a failure.	Review the wiring.	
					It has no failure.	Check (2).	
		(2)	The input device setting parameter is not set correctly.	Check if the parameter is set correctly.	It is not set correctly.	Review the parameter.	
					It is set correctly.	Check (3).	
		(3)	The test pulse time was not set correctly.	Check the setting of [Pr.PSD26 Input device -Test pulse off time].	The test pulse width is longer than the set value.	Set the value longer.	
					The test pulse width is shorter than the set value.	Check (4).	
		(4)	The functional safety unit is malfunctioning.	Replace the functional safety unit, and then check the repeatability.	It is not repeatable.	Replace the functional safety unit.	
					It is repeatable	Check (5).	
		(5)	Something near the device caused it.	Check the noise, ambient temperature, etc.	There is a problem in the surrounding.	Take countermeasures against its cause.	
79.6	Output device error	(1)	A signal of an output device has not been outputted correctly.	Check if the output device cable is wired correctly. Or check if the load of the output device is within the specifications.	It has a failure.	Review the wiring or load.	
					It has no failure.	Check (2).	
		(2)	The test pulse time was not set correctly.	Check the setting of [Pr.PSD30 Output device -Test pulse off time].	The test pulse width is longer than the set value.	Set the value longer.	
					The test pulse width is shorter than the set value.	Check (3).	
		(3)	Current of the output device is excessive.	Check if the current is used within prescribed	Not within prescribed.	Reduce the output current.	
					Within prescribed.	Check (4).	
		(4)	The functional safety unit is malfunctioning.	Replace the functional safety unit, and then check the repeatability.	It is not repeatable.	Replace the functional safety unit.	
					It is repeatable.	Check (5).	
		(5)	Something near the device caused it.	Check the noise, ambient temperature, etc.	There is a problem in the surrounding.	Take countermeasures against its cause.	

79.7	Mismatched input signal error	(1)	A mismatch of input signal DI_A and DI_B continued for a fixed time ([Pr. PSD18] to [Pr. PSD23]).	Check if the input device cable is wired correctly.	It has a failure.	Review the wiring.
					It has no failure.	Check (2).
		(2)	An input mismatch time was not set correctly.	Check the settings of [Pr.PSD18 Mismatch permissible time DI1] to [Pr. PSD23 Mismatch permissible time DI6].	The mismatched time is longer than the set value.	Set the value longer.
					The mismatched time is shorter than the set value.	Check (3).
		(3)	The functional safety unit is malfunctioning.	Replace the functional safety unit, and then check the repeatability.	It is not repeatable.	Replace the functional safety unit.
					It is repeatable.	Check (4).
		(4)	Something near the device caused it.	Check the noise, ambient temperature, etc.	There is a problem in the surrounding.	Take countermeasures against its cause.
79.8	Position feedback fixing error	(1)	The position feedback data do not change within the position feedback fixing error detection time [Pr. PSA22].	Check the [Pr. PSA22] setting.	It is not set correctly.	Review the parameter.
					It is set correctly.	Check (2).
		(2)	The position feedback data do not change.	Check the feedback data by rotating the servo motor.	The position feedback data changes.	Perform an operation which rotates the servo motor within the position feedback fixing error detection time [Pr. PSA22].
					The position feedback data do not change.	Check (3).
		(3)	The servo motor is malfunctioning.	Replace the servo motor,and then check the repeatability.	It is not repeatable.	Replace the servo motor.
					It is repeatable.	Check (4).
		(4)	The functional safety unit is malfunctioning.	Replace the functional safety unit, and then check the repeatability.	It is not repeatable.	Replace the functional safety unit.

Alarm No.: 7A		**Name: Parameter setting error (safety observation function)**				
Alarm content		**・A parameter of the functional safety unit failed.**				
Detail No.	**Detail name**	**Cause**		**Check method**	**Check result**	**Action**
7A.1	Parameter verification error (safety observation function)	(1)	A parameter of the functional safety unit is incorrect.	Review the parameter.	It is not repeatable.	Set the parameter correctly.
					It is repeatable.	Check (2).
		(2)	The functional safety unit is malfunctioning.	Replace the functional safety unit, and then check the repeatability.	It is not repeatable.	Replace the functional safety unit.
					It is repeatable.	Check (3).
		(3)	Something near the device caused it.	Check the noise, ambient temperature, etc.	There is a problem in the surrounding.	Take countermeasures against its cause.
7A.2	Parameter setting range error (safety observation function)	(1)	The initial settings for the functional safety unit have not been finished.	Check the [Pr. PSA01] setting.	It is not enabled.	Enable the setting with checking parameter contents.
					It is enabled.	Check (2).
		(2)	A parameter of the functional safety unit was set out of range.	Check the value of set parameters.	It is out of setting range.	Set it within the range.

7A.3	Parameter combination error (safety observation function)	(1)	A parameter of the functional safety unit or driver is incorrect.	Check the parameter settings of the functional safety unit and driver. Functional safety unit: [Pr. PSA02], [Pr. PSA18] to [Pr. PSA21], [Pr. PSC03], [Pr. PSD01] to [Pr. PSD17], [Pr. PSD26] driver:[Pr. PA14]	It is not set correctly.	Set the parameter correctly.
7A.4	Functional safety unit combination error (safety observation function)	(1)	A combination of functional safety unit and driver is incorrect.	Check if correct combination of driver is connected.	A different driver is connected	Return to the driver which was combined with the functional safety unit and was set the safety observation function, or initialize the setting.

Alarm No.: 7B	Name: Encoder diagnosis error (safety observation function)					
Alarm content	·Error occurred in encoder.					
Detail No.	Detail name	Cause		Check method	Check result	Action
7B.1	Encoder diagnosis error 1 (safety observation function)	(1)	An encoder cable is malfunctioning.	Check if the encoder cable is disconnected or shorted.	It has a failure.	Repair or replace the cable.
					It has no failure.	Check (2).
		(2)	An encoder is malfunctioning.	Replace the servo motor,and then check the repeatability.	It is not repeatable.	Replace the servo motor.
					It is repeatable.	Check (3).
		(3)	The functional safety unit is malfunctioning.	Replace the functional safety unit, and then check the repeatability	It is not repeatable.	Replace the functional safety unit.
					It is repeatable.	Check (4).
		(4)	The driver is	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace thedriver.
					It is repeatable.	Check (5).
		(5)	Something near the device caused it.	Check the noise, ambient temperature, vibration, etc.	There is a problem in the surrounding.	Take countermeasures against its cause.
7B.2	Encoder diagnosis error 2 (safety observation function)	Check it with the check method for [AL. 7B.1].				
7B.3	Encoder diagnosis error 3 (safety observation function)					
7B.4	Encoder diagnosis error 4 (safety observation function)	(1)	Ambient temperature of the encoder has exceeded 40 ℃.	Check the ambient temperature of the encoder.	It is over 40 ℃.	Lower the ambient temperature.
					It is 40℃.or less.	Check (2).
		(2)	Ambient temperature of the encoder is less than 0 ℃..	Check the ambient temperature of the encoder.	It is 0 ℃ or more.	Increase the ambient temperature.
					It is 0 ℃ or more.	Check (3).
		(3)	Servo motor is overloaded.	Check the effective load ratio.	The effective load ratio is high.	Reduce the load or review the operation pattern.
					The effective load ratio is small.	Check (4).
		(4)	The thermal sensor in the encoder is malfunctioning.	Replace the servo motor, and then check the repeatability.	It is not repeatable.	Replace the servo motor.
					It is repeatable.	Check (5).
		(5)	The functional safety unit is malfunctioning.	Replace the functional safety unit, and then check the repeatability.	It is not repeatable.	Replace the functional safety unit.

Alarm No.: 7D		Name: Safety observation error			
Alarm content		・The safety observation function detected an error.			
Detail No.	**Detail name**	**Cause**	**Check method**	**Check result**	**Action**
7D.1	Stop observation error	(1) During activation of SOS function, the position of the servo motor has changed by more than the SOS allowance value set by parameter	Check that the actual servo motor position is higher than the setting value of [Pr. PSA05].	The travel distance of the servo motor is larger than the setting value in [Pr.PSA05].	Review the alarm level.
				The travel distance of the servo motor is smaller than the alarm detection level.	Check (2).
		(2) During activation of SOS function, the servo motor speed has changed by larger than the SOS allowance value set by parameter, and that state has continued for longer than the set time (specified by [Pr.PSA15]).	The actual servo motor speed is higher than the setting value of [Pr.PSA04].	The servo motor speed is higher than the setting value in [Pr. PSA04].	Review the parameter setting.
				The servo motor speed is higher than the setting value in [Pr. PSA15] and equal to or lower than that in [Pr.PSA04].	Check (3).
		(3) During activation of SOS function, the speed command has changed by larger than the SOS allowance value set by parameter, and that state has continued for longer than the set time (specified by [Pr. PSA15]).	Check if the command from the controller is over the standstill speed set in [Pr. PSA04].	The command from the controller is over the setting valued in [Pr.PSA04].	Check the operation pattern.
				The command from controller is higher than the setting value in [Pr.PSA15] and equal to or lower than that in [Pr.PSA04].	Check (4).
		(4) An encoder is malfunctioning.	Replace the servo motor,and then check the repeatability.	It is not repeatable.	Replace the servo motor.
				It is repeatable.	Check (5).
		(5) The functional safety unit is malfunctioning.	Replace the functional safety unit, and then check the repeatability.	It is not repeatable.	Replace the functional safety unit.
				It is repeatable.	Check (6).
		(6) The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the servo motor.
				It is repeatable.	Check (7).
		(7) Something near the device caused it.	Check the noise, ambient temperature, vibration, etc.	There is a problem in the surrounding.	Take countermeasures against its cause.
7D.2	Speed observation error	(1) The command pulse frequency is high.	Check the command pulse frequency.	The command pulse frequency is high.	Check operation pattern.
				The command pulse [GF] frequency is low.	Check (2).
		(2) The settings of the electronic gear are incorrect.	Check the setting value of the electronic gear.	The setting value is incorrect.	Review the settings.
				The setting value is correct.	Check (3).
		(3) The command from the controller is excessive.	Check if the command from the controller is the SLS speed ([Pr. PSA11] to [Pr. PSA14]) or more.	It is over the permissible speed.	Check operation pattern.
				It is less than the permissible speed.	Check (4).
		(4) A larger speed command than the SLS speed ([Pr. PSA11] to [Pr. PSA14]) was inputted.	Check that the actual servo motor speed is higher than the setting value of the SLS speed.	The servo motor speed is higher than the SLS speed.	Review the setting value of the SLS speed.
				The servo motor speed is lower than the SLS speed.	Check (5).
		(5) The servo system is	Check if the servo	It is oscillating.	Adjust the servo gain. Or

			unstable and oscillating.	motor is oscillating.		reduce the load.
					It is not oscillating.	Check (6).
		(6)	The velocity waveform has overshot.	Check if it is overshooting because the acceleration time constant is too short.	It is overshooting.	Increase the acceleration/deceleration time constant.
					It is not overshooting.	Check (7).
		(7)	The connection destination of the encoder cable is incorrect.	Check the connection destination of the encoder.	It is not correct.	Wire it correctly.
					It is correct.	Check (8).
		(8)	The encoder or linear encoder is malfunctioning.	Replace the servo motor, and then check the repeatability.	It is not repeatable.	Replace the servo motor.
					It is repeatable.	Check (9).
		(9)	The functional safety unit is malfunctioning.	Replace the functional safety unit, and then check the repeatability.	It is not repeatable.	Replace the functional safety unit.
					It is repeatable.	Check (10).
		(10)	The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.
					It is repeatable.	Check (11).
		(11)	Something near the device caused it.	Check the noise, ambient temperature, etc.	There is a problem in the surrounding.	Take countermeasures against its cause.

Alarm No.: 8A	**Name: USB communication time-out error/serial communication time-out error/Modbus RTU communication time-out error**				
Alarm content	**・Communication between the driver and a personal computer/controller stopped for the specified time or longer.** **・An error occurred in USB communication, serial communication (Mitsubishi Electric general-purpose**				
Detail No.	**Detail name**	**Cause**	**Check method**	**Check result**	**Action**
8A.1	USB communication time-out error/ serial communication time-out error	(1) Communication commands have not been transmitted.	Check if a command was transmitted from the personal computer, etc.	It was not transmitted.	Transmit a command.
				It was transmitted.	Check (2).
		(2) A communication cable was disconnected.	Replace the communication cable, and then check the repeatability.	It is not repeatable.	Replace the communication cable.
				It is repeatable.	Check (3).
		(3) The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.

Alarm No.: 8E		Name: USB communication error/serial communication error/Modbus RTU communication error				
Alarm content		· A communication error occurred between the driver and a personal computer/controller. · An error occurred in USB communication, serial communication (Mitsubishi Electric general-purpose · AC servo protocol), or Modbus RTU communication.				
Detail No.	**Detail name**	**Cause**		**Check method**	**Check result**	**Action**
8E.1	USB communication receive error/ serial communication receive error	(1)	The setting of the personal computer, etc. is incorrect.	Check the setting of the personal computer, etc.	It is incorrect.	Review the settings.
					It is correct.	Check (2).
		(2)	A communication cable is malfunctioning.	Check the communication cable, and then check the repeatability.	It is not repeatable.	Replace the communication cable.
					It is repeatable.	Check (3).
		(3)	The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.
8E.2	USB communication checksum error/ serial communication checksum error	(1)	The setting of the personal computer, etc. is incorrect.	Check the setting of the personal computer, etc.	It is incorrect.	Review the settings.
8E.3	USB communication character error/ serial communication character error	(1)	The transmitted character is out of specifications.	Check the character code at the time of transmission.	The transmitted character is out of specifications.	Correct the transmission data.
					The transmitted [RJ010] character is within specifications.	Check (2).
		(2)	The communication protocol is failure.	Check if transmission data supports the communication protocol.	It is not conforming.	Replace the communication cable.
					It is conforming.	Check (3).
		(3)	The setting of the personal computer, etc. is incorrect.	Check the setting of the personal computer, etc.	It is not repeatable.	Replace the driver.
8E.4	USB communication command error/ serial communication command error	(1)	The transmitted command is out of specifications.	Check the command at the time of transmission.	The transmitted command is out of specifications.	Correct the transmission data.
					The transmitted command is within specifications.	Check (2).
		(2)	The communication protocol is failure.	Check if transmission data supports the communication protocol.	It is not conforming.	Modify the transmission data according to the communication protocol.
					It is conforming.	Check (3).
		(3)	The setting of the personal computer, etc. is incorrect.	Check the setting of the personal computer, etc.	It is incorrect.	Review the settings.
8E.5	USB communication data number error/serial communication data number error	(1)	The transmitted data number is out of specifications.	Check the data number at the time of transmission.	The transmitted data number is out of specifications.	Correct the transmission data.
					The transmitted data number is within specifications.	Check (2).
		(2)	The communication protocol is failure.	Check if transmission data supports the communication protocol.	It is not conforming.	Modify the transmission data according to the communication protocol.
					It is conforming.	Check (3).
		(3)	The setting of the personal computer, etc. is incorrect.	Check the setting of the personal computer, etc.	It is incorrect.	Review the settings.

Alarm No.: 88888	Name: Watchdog						
Alarm content	・A part such as CPU is malfunctioning.						
Detail No.	Detail name	Cause		Check method	Check result	Action	
88._/ 8888._	Watchdog	(1)	A part in thedriver is failure.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.	

8.5 Remedies for warnings

> ⚠CAUTION
> - If [AL. E3 Absolute position counter warning] occurs, always make home position setting again. Otherwise, it may cause an unexpected operation.

> POINT
> - When any of the following alarms has occurred, do not cycle the power of the driver repeatedly to restart. Doing so will cause a malfunction of the driver and the servo motor. If the power of the driver is switched off/on during the alarms, allow more than 30 minutes for cooling before resuming operation.
>   - [AL. 91 Driver overheat warning]
>   - [AL. E0 Excessive regeneration warning]
>   - [AL. E1 Overload warning 1]
>   - [AL. E2 Servo motor overheat warning]
>   - [AL. EC Overload warning 2]

If [AL. E6], [AL. E7], or [AL. E9] 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 Setup software (MR Configurator2™) to refer to a factor of warning occurrence.

Alarm No.: 90		**Name: Home position return incomplete warning**			
Alarm content		**A home position return did not complete normally with the positioning function.**			
Detail No.	**Detail name**	**Cause**	**Check method**	**Check result**	**Action**
90.1	Home position return incomplete	(1) An automatic operation was executed at home position return incompletion.	Check if the home position return was not executed (the following devices are not off.). ZP (Home position return completion)	A home position return was not executed.	Execute a home position return.
				A home position return was executed.	Check (2).
		(2) A positioning operation was executed without home position setting with absolute position after [AL. 25 Absolute position erased] occurred.	Check if [AL. 25 Absolute position erased] occurred using alarm history.	[AL. 25 Absolute position erased] occurred.	Check the battery voltage and battery cable if they have a failure and execute a home position return after remove the failure.
				[AL. 25 Absolute position erased] did not occur.	Check (3).
		(3) With the indexer method, [AL. E3 Absolute position counter warning] Occurred simultaneously with the alarm.	Check if [AL. 90.1] occurred simultaneously with start of the positioning operation.	[AL. 90.1] did not occur simultaneously with start of the positioning operation but occurred during positioning operation.	Remove the cause of [AL. E3], and perform home position return. (Check it with the check method for [AL. E3].)
				[AL. 90.1] occurred simultaneously with start of the positioning operation.	Check (4).
		(4) ZP (Home position return completion) turned off after the home position return was executed.	Check if ZP (Home position return completion) is off.	ZP (Home position return completion) is off.	Check the conditions if ZP (Home position return completion) can be off. (Positioning Mode)")

Alarm No.: 90		Name: Home position return incomplete warning				
Alarm content		A home position return did not complete normally with the positioning function.				
Detail No.	Detail name	Cause		Check method	Check result	Action
90.2	Home position return abnormal termination	(1)	The proximity dog is not connected to DOG.	Check if the proximity dog is connected correctly.	It is not connected.	Connect it correctly.
					It is connected.	Check (2).
		(2)	The stroke limit was detected after the home position return start.	Check if the stroke limit is connected correctly. Or check if the stroke limit is not reached.	The stroke limit is not connected. Or the stroke limit is reached.	Connect the stroke limit correctly. Review the stroke limit position.
					The stroke limit is connected. Or the stroke limit is not reached.	Check (3).
		(3)	A home position return speed did not decelerate to a creep speed.	Check if the proximity dog turned off before a home position return completed deceleration to a creep speed.	The proximity dog turned off before the deceleration to a creep speed.	Review the dog position. Or review the parameter values of the home position return speed, creep speed, and travel distance after proximity dog.
		(4)	Deceleration from the home position return speed/creep speed to the home position failed at the indexer method.	Check if the home position was turned on before the deceleration from the home position return speed/creep speed to the home position was complete.	It was not turned on before the deceleration was complete.	Review the positional relationship of the stroke limit and home position. Or review the parameter values of the home position return speed, creep speed, deceleration time constant, and home position shift distance.
90.5	Z-phase unpassed	(1)	The Z-phase signal was not detected normally.	Check if the Z-phase signal of the servo motor was detected normally.	The Z-phase signal was not detected.	Review the Z-phase signal and wirings.
					The Z-phase signal was detected.	Check (2).
		(2)	A home position return was executed while the servo motor did not pass the Z-phase.	Check if the motor passed the Z-phase signal until the proximity dog turned off after the home position return started.	The Z-phase was not turned on.	Review the setting position of the home position return start and proximity dog.

Alarm No.: 91		Name: driver overheat warning				
Alarm content		· The temperature inside of the driver reached a warning level.				
Detail No.	Detail name	Cause		Check method	Check result	Action
91.1	Main circuit device overheat warning	(1)	Ambient temperature of the driver has exceeded 55 ℃	Check the ambient temperature.	It is over 55 ℃.	Lower the ambient temperature.
					It is less than 55 ℃.	Check (2).
		(2)	The close mounting is out of specifications.	Check the specifications of close mounting.	It is out of specifications.	Use within the range of specifications.

Alarm No.: 92		Name: Battery cable disconnection warning				
Alarm content		・Battery voltage for absolute position detection system decreased.				
Detail No.	Detail name	Cause		Check method	Check result	Action
92.1	Encoder battery cable disconnection warning	(1)	1) When a battery was used, the battery was not connected to CN4.	Check if the battery is connected correctly.	It is not connected.	Connect it correctly.
					It is connected.	Check (2).
		(2)	A battery cable was disconnected.	Check if the battery cable is malfunctioning.	It has a failure.	Replace or repair the cable.
					It has no failure.	Check (3).
		(3)	The battery voltage is low. The battery is consumed.	Check the battery voltage with a tester.	It is less than 3.1 V DC.	Replace or repair the cable.
					It is 3.1 V DC or more.	Replace the battery.
		(4)	An encoder cable was disconnected.	Check if the encoder cable is disconnected.	It is disconnected.	Replace or repair the cable.
92.3	Battery degradation	(1)	The battery voltage is low. The battery is consumed	Check the battery voltage with a tester.	It is less than 3.0 V DC.	Replace the battery.
					It is 3.0 V DC or more.	Check (2).
		(2)	The battery has deteriorated.	Replace the battery, and then check the	It is not repeatable.	Replace the battery.

Alarm No.: 93		Name: ABS data transfer warning				
Alarm content		・ABS data were not transferred.				
Detail No.	Detail name	Cause		Check method	Check result	Action
93.1	ABS data transfer requirement warning during magnetic pole detection	(1)	The Z-phase was not turned on at servo-on.	Check if the position within one-revolution is "0".	It is "0". (The Z-phase was not turned on.)	Turn on the Z-phase and disable the magnetic pole detection. Always make home position setting again.
					It is other than "0". (The Z-phase was turned on.)	Check (2).
		(2)	The magnetic pole detection was executed.	Check if the ABS data is transferred during the magnetic pole detection.	The ABS data is transferred.	Disable the magnetic pole detection. After that, cycle SON (Servo-on) and transfer the ABS data.

Alarm No.: 95		Name: STO warning				
Alarm content		・STO input signal turns off while the servo motor stops. ・A diagnosis of input devices was not executed. ・The safety observation function was enabled in the test mode.				
Detail No.	Detail name	Cause		Check method	Check result	Action
95.1	STO1 off detection	(1)	STO1 is not inputted correctly.	Check if the STO1 of CN8 connector is wired correctly.	It is not wired correctly.	Wire it correctly. (When not using the STO function, attach the shortcircuit connector came with the driver to CN8.)
					It is wired correctly.	Check (2).
		(2)	STO1 was turned off (enabled) under the following speed conditions. 1) Servo motor speed: 50 r/min or less	Check if STO1 is off (enabled).	It is off (enabled).	Turn on STO1 (disabled).

95.2	STO2 off detection	(1)	STO2 is not inputted correctly.	Check if the STO2 of CN8 connector is wired correctly.	It is not wired correctly.	Wire it correctly. (When not using the STO function, attach the shortcircuit connector came with the driver to CN8.)
					It is wired correctly.	Check (2).
		(2)	STO2 was turned off (enabled) under the following speed conditions. 1) Servo motor speed: 50 r/min or less	Check if STO2 is off (enabled).	It is off (enabled).	Turn on STO2(disabled).
95.3	STO warning 1 (safety observation function)	(1)	"Input device - Fixingdiagnosis Execution selection at start-up" was not executed.	Check if "Input device - Fixing-diagnosis execution selection at start-up" was executed	It was not executed.	Execute it.
					It was executed.	Check (2).
		(2)	Set "Input device - Fixing-diagnosis execution selection at start-up" correctly using parameters.	Check if [Pr. PSD27] and [Pr. PSD28] are set correctly.	It is not set correctly.	Review the parameter
					It is set correctly.	Check (3).
		(3)	The wiring is incorrect.	Check if the wiring has a failure.	It has a failure.	Review the wiring.
					It has no failure.	Check (4).
		(4)	The functional safety unit is malfunctioning.	Replace the functional safety unit, and then check the repeatability.	It is not repeatable.	Replace the functional safety unit.
					It is repeatable.	Check (5).
		(5)	Something near the device caused it.	Check the noise, ambient temperature, etc.	There is a problem in the surrounding.	Take countermeasures against its cause.
95.4	STO warning 2 (safety observation function)	(1)	The test operation mode was not set correctly.	Check if the driver and functional safety unit are set to the test operation mode.	It is not set.	Set it correctly.
					It is set.	Check (2).
		(2)	An error occurred in the safety communication. Or the network is disconnected.	Check the description "The display shows "Ab"." . ⇒Page 124 Trouble which does not trigger alarm/warning	It is not repeatable.	Take countermeasures against its cause.
					It is repeatable.	Check (3).
		(3)	"Input mode selection" in [Pr. PSA02 Functional safety unit setting] is not set correctly.	Set [Pr. PSA02] correctly and check the repeatability.	It is not repeatable.	Review the parameter.
					It is repeatable.	Check (4).
		(4)	The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.
					It is repeatable.	Check (7).
		(5)	The functional safety unit is malfunctioning.	Replace the functional safety unit, and then check the repeatability.	It is not repeatable.	Replace the functional safety unit.
					It is repeatable.	Check (8).
		(6)	Something near the device caused it.	Check the noise, ambient temperature, etc.	There is a problem in the surrounding.	Take countermeasures against its cause.
95.5	STO warning 3 (safety observation function)	(1)	STO command/SS1 command of the functional safety unit was turned off (enabled) under the following speed conditions. 1) Servo motor speed: 50 r/min or less	Check if STO command/ SS1 command of the functional safety unit is off (enabled).	It is off (enabled).	Turn on (disabled) STO command/SS1 command of the functional safety unit.

Alarm No.: 96	Name: Home position setting warning					
Alarm content	· Home position setting could not be made.					
Detail No.	Detail name	Cause		Check method	Check result	Action
96.1	In-position warning at home positioning	(1)	INP (In-position) did not turn on within the specified time during home positioning.	Check the droop pulses during home positioning.	It is In-position range or more.	Adjust gains to set droop pulses within the Inposition range. Remove the cause of droop pulse occurrence, and make home position setting.
96.2	Command input warning at home positioning	(1)	A command has already inputted at the time of home positioning.	Check if a command is inputted at home positioning.	A command is inputted.	Set it after home positioning.
					A command is not inputted.	Check (2).
		(2)	Creep speed is high.	Decrease the creep speed, and then check the repeatability.	It is not repeatable.	Decelerate the creep speed, and make home position setting.
96.3	Servo off warning at home positioning	(1)	A home positioning was executed during servooff.	Check if the status is servo-off at home positioning.	It is servo-off.	Turn to servo-on, and then execute the home positioning.
96.4	Home positioning warning during magnetic pole detection	(1)	Z-phase was not turned on after servo-on.	Check if the Z-phase was turned on.	The Z-phase was not turned on.	Rotate the direct drive motor to turn on the Zphase, and make home position setting.

Alarm No.: 97	Name: Positioning specification warning					
Alarm content	How to specify a positioning is incorrect for the positioning function.					
Detail No.	Detail name	Cause		Check method	Check result	Action
97.1	Program operation disabled warning	(1)	When using the positioning function, start a program with the program operation disabled.	Check if the power of the driver was cycled after the program was changed.	The power of the driver was not cycled.	Cycle the power of the driver.
97.2	Next station position warning	(1)	An abnormal value was specified to a signal input of the next station position specification and automatic operation was started.	Check if a number of stations per rotation ([Pr.PT28]) or more value was not specified to the next station position.	The number of stations per rotation ([Pr. PT28]) or more value was specified.	Review the parameter setting or next station position input signal.
					The number of stations per rotation ([Pr. PT28]) or more value was not specified.	Check (2).
		(2)	The power of the driver was not cycled after the number of stations per rotation ([Pr. PT28]) was changed.	Check if the power of the driver was cycled after the number of stations per rotation ([Pr. PT28]) was changed.	The power was not cycled.	Cycle the power of the driver.

Alarm No.: 98	Name: Software limit warning					
Alarm content	· A software limit set with the parameter was reached for the positioning function.					
Detail No.	Detail name	Cause		Check method	Check result	Action
98.1	Forward rotation-side software stroke limit reached	(1)	A software limit was set within the actual operation range.	Check if the parameter settings ([Pr. PT15] to [Pr. PT18]) to the operation range are correct.	The setting was out of operation range.	Set [Pr. PT15] to [Pr.PT18] correctly.
					The setting was within operation range.	Check (2).
		(2)	A point table of the position data which exceeds the software limit was executed.	Check if the target position of the point data to the operation range was correct.	The setting was out of operation range.	Set the point table correctly.
					The setting was within operation range.	Check (3).
		(3)	A software limit was	Check if the JOG	It reached to the out	Operate within the

Detail No.	Detail name		Cause	Check method	Check result	Action
			reached by using the JOG operation or manual pulse generator operation.	operation or manual pulse generator operation was executed properly to the operation range.	of operation range.	software limit. Adjust properly the parameters such as JOG speed and multiplication of the manual pulse as necessary.
98.2	Reverse rotation-side software stroke limit reached	Check it with the check method for [AL. 98.1].				

Alarm No.: 99		Name: Stroke limit warning				
Alarm content		The stroke limit signal is off.				
Detail No.	**Detail name**		**Cause**	**Check method**	**Check result**	**Action**
99.1	Forward rotation stroke end off	(1)	The forward rotation stroke limit switch is connected to LSP.	Check if the limit switch is connected correctly.	It is not connected.	Connect it correctly.
					It is connected.	Check (2).
					It turned off.	Check operation attern.
		(2)	The forward rotation stroke end was exceeded during driving.	Check if the forward rotation stroke limit switch turned off.	It is not connected.	Set the point table correctly.
					It is connected.	Check (3).
99.2	Reverse rotation stroke end off	(1)	The reverse rotation stroke limit switch is connected to LSN.	Check if the limit switch is connected correctly.	It is not connected.	Connect it correctly.
					It is connected.	Check (2).
		(2)	The reverse rotation stroke end was exceeded during driving.	Check if the reverse rotation stroke limit switch turned off.	It turned off.	Check operation pattern.

Alarm No.: 9B		Name: Error excessive warning				
Alarm content		・Droop pulses have exceeded the warning occurrence level.				
Detail No.	**Detail name**		**Cause**	**Check method**	**Check result**	**Action**
9B.1	Excess droop pulse 1 warning	(1)	The servo motor power cable was disconnected.	Check the servo motor power cable.	It is disconnected.	Repair or replace the servo motor power cable.
					It is not disconnected.	Check (2).
		(2)	The connection of the servo motor is incorrect	Check the wiring of U/V/W.	It is incorrect.	Connect it correctly.
					It is correct.	Check (3).
		(3)	The connection of the encoder cable is incorrect.	Check if the encoder cable is connected correctly.	It is incorrect.	Connect it correctly.
					It is correct.	Check (4).
		(4)	The torque limit has been enabled.	Check if the limiting torque is in progress.	The limiting torque is in progress.	Increase the torque limit value.
					The limiting torque is not in progress.	Check (5).
		(5)	A moving part collided against the machine.	Check if it collided.	It collided.	Check operation pattern.
					It did not collide.	Check (6).
		(6)	The torque isinsufficient.	Check the peak load Ratio	The torque is saturated.	Reduce the load or review the operation pattern. Or use a larger capacity motor.
					The torque is not saturated.	Check (7).
		(7)	Power supply voltage dropped.	Check the bus voltage value.	The bus voltage is low	Check the power supply voltage and power supply capacity.
					The bus voltage is high.	Check (8).
		(8)	Acceleration/ deceleration time constant is too short.	Set a longer deceleration time constant, and then check the repeatability.	It is not repeatable.	Increase the acceleration/deceleration time constant.
					It is repeatable.	Check (9).

		(9)	The position loop gain is small.	Increase the position loop gain, and then check the repeatability.	It is not repeatable.	Increase the position loop gain ([Pr. PB08]).
					It is repeatable.	Check (10).
		(10)	Servo motor shaft was rotated by external force.	Measure the actual position under the servolock status.	It is rotated by external force.	Review the machine.
					It is not rotated by external force.	Check (11).
		(11)	An encoder is malfunctioning.	Replace the servo motor, and then check the repeatability.	It is not repeatable.	Replace the servo motor.
9B.3	Excess droop pulse 2 warning	Check it with the check method for [AL. 9B.1].				
9B.4	Error excessive warning during 0 torque limit	(1)	The torque limit has been 0.	Check the torque limit value.	The torque limit has been 0.	Do not input a command while the torque limit value is 0.

Alarm No.: 9C	Name: Converter warning					
Alarm content	A warning occurred in the converter unit during the servo-on.					
Detail No.	Detail name	Check method		Check method	Check result	Action
9C.1	Converter unit warning	(1)	A warning occurred in the converter unit during the servo-on.	Check the warning of the converter unit, and take the action following the remedies for warnings of the converter unit.		

Alarm No.: 9F	Name: Battery warning					
Alarm content	・Battery voltage for absolute position detection system decreased.					
Detail No.	Detail name	Cause		Check method	Check result	Action
9F.1	Low battery	(1)	The battery is not connected to CN4.	Check if the battery is connected correctly.	It is not connected.	Connect it correctly.
					It is connected.	Check (2).
		(2)	The battery voltage is low. The battery is consumed.	Check the battery voltage with a tester.	It is less than 4.9 V DC.	Replace the battery.
9F.2	Battery degradation warning	(1)	The absolute position storage unit has not connected.	Check if the absolute position storage unit is connected correctly.	It is not connected.	Connect it correctly.

Alarm No.: E0	Name: Excessive regeneration warning					
Alarm content	・There is a possibility that regenerative power may exceed permissible regenerative power of built-in regenerative resistor or regenerative option.					
Detail No.	Detail name	Cause		Check method	Check result	Action
E0.1	Excessive Regeneration warning	(1)	The regenerative power exceeded 85% of the permissible regenerative power of the built-in regenerative resistor or regenerative option.	Check the effective load ratio.	It is 85% or more.	Reduce the frequency of positioning. Increase the deceleration time constant. Reduce the load. Use a regenerative option if it is not being used.

Alarm No.: E1		Name: Overload warning 1					
Alarm content		□□[AL. 50 Overload 1] or [AL. 51 Overload 2] can occur.					
Detail No.	Detail name	Cause		Check method	Check result	Action	
E1.1	Thermal overload warning 1 during operation	(1)	The load was over 85% to the alarm level of [AL. 50.1 Thermal overload error 1 during operation].	Check it with the check method for [AL. 50.1].			
E1.2	Thermal overload warning 2 during operation	(1)	The load was over 85% to the alarm level of [AL. 50.2 Thermal overload error 2 during operation].	Check it with the check method for [AL. 50.2].			
E1.3	Thermal overload warning 3 during operation	(1)	The load was over 85% to the alarm level of [AL. 51.1 Thermal overload error 3 during operation].	Check it with the check method for [AL. 51.1].			
E1.4	Thermal overload warning 4 during operation	(1)	The load was over 85% to the alarm level of [AL. 50.3 Thermal overload error 4 during operation].	Check it with the check method for [AL. 50.3].			
E1.5	Thermal overload error 1 during a stop	(1)	TThe load was over 85% to the alarm level of [AL. 50.4 Thermal overload error 1 during a stop].	Check it with the check method for [AL. 50.4].			
E1.6	Thermal overload error 2 during a stop	(1)	The load was over 85% to the alarm level of [AL. 50.5 Thermal overload error 2 during a stop].	Check it with the check method for [AL. 50.5].			
E1.7	Thermal overload error 3 during a stop	(1)	The load was over 85% to the alarm level of [AL. 51.2 Thermal overload error 3 during operation].	Check it with the check method for [AL. 51.2].			
E1.8	Thermal overload error 4 during a stop	(1)	The load was over 85% to the alarm level of [AL. 50.6 Thermal overload error 4 during a stop].	Check it with the check method for [AL. 50.6].			

Alarm No.: E2		Name: Servo motor overheat warning					
Alarm content		・ [AL. 46.2 Abnormal temperature of servo motor 2] can occur.					
Detail No.	Detail name	Cause		Check method	Check result	Action	
E2.1	Servo motor temperature warning	(1)	The temperature of the linear servo motor or direct drive motor reached 85% of the occurrence level of [AL. 46.2 Abnormal temperature of servo motor 2].	Check it with the check method for [AL. 46.2].			

Alarm No.: E3	Name: Absolute position counter warning				
Alarm content	· The multi-revolution counter value of the absolute position encoder exceeded the maximum range. · Absolute position encoder pulses are faulty. · An update cycle is short for writing multi-revolution counter value of the absolute position encoder to EEP-ROM.				
Detail No.	Detail name	Cause	Check result	Action	Target
E3.1	Multi-revolution counter travel distance excess warning	(1) The travel distance from the home position is 32768 rev or more in the absolute position system.	Check the value of the multi-revolution counter.	It is 32768 rev or more.	Review operation range. Execute the home position return again. After the power is surely cycled, perform home position return again.
E3.2	Absolute position counter warning	(1) Something near the device caused it.	Check the noise, ambient temperature, etc.	There is a problem in the surrounding.	Take countermeasures against its cause. After the power is surely cycled, perform home position return again.
				There is no problem in the surrounding.	Check (2).
		(2) An encoder is malfunctioning.	Replace the servo motor,and then check the repeatability.	It is not repeatable.	Replace the servo motor.
E3.4	Absolute positioning counter EEPROM writing frequency warning	(1) A home position was renewed (EEP-ROM write) twice or more in 10 minutes in the driver due to rotation to the same direction in short time in the point table method of the positioning mode, degree setting with the program method, or the indexer method.	Check if the operation was within the following conditions between the number of gear teeth on machine side ([Pr. PA06] CMX) and servo motor speed (N). • When CMX □□2000, N < 3076.7 r/min • When CMX > 2000, N < 3276.7 - (CMX × 0.1) r/min • When (CMX/CDV) is reduced to its lowest terms, CMX 15900	The operation was out of conditions.	Set the command speed within the conditions. Set the number of gear teeth on machine side within the conditions. After the power is surely cycled, perform home position return again.
E3.5	Encoder absolute positioning counter warning	Check it with the check method for [AL. E3.2].			

Alarm No.: E5	Name: ABS time-out warning				
Alarm content	·A response from the programmable controller was over 5 s at the absolute position erased data transfer. ·ABSM (ABS transfer mode) turned off during the absolute position erased data transfer. ·SON (Servo-on), RES (Reset), or EM2/EM1 (Forced stop) turned off during the absolute position erased data transfer.				
Detail No.	Detail name	Cause	Check method	Check result	Action
E5.1	Time-out during ABS data transfer	(1) The wiring of I/O signals is incorrect.	Check if the I/O signal wire is disconnected or connected loosely.	It has a failure.	Repair or replace the I/O signal wire.
				It has no failure.	Check (2).
		(2) The sequence program is incorrect.	Check the sequence program.	The sequence program is incorrect.	Modify the sequence program.
E5.2	ABSM off during ABS data transfer	Check it with the check method for [AL. E5.1].			
E5.3	SON off during ABS data transfer				

Alarm No.: E6	Name: Servo forced stop warning					
Alarm content	· EM2/EM1 (Forced stop) turned off. · SS1 command was inputted.					
Detail No.	Detail name	Cause		Check method	Check result	Action
E6.1	Forced stop warning	(1)	EM2/EM1 (Forced stop) turned off.	Check the status of EM2/EM1.	It is off.	Ensure safety and turnbon EM2/EM1 (Forced stop).
					It is on.	Check (2).
		(2)	The external 24 V DC power supply is off.	Check if the external 24 V DC power supply is inputted.	It is not inputted.	Input the 24 V DC power supply.
					It is inputted.	Check (3).
		(3)	The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.
E6.2	SS1 forced stop warning 1 (safety observation function)	(1)	The SS1 command is off (enabled).	Check if the SS1 command is off (enabled).	The SS1 command is off (enabled).	Turn on the SS1 input (disabled).
		(2)	An external 24 V DC is not inputted to the functional safety unit.	Check if an external 24 VDC is inputted to the functional safety unit.	It is not inputted.	Input the 24 V DC power supply.
					It is inputted.	Check (3).
		(3)	The functional safety unit is malfunctioning.	Replace the functional safety unit, and then check the repeatability.	It is not repeatable.	Replace the functional safety unit.
E6.3	SS1 forced stop warning 2 (safety observation function)	(1)	An error occurred in the safety communication.	Check the description "The display shows "Ab".". ⇒Page 124 Trouble which does not trigger alarm/warning	It is not repeatable.	Take countermeasures against its cause.

Alarm No.: E7	Name: Controller forced stop warning					
Alarm content	The forced stop signal of the servo system controller was enabled.					
Detail No.	Detail name	Cause		Check method	Check result	Action
E7.1	Controller forced stop input warning	(1)	The forced stop signal of the controller was inputted with Modbus RTU communication.	Check if the controller is in a forced stop status.	It is the forced stop status.	Ensure safety and cancel the forced stop signal of the controller.

Alarm No.: E8	Name: Cooling fan speed reduction warning					
Alarm content	· The cooling fan speed decreased to the warning occurrence level or less.					
Detail No.	Detail name	Cause		Check method	Check result	Action
E8.1	Decreased cooling fan speed warning	(1)	Foreign matter was caught in the cooling fan.	Check if a foreign matter is caught in the cooling fan.	Something has been caught.	Remove the foreign matter.
					Nothing has been caught.	Check (2).
		(2)	Cooling fan life expired.	Check the total of power on time of the driver.	It exceed the cooling fan life.	Replace the driver.
E8.2	Cooling fan stop	Check it with the check method for [AL. E8.1].				

Alarm No.: E9		Name: Main circuit off warning				
Alarm content		· The servo-on command was inputted with main circuit power supply off ·The bus voltage dropped during the servo motor driving under 50 r/min.				
Detail No.	Detail name	Cause		Check method	Check result	Action
E9.1	Servo-on signal on during main circuit off	(1)	The main circuit power supply is off. For the drive unit, the power supply of the converter unit is off.	Check if the main circuit power supply is inputted. Check if the power supply of the converter unit is inputted.	It is not inputted.	Turn on the main circuit power.
					It is inputted.	Check (2).
		(2)	The wiring between P3 and P4 was disconnected. For the drive unit, the wiring between P1 and P2 of the converter unit was disconnected.	Check the wiring between P3 and P4. Check the wiring between P1 and P2 of the converter unit.	It is disconnected.	Connect it correctly.
					It is connected.	Check (3).
		(3)	The main circuit power supply wiring was disconnected. For the drive unit, the main circuit power supply wiring of the converter unit was disconnected.	Check the main circuit power supply wiring. Check the main circuit power supply wiring of the converter unit.	It is disconnected.	Connect it correctly.
					It has no failure.	Check (4).
		(4)	For the drive unit, the magnetic contactor control connector of the converter unit was disconnected.	Check the magnetic contactor control connector of the converter unit.	It is disconnected.	Connect it correctly.
					It has no failure.	Check (5).
		(5)	For the drive unit, the bus bar between the converter unit and drive unit was disconnected.	Check the bus bar between the converter unit and drive unit.	It is disconnected.	Connect it correctly.
					It has no failure.	Check (6).
		(6)	The setting value of [Pr. PA02 Magnetic contactor drive output selection] contradicts the wiring constitution.	Check the [Pr. PA02] setting and the wiring constitution.	The setting or wiring is incorrect.	Review the setting of [Pr. PA02].
					The setting and wiring are correct.	Check (7).
					The setting is correct.	Check (8).
		(8)	The bus voltage is low.	Check if the bus voltage is lower than the prescribed value. 215 V DC	The voltage is lower than the prescribed value.	Review the wiring. Check the power supply capacity.
					The voltage is equal to or higher than the prescribed value.	Check (9).
		(9)	The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	(10) Replace the driver.
		(10)	For the drive unit, the converter unit is malfunctioning.	Replace the converter unit, and then check the repeatability.	It is not repeatable.	Replace the converter unit.

E9.2	Bus voltage drop during low speed operation	(1)	The bus voltage dropped during the servo motor driving under 50 r/min.	Check the bus voltage.	It is lower than the prescribed value. 200 V	Review the power supply capacity. Increase the acceleration time constant.	
E9.3	Ready-on signal on during main circuit off	Check it with the check method for [AL. E9.1].					
E9.4	Converter unit forced stop	(1)	The forced stop of the converter unit is enabled during the servo-on command.	Check if the forced stop of the converter unit is enabled.	It is enabled.	Deactivate the forced stop of the converter unit.	
					It is not enabled.	Check (2).	
		(2)	The protection coordination cable is not correctly connected.	Check the protection coordination cable.	It is not connected.	Connect the protection coordination cable correctly.	

Alarm No.: EA		Name: ABS servo-on warning					
Alarm content		▪The servo-on was not enabled within 1 s after ABSM (ABS transfer mode) was turned on.					
Detail No.	**Detail name**	**Cause**		**Check method**	**Check result**	**Action**	
EA.1	ABS servo-on warning	(1)	The wiring of I/O signals is incorrect.	Check if the I/O signal wire is disconnected or connected loosely.	It has a failure.	Repair or replace the I/O signal wire.	
					It has no failure.	Check (2).	
		(2)	The sequence program is incorrect.	Check the sequence program.	The sequence program is incorrect.	Modify the sequence program.	

Alarm No.: EC		Name: Overload warning 2				
Alarm content		Operations over rated output were repeated while the servo motor shaft was not rotated.				
Detail No.	Detail name	Cause		Check method	Check result	Action
EC.1	Overload warning 22	(1)	The load is too large or the capacity is not enough.	Check the effective load ratio.	The effective load ratio is high.	Reduce the load. Replace the servo motor with the one of larger capacity.

Alarm No.: ED		Name: Output watt excess warning				
Alarm content		· The status, in which the output wattage (speed × torque) of the servo motor exceeded the rated output, continued steadily.				
Detail No.	Detail name	Cause		Check method	Check result	Action
ED.1	Output watt excess warning	(1)	The status, in which the output wattage (speed × torque or thrust) of the servo motor exceeded 120% of the rated output (continuous thrust), continued steadily.	Check the servo motor speed and torque, or check the motor speed and thrust.	The output wattage is 120% of rating.	Reduce the servo motor speed. Reduce the load.

Alarm No.: F0		Name: Tough drive warning				
Alarm content		·Tough drive function was activated.				
Detail No.	Detail name	Cause		Check method	Check result	Action
F0.1	Instantaneous power failure tough drive warning	(1)	The voltage of the control circuit power supply has dropped.	Check it with the check method for [AL. 10.1].		
F0.3	Vibration tough [GF] drive warning	(1)	The setting value of the machine resonance suppression filter was changed due to a machine resonance.	Check if it was changed frequently.	It was changed frequently.	Set the machine resonance suppression filter. Check the machine status if screws are loose or the like.

Alarm No.: F2		Name: Drive recorder - Miswriting warning				
Alarm content		A waveform measured by the drive recorder function was not recorded.				
Detail No.	Detail name	Cause		Check method	Check result	Action
F2.1	Drive recorder - Area writing time-out warning	(1)	The Flash-ROM is malfunctioning.	Disconnect the cables except for the control circuit power supply, and then check the repeatability.	It is repeatable	Replace the driver.
F2.2	Drive recorder - Data miswriting warning	(1)	Data were not written to the drive recorder area.	Check if clearing alarm history disables this alarm with setup software (MR Configurator2™)	It is not canceled.	Replace the driver.

Alarm No.: F3		Name: Oscillation detection warning				
Alarm content		· [AL. 54 Oscillation detection] can occur.				
Detail No.	Detail name	Cause		Check method	Action	Target
F3.1	Oscillation detection warning	Check it with the check method for [AL. 54.1].				

Alarm No.: F4	Name: Positioning warning					
Alarm content	・Target position or acceleration time constant/deceleration time constant was set out of setting range.					
Detail No.	**Detail name**	**Cause**		**Check method**	**Check result**	**Action**
F4.4	Target position setting range error warning	(1)	A target position was set out of setting range.	Check the setting value of the target position.	It is out of setting range.	Set the target position correctly, and cancel the warning (turn on C_ORST).

Alarm No.: F5	Name: Simple cam function - Cam data miswriting warning					
Alarm content	▪The cam data written by setup software (MR Configurator2™) is not written to a Flash-ROM.					
Detail No.	**Detail name**	**Cause**		**Check method**	**Check result**	**Action**
F5.1	Cam data - Area writing time-out warning	(1)	The Flash-ROM is malfunctioning.	Disconnect the cables except for the control circuit power supply, and then check the repeatability.	It is repeatable.	Replace the driver.
F5.2	Cam data - Miswriting warning	(1)	The cam data was not written.	After the power is cycled,perform writing, and check the repeatability again. When the cam data is initialized, perform writing, and check the repeatability again. • Section 7.2.9 [Pr. PT34] of driver Instruction Manual (Positioning Mode)"	It is repeatable.	Replace the driver.
F5.3	Cam data checksum error	(1)	When the power is switched on after the cam data is written, a checksum of the cam data does not match. (Error occurred in cam data.)	Check if an error occurred (such as entered noise, power-off) at cam data write.	It has a failure.	After writing the cam data again, cycle the power.
					It has no failure.	Check (2).
		(2)	When the cam control command is turned on after the temporal writing of cam data, a checksum of the cam data does not match. (Error occurred in cam data.)	Check if an error occurred (such as entered noise) at temporal writing of cam data.	It has a failure.	After performing the temporal writing of cam data again, turn on the cam control command.
					It has no failure.	Check (3).
		(3)	The Flash-ROM is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.

Alarm No.: F6		Name: Simple cam function - Cam control warning				
Alarm content		・The cam axis position restoration at a time of cam control start was a failure. ・The cam control is not normal.				
Detail No.	Detail name		Cause	Check method	Check result	Action
F6.1	Cam axis one cycle current value restoration failed	(1)	The cam axis one cycle current value corresponding to the feed current value at cam control start cannot be restored. (It occurs in a reciprocating motion pattern of the cam.)	Check if the feed current value is within the stroke in a reciprocating motion pattern of the cam.	The feed current value is the outside of the stroke.	Move the feed current value to within the stroke in a reciprocating motion pattern of the cam. Or set the cam standard position within the stroke in a reciprocating motion pattern of the cam.
F6.2	Cam axis feed current value restoration failed	(1)	The difference (command unit) between the restored cam axis feed current value and the command position at cam control start is bigger than "inposition range".	Check if the difference (command unit) between the restored cam axis feed current value and the command position at cam control start is in the "in-position range".	The difference of the command position (command unit) is not within "in-position range".	Calculate the cam axis feed current value to be restored, move the command position to the position, and then start the cam control. (For the calculation method, refer to the following. Manual (Positioning Mode)"
F6.3	Cam unregistered error	(1)	Cam data has never been written.	Check if the cam data was written.	It was not written.	Write the cam data.
					It was written.	Check (2).
		(2)	The cam data of the specified cam No. was not written.	Check if the cam data of the specified cam No. was written.	It was not written.	Write the cam data of the specified cam No.
					It was written.	Check (3).
		(3)	Cam data has changed due to a driver malfunction.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.
F6.4	Cam control data setting range error	(1)	An out of range value is set to the cam control data.	Check the setting of the cam control data.	The setting is ncorrect.	Set it correctly.
F6.5	Cam No. external error	(1)	An out of range value is set to the cam No.	Check the setting of the cam No.	The setting is incorrect.	Set it correctly.
F6.6	Cam control inactive	(1)	After cam data was written, the cam control command was turned on without cycling the power.	Check if the power was cycled after the cam data was written.	The power was not cycled.	Cycle the power.
					The power was cycled.	Check (2).
		(2)	After the cam control command was turned on, the servo-on was turned on.	Check if the cam control command was turned on during servo-on.	The cam control command was not turned on during servo-on.	Turn on the cam control Command during servoon.
					The cam control command was turned on during servo-on.	Check (3).

		(3)	The cam control command was turned on during servo motor driving, and the servo motor stopped.	Check if the cam control command was turned on while the travel completion was on.	The cam control command was not turned on while the travel completion was on.	Turn on the cam control command while the travel completion was on.	
					The cam control command was turned on while the travel completion was on.	Check (4).	
		(4)	The cam control command was turned on at the time of incompletion of home position return.	Check if the home position return completion is on.	The home position return completion is off.	Make a home position return, and turn on the cam control command.	
					The home position return completion is on.	Check (5).	
		(5)	It became servo-off during cam control.	Check if it is servo-off.	It is servo-off.	After servo-on, turn on the cam control command again.	
					It is servo-on.	Check (6).	
		(6)	A home position is erased during cam control.	Check if the home position return completion is off.	The home position return completion is off.	After the home position return completion, turn on the cam control command again.	
					The home position return completion is on.	Check (7).	
		(7)	It is stopped at a software limit during cam control.	Check if a software limit is reached.	A software limit is reached.	After it is retracted from the position of a software limit, turn on the cam control command again.	
					A software limit is not reached.	Check (8).	
		(8)	It is stopped at a stroke limit during cam control.	Check if a stroke limit is reached.	A stroke limit is reached.	After it is retracted from the position of a stroke limit, turn on the cam control command again.	

8.6 Trouble which does not trigger alarm/warning

POINT
●When the driver, servo motor, or encoder malfunctions, the following status may occur.

The following example shows possible causes which do not trigger alarm or warning. Remove each cause referring this section.

Description	Cause	Checkpoint	Action
The display shows "dEF".	Initializing point table/program is in progress.	Initializing of point table/ program was set in the parameter ([Pr. PT34] = 5001) and the power was cycled.	It takes about 20 s for startup the driver at initializing. Please wait until the display changes.
The display shows "off".	The external I/O terminal was shorted.	When the display is on by disconnecting the following connectors, check if the disconnected cable wire is shorted. CN1, CN2, CN3	Review the wiring of I/O signals.
	The control circuit power supply is not applied.	Check if the control circuit power supply of the driver is off.	Turn on the control circuit power.
	The voltage of the control circuit power supply has dropped.	Check if the voltage of the control circuit power supply dropped.	Increase the voltage of the control circuit power supply.
The servo motor does not operate.	The connection of the servo motor is incorrect.	Check the wiring of U/V/W.	Connect it correctly.
	The servo motor power supply cable was connected to a driver of other axis.	Check if the encoder cable and servo motor power supply cable are connected to the same driver.	Connect the encoder cable and servo motor power supply cable correctly.
	An alarm or warning is occurring.	Check if an alarm or warning is occurring.	Check the content of the alarm/ warning and remove its cause.
	The system has been in the test operation mode.	Check if the lower right point is blinking.	Cancel the test operation mode.
	The motor-less operation has been enabled.	A]: Check the [Pr. PC60] setting.	Disable the motor-less operation.
	The torque is insufficient due to large load.	Check instantaneous torque using status display or setup software (MR Configurator2™) if the load exceeds the maximum torque or torque limit value.	Reduce the load or use a larger capacity servo motor.
	An unintended torque limit has been enabled.	Check if the torque limit is enabled.	Cancel the torque limit.

Description	Cause	Checkpoint	Target
	The setting of the torque limit is incorrect.	Check if the torque limit is "0". [Pr. PA11] and [Pr. PA12], or analog input	Set it correctly.
	Machine is interfering with the motor.	Check if machine is interfering.	Remove the interference.
	For a servo motor with an electromagnetic brake, the lock has not released.	Check the power supply of the electromagnetic brake.	Turn on the electromagnetic brake power.
	LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end) are not on.	Check if [AL. 99] is occurring.	Turn on LSP and LSN.
	SON (Servo-on) is not on.	Check the SON (Servo-on) state.	Turn on SON (Servo-on).
	RES (Reset) is on.	Check the RES (Reset) state.	Turn off RES (Reset).
	The setting of the control mode is incorrect.	Check the [Pr. PA01] setting.	Set it correctly.
	The command pulse is not inputted in the position control mode.	Check if the pulse train is outputted on the controller side.	Review the setting on the controller side.
	The wiring of the command pulse train signal is incorrect in the position control mode.	Check the cumulative command pulses using the status display or setup software (MR Configurator2TM). Input the pulse train command and check if the display changes.	Review the wiring. When the signal is used in open-collector type, input 24 V DC to OPC.
	The setting of the command pulse input form is incorrect in the position control mode.	Check that the pulse train form outputted with the controller and the setting of [Pr. PA13] are matched.	Review the [Pr. PA13] setting.
	Both of ST1 (Forward rotation start) and ST2 (Reverse rotation start) are on or off in the speed control mode or the positioning mode.	Check the status of ST1 (Forward rotation start) and ST2 (Reverse rotation start).	Turn on ST1 (Forward rotation start) or ST2 (Reverse rotation start).
	Both of RS1 (Forward rotation selection) and RS2 (Reverse rotation selection) are on or off in the torque control mode.	Check the status of RS1 (Forward rotation selection) and RS2 (Reverse rotation selection).	Turn on RS1 (Forward rotation selection) or RS2 (Reverse rotation selection).
	The value selected in the speed control mode or the torque control mode is low.	Check SP1 (Speed selection 1), SP2 (Speed selection 2), and SP3 (Speed selection 3), and then check if the selected internal speed is correct.	Review the selections of SP1 (Speed selection 1), SP2 (Speed selection 2), SP3 (Speed selection 3), and setting of internal speed.
	The value selected in the positioning mode (point table method) with BCD input is low.	Check SPD1 (Speed selection 1), SPD2 (Speed selection 2), SPD3 (Speed selection 3) and SPD4 (Speed selection 4), and then check if the selected internal speed is correct.	Review the wiring. Review the selections of SPD1 (Speed selection 1), SPD2 (Speed selection 2), SPD3 (Speed selection 3), SPD4 (Speed selection 4), and setting of internal speed.
	An analog signal is not inputted correctly.	Check the values of analog speed command and analog torque command using status display or setup software (MR Configurator2TM).	Input the analog signals correctly.
	The ABS transfer mode is selected when the absolute position detection system is used.	Check if ABSM is on.	Turn off ABSM.
	The settings of the electronic gear are incorrect.	Check the setting value of the electronic gear.	Set a proper value of the electronic gear.
	The setting of point tables is incorrect.	Check the point table setting.	Review the point table setting.
	Wiring or the command pulse multiplication setting is	When using an MR-HDP01 manual pulse generator,	Review the wiring and the command pulse multiplication

	incorrect.	check the wiring and the command pulse multiplication setting (assignment of TP0, TP1 and [Pr. PT03] setting).	setting.
	Power is not supplied to the MRHDP01 manual pulse generator.	A power supply is not connected between +5 V to 12 V and 0 V of MR-HDP01.	Connect a power supply between +5 V to 12 V and 0 V of MRHDP01.
	Power is not supplied to OPC (power input for open-collector sink interface).	Between DICOM and OPC of the CN1 connector of the driver is not connected.	Connect between DICOM and OPC.
	Power is not supplied to OPC (power input for open-collector sink interface).	Between DICOM and OPC of the CN1 connector of the driver is not connected	Connect between DICOM and OPC.
The speed of the servo motor is not increased. Or the speed is increased too much.	The setting of the speed command, speed limit, or electronic gear is not correct.	Check the settings of the speed command, speed limit, and electronic gear.	Review the settings of the speed command, speed limit, and electronic gear.
	The connection of the servo motor is incorrect.	Check the wiring of U/V/W.	Connect it correctly.
	The voltage of the main circuit power supply has dropped.	Check if the voltage of the main circuit power supply dropped.	Increase the voltage of the main circuit power supply.
	For a servo motor with an electromagnetic brake, the lock has not released.	Check the power supply of the electromagnetic brake.	Turn on the electromagnetic brake power.
	The selection of SP1 (Speed selection 1), SP2 (Speed selection 2), or SP3 (Speed selection 3) is incorrect in the speed control mode or the torque control mode.	Check SP1 (Speed selection 1),SP2 (Speed selection 2), and SP3(Speed selection 3), and then check if the selected internal speed is correct.	Review the settings of SP1 (Speed selection 1), SP2 (Speed selection 2), SP3 (Speed selection 3), and setting of internal speed.
	An analog signal is not input correctly in the speed control mode or the torque control mode.	Check the values of the analog speed command and the analog torque command using the status display orsetup software (MR Configurator2TM).	Set the VC (Analog override) and input the analog signal correctly.
	The selection of SPD1 (Speed selection 1), SPD2 (Speed selection 2), SPD3 (Speed selection 3), or SPD4 (Speed selection 4) is incorrect in the positioning mode (point table method) with BCD input.	Check SPD1 (Speed selection 1),SPD2 (Speed selection 2), SPD3(Speed selection 3) and SPD4(Speed selection 4), and then check if the selected internal speed is correct.	Review the wiring. Review the settings of SPD1 (Speed selection 1), SPD2 (Speed selection 2), SPD3 (Speed selection 3), SPD4 (Speed selection 4), and setting of internal speed.
	An analog signal is not input correctly in the positioning mode (point table method and program method).	Check the value of VC (Analog override) using the status display or setup software (MR Configurator2TM).	Set the VC (Analog override) and input the analog signal correctly.
	The selection of OV0 (Digital override selection 1), OV1 (Digital override selection 2), OV2 (Digital override selection 3), or OV3 (Digital override selection 4) is incorrect in the positioning mode (indexer method).	Check OV0 (Digital override selection 1), OV1 (Digital override selection 2), OV2 (Digital override selection 3) and OV3 (Digital override selection 4), and then check if the selected override level ([%]) is correct.	Review the wiring. Review the settings of OV0 (Digital override selection 1), OV1 (Digital override selection 2), OV2 (Digital override selection 3), and OV3 (Digital override selection 4).
The servo motor vibrates with low frequency.	The estimated value of the load to motor inertia ratio by auto tuning is incorrect. When the load to motor inertia ratio is set by manual, the setting value is incorrect.	If the servo motor may be driven with safety, repeat acceleration and deceleration several times to complete auto tuning. Check if the load to motor inertia ratio is proper compared with the actual ratio for manual setting.	Execute auto tuning and onetouch tuning to reset the load to motor inertia ratio. Set the load to motor inertia ratio correctly for manual setting.
	The command from the controller is unstable.	Check the command from the controller.	Review the command from the controller. Check the cable for command if there is failure such as disconnection.
	Torque or thrust during	Check the effective load ratio	Reduce the effective load ratio by

	acceleration/deceleration is overshooting exceeding the limit of the servo motor when the motor stops.	during acceleration/deceleration if torque/thrust exceeds the maximum torque/thrust.	increasing acceleration/ deceleration time and reducing load.
	The servo gain is low. Or the response of auto tuning is low.	Check if the trouble is solved by increasing auto tuning response ([Pr. PA09]).	Adjust gains.
An unusual noise is occurring atthe servo motor.	The servo gain is low. Or the response of auto tuning is low.	Check if the trouble is solved by increasing auto tuning response ([Pr. PA09]).	Adjust gains.
	Bearing life expired.	If the servo motor may be driven with safety, remove the load and check the noise with the servo motor only. If you can remove the servo motor from machine, remove the servo motor power cable to release the lock and check the noise by rotating the shaft by your hands.	Noising means that the bearing life expired. Replace the servo motor. When not noising, maintain the machine.
	For a servo motor with an electromagnetic brake, the lock has not released.	Check the power supply of the electromagnetic brake.	Turn on the electromagnetic brake power.
	For a servo motor with an electromagnetic brake, the lock release timing is not correct.	Check the lock release timing.	Review the lock release timing. Please consider that the electromagnetic brake has release delay time.
The servo motor vibrates.	The servo gain is too high. Or the response of auto tuning is too high.	Check if the trouble is solved by reducing auto tuning response ([Pr. PA09]).	Adjust gains.
	The machine is vibrating (resonating).	If the servo motor may be driven with safety, check if the trouble is solved by one-touch tuning or adaptive tuning.	Adjust the machine resonance suppression filter.
	The load side is vibrating.	If the servo motor may be driven with safety, check if the trouble is solved by advanced vibration suppression control.	Execute the advanced vibration suppression control .
	Feedback pulses are being miscounted due to entered noise into an encoder cable.	Check the cumulative feedback pulses using status display or setup software (MR Configurator2TM) if its numerical value is skipped.	Please take countermeasures against noise by laying the encoder cable apart from power cables, etc.
	There is a backlash between the servo motor and machine (such as gear, coupling).	Check if there is a backlash on the machine.	Adjust the backlash on the coupling and machine.
	The rigidity of the servo motor mounting part is low.	Check the mounting part of the servo motor.	Increase the rigidity of the mounting part by such as increasing the board thickness and by reinforcing the part with ribs.
	The connection of the servo motor is incorrect.	Check the wiring of U/V/W.	Connect it correctly.
	An unbalanced torque of the machine is large.	Check if the vibration varies depending on the speed.	Adjust balance of the machine.
	The eccentricity due to core gap is large.	Check the mounting accuracy of the servo motor and machine.	Review the accuracy.

	A load for the shaft of the servo motor is large.	Check the load for the shaft of the servo motor.	Adjust the load for the shaft to within specifications of the servo motor. For the shaft permissible load, refer to "Servo Motor Instruction Manual (Vol. 3)".
	An external vibration propagated to the servo motor.	Check the vibration from outside.	Prevent the vibration from the external vibration source.
The rotation accuracy is low. (The speed is unstable.)	The servo gain is low. Or the response of auto tuning is low.	Check if the trouble is solved by increasing auto tuning response ([Pr. PA09]).	Adjust gains.
	The torque is insufficient due to large load.	Check instantaneous torque using status display or setup software (MR Configurator2TM) if the load exceeds the maximum torque or torque limit value.	Reduce the load or use a larger capacity servo motor.
	An unintended torque limit has been enabled.	Check if TLC (Limiting torque) is on using status display or setup software (MR Configurator2TM).	Cancel the torque limit.
	The setting of the torque limit is incorrect.	Check if the limiting torque is too low. [Pr. PA11] and [Pr. PA12], or analog input	Set it correctly.
	For a servo motor with an electromagnetic brake, the lock has not released.	Check the power supply of the electromagnetic brake.	Turn on the electromagnetic brake power.
	The command from the controller is unstable.	Check the ripple of the command frequency with setup software (MR Configurator2TM).	Review the command from the controller. Check the cable for command if there is failure such as disconnection.
The machine vibrates unsteadily when it stops.	The servo gain is low. Or the response of auto tuning is low.	Check if the trouble is solved by increasing auto tuning response ([Pr. PA09]).	Adjust gains.
The servo motor starts to drive immediately after power on of the driver.The servo motor starts to drive immediately after servo-on.	SON (Servo-on) is on at power on.	Check if SON (Servo-on) and RD (Ready) are on using status display or setup software (MR Configurator2TM).	Review the sequence of SON(Servo-on).
	An analog signal is inputted from the beginning.	Check the status of analog speed command and analog torque command using status display or setup software (MR Configurator2TM).	Review the timing of inputting analog signal.
	Zero point of an analog signal deviates.	Check if the servo motor drives while 0 V is inputted to the analog signal.	Execute the VC automatic offset or adjust offset of the analog signal with ［Pr.PC37］ or ［Pr.PC38］.
	For a servo motor with an electromagnetic brake, the lock release timing is not correct.	Check the lock release timing.	Review the lock releae timing.
	The connection of the servo motor is incorrect.	Check the wiring of U/V/W.	Connect is correctly.

Description	Cause	Checkpoint	Action
Home position deviates at home position return.	For the dog type home position return, the point which the dog turns off and the point which Zphase pulse is detected (CR input position) are too close.	Check if a fixed amount (in one revolution) deviates.	Adjust the dog position.
	The in-position range is too large.	Check the setting of the inposition range in [Pr. PA10].	Set a narrower in-position range.
	The proximity dog switch is failure. Or mounting proximity dog switch is incomplete.	Check if the proximity dog signal is inputted correctly.	Repair or replace the proximity dog switch. Adjust the mounting of the proximity dog switch.
	The program on the controller side is incorrect.	Check the program on the controller side such as home position address settings or sequence programs.	Review the programs on the controller side.
The position deviates during operation after home position return	The position command and actual machine position are different.	Check that "cumulative feedback pulses × travel distance per pulse" matches the actual machine position. Check if "cumulative feedback pulses × feed length multiplication" matches the actual machine position.	Review the position command and electronic gear setting.
	An alarm or warning is occurring.	Check if an alarm or warning is occurring.	Check the content of the alarm/ warning and remove its cause.
	The servo gain is low. Or the response of auto tuning is low.	Check if the trouble is solved by increasing auto tuning response ([Pr. PA09]).	Adjust gains.
	The reduction ratio is not calculated correctly for the geared servo motor.	Check the following settings. Number of command input pulses per revolution ([Pr. PA05]) or electronic gear ([Pr. PA06] and [Pr. PA07])	Review the calculation of the reduction ratio.
	The in-position range is too large.	Check the setting of the inposition range in [Pr. PA10].	Set a narrower in-position range.
	The command pulses were miscounted due to noise.	Check that the command value of the controller and the number of cumulative command pulses are matched.	Please take countermeasures against noise for the command cable. Review the shield procedure of the command cable.
	The cable for a command is connected loosely or disconnected.	Check that the command value of the controller and the number of cumulative command pulses are matched.	Repair the cable for a command.

	Frequency of the pulse train command is too high.	Check the pulse train command frequency is within the range of specifications. It is 500 kpulses/s or less for the open-collector type. It is 4 Mpulses/s or less for the differential line driver type.	Review the pulse train command frequency. Select a filter according to the pulse train command frequency from "Command input pulse train filter selection" in [Pr. PA13].
	A cable for command is too long.	Check the ripple of the command frequency with oscilloscope.	Shorten the wiring length. Cable length must be 10 m or shorter for differential line driver output and 2 m or shorter for open-collector output.
	SON (Servo-on) turned off during operation.	Check if SON (Servo-on) is off during operation using status display or setup software (MR Configurator2™).	Review the wiring and sequence not to turn off SON (Servo-on) during operation.
	LSP (Forward rotation stroke end) or LSN (Reverse rotation stroke end) is turned off. ([AL.99] occurred.)	Check that the operating range does not exceed the stroke end. The command position does not match the current position.	Operating range or stroke end positionPlease Confirm.
	CR (Clear) or RES (Reset) turned on during operation.	Check if CR (Clear) or RES (Reset) is on during operation using status display or setup software (MR Configurator2™).	Review the wiring and sequence not to turn on CR (Clear) or RES (Reset) during operation.
	The setting of point tables and start timing is incorrect.	Check if a time period from after switching timing of point table setting value and point table No.until a start timing is 3 ms or more.	Review the point table setting. Review the start timing.
	An input signal to the MR-D01 extension IO unit is incorrect.	Check the selection of the point table No. selection 1 to point table No. selection 8 and check the wiring.	Check the input signal switch to the MR-D01 extension IO unit and check the wiring.
	The program, start timing, etc. are incorrect.	Check if a time period from after switching timing of BCD input program and point table No. until a start timing is 3 ms or more, etc.	Review the controller programs.
	The setting of MR-DS60 digital switch is incorrect.	Check the [Pr. Po10] setting.	Review the [Pr. Po10] setting.
	The wiring between MR-DS60 digital switch and MR-D01 extension IO unit is incorrect.	Check the wiring between MRDS60 digital switch and MR-D01 extension IO unit.	Review the wiring between MRDS60 digital switch and MR-D01 extension IO unit.
	Wiring of the MR-HDP01 manual pulse generator or setting of "manual pulse generator multiplication" ([Pr. PT03], TP0 (manual pulse generator multiplication 1), TP1 (manual pulse generator multiplication 2)) is incorrect.	The input value from the MRHDP01 manual pulse generator and the command position do not match.	Review the wiring. Set the multiplication setting correctly.
	A mechanical slip occurred. Or the backlash of the machine part is large.	Check if there is a slip or backlash on the machine part.	Adjust the machine part.

A restoration position deviates at restoration of power for the absolute position detection system.	The motor was rotated exceeding the maximum permissible speed at power failure (6000 r/min) by an external force during driver power off. (Note: The acceleration time is 0.2 s or less.)	Check if the motor was accelerated suddenly to 6000 r/ min by an external force.	Extend the acceleration time.
	The driver power turned on while the servo motor was rotated exceeding 3000 r/min by an external force.	Check if the driver power turned on while the servo motor was rotated exceeding 3000 r/min by an external force.	Review the power-on timing.
	Transfer data to the controller is incorrect.	Check the ABS data with setup software (MR Configurator2TM).	Review the controller programs.

Overshoot/undershoot occurs.	The servo gain is low or too high. The response of auto tuning is low or too high.	Check the velocity waveform with a graph using setup software (MR Configurator2TM) if overshoot/ undershoot is occurring.	Adjust the response of auto tuning and execute the gain adjustment again.
	The setting of [Pr. PB06 Load to [GF] motor inertia ratio/ load to motor mass ratio] is incorrect.	Check that the setting value of [Pr.PB06 Load to motor inertia ratio/load to motor mass ratio] and the actual load moment of inertia or load mass are matched.	Set it correctly.
	Capacity shortage or shortage of the maximum torque (thrust) due to too large load.	Check the instantaneous torque using status display if the maximum torque (maximum thrust) exceeds the torque limit value (thrust limit value).	Reduce the effective load ratio by increasing acceleration/ deceleration time and reducing load.
	The setting of the torque limit is incorrect.	Check the instantaneous torque using status display if the maximum torque (maximum thrust) exceeds the torque limit value (thrust limit value).	Review the torque limit setting.
	Backlash of the machine part is large.	Check if there is a backlash on the machine part.	Adjust the backlash on the coupling and machine part.
A communication with driver fails using setup software (MR Configurator2TM). (For details, refer to Help of setup software (MR Configurator2TM).)	The communication setting is incorrect.	Check the communication setting such as baud rate and ports.	Set the communication setting correctly.
	A model is being connected other than the model set in model selection.	Check if the model selection is set correctly.	Set the mode selection correctly.
	The driver was not set correctly.	Check the bottom of the USB (Universal Serial Bus) controller with the device manager of the personal computer if "MITSUBISHI MELSERVO USB Controller" is being displayed.	Delete an unknown device or other devices, cycle the power of the driver, and reset according to Found New Hardware Wizard.
	They are off-line status.	Check if they are off-line.	Set them to on-line.

Description	Cause	Checkpoint	Action
	They are off-line status.	Check if they are off-line.	Set them to on-line.
	A communication cable is malfunctioning.	Check if the communication cable is malfunctioning.	Replace the communication cable.
For a servo motor with an electromagnetic brake, the lock went out.	The electromagnetic brake is failure due to its life. For the life of electromagnetic brake, refer to "Servo Motor Instruction Manual (Vol. 3)".	Remove the servo motor and all wirings from the machine and check if the servo motor shaft can be rotated by hands. (If it is rotated by hands, the lock is failure.)	Replace the servo motor.
The coasting distance of the servo motor became longer.	The load was increased and permissible load to motor inertia ratio was exceeded.	Check if the load was increased.	Reduce the load.
	An external relay is malfunctioning. Or the wiring of MBR (Electromagnetic brake interlock) is incorrect.	Check the external relay and wirings connected to MBR (Electromagnetic brake interlock) if they are malfunctioning.	Replace the external relay. Or review the wiring.
	The electromagnetic brake is failure due to its life. For the life of electromagnetic brake, refer to "Servo Motor Instruction Manual (Vol. 3)".	Remove the servo motor and all wirings from the machine and check if the servo motor shaft can be rotated by hands. (If it is rotated by hands, the lock is failure.)	Replace the servo motor.
The program operation is not in progress.	The command speed of the positioning operation is low.	An abnormal value such as 0 [r/min] was set for specifying the servo motor speed.	Review the program.
	The program stops at the state of waiting for external signal on.V	A program input number set with SYNC command does not match with the actual inputted signal.	Review the program or signal to use.
A point table was executed but the operation did not start.	A positioning to the same position is repeated.	Multiple operation starts which have the same specified number of point table are in progress.	Review the setting of the point table or procedures of the operation.
		Positioning to a same point was endlessly repeated with automatic continuous operation "8, 9, 10, 11" was selected in sub functions of the point table operation.	Review the setting of the point table or procedures of the operation.

Description	Cause	Checkpoint	Action
RS-422 communication (Mitsubishi Electric generalpurpose AC servo protocol) is not established.	The driver is not set to RS-422 communication protocol.	Check if "communication protocol selection" in [Pr. PC71] is correctly set.	Select RS-422/RS-485 communication (Mitsubishi Electric general-purpose AC servo protocol).
	The communication setting is not set correctly.	Check if [Pr. PC20 Station number setting] is set correctly.	Check [Pr. PC20 Station number setting] and the station No. specified by the controller if they are matched together.
		Check if "RS-422 communication baud rate selection" in [Pr. PC21] is set correctly.	Check "RS-422 communication baud rate selection" and the communication baud rate setting of the controller if they are matched together.
	A communication cable is malfunctioning	Check if the communication cable has any failure such as damage.	Replace the communication cable.

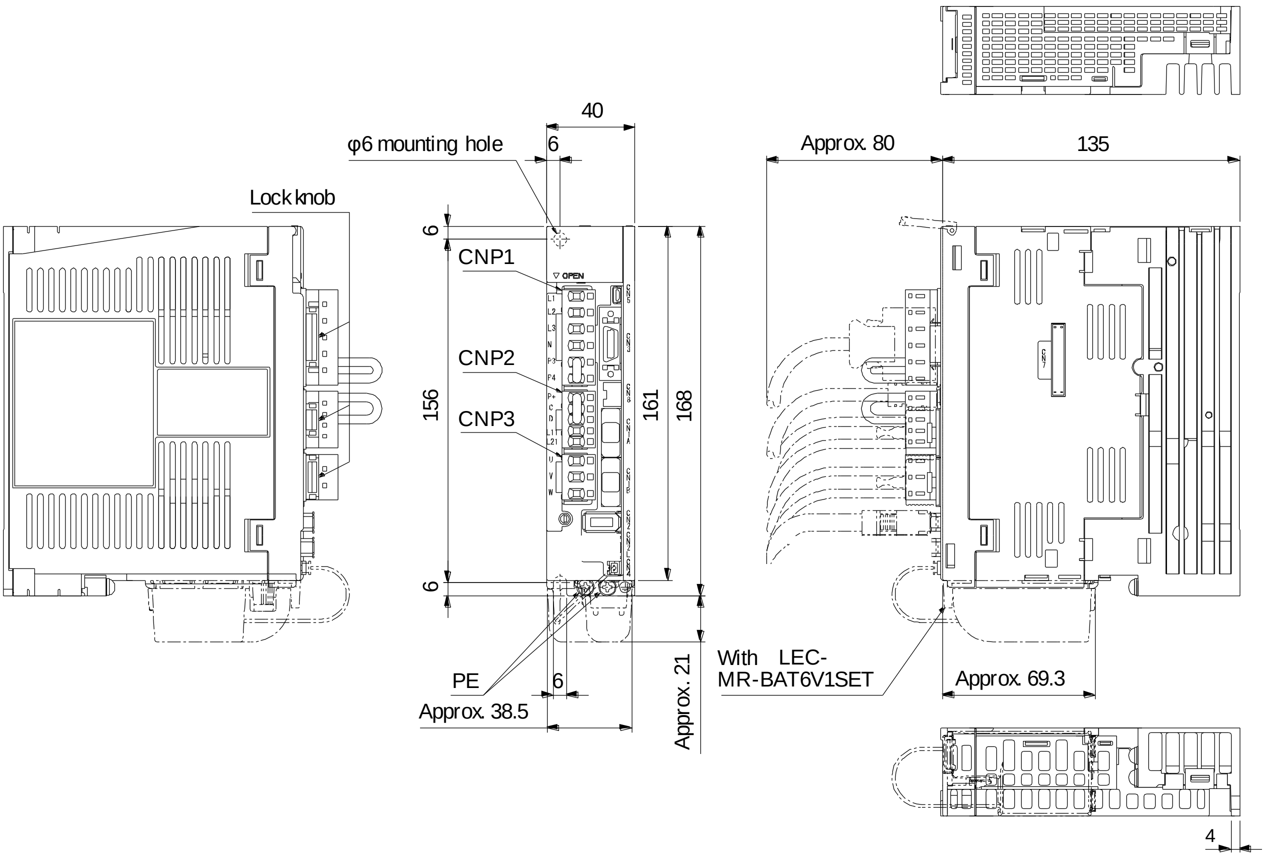
9. OUTLINE DRAWINGS

9. OUTLINE DRAWINGS

9.1 Driver

(1) LECSB2-T5/LECSB2-T7

[Unit: mm]



Mass: 0.8 [kg]

Mounting screw

Screw size: M5

Tightening torque: 3.24 [N m]

Terminal

CNP1

L1
L2
L3
N-
P3
P4

CNP2

P+
C
D
L11
L21

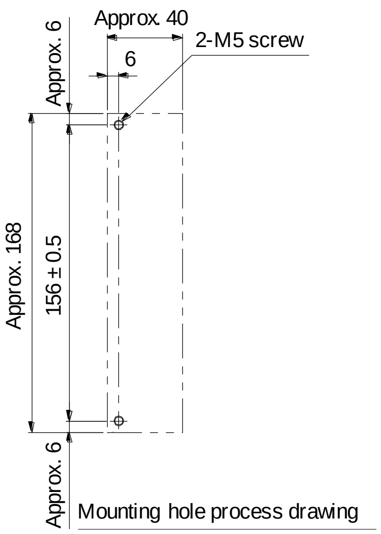
CNP3

U
V
W

PE

Screw size: M4

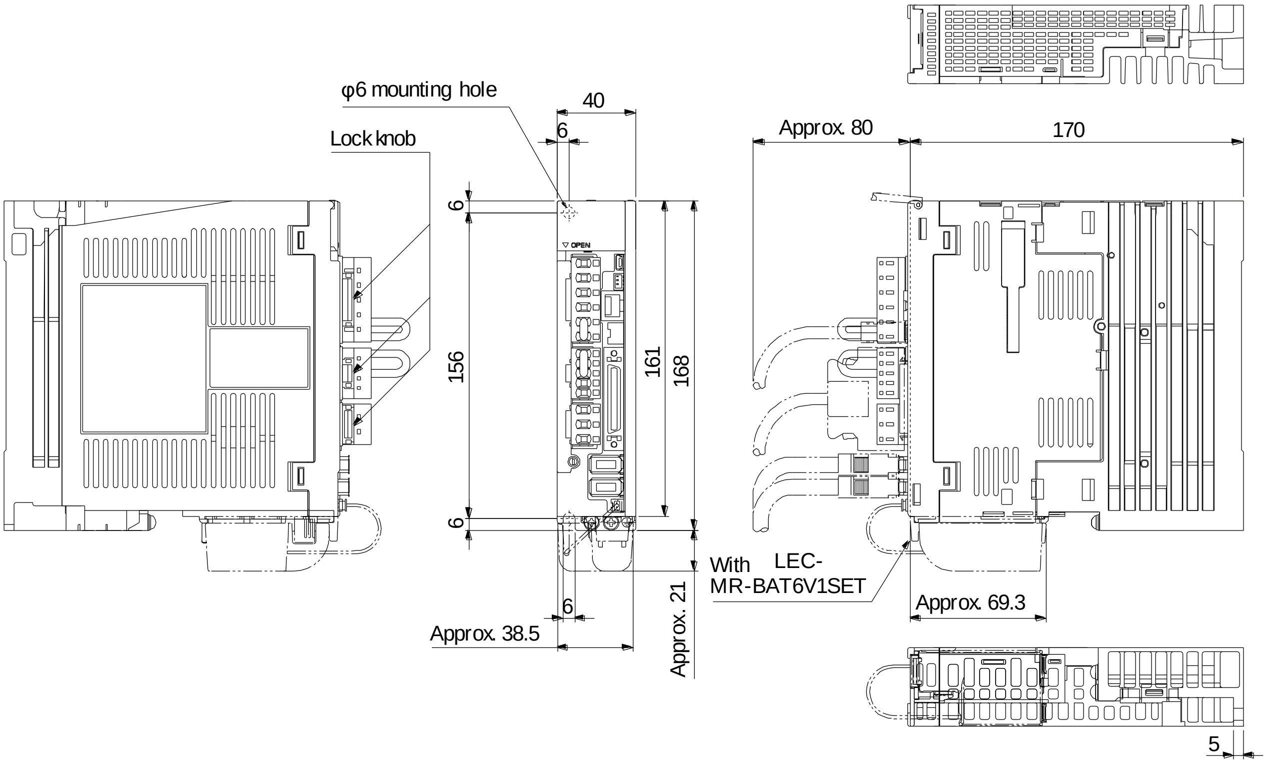
Tightening torque: 1.2 [N m]



Mounting hole process drawing

(2) LECSB2-T8

[Unit: mm]



Mass: 1.0 [kg]

Mounting screw

Screw size: M5

Tightening torque: 3.24 [N m]

Terminal

CNP1

L1
L2
L3
N-
P3
P4

CNP2

P+
C
D
L11
L21

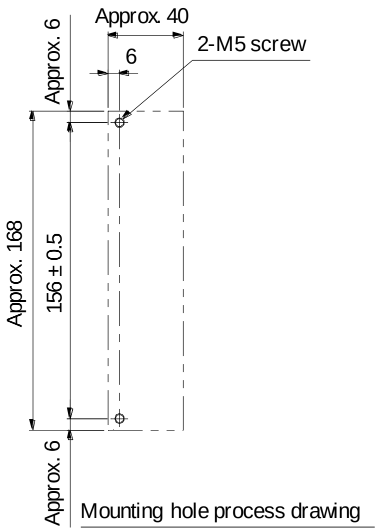
CNP3

U
V
W

PE

Screw size: M4

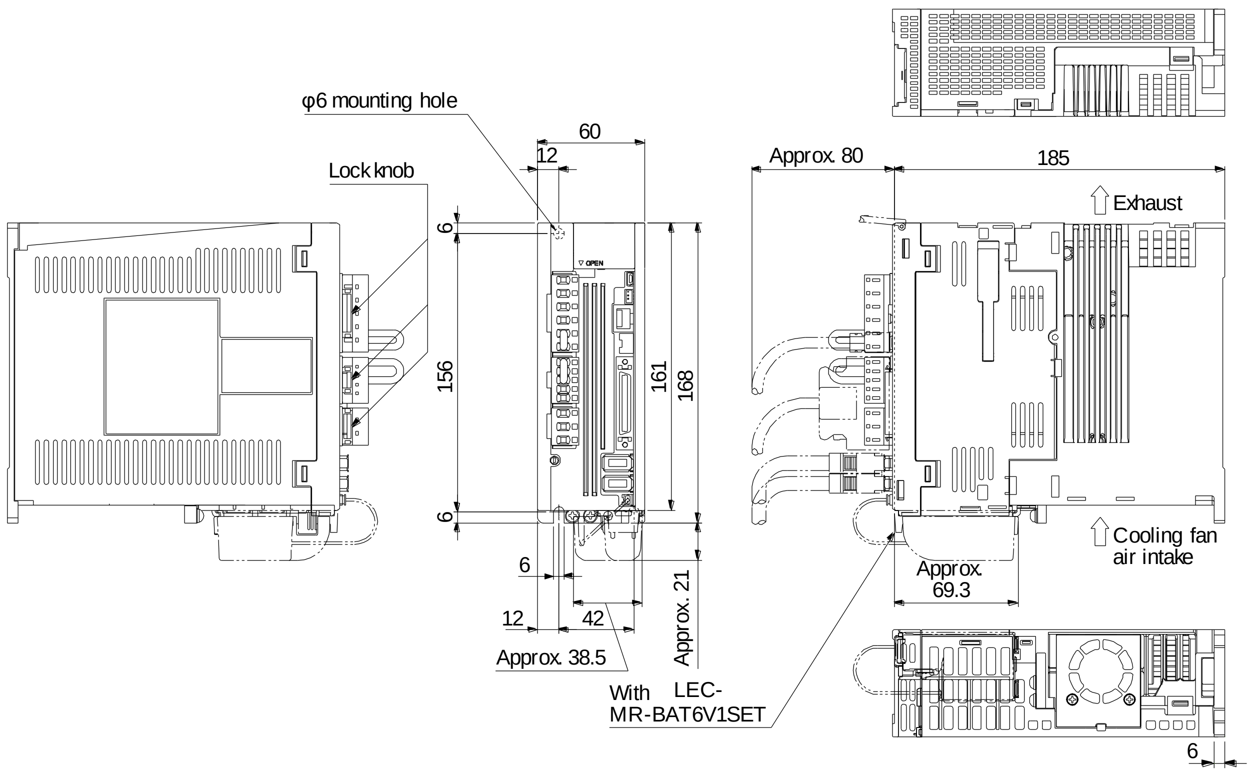
Tightening torque: 1.2 [N m]



Mounting hole process drawing

(3) LECSB2-T9

[Unit: mm]



Mass: 1.4 [kg]

Mounting screw
Screw size: M5
Tightening torque: 3.24 [N m]

Terminal

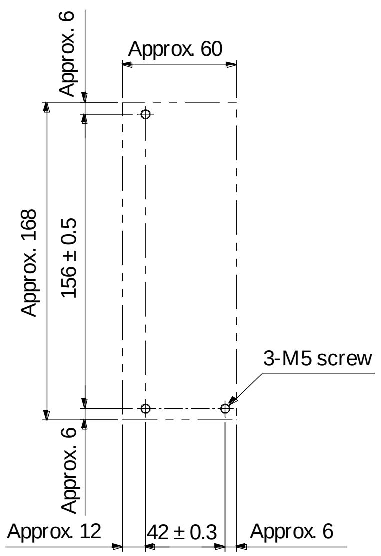
CNP1
L1
L2
L3
N-
P3
P4

CNP2
P+
C
D
L11
L21

CNP3
U
V
W

PE

Screw size: M4
Tightening torque: 1.2 [N m]

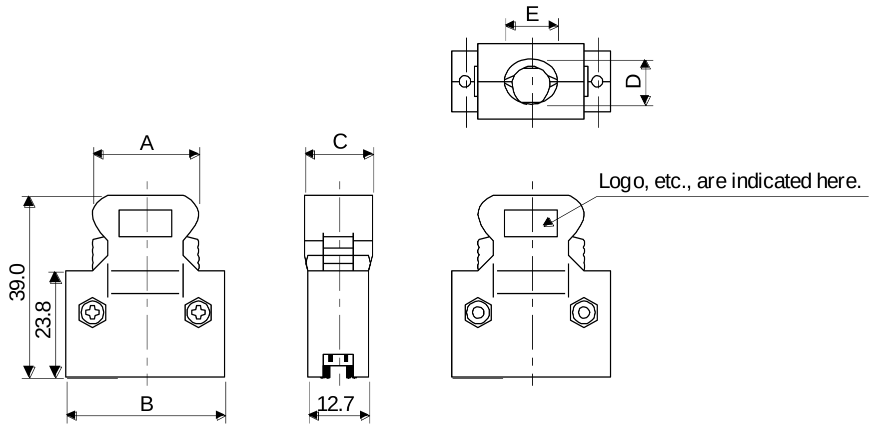


Mounting hole process drawing

9.2 Connector

(1) LE-CSNB connector

[Unit: mm]



Connector	Shell kit	Variable dimensions				
		A	B	C	D	E
10150-3000PE	10350-52F0-008	41.1	52.4	18.0	14.0	17.0

Accept wire : AWG 24, 26, 28, 30

10. CHARACTERISTICS

10. CHARACTERISTICS

10.1 Overload protection characteristics

An electronic thermal is built in the driver to protect the servo motor, driver and servo motor power wires from overloads.

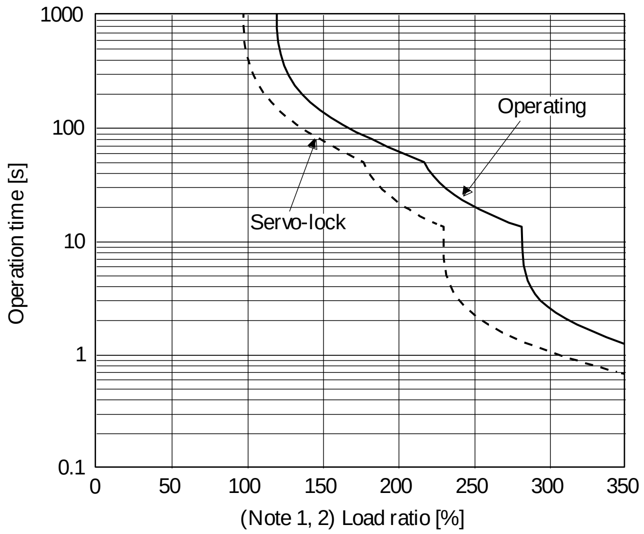
[AL. 50 Overload 1] occurs if overload operation performed is above the electronic thermal protection curve shown in fig. 10.1 [AL. 51 Overload 2] occurs if the maximum current is applied continuously for several seconds due to machine collision, etc. Use the equipment on the left-hand side area of the continuous or broken line in the graph.

For the system where the unbalanced torque occurs, such as a vertical axis system, the unbalanced torque of the machine should be kept at 70% or less of the rated torque.

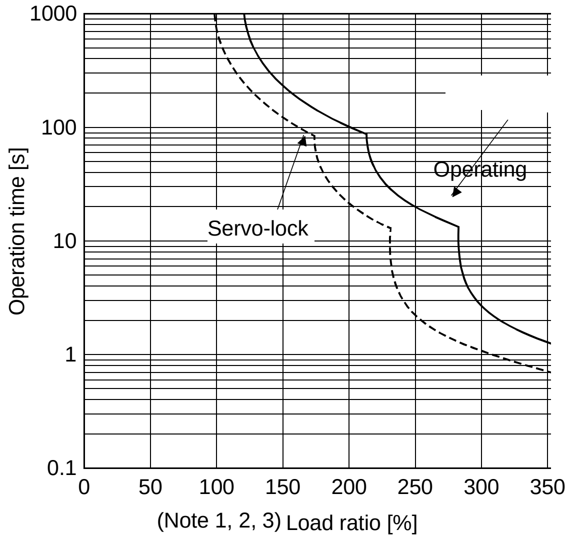
This driver has solid-state servo motor overload protection. (The servo motor overload current (full load current) is set on the basis of 120% rated current of the driver.)

The following table shows combinations of each servo motor and graph of overload protection characteristics.

The following graphs show overload protection characteristics.



LECSB2-T5



LECSB2-T7, LECSB2-T8, LECSB2-T9

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 50 r/min or less low-speed operation status, the driver may malfunction regardless of the electronic thermal protection.

2. The load ratio ranging from 300% to 350% applies to the LE-T□-□ servo motor.

Fig. 10.1 Electronic thermal protection characteristics

10.2 Power supply capacity and generated loss

(1) Amount of heat generated by the driver

Table 10.1 indicates drivers' power supply capacities and losses generated under rated load. For thermal design of an enclosed type cabinet, use the values in the table 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 rated speed, the power supply capacity will be smaller than the value in the table, but the driver's generated heat will not change.

Table 10.1 Power supply capacity and generated loss per servo motor 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 output	With servo-off	
LECSB2-T5	LE-T6-□	0.3	25	15	0.5
LECSB2-T7	LE-T7-□	0.5	25	15	0.5
LECSB2-T8	LE-T8-□	0.9	35	15	0.7
LECSB2-T9	LE-T9-□	1.3	50	15	1.0

Note 1. Note that the power supply capacity will vary according to the power supply impedance.
2. Heat generated during regeneration is not included in the driver-generated heat.

(2) Heat dissipation area for an enclosed type cabinet

The enclosed type cabinet (hereafter called the cabinet) which will contain the driver should be designed to ensure that its temperature rise is within +10 °C at the ambient temperature of 40 °C. (With an approximately 5 °C safety margin, the system should operate within a maximum 55 °C limit.) The necessary cabinet heat dissipation area can be calculated by equation 10.1.

$$A = \frac{P}{K \cdot \Delta T} \quad \cdots\cdots (10.1)$$

A: Heat dissipation area [m^2]
P: Loss generated in the cabinet [W]
ΔT: Difference between internal and ambient temperatures [°C]
K: Heat dissipation coefficient [5 to 6]

When calculating the heat dissipation area with equation 10.1, assume that P is the sum of all losses generated in the cabinet. Refer to table 10.1 for heat generated by the driver. "A" indicates the effective area for heat dissipation, but if the cabinet is directly installed on an insulated wall, that extra amount must be added to the cabinet's surface area. The required heat dissipation area will vary with the conditions in the cabinet. If convection in the cabinet is poor and heat builds up, effective heat dissipation will not be possible. Therefore, arrangement of the equipment in the cabinet and the use of a cooling fan should be considered. Table 10.1 lists the cabinet dissipation area for each driver (guideline) when the driver is operated at the ambient temperature of 40 °C under rated load.

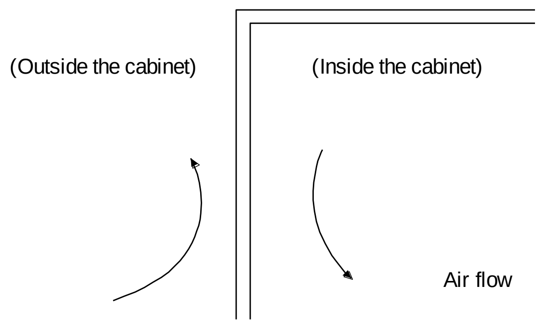


Fig. 10.2 Temperature distribution in an enclosed type cabinet

When air flows along the outer wall of the cabinet, effective heat exchange will be possible, because the temperature slope inside and outside the cabinet will be steeper.

10.3 Dynamic lock characteristics

⚠CAUTION	●The coasting distance is a theoretically calculated value which ignores the running load such as friction. The calculated value will be longer than the actual distance. If an enough braking distance is not provided, a moving part may crash into the stroke end, which is very dangerous. Install the anti-crash mechanism such as an air lock or an electric/mechanical stopper such as a shock absorber to reduce the shock of moving parts.

POINT

- ●Do not use dynamic lock to stop in a normal operation as it is the function to stop in emergency.
- ●For a machine operating at the recommended load to motor inertia ratio or less, the estimated number of usage times of the dynamic lock is 1000 times while the machine decelerates from the rated speed to a stop once in 10 minutes.
- ●Be sure to enable EM1 (Forced stop 1) after servo motor stops when using EM1 (Forced stop 1) frequently in other than emergency.
- ●Servo motors for LECSB2-T□ may have the different coasting distance from that of the previous model.
- ●The electronic dynamic lock operates in the initial state for the servo motors of 400 W or smaller capacity. The time constant "τ" for the electronic dynamic lock will be shorter than that of normal dynamic lock. Therefore, coasting distance will be longer than that of normal dynamic lock. For how to set the electronic dynamic lock, refer to [Pr. PF06] and [Pr. PF12].

10.3.1 Dynamic lock operation

(1) Calculation of coasting distance

Fig. 10.3 shows the pattern in which the servo motor comes to a stop when the dynamic lock is operated. Use equation 10.2 to calculate an approximate coasting distance to a stop. The dynamic lock time constant τ varies with the servo motor and machine operation speeds. (Refer to (2) of this section.)

A working part generally has a friction force. Therefore, actual coasting distance will be shorter than a maximum coasting distance calculated with the following equation.

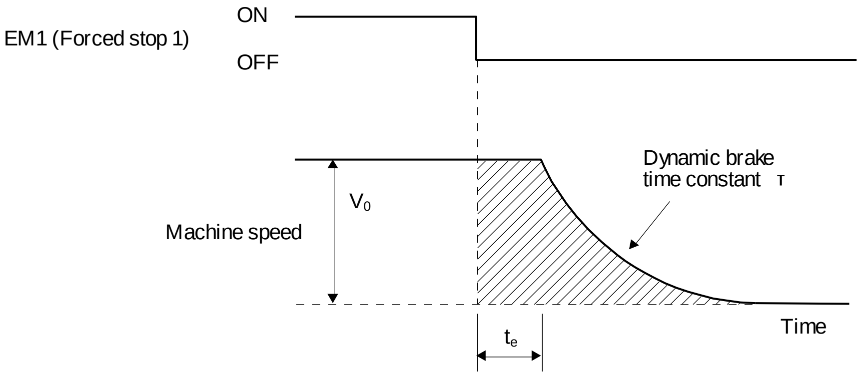


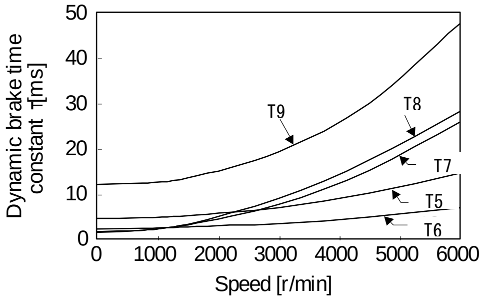
Fig. 10.3 Dynamic lock operation diagram

$$L_{max} = \frac{V_0}{60} \cdot \left\{ t_e + \tau \left(1 + \frac{J_L}{J_M} \right) \right\} \quad \cdots\cdots (10.2)$$

L_{max}: Maximum coasting distance ··· [mm]
V_0: Machine's fast feed speed ·· [mm/min]
J_M: Moment of inertia of the servo motor ··· [$\times 10^{-4}$ kg•m^2]
J_L: Load moment of inertia converted into equivalent value on servo motor shaft ·············· [$\times 10^{-4}$ kg•m^2]
τ: Dynamic lock time constant ·· [s]
t_e: Delay time of control section ·· [s]
There is internal relay delay time of about 10 ms.

(2) Dynamic lock time constant

The following shows necessary dynamic lock time constant τ for equation 10.2.



LE-T□-□

10.3.2 Permissible load to motor inertia when the dynamic lock is used

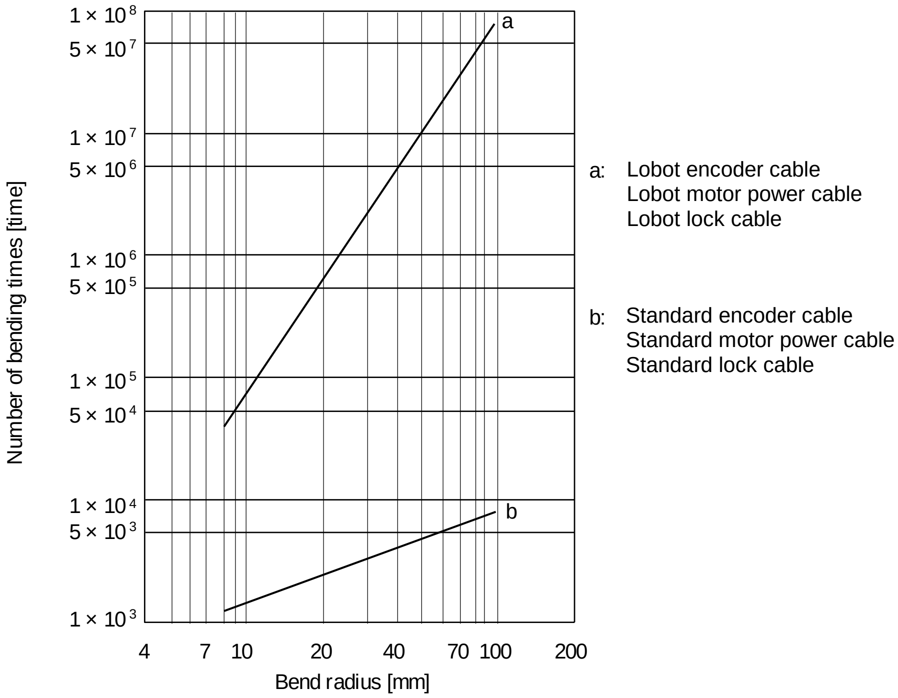
Use the dynamic lock under the load to motor inertia ratio indicated in the following table. If the load inertia moment is higher than this value, the dynamic lock may burn. If the load to motor inertia ratio exceeds the indicated value, contact your local sales office.

The values of the permissible load to motor inertia ratio in the table are the values at the maximum rotation speed of the servo motor. The value in the parenthesis shows the value at the rated speed.

Servo motor	Permissible load to motor inertia ratio [multiplier]
LE-T6-□	30
LE-T7-□	
LE-T8-□	
LE-T9-□	

10.4 Cable bending life

The bending 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.



10.5 Inrush currents at power-on of main circuit and control circuit

POINT
●For a driver of LECSB2-T8 or less, the inrush current values can change depending on frequency of turning on/off the power and ambient temperature.

Since large inrush currents flow in the power supplies, always use molded-case circuit breakers and magnetic contactors. (Refer to section 11.6.)
When circuit protectors are used, it is recommended that the inertia delay type, which is not tripped by an inrush current, be used.

The following table indicates the inrush currents (reference data) that will flow when 240 V AC is applied at the power supply capacity of 2500 kVA and the wiring length of 1 m. Even when you use a 1-phase 200 V AC power supply with LECSB2-T5 to LECSB2-T9, the inrush currents of the main circuit power supply is the same.

Driver	Inrush currents (A_{0-P})	
	Main circuit power supply (L1, L2, and L3)	Control circuit power supply (L11 and L21)
LECSB2-T5/ LECSB2-T7/ LECSB2-T8	30 A (attenuated to approx. 3 A in 20 ms)	20 A to 30 A (attenuated to approx. 1 A in 20 ms)
LECSB2-T9	34 A (attenuated to approx. 7 A in 20 ms)	

11. OPTIONS AND PERIPHERAL EQUIPMENT

⚠WARNING	●Before connecting any option or peripheral equipment, turn off the power and wait for 15 minutes or more 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, when confirming whether the charge lamp is off or not, always confirm it from the front of the driver.

⚠CAUTION	●Use the specified peripheral equipment and options to prevent a malfunction or a fire.

POINT

●We recommend using HIV wires to wire the drivers, options, and peripheral equipment. Therefore, the recommended wire sizes may differ from those used for the previous drivers.

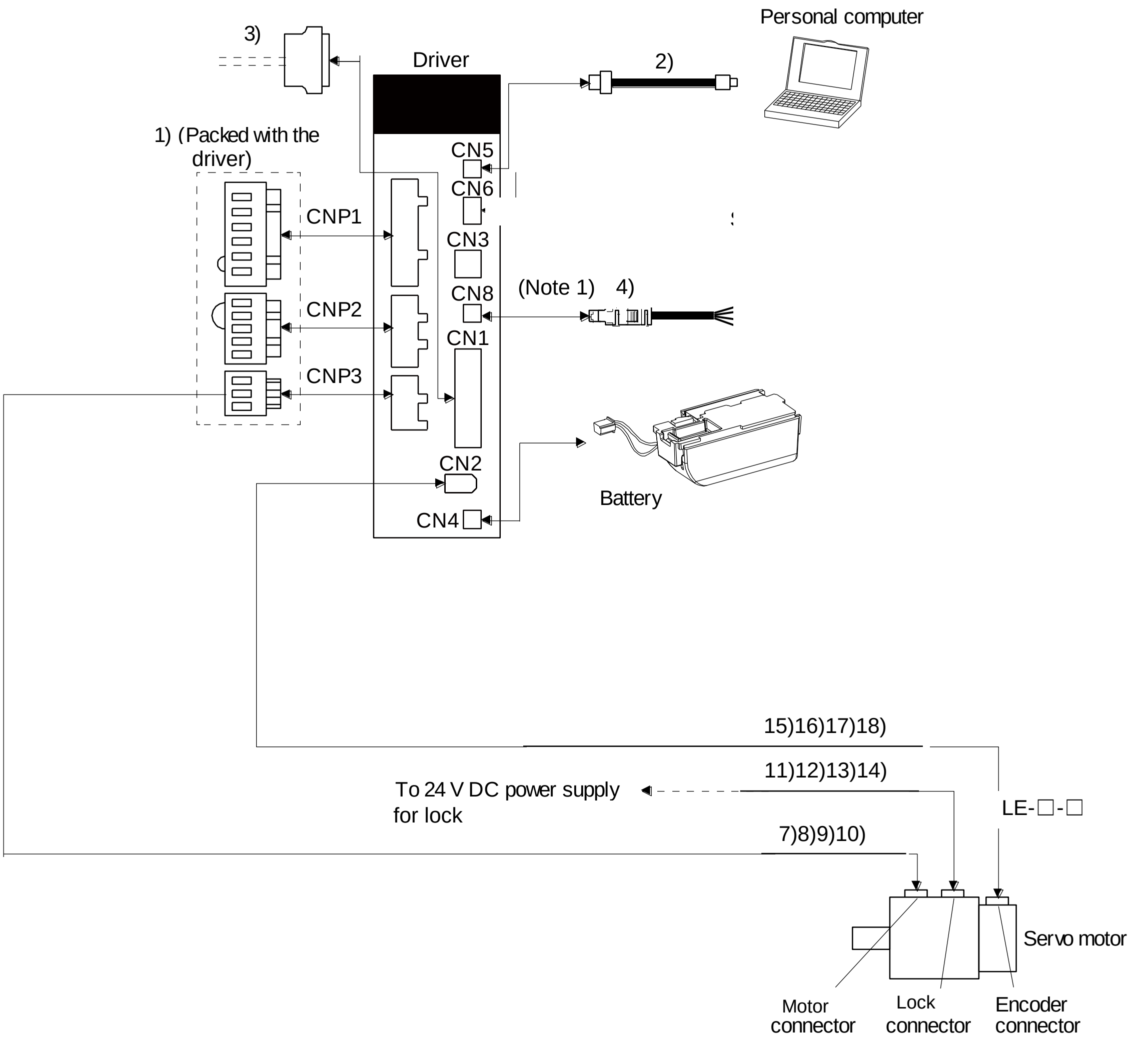
11.1 Cable/connector sets

POINT

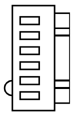
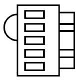
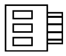
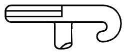
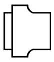
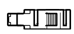
●The IP rating indicated for cables and connectors is their protection against ingress of dust and raindrops when they are connected to a driver or servo motor. If the IP rating of the cable, connector, driver and servo motor vary, the overall IP rating depends on the lowest IP rating of all components.

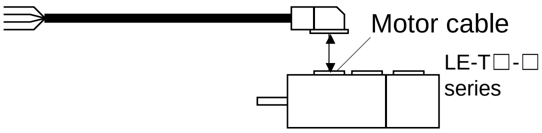
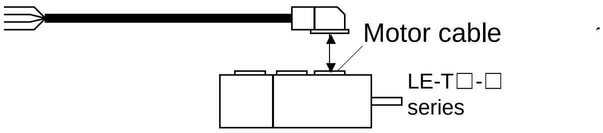
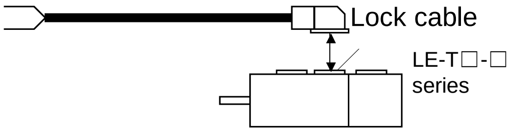
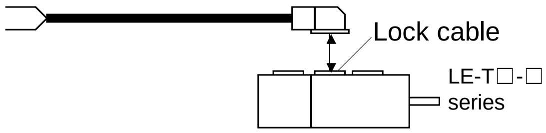
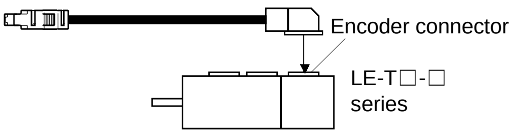
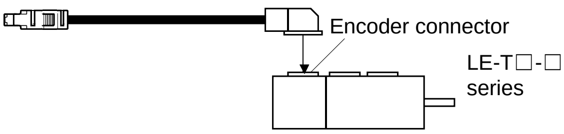
Please purchase the cable and connector options indicated in this section.

11.1.1 Combinations of cable/connector sets
For LECSB2-T□ driver



Note 1. When not using the STO function, attach the short-circuit connector (4)) came with a driver.

No.	Product name	Model	Description	Application
1)	Driver power connector set		   CNP1 Connector: K05A01490216 (MITSUBISHI ELECTRIC SYSTEM & SERVICE CO., LTD) (Open tool comes with) CNP2 Connector: K05A01490209 (MITSUBISHI ELECTRIC SYSTEM & SERVICE CO., LTD) CNP3 Connector: K05A01490210 (MITSUBISHI ELECTRIC SYSTEM & SERVICE CO., LTD) Applicable wire size: 0.8 mm^2 to 2.1 mm^2 (AWG 18 to 14) Insulator OD: to 3.9 mm  Open tool (CNP1 Connector comes with)	Supplied with drivers of 750 W or less
2)	USB cable	LEC-MR-J3USB Cable length: 3 m	CN5 connector mini-B connector (5 pins) Personal computer connector A connector 	For connection with PC-AT compatible personal computer
3)	Connector set	LE-CSNS	 Connector: 10120-3000PE Shell kit: 10320-52F0-008 (Sumitomo 3M Limited or equivalent)	
4)	STO cable	LEC-MR-D05UDL3M	Connector set: 2069250-1 (TE Connectivity) 	Connection cable for the CN8 connector
5)	Short-circuit connector			Supplied with driver

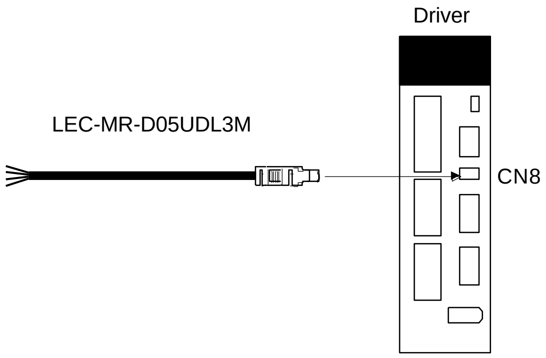
No.	Product name	Model	Description	Application
7)	Motor power supply cable	LE-CSM-S□A Cable length: 2・5・10m		IP65 Load side lead
8)	Motor power supply cable	LE-CSM-R□A Cable length: 2・5・10m		IP65 Load side lead Robot cable
9)	Motor power supply cable	LE-CSM-S□B Cable length: 2・5・10m		IP65 Opposite-to-load side lead
10)	Motor power supply cable	LE-CSM-R□B Cable length: 2・5・10m		IP65 Opposite-to-load side lead Robot cable
11)	Lock cable	LE-CSB-S□A Cable length: 2・5・10m		IP65 Load side lead
12)	Lock cable	LE-CSB-R□A Cable length: 2・5・10m		IP65 Load side lead Robot cable
13)	Lock cable	LE-CSB-S□B Cable length: 2・5・10m		IP65 Opposite-to-load side lead
14)	Lock cable	LE-CSB-R□B Cable length: 2・5・10m		IP65 Opposite-to-load side lead Robot cable
15)	Encoder cable	LE-CSE-S□A Cable length: 2・5・10m		IP65 Load side lead
16)	Encoder cable	LE-CSE-R□A Cable length: 2・5・10m		IP65 Load side lead Robot cable
17)	Encoder cable	LE-CSE-S□B Cable length: 2・5・10m		IP65 Opposite-to-load side lead
18)	Encoder cable	LE-CSE-R□B Cable length: 2・5・10m		IP65 Opposite-to-load side lead Robot cable

11.1.2 STO cable

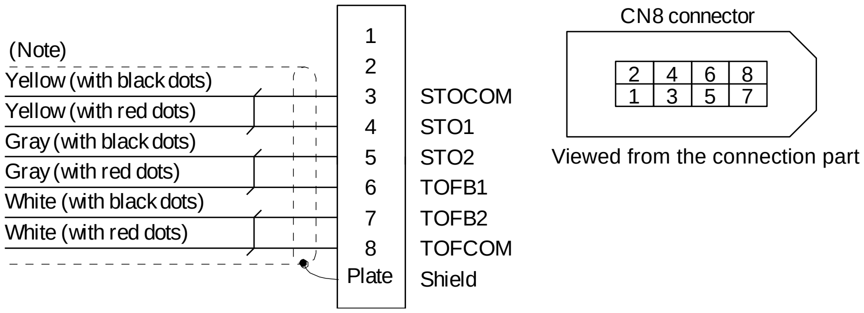
This cable is for connecting an external device to the CN8 connector.

Cable model	Cable length	Application
LEC-MR-D05UDL3M	3 m	Connection cable for the CN8 connector

(1) Configuration diagram



(2) Internal wiring diagram



Note. Do not use the two core wires with orange insulator (with red or black dots).

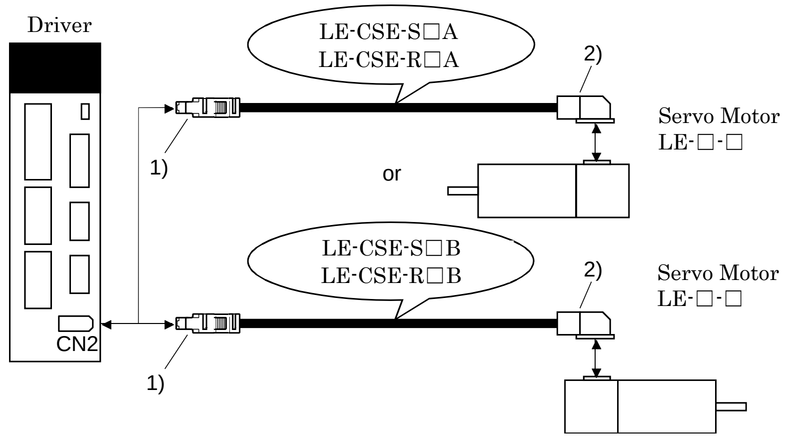
11.1.3 Encoder cable/connector sets

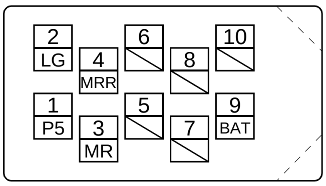
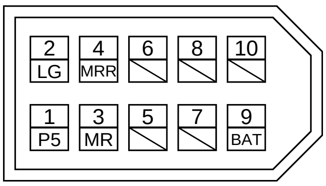
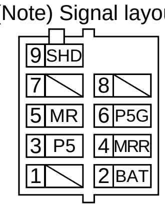
(1) LE-CSE- □□A・LE-CSE-□□B

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.

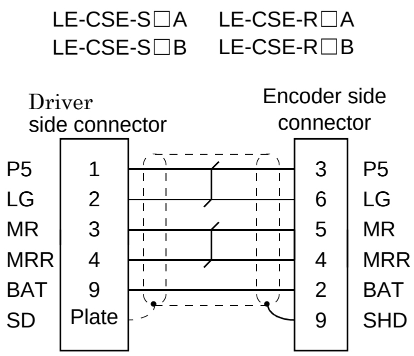
Cable model	Cable length			Protective structure	Flex life	Application
	2m	5m	10m			
LE-CSE-S□A	2	5	A	IP65	Standard	For LE-□-□ servo motor Axis side lead
LE-CSE-R□A	2	5	A	IP65	Robot cable	
LE-CSE-S□B	2	5	A	IP65	Standard	For LE-□-□ servo motor Counter axis side lead
LE-CSE-R□B	2	5	A	IP65	Robot cable	

(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) Connector set: 54599-1019(Molex) (Note) Signal layout  View seen from wiring side. or (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

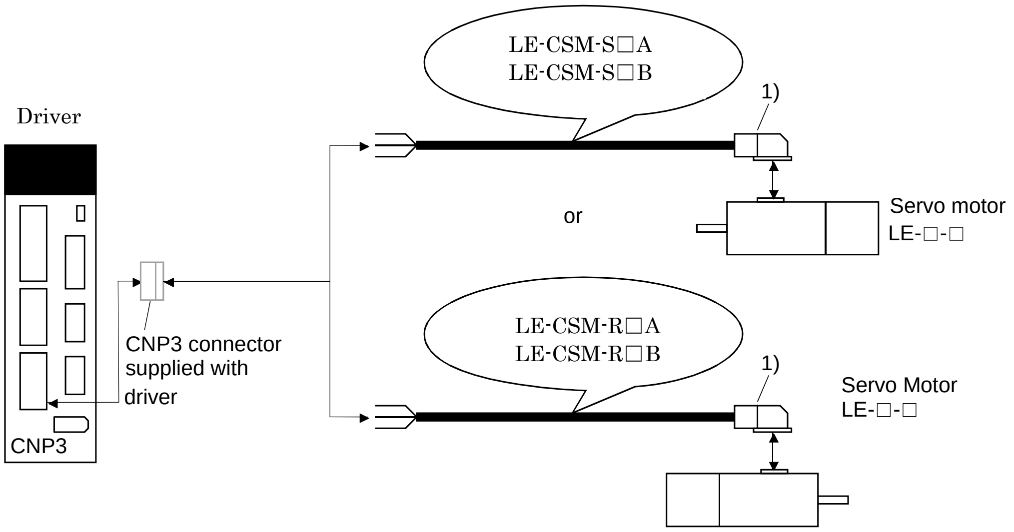


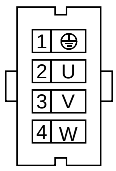
11.1.4 Motor cables

These cables are motor power supply 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-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

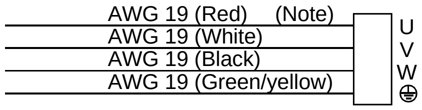


Cable model	1) For motor power supply connector	
LE-CSM−S□A	Connector: JN4FT04SJ1-R Hood, socket insulator Bushing, ground nut Contact: ST-TMH-S-C1B-100-(A534G) Crimping tool: CT160-3-TMH5B (Japan Aviation Electronics Industry)	Signal layout  View seen from wiring side.
LE-CSM−S□B		
LE-CSM-R□A		
LE-CSM−R□B		

(2) Internal wiring diagram

LE-CSM-S□A
LE-CSM-S□B

LE-CSM-R□A
LE-CSM-R□B



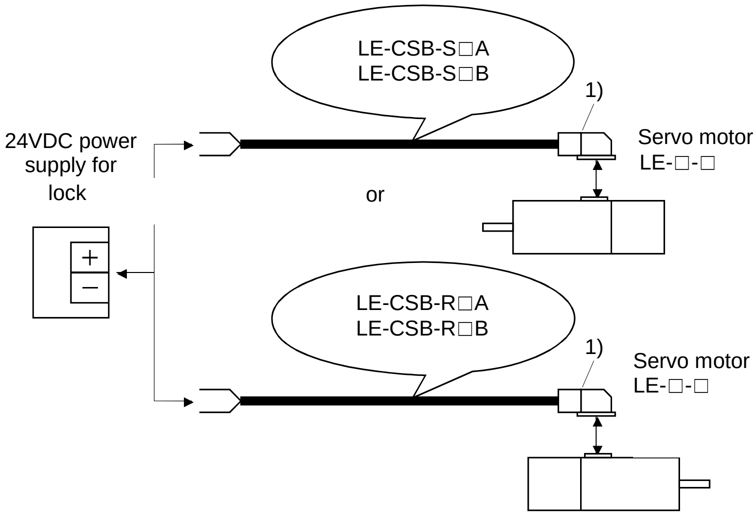
Note. These are not shielded cables.

11.1.5 Lock cables

These cables 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.

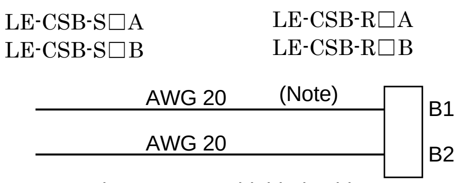
Cable model	Cable length			Protective structure	Flex life	Application
	2m	5m	10m			
LE-CSB-S□A	2	5	A	IP65	Standard	For LE-□-□ servo motor Axis side lead
LE-CSB-S□B	2	5	A	IP65	Standard	For LE-□-□ servo motor Counter axis side lead
LE-CSB-R□A	2	5	A	IP65	Robot cable	For LE-□-□ servo motor Axis side lead
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 lock 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 1 B1 2 B2 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.

11.2 Regenerative options

> ⚠CAUTION
> ●Do not use drivers with regenerative options other than the combinations specified below.
> Otherwise, it may cause a fire.

11.2.1 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 [40 Ω]	LEC-MR-RB-12 [40 Ω]
LECSB2-T5		30	
LECSB2-T7	10	30	100
LECSB2-T8	10	30	100
LECSB2-T9	20	30	100

11.2.2 Parameter setting

Set [Pr. PA02] according to the option to be used.

[Pr. PA02]

0	0		

Regenerative option selection
00: Regenerative option is not used.
・For driver of 100 W, regenerative resistor is not used.
・For driver of 200 W to 750W, built-in regenerative resistor is used.
02: LEC-MR-RB-032
03: LEC-MR-RB-12

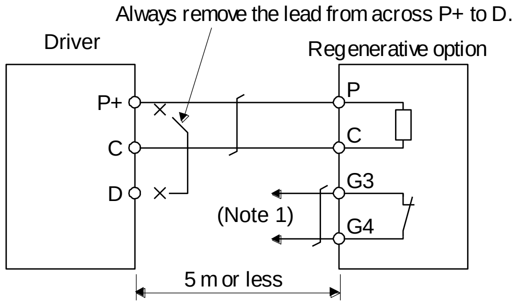
11.2.3 Selection of regenerative option

POINT
●For the wire sizes used for wiring, refer to section 11.5.

The regenerative option generates heat of 100 °C higher than the ambient temperature. Fully consider heat dissipation, installation position, wires used, etc. before installing the option. For wiring, use flame-resistant wires or make the wires flame-resistant and keep them away from the regenerative option. Always use twisted cables of max. 5 m length for connection with the driver.

(1) LECSB2-T□

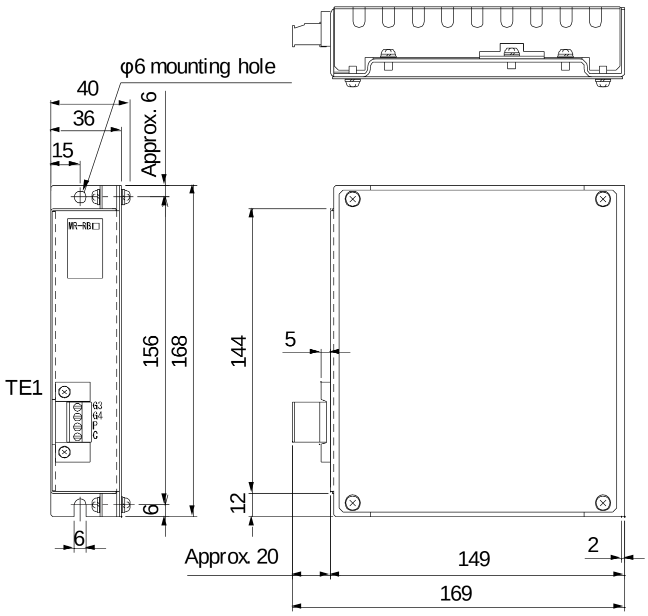
Always remove the wiring from across P+ to D and fit the regenerative option across P+ to C. G3 and G4 are thermal sensor's terminals. Between G3 and G4 is opened when the regenerative option overheats abnormally.



Note 1. Make up a sequence which will switch off the magnetic contactor when abnormal heating occurs.
G3-G4 contact specifications
Maximum voltage: 120 V AC/DC
Maximum current: 0.5 A/4.8 V DC
Maximum capacity: 2.4 VA

11.2.4 Dimensions

(1) LEC-MR-RB-12



▪ TE1 terminal

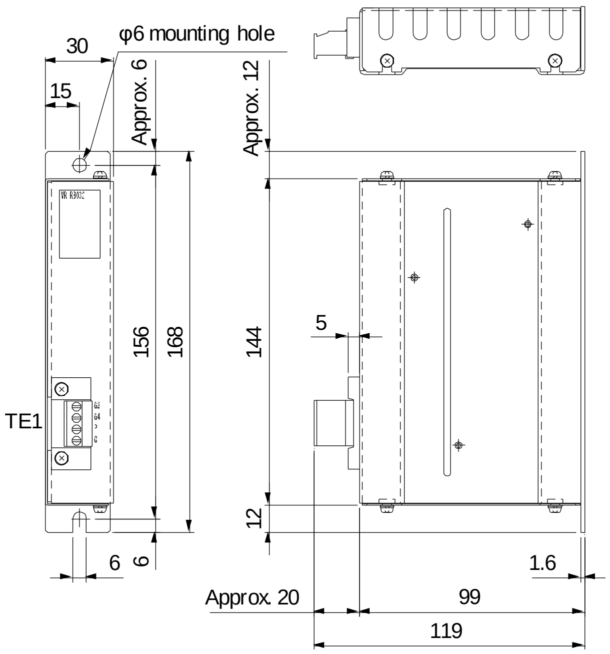
G3
G4
P
C

Applicable wire size: 0.2 mm² to 2.5 mm² (AWG 14 to 12)
Tightening torque: 0.5 to 0.6 [N•m]

▪ Mounting screw
Screw size: M5
Tightening torque: 3.24 [N•m]

Mass: 1.1 [kg]

(2) LEC-MR-RB-032



▪ TE1 terminal

G3
G4
P
C

Applicable wire size: 0.2 mm² to 2.5 mm² (AWG 24 to 12)
Tightening torque: 0.5 to 0.6 [N•m]

▪ Mounting screw
Screw size: M5
Tightening torque: 3.24 [N•m]

Mass: 0.5 [kg]

11.3 Setup software (MR Configurator2TM)

Setup software (MR Configurator2TM) (LEC-MRC2□) 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 Configurator2TM) is used, the selection of the model of LECSB□-T□ is needed. Please select 'MR-J4-A(-RJ)' by "Model" - "New" - "Project".
When using the point table pushing operation, refer to "LECSB2-T □ Operation Manual Chapter 17".

11.3.1 Specifications

Item	Description
Project	Create/read/save/delete project, system setting, and print
Parameter	Parameter setting
Monitor	Display all, I/O monitor, graph, and ABS data display
Diagnosis	Alarm display, alarm onset data, drive recorder, no motor rotation, system configuration, life diagnosis, and machine diagnosis
Test operation	JOG operation (Note 1), positioning operation, motor-less operation (Note), DO forced output, and program operation
Adjustment	One-touch tuning, tuning, and machine analyzer
Others	Servo assistant, parameter setting range update, machine unit conversion setting, and help display

11.3.2 System configuration

(1) Components

To use this setup 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

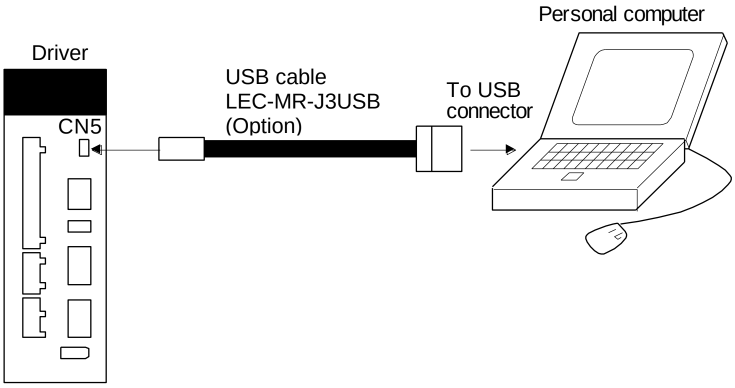
Note 1. Using a PC for setting Windows® 10, upgrade to version 1.52E.
Using a PC for setting Windows® 8.1, upgrade to version 1.25B.
Using a PC for setting Windows® 8, upgrade to version 1.20W.
Refer to Mitsubishi Electric Corporation's website for version upgrade information.

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).

(2) Connection with driver

For use of USB



11.3.3 Precautions for using USB communication function

Note the following to prevent an electric shock and malfunction of the driver.

(1) Power connection of personal computers

Connect your personal computer with the following procedures.

(a) When you use a personal computer with AC power supply

1) When using a personal computer with a three-core power plug or power plug with grounding wire, use a three-pin socket or ground the grounding wire.

2) When your personal computer has two-core plug and has no grounding wire, connect the personal computer to the driver with the following procedures.

a) Disconnect the power plug of the personal computer from an AC power socket.

b) Check that the power plug was disconnected and connect the device to the driver.

c) Connect the power plug of the personal computer to the AC power socket.

(b) When you use a personal computer with battery

You can use as it is.

(2) Connection with other devices using driver communication function

When the driver is charged with electricity due to connection with a personal computer and the charged driver is connected with other devices, the driver or the connected devices may malfunction. Connect the driver and other devices with the following procedures.

(a) Shut off the power of the device for connecting with the driver.

(b) Shut off the power of the driver which was connected with the personal computer and check the charge lamp is off.

(c) Connect the device with the driver.

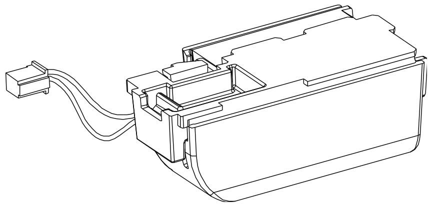
(d) Turn on the power of the driver and the device.

11.4 Battery (LEC-MR-BAT6V1SET)

POINT
●Refer to appendix 2 and 3 for battery transportation and the new EU Battery Directive.

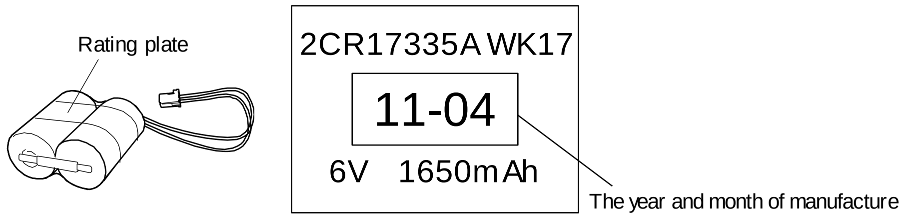
(1) Purpose of use for LEC-MR-BAT6V1SET

This battery is used to construct an absolute position detection system. Refer to section 12.3 for the fitting method, etc.



(2) Year and month of manufacture of battery

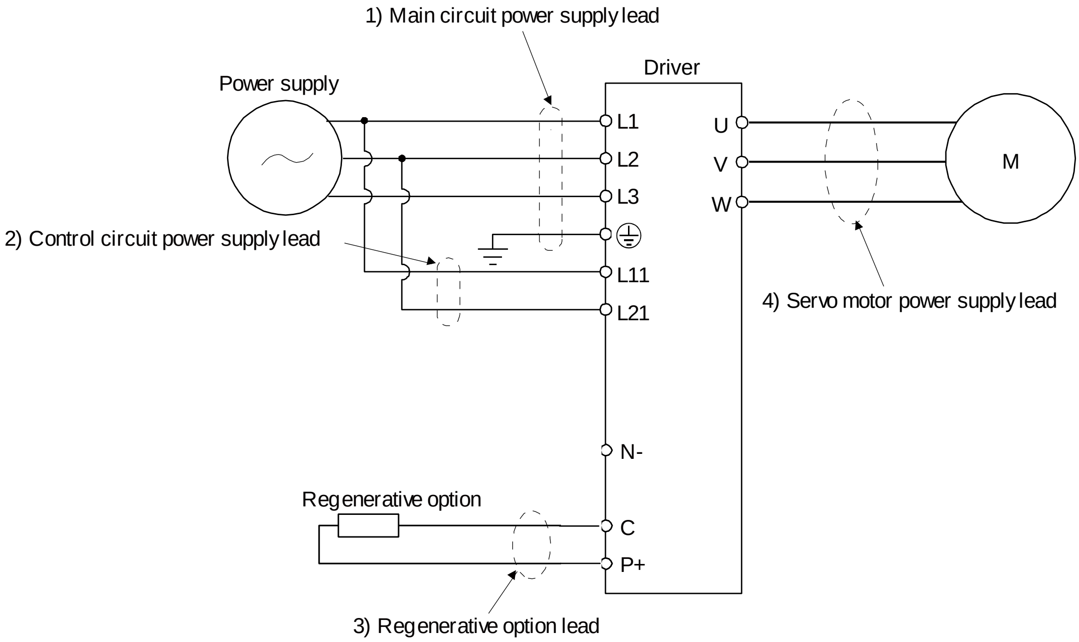
The year and month of manufacture of LEC-MR-BAT6V1SET have been described to the rating plate.



11.5 Selection example of wires

POINT
●To comply with the UL/CSA standard, use the wires shown in appendix 4 for wiring. To comply with other standards, use a wire that is complied with each standard. ●Selection conditions of wire size is as follows. Construction condition: One wire is constructed in the air. Wire length: 30 m or less

The following diagram shows the wires used for wiring. Use the wires given in this section or equivalent.



(1) Example of selecting the wire sizes

Use the 600 V Grade heat-resistant polyvinyl chloride insulated wire (HIV wire) for wiring. The following shows the wire size selection example.

Table 11.1 Wire size selection example (HIV wire)

Driver	Wire [mm^2]						
	L_1・L_2・L_3・⏚	(Note 1) L_{11}・L_{21}	(Note 2) U・V・W・⏚		P・C	(Note 3) B1・B2	
			10m or less	Extension cable		10m or less	Extension cable
LECSB2-T5	2(AWG14)	1.25(AWG16)	0.75(AWG18)	1.25(AWG16)	2(AWG14)	0.5(AWG20)	1.25(AWG16)
LECSB2-T7							
LECSB2-T8							
LECSB2-T9							

Note1. Use 2 mm^2 (AWG14) to comply with IEC/EN/UL/CSA standards.

Note2. Use 2 mm^2 (AWG14) to comply with IEC/EN/UL/CSA standards.

Note3. Use 1.25 mm^2 (AWG16) to comply with IEC/EN/UL/CSA standards.

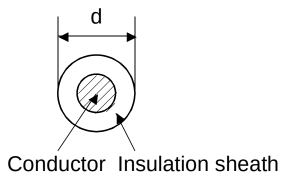
(2) Wires for cables

When fabricating a cable, use the wire models given in the following table or equivalent.

Table 11.3 Wires for option cables

Type	Model	Length [m]	Core size [mm²]	Number of Cores	Characteristics of one core			(Note 2) Finishing OD [mm]	Wire model
					Structure [Wires/mm]	Conductor resistance [Ω/km]	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	6.2±0.3	HRZFEV-A(CL3) AWG18 4 cores
	LE-CSM-S□B	2 to 10							
	LE-CSM-R□A	2 to 10	(Note 5) AWG19	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	HRZFEV-A(CL3) AWG20 2 cores
	LE-CSB-S□B	2 to 10							
	LE-CSB-R□A	2 to 10	Note 5) AWG20	2	110/0.08	39.0 or less	1.37	4.5±0.3	(Note 4) RMFES-A(CL3X) AWG20 2 cores
	LE-CSB-R□B	2 to 10							

Note 1. d is as shown below.



2. Standard OD. Max. OD is about 10% greater.
3. Purchased from Toa Electric Industry
4. Purchased from taisei
5. These wire sizes assume that the UL-compliant wires are used at the wiring length of 10m.

11.6 Molded-case circuit breakers, fuses, magnetic contactors (recommended)

(1) For main circuit power supply

To prevent the driver from smoke and a fire, select a molded-case circuit breaker which shuts off with high speed.

Always use one molded-case circuit breaker and one magnetic contactor with one driver.

When using a fuse instead of the molded-case circuit breaker, use the one having the specifications given in this section.

Driver	Molded-case circuit breaker (Note 1, 3)			Fuse			Magnetic contactor (Note 2)
	Frame, rated current		Voltage AC [V]	Class	Current [A]	Voltage AC [V]	
	Power factor Improving reactor is not used	Power factor Improving reactor is used					
LECSB2-T5	30 A frame 5 A		240	T	10	300	S-N10 (Mitsubishi Electric Corporation)
LECSB2-T7							
LECSB2-T8	30 A frame 10 A	30 A frame 5 A			15		
LECSB2-T9	30 A frame 15 A	30 A frame 10 A			20		

Note 1. When having the driver comply with the IEN/EN/UL/CSA standard, refer to app.4.
2. Use a magnetic contactor with an operation delay time (interval between current being applied to the coil until closure of contacts) of 80 ms or less.
3. Use a molded-case circuit breaker with equal or higher operating characteristics.

(2) For control circuit power supply

When the wiring for the control circuit power supply (L11, L21) is thinner than that for the main circuit power supply (L1, L2, L3), install an overcurrent protection device (molded-case circuit breaker or fuse) to protect the branch circuit.

Driver	Molded-case circuit breaker		Fuse (Class T)		Fuse (Class K5)	
	Frame, rated current	Voltage AC [V]	Current [A]	Voltage AC [V]	Current [A]	Voltage AC [V]
LECSB2-T5	30 A frame 5 A	240	1	300	1	250
LECSB2-T7						
LECSB2-T8						
LECSB2-T9						

11.7 Relay (recommended)

The following relays should be used with the interfaces

Interface	Selection example
Digital input (interface DI-1) Relay used for digital input command signals	To prevent defective contacts, use a relay for small signal (twin contacts). (Ex.) Omron : type G2A, MY
Digital output (interface DO-1) Relay used for digital output signals	Small relay with 12 V DC or 24 V DC of rated current 40 mA or less (Ex.) Omron : type MY

11.8 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 equipment 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 equipment 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 bundling power lines (input/output) and signal cables together or running them in parallel to each other. Separate the power lines from the signal cables.
- Use a shielded twisted pair cable for connection with the encoder and for control signal transmission, and connect the external conductor of the cable to the SD terminal.
- Ground the driver, servo motor, etc. together at one point. (Refer to section 3.11.)

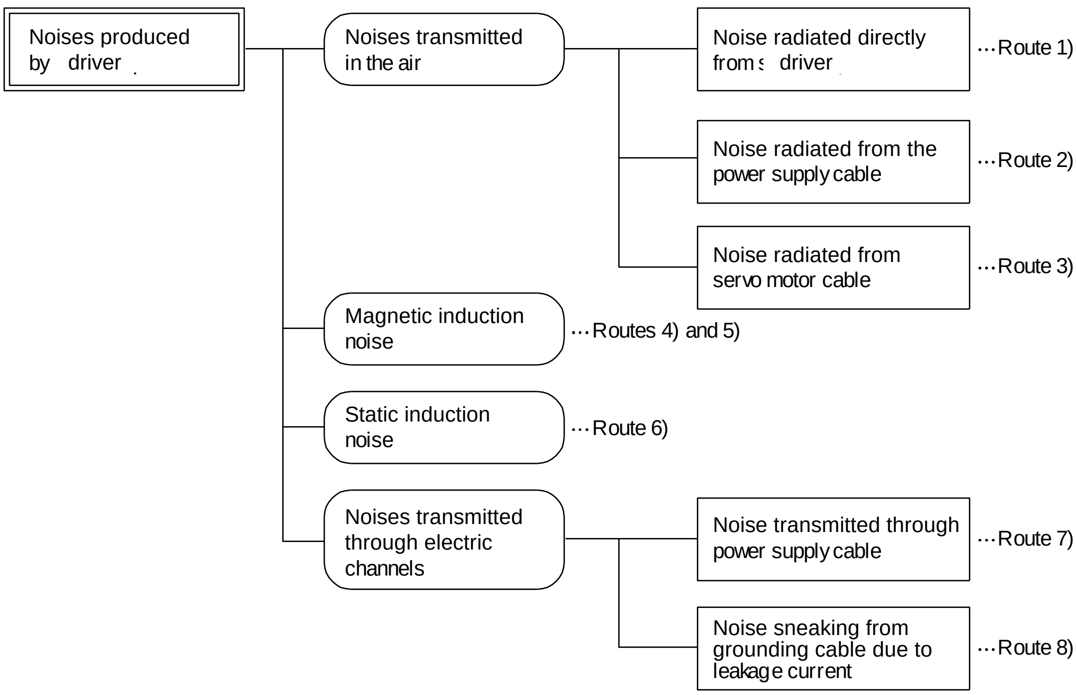
(b) Reduction techniques for external noises that cause the driver to malfunction

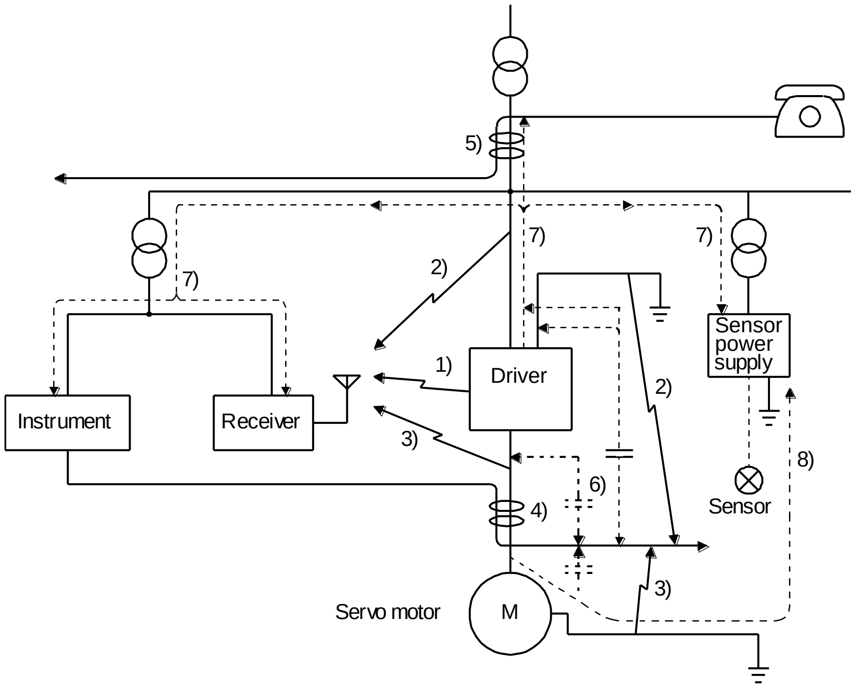
If there are noise sources (such as a magnetic contactor, a lock, and many relays which make a large amount of noise) near the driver and the driver may malfunction, the following countermeasures are required.

- 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 equipment 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 equipment 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 cabinet 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 wiring the power lines (input/output lines of the driver) and signal lines 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 the signal and power lines, or put the lines in separate metal conduits.
4) 5) 6)	When the power lines and the signal lines 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 wiring the power lines (input/output lines of the driver) and signal lines side by side or bundling them together. 4. Use shielded wires for the signal and power lines, or put the lines in separate metal conduits.
7)	When the power supply of peripheral equipment 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. Install the radio noise filter (FR-BIF of Mitsubishi Electric Corparation) on the power lines (Input lines) of the driver. 2. Install the line noise filter (FR-BSF01/FR-BLF of Mitsubishi Electric Corparation) on the power lines of the driver.
8)	When the cables of peripheral equipment are connected to the driver to make a closed loop circuit, leakage current may flow to malfunction the peripheral equipment. If so, malfunction may be prevented by disconnecting the grounding cable of the peripheral device.

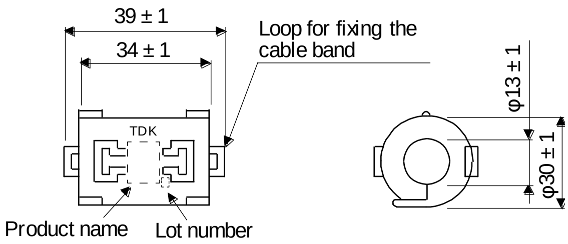
(2) Noise reduction techniques

(a) Data line filter (recommended)

Noise can be prevented by installing a data line filter onto the encoder cable, etc.
For example, ZCAT3035-1330 by TDK, ESD-SR-250 by NEC TOKIN, and GRFC-13 by Kitagawa Industries are available as data line filters.
As a reference example, the impedance specifications of the ZCAT3035-1330 (TDK) are indicated below. This impedances are reference values and not guaranteed values.

Impedance [Ω]	
10 MHz to 100 MHz	100 MHz to 500 MHz
80	150

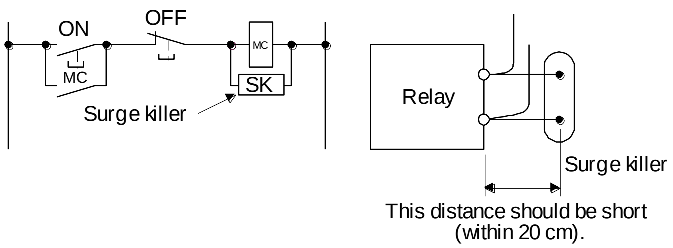
[Unit: mm]



Outline drawing (ZCAT3035-1330)

(b) Surge killer (recommended)

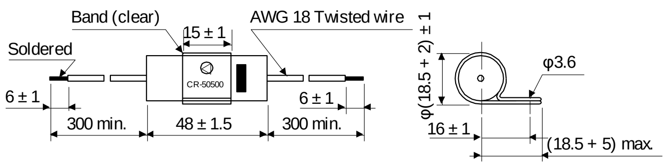
Use of a surge killer is recommended for AC relay, magnetic contactor or the like near the driver. Use the following surge killer or equivalent.



(Ex.) CR-50500 Okaya Electric Industries)

Rated voltage AC [V]	C [µF ± 20%]	R [Ω ± 30%]	Test voltage
250	0.5	50 (1/2W)	Between terminals: 625 V AC, 50 Hz/60 Hz 60 s Between terminal and case: 2000 V AC 50/60 Hz 60 s

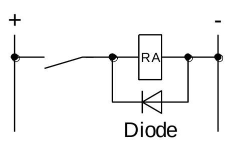
Dimensions [Unit: mm]



Note that a diode should be installed to a DC relay or the like.

Maximum voltage: Not less than four 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.



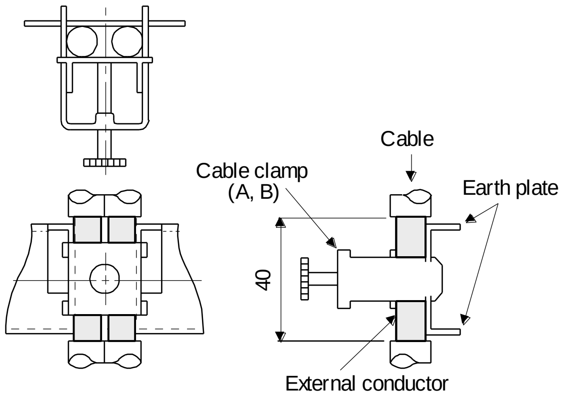
(c) Cable clamp fitting (AERSBAN -□ SET (Mitsubishi Electric Corporation))

Generally, the grounding of the shielded wire may only be connected to the connector's SD terminal. However, the effect can be increased by directly connecting the cable to an grounding plate as shown below.

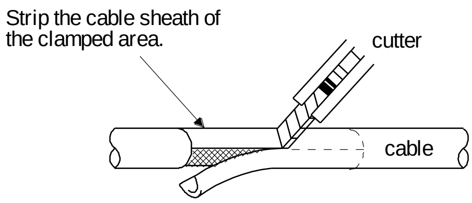
Install the grounding plate near the driver for the encoder cable. Peel part of the cable sheath to expose the external conductor, and press that part against the grounding plate with the cable clamp. If the cable is thin, clamp several cables in a bunch.

The cable clamp comes as a set with the grounding plate.

[Unit: mm]



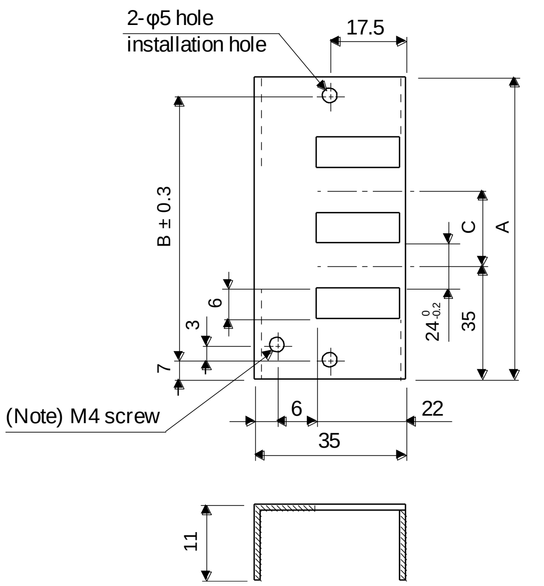
Clamp section diagram



・Dimensions

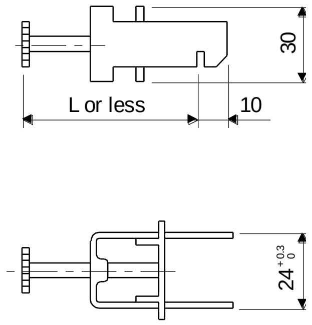
[Unit: mm]

Earth plate



[Unit: mm]

Clamp section diagram



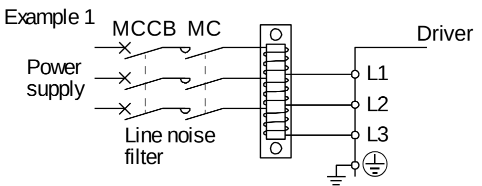
Note. Screw hole for grounding. Connect it to the grounding plate of the cabinet.

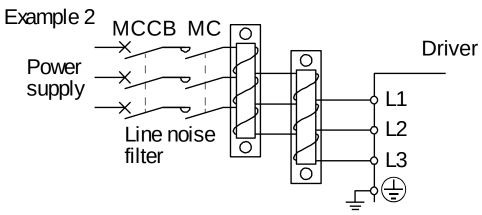
Model	A	B	C	Accessory fittings
AERSBAN-DSET	100	86	30	Clamp A: 2pcs.
AERSBAN-ESET	70	56		Clamp B: 1pc.

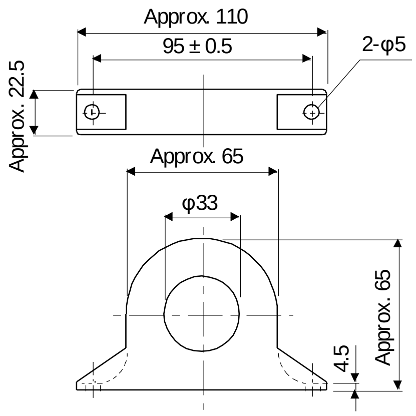
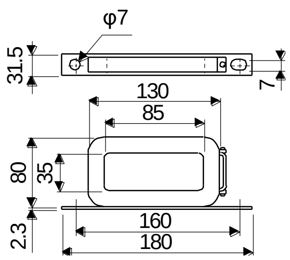
Clamp fitting	L
A	70
B	45

(d) Line noise filter (FR-BSF01/FR-BLF of Mitsubishi Electric Corparation)

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 (0-phase current). It especially affects the noises between 0.5 MHz and 5 MHz band.

<table>
<tr><th>Connection diagram</th><th>Dimensions [Unit: mm]</th></tr>
<tr><td rowspan="2">Use the line noise filters for lines of the main power supply (L1, L2, and L3) and of the servo motor power (U, V, and W). Pass each of the 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 servo motor power lines, passes must be four times or less. Do not pass the grounding 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.


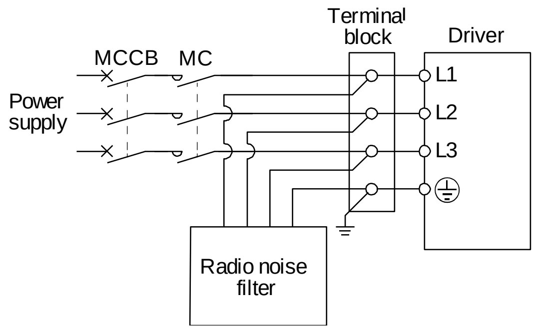
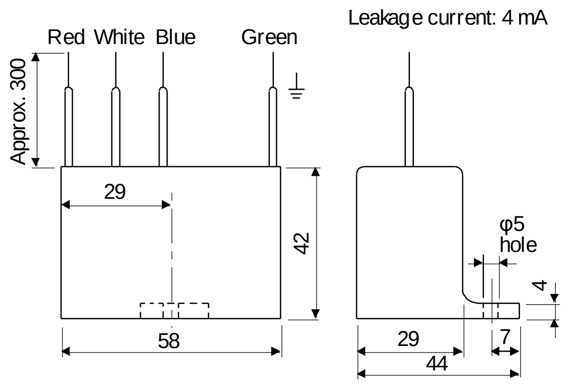
(Number of turns: 4)


Two filters are used
(Total number of turns: 4)</td>
<td>FR-BSF01 (for wire size 3.5 mm^2 (AWG 12) or less)

</td></tr>
<tr><td>FR-BLF (for wire size 5.5 mm^2 (AWG 10) or more)

</td></tr>
</table>

(e) Radio noise filter (FR-BIF of Mitsubishi Electric Corparation)

This filter is effective in suppressing noises radiated from the power supply side of the driver especially in 10 MHz and lower radio frequency bands. The FR-BIF is designed for the input only.

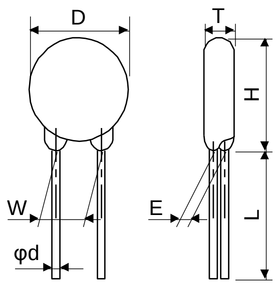
200 V class: FR-BIF

Connection diagram	Dimensions [Unit: mm]
Make the connection cables as short as possible. Grounding is always required. When using the FR-BIF with a single-phase power supply, always insulate the lead wires that are not used for wiring. ・LECSB2-T□  	

(f) Varistor 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 and TND20V-471K, 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) V1 mA
		Permissible circuit voltage		Surge current immunity	Energy immunity	Rated pulse power		[A]	[V]		
		AC [Vrms]	DC [V]	8/20 µs [A]	2 ms [J]	[W]				[pF]	[V]
200 V class	TND20V-431K	275	350	10000/1 times	195	1.0		100	710	1300	430 (387 to 473)
	TND20V-471K	300	385	7000/2 times	215				775	1200	470 (423 to 517)



[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			

Note. For special purpose items for lead length (L), contact the manufacturer.

11.9 Earth-leakage current breaker

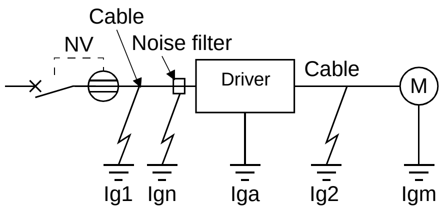
(1) Selection method

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 an earth-leakage current breaker according to the following formula, and ground the driver, servo motor, etc. securely.

To minimize leakage currents, make the input and output cables as short as possible, and make the grounding cable longer than 30 cm.

Rated sensitivity current ≥ 10 • {Ig1 + Ign + Iga + K • (Ig2 + Igm)} [mA] ·································· (11.1)



Earth-leakage current breaker		K
Type	Mitsubishi Electric Corparation products	
Models provided with harmonic and surge reduction techniques	NV-SP NV-SW NV-CP NV-CW NV-HW	1
General models	BV-C1 NFB NV-L	3

Ig1: Leakage current on the electric channel from the earth-leakage current breaker to the input terminals of the driver (Found from Fig. 11.5.)

Ig2: Leakage current on the electric channel from the output terminals of the driver to the servo motor (Found from Fig. 11.5.)

Ign: Leakage current when a filter is connected to the input side (4.4 mA per one FR-BIF)

Iga: Leakage current of the driver (Found from table 11.3.)

Igm: Leakage current of the servo motor (Found from table 11.2.)

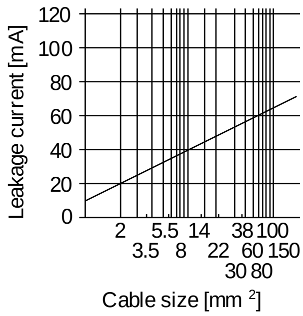


Fig. 11.7 Example of leakage current per km (lg1, lg2) for CV cable run in metal conduit

Table 11.2 Servo motor leakage current example (Igm)

Servo motor power [W]	Leakage current [mA]
50 to 750	0.1

Table 11.3 Driver leakage current example (Iga)

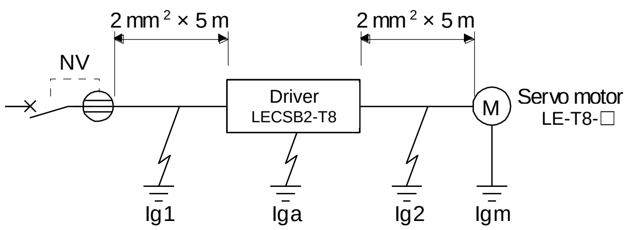
Driver capacity [W]	Leakage current [mA]
100 to 400	0.1
750	0.15

Table 11.4 Earth-leakage current breaker selection example

Driver	Rated sensitivity current of earth-leakage current breaker [mA]
LECSB2-T□	15

(2) Selection example

Indicated below is an example of selecting an earth-leakage current breaker under the following conditions.



Use an earth-leakage current breaker designed for suppressing harmonics/surges.
Find the terms of equation (11.1) 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 (11.1).

$$Ig \geq 10 \cdot \{0.1 + 0 + 0.1 + 1 \cdot (0.1 + 0.1)\}$$
$$\geq 4 \text{ [mA]}$$

According to the result of calculation, use an earth-leakage current breaker having the rated sensitivity current (Ig) of 4.0 mA or more.
An earth-leakage current breaker having Ig of 15 mA is used with the NV-SP/SW/CP/CW/HW series.

11.10 EMC filter (recommended)

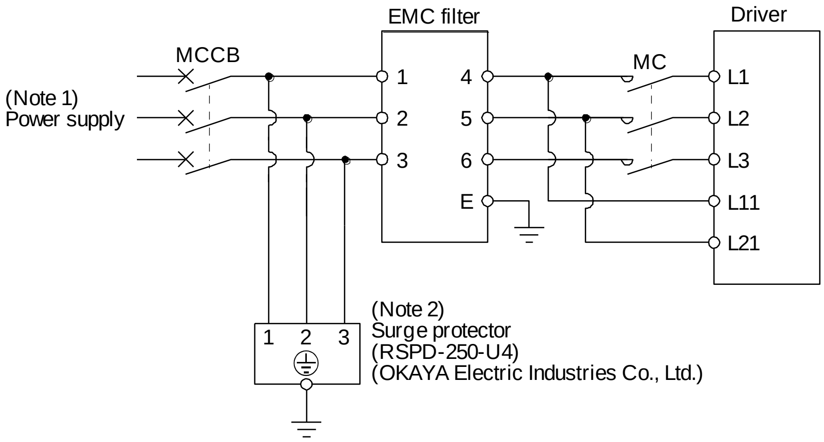
It is recommended that one of the following filters be used to comply with EN EMC directive. Some EMC filters have large in leakage current.

(1) Combination with the driver

Driver	Recommended filter (Soshin Electric)				Mass [kg]
	Model	Rated current [A]	Rated voltage [VAC]	Leakage current [mA]	
LECSB2-T□	(Note) HF3010A-UN	10	250	5	3.5

Note. A surge protector is separately required to use any of these EMC filters.

(2) Connection example



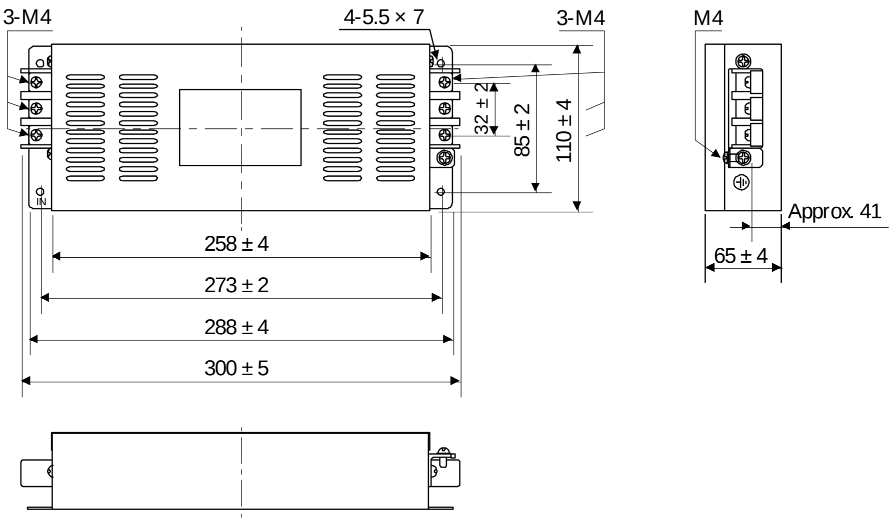
Note 1. For 1-phase 200 V AC to 240 V AC, connect the power supply to L1 and L3. Leave L2 open.
2. The example is when a surge protector is connected.

(3) Dimensions

(a) EMC filter

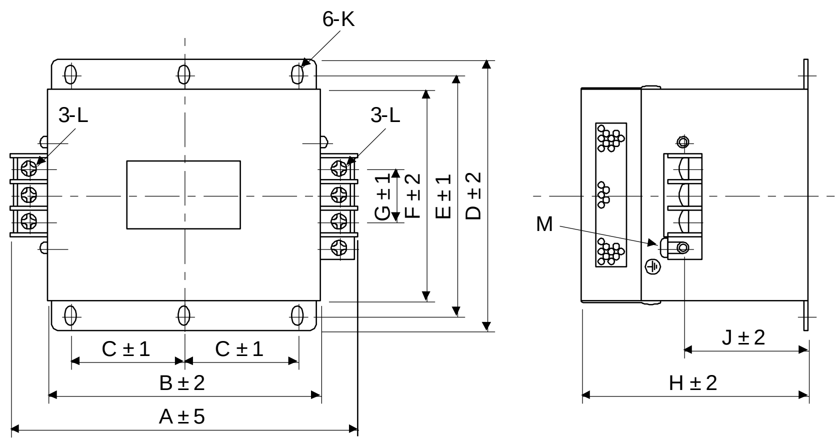
HF3010A-UN

[Unit: mm]



HF3030A-UN/HF-3040A-UN

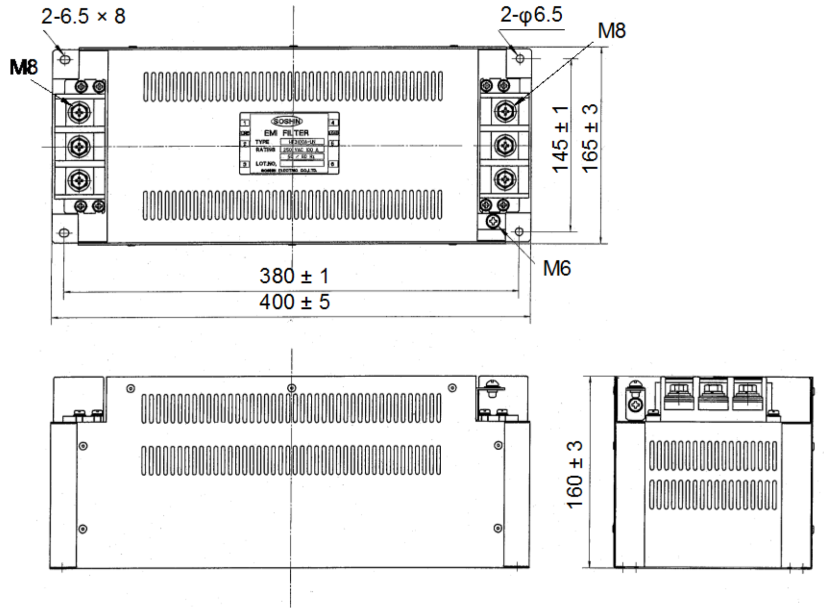
[Unit: mm]



Model	Dimensions [mm]											
	A	B	C	D	E	F	G	H	J	K	L	M
HF3030A-UN HF3040A-UN	260	210	85	155	140	125	44	140	70	R3.25 length: 8	M5	M4

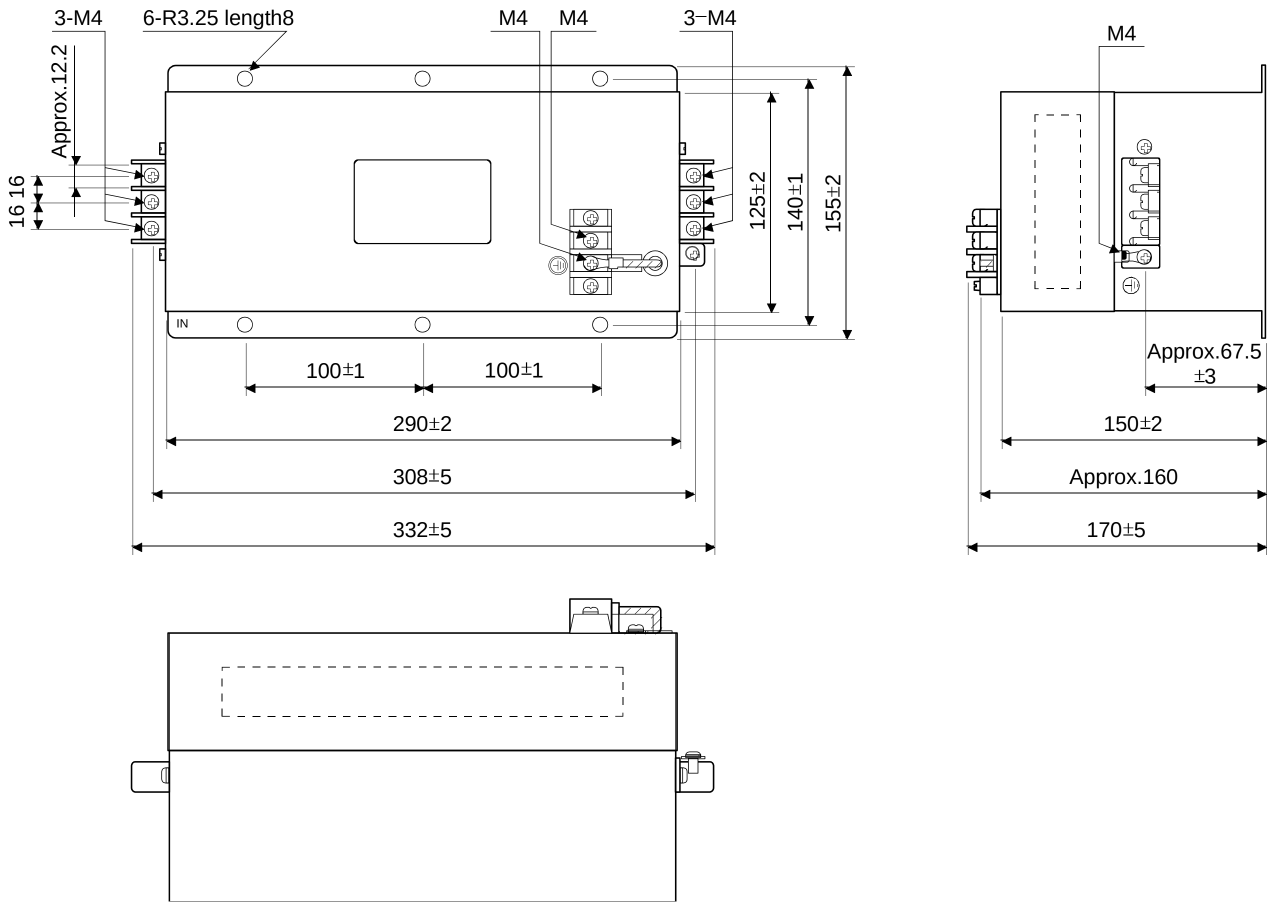
HF3100A-UN

[Unit: mm]



TF3005C-TX/TX3020C-TX/TF3030C-TX

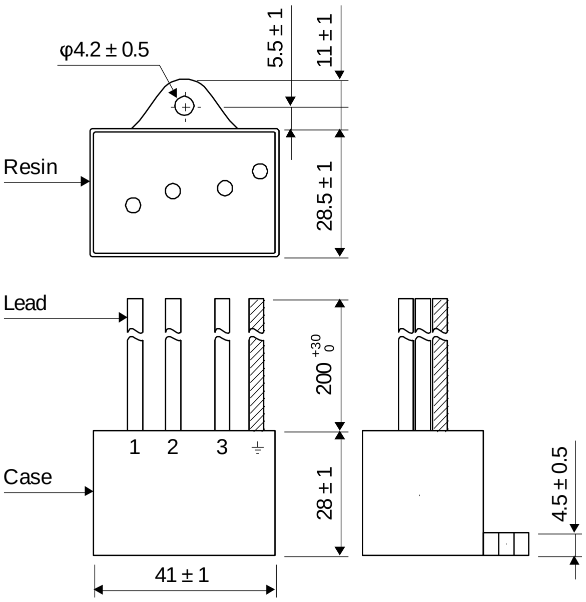
[Unit: mm]

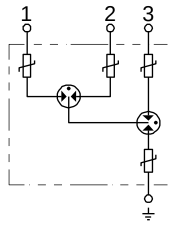


(b) Surge protector

RSPD-250-U4

[Unit: mm]





12. ABSOLUTE POSITION DETECTION SYSTEM

⚠CAUTION

- If [AL. 25 Absolute position erased] or [AL. E3 Absolute position counter warning] has occurred, always perform home position setting again. Otherwise, it may cause an unexpected operation.
- If [AL. 25], [AL. 92], or [AL. 9F] occurs due to such as short circuit of the battery, the battery can become hot. Use the battery with case to prevent getting burnt.

POINT

- Refer to section 12.9 for the replacement procedure of the battery.
- When absolute position data is erased from the encoder, always execute home position setting before operation. The absolute position data of the encoder will be erased in the followings. Additionally, when the battery is used out of specification, the absolute position data can be erased.
  - The encoder cable was disconnected.
  - The battery was replaced when the control circuit power supply was off.
- If the following parameters are changed, the home position will be erased at the next power-on. Execute the home position return again after power-on.
  - [Pr. PA06 Electronic gear numerator (command pulse multiplication numerator)]
  - [Pr. PA07 Electronic gear denominator (command pulse multiplication denominator)]
  - [Pr. PA14 Rotation direction selection/travel direction selection]
  - [Pr. PT08 Home position return position data]
  - [Pr. PT28 Number of stations per rotation]

12.1 Summary

12.1.1 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 servo system PC or PLC...etc power is on or off.
Therefore, once home position return is made at the time of machine installation, home position return is not needed when power is switched on thereafter.
Even at a power failure or a malfunction, the system can be easily restored.

12.1.2 Restrictions

The system cannot be configured under the following conditions. Additionally, test operation cannot be performed in the absolute position detection system. To perform test operation, select incremental system in [Pr. PA03].

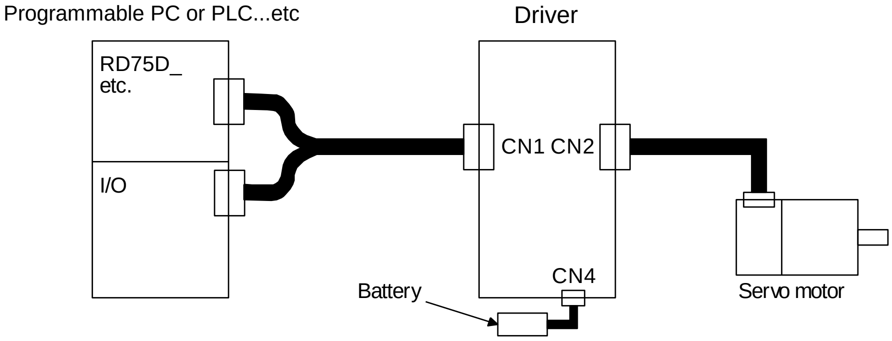
(1) Speed control mode and torque control mode
(2) Control switch-over mode (position/speed, speed/torque, and torque/position)
(3) Stroke-less coordinate system, e.g. rotary shaft, infinitely long positioning
(4) Changing electronic gear after home position setting.
(5) Using alarm code output.
(6) Using incremental value command method ([Pr. PT01] = "_ _ _ 1").

To configure absolute position detection system in incremental value command method, specify the incremental value command with the sub function of the point table or the command in the program. For details, refer to section 16.

12.1.3 Structure

The following shows a configuration of the absolute position detection system.

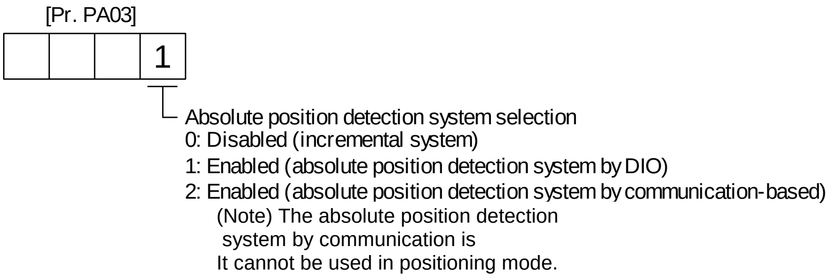
Positioning module	I/O module
RD75P4, RD75D4	RX40C7, RX41C4, RX42C4 RY40NT5P, RY41NT2P, RY42NT2P RY40PT5P, RY41PT1P, RY42PT1P
QD75P_N, QD75D_N	QX40, QX41, QX42 QY40, QY41P, QY42P, QY50
LD75P4, LD75D4	LX40C6, LX41C4, LX42C4 LY40NT5P, LY41NT1P, LY42NT1P LY40PT5P, LY41PT1P, LY42PT1P
FX_{2N}-_GM, FX_{2N}-_PG	FX_{2N} series, FX_{0N} series



12.1.4 Parameter setting

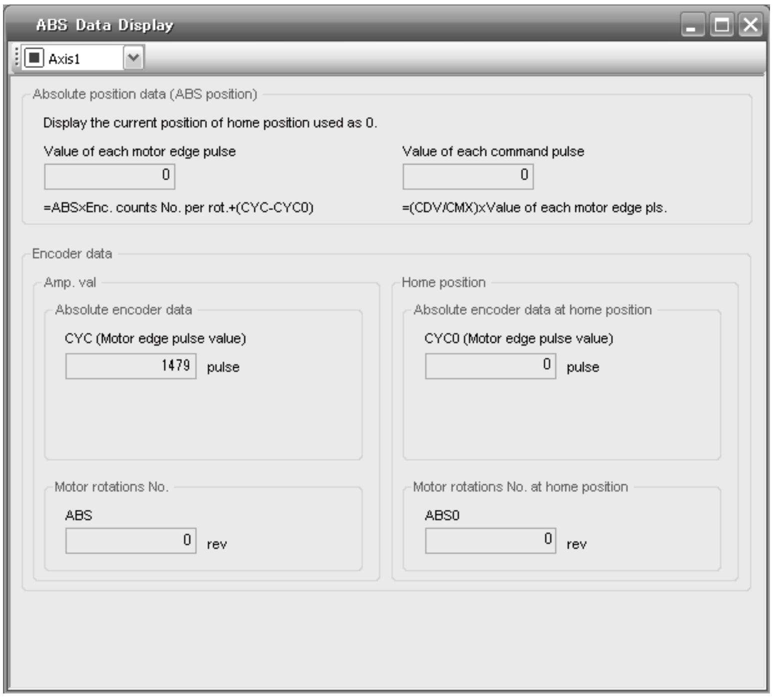
POINT
●Set "_ _ _ 2" in [Pr. PA03] when using the absolute position detection system by communication.

Set "_ _ _ 1" in [Pr. PA03] to enable the absolute position detection system. Set "_ _ _ 2" when using the ABS transfer system by communication. Refer to section 12.8 for the ABS transfer system by communication.



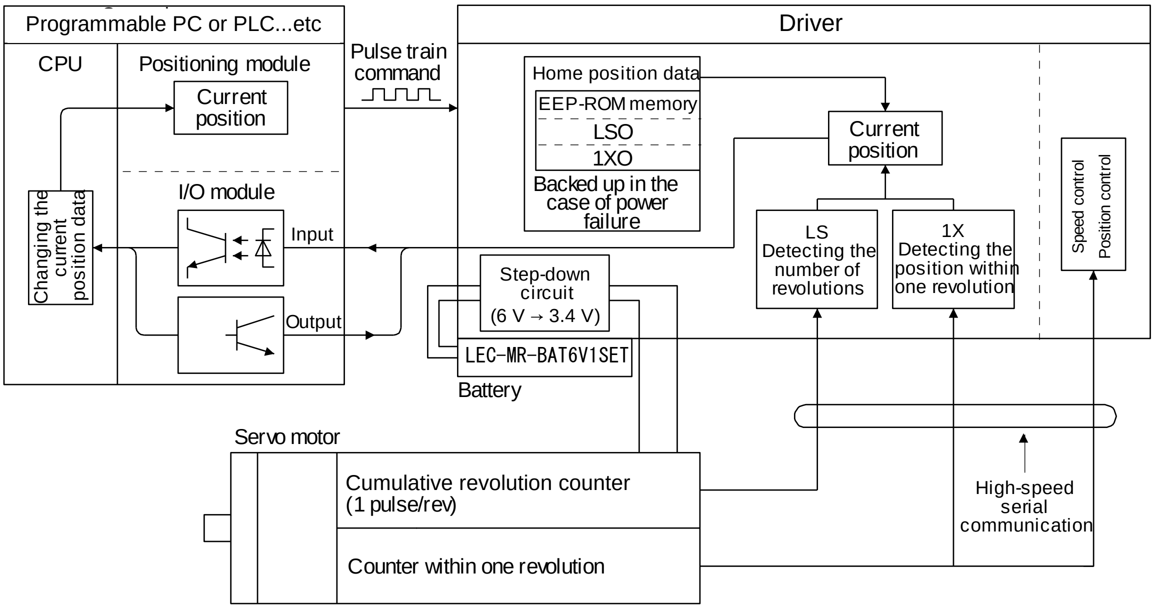
12.1.5 Confirmation of absolute position detection data

You can check the absolute position data with SETUP SOFTWER MR (Setup software MR Configurator2TM^{TM}). Choose "Monitor" and "ABS Data Display" to open the absolute position data display screen.



12.2 Battery

(1) Configuration diagram



(2) Specifications

(a) Specification list

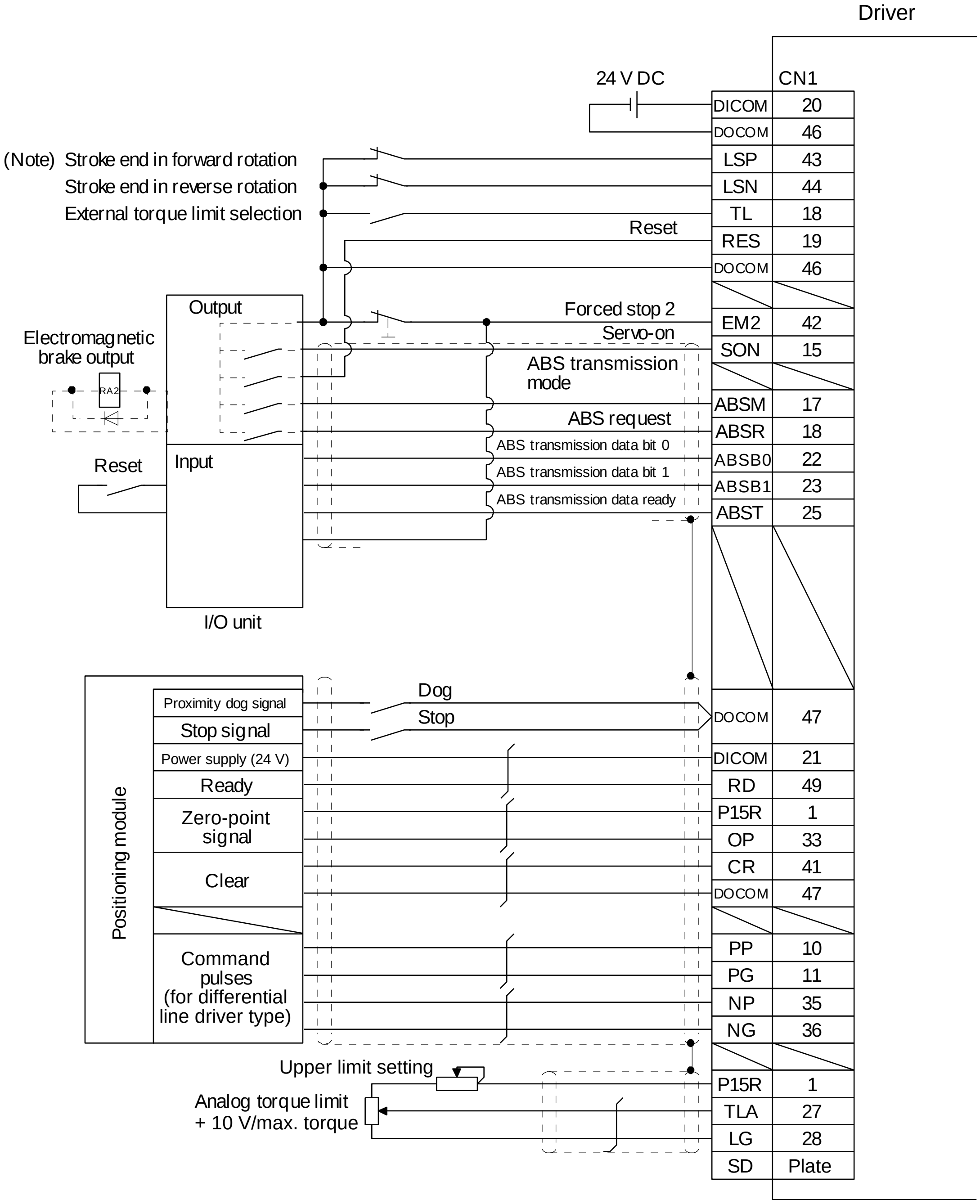
Item		Description
System		Electronic battery backup type
Maximum revolution range		Home position ± 32767 rev.
(Note 1) Maximum speed at power failure [r/min]	Rotary servo motor	6000 (only when acceleration time until 6000 r/min is 0.2 s or more)
(Note 2) Battery backup time	Rotary servo motor	Approximately 20,000 hours (equipment power supply: off, ambient temperature: 20 °C) Approximately 29,000 hours (power-on time ratio: 25%, ambient temperature: 20 °C) (Note 3)

Note 1. Maximum speed available when the shaft is rotated by external force at the time of power failure or the like. Also, if power is switched on at the servo motor speed of 3000 r/min or higher, position mismatch may occur due to external force or the like.

2. The data-holding time by the battery. Replace the batteries within three years since the operation start regardless of the power supply of the driver on/off. If the battery is used out of specification, [AL. 25 Absolute position erased] may occur.

3. The power-on time ratio 25% is equivalent to 8 hours power on for a weekday and off for a weekend.

12.3 Standard connection example



Note. For operation, always turn on LSP and LSN.

12.4 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 connector 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 CN1-22, CN1-23, and CN1-25 are as indicated in this table.	DI-1	P (Position control)
ABS request	ABSR	(Note) 18	Turn on ABSR to request the absolute position data in the ABS transfer mode.	DI-1	
ABS transmission data bit 0	ABSB0	22	Indicates the lower bit of the absolute position 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 absolute position data (2 bits) which is sent from the servo to the programmable PC or PLC...etc in the ABS transfer mode.	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, ABST 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 [Pr. PA03], pin 17 acts as ABSM and pin 18 as ABSR. They do not return to the original signals if data transfer ends.

12.5 Startup procedure

(1) Battery installation.
Refer to section 12.9.

(2) Parameter setting
Set "_ _ _ 1" in [Pr. PA03] of the driver and switch power off, then on.

(3) Resetting of [AL. 25 Absolute position erased]
After connecting the encoder cable, [AL. 25] occurs at first power-on. Turn off the power, then on to reset the alarm.

(4) Confirmation of absolute position data transfer
When SON is turned on, the absolute position data is transferred to the programmable PC or PLC...etc. Transferring the proper absolute position data will trigger the followings.

(a) RD (Ready) turns on.

(b) The absolute position data ready contact of programmable PC or PLC...etc turns on.

(c) The Setup software MR Configurator2™ ABS data display window (refer to section 12.1.5) 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 [AL. E5 ABS time-out warning] or programmable PC or PLC...etc side transfer error occurs, refer to section 12.7 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) [AL. 25 Absolute position erased] 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.
For the home position setting method and types, refer to section 12.6.3.

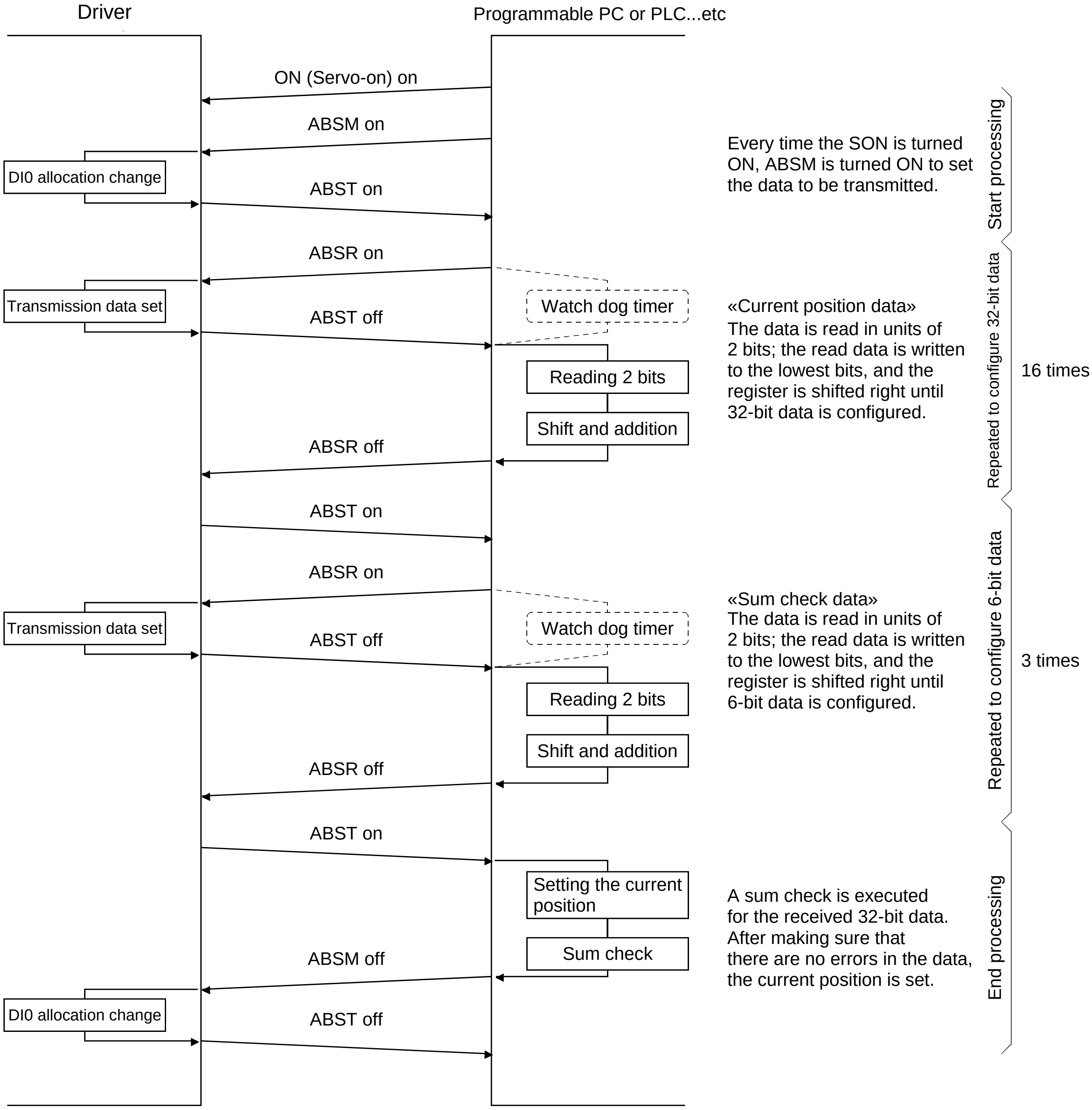
12.6 Absolute position data transfer protocol

POINT
●After switching on ABSM, turn on SON. When the ABS transfer mode is off, turning on SON does not switch on the base circuit.

12.6.1 Data transfer procedure

Each time 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.

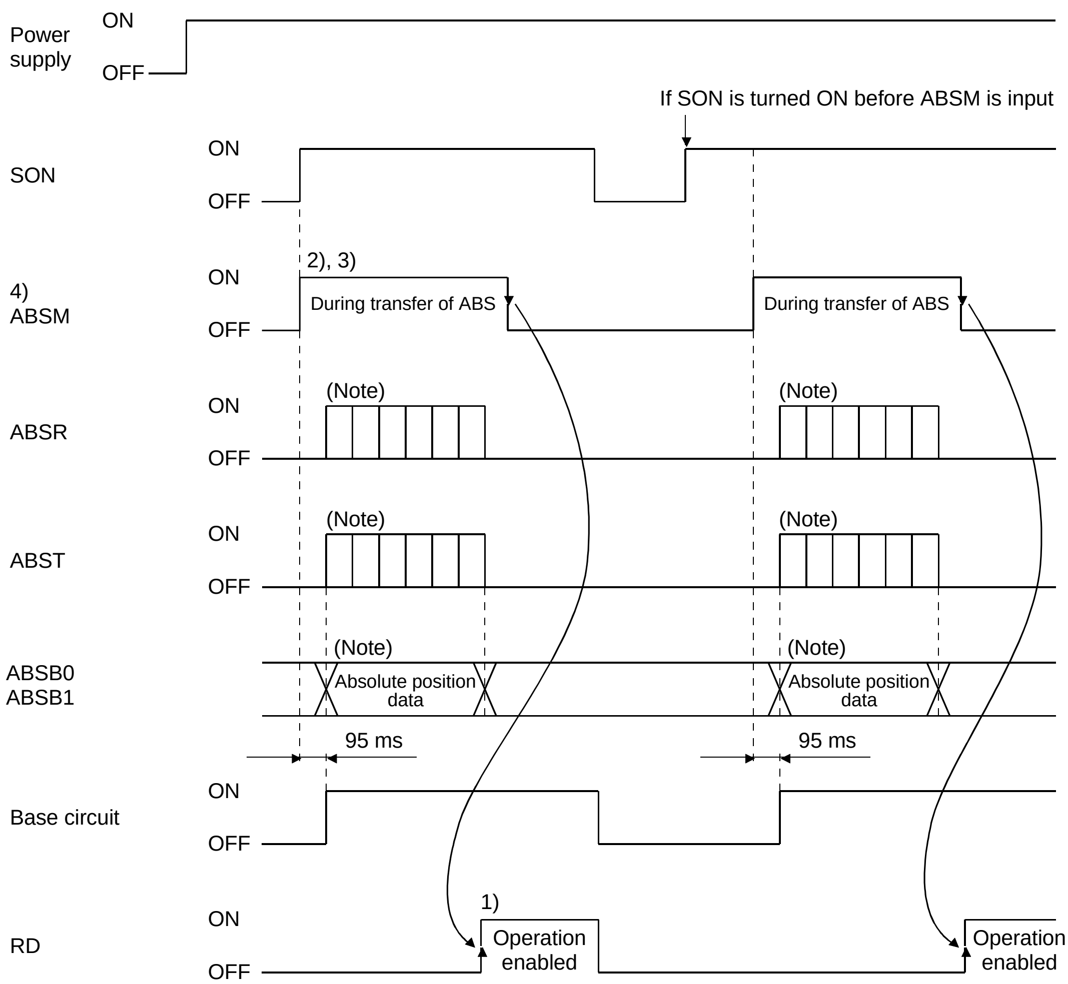


12.6.2 Transfer method

The following shows a sequence how to turn on the base circuit while it is off state because SON is off, EM2 is off, or an alarm is occurring. In the absolute position detection system, every time SON is turned on, 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 ABSM switches from off to on. At the same time, this data is set as a position command value inside the driver. Unless ABSM (ABS transfer mode) is turned on, the base circuit cannot be turned on.

(1)At power-on

(a) Timing chart



Note. For details, refer to (1) (b) in this section.

1) After the absolute position data is transmitted, RD turns on by ABSM-off. When RD is on, ABSM-on is not received.

2) Even if SON is turned on before ABSM is turned on, the base circuit is not turned on until ABSM is turned on.
If an alarm has occurred, ABSM is not received. ABSM allows data transmission even while a warning is occurring.

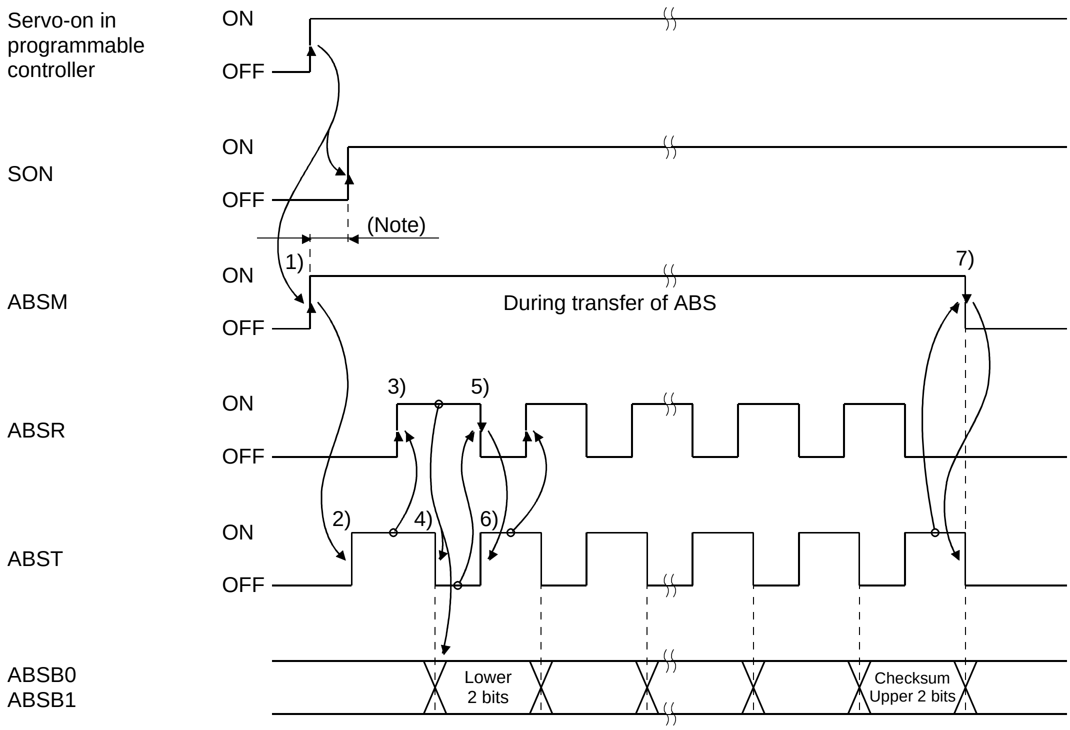
3) If ABSM is turned off during the ABS transfer mode, the ABS transfer mode is interrupted and [AL. E5 ABS time-out warning] occurs.
If SON is turned off, RES is turned on, and EM2 is turned off during the ABS transfer mode, [AL. E5 ABS time-out warning] occurs.

4) Note that if ABSM is turned on for a purpose other than absolute position data transmission, the output signals will be assigned the functions of absolute position data transmission.

CN1 Pin No.	Output signal	
	ABSM (ABS transfer mode): off	ABSM (ABS transfer mode): on
22	Positioning completion	transmission data bit 03
23	Zero speed detection	transmission data bit 1
25	During torque limit control	transmission data ready

5) ABSM is not accepted while the base circuit is on. For re-transferring, turn off SON signal and keep the base circuit in the off state for 20 ms or longer.

(b) Detailed description of absolute position data transfer



Note. If SON does not turn on within 1 s after ABSM off, [AL. EA ABS servo-on warning] will occur. But it will not influence the transfer. SON on will cancel [AL. EA] automatically.

1) The programmable PC or PLC...etc turns on ABSM and SON at the leading edge of the internal servo-on.

2) In response to ABS transfer mode, the servo detects and calculates the absolute position and turns on ABST to notify the programmable PC or PLC...etc that the servo is ready for data transmission.

3) After acknowledging that ABST is turned on, the programmable PC or PLC...etc will turn on ABSR.

4) In response to ABSR, the servo outputs the lower 2 bits of the absolute position data and ABST in the off state.

5) After acknowledging that ABST has been turned off, which implies that 2 bits of the absolute position data have been transmitted, the programmable PC or PLC...etc reads the lower 2 bits of the absolute position data and then turns off ABSR.

6) The servo turns on 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 ABST is turned on, and then turns off ABSM. If ABSM is turned off during data transmission, ABSM is interrupted and the [AL. E5 ABS time-out warning] occurs.

(c) Checksum

he checksum is the code which is used by the programmable PC or PLC...etc to check for errors in the received absolute position data. The 6-bit checksum is transmitted following the 32-bit absolute position data.
At the programmable PC or PLC...etc, calculate the sum of the received absolute position 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 absolute position data, it adds the data to obtain the sum of the received data. The checksum is 6-bit data.

Example: absolute position data: -10 (FFFFFFF6H)

$$\begin{array}{r} 10^{b} \\ 01^{b} \\ 11^{b} \\ 11^{b} \\ 11^{b} \\ 11^{b} \\ 11^{b} \\ 11^{b} \\ 11^{b} \\ 11^{b} \\ 11^{b} \\ 11^{b} \\ 11^{b} \\ 11^{b} \\ 11^{b} \\ +)\quad 11^{b} \\ \hline 101101^{b} \end{array}$$

«Appendix»

Decimal	- 10
Hexadecimal	FFFF FFF6
Binary	1111 1111 1111············0110

When the binary data of each 2 bits of the absolute position data is added up, "10 1101 ^{b}" is obtained.

Therefore, the checksum of "-10" (absolute position data) is "2DH"

(2) Transmission error

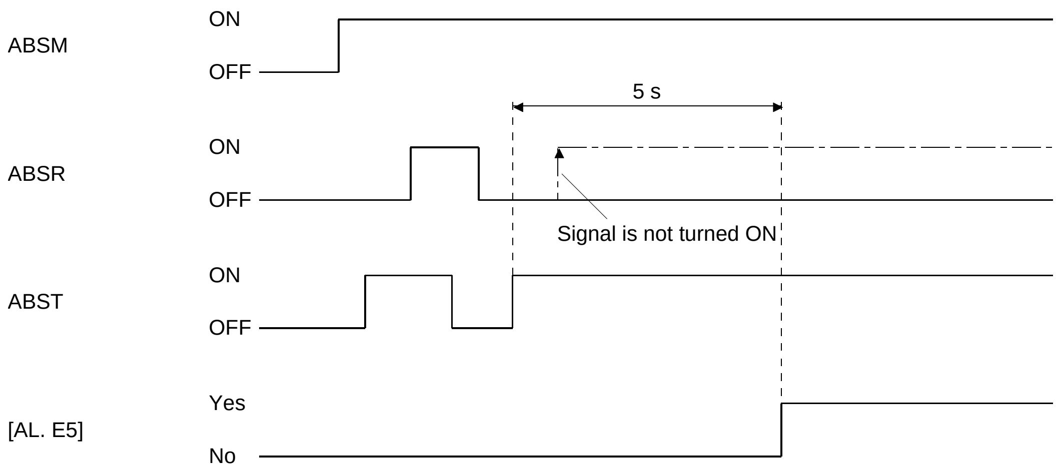
(a) [AL. E5 ABS time-out warning]

In the ABS transfer mode, the driver processes time-out below, and displays [AL. E5] when a time-out error occurs.

[AL. E5 ABS time-out warning] is cleared when ABSM changes from off to on.

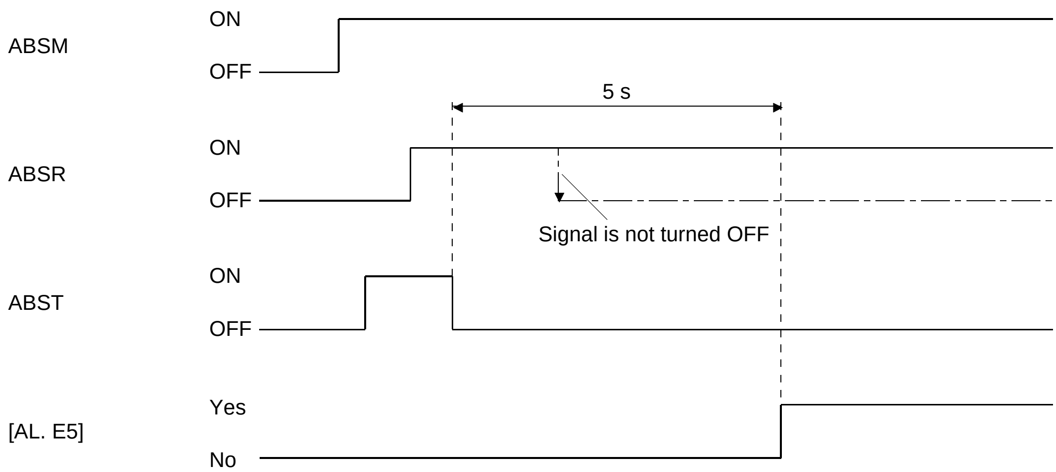
1) ABS request off-time time-out check (applied to 32-bit absolute position data in 2-bit units checksum)

If the ABS request signal is not turned on by the programmable PC or PLC...etc within 5 s after ABST is turned on, this is regarded as a transmission error and [AL. E5 ABS time-out warning] is output.

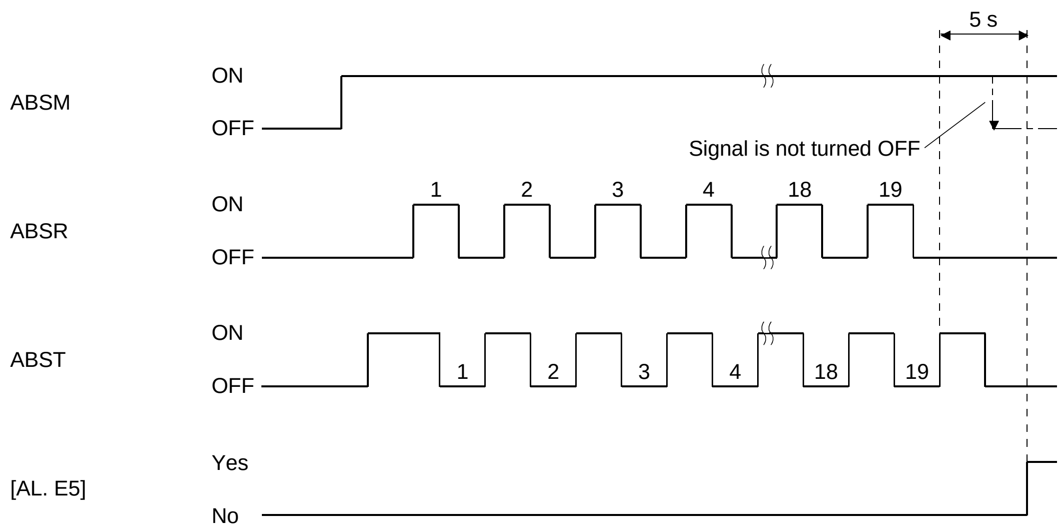


2) ABS request on-time time-out check (applied to 32-bit absolute position data in 2-bit units checksum)

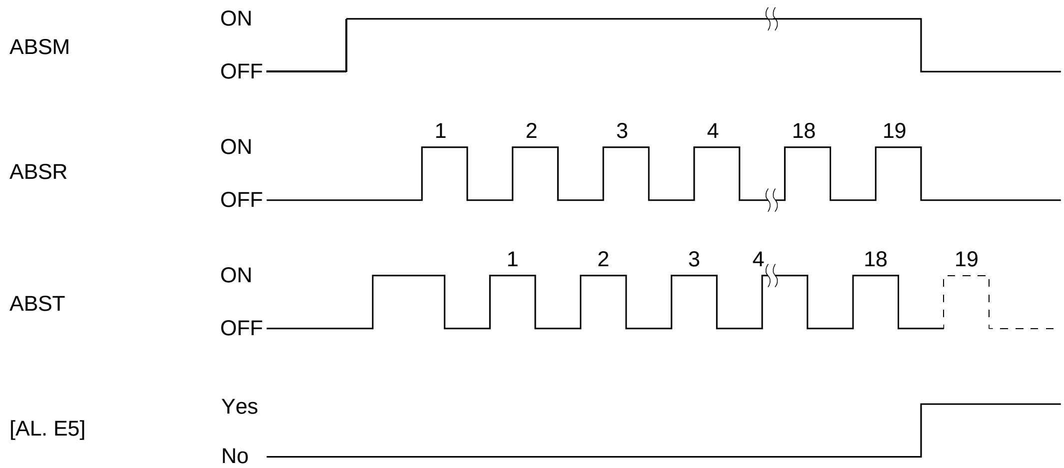
If the ABSR is not turned off by the programmable PC or PLC...etc within 5 s after ABST is turned off, this is regarded as the transmission error and [AL. E5 ABS time-out warning] is output.



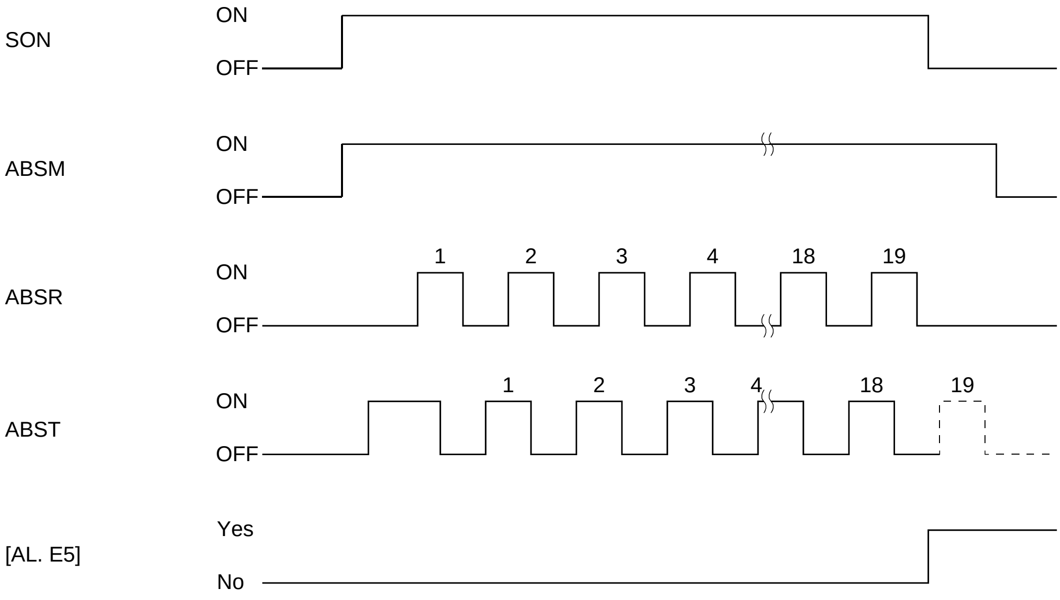
3) ABS transfer mode finish-time time-out check
If ABSM is not turned off within 5 s after the last ABS transmission data ready (19th signal for absolute position data transmission) is turned on, it is regarded as the transmission error and the [AL. E5 ABS time-out warning] is output.



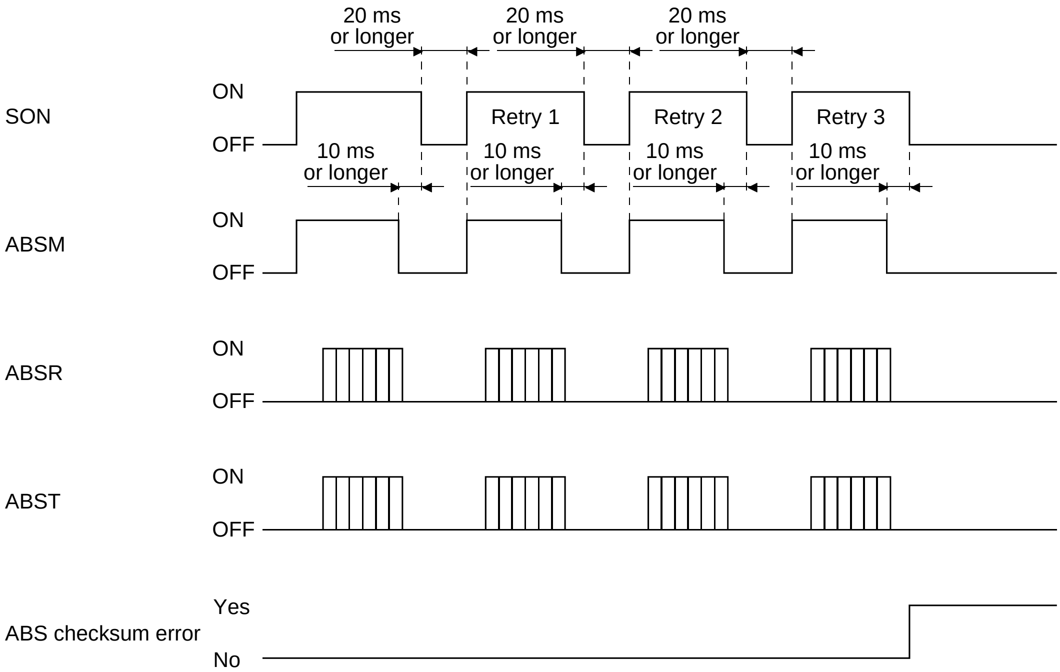
4) ABSM-off check during the ABS transfer
When the ABSM is turned on to start transferring and then the ABS transfer mode is turned off before the 19th ABS transmission data ready is turned on, [AL. E5 ABS time-out warning] occurs, regarding it as a transfer error.



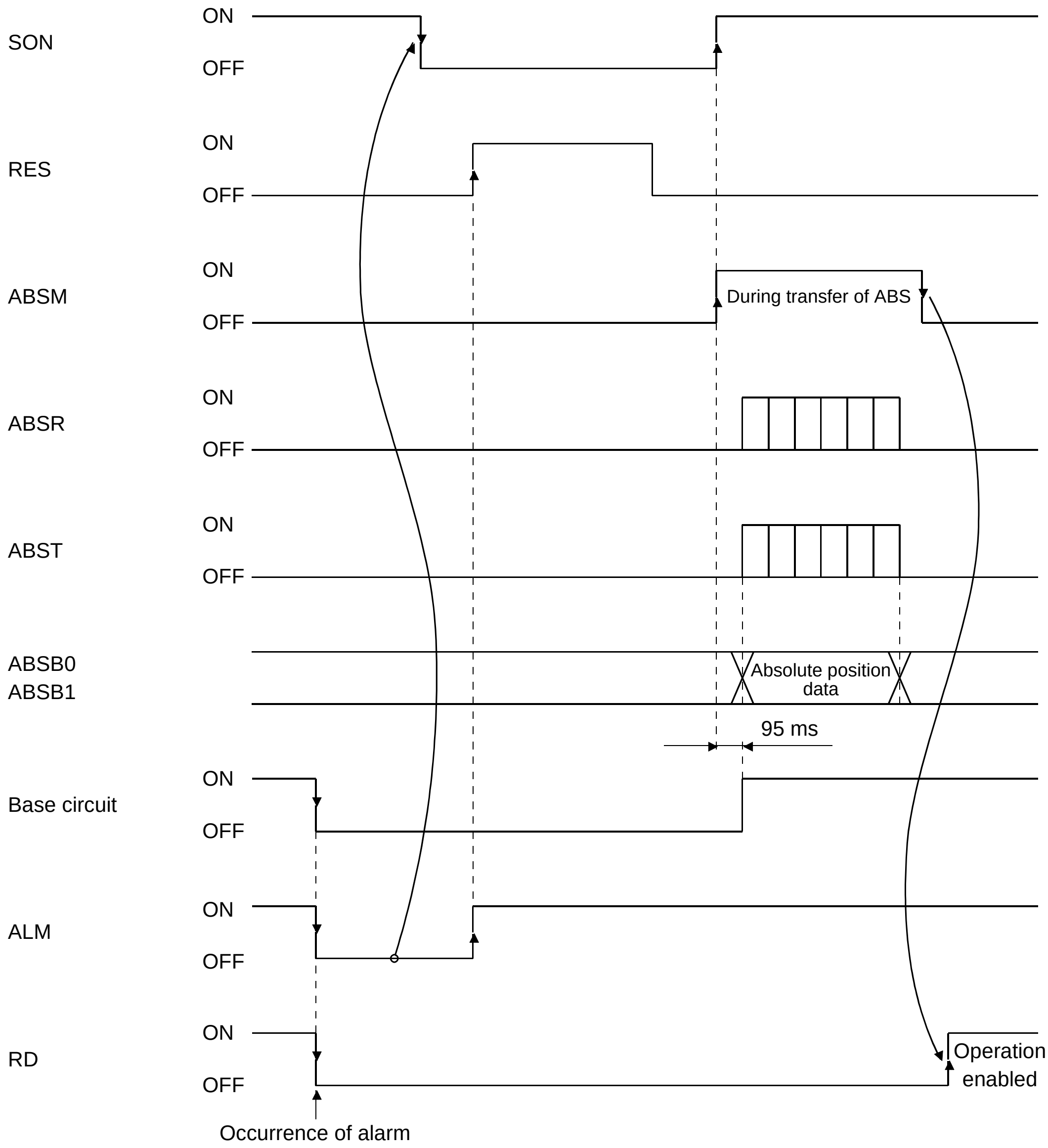
5) SON off, RES on, and EM2 off check during the ABS transfer
When the ABS transfer mode is turned on to start transferring and then SON is turned off, RES is turned on, or EM2 is turned on before the 19th ABST is turned on, [AL. E5 ABS time-out warning] occurs, regarding it as a transfer error.



(b) Checksum error
If the checksum error occurs, the programmable PC or PLC...etc should retry transmission of the absolute position data.
Using the ladder check program of the programmable PC or PLC...etc, turn off ABSM. After a lapse of 10 ms or longer, turn off SON (off time should be longer than 20 ms) and then turn it on again.
If the absolute position data transmission fails even after retry, process the ABS checksum error.
The start command should be interlocked with ABST to disable positioning operation when an checksum error occurs.
The following shows an example of three retries.



(3) At the time of alarm reset
If an alarm occurs, turn off SON by detecting ALM. If an alarm has occurred, ABSM cannot be accepted. In the reset state, ABSM can be input.

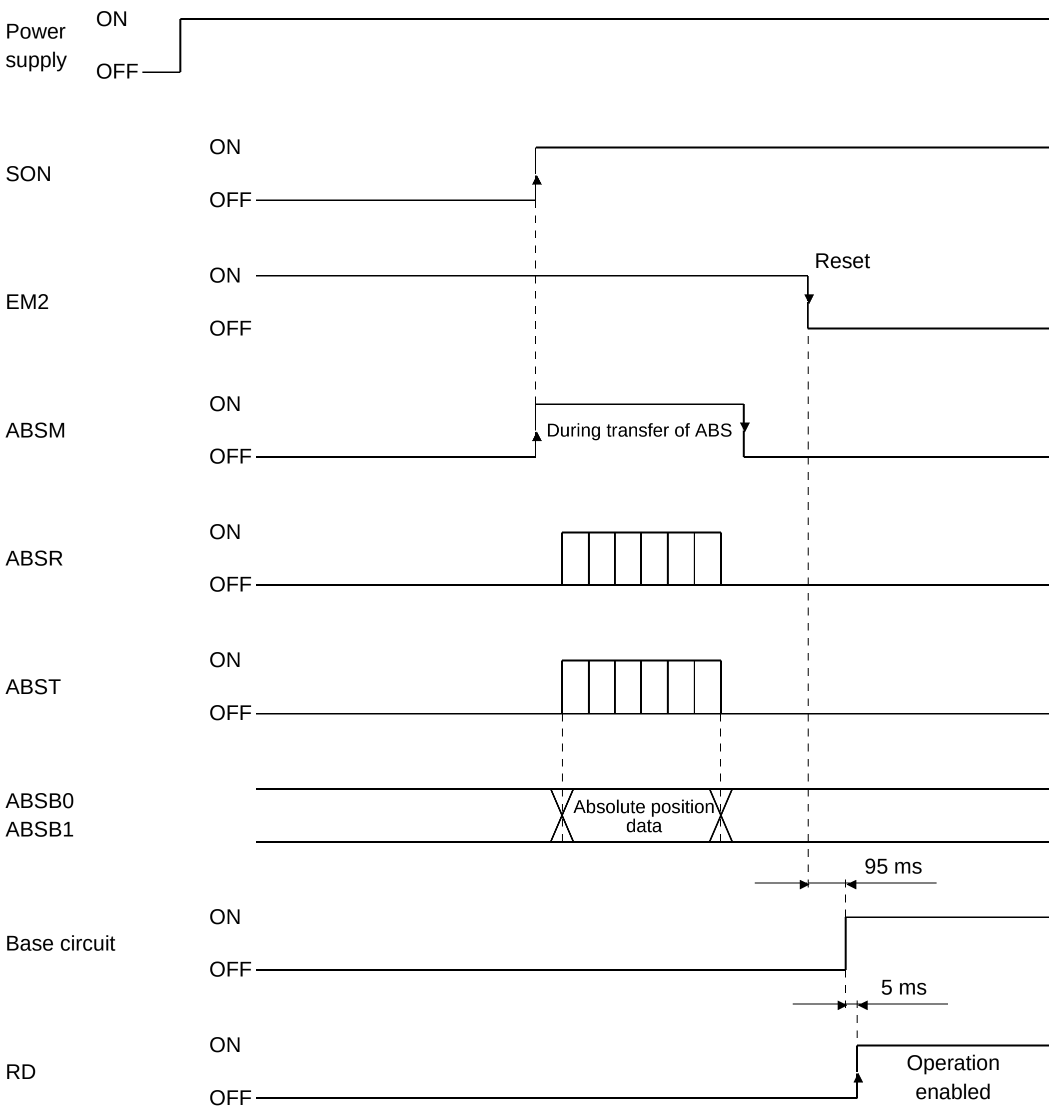


(4) At the time of forced stop reset

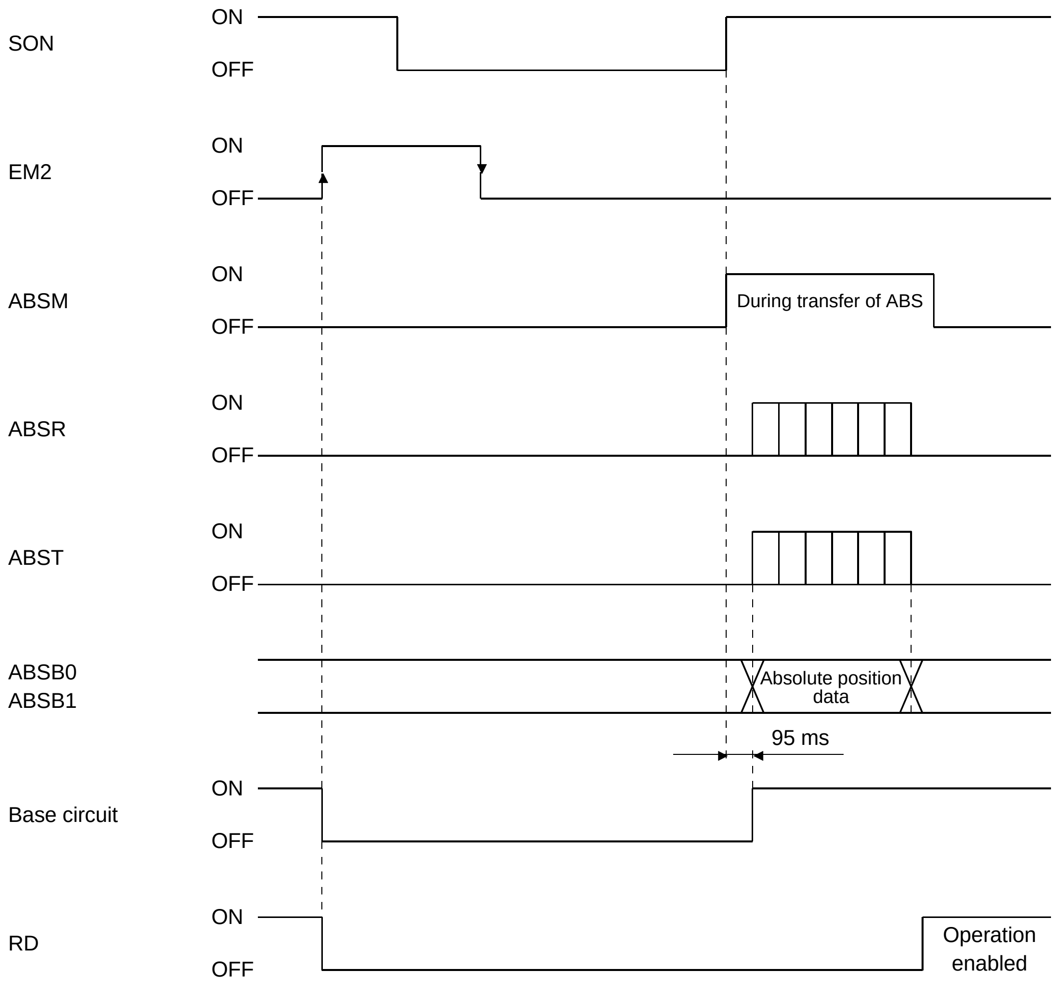
(a) If the power is switched on in the forced stop state

he forced stop state can be reset while the absolute position data is being transferred. If the forced stop state is reset while the absolute position data is transmitted, the base circuit is turned on 95 ms after resetting. If ABSM is off when the base circuit is turned on, RD is turned on 5 ms after the turning on of the base circuit. If ABSM is on when the base circuit is turned on, it is turned off and then RES is turned on. The absolute position data can be transmitted after the forced stop state is reset.

The current position in the driver is updated even during an forced stop. When SON or ABSM are turned on during an forced stop as shown below, the driver transmits to the PC or PLC...etc the current position latched when 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 a forced stop, the servo-lock status is not encountered. Therefore, if the servo motor is rotated by external force or the like after ABSM is turned on, this travel distance is accumulated in the driver as droop pulses. If the forced 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 absolute position data before clearing the forced stop.



(b) If forced stop is activated during servo-on
ABSM is permissible while in the forced stop state. In this case, the base circuit and RD are turned on after the forced stop state is reset.



12.6.3 Home position setting

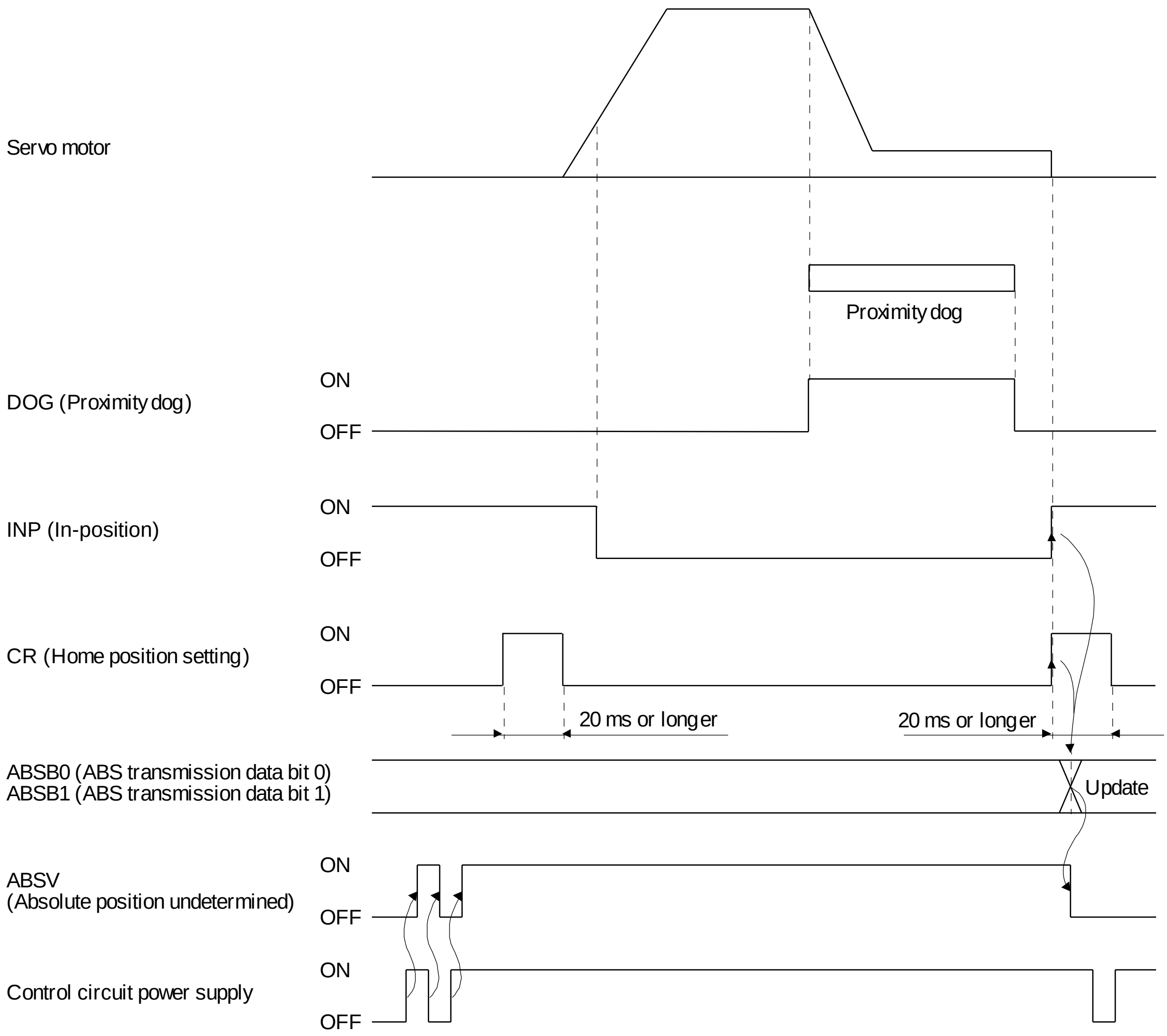
(1) Dog type home position return

Preset a home position return creep speed at which the machine will not be given impact.

On detection of a zero pulse, 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 absolute position data.

CR should be turned on after it has been confirmed that INP is on. If this condition is not satisfied, [AL. 96 Home position setting warning] will occur, but that warning will be reset automatically by making home position return correctly.

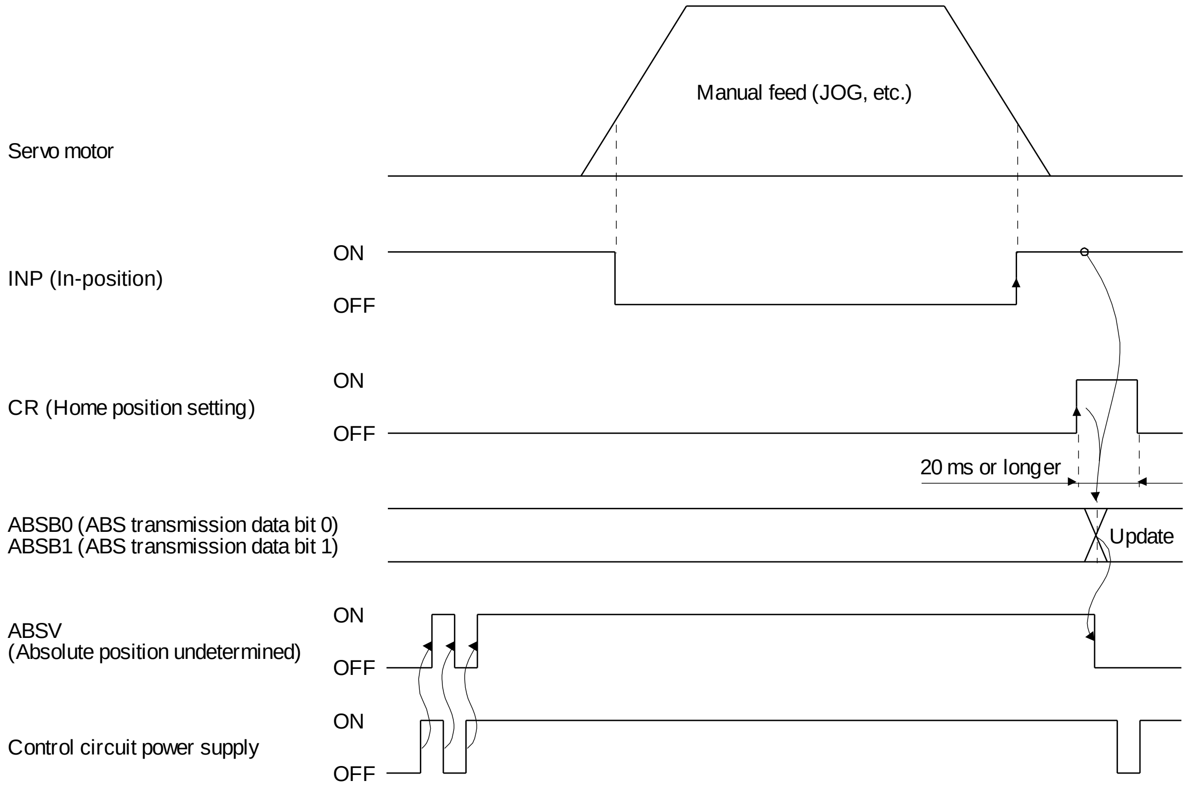
The number of home position setting times is limited to 1,000,000 times.



(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 during the servo off.

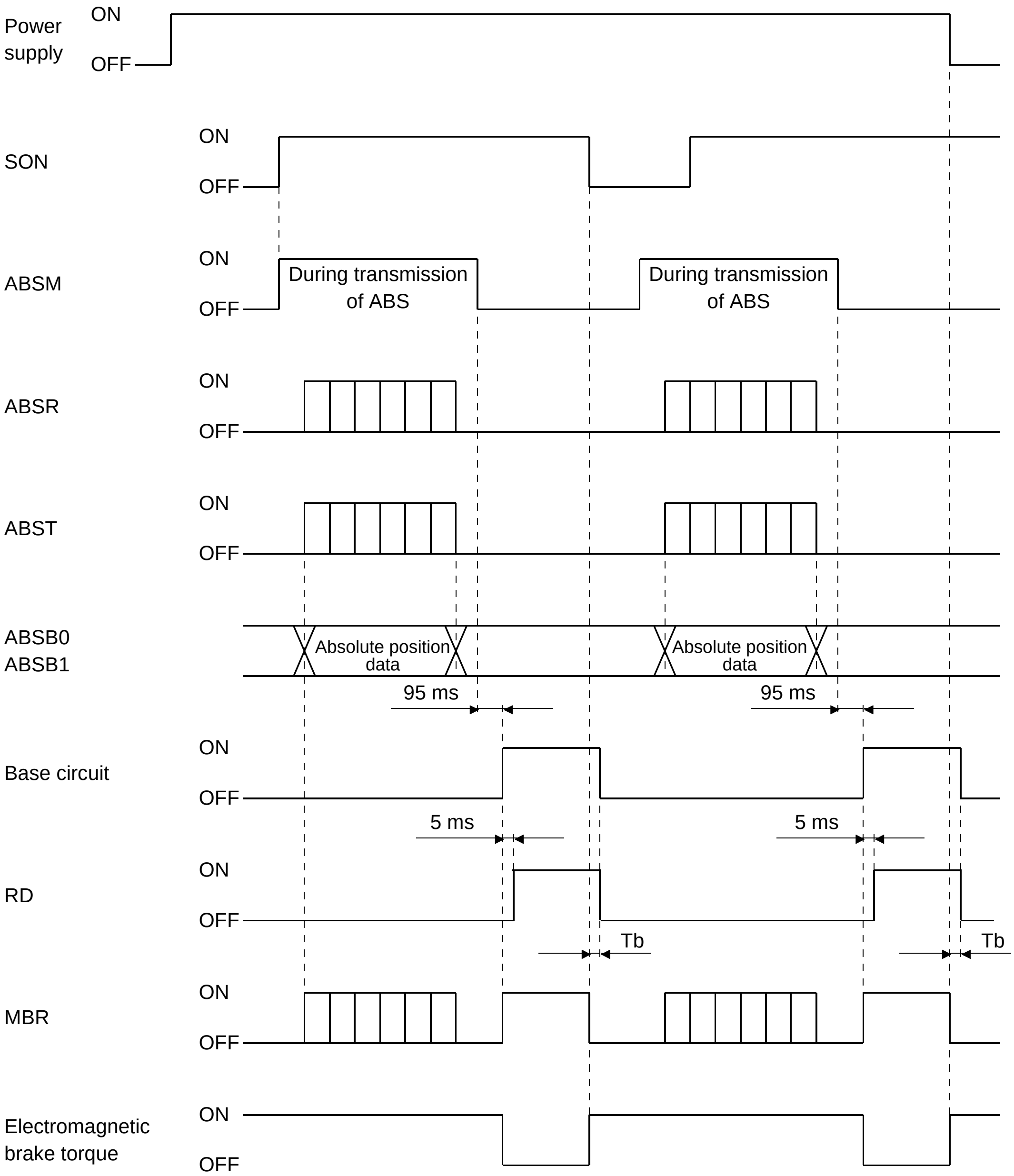
Move the machine to the position where the home position is to be set by performing manual operation such as JOG operation. When CR is on for longer than 20 ms, the stop position is stored into the non-volatile memory as the home position absolute position data.
When the servo on, set CR to on after confirming that INP is on. If this condition is not satisfied, [AL. 96 Home position setting warning] 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 100,000 times.



12.6.4 Use of servo motor with an electromagnetic lock

The timing charts at power on/off and SON on/off are given below.

Preset [Pr. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47] of the driver to enable MBR. When MBR is set for the CN1-23 pin, turning ABSM on will change the CN1-23 pin to ABSB1 (ABS transmission data bit 1). Therefore, configure an external sequence to generate the electromagnetic lock torque as soon as ABSM and MBR turn off.



12.6.5 How to process the absolute position data at detection of stroke end

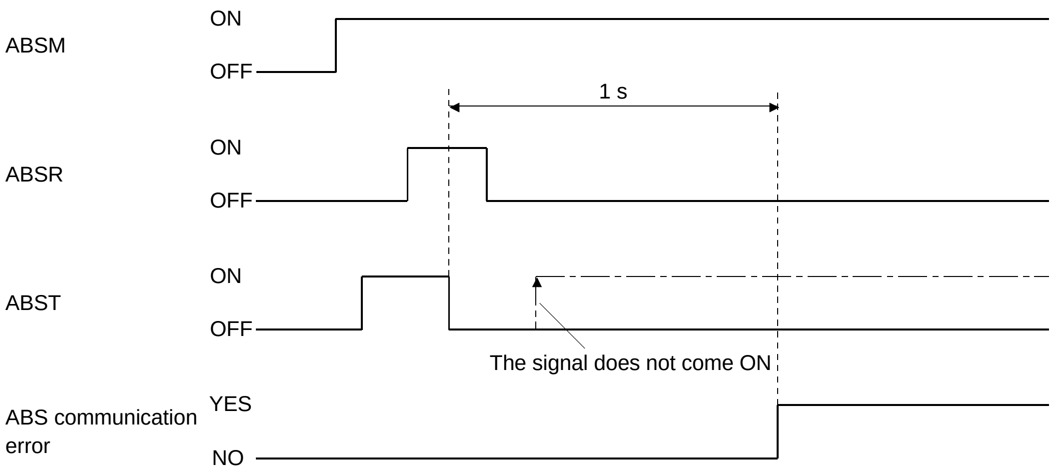
The driver stops the acceptance of the command pulse when off of LSP or LSN are detected, clears the droop pulses to 0 at the same time, and stops the servo motor. At this time, the programmable PC or PLC...etc keeps outputting the command pulse. Since this causes a discrepancy between the absolute position data of the driver and the programmable PC or PLC...etc, position mismatch will occur if the operation is continued. 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 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.

12.7 Absolute position data transfer errors

POINT

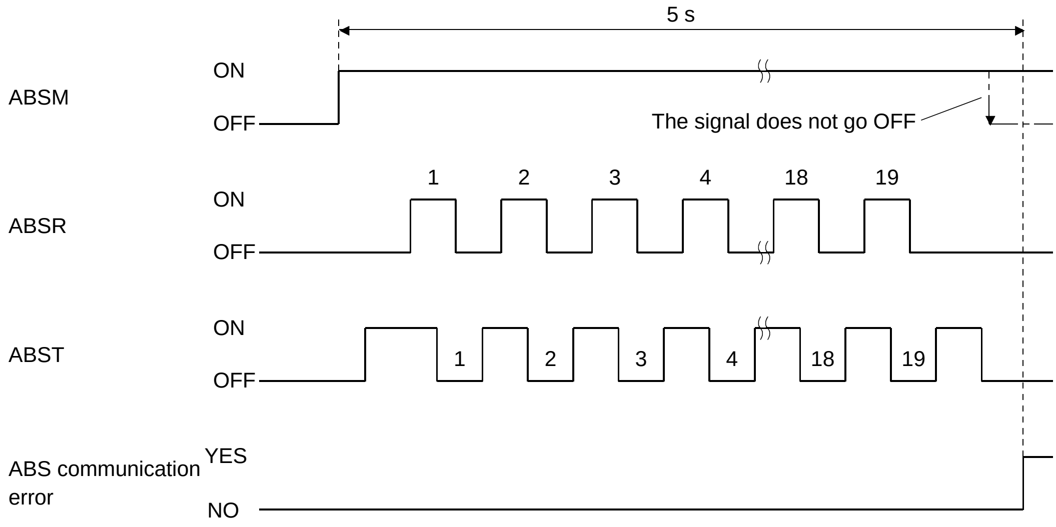
- When the following alarm or warning occurs, refer to "section 8" to remove the failure.
  [AL. 25 Absolute position erased]
  [AL. 96 Home position setting warning]
  [AL. E3 Absolute position counter warning]
  [AL. E5 ABS time-out warning]
  [AL. EA ABS servo-on warning]

(1) The off period of the ABS transmission data ready signal output from the driver is checked. If the off period is 1 s or longer, regard as a transfer fault and generate the ABS communication error. Generate the ABS communication error if [AL. E5 ABS time-out warning] is generated at the driver due to an ABS request on time time-out.

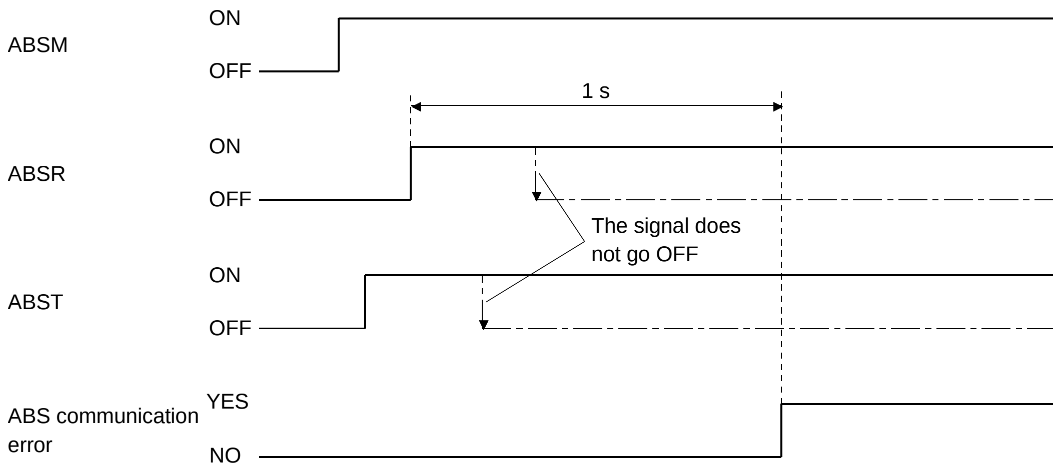


(2) The time required for the ABS transfer mode signal to go off after it has been turned on (ABS transfer time) is checked. If the ABS transfer time is longer than 5 s, regard that a transfer fault has occurred, and

generate the ABS communication error. Generate the ABS communication error if [AL. E5 ABS time-out warning] is generated at the driver due to an ABS transfer mode completion time time-out.



(3) The time required for the ABS request signal to go off after it has been turned on (ABS transfer time) is checked. To detect [AL. E5 ABS time-out warning] at the driver. If the ABS request remains on for longer than 1 s, regard that a fault relating to the ABS request signal or the ABST has occurred and generate the ABS communication error.
Generate the ABS communication error if [AL. E5 ABS time-out warning] is generated at the driver due to an ABS request off time time-out.



12.8 Communication-based absolute position transfer system

12.8.1 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 driver from where the data will be read.

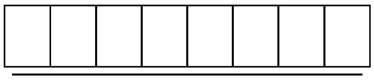
When the master station sends the data No. to the slave station (driver), the slave station returns the data value to the master station.

(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.



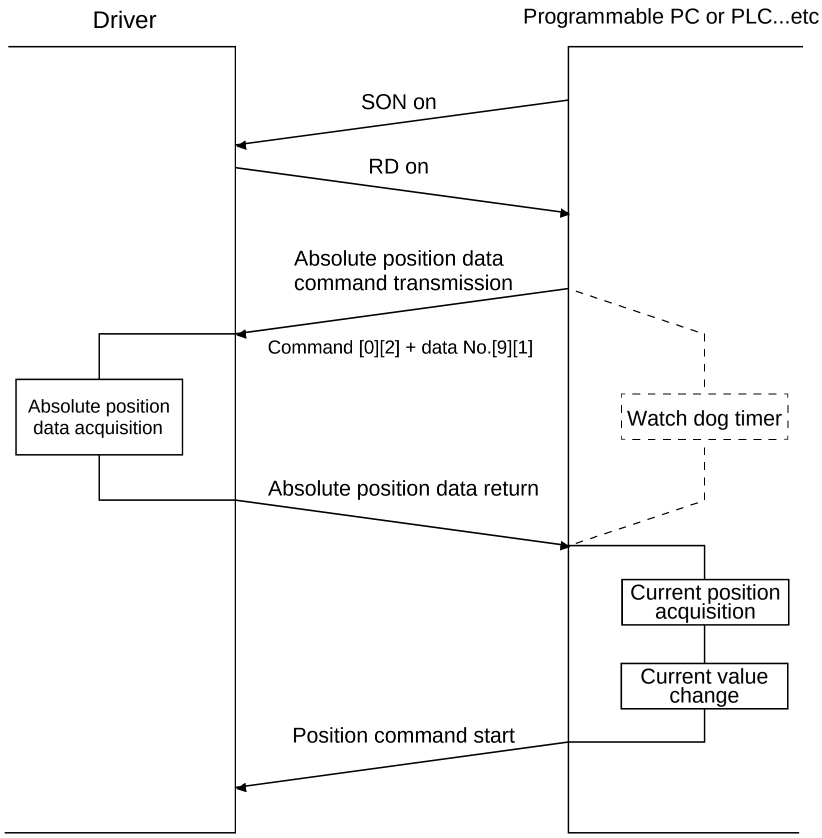
Data 32-bit length (hexadecimal representation)

12.8.2 Absolute position data transfer protocol

(1)Data transfer procedure

Every time 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.

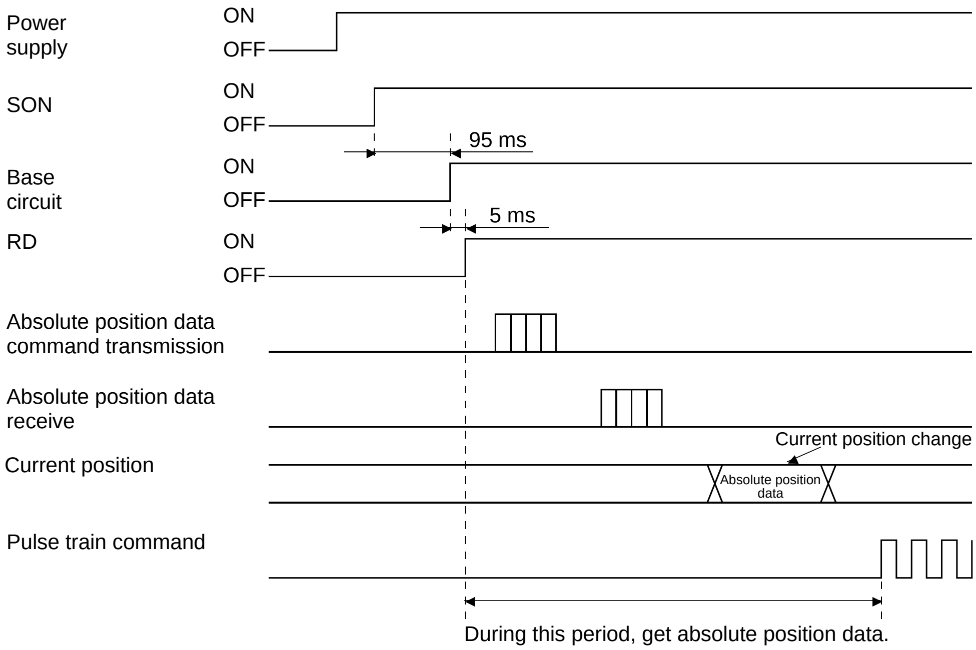
Time-out monitoring should be performed by the PC or PLC...etc.



(2)Transfer method

The following shows a sequence how to turn on the base circuit while it is off state because SON is off, EM2 is off, or an alarm is occurring. 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 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) The base circuit turns on after 95 ms.

2) After the base circuit is turned on, RD turns on.

3) After RD turned on and the PC or PLC...etc acquired the absolute position data, give command pulses to the driver. If the PC or PLC...etc gives command pulses before acquiring the absolute position data, a position shift can occur.

(b) Communication error

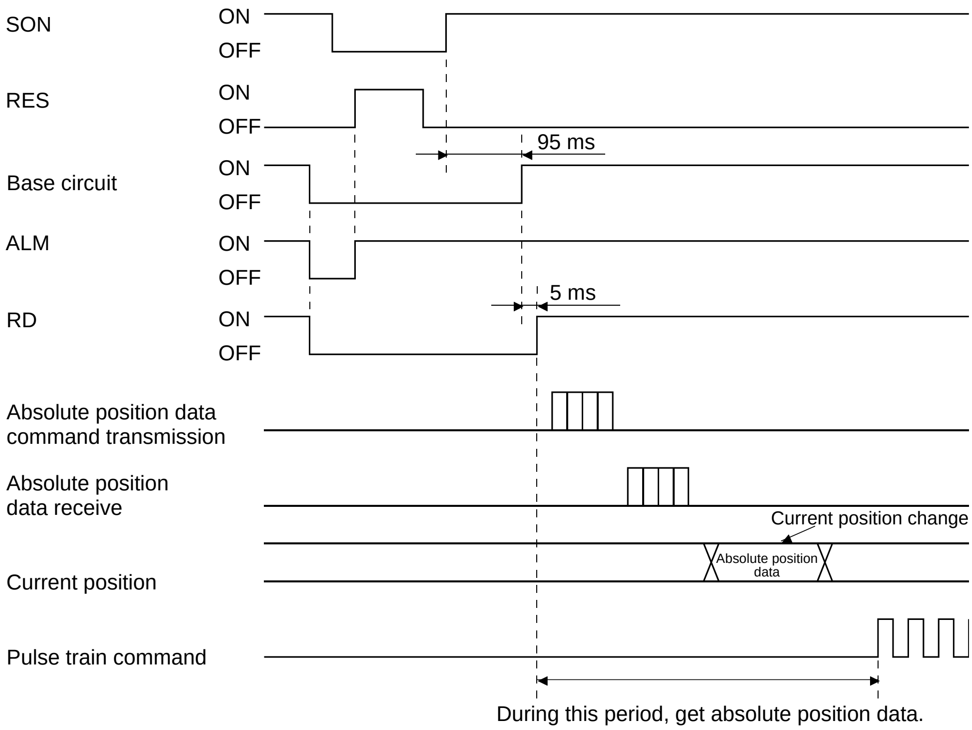
If a communication error occurs between the PC or PLC...etc and driver, the driver sends the error code. The definition of the error code is the same as that of the communication function.

Refer to section 14.3.3 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

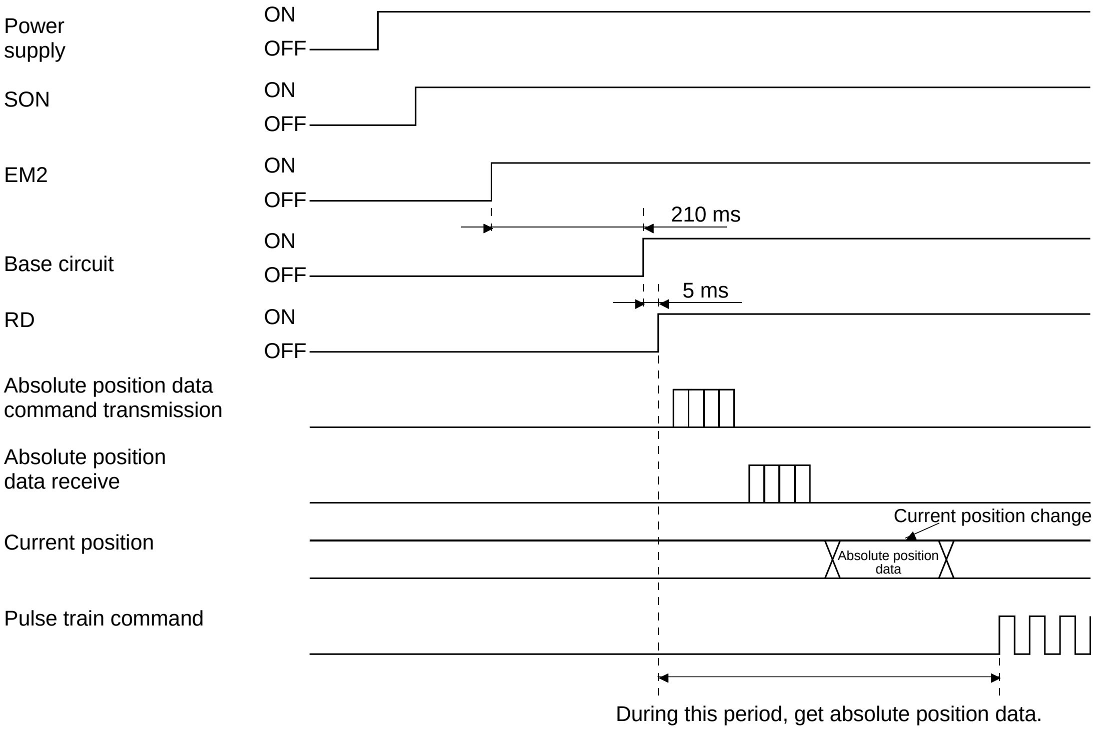
If an alarm has occurred, detect ALM and turn off SON. After removing the alarm occurrence factor and deactivating the alarm, get the absolute position data again from the driver in accordance with the procedure in (a) in this section.



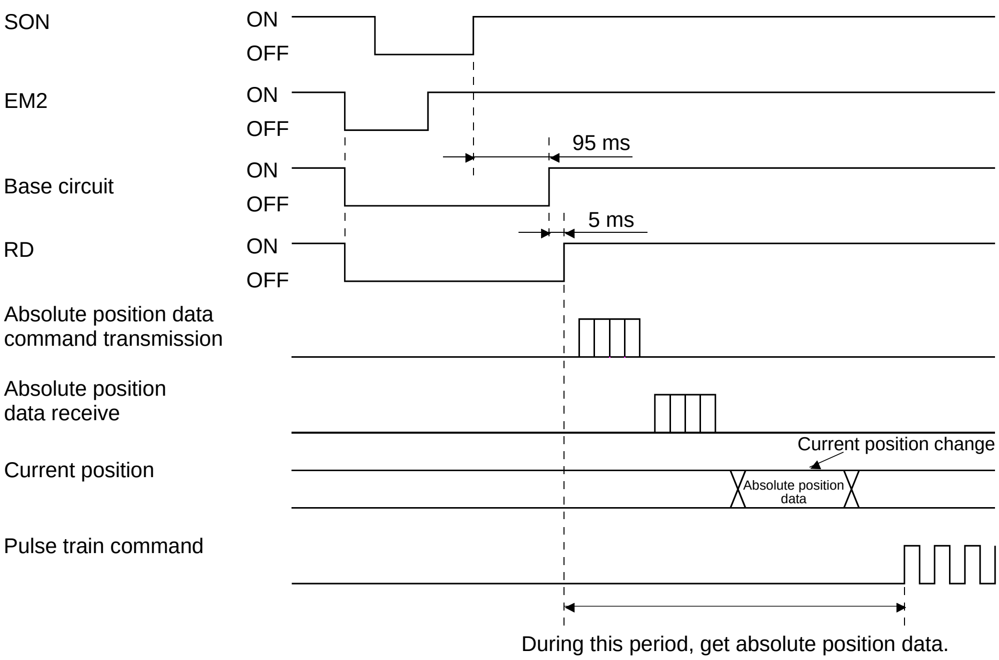
(d) At the time of forced stop reset

210 ms after the forced stop is deactivated, the base circuit turns on, and RD turns on further 5 ms after that, turns on. Always get the current position data using RD as the trigger before the position command is issued.

1) When power is switched on in a forced stop status



2) When a forced stop is activated during servo on



12.9 Battery replacement procedure

⚠WARNING	●Before installing a battery, turn off the main circuit power and wait for 15 minutes or longer 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, when confirming whether the charge lamp is off or not, always confirm it from the front of the driver.

⚠CAUTION	●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.

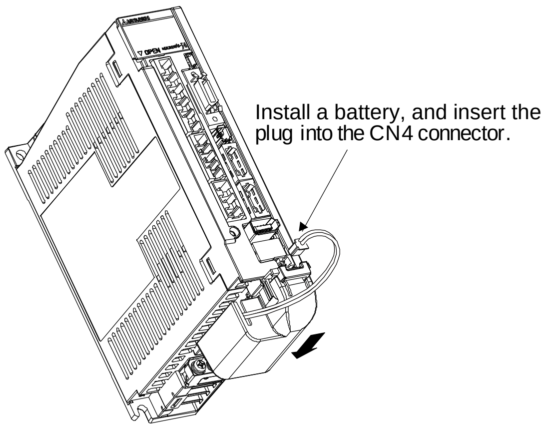
POINT

- ●Replacing battery with the control circuit power off will erase the absolute position data.
- ●Before replacing batteries, check that the new batteries are within battery life.

Replace the battery with only the control circuit power on. Replacing battery with the control circuit power on will not erase the absolute position data.

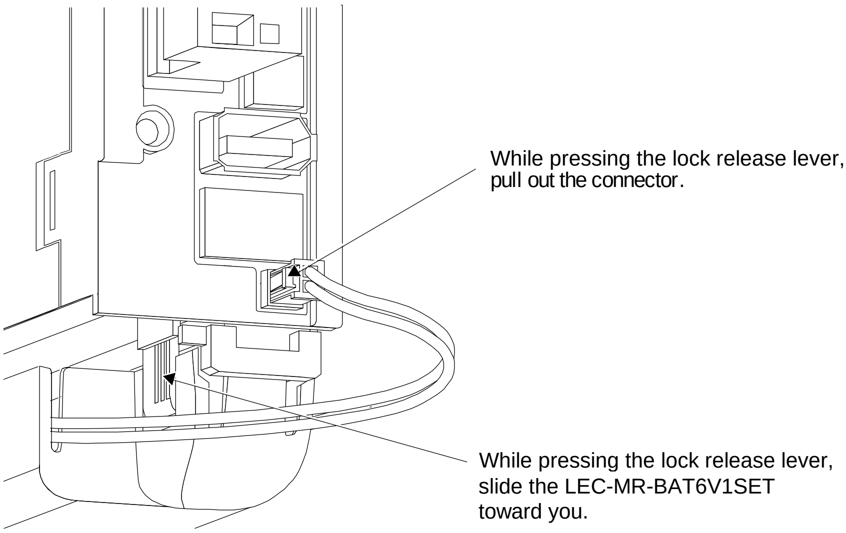
(1) Installation procedure

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.



(2) Removal procedure

⚠CAUTION	●Pulling out the connector of the LEC-MR-BAT6V1SET without the lock release lever pressed may damage the CN4 connector of the driver or the connector of the LEC-MR-BAT6V1SET.



13. USING STO FUNCTION

POINT
●In the torque control mode, the forced stop deceleration function is not available.

13.1 Introduction

This section provides the cautions of the STO function.

13.1.1 Summary

This driver complies with the following safety standards.

- ISO/EN ISO 13849-1 category 3 PL e
- IEC/EN 61508 SIL 3
- IEC/EN 61800-5-2
- IEC/EN 62061 SIL CL3

13.1.2 Terms related to safety

The STO function shuts down energy to servo motors, thus removing torque. This function electronically cuts off power supply in the driver.

The purpose of this safety function is as follows.

(1) Uncontrolled stop according to stop category 0 of IEC/EN 60204-1

(2) Preventing unexpected start-up

13.1.3 Cautions

The following basic safety notes must be read carefully and fully in order to prevent injury to persons or damage to property.

Only qualified personnel are authorized to install, start-up, repair, or service the machines in which these components are installed.

They must be familiar with all applicable local regulations and laws in which machines with these components are installed, particularly the standards mentioned in this manual.

The staff responsible for this work must be given express permission from the company to perform start-up, programming, configuration, and maintenance of the machine in accordance with the safety standards.

⚠WARNING	●Improper installation of the safety related components or systems may cause improper operation in which safety is not assured, and may result in severe injuries or even death.

Protective Measures

- This driver satisfies the Safe Torque Off (STO) function described in IEC/EN 61800-5-2 by preventing the energy supply from the driver to the servo motor. If an external force acts upon the drive axis, additional safety measures, such as locks or counterbalances must be used.

13.1.4 Residual risks of the STO function

Machine manufacturers are responsible for all risk evaluations and all associated residual risks. Below are residual risks associated with the STO function. SMC is not liable for any damages or injuries caused by these risks.

(1) The STO function disables energy supply to the servo motor by electrical shut-off. The function does not mechanically disconnect electricity from the motor. Therefore, it cannot prevent exposure to electric shock. To prevent an electric shock, install a magnetic contactor or a molded-case circuit breaker to the main circuit power supply (L1, L2, and L3) of the driver.

(2) The STO function disables energy supply to the servo motor by electrical shut-off. It does not guarantee the stop control or the deceleration control of the servo motor.

(3) For proper installation, wiring, and adjustment, thoroughly read the manual of each individual safety related component.

(4) In the safety circuit, use components that are confirmed safe or meet the required safety standards.

(5) The STO function does not guarantee that the drive part of the servo motor will not rotate due to external or other forces.

(6) Safety is not assured until safety-related components of the system are completely installed or adjusted.

(7) When replacing this driver, confirm that the model name of drivers are exactly the same as those being replaced. Once installed, make sure to verify the performance of the safety functions before commissioning the system.

(8) Perform all risk assessments to the machine or the whole system.

(9) To prevent accumulation of malfunctions, perform malfunction checks at regular intervals based on the risk assessments of the machine or the system. Regardless of the system safety level, malfunction checks should be performed at least once per year.

(10) If the upper and lower power module in the driver are shorted and damaged simultaneously, the servo motor may make a half revolution at a maximum.

(11) The STO input signals (STO1 and STO2) must be supplied from one power source. Otherwise, the STO function may not function properly due to a sneak current, failing to bring the STO shut-off state.

(12) For the STO I/O signals of the STO function, supply power by using a safety extra low voltage (SELV) power supply with the reinforced insulation.

13.1.5 Specifications

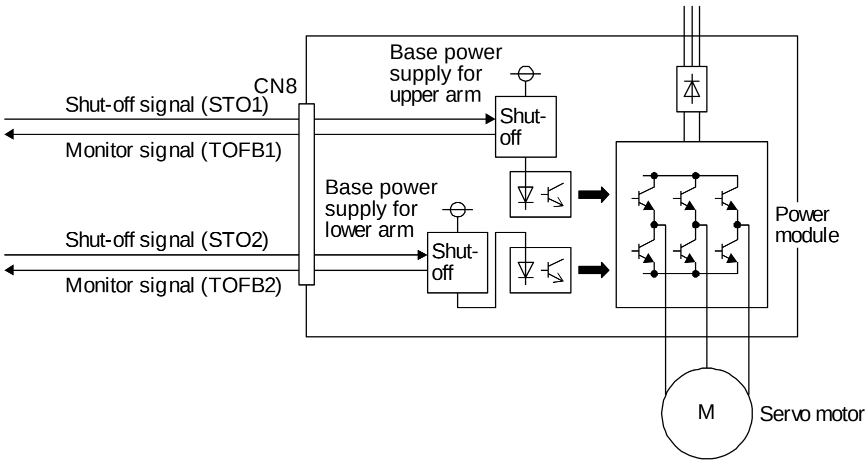
(1) Specifications

Item	Specifications
Safety function	STO (IEC/EN 61800-5-2)
Safety performance	ISO/EN ISO 13849-1 category 3 PL e, IEC/EN 61508 SIL 3, EN 62061 SIL CL3, EN 61800-5-2
Mean time to dangerous failure (MTTFd)	MTTFd ≥ 100 [years] (Note)
Diagnostic converge (DC)	DC = Medium, 97.6[%] (Note)
Average probability of dangerous failures per hour (PFH)	PFH = 6.4 × 10^{-9} [1/h]
Number of on/off times of STO	1,000,000 times
CE marking	LVD: EN 61800-5-1 EMC: EN 61800-3 MD: EN ISO 13849-1, EN 61800-5-2, EN 62061

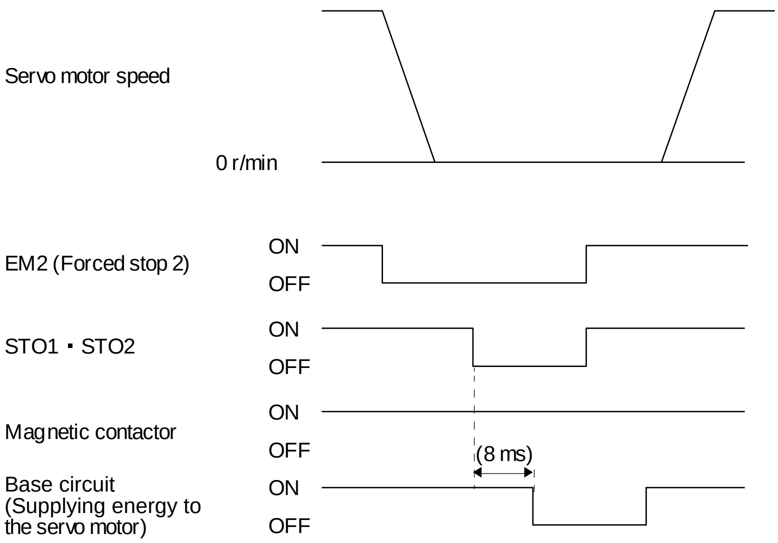
Note 1. This is the value required by safety standards.

2. The safety level is determined by the setting value of [Pr. PF18 STO diagnosis error detection time] and whether or not STO input diagnosis by TOFB output is performed. For details, refer to the function column of [Pr. PF18] described in section 5.2.6.

(2) Function block diagram (STO function)



(3) Operation sequence (STO function)



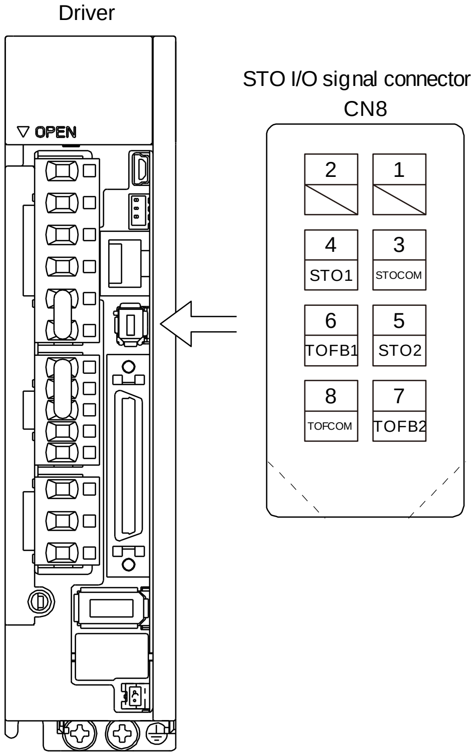
13.1.6 Maintenance

This driver has alarms and warnings for maintenance that supports the drive safety function. (Refer to chapter 8.)

13.2 STO I/O signal connector (CN8) and signal layouts

13.2.1 Signal layouts

POINT
●The pin configurations of the connectors are as viewed from the cable connector wiring section.



13.2.2 Signal (device) explanations

(1) I/O device

Signal name	Connector pin No.	Description	I/O division
STOCOM	CN8-3	Common terminal for input signal of STO1 and STO2	DI-1
STO1	CN8-4	Inputs STO state 1. STO state (base shut-off): Open between STO1 and STOCOM. STO release state (in driving): Close between STO1 and STOCOM. Be sure to turn off STO1 after the servo motor stops by the servo-off state or with forced stop deceleration by turning off EM2 (Forced stop 2).	DI-1
STO2	CN8-5	Inputs STO state 2. STO state (base shut-off): Open between STO2 and STOCOM. STO release state (in driving): Close between STO2 and STOCOM. Be sure to turn off STO2 after the servo motor stops by the servo-off state or with forced stop deceleration by turning off EM2 (Forced stop 2).	DI-1
TOFCOM	CN8-8	Common terminal for monitor output signal in STO state	DO-1
TOFB1	CN8-6	Monitor output signal in STO1 state STO state (base shut-off): Between TOFB1 and TOFCOM is closed. STO release state (in driving): Between TOFB1 and TOFCOM is opened.	DO-1
TOFB2	CN8-7	Monitor output signal in STO2 state STO state (base shut-off): Between TOFB2 and TOFCOM is closed. STO release state (in driving): Between TOFB2 and TOFCOM is opened.	DO-1

(2) Signals and STO state

The following table shows the TOFB and STO states when the power is on in normal state and STO1 and STO2 are on (closed) or off (opened).

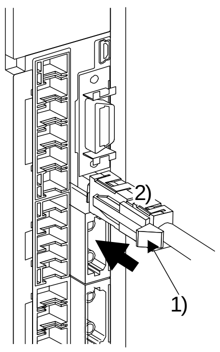
Input signal		State		
STO1	STO2	Between TOFB1 and TOFCOM (Monitoring STO1 state)	Between TOFB2 and TOFCOM (Monitoring STO2 state)	Between TOFB1 and TOFB2 (Monitoring STO state of driver)
Off	Off	On: STO state (base circuit shut-off)	On: STO state (base circuit shut-off)	On: STO state (base circuit shut-off)
Off	On	On: STO state (base circuit shut-off)	Off: STO release state	Off: STO state (base circuit shut-off)
On	Off	Off: STO release state	On: STO state (base circuit shut-off)	Off: STO state (base circuit shut-off)
On	On	Off: STO release state	Off: STO release state	Off: STO release state

(3) Test pulse of STO input signal

Set the test pulse off time inputted from outside to 1 ms or less.

13.2.3 How to pull out the STO cable

The following shows how to pull out the STO cable from the CN8 connector of the driver.

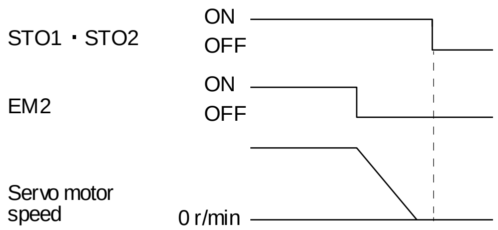


While pressing knob 1) of the STO cable plug in the direction of the arrow, pull out the plug 2).

13.3 Connection example

POINT

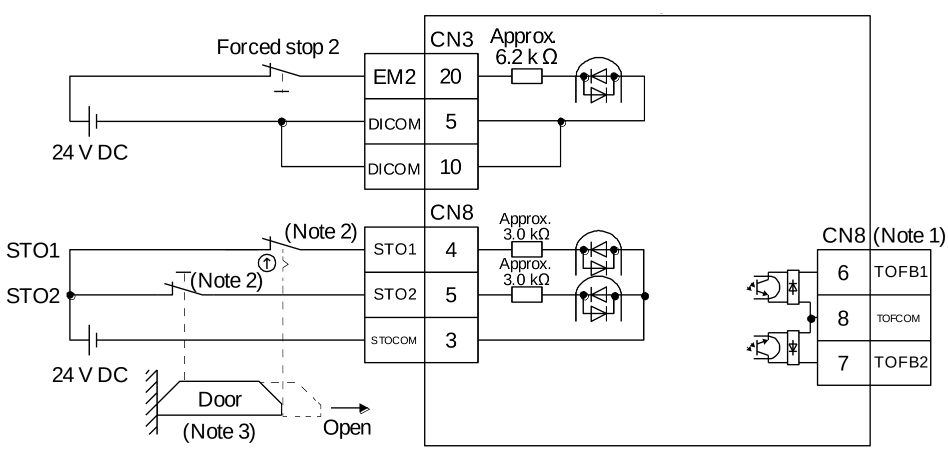
- Turn off STO (STO1 and STO2) after the servo motor stops by the servo off state or with forced stop deceleration by turning off EM2 (Forced stop 2). Configure an external sequence that has the timings shown as below using an external device such as the MR-J3-D05 safety logic unit of Mitsubishi Electric Corporation.



- If STO is turned off during operation, the servo motor is in dynamic lock stop (stop category 0), and [AL.63 STO timing error] will occur.

13.3.1 Connection example for CN8 connector

This driver is equipped with the connector (CN8) in accordance with the STO function. When this connector is used with a certified external safety relay, power to the motor can be safely removed and unexpected restart can be prevented. The safety relay used should meet the applicable safety standards and have forcibly guided or mirror contacts for the purpose of error detection.
In addition, the MR-J3-D05 safety logic unit of Mitsubishi Electric Corporation can be used instead of a safety relay for implementation of various safety standards. Refer to Appendix 5 for details.
The following diagram is for source interface. For sink interface, refer to section 13.4.1.



Note 1. By using TOFB, whether the servo is in the STO state can be confirmed. For connection examples, refer to section 13.3.2 to 13.3.3. The safety level is determined by the setting value of [Pr. PF18 STO diagnosis error detection time] and whether or not STO input diagnosis by TOFB output is performed. For details, refer to the function column of [Pr. PF18] described in section 5.2.6.

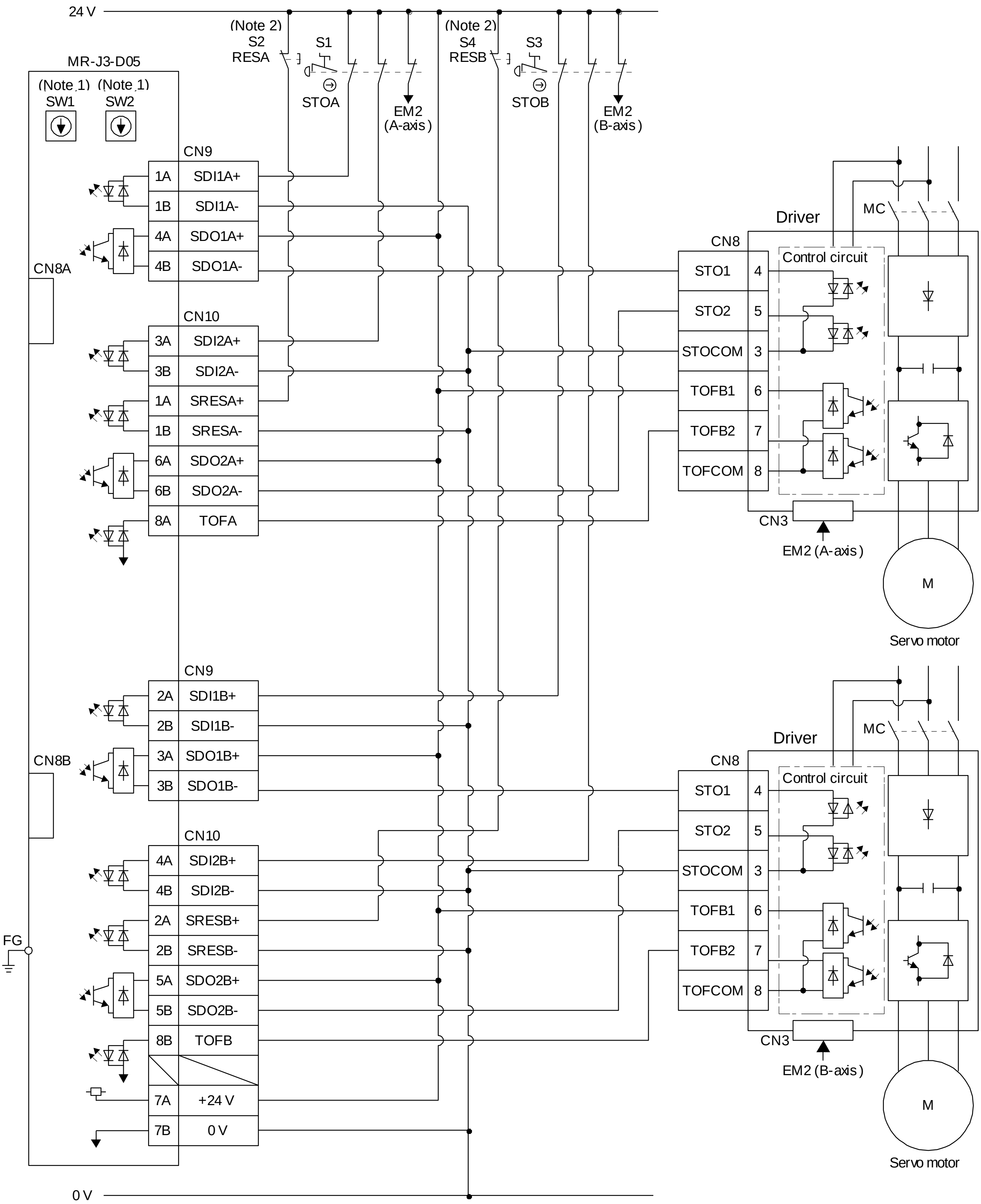
2. When using the STO function, turn off STO1 and STO2 at the same time. Turn off STO1 and STO2 after the servo motor stops by the servo off state or with forced stop deceleration by turning off EM2 (Forced stop 2).

3. Configure the interlock circuit so that the door is open after the servo motor is stopped.

13.3.2 External I/O signal connection example using an MR-J3-D05 safety logic unit of Mitsubishi Electric Corporation

POINT
●This connection is for the source interface. For the other I/O signals, refer to the connection examples in section 3.2.

(1) Connection example



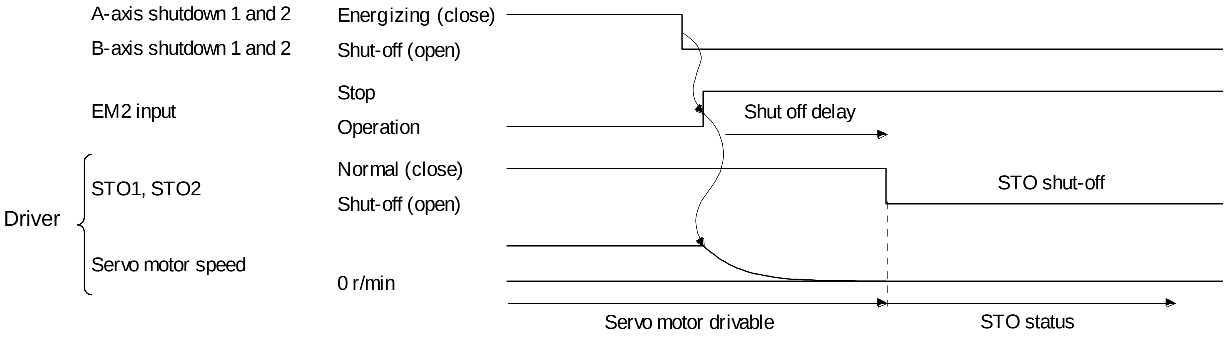
Note 1. Set the delay time of STO output with SW1 and SW2. These switches for MR-J3-D05 of Mitsubishi Electric Corporation are located where dented from the front panel.

Note 2. To release the STO state (base circuit shut-off), turn RESA and RESB on and turn them off.

(2) Basic operation example

STOA switch input is output to SDO1A and SDO2A of MR-J3-D05 (Mitsubishi Electric Corporation) and input to driver.

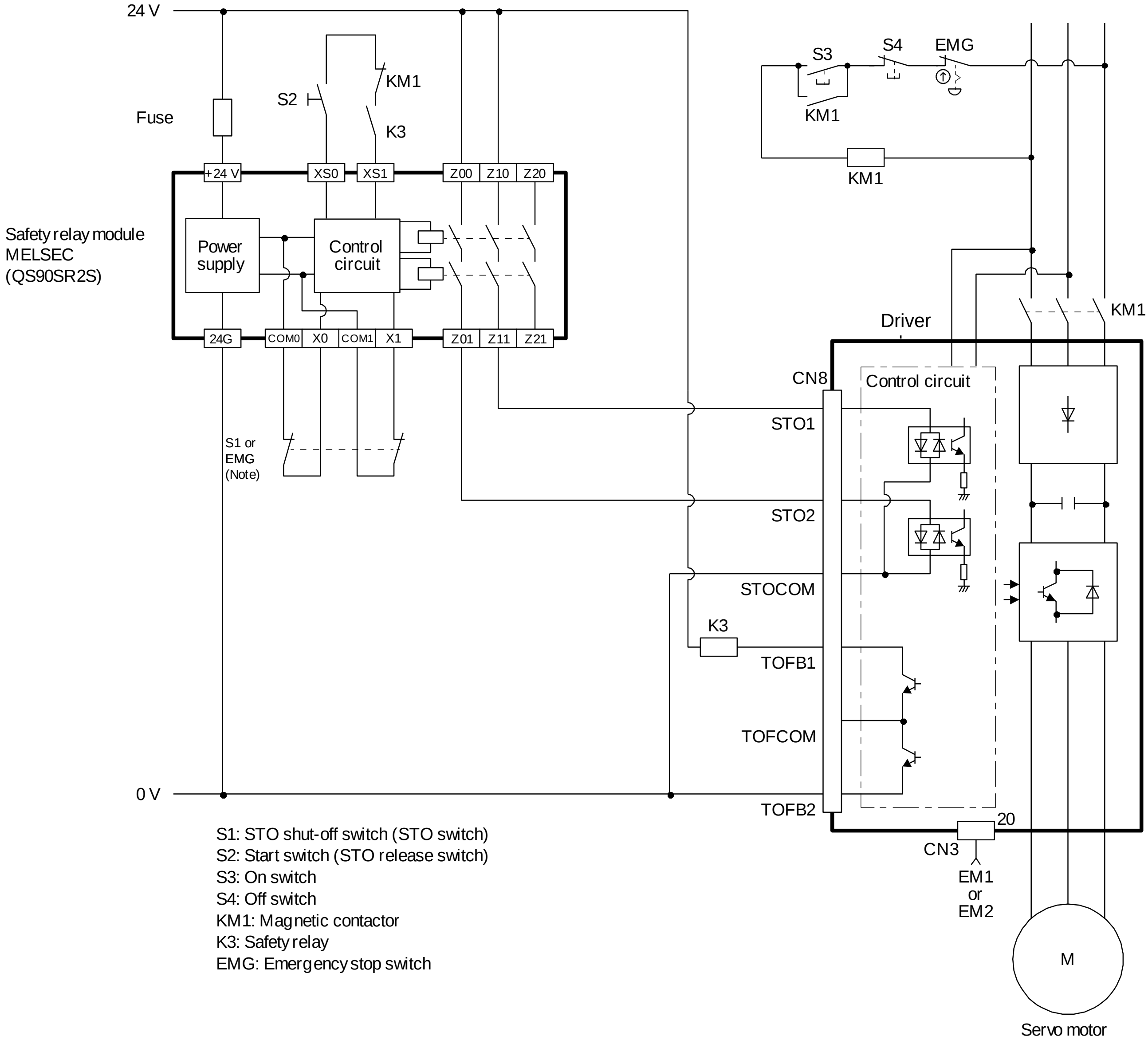
STOB switch input is output to SDO1B and SDO2B of MR-J3-D05 (Mitsubishi Electric Corporation) and input to the driver.



13.3.3 External I/O signal connection example using an external safety relay unit

POINT
● This connection is for the source interface. For the other I/O signals, refer to the connection examples in section 3.2.

This connection example complies with the requirement of ISO/EN ISO 13849-1 category 3 PL d.



S1: STO shut-off switch (STO switch)
S2: Start switch (STO release switch)
S3: On switch
S4: Off switch
KM1: Magnetic contactor
K3: Safety relay
EMG: Emergency stop switch

Note. To enable the STO function of the driver by using "Emergency switching off", change S1 to EMG. The stop category at this time is "0". If STO is turned off while the servo motor is rotating, [AL. 63 STO timing error] will occur.

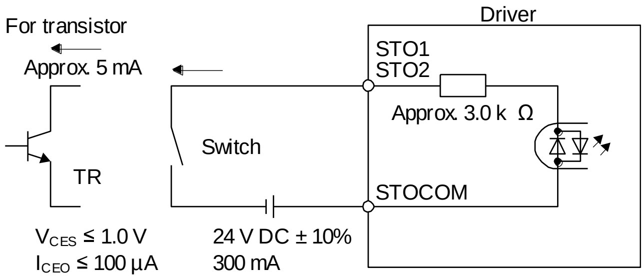
13.4 Detailed description of interfaces

This section provides the details of the I/O signal interfaces (refer to the I/O division in the table) given in section 13.2. Refer to this section and make connection with the external device.

13.4.1 Sink I/O interface

(1) Digital input interface DI-1

This is an input circuit whose photocoupler cathode side is input terminal. Transmit signals from sink (open-collector) type transistor output, relay switch, etc.



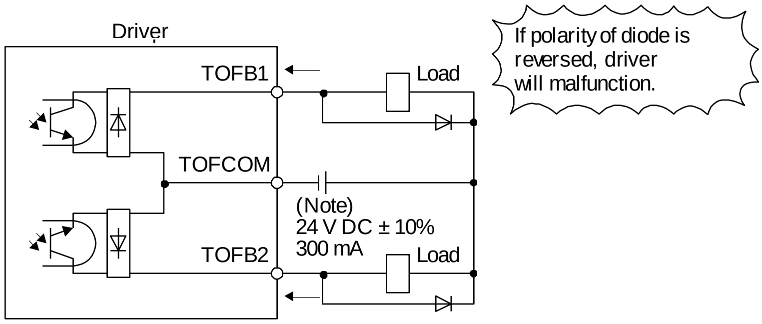
(2) Digital output interface DO-1

This is a circuit of collector output terminal of the output transistor. When the output transistor is turned on, collector terminal current will be applied for the output.

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.

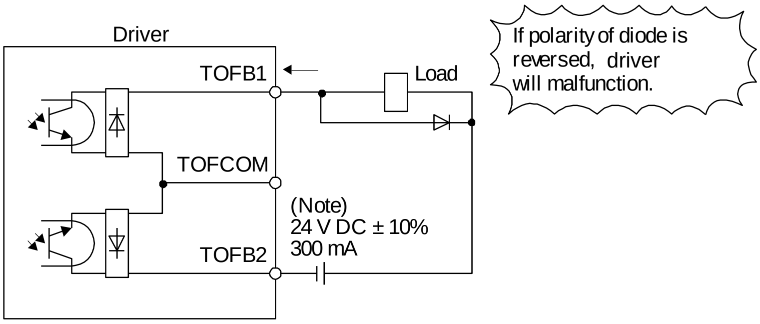
(Rated current: 40 mA or less, maximum current: 50 mA or less, inrush current: 100 mA or less) A maximum of 5.2 V voltage drop occurs in the driver.

(a) When outputting two STO states by using each TOFB



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

(b) When outputting two STO states by using one TOFB



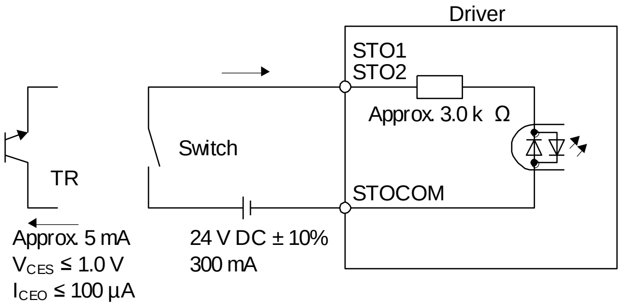
Note. If the voltage drop (maximum of 5.2 V) interferes with the relay operation, apply high voltage (maximum of 26.4 V) from external source.

13.4.2 Source I/O interface

In this driver, source type I/O interfaces can be used.

(1) Digital input interface DI-1

This is an input circuit whose photocoupler anode side is input terminal. Transmit signals from source (open-collector) type transistor output, relay switch, etc.

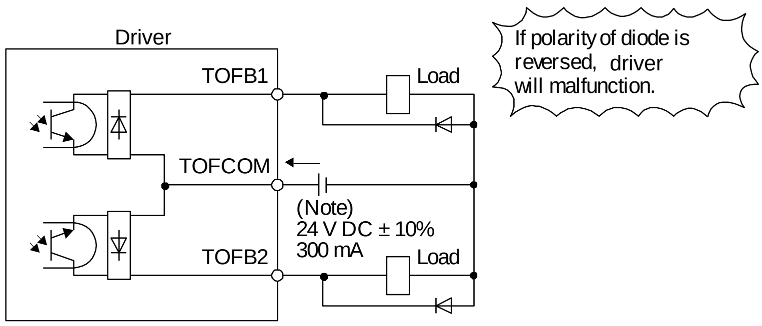


(2) Digital output interface DO-1

This is a circuit of emitter output terminal of the output transistor. When the output transistor is turned on, current will be applied from the output to a load.

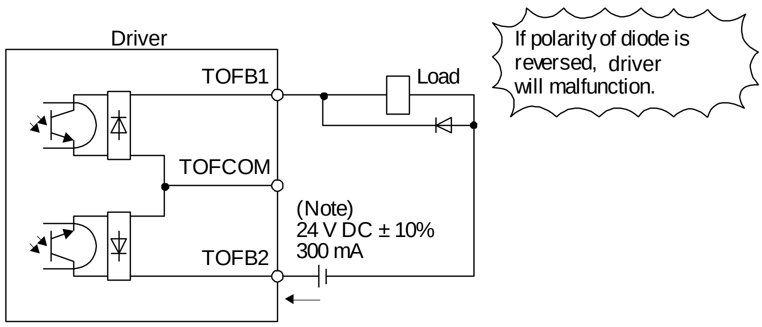
A maximum of 5.2 V voltage drop occurs in the driver.

(a) When outputting two STO states by using each TOFB



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

(b) When outputting two STO states by using one TOFB



Note. If the voltage drop (maximum of 5.2 V) interferes with the relay operation, apply high voltage (maximum of 26.4 V) from external source.

14. COMMUNICATION FUNCTION

⚠CAUTION	●The CN3 connector is designed for RS-422/RS-485 communication only. Do not connect the CN3 connector to an Ethernet port, etc. Doing so may cause a malfunction.

POINT
●The USB communication function (CN5 connector) and the RS-422 communication function (CN3 connector) are mutually exclusive functions. They cannot be used together.

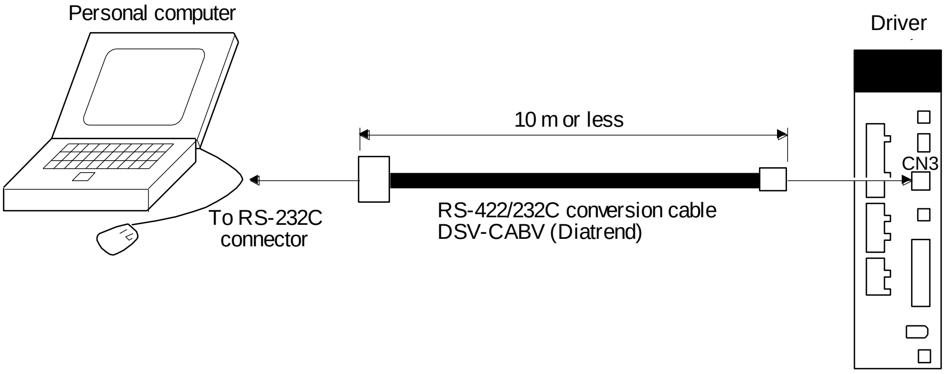
You can operate servo driving, parameter change, monitor function, etc. using RS-422 communication with the driver.

14.1 Structure

14.1.1 Configuration diagram

(1) Single axis

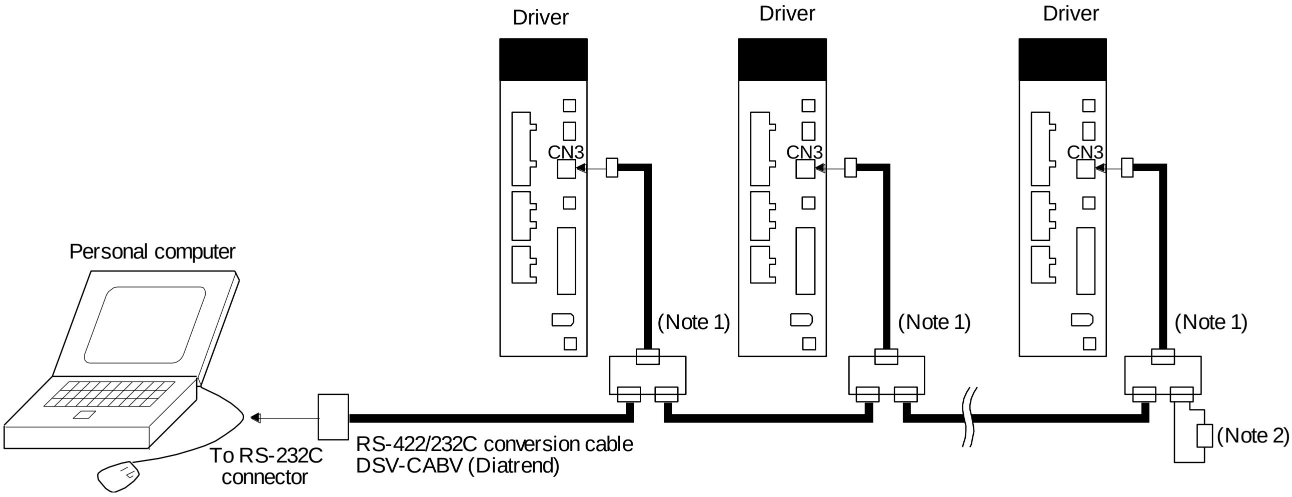
Operate the single-axis driver. It is recommended to use the following cable.



(2) Multi-drop connection

(a) Diagrammatic sketch

Up to 32 axes of drivers from stations 0 to 31 can be operated on the same bus.

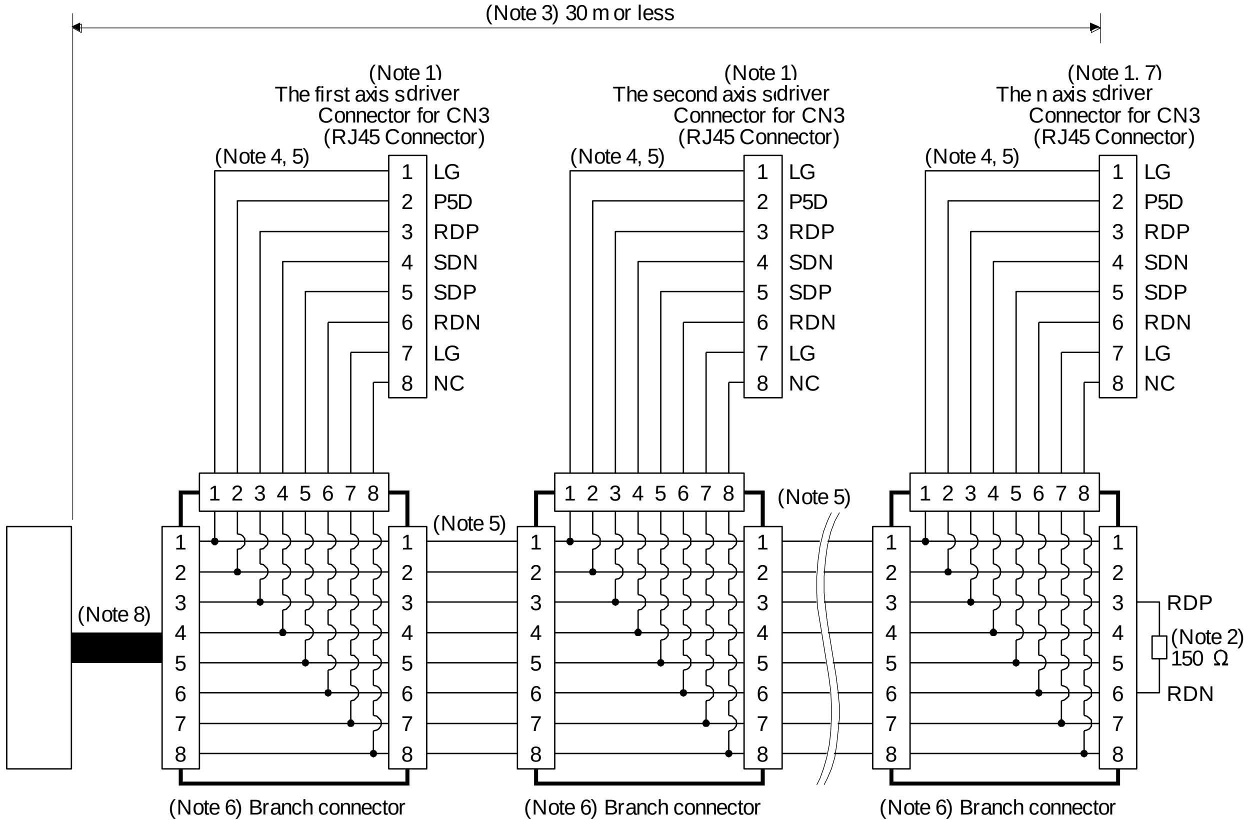


Note 1. The BMJ-8 (Hachiko Electric) is recommended as the branch connector.

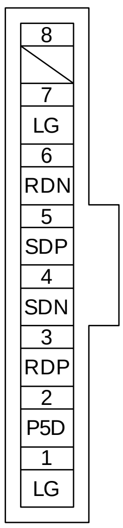
2. The final axis must be terminated between RDP (pin No. 3) and RDN (pin No. 6) on the receiving side (driver) with a 150 Ω resistor.

(b) Cable connection diagram

Wire the cables as follows.



Note 1. Recommended connector (Hirose Electric)
Plug: TM10P-88P
Connection tool: CL250-0228-1
The following shows pin assignment viewed from connector wiring section.



2. The final axis must be terminated between RDP (pin No. 3) and RDN (pin No. 6) on the receiving side (driver) with a 150 Ω resistor.
3. The overall length is 30 m 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 (Hachiko Electric)
7. n ≤ 32 (Up to 32 axes can be connected.)
8. RS-422/232C conversion cable DSV-CABV (Diatrend)

14.1.2 Precautions for using RS-422/RS-232C/USB communication function

Note the following to prevent an electric shock and malfunction of the driver.

(1) Power connection of personal computers
Connect your personal computer with the following procedures.

(a) When you use a personal computer with AC power supply

1) When using a personal computer with a three-core power plug or power plug with grounding wire, use a three-pin socket or ground the grounding wire.

2) When your personal computer has two-core plug and has no grounding wire, connect the personal computer to the driver with the following procedures.

a) Disconnect the power plug of the personal computer from an AC power socket.

b) Check that the power plug was disconnected and connect the device to the driver.

c) Connect the power plug of the personal computer to the AC power socket.

(b) When you use a personal computer with battery
You can use as it is.

(2) Connection with other devices using driver communication function
When the driver is charged with electricity due to connection with a personal computer and the charged driver is connected with other devices, the driver or the connected devices may malfunction. Connect the driver and other devices with the following procedures.

(a) Shut off the power of the device for connecting with the driver.

(b) Shut off the power of the driver which was connected with the personal computer and check the charge lamp is off.

(c) Connect the device with the driver.

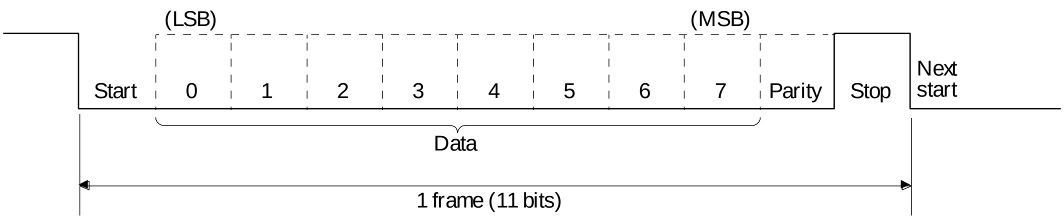
(d) Turn on the power of the driver and the device.

14.2 Communication specifications

14.2.1 Outline of communication

Receiving a command, this driver returns data. The device which gives the command (e.g. personal computer) is called a master station and the device (driver) which returns data in response to the command is called a slave station. When fetching data successively, the master station repeatedly commands the slave station to send data.

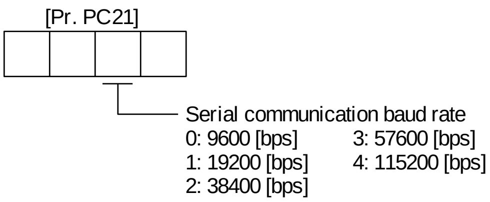
Item	Definition	
Baud rate [bps]	9600/19200/38400/57600/115200 asynchronous system	
Transfer code	Start bit Data bit Parity bit Stop bit	1 bit 8 bits 1 bit (even) 1 bit
Transfer method	Character method	Half-duplex communication method



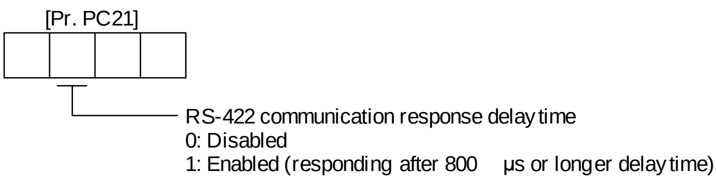
14.2.2 Parameter setting

When the RS-422 communication function is used to operate the servo, set the communication specifications of the driver with the parameters.
To enable the parameter values, cycle the power after setting.

(1) Serial communication baud rate
Select 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 returns data.
Set "0" to return data in less than 800 μs or "1" to return data in 800 μs or longer.



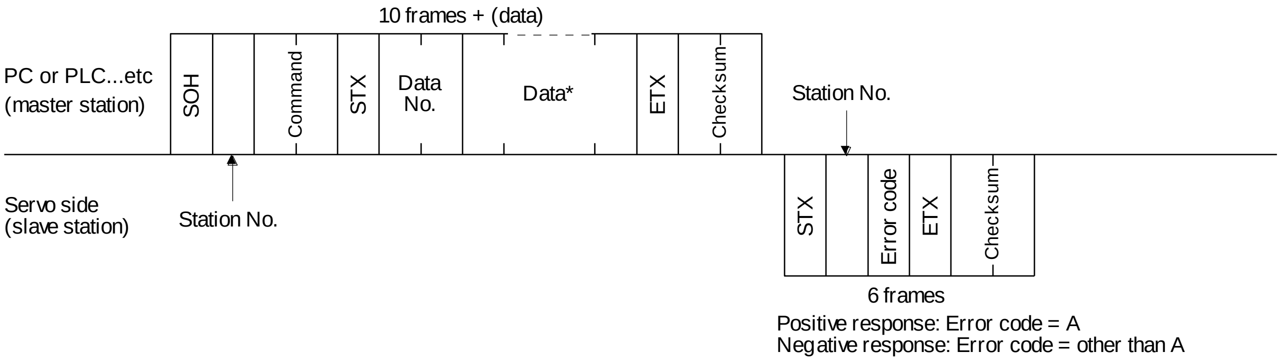
(3) Station No. setting
Set the station No. of the driver to [Pr. PC20]. The setting range is station No. 0 to 31.

14.3 Protocol

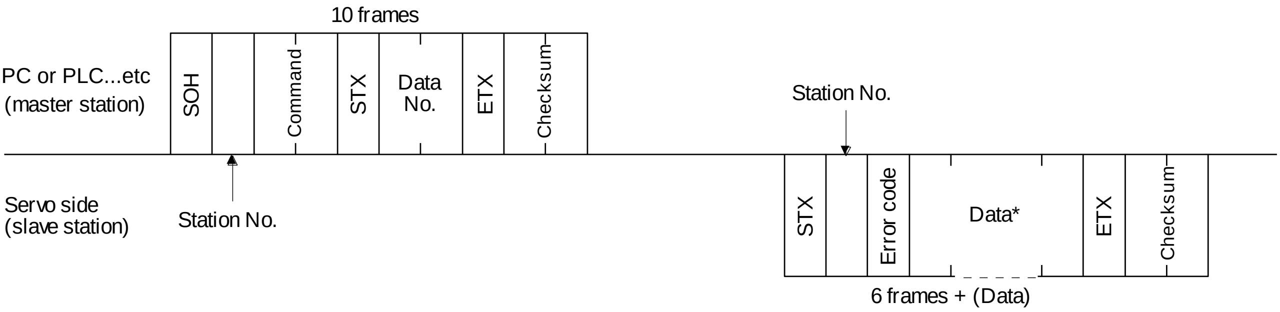
14.3.1 Transmission data configuration

Since up to 32 axes may be connected to the bus, add a station No. to the command, data No., etc. to determine the destination driver of data communication. Set the station No. to each driver using the parameters. Transmission data is enabled for the driver of the specified station No.
When "*" is set as the station No. added to the transmission data, the transmission data is enabled for all drivers connected. However, when return data is required from the driver in response to the transmission data, set "0" to the station No. of the driver which must provide the return data.

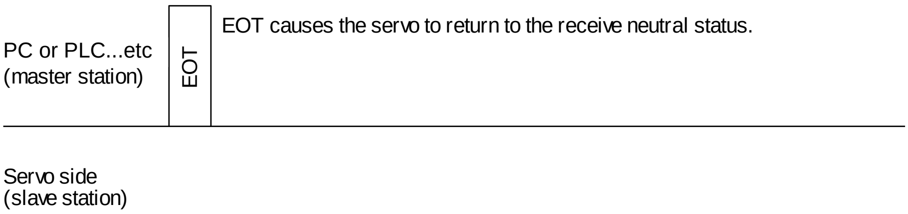
(1) Transmission of data from the PC or PLC...etc to the servo



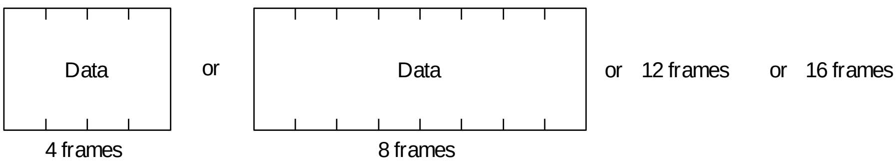
(2) Transmission of data request from the PC or PLC...etc to the servo



(3) Recovery of communication status by time-out



(4) Data frames
The data length depends on the command.



14.3.2 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.

					b8	0	0	0	0	0	0	0	0
					b7	0	0	0	0	1	1	1	1
					b6	0	0	1	1	0	0	1	1
					b5	0	1	0	1	0	1	0	1
b8 to b5	b4	b3	b2	b1	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 Nos. from station 0 to station 31 and the ASCII unit codes are used to specify the stations.

Station No.	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 No.	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 No. "0" (axis 1).

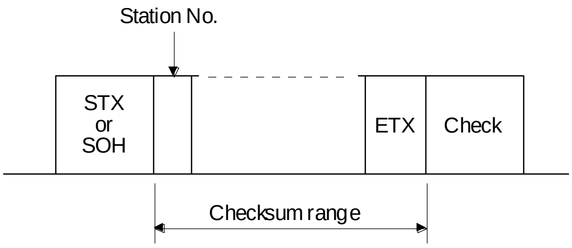
14.3.3 Error codes

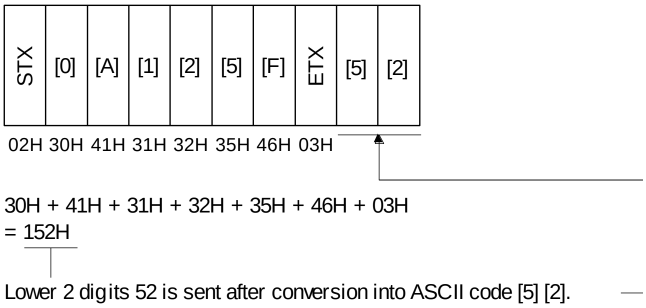
Error codes are used in the following cases and an error code of single-code length is transmitted.
Receiving data from the master station, the slave station sends the error code corresponding to that data to the master station. The error code sent in upper case indicates that the servo is normal and the one in lower case indicates that an alarm occurred.

Error code		Error name	Explanation	Remark
Servo: normal	Servo: alarm			
[A]	[a]	Normal	Data transmitted was processed normally.	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	The transmitted character is out of specifications.	
[E]	[e]	Command error	The transmitted command is out of specifications.	
[F]	[f]	Data No. error	The transmitted data No. is out of specifications.	

14.3.4 Checksum

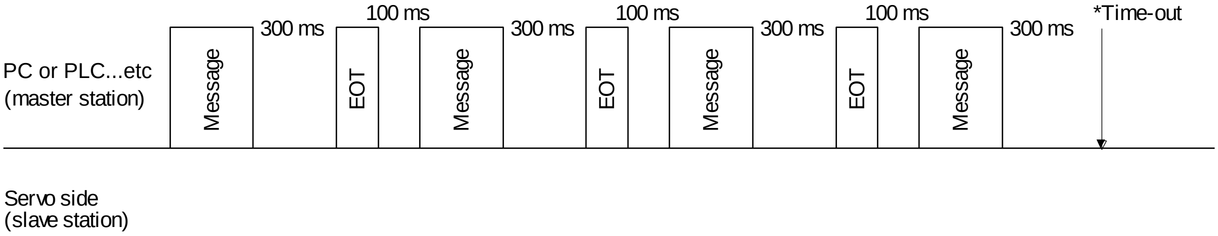
The checksum is an ASCII-coded hexadecimal representing the lower two digits of the sum of ASCII-coded hexadecimal numbers up to ETX, with the exception of the first control code (STX or SOH).





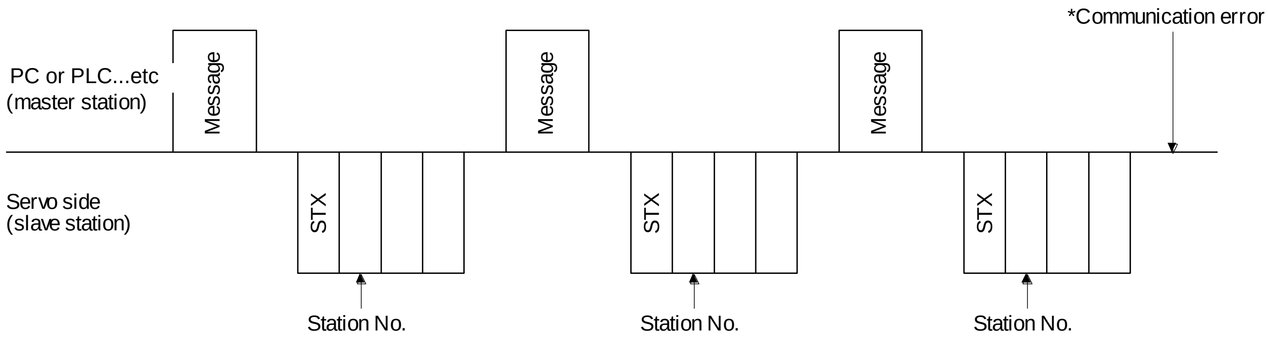
14.3.5 Time-out processing

The master station transmits EOT when the slave station does not start return 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)



14.3.6 Retry processing

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.

14.3.7 Initialization

After the slave station is switched on, it cannot return to communication until the internal initialization processing terminates. Hence, at power-on, ordinary communication should be started after.

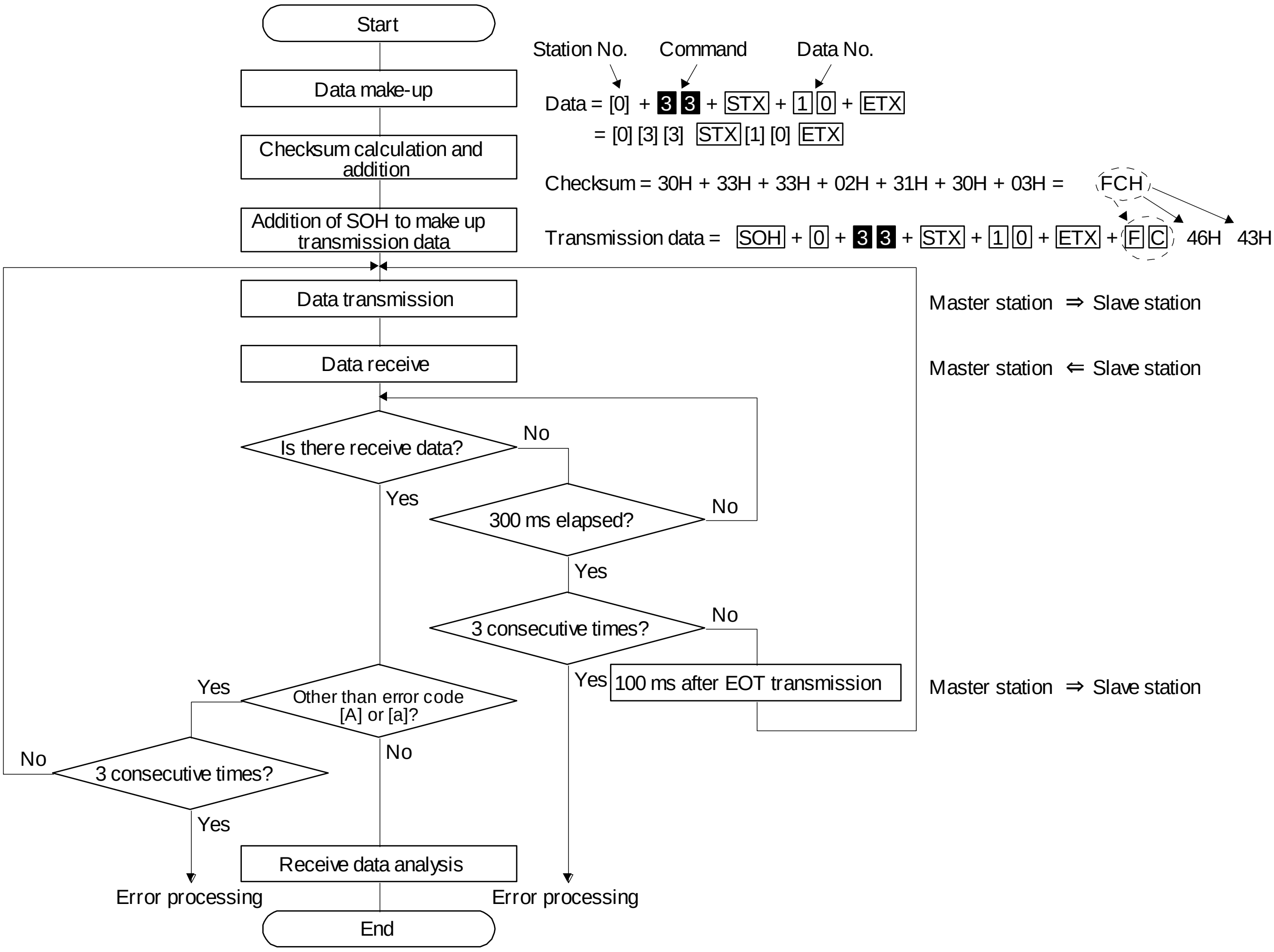
(1) Wait for 3.5 s or longer after the slave station is switched on.

(2) Check that normal communication can be made by reading the parameter or other data which does not pose any safety problems.

14.3.8 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 No.	0	Driver station 0
Command	3 3	Reading command
Data No.	1 0	Alarm history (last alarm)



14.4 Command and data No. list

POINT
●Even if a command or data No. is the same between different model drivers, its description may differ.

14.4.1 Reading command

(1) Status display (command [0] [1])

Command	Data No.	Description	Status display	Frame length
[0] [1]	[0] [0]	Status display symbol and unit	Cumulative feedback pulses	16
	[0] [1]		Servo motor speed	
	[0] [2]		Droop pulses	
	[0] [3]		Cumulative command pulses	
	[0] [4]		Command pulse frequency	
	[0] [5]		Analog speed command voltage Analog speed limit voltage	
	[0] [6]		Analog torque limit voltage Analog torque command voltage	
	[0] [7]		Regenerative load ratio	
	[0] [8]		Effective load ratio	
	[0] [9]		Peak load ratio	
	[0] [A]		Instantaneous torque	
	[0] [B]		Position within one-revolution	
	[0] [C]		ABS counter	
	[0] [D]		Load to motor inertia ratio	
	[0] [E]		Bus voltage	
	[0] [F]		Load-side cumulative feedback pulses	
	[1] [0]		Load-side droop pulses	
	[1] [1]		Load-side encoder information 1 Z-phase counter	
	[1] [2]		Load-side encoder information 2	
	[1] [6]		Temperature of motor thermistor	
	[1] [7]		Motor-side cumu. feedback pulses (before gear)	
	[1] [8]		Electrical angle	
	[1] [E]		Motor-side/load-side position deviation	
	[1] [F]		Motor-side/load-side speed deviation	
	[2] [0]		Internal temperature of encoder	
	[2] [1]		Settling time	
	[2] [2]		Oscillation detection frequency	
	[2] [3]		Number of tough operations	
	[2] [8]		Unit power consumption	
	[2] [9]		Unit total power consumption	

Command	Data No.	Description	Status display	Frame length
[0] [1]	[8] [0]	Status display data value and processing information	Cumulative feedback pulses	12
	[8] [1]		Servo motor speed	
	[8] [2]		Droop pulses	
	[8] [3]		Cumulative command pulses	
	[8] [4]		Command pulse frequency	
	[8] [5]		Analog speed command voltage Analog speed limit voltage	
	[8] [6]		Analog torque limit voltage Analog torque command voltage	
	[8] [7]		Regenerative load ratio	
	[8] [8]		Effective load ratio	
	[8] [9]		Peak load ratio	
	[8] [A]		Instantaneous torque	
	[8] [B]		Position within one-revolution	
	[8] [C]		ABS counter	
	[8] [D]		Load to motor inertia ratio	
	[8] [E]		Bus voltage	
	[8] [F]		Load-side cumulative feedback pulses	
	[9] [0]		Load-side droop pulses	
	[9] [1]		Load-side encoder information 1 Z-phase counter	
	[9] [2]		Load-side encoder information 2	
	[9] [6]		Temperature of motor thermistor	
	[9] [7]		Motor-side cumu. feedback pulses (before gear)	
	[9] [8]		Electrical angle	
	[9] [E]		Motor-side/load-side position deviation	
	[9] [F]		Motor-side/load-side speed deviation	
	[A] [0]		Internal temperature of encoder	
	[A] [1]		Settling time	
	[A] [2]		Oscillation detection frequency	
	[A] [3]		Number of tough operations	
	[A] [8]		Unit power consumption	
	[A] [9]		Unit total power consumption	

(2) Parameters (command [0] [4], [0] [5], [0] [6], [0] [7], [0] [8], and [0] [9])

Command	Data No.	Description	Frame length
[0] [4]	[0] [1]	Parameter group reading 0000: Basic setting parameters ([Pr. PA_ _]) 0001: Gain/filter parameters ([Pr. PB_ _]) 0002: Extension setting parameters ([Pr. PC_ _]) 0003: I/O setting parameters ([Pr. PD_ _]) 0004: Extension setting 2 parameters ([Pr. PE_ _]) 0005: Extension setting 3 parameters ([Pr. PF_ _])	4
[1] [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 No.	12
[1] [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 No.	12
[1] [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 No.	12
[0] [8]	[0] [1] to [F] [F]	Parameter symbols Reads the symbols of the parameters in the parameter group specified with the command [8] [5] + data No. [0] [0]. Before reading the symbols, 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 No.	12
[0] [9]	[0] [1] to [F] [F]	Writing enable/disable of parameters Reads writing enable/disable 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]. 0000: Writing enabled 0001: Writing 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 No. 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	
	[1] [6]		Sixth alarm in past	
	[1] [7]		Seventh alarm in past	
	[1] [8]		Eighth alarm in past	
	[1] [9]		Ninth alarm in past	
	[1] [A]		Tenth alarm in past	
	[1] [B]		Eleventh alarm in past	
	[1] [C]		Twelfth alarm in past	
	[1] [D]		Thirteenth alarm in past	
	[1] [E]		Fourteenth alarm in past	
	[1] [F]		Fifteenth 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	
	[2] [6]		Sixth alarm in past	
	[2] [7]		Seventh alarm in past	
	[2] [8]		Eighth alarm in past	
	[2] [9]		Ninth alarm in past	
	[2] [A]		Tenth alarm in past	
	[2] [B]		Eleventh alarm in past	
	[2] [C]		Twelfth alarm in past	
	[2] [D]		Thirteenth alarm in past	
	[2] [E]		Fourteenth alarm in past	
	[2] [F]		Fifteenth alarm in past	

(5) Current alarm (command [0] [2])

Command	Data No.	Description	Frame length
[0] [2]	[0] [0]	Current alarm No.	4

(6) Status display at alarm occurrence (command [3] [5])

Command	Data No.	Description	Status display	Frame length
[3] [5]	[0] [0]	Status display symbol and unit	Cumulative feedback pulses	16
	[0] [1]		Servo motor speed	
	[0] [2]		Droop pulses	
	[0] [3]		Cumulative command pulses	
	[0] [4]		Command pulse frequency	
	[0] [5]		Analog speed command voltage Analog speed limit voltage	
	[0] [6]		Analog torque limit voltage Analog torque command voltage	
	[0] [7]		Regenerative load ratio	
	[0] [8]		Effective load ratio	
	[0] [9]		Peak load ratio	
	[0] [A]		Instantaneous torque	
	[0] [B]		Position within one-revolution	
	[0] [C]		ABS counter	
	[0] [D]		Load to motor inertia ratio	
	[0] [E]		Bus voltage	
	[0] [F]		Load-side cumulative feedback pulses	
	[1] [0]		Load-side droop pulses	
	[1] [1]		Load-side encoder information 1 Z-phase counter	
	[1] [2]		Load-side encoder information 2	
	[1] [6]		Temperature of motor thermistor	
	[1] [7]		Motor-side cumu. feedback pulses (before gear)	
	[1] [8]		Electrical angle	
	[1] [E]		Motor-side/load-side position deviation	
	[1] [F]		Motor-side/load-side speed deviation	
	[2] [0]		Internal temperature of encoder	
	[2] [1]		Settling time	
	[2] [2]		Oscillation detection frequency	
	[2] [3]		Number of tough operations	
	[2] [8]		Unit power consumption	
	[2] [9]		Unit total power consumption	

Command	Data No.	Description	Status display	Frame length
[3] [5]	[8] [0]	Status display data value and processing information	Cumulative feedback pulses	12
	[8] [1]		Servo motor speed	
	[8] [2]		Droop pulses	
	[8] [3]		Cumulative command pulses	
	[8] [4]		Command pulse frequency	
	[8] [5]		Analog speed command voltage Analog speed limit voltage	
	[8] [6]		Analog torque limit voltage Analog torque command voltage	
	[8] [7]		Regenerative load ratio	
	[8] [8]		Effective load ratio	
	[8] [9]		Peak load ratio	
	[8] [A]		Instantaneous torque	
	[8] [B]		Position within one-revolution	
	[8] [C]		ABS counter	
	[8] [D]		Load to motor inertia ratio	
	[8] [E]		Bus voltage	
	[8] [F]		Load-side cumulative feedback pulses	
	[9] [0]		Load-side droop pulses	
	[9] [1]		Load-side encoder information 1 Z-phase counter	
	[9] [2]		Load-side encoder information 2	
	[9] [6]		Temperature of motor thermistor	
	[9] [7]		Motor-side cumu. feedback pulses (before gear)	
	[9] [8]		Electrical angle	
	[9] [E]		Motor-side/load-side position deviation	
	[9] [F]		Motor-side/load-side speed deviation	
	[A] [0]		Internal temperature of encoder	
	[A] [1]		Settling time	
	[A] [2]		Oscillation detection frequency	
	[A] [3]		Number of tough operations	
	[A] [8]		Unit power consumption	
	[A] [9]		Unit total power consumption	

(7) Test operation mode (command [0] [0])

Command	Data No.	Description	Frame length
[0] [0]	[1] [2]	Test operation mode reading 0000: Normal mode (not test operation mode) 0001: JOG operation 0002: Positioning operation 0003: Motor-less operation 0004: Output signal (DO) forced output	4

(8) Software version (command [0] [2])

Command	Data No.	Description	Frame length
[0] [2]	[9] [0]	Servo motor-side pulse unit absolute position	8
	[9] [1]	Command unit absolute position	8
	[7] [0]	Software version	16

14.4.2 Writing commands

(1) Status display (command [8] [1])

Command	Data No.	Description	Setting range	Frame length
[8] [1]	[0] [0]	Status display data deletion	1EA5	4

(2) Parameters (command [9] [4], [8] [5])

Command	Data No.	Description	Setting range	Frame length
[9] [4]	[0] [1] to [F] [F]	Writing each parameter 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 No.	Depending on the parameter	12
[8] [5]	[0] [0]	Parameter group writing 0000: Basic setting parameters ([Pr. PA_ _]) 0001: Gain/filter parameters ([Pr. PB_ _]) 0002: Extension setting parameters ([Pr. PC_ _]) 0003: I/O setting parameters ([Pr. PD_ _]) 0004: Extension setting 2 parameters ([Pr. PE_ _]) 0005: Extension setting 3 parameters ([Pr. PF_ _])	0000 to 0005	4

(3) External I/O signals (command [9] [2])

Command	Data No.	Description	Setting range	Frame length
[9] [2]	[6] [0]	Communication input device signal	Refer to section 14.5.5.	8

(4) Alarm history (command [8] [2])

Command	Data No.	Description	Setting range	Frame length
[8] [2]	[2] [0]	Alarm history clear	1EA5	4

(5) Current alarm (command [8] [2])

Command	Data No.	Description	Setting range	Frame length
[8] [2]	[0] [0]	Alarm clear	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]	Selection of test operation mode 0000: Test operation mode cancel 0001: JOG operation 0002: Positioning operation 0004: Output signal (DO) forced output	0000 to 0002, 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 14.5.7.	8
	[A] [0]	Forced output of signal pin	Refer to section 14.5.9.	8
[A] [0]	[1] [0]	Writes the servo motor speed in the test operation mode (JOG operation and positioning operation).	0000 to 7FFF	4
	[1] [1]	Writes the acceleration/deceleration time constant in the test operation mode (JOG operation and positioning operation).	00000000 to 7FFFFFFF	8
	[2] [0]	Sets the travel distance in the test operation mode (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 0101	4
	[4] [0]	This is a start command for test operation (positioning operation).	1EA5	4
	[4] [1]	This is 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

14.5 Detailed explanations of commands

14.5.1 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 response or data in accordance with 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 in accordance with 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 a 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 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

For 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 least significant 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.

14.5.2 Status display mode

(1) Reading the status display name and unit

The following shows how to read the status display name and unit.

(a) Transmission

Transmit the command [0] [1] and the data No. corresponding to the status display item to be read, [0] [0] to [0] [E] and [2] [0] to [2] [9]. (Refer to section 14.4.1.)

(b) Return

The slave station returns the status display name and unit requested.

0	0														

Unit characters (5 digits) Name characters (9 digits)

(2) Status display data reading

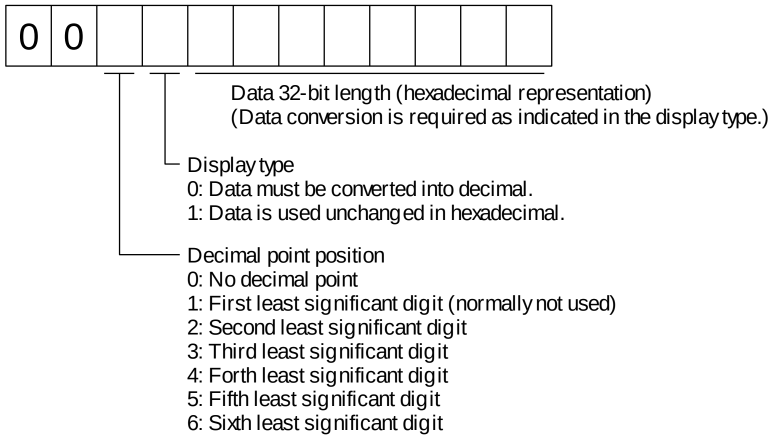
The following shows how to read the status display data and processing information.

(a) Transmission

Transmit the command [0] [1] and the data No. corresponding to the status display item to be read, [8] [0] to [8] [E] and [A] [0] to [A] [9]. (Refer to section 14.4.1.)

(b) Return

The slave station returns the status display data requested.



(3) Status display data clear

To clear the cumulative feedback pulse data of the status display, send this command immediately after reading each status display item. The data of the status display item transmitted is cleared to "0".

Command	Data No.	Data
[8] [1]	[0] [0]	1EA5

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 "0".

14.5.3 Parameter

(1) Specification of the parameter group

To read or write the parameter settings, etc., the group of the parameters to be operated must be specified in advance. Write data to the driver as follows to specify the parameter group.

Command	Data No.	Transmission data	Parameter group
[8] [5]	[0] [0]	0000	Basic setting parameters ([Pr. PA_ _])
		0001	Gain/filter parameters ([Pr. PB_ _])
		0002	Extension setting parameters ([Pr. PC_ _])
		0003	I/O setting parameters ([Pr. PD_ _])
		0004	Extension setting 2 parameters ([Pr. PE_ _])
		0005	Extension setting 3 parameters ([Pr. PF_ _])

(2) Parameter group reading

The following shows how to read the parameter group set with slave station.

(a) Transmission

Transmit command [0] [4] and data No. [0] [1].

Command	Data No.
[0] [4]	[0] [1]

(b) Return

The slave station returns the preset parameter group.

0	0	0	

Parameter group
0: Basic setting parameters ([Pr. PA_ _])
1: Gain/filter parameters ([Pr. PB_ _])
2: Extension setting parameters ([Pr. PC_ _])
3: I/O setting parameters ([Pr. PD_ _])
4: Extension setting 2 parameters ([Pr. PE_ _])
5: Extension setting 3 parameters ([Pr. PF_ _])

(3) Reading symbols

The following shows how to read symbols of parameters. Specify a parameter group in advance. (Refer to (1) in this section.)

(a) Transmission

Transmit the command [0] [8] and the data No. [0] [1] to [F] [F] corresponding to the parameter No. (Refer to section 14.4.1.)

The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter No.

(b) Return

The slave station returns the symbol of the parameter requested.

0	0	0									

Symbol characters (9 digits)

(4) Reading the setting

The following shows how to read the parameter setting. Specify a parameter group in advance. (Refer to (1) in this section.)

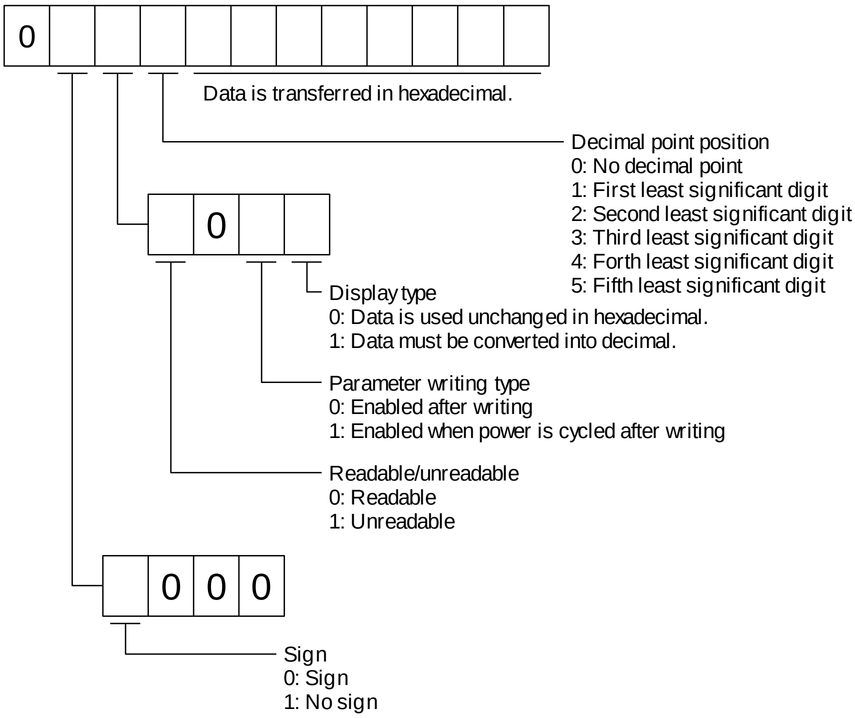
(a) Transmission

Transmit the command [1] [5] and the data No. corresponding to the parameter No [0] [1] to [F] [F]. (Refer to section 14.4.1.)

The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter No.

(b) Return

The slave station returns the data and processing information of the parameter No. requested.



For example, data "00120000270F" means 999.9 (decimal display format) and data "000000003ABC" 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 "0001FFFFF053" means 053 (special hexadecimal display format).

"008000000000" is transferred when the parameter that was read is the one inaccessible for reference in the parameter writing inhibit setting of [Pr. PA19].

(5) Reading the setting range

The following shows how to read the parameter setting range. Specify a parameter group in advance. (Refer to (1) in this section.)

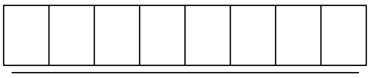
(a) Transmission

When reading an upper limit value, transmit the command [1] [6] and the data No. [0] [1] to [F] [F] corresponding to the parameter No. When reading an lower limit value, transmit the command [1] [7] and the data No. [0] [1] to [F] [F] corresponding to the parameter No. (Refer to section 14.4.1.)

The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter No.

(b) Return

The slave station returns the data and processing information of the parameter No. requested.



Data is transferred in hexadecimal.

For example, data "FFFFFFEC" means "-20".

(6) Writing setting values

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 EEPROM 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 a parameter group in advance. (Refer to (1) in this section.)
Write any value within the setting enabled range. For the setting enabled range, refer to chapter 5 or read the setting range by performing operation in (4) in this section.
Transmit command [9] [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 No.
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.
Check the writing data is within the upper/lower limit value before writing. To prevent an error, read the parameter data to be written, confirm the decimal point position, and create transmission data.
On completion of writing, read the same parameter data to verify that data has been written correctly.

Command	Data No.	Data
[9] [4]	[0] [1] to [F] [F]	See below.

0	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

Writing mode
0: Writing to EEP-ROM
3: Writing to RAM
When the parameter data is changed frequently through communication, set "3" to the mode to change only the RAM data in the s driver.
When changing data frequently (once or more within one hour), do not write it to the EEP-ROM.

14.5.4 External I/O signal status (DIO diagnosis)

(1) Reading input device status
The following shows how to read the status of the input devices.

(a) Transmission
Transmit command [1] [2] and data No. [0] [0].

Command	Data No.
[1] [2]	[0] [0]

(b) Return
The slave station returns the status of the input devices.

b31 - b1b0

1: On
0: Off

Command of each bit is transmitted to the master station as hexadecimal data.

Bit	Symbol	Bit	Symbol	Bit	Symbol	Bit	Symbol
0	SON	8	SP1	16		24	
1	LSP	9	SP2	17		25	
2	LSN	10	SP3	18		26	
3	TL	11	ST1/RS2	19		27	CDP
4	TL1	12	ST2/RS1	20	STAB2	28	CLD
5	PC	13	CM1	21		29	MECR
6	RES	14	CM2	22		30	
7	CR	15	LOP	23		31	

(2) Reading external input pin status
The following shows how to read the on/off status of the external input pins.

(a) Transmission
Transmit command [1] [2] and data No. [4] [0].

Command	Data No.
[1] [2]	[4] [0]

(b) Return
The on/off status of the input pins are returned.

b31 - b1b0

1: On
0: Off

Command of each bit is transmitted to the master station as hexadecimal data.

Bit	CN1 connector pin	Bit	CN1 connector pin	Bit	CN1 connector pin	Bit	CN1 connector pin
0	43	8	18	16		24	
1	44	9	45	17		25	
2	42	10		18		26	
3	15	11		19		27	
4	19	12		20		28	
5	41	13		21		29	
6	16	14		22		30	
7	17	15		23		31	

(3) Reading the status of input devices switched on with communication

The following shows how to read the on/off status of the input devices switched on with communication.

(a) Transmission

Transmit command [1] [2] and data No. [6] [0].

Command	Data No.
[1] [2]	[6] [0]

(b) Return

The slave station returns the status of the input devices.

b31 - - - - - - - - b1b0

1: On
0: Off

Command of each bit is transmitted to the master station as hexadecimal data.

Bit	Symbol	Bit	Symbol	Bit	Symbol	Bit	Symbol
0	SON	8	SP1	16		24	
1	LSP	9	SP2	17		25	
2	LSN	10	SP3	18		26	
3	TL	11	ST1/RS2	19		27	CDP
4	TL1	12	ST2/RS1	20	STAB2	28	CLD
5	PC	13	CM1	21		29	MECR
6	RES	14	CM2	22		30	
7	CR	15	LOP	23		31	

(4) Reading external output pin status

The following shows how to read the on/off status of the external output pins.

(a) Transmission

Transmit command [1] [2] and data No. [C] [0].

Command	Data No.
[1] [2]	[C] [0]

(b) Return

The slave station returns the status of the output devices.

b31 - - - - - - - - b1b0

1: On
0: Off

Command of each bit is transmitted to the master station as hexadecimal data.

Bit	CN1 connector pin	Bit	CN1 connector pin	Bit	CN1 connector pin	Bit	CN1 connector pin
0	49	8	14	16		24	
1	24	9		17		25	
2	23	10		18		26	
3	25	11		19		27	
4	22	12		20		28	
5	48	13		21		29	
6	33	14		22		30	
7	13	15		23		31	

(5) Reading output device status

The following shows how to read the on/off status of the output devices.

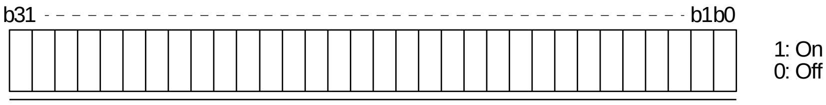
(a) Transmission

Transmit command [1] [2] and data No. [8] [0].

Command	Data No.
[1] [2]	[8] [0]

(b) Return

The slave station returns the status of the input/output devices.



Command of each bit is transmitted to the master station as hexadecimal data.

Bit	Symbol	Bit	Symbol	Bit	Symbol	Bit	Symbol
0	RD	8	ALM	16		24	
1	SA	9	OP	17		25	CDPS
2	ZSP	10	MBR	18		26	CLDS
3	TLC	11	DB	19		27	ABSV
4	VLC	12	ACD0	20		28	
5	INP	13	ACD1	21		29	
6		14	ACD2	22		30	
7	WNG	15	BWNG	23		31	MTTR

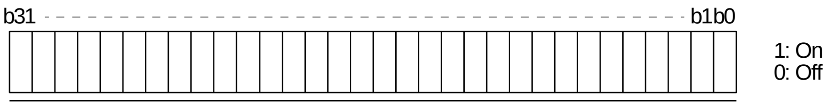
14.5.5 Input device on/off

POINT
● The on/off status of all devices in the driver are the status of the data received at last. Therefore, when there is a device which must be kept on, transmit data which turns the device on every time.

Each input device can be switched on/off. However, when the device to be switched off is in the external input signal, also switch off the input signal.

Transmit 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 master station as hexadecimal data.

Bit	Symbol	Bit	Symbol	Bit	Symbol	Bit	Symbol
0	SON	8	SP1	16		24	
1	LSP	9	SP2	17		25	
2	LSN	10	SP3	18		26	
3	TL	11	ST1/RS2	19		27	CDP
4	TL1	12	ST2/RS1	20	STAB2	28	CLD
5	PC	13	CM1	21		29	MECR
6	RES	14	CM2	22		30	
7	CR	15	LOP	23		31	

14.5.6 Disabling/enabling I/O devices (DIO)

You can disable inputs regardless of the I/O device status. When inputs are disabled, the input signals (devices) are recognized as follows. However, EM2 (Forced stop 2), LSP (Forward rotation stroke end), and LSN (Reverse rotation stroke end) cannot be disabled.

Signal	Status
Input device (DI)	Off
External analog input signal	0 V
Pulse train input	None

(1) Disabling/enabling the input devices (DI), external analog input signals and pulse train inputs except EM2 (Forced stop 2), LSP (Forward rotation stroke end), and LSN (Reverse rotation stroke end).
Transmit the following communication commands.

(a) Disabling

Command	Data No.	Data
[9] [0]	[0] [0]	1EA5

(b) Enabling

Command	Data No.	Data
[9] [0]	[1] [0]	1EA5

(2) Disabling/enabling the output devices (DO)
Transmit the following communication commands.

(a) Disabling

Command	Data No.	Data
[9] [0]	[0] [3]	1EA5

(b) Enabling

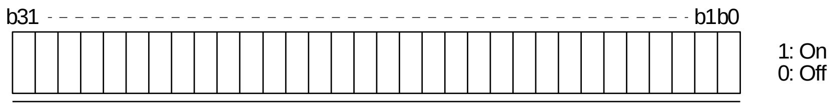
Command	Data No.	Data
[9] [0]	[1] [3]	1EA5

14.5.7 Input devices on/off (test operation)

Each input devices can be turned on/off for test operation. However, when the device to be switched off is in the external input signal, also switch off the input signal.

Transmit 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 master station as hexadecimal data.

Bit	Symbol	Bit	Symbol	Bit	Symbol	Bit	Symbol
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	CLD
5	PC	13	CM1	21		29	MECR
6	RES	14	CM2	22		30	
7	CR	15	LOP	23		31	

14.5.8 Test operation mode

POINT
●The test operation mode is used to check operation. Do not use it for actual operation. ●If communication stops for longer than 0.5 s during test operation, the driver decelerates to a stop, resulting in servo-lock. To prevent this, continue communication all the time by monitoring the status display, etc. ●Even during operation, you can switch the driver to the test operation mode. In this case, switching to the test operation mode will shut off the base circuit to coast the motor.

(1) How to prepare and cancel the test operation mode

(a) Preparing the test operation mode

Set the test operation mode type with the following procedure.

1) Selection of test operation mode

Send the command [8] [B] + data No. [0] [0] + data to select the test operation mode.

Command	Data No.	Transmission data	Selection of test operation mode
[8] [B]	[0] [0]	0001	JOG operation
		0002	Positioning operation
		0004	Output signal (DO) forced output (Note)

Note. Refer to section 14.5.9 for output signal (DO) forced output.

2) Check of test operation mode

Read the test operation mode set for the slave station, and check that it is set correctly.

a) Transmission

Transmit command [0] [0] and data No. [1] [2].

Command	Data No.
[0] [0]	[1] [2]

b) Reply

The slave station returns the preset operation mode.

0	0	0	

Test operation mode reading
0: Normal mode (not test operation mode)
1: JOG operation
2: Positioning operation
3: Motor-less operation
4: Output signal (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	Selection of test operation mode
[8] [B]	[0] [0]	0000	Test operation mode cancel

(2) JOG operation

Transmit the command, data No., and data as follows 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 servo motor 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 (Turn on SON, LSP, LSN, and ST1.)
•Reverse rotation direction 00001007 (Turn on SON, LSP, LSN, and ST2.)

Stop
Command : [9] [2]
Data No. : [0] [0]
Data : 00000007 (Turn on SON, LSP, and LSN.)

When LSP/LSN was turned On by external input signal or automatically

Start
Command : [9] [2]
Data No. : [0] [0]
Data : •Forward rotation direction 00000801 (Turn on SON and ST1.)
•Reverse rotation direction 00001001 (Turn on SON and ST2.)

Stop
Command : [9] [2]
Data No. : [0] [0]
Data 00000001 (Turn on SON.)

Start

Stop

End
Command : [8] [B]
Data No. : [0] [0]
Data 0000 (Test operation mode is canceled.)

Test operation mode is canceled.

(3) Positioning operation

(a) Operation procedure

Transmit the command, data No., and data as follows to execute positioning operation.

Start
Command : [8] [B]
Data No. : [0] [0]
Data : 0002 (Positioning 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.

Travel distance setting
Command : [A] [0]
Data No. : [2] [0]
Data : Write the travel distance [pulse] in hexadecimal.

Rotation direction selection
Command : [A] [0]
Data No. : [2] [1]
Data : 0000 (Forward rotation direction)
0001 (Reverse rotation direction)

Set the operation pattern.

When LSP/LSN was turned Off by external input signal

Enable input device.
Command : [9] [2]
Data No. : [0] [0]
Data : 00000007
(SON, LSP, and LSN turned on.)

When LSP/LSN was turned On by external input signal or automatically

Enable input device.
Command : [9] [2]
Data No. : [0] [0]
Data : 00000001
(SON turned on.)

Turn on SON (Servo-on) to make the driver ready.

(Note)

Start positioning operation
Command : [A] [0]
Data No. : [4] [0]
Data : 1EA5

Start

End
Command : [8] [B]
Data No. : [0] [0]
Data : 0000
(Test operation mode is canceled.)

Test operation mode is canceled.

Note. It has 100 ms delay.

(b) Temporary stop/restart/remaining distance clear

Transmit 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

Transmit the following command, data No., and data during a temporary stop to restart.

Command	Data No.	(Note) Data
[A] [0]	[4] [1]	GO□□

Note. "□" indicates a blank.

Transmit the following command, data No., and data during a temporary stop to stop positioning operation and erase the travel remaining distance.

Command	Data No.	(Note) Data
[A] [0]	[4] [1]	CLR□

Note. "□" indicates a blank.

14.5.9 Output signal pin on/off (output signal (DO) forced output)

In the test operation mode, the output signal pins can be turned on/off regardless of the servo status. Using command [9] [0], disable the external output signals in advance.

(1) Selecting output signal (DO) forced output in the test operation mode
Transmit command + [8] [B] + data No. [0] [0] + data "0004" to select output signal (DO) forced output.

0	0	0	4

Selection of test operation mode
4: Output signal (DO) forced output

(2) External output signal on/off
Transmit the following communication commands.

Command	Data No.	Set data
[9] [2]	[A] [0]	See below.

b31 - - - b1 b0

1: On
0: Off

Command of each bit is transmitted to the master station as hexadecimal data.

Bit	CN1 connector pin	Bit	CN1 connector pin	Bit	CN1 connector pin	Bit	CN1 connector pin
0	49	8	14	16		24	
1	24	9		17		25	
2	23	10		18		26	
3	25	11		19		27	
4	22	12		20		28	
5	48	13		21		29	
6	33	14		22		30	
7	13	15		23		31	

(3) Output signal (DO) forced output
Transmit command [8] [B] + data No. [0] [0] + data to stop output signal (DO) forced output.

Command	Data No.	Transmission data	Selection of test operation mode
[8] [B]	[0] [0]	0000	Test operation mode cancel

14.5.10 Alarm history

(1) Alarm No. reading

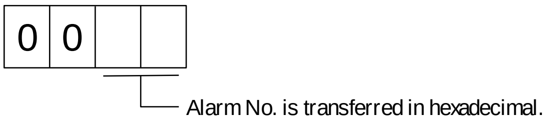
The following shows how to read alarm Nos. which occurred in the past. Alarm Nos. and occurrence times of No. 0 (last alarm) to No. 15 (sixteenth alarm in the past) are read.

(a) Transmission

Transmit command [3] [3] + data No. [1] [0] to [1] [F]. Refer to section 14.4.1.

(b) Return

Alarm Nos. corresponding to the data No. is provided.



For example, "0032" means [AL. 32] and "00FF" means [AL. _ _] (no alarm).

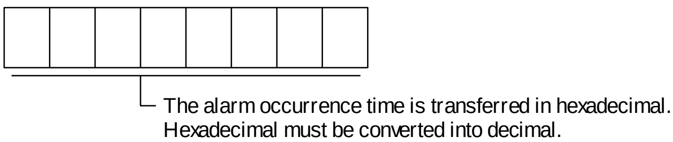
(2) Alarm occurrence time reading

The following shows how to read alarm occurrence times which occurred in the past.
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

Transmit command [3] [3] + data No. [2] [0] to [2] [F].
Refer to section 14.4.1.

(b) Return



For example, data "01F5" means that the alarm occurred in 501 hours after starting operation.

(3) Clearing the alarm history

Alarm history is cleared.
Transmit command [8] [2] and data No. [2] [0].

Command	Data No.	Data
[8] [2]	[2] [0]	1EA5

14.5.11 Current alarm

(1) Current alarm reading

The following shows how to read the alarm No. which is occurring currently.

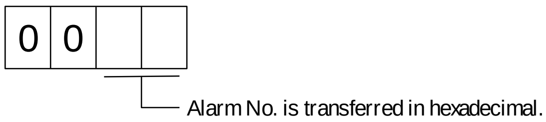
(a) Transmission

Transmit command [0] [2] and data No. [0] [0].

Command	Data No.
[0] [2]	[0] [0]

(b) Return

The slave station returns the alarm currently occurring.



For example, "0032" means [AL. 32] and "00FF" means [AL. _ _] (no alarm).

(2) Reading status display at alarm occurrence

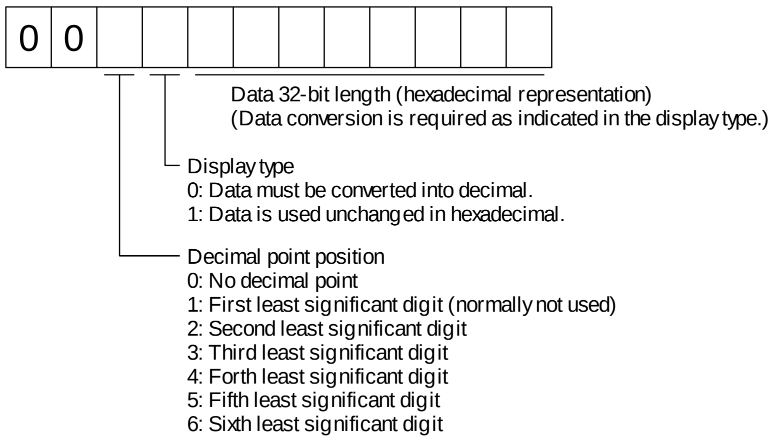
The following shows how to read the status display data at alarm occurrence. When the data No. corresponding to the status display item is transmitted, the data value and data processing information will be returned.

(a) Transmission

Transmit the command [3] [5] + the data No. corresponding to the status display item to read, [8] [0] to [8] [E] and [A] [0] to [A] [9]. Refer to section 14.4.1.

(b) Return

The slave station returns the status display data of requested alarm at occurrence.



(3) Current alarm reset

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

14.5.12 Other commands

(1) Servo motor-side pulse unit absolute position

The following shows how to 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.

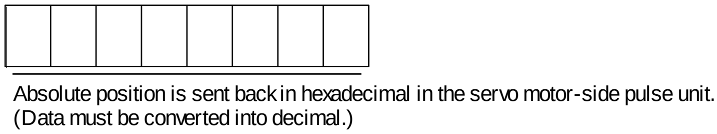
(a) Transmission

Transmit command [0] [2] and data No. [9] [0].

Command	Data No.
[0] [2]	[9] [0]

(b) Return

The slave station returns the requested servo motor-side pulses.



For example, data "000186A0" is 100000 pulses in the motor-side pulse unit.

(2) Command unit absolute position

The following shows how to read the absolute position in the command unit.

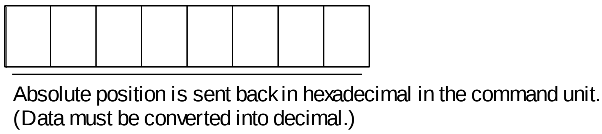
(a) Transmission

Transmit command [0] [2] and data No. [9] [1].

Command	Data No.
[0] [2]	[9] [1]

(b) Return

The slave station returns the requested command pulses.



For example, data "000186A0" is 100000 pulses in the command unit.

(3) Software version

The following shows how to read the software version of the driver.

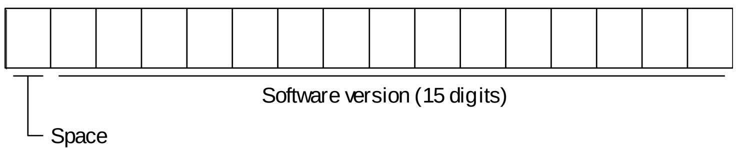
(a) Transmission

Transmit command [0] [2] and data No. [7] [0].

Command	Data No.
[0] [2]	[7] [0]

(b) Return

The slave station returns the requested software version.



15. SERVO MOTOR

15. SERVO MOTOR

15.1 Servo motor with a lock

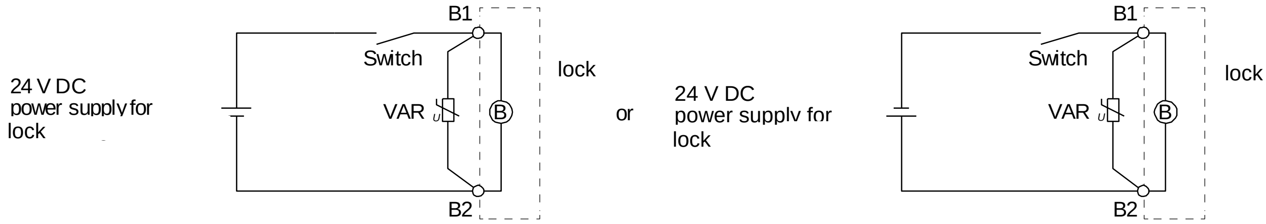
15.1.1 Features

CAUTION	
⚠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.



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.

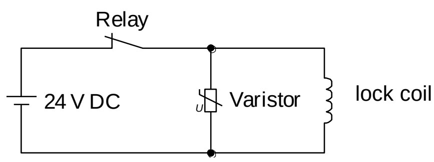
(3) Selection of surge absorbers for lock circuit

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 ( )

Given that the varistor absorbs all energies, the surge current width ( ) will be as follows.

$$= \frac{E}{Vi \times Ib} \text{ [S]}$$

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 ( ). 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.

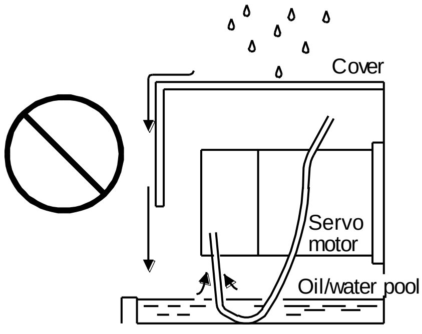
The characteristics (reference value) of the lock provided for the servo motor with a lock are indicated below.

Item \ Servo motor		LE-□-B T6 (100W)	T7 (200W)	T8 (400W)	T9 (750W)
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		10
Coil resistance (Note 6) [Ω]		91.0	73.0		57.0
Inductance (Note 6) [H]		0.15	0.18		0.13
Lock static friction torque [N m		0.32	1.3		2.4
Release delay time (Note 2) [s]		0.03	0.03		0.04
Locking delay time (Note 2) [s]	DC off	0.01	0.02		0.02
Permissible locking work	Per locking [J]	5.6	22		64
	Per hour [J]	56	220		640
Lock looseness at servo motor shaft (Note 5) [degrees]		2.5	1.2		0.9
Lock life (Note 3)	Number of lockings [times]	20000			
	Work per locking [J]	5.6	22		64
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.

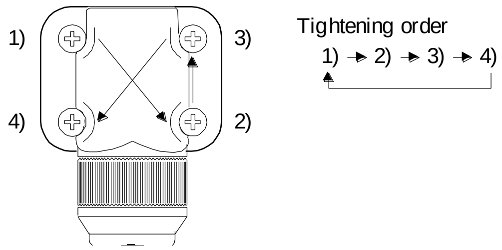
15.4 Rated speed of servo motor

The rated speed of servo motor (LE-T6-□, LE-T7-□, LE-T8-□, LE-T9-□) is 3000[r/min].

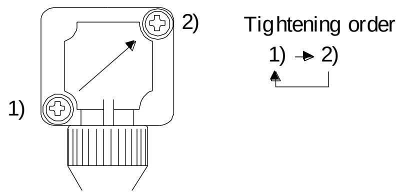
15.5 Mounting connectors

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.

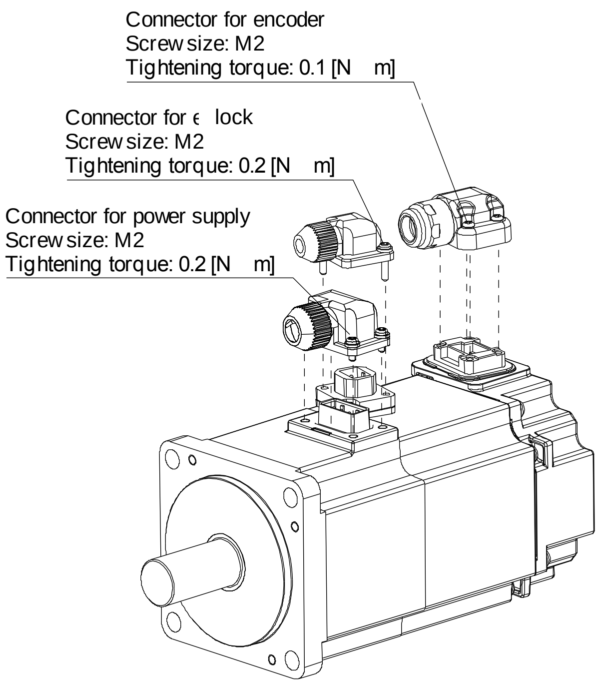


Connector for power supply, connector for encoder



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.

16. POSITIONING MODE

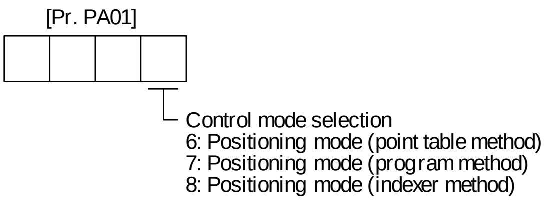
16.1 FUNCTIONS AND CONFIGURATION

16.1.1To use positioning mode

(1) Parameter setting

(a) Selection of the positioning mode

Select a positioning mode with [Pr. PA01 Operation mode] to use.



(b) Positioning control parameters ([Pr. PT_ _])

To enable read/write the positioning control parameters ([Pr. PT_ _]), set [Pr. PA19 Parameter writing inhibit] to "0 0 A B".

(c) Assigning recommended input/output devices

Assign recommended input/output devices to the pins of CN1 in accordance with each chapter of point table/program/indexer method.

16.1.2 Positioning mode specification list

The specifications only of the positioning mode are listed here. For other specifications, refer to section 1.3.

Item	Description
Driver model	LECSB□-T□
Positioning mode / Command method / Point table / Operational specifications	Positioning with specification of point table No. (255 points) Pushing operation by specifying the point table number (127 points) *refer to Chapter 17.
Positioning mode / Command method / Point table / Position command input (Note 1) / Absolute value command method	Set in the point table. Setting range of feed length per point: -999999 to 999999 [×10^{STM} m], -99.9999 to 99.9999 [×10^{STM} inch], -999999 to 999999 [pulse], Setting range of rotation angle: -360.000 to 360.000 [degree]
Positioning mode / Command method / Point table / Position command input (Note 1) / Incremental value command method	Set in the point table. Setting range of feed length per point: 0 to 999999 [×10^{STM} m], 0 to 99.9999 [×10^{STM} inch], 0 to 999999 [pulse], Setting range of rotation angle: 0 to 999.999 [degree]
Positioning mode / Command method / Point table / Speed command input	Set the acceleration/deceleration time constants in the point table. Set the S-pattern acceleration/deceleration time constants with [Pr. PC03].
Positioning mode / Command method / Point table / System	Signed absolute value command method/incremental value command method
Positioning mode / Command method / Point table / Analog override	0 V DC to ±10 V DC/0% to 200%
Positioning mode / Command method / Point table / Torque limit	Set with parameter or external analog input (0 V DC to +10 V DC/maximum torque)
Positioning mode / Command method / Point table / Position command data input / RS-422/RS-485 communication (Note 5) / Position command input (Note 1) / Absolute value command method	Setting of position command data with RS-422/RS-485 communication Setting range of feed length per point: -999999 to 999999 [×10^{STM} m], -99.9999 to 99.9999 [×10^{STM} inch], -999999 to 999999 [pulse], Setting range of rotation angle: -360.000 to 360.000 [degree]
Positioning mode / Command method / Point table / Position command data input / RS-422/RS-485 communication (Note 5) / Position command input (Note 1) / Incremental value command method	Setting of position command data with RS-422/RS-485 communication Setting range of feed length per point: 0 to 999999 [×10^{STM} m], 0 to 99.9999 [×10^{STM} inch], 0 to 999999 [pulse], Setting range of rotation angle: 0 to 999.999 [degree]
Positioning mode / Command method / Point table / Position command data input / RS-422/RS-485 communication (Note 5) / Speed command input	Selects the rotation speed and acceleration/deceleration time constant through RS-422/RS-485 communication. Set the S-pattern acceleration/deceleration time constants with [Pr. PC03].
Positioning mode / Command method / Point table / Position command data input / RS-422/RS-485 communication (Note 5) / System	Signed absolute value command method/incremental value command method
Positioning mode / Command method / Program / Operational specifications	Program language (program with setup software (MR Configurator2™) Program capacity: 640 steps (256 programs)
Positioning mode / Command method / Program / Position command input (Note 1) / Absolute value command method	Set with program language. Setting range of feed length: -999999 to 999999 [×10^{STM} m], -99.9999 to 99.9999 [×10^{STM} inch], -999999 to 999999 [pulse], Setting range of rotation angle: -360.000 to 360.000 [degree]
Positioning mode / Command method / Program / Position command input (Note 1) / Incremental value command method	Set with program language. Setting range of feed length: -999999 to 999999 [×10^{STM} m], -99.9999 to 99.9999 [×10^{STM} inch], -999999 to 999999 [pulse], Setting range of rotation angle: -999.999 to 999.999 [degree]
Positioning mode / Command method / Program / Speed command input	Set servo motor speed, acceleration/deceleration time constants, and S-pattern acceleration/deceleration time constants with program language. S-pattern acceleration/deceleration time constants are also settable with [Pr. PC03].
Positioning mode / Command method / Program / System	Signed absolute value command method/signed incremental value command method
Positioning mode / Command method / Program / Analog override	Set with external analog input (0 V DC to ±10 V DC/0% to 200%)
Positioning mode / Command method / Program / Torque limit	Set with parameter or external analog input (0 V DC to +10 V DC/maximum torque)

Item					Description
Positioning mode	Command method	Indexer	Operational specifications		Positioning by specifying the station position (Note 7) The maximum number of divisions: 255
Positioning mode	Command method	Indexer	Speed command input		Selects the rotation speed and acceleration/deceleration time constant by a contact input.
Positioning mode	Command method	Indexer	System		Rotation direction specifying indexer/shortest rotating indexer
Positioning mode	Command method	Indexer	Digital override		Selects the override multiplying factor by a contact input.
Positioning mode	Command method	Indexer	Torque limit		Set with parameter or external analog input (0 V DC to +10 V DC/maximum torque)
Positioning mode	Operation mode	Automatic operation mode	Point table	Each positioning operation	Point table No. input method/position data input method Operates each positioning based on position command and speed command.
Positioning mode	Operation mode	Automatic operation mode	Point table	Automatic continuous positioning operation	Varying-speed operation (2 to 255 speeds)/automatic continuous positioning operation (2 to 255 points)/ automatic continuous operation to a point table selected at startup/ automatic continuous operation to the point table No. 1
Positioning mode	Operation mode	Automatic operation mode	Program		Depends on settings of program language.
Positioning mode	Operation mode	Automatic operation mode	Indexer	Rotation direction specifying indexer	Positions to the specified station. Rotation direction settable
Positioning mode	Operation mode	Automatic operation mode	Indexer	Shortest rotating indexer	Positions to the specified station. Rotates in the shorter direction from the current position.
Positioning mode	Operation mode	Manual operation mode	Point table/program	JOG operation	Executes a contact input or an inching operation with the RS-422/RS-485 communication function based on speed command set with parameters.
Positioning mode	Operation mode	Manual operation mode	Point table/program	Manual pulse generator operation	Manual feeding is executed with a manual pulse generator. Command pulse multiplication: select from ×1, ×10, and ×100 with a parameter.
Positioning mode	Operation mode	Manual operation mode	Indexer	JOG operation	Decelerates to a stop regardless of the station.
Positioning mode	Operation mode	Manual operation mode	Indexer	Station JOG operation	Rotates in a direction specified by the rotation direction decision when the start signal turns on. Positions to the nearest station where the servo motor can decelerate to a stop when the start signal turns off.
Positioning mode	Home position return mode	Point table/program	Dog type		Returns to home position upon Z-phase pulse after passing through the proximity dog. home position address settable/home position shift amount settable/home position return direction selectable/ automatic retract on dog back to home position/automatic stroke retract function
Positioning mode	Home position return mode	Point table/program	Count type		Returns to home position upon the encoder pulse count after touching the proximity dog. Home position return direction selectable/home position shift amount settable/home position address settable/ automatic retract on dog back to home position/automatic stroke retract function
Positioning mode	Home position return mode	Point table/program	Data set type		Returns to home position without dog. Sets any position as a home position using manual operation, etc./home position address settable
Positioning mode	Home position return mode	Point table/program	Stopper type		Returns to home position upon hitting the stroke end. Home position return direction selectable/home position address settable
Positioning mode	Home position return mode	Point table/program	Home position ignorance (servo-on position as home position)		Sets a home position where SON (Servo-on) signal turns on. Home position address settable
Positioning mode	Home position return mode	Point table/program	Dog type rear end reference		Returns to home position based on the rear end of the proximity dog. Home position return direction selectable/home position shift amount settable/home position address settable/ automatic retract on dog back to home position/automatic stroke retract function
Positioning mode	Home position return mode	Point table/program	Count type front end reference		Returns to home position based on the front end of the proximity dog. Home position return direction selectable/home position shift amount settable/home position address settable/ automatic retract on dog back to home position/automatic stroke retract function
Positioning mode	Home position return mode	Point table/program	Dog cradle type		Returns to home position upon the first Z-phase pulse based on the front end of the proximity dog. Home position return direction selectable/home position shift amount settable/home position address settable/ automatic retract on dog back to home position/automatic stroke retract function
Positioning mode	Home position return mode	Point table/program	Dog type last Z-phase reference (Note 4)		Returns to home position upon the Z-phase pulse right before the proximity dog based on the front end of the proximity dog. Home position return direction selectable/home position shift amount settable/home position address settable/ automatic retract on dog back to home position/automatic stroke retract function
Positioning mode	Home position return mode	Point table/program	Dog type front end reference		Returns to home position to the front end of the dog based on the front end of the proximity dog. Home position return direction selectable/home position shift amount settable/home position address settable/ automatic retract on dog back to home position/automatic stroke retract function
Positioning mode	Home position return mode	Point table/program	Dogless Z-phase reference (Note 4)		Returns to home position to the Z-phase pulse with respect to the first Z-phase pulse. Home position return direction selectable/home position shift amount settable/home position address settable
Positioning mode	Home position return mode	Indexer	Torque limit changing dog type		Returns to home position upon Z-phase pulse after an external limit is detected. Home position return direction selectable/home position shift amount settable/home position address settable Torque limit automatic changing function
Positioning mode	Home position return mode	Indexer	Torque limit changing data set type		Returns to home position without external limits. Sets any position as home position/home position address settable/torque limit automatic changing function
Positioning mode	Automatic positioning to home position function (Note 2)				High-speed automatic positioning to a defined home position

Item		Description
Positioning mode	Other functions	Absolute position detection/backlash compensation/overtravel prevention with external limit switch (LSP/LSN)/software stroke limit/mark detection function (Note 3)/override

Note 1. STM is the ratio to the setting value of the position data. STM can be changed with [Pr. PT03 Feeding function selection].

2. The automatic positioning to home position function is not available with the program method and the indexer method.

3. Indexer method does not have the mark detection function.

16.1.3 Function list

POINT
●The symbols in the control mode column mean as follows. CP: Positioning mode (point table method) CL: Positioning mode (program method) PS: Positioning mode (indexer method)

The following table lists the functions of this servo. For details of the functions, refer to each section indicated in the detailed explanation field.

Function		Description	Control mode CP	Control mode CL	Control mode PS	Detailed explanation
Model adaptive control		This function achieves a high response and stable control following the ideal model. The two-degrees-of-freedom model adaptive control enables you to set a response to the command and response to the disturbance separately. Additionally, this function can be disabled. To disable this function, refer to section 7.5.	○	○	○	
Positioning mode (point table method)		Set 1 to 255 point tables in advance, and select any point table to perform operation in accordance with the set values. To select point tables, use external input signals or communication function.	○			Chapter 4
Positioning mode (program method)		Set 1 to 256 programs in advance and select any program to perform operation in accordance with the programs. To select programs, use external input signals or communication function.		○		Chapter 5
Positioning mode (indexer method)		Set 2 to 255 divided stations in advance to perform operation to the station positions. To select station positions, use external input signals or communication function.			○	Chapter 6
Roll feed display function		Positions based on specified travel distance from a status display "0" of current/command positions at start.	○	○		Section 4.5
Mark detection	Current position latch function	When the mark detection signal turns on, the current position is latched. The latched data can be read with communication commands.	○	○		Section 12.2.1
Mark detection	Interrupt positioning function	When MSD (Mark detection) turns on, this function converts the remaining distance to the travel amount set in [Pr. PT30] and [Pr. PT31] (Mark sensor stop travel distance).	○	○		Section 12.2.2
Infinite feed function (setting degree)		When the unit of position data of the automatic operation or manual operation is set to degree, the detection of [AL. E3.1 Multi-revolution counter travel distance excess warning] is disabled and the home position is retained even if the servo motor rotates 32768 revolutions or more are in the same direction. Thus, the current position is restored after the power is cycled. This function can be used with the absolute position detection system.	○	○		Section 12.3
Simple cam function		This function enables the encoder following function, mark sensor input compensation function, synchronous operation using positioning data, and synchronous interpolation operation.	○	○		Section 12.1

Function	Description	Control mode CP	Control mode CL	Control mode PS	Detailed explanation
home position return	Dog type/count type/data setting type/stopper type/home position ignorance/dog type rear end reference/count type front end reference/dog cradle type/dog type last Z-phase reference/dog type Z-phase reference/dogless Z-phase reference	○	○		Section 4.4 Section 5.4
	Torque limit changing dog type/torque limit changing data set type			○	Section 6.4
High-resolution encoder	The encoder resolution of the rotary servo motor will be 262144 pulses/rev.	○	○	○	
Absolute position detection system	Home position return is required only once, and not required at every power-on. Only "12.1 Summary" and "12.2 Battery" will be appropriate references for the positioning mode.	○	○	○	chapter 12
Gain switching function	You can switch gains during rotation/stop, and can use input devices to switch gains during operation.	○	○	○	section 7.2
Advanced vibration suppression control II	This function suppresses vibration at the arm end or residual vibration.	○	○	○	section 7.1.5
Machine resonance suppression filter	This is a filter function (notch filter) which decreases the gain of the specific frequency to suppress the resonance of the mechanical system.	○	○	○	section 7.1.1
Shaft resonance suppression filter	When a load is mounted to the servo motor shaft, resonance by shaft torsion during driving may generate a mechanical vibration at high frequency. The shaft resonance suppression filter suppresses the vibration.	○	○	○	section 7.1.3
Adaptive filter II	Driver detects mechanical resonance and sets filter characteristics automatically to suppress mechanical vibration.	○	○	○	section 7.1.2
Low-pass filter	Suppresses high-frequency resonance which occurs as servo system response is increased.	○	○	○	section 7.1.4
Machine analyzer function	Analyzes the frequency characteristic of the mechanical system by simply connecting an Setup software (MR Configurator2™) installed personal computer and driver. Setup software (MR Configurator2™) is necessary for this function.	○	○	○	
Robust filter	This function provides better disturbance response in case low response level that load to motor inertia ratio is high for such as roll send axes.	○	○	○	[Pr. PE41]
Slight vibration suppression control	Suppresses vibration of ±1 pulse generated at a servo motor stop.	○	○	○	[Pr. PB24]
Electronic gear	Position commands can be multiplied by 1/864 to 33935.	○	○		[Pr. PA06]
	Position commands can be multiplied by 1/9999 to 9999.			○	[Pr. PA07]
Auto tuning	Automatically adjusts the gain to optimum value if load applied to the servo motor shaft varies.	○	○	○	section 6.3
Regenerative option	Used when the built-in regenerative resistor of the driver does not have sufficient regenerative capability for the regenerative power generated.	○	○	○	section 11.2
Alarm history clear	Alarm history is cleared.	○	○	○	[Pr. PC18]
Input signal selection (device settings)	ST1 (Forward rotation start), ST2 (Reverse rotation start), and SON (Servo-on) and other input device can be assigned to any pins.	○	○	○	[Pr. PD04] [Pr. PD06] [Pr. PD08] [Pr. PD10] [Pr. PD12] [Pr. PD14] [Pr. PD18] [Pr. PD20] [Pr. PD22] [Pr. PD44] [Pr. PD46]

Function	Description	Control mode CP	Control mode CL	Control mode PS	Detailed explanation
Output signal selection (device settings)	The output devices including MBR (Electromagnetic brake interlock) can be assigned to certain pins of the CN1 connector.	○	○	○	[Pr. PD23] to [Pr. PD26] [Pr. PD28] [Pr. PD47]
Output signal (DO) forced output	Output signal can be forced on/off independently of the servo status. Use this function for checking output signal wiring, etc.	○	○	○	Section 3.1.8 Section 3.2.8 section 4.5.8 section 18.5.9
Command pulse selection	Supports only A-axis/B-axis pulse trains.	○	○		[Pr. PA13]
Torque limit	Servo motor torque can be limited to any value.	○	○	○	[Pr. PA11] [Pr. PA12]
Status display	Servo status is shown on the 5-digit, 7-segment LED display.	○	○	○	Section 3.1.2 Section 3.2.2
External I/O signal display	On/off statuses of external I/O signals are shown on the display.	○	○	○	Section 3.1.7 Section 3.2.7
Alarm code output	If an alarm has occurred, the corresponding alarm number is outputted in 3-bit code.	○	○	○	Chapter 8
Test operation mode	Jog operation/positioning operation/motor-less operation/DO forced output/program operation/single-step feed However, setup software (MR Configurator2™) is necessary for positioning operation, program operation, and single-step feed.	○	○	○	Section 3.1.8 Section 3.1.9 Section 3.2.8 Section 3.2.9 section 4.5.8 section 4.5.9 section 18.5.9 section 18.5.10
Analog monitor output	Servo status is outputted in terms of voltage in real time.	○	○	○	[Pr. PC14] [Pr. PC15]
setup software (MR Configurator2™)	Using a personal computer, you can perform the parameter setting, test operation, monitoring, and others.	○	○	○	section 11.7
One-touch tuning	Gain adjustment is performed just by one click on a certain button on setup software (MR Configurator2™) or operation section.	○	○	○	section 6.2 section 18.5.4

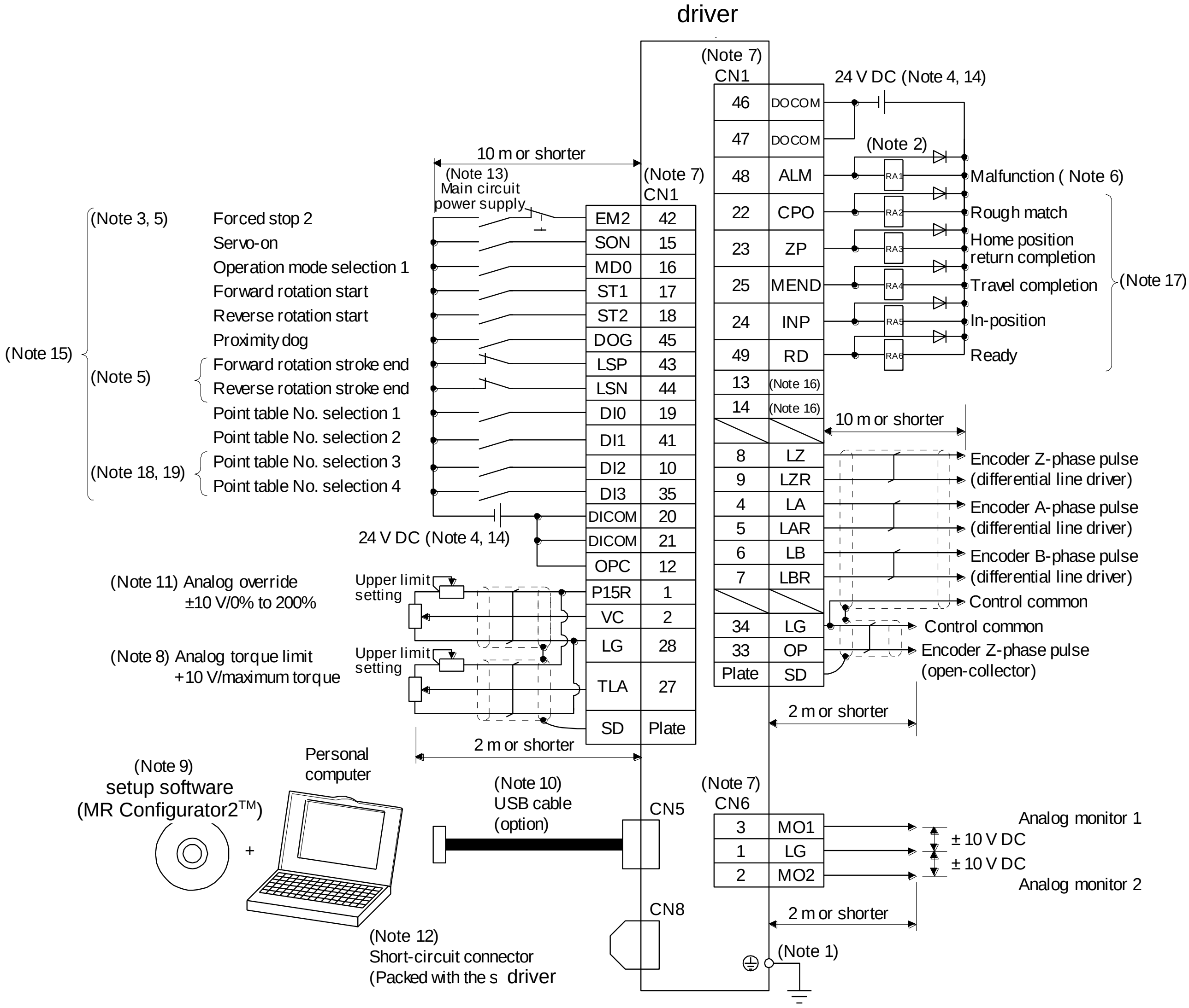
Function	Description	Control mode CP	CL	PS	Detailed explanation
SEMI-F47 function	This function which complies with the SEMI-F47 standard enables to avoid triggering [AL. 10 Undervoltage] using the electrical energy charged in the capacitor in case that an instantaneous power failure occurs during operation.	○	○	○	_ section 7.4 [Pr. PA20] [Pr. PF25]
Tough drive function	This function makes the equipment continue operating even under the condition that an alarm occurs. The tough drive function includes two types: the vibration tough drive and the instantaneous power failure tough drive.	○	○	○	section 7.3
Drive recorder function	This function continuously monitors the servo status and records the status transition before and after an alarm for a fixed period of time. You can check the recorded data on the drive recorder window on setup software (MR Configurator2™) by clicking the "Graph" button. However, the drive recorder will not operate on the following conditions. 1. You are using the graph function of setup software (MR Configurator2™). 2. You are using the machine analyzer function. 3. [Pr. PF21] is set to "-1".	○	○	○	[Pr. PA23]
STO function	This driver complies with the STO function as functional safety of IEC/EN 61800-5-2. You can create a safety system for the equipment easily.	○	○	○	chapter 13
Driver life diagnosis function	You can check the cumulative energization time and the number of on/off times of the inrush relay. This function gives an indication of the replacement time for parts of the Driver including a capacitor and a relay before they malfunction.	○	○	○	
Power monitoring function	This function calculates the power running energy and the regenerative power from the data in the driver such as speed and current. Power consumption and others are displayed on setup software (MR Configurator2™).	○	○	○	
Machine diagnosis function	From the data in the driver, this function estimates the friction and vibrational component of the drive system in the equipment and recognizes an error in the machine parts, including a ball screw and bearing. setup software (MR Configurator2™) is necessary for this function.	○	○	○	
Lost motion compensation function	This function improves the response delay occurred when the machine moving direction is reversed.	○	○	○	section 7.6
Super trace control	This function sets constant and uniform acceleration/deceleration droop pulses to almost 0.	○	○	○	section 7.7
Limit switch	Limits travel intervals using LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end).	○	○	○	
S-pattern acceleration/deceleration	Enables smooth acceleration and deceleration. Set S-pattern acceleration/deceleration time constants with [Pr. PC03]. Compared with linear acceleration/deceleration, the acceleration/deceleration time will be longer for the S-pattern acceleration/deceleration time constants regardless of command speed.	○	○		[Pr. PC03] section 5.2.2
Software limit	Limits travel intervals by address using parameters. Enables the same function with the limit switch by setting parameters.	○	○		Section 7.4
Analog override	Limits a servo motor speed with analog inputs. A value can be changed from 0% to 200% for a set speed.	○	○		Section 2.4
Digital override	A commanded speed multiplied by an override value selected with OVR (Override selection) will be an actual servo motor speed. A value can be changed from 0% to 360% for a set speed.			○	[Pr. PT42] [Pr. PT43] section 6.4.4 (2)
Teaching function	After an operation travels to a target position with a JOG operation or manual pulse generator operation, pushing the SET button of the operation part or turning on TCH (Teach) will import position data.	○			Section 3.1.10 Section 3.2.10
High-resolution analog input (VC)	The analog input resolution can be increased to 16 bits.	○	○		[Pr. PC60]

16.2 SIGNALS AND WIRING

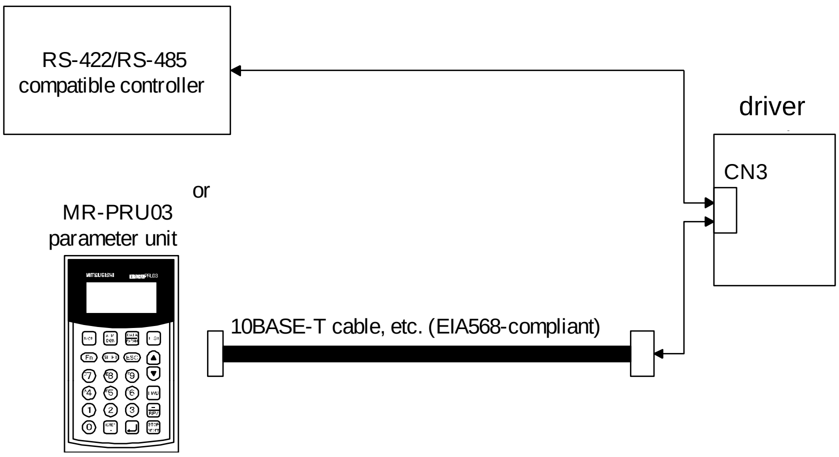
16.2.1 I/O signal connection example

(1) Point table method

POINT
●Assign the following output devices to CN1-22, CN1-23, and CN1-25 pins with [Pr. PD23], [Pr. PD24], and [Pr. PD26]. CN1-22: CPO (Rough match) CN1-23: ZP (Home position return completion) CN1-25: MEND (Travel completion)



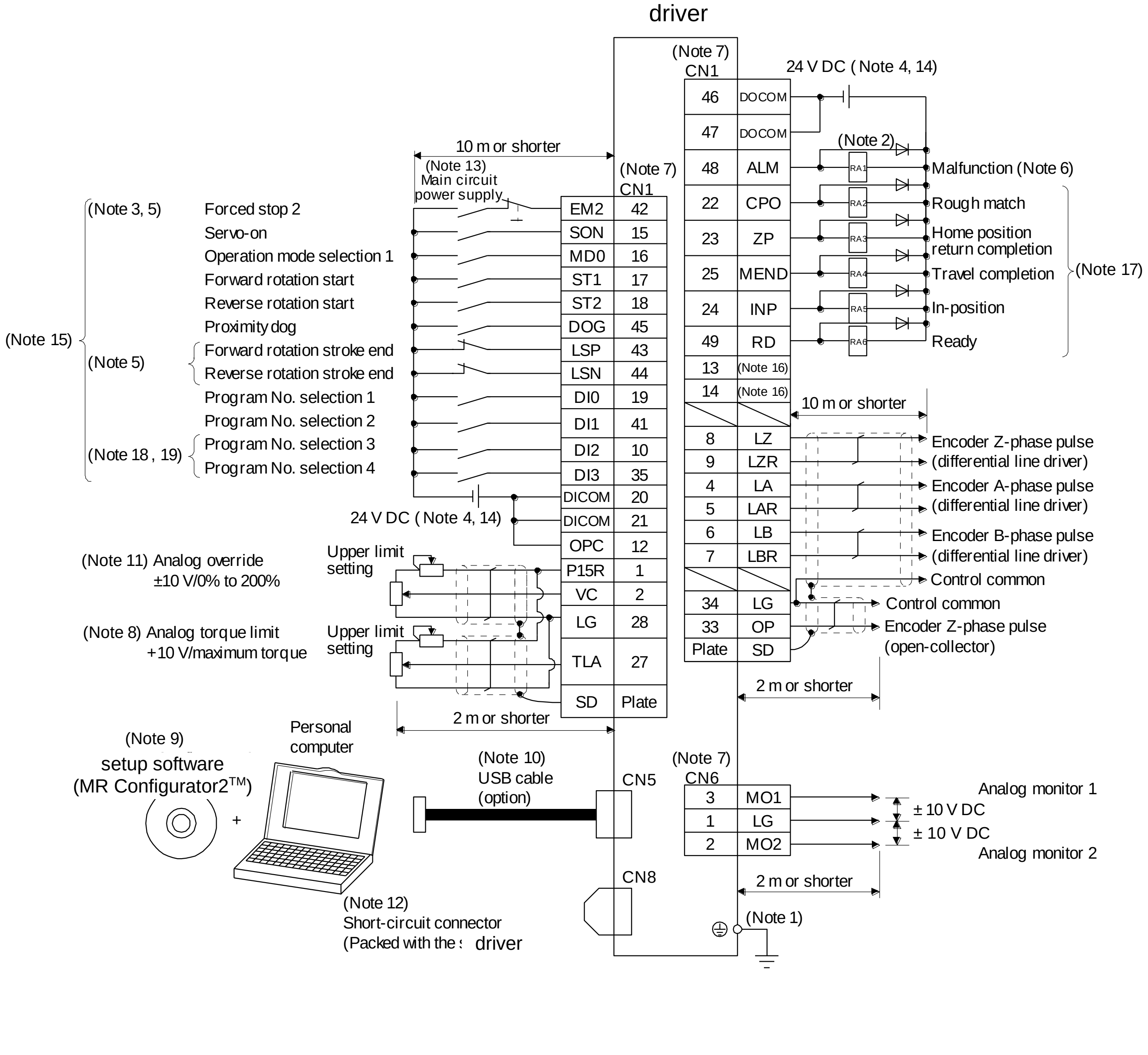
Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal (marked ⏚) of the driver to the protective earth (PE) of the cabinet.
2. Connect the diode in the correct direction. If it is connected reversely, the driver will malfunction and will not output signals, disabling EM2 (Forced stop 2) and other protective circuits.
3. The forced stop switch (normally closed contact) must be installed.
4. Supply 24 V DC ± 10% to interfaces from outside. The total current capacity is up to 500 mA. 500 mA 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 3.9.2 (1) that gives the current value necessary for the interface. A 24 V DC power supply can be used for both input signal and output signal.
5. When starting operation, always turn on EM2 (Forced stop 2), LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end) (normally closed contact).
6. ALM (Malfunction) turns on in normal alarm-free condition (normally closed contact).
7. The pins with the same signal name are connected in the driver.
8. TLA will be available when TL (External torque limit selection) is enabled with [Pr. PD04], [Pr. PD06], [Pr. PD08], [Pr. PD10], [Pr. PD12], [Pr. PD14], [Pr. PD18], [Pr. PD20], [Pr. PD22], [Pr. PD44], and [Pr. PD46]. (Refer to section 3.6.1 (5).)
9. Use Setup software (MR Configurator2™) (Refer to section 11.7)
10. PC or PLC...etcs or parameter units can also be connected via the CN3 connector with the RS-422/RS-485 communication. Note that using the USB communication function (CN5 connector) prevents the RS-422/RS-485 communication function (CN3 connector) from being used, and vice versa. They cannot be used together.



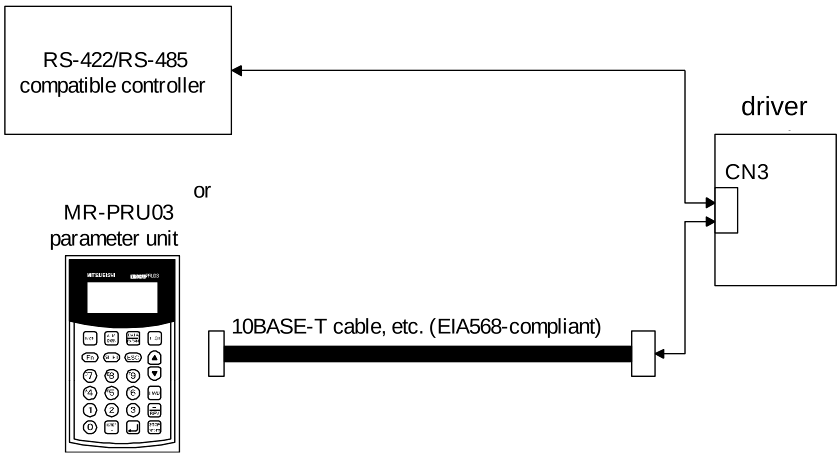
11. Use an external power supply when inputting a negative voltage.
12. When not using the STO function, attach the short-circuit connector came with a driver.
13. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the driver .
14. This diagram shows sink I/O interface.
15. The device can be changed with [Pr. PD04], [Pr. PD06], [Pr. PD08], [Pr. PD10], [Pr. PD12], [Pr. PD14], [Pr. PD18], [Pr. PD20], [Pr. PD22], [Pr. PD44], and [Pr. PD46].
16. These output devices are not assigned by default. Assign the output device with [Pr. PD47] as necessary.
17. These devices are recommended assignments. The device can be changed by [Pr. PD23] to [Pr. PD26], and [Pr. PD28].
18. DI2 and DI3 are assigned to the CN1-10 and CN1-35 pins by default.
19. Supply + of 24 V DC to OPC (Power input for open-collector sink interface) when input devices are assigned to the CN1-10 pin and the CN1-35 pin. They are not used with source input interface. For the positioning mode, input devices (DI2 and DI3) are assigned by default.

(2) Program method

POINT
●Assign the following output devices to CN1-22, CN1-23, and CN1-25 pins with [Pr. PD23], [Pr. PD24], and [Pr. PD26]. CN1-22: CPO (Rough match) CN1-23: ZP (Home position return completion) CN1-25: MEND (Travel completion)



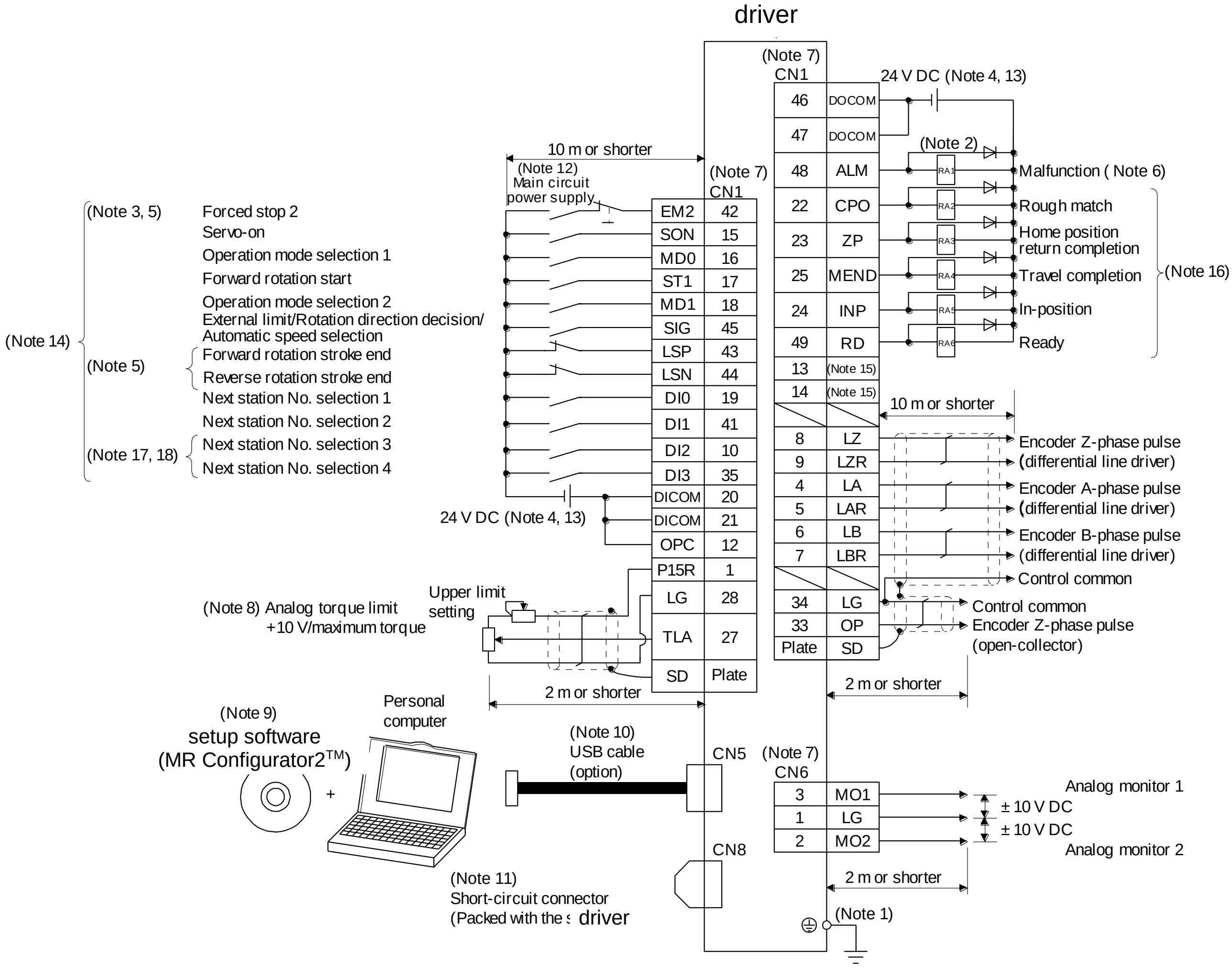
Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal (marked ⏚) of the driver to the protective earth (PE) of the cabinet.
2. Connect the diode in the correct direction. If it is connected reversely, the driver will malfunction and will not output signals, disabling EM2 (Forced stop 2) and other protective circuits.
3. The forced stop switch (normally closed contact) must be installed.
4. Supply 24 V DC ± 10% to interfaces from outside. The total current capacity is up to 500 mA. 500 mA 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 3.9.2 (1) that gives the current value necessary for the interface. A 24 V DC power supply can be used for both input signal and output signal.
5. When starting operation, always turn on EM2 (Forced stop 2), LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end) (normally closed contact).
6. ALM (Malfunction) turns on in normal alarm-free condition (normally closed contact).
7. The pins with the same signal name are connected in the driver.
8. TLA will be available when TL (External torque limit selection) is enabled with [Pr. PD04], [Pr. PD06], [Pr. PD08], [Pr. PD10], [Pr. PD12], [Pr. PD14], [Pr. PD18], [Pr. PD20], [Pr. PD22], [Pr. PD44], and [Pr. PD46]. (Refer to section 3.6.1 (5))
9. Use Setup software (MR Configurator2™) (Refer to section 11.7)
10. PC or PLC...etcs or parameter units can also be connected via the CN3 connector with the RS-422/RS-485 communication. Note that using the USB communication function (CN5 connector) prevents the RS-422/RS-485 communication function (CN3 connector) from being used, and vice versa. They cannot be used together.



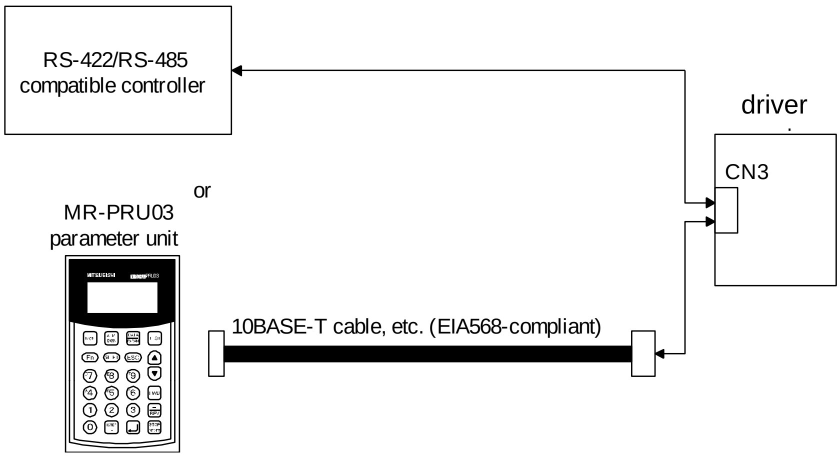
11. Use an external power supply when inputting a negative voltage.
12. When not using the STO function, attach the short-circuit connector came with a driver
13. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the driver .
14. This diagram shows sink I/O interface.
15. The device can be changed with [Pr. PD04], [Pr. PD06], [Pr. PD08], [Pr. PD10], [Pr. PD12], [Pr. PD14], [Pr. PD18], [Pr. PD20], [Pr. PD22], [Pr. PD44], and [Pr. PD46].
16. These output devices are not assigned by default. Assign the output device with [Pr. PD47] as necessary.
17. These devices are recommended assignments. The device can be changed by [Pr. PD23] to [Pr. PD26], and [Pr. PD28].
18. DI2 and DI3 are assigned to the CN1-10 and CN1-35 pins by default. When connecting a manual pulse generator, change them with [Pr. PD44] and [Pr. PD46]. Refer to section 9.1 for details of the manual pulse generator.
19. Supply + of 24 V DC to OPC (Power input for open-collector sink interface) when input devices are assigned to the CN1-10 pin and the CN1-35 pin. They are not used with source input interface. For the positioning mode, input devices (DI2 and DI3) are assigned by default.

(3) Indexer method

POINT
●In the indexer method, assign the following input device to CN1-18 pin with [Pr. PD10]. CN1-18: MD1 (Operation mode selection 2) ●Assign the following output devices to CN1-22, CN1-23, and CN1-25 pins with [Pr. PD23], [Pr. PD24], and [Pr. PD26]. CN1-22: CPO (Rough match) CN1-23: ZP (Home position return completion) CN1-25: MEND (Travel completion)



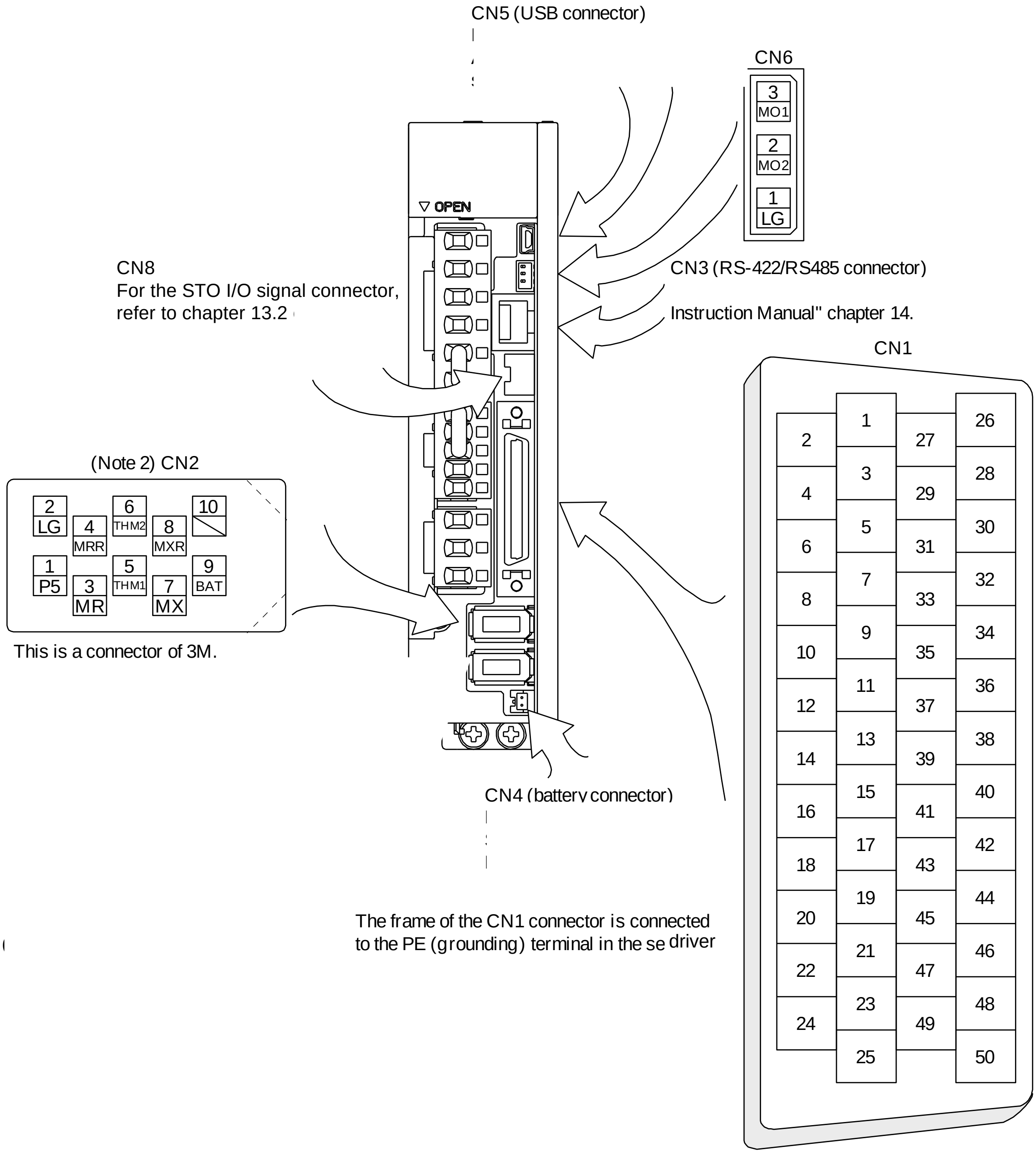
Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal (marked ⏚) of the driver to the protective earth (PE) of the cabinet.
2. Connect the diode in the correct direction. If it is connected reversely, the driver will malfunction and will not output signals, disabling EM2 (Forced stop 2) and other protective circuits.
3. The forced stop switch (normally closed contact) must be installed.
4. Supply 24 V DC ± 10% to interfaces from outside. The total current capacity is up to 500 mA. 500 mA 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 3.9.2 (1) that gives the current value necessary for the interface. A 24 V DC power supply can be used for both input signal and output signal.
5. When starting operation, always turn on EM2 (Forced stop 2), LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end) (normally closed contact).
6. ALM (Malfunction) turns on in normal alarm-free condition (normally closed contact).
7. The pins with the same signal name are connected in the driver.
8. TLA will be available when TL (External torque limit selection) is enabled with [Pr. PD04], [Pr. PD06], [Pr. PD08], [Pr. PD10], [Pr. PD12], [Pr. PD14], [Pr. PD18], [Pr. PD20], [Pr. PD22], [Pr. PD44], and [Pr. PD46]. (Refer to section 3.6.1 (5).)
9. Use Setup software (MR Configurator2TM) (Refer to section 11.7)
10. PC or PLC...etcs or parameter units can also be connected via the CN3 connector with the RS-422/RS-485 communication. Note that using the USB communication function (CN5 connector) prevents the RS-422/RS-485 communication function (CN3 connector) from being used, and vice versa. They cannot be used together.



11. When not using the STO function, attach the short-circuit connector came with a driver..
12. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the driver.
13. This diagram shows sink I/O interface.
14. The signals can be changed with [Pr. PD04], [Pr. PD06], [Pr. PD08], [Pr. PD10], [Pr. PD12], [Pr. PD14], [Pr. PD18], [Pr. PD20], [Pr. PD22], [Pr. PD44], and [Pr. PD46].
15. These output devices are not assigned by default. Assign the output device with [Pr. PD47] as necessary.
16. These devices are recommended assignments. The device can be changed by [Pr. PD23] to [Pr. PD26], and [Pr. PD28].
17. DI2 and DI3 are assigned to the CN1-10 and CN1-35 pins by default. When connecting a manual pulse generator, change them with [Pr. PD44] and [Pr. PD46]. Refer to section 9.1 for details of the manual pulse generator.
18. Supply + of 24 V DC to OPC (Power input for open-collector sink interface) when input devices are assigned to the CN1-10 pin and the CN1-35 pin. They are not used with source input interface. For the positioning mode, input devices (DI2 and DI3) are assigned by default.

16.2.2 Connector and signal arrangement

The driver front view shown is that of the LECSB2-T7 or less. For other views of driver, connector arrangements, and details, refer to chapter 9.



The device assignment of CN1 connector pins changes depending on the control mode. For the pins which are given parameters in the related parameter column, their devices will be changed using those parameters.

Pin No.	(Note 1) I/O	(Note 2) I/O signals in control modes			Related parameter
		CP	CL	PS	
1		P15R	P15R	P15R	
2	I	VC	VC		
3		LG	LG	LG	
4	O	LA	LA	LA	
5	O	LAR	LAR	LAR	
6	O	LB	LB	LB	
7	O	LBR	LBR	LBR	
8	O	LZ	LZ	LZ	
9	O	LZR	LZR	LZR	
10	(Note 8) I	(Note 10)	(Note 10)	(Note 10)	PD44
11	I	PG	PG	PG	
12		OPC	OPC	OPC	
13	O	(Note 4)	(Note 4)	(Note 4)	PD47
14	O	(Note 4)	(Note 4)	(Note 4)	PD47
15	I	SON	SON	SON	PD04
16	I	MD0	MD0	MD0	PD06
17	I	ST1	ST1	ST1	PD08
18	I	ST2	ST2	(Note 5) MD1	PD10
19	I	DI0	DI0	DI0	PD12
20		DICOM	DICOM	DICOM	
21		DICOM	DICOM	DICOM	
22	O	(Note 6) CPO	(Note 6) CPO	(Note 6) CPO	PD23
23	O	(Note 6) ZP	(Note 6) ZP	(Note 6) ZP	PD24
24 or less	O	INP	INP	INP	PD25
25	O	(Note 6) MEND	(Note 6) MEND	(Note 6) MEND	PD26
26					
27	I	(Note 3) TLA	(Note 3) TLA	(Note 3) TLA	
28		LG	LG	LG	
29					
30		LG	LG	LG	
31					
32					
33	O	OP	OP	OP	
34		LG	LG	LG	
35	(Note 8) I	(Note 10)	(Note 10)	(Note 10)	PD46
36	I	NG	NG	NG	
37	I	(Note 11)	(Note 11)	(Note 11)	PD44
38	I	(Note 11)	(Note 11)	(Note 11)	PD46
39					
40					
41	I	DI1	DI1	DI1	PD14
42	I	EM2	EM2	EM2	
43	I	LSP	LSP	LSP	PD18
44	I	LSN	LSN	LSN	PD20
45	I	DOG	DOG	SIG	PD22
46		DOCOM	DOCOM	DOCOM	
47		DOCOM	DOCOM	DOCOM	
48	O	ALM	ALM	ALM	
49	O	RD	RD	RD	PD28
50					

Note 1. I: input signal, O: output signal
2. CP: Positioning mode (point table method)
CL: Positioning mode (program method)
PS: Positioning mode (indexer method)
3. TLA will be available when TL (External torque limit selection) is enabled with [Pr. PD04], [Pr. PD06], [Pr. PD08], [Pr. PD10], [Pr. PD12], [Pr. PD14], [Pr. PD18], [Pr. PD20], [Pr. PD22], [Pr. PD44], and [Pr. PD46].
4. Assign any device with [Pr. PD47].
5. In the indexer method, assign the following input device to CN1-18 pin with [Pr. PD10].
CN1-18: MD1 (Operation mode selection 2)
6. Assign the following output devices to CN1-22, CN1-23, and CN1-25 pins with [Pr. PD23], [Pr. PD24], and [Pr. PD26].
CN1-22: CPO (Rough match)
CN1-23: ZP (Home position return completion)
CN1-25: MEND (Travel completion)
8. Supply + of 24 V DC to OPC (power input for open-collector sink interface) when using the CN1-10 pin and CN1-35 pin for DI.
10. This signal is used with sink interface. Input devices are not assigned by default. Assign the input devices with [Pr. PD44] and [Pr. PD46] as necessary. In addition, supply + of 24 DC V to the CN1-12 pin of OPC (Power input for open-collector sink interface).
11. This signal is used with source interface. Input devices are not assigned by default. Assign the input devices with [Pr. PD44] and [Pr. PD46] as necessary.

16.2.3 Signal (device) explanations

The pin numbers in the connector pin No. column are those in the initial status.
For the I/O interfaces (symbols in I/O division column in the table), refer to section 3.9.2. The symbols in the control mode field of the table show the followings.
CP: Positioning mode (point table method)
CL: Positioning mode (program method)
PS: Positioning mode (indexer method)
"○" and "△" of the table show the followings.
○: Usable device by default.
△: Usable device by setting the following parameters.
[Pr. PD04], [Pr. PD06], [Pr. PD08], [Pr. PD10], [Pr. PD12], [Pr. PD14], [Pr. PD18], [Pr. PD20], [Pr. PD22] to [Pr. PD26], [Pr. PD28], [Pr. PD44], [Pr. PD46], and [Pr. PD47]

(1) I/O device
 (a) Input device

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Function and application</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>CP</th><th>CL</th><th>PS</th></tr>
<tr><td>Forced stop 2</td><td>EM2</td><td>CN1-42</td><td>Turn off EM2 (open between commons) to decelerate the servo motor to a stop with commands.
Turn EM2 on (short between commons) in the forced stop state to reset that state.
The following shows the setting of [Pr. PA04].
<table>
<tr><th rowspan="2">[Pr. PA04] setting</th><th rowspan="2">EM2/EM1</th><th colspan="2">Deceleration method</th></tr>
<tr><th>EM2 or EM1 is off</th><th>Alarm occurred</th></tr>
<tr><td>0 _ _ _</td><td>EM1</td><td>MBR (Electromagnetic brake interlock) turns off without the forced stop deceleration.</td><td>MBR (Electromagnetic brake interlock) turns off without the forced stop deceleration.</td></tr>
<tr><td>2 _ _ _</td><td>EM2</td><td>MBR (Electromagnetic brake interlock) turns off after the forced stop deceleration.</td><td>MBR (Electromagnetic brake interlock) turns off after the forced stop deceleration.</td></tr>
</table>
EM2 and EM1 are mutually exclusive.</td><td>DI-1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Forced stop 1</td><td>EM1</td><td>(CN1-42)</td><td>When using EM1, set [Pr. PA04] to "0 _ _ _" to enable EM1.
When EM1 is turned off (open between commons), the base circuit shuts off, and the dynamic brake operates to decelerate the servo motor to a stop.
Turn EM1 on (short between commons) in the forced stop state to reset that state.</td><td>DI-1</td><td>△</td><td>△</td><td>△</td></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 status)
Turn it off to shut off the base circuit and coast the servo motor.
Set "_ _ _ 4" in [Pr. 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></td><td>Turn on RES for more than 50 ms to reset the alarm.
Some alarms cannot be deactivated by RES (Reset). Refer to chapter 8.
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 [Pr. PD30].
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>
</table>

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Function and application</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>CP</th><th>CL</th><th>PS</th></tr>
<tr><td>Forward rotation stroke end</td><td>LSP</td><td>CN1-43</td><td rowspan="2">To start operation, turn on LSP and LSN. Turn it off to bring the motor to a sudden stop and make it servo-locked.
Setting [Pr. PD30] to " _ _ _ 1" will enable "Slow stop (home position erased)".
<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 Positive direction</th><th>CW direction Negative 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

The stop method can be changed with [Pr. PD30].
Set [Pr. PD01] as indicated below to switch on the signals (keep terminals connected) automatically in the driver.
<table>
<tr><th rowspan="2">[Pr. 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 is turned off, [AL. 99 Stroke limit warning] occurs, and WNG (Warning) turns on. When using WNG, enable it by setting [Pr. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47].</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>
<tr><td>External torque limit selection</td><td>TL</td><td></td><td>Turning off TL will enable [Pr. PA11 Forward torque limit] and [Pr. PA12 Reverse torque limit], and turning on it will enable TLA (Analog torque limit). For details, refer to section 3.6.1 (5).
For the indexer method, [Pr. PC35 Internal torque limit 2] will be enabled automatically depending on operation status. Refer to each timing chart in section 6.2 and section 6.4.5.</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>To select [Pr. PC35 Internal torque limit 2/internal thrust limit 2], enable TL1 with [Pr. PD04], [Pr. PD06], [Pr. PD08], [Pr. PD10], [Pr. PD12], [Pr. PD14], [Pr. PD18], [Pr. PD20], [Pr. PD22], [Pr. PD44], and [Pr. PD46]. For details, refer to section 3.6.1 (5).
For the indexer method, [Pr. PC35 Internal torque limit 2] will be enabled automatically depending on operation status. Refer to each timing chart in section 6.2 and section 6.4.5.</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">Connector pin No.</th><th rowspan="2">Function and application</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>CP</th><th>CL</th><th>PS</th></tr>
<tr><td>Operation mode selection 1</td><td>MD0</td><td>CN1-16</td><td rowspan="2">Point table method/program method
Turning on MD0 will be automatic operation mode, off will be manual operation mode. Changing an operation mode during operation will clear the command remaining distance and the motor will decelerate to stop.
MD1 cannot be used.

Indexer method
Select an operation mode with combinations of MD0 and MD1. Refer to the following table for combinations.
Changing an operation mode during operation will clear the command remaining distance and the motor will decelerate to stop.

Device (Note) MD1 / MD0 — Operation mode
0 / 0 — Home position return mode
0 / 1 — Manual operation mode
1 / 0 — Automatic operation mode 1 (rotation direction specifying indexer)
1 / 1 — Automatic operation mode 2 (shortest rotating indexer)
Note. 0: Off
1: On</td><td>DI-1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Operation mode selection 2</td><td>MD1</td><td></td><td>DI-1</td><td></td><td></td><td>△</td></tr>
</table>

Device (Note)		Operation mode
MD1	MD0	
0	0	Home position return mode
0	1	Manual operation mode
1	0	Automatic operation mode 1 (rotation direction specifying indexer)
1	1	Automatic operation mode 2 (shortest rotating indexer)

Note. 0: Off
1: On

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode CP	CL	PS
Forward rotation start	ST1	CN1-17	Point table method Absolute value command method Turning on ST1 during automatic operation will execute one positioning based on position data set in point tables. Turning on ST1 during home position return will also start home position return. Turning on ST1 during JOG operation will rotate the motor in the forward rotation direction while it is on. The forward rotation means address increasing direction. Turning on both ST1 and ST2 during JOG operation will stop the servo motor. Incremental value command method Turning on ST1 during automatic operation will execute one positioning in the forward rotation direction based on position data set in point tables. Turning on ST1 during home position return will also start home position return. Turning on ST1 during JOG operation will rotate the motor in the forward rotation direction while it is on. The forward rotation means address increasing direction. Turning on both ST1 and ST2 during JOG operation will stop the servo motor.	DI-1	○		
			Program method Automatic operation mode Turning on ST1 will execute a program operation selected with DI0 to DI7. The forward rotation means address increasing direction. Turning on both ST1 and ST2 during manual operation mode will stop the servo motor. Manual operation mode Turning on ST1 will rotate the motor in the forward rotation direction while it is on. The forward rotation means address increasing direction. Turning on both ST1 and ST2 during manual operation mode will stop the servo motor.			○	
			Indexer method Automatic operation mode 1 or automatic operation mode 2 Turning on ST1 will execute one positioning to the specified station No. Manual operation mode Turning on ST1 with the station JOG operation will rotate the motor in the specified direction with SIG only while it is on. Turning off ST1 will execute a positioning to a station which can be decelerated to a stop. Turning on ST1 with JOG operation will rotate the motor in the direction specified with SIG only while it is on. Turning off will decelerate the motor to a stop regardless of stations. Home position return mode Turning on ST1 will also start home position return.				○

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode CP	Control mode CL	Control mode PS
Reverse rotation start	ST2	CN1-18	Point table method Use this device with the incremental value command method. Turning on ST2 during automatic operation will execute one positioning in the reverse rotation direction based on position data set in point tables. Turning on ST2 during JOG operation will rotate the motor in the reverse rotation direction while it is on. Turning on both ST1 and ST2 will stop the servo motor. Turning on ST2 during in the home position return mode will execute an automatic positioning to the home position. The reverse rotation means address decreasing direction. Turning on both ST1 and ST2 during JOG operation will stop the servo motor.	DI-1	○		
			Program method Turning on ST2 with JOG operation in the manual operation mode will rotate the motor in the reverse rotation direction while it is on. Turning on both ST1 and ST2 will stop the servo motor. The reverse rotation means address decreasing direction. Turning on both ST1 and ST2 during manual operation mode will stop the servo motor. ST2 will be disabled in the automatic operation mode.			○	
			Indexer method This device is not used.				
Temporary stop/restart	TSTP		Turning on TSTP during automatic operation will temporarily stop the motor. Turning on TSTP again will restart. Turning on ST1 (Forward rotation start)/ST2 (Reverse rotation start) during a temporary stop will not rotate the motor. Changing the automatic operation mode to manual operation mode during a temporary stop will erase a travel remaining distance. The temporary stop/restart input will not function during home position return/JOG operation.	DI-1	△	△	
Proximity dog	DOG	CN1-45	Turning off DOG will detect a proximity dog. The polarity for dog detection can be changed with [Pr. PT29]. <table><tr><th>[Pr. PT29]</th><th>Polarity for proximity dog detection</th></tr><tr><td>_ _ _ 0</td><td>Detection with off</td></tr><tr><td>_ _ _ 1</td><td>Detection with on</td></tr></table>	DI-1	○	○	

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Function and application</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>CP</th><th>CL</th><th>PS</th></tr>
<tr><td>External limit/ Rotation direction decision/ Automatic speed selection</td><td>SIG</td><td>CN1-45</td><td>The function varies depending on the operation mode.
1. Home position return mode (MD1 = 0, MD0 = 0)
You can use SIG as an input device of external limit. This operation mode is enabled when the home position return type of the torque limit changing dog type is selected.
2. Manual operation mode (MD1 = 0, MD0 = 1)
You can use this as an input device for specifying a rotation direction of the servo motor. The rotation direction varies depending on the setting of [Pr. PA14 Rotation direction selection]. (Refer to section 2.1.)
Automatic operation mode 1 (rotation direction specifying indexer) (MD1 = 1, MD0 = 0)
You can use this as an input device for specifying a rotation direction of the servo motor. The rotation direction varies depending on the setting of [Pr. PA14 Rotation direction selection]. (Refer to section 2.1.)
Automatic operation mode 2 (shortest rotating indexer) (MD1 = 1, MD0 = 1)
You can use SIG as an input device for selecting a speed of the servo motor.

Table 2.1 Rotation direction selection<table><tr><th>[Pr. PA14]</th><th>SIG (Note)</th><th>Servo motor rotation direction</th></tr><tr><td>0</td><td>0</td><td>CCW direction</td></tr><tr><td>0</td><td>1</td><td>CW direction</td></tr><tr><td>1</td><td>0</td><td>CW direction</td></tr><tr><td>1</td><td>1</td><td>CCW direction</td></tr></table>Note. 0: Off
1: On</td><td>DI-1</td><td></td><td></td><td>○</td></tr>
<tr><td>Manual pulse generator multiplication 1</td><td>TP0</td><td></td><td rowspan="2">Select a multiplication of the manual pulse generator.
When a multiplication is not selected, the setting of [Pr. PT03] will be enabled.<table><tr><th colspan="2">Device (Note)</th><th rowspan="2">Manual pulse generator multiplication</th></tr><tr><th>TP1</th><th>TP0</th></tr><tr><td>0</td><td>0</td><td>[Pr. PT03] setting</td></tr><tr><td>0</td><td>1</td><td>× 1</td></tr><tr><td>1</td><td>0</td><td>× 10</td></tr><tr><td>1</td><td>1</td><td>× 100</td></tr></table>Note. 0: Off
1: On</td><td>DI-1</td><td>△</td><td>△</td><td></td></tr>
<tr><td>Manual pulse generator multiplication 2</td><td>TP1</td><td></td><td>DI-1</td><td>△</td><td>△</td><td></td></tr>
</table>

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode CP	CL	PS
Analog override selection	OVR		Turning on OVR will enable VC (Analog override).	DI-1	△	△	
Teach	TCH		Use this for teaching. Turning on TCH in the point table method will rewrite a position data of the selected point table No. to the current position.	DI-1	△		
Program input 1	PI1		Turning on PI1 will restart a step which was suspended with the SYNC (1) command during programming.	DI-1		△	
Program input 2	PI2		Turning on PI2 will restart a step which was suspended with the SYNC (2) command during programming.	DI-1		△	
Program input 3	PI3		Turning on PI3 will restart a step which was suspended with the SYNC (3) command during programming.	DI-1		△	
Current position latch input	LPS		Turning on LPS during execution of the LPOS command will latch a current position with its rising edge. The latched current position can be read with communication commands.	DI-1		△	

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode CP	Control mode CL	Control mode PS
Point table No./program No. selection 1	DI0	CN1-19	Point table method Select point tables and home position return mode with DI0 to DI7.	DI-1	○	○	
Point table No./program No. selection 2	DI1	CN1-41			○	○	
Point table No./program No. selection 3	DI2	CN1-10			○	○	
Point table No./program No. selection 4	DI3	CN1-35			○	○	
Point table No./program No. selection 5	DI4				△	△	
Point table No./program No. selection 6	DI5				△	△	
Point table No./program No. selection 7	DI6				△	△	
Point table No./program No. selection 8	DI7				△	△	

Point table method

Select point tables and home position return mode with DI0 to DI7.

Device (Note)								Selection contents
DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0	
0	0	0	0	0	0	0	0	Home position return mode
0	0	0	0	0	0	0	1	Point table No. 1
0	0	0	0	0	0	1	0	Point table No. 2
0	0	0	0	0	0	1	1	Point table No. 3
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
1	1	1	1	1	1	1	0	Point table No. 254
1	1	1	1	1	1	1	1	Point table No. 255

Note. 0: Off
1: On

Program method

Select program Nos. with DI0 to DI7.

Device (Note)								Selection contents
DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0	
0	0	0	0	0	0	0	0	Program No. 1
0	0	0	0	0	0	0	1	Program No. 2
0	0	0	0	0	0	1	0	Program No. 3
0	0	0	0	0	0	1	1	Program No. 4
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
1	1	1	1	1	1	1	0	Program No. 255
1	1	1	1	1	1	1	1	Program No. 256

Note. 0: Off
1: On

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Function and application</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>CP</th><th>CL</th><th>PS</th></tr>
<tr><td>Next station No. selection 1</td><td>DI0</td><td>CN1-19</td><td rowspan="8">Indexer method
Select next station Nos. with DI0 to DI7.
A setting value at ST1 on will be enabled.
<table>
<tr><th colspan="8">Device (Note 1)</th><th rowspan="2">Selection contents</th></tr>
<tr><th>DI7</th><th>DI6</th><th>DI5</th><th>DI4</th><th>DI3</th><th>DI2</th><th>DI1</th><th>DI0</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>Next station No. 0</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>Next station No. 1</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>Next station No. 2</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>Next station No. 3</td></tr>
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<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>Next station No. 254</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>Setting inhibited (Note 2)</td></tr>
</table>
Note 1. 0: Off
1: On
2. [AL. 97.2 Next station position warning] will occur.</td><td rowspan="8">DI-1</td><td></td><td></td><td>○</td></tr>
<tr><td>Next station No. selection 2</td><td>DI1</td><td>CN1-41</td><td></td><td></td><td>○</td></tr>
<tr><td>Next station No. selection 3</td><td>DI2</td><td>CN1-10</td><td></td><td></td><td>○</td></tr>
<tr><td>Next station No. selection 4</td><td>DI3</td><td>CN1-35</td><td></td><td></td><td>○</td></tr>
<tr><td>Next station No. selection 5</td><td>DI4</td><td></td><td></td><td></td><td>△</td></tr>
<tr><td>Next station No. selection 6</td><td>DI5</td><td></td><td></td><td></td><td>△</td></tr>
<tr><td>Next station No. selection 7</td><td>DI6</td><td></td><td></td><td></td><td>△</td></tr>
<tr><td>Next station No. selection 8</td><td>DI7</td><td></td><td></td><td></td><td>△</td></tr>
<tr><td>Second acceleration/deceleration selection</td><td>RT</td><td></td><td>Turning on ST1 with RT-off will select acceleration/deceleration time constants set with [Pr. PC01 Acceleration time constant 1] and [Pr. PC02 Deceleration time constant 1].
Turning on ST1 with RT-on will select acceleration/deceleration time constants set with [Pr. PC30 Acceleration time constant 2] and [Pr. PC31 Deceleration time constant 2].
RT will not be accepted during operation.
<table>
<tr><th>Device (Note)</th><th colspan="2">Description</th></tr>
<tr><th>RT</th><th>Acceleration time constant</th><th>Deceleration time constant</th></tr>
<tr><td>0</td><td>[Pr. PC01]</td><td>[Pr. PC02]</td></tr>
<tr><td>1</td><td>[Pr. PC30]</td><td>[Pr. PC31]</td></tr>
</table>
Note. 0: Off
1: On</td><td>DI-1</td><td></td><td></td><td>△</td></tr>
<tr><td>Second acceleration/deceleration gain selection</td><td>RTCDP</td><td></td><td>This has two functions of CDP (Gain switching) and RT (Second acceleration/deceleration selection).
When RTCDP is off, the servo control gain set with [Pr. PB06], [Pr. PB08] to [Pr. PB10] will be selected. Turning on ST1 (Forward rotation start) will select acceleration/deceleration time constants set with [Pr. PC01 Acceleration time constant 1] and [Pr. PC02 Deceleration time constant 1].
When RTCDP is on, the servo control gain set with [Pr. PB29] to [Pr. PB32] will be selected. Turning on ST1 (Forward rotation start) will select acceleration/deceleration time constants set with [Pr. PC30 Acceleration time constant 2] and [Pr. PC31 Deceleration time constant 2].</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">Connector pin No.</th><th rowspan="2">Function and application</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>CP</th><th>CL</th><th>PS</th></tr>
<tr><td>Digital override selection 1</td><td>OV0</td><td></td><td rowspan="4">To enable the digital override function, set [Pr. PT38] to "_ _ 1 _".
This signal is for multiplying a command speed by the digital override (multiplying factor).
A command speed multiplied by the digital override value selected with this signal will be an actual servo motor speed.
If the servo motor speed multiplied by the digital override value exceeds the servo motor maximum speed, the speed will be limited at the maximum speed.

The following table shows an example of setting "50" to [Pr. PT42] and "5" to [Pr. PT43].

<table>
<tr><th colspan="4">Device (Note)</th><th rowspan="2">Description</th></tr>
<tr><th>OV3</th><th>OV2</th><th>OV1</th><th>OV0</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>100 [%] of command speed</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td><td>50 [%] of command speed</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>55 [%] of command speed</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>60 [%] of command speed</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td><td>65 [%] of command speed</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1</td><td>70 [%] of command speed</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>0</td><td>75 [%] of command speed</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>1</td><td>80 [%] of command speed</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>0</td><td>85 [%] of command speed</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>1</td><td>90 [%] of command speed</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>0</td><td>95 [%] of command speed</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>1</td><td>100 [%] of command speed</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>0</td><td>105 [%] of command speed</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>1</td><td>110 [%] of command speed</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>0</td><td>115 [%] of command speed</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>0 [%] of command speed</td></tr>
</table>
Note. 0: Off
1: On</td><td rowspan="4">DI-1</td><td></td><td></td><td>△</td></tr>
<tr><td>Digital override selection 2</td><td>OV1</td><td></td><td></td><td></td><td>△</td></tr>
<tr><td>Digital override selection 3</td><td>OV2</td><td></td><td></td><td></td><td>△</td></tr>
<tr><td>Digital override selection 4</td><td>OV3</td><td></td><td></td><td></td><td>△</td></tr>
<tr><td>Mark detection</td><td>MSD</td><td></td><td>The current position latch function by sensor input can be used. For the current position latch function, refer to section 12.2.1. For the current position latch function, refer to section 12.2.2.</td><td>DI-1</td><td>△</td><td>△</td><td></td></tr>
</table>

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode CP	CL	PS
Proportion control	PC		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 PC (Proportion control) 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 PC (Proportion control) and TL (External torque limit selection) at the same time to make the torque less than the rated by TLA (Analog torque limit).	DI-1	△	△	△
Clear	CR		Turn CR on to clear the position control counter droop pulse on its leading edge. The pulse width should be 10 ms or longer. The delay amount set in [Pr. PB03 Position command acceleration/deceleration time constant] is also cleared. When " _ _ _1 " is set to [Pr. PD32], the pulses are always cleared while CR is on.	DI-1	△	△	△
Gain switching	CDP		Turn on CDP to use the values of [Pr. PB29] to [Pr. PB36] and [Pr. PB56] to [Pr. PB60] as the load to motor inertia ratio and gain values.	DI-1	△	△	△
Fully closed loop selection	CLD		Not used with the positioning mode.	DI-1			
Motor-side/load-side deviation counter clear	MECR		Turn on MECR to clear the motor-side/load-side position deviation counter to zero. It operates during the fully closed loop control. It does not affect the position control droop pulses. Turning on this device during the semi closed loop control does not affect the operation. Turning on this device while the fully closed loop control error detection function is disabled in [Pr. PE03] does not affect the operation.	DI-1	△	△	
Cam control command	CAMC		When using CAMC, set [Pr. PT35] to "_ 1 _ _" to enable it. Turning CAMC on switches the control from the normal positioning control to the cam control.	DI-1	△	△	
Cam position compensation request	CPCD		Turning CPCD on compensates the cam axis one cycle current value to be in the position set in [Cam control data No. 60 - Cam position compensation target position].	DI-1	△	△	
Clutch command	CLTC		This is used to turning on/off the main shaft clutch command. This is used when [Cam control data No. 36 - Main shaft clutch control setting] is set to "_ _ _ 1".	DI-1	△	△	

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Function and application</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>CP</th><th>CL</th><th>PS</th></tr>
<tr><td>Cam No. selection 0</td><td>CI0</td><td></td><td rowspan="4">Select cam No.
This is enabled when [Cam control data No. 49 - Cam No.] is set to "0". Set the cam control data on the cam setting window of setup software (MR Configurator2TM).
<table><tr><th colspan="4">Device (Note 1)</th><th rowspan="2">Selection contents</th></tr><tr><th>CI3</th><th>CI2</th><th>CI1</th><th>CI0</th></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>Linear cam</td></tr><tr><td>0</td><td>0</td><td>0</td><td>1</td><td>Cam No. 1</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td><td>Cam No. 2</td></tr><tr><td>0</td><td>0</td><td>1</td><td>1</td><td>Cam No. 3</td></tr><tr><td>.
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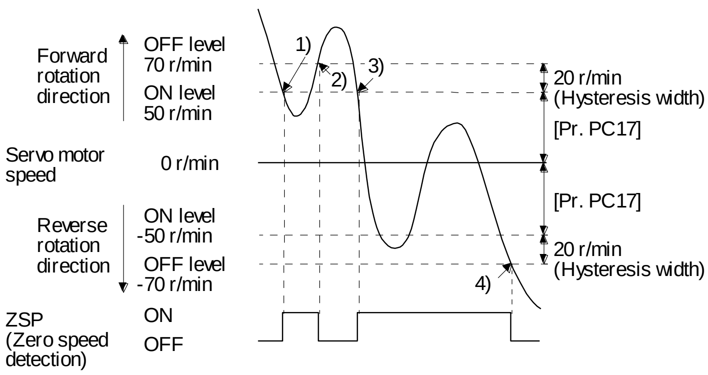
Note 1. 0: Off
1: On
2. [AL. F6.5 Cam No. external error] occurs.</td><td rowspan="4">DI-1</td><td>△</td><td>△</td><td></td></tr>
<tr><td>Cam No. selection 1</td><td>CI1</td><td></td><td>△</td><td>△</td><td></td></tr>
<tr><td>Cam No. selection 2</td><td>CI2</td><td></td><td>△</td><td>△</td><td></td></tr>
<tr><td>Cam No. selection 3</td><td>CI3</td><td></td><td>△</td><td>△</td><td></td></tr>
</table>

(b) Output device

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode CP	Control mode CL	Control mode PS
Malfunction	ALM	CN1-48	When an alarm occurs, ALM will turn off. When an alarm does not occur, ALM will turn on after 4 s to 5 s after power-on. When [Pr. PD34] is "_ _ 1 _", an alarming or warning will turn off ALM.	DO-1	○	○	○
Malfunction/Warning	ALM WNG		When an alarm occurs, ALMWNG will turn off. When a warning (except [AL. 9F Battery warning]) occurs on and off will be repeated every 1 s. When an alarm/warning is not occurring, turning on the power will turn on ALMWNG after 4 s to 5 s.	DO-1	△	△	△
Warning	WNG		When warning has occurred, WNG turns on. When a warning is not occurring, turning on the power will turn off WNG after 4 s to 5 s.	DO-1	△	△	△
Battery warning	BWNG		BWNG turns on when [AL. 92 Battery cable disconnection warning] or [AL. 9F Battery warning] has occurred. When the battery warning is not occurring, turning on the power will turn off BWNG after 4 s to 5 s.	DO-1	△	△	△
AL9F warning	BW9F		When [AL. 9F Battery warning] occurs, BW9F will turn on.	DO-1	△	△	△
Dynamic brake interlock	DB		it is not necessary to use this device.	DO-1	△	△	△
Ready	RD	CN1-49	Enabling servo-on to make the driver ready to operate will turn on RD.	DO-1	○	○	○
In-position	INP	CN1-24	When the number of droop pulses is in the preset in-position range, INP will turn on. The in-position range can be changed using [Pr. PA10]. When the in-position range is increased, INP may be on during low-speed rotation. INP turns on when servo-on turns on.	DO-1	○	○	○
Limiting torque	TLC	CN1-25	TLC turns on when a generated torque reaches a value set with any of [Pr. PA11 Forward torque limit], [Pr. PA12 Reverse torque limit], or TLA (Analog torque limit).	DO-1	○	○	○
Zero speed detection	ZSP	CN1-23	ZSP turns on when the servo motor speed is zero speed (50 r/min) or less. Zero speed can be changed with [Pr. PC17].  ZSP will turn on when the servo motor is decelerated to 50 r/min (at 1)), and will turn off when the servo motor is accelerated to 70 r/min again (at 2)). ZSP will turn on when the servo motor is decelerated again to 50 r/min (at 3)), and will turn off when the servo motor speed has reached -70 r/min (at 4)). 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 20 r/min for this driver.	DO-1	○	○	○

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode CP	Control mode CL	Control mode PS
Electromagnetic brake interlock	MBR		When using the device, set operation delay time of the electromagnetic brake in [Pr. PC16]. When a servo-off status or alarm occurs, MBR will turn off.	DO-1	△	△	△
Speed command reached	SA		When a command speed is within a target speed at servo-on status, SA will be on. When the command speed is 0 r/min (mm/s), this will be continuously on. When the command speed is in acceleration/deceleration or at servo-off status, SA will be off.	DO-1	△	△	
Home position return completion	ZP		When a home position return completes normally, ZP (Home position return completion) will be on. This will be off with the following conditions in the incremental system. 1) SON (Servo-on) is off. 2) EM2 (Forced stop 2) is off. 3) RES (Reset) is on. 4) At alarm occurrence 5) LSP (Forward rotation stroke end) or LSN (Reverse rotation stroke end) is off. 6) Home position return is not being executed. 7) Software limit is being detected. 8) Home position return is in progress. If once home position return is completed in the absolute position detection system, ZP (Home position return completion) will be the same output status as RD (Ready). However, it will be off with the above 1) to 8) and the following 9) to 14). 9) The home position return is not performed after [AL. 25 Absolute position erased] or [AL. E3 Absolute position counter warning] occurred. 10) The home position return is not performed after the electronic gear ([Pr. PA06] and [Pr. PA07]) was changed. 11) The home position return is not performed after the setting of [Pr. PA03 Absolute position detection system selection] was changed from "Disabled" to "Enabled". 12) [Pr. PA14 Rotation direction selection/travel direction selection] was changed. 13) [Pr. PA01 Operation mode] was changed. 14) [Pr. PT08 Home position return position data] or [Pr. PT28 Number of stations per rotation] was changed.	DO-1	△	△	△
Rough match	CPO		When a command remaining distance is lower than the rough match output range set with [Pr. PT12], CPO will be on. This is not outputted during base circuit shut-off. CPO turns on with servo-on.	DO-1	△	△	△
Position range output	POT		When an actual current position is within the range set with [Pr. PT21] and [Pr. PT22], POT will be on. This will be off when a home position return does not complete or base circuit shut-off is in progress.	DO-1	△	△	
Temporary stop	PUS		When a deceleration begins for a stop, PUS will be on by TSTP (Temporary stop/restart). When you enable TSTP (Temporary stop/restart) again and start operation, PUS will be off.	DO-1	△	△	

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode CP	CL	PS
Travel completion	MEND		When the droop pulses are within the in-position output range set with [Pr. PA10] and the command remaining distance is "0", MEND will be on. MEND turns on with servo-on. MEND is off at servo-off status. However, MEND will not be off in the indexer method.	DO-1	△	△	△
Position end	PED		When the droop pulses are within the position end output range set with [Pr. PA10] and the command remaining distance is "0", PED will be on. When MEND (Travel completion) is on and ZP (Home position return completion) is on, PED (Position end) will be on. When ZP (Home position return completion) is on with servo-on status, PED will be on. PED is off at servo-off status.	DO-1	△	△	
SYNC synchronous output	SOUT		When the status is waiting for input of the program SYNC (1 to 3), SOUT will be on. When PI1 (Program input 1) to PI3 (Program input 3) turn on, SOUT will be off.	DO-1		△	

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode CP	Control mode CL	Control mode PS
Program output 1	OUT1		OUT1 will turn on with the OUTON (1) command during programming. The OUTOF (1) command will turn off OUT1. You can also set time to off with [Pr. PT23].	DO-1		△	
Program output 2	OUT2		OUT2 will turn on with the OUTON (2) command during programming. The OUTOF (2) command will turn off OUT2. You can also set time to off with [Pr. PT24].	DO-1		△	
Program output 3	OUT3		OUT3 will turn on with the OUTON (3) command during programming. The OUTOF (3) command will turn off OUT3. You can also set time to off with [Pr. PT25].	DO-1		△	

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode CP	Control mode CL	Control mode PS
Point table No. output 1	PT0		The signals output point table Nos. in 8 bit code simultaneously with MEND (Travel completion) on.	DO-1	△		
Point table No. output 2	PT1				△		
Point table No. output 3	PT2				△		
Point table No. output 4	PT3				△		
Point table No. output 5	PT4				△		
Point table No. output 6	PT5				△		
Point table No. output 7	PT6				△		
Point table No. output 8	PT7				△		

Device (Note 1, 2)								Description
PT7	PT6	PT5	PT4	PT3	PT2	PT1	PT0	
0	0	0	0	0	0	0	1	Point table No. 1
0	0	0	0	0	0	1	0	Point table No. 2
0	0	0	0	0	0	1	1	Point table No. 3
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
1	1	1	1	1	1	1	0	Point table No. 254
1	1	1	1	1	1	1	1	Point table No. 255

Note 1. 0: Off
1: On

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode CP	Control mode CL	Control mode PS
Station output 1	PS0		The signals output station Nos. simultaneously with MEND on while an alarm is not occurring.	DO-1			△
Station output 2	PS1						△
Station output 3	PS2						△
Station output 4	PS3						△
Station output 5	PS4						△
Station output 6	PS5						△
Station output 7	PS6						△
Station output 8	PS7						△

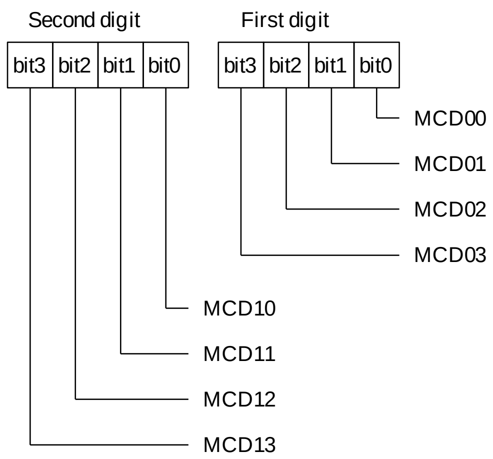
Device (Note 1, 2)								Description
PS7	PS6	PS5	PS4	PS3	PS2	PS1	PS0	
0	0	0	0	0	0	0	0	In-position out of range
1	1	1	1	1	1	1	1	Next station No. 0
1	1	1	1	1	1	1	0	Next station No. 1
1	1	1	1	1	1	0	1	Next station No. 2
1	1	1	1	1	1	0	0	Next station No. 3
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
0	0	0	0	0	0	1	0	Next station No. 253
0	0	0	0	0	0	0	1	Next station No. 254

Note 1. 0: Off
1: On

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode		
					CP/	CL	PS
M code 1 (bit 0)	MCD00			DO-1			
M code 2 (bit 1)	MCD01			DO-1			
M code 3 (bit 2)	MCD02			DO-1			
M code 4 (bit 3)	MCD03			DO-1			
M code 5 (bit 4)	MCD10			DO-1			
M code 6 (bit 5)	MCD11			DO-1			
M code 7 (bit 6)	MCD12			DO-1			
M code 8 (bit 7)	MCD13			DO-1			

This device can be used in the point table method.
These signals can be checked with output devices of the communication function. (Refer to section 10.2 (1).)
To use these signals, set " _ _ 1 _" in [Pr. Po12].
The signals output M code simultaneously with CPO (Rough match) on.
Set M code with point tables.

The code represents one digit of decimal using four digits of binary.
The following shows correspondence of each digit and device.



M code	Device (Note)			
First/second digit	MCD03/ MCD13	MCD02/ MCD12	MCD01/ MCD11	MCD00/ MCD10
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

Note. 0: Off
1: On

MCD00 to MCD03 and MCD10 to MCD13 will turn off with the following status.
- Power on
- Servo-off
- Manual operation mode
- At alarm occurrence

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode CP	CL	PS
Mark detection rising latch completed	MSDH		Turning on MSD (Mark detection) will turn on MSDH.	DO-1	△	△	
Mark detection falling latch completed	MSDL		After MSD (Mark detection) is turned on, turning off MSD will turn on MSDL.	DO-1	△	△	
Alarm code	ACD0 ACD1 ACD2	(CN1-24) (CN1-23) (CN1-22)	To use these signals, set " _ _ _ 1" in [Pr. PD34]. This signal is outputted when an alarm occurs. When an alarm is not occurring, respective ordinary signals are outputted. For details of the alarm codes, refer to chapter 8. When [Pr. PD34] is set to "_ _ _ 1", setting the following will trigger [AL. 37 Parameter error]. ・"_ _ _ 1" is set in [Pr. PA03] and the absolute position detection system by DIO is selected. ・MBR, DB, or ALM is assigned to the CN1-22 pin, CN1-23 pin, or CN1-24 pin.	DO-1	△	△	△
Variable gain selection	CDPS		CDPS turns on during gain switching.	DO-1	△	△	△
Absolute position undetermined	ABSV		ABSV turns on when the absolute position is undetermined.	DO-1	△	△	△
During tough drive	MTTR		When a tough drive is "Enabled" in [Pr. PA20], activating the instantaneous power failure tough drive will turn on MTTR.	DO-1	△	△	△
During fully closed loop control	CLDS		CLDS turns on during fully closed loop control.	DO-1	△	△	
Under cam control	CAMS		It turns on when the control switches to the cam control. It turns off when the control switches to the normal positioning control.	DO-1	△	△	
Cam position compensation execution completed	CPCC		It turns on when the cam compensation execution is enabled. It turns on when the position compensation is not being executed during the cam control.	DO-1	△	△	
Clutch on/off status	CLTS		It turns on with clutch-on. It is always off when [Cam control data No. 36 - Main shaft clutch control setting] is set to "_ _ _ 0".	DO-1	△	△	
Clutch smoothing status	CLTSM		It outputs clutch smoothing status. The output depends on the setting in [Cam control data No. 42 - Main shaft clutch smoothing system] as follows: 0: Direct Always off 1: Time constant method (index) Always on in clutch-on status It turns off when the clutch is off and the smoothing is complete.	DO-1	△	△	

(2) Input signal

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode CP	Control mode CL	Control mode PS
Manual pulse generator	PP	(CN1-10)	Connect the manual pulse generator (MR-HDP01). When using the signal, enable PP and NP with [Pr. PD44] and [Pr. PD46].	DI-2	△	△	
	NP	(CN1-35)					
Analog torque limit	TLA	CN1-27	When using the signal, enable TL (External torque limit selection) with [Pr. PD04], [Pr. PD06], [Pr. PD08], [Pr. PD10], [Pr. PD12], [Pr. PD14], [Pr. PD18], [Pr. PD20], [Pr. PD22], [Pr. PD44], and [Pr. PD46]. When TLA is enabled, torque is limited in the full servo motor output torque range. Apply 0 V to +10 V DC between TLA and LG. Connect the positive terminal of the power supply to TLA. The maximum torque is generated at +10 V. (Refer to section 3.6.1 (5)) If a value equal to or larger than the maximum torque is inputted to TLA, the value is clamped at the maximum torque. Resolution: 10 bits	Analog input	△	△	△
Analog override	VC	CN1-2	The signal controls the servo motor setting speed by applying -10 V to +10 V to between VC and LG. The percentage will be 0% with -10 V, 100% with 0 V, and 200% with +10 V to the setting speed of the servo motor. Resolution: 14 bits or equivalent Setting [Pr. PC60] to "_ _ 1 _" increases the analog input resolution to 16 bits.	Analog input	○	○	

(3) Output signal

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode CP	Control mode CL	Control mode PS
Encoder A-phase pulse (differential line driver)	LA LAR	CN1-4 CN1-5	These devices output pulses of encoder output pulse set in [Pr. PA15] in the differential line driver type. In CCW rotation of the servo motor, the encoder B-phase pulse lags the encoder A-phase pulse by a phase angle of /2. The relation between rotation direction and phase difference of the A-phase and B-phase pulses can be changed with [Pr. 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 encoder zero-point signal is outputted in the differential line driver type. One pulse is outputted per servo motor revolution. This turns on when the zero-point position is reached. (negative logic) The minimum pulse width is about 400 s. For home position return using this pulse, set the creep speed to 100 r/min or less.	DO-2	○	○	○
Encoder Z-phase pulse (open-collector)	OP	CN1-33	The encoder zero-point signal is outputted in the open-collector type.	DO-2	○	○	○
Analog monitor 1	MO1	CN6-3	This is used to output the data set in [Pr. PC14] to between MO1 and LG in terms of voltage. Output voltage: ±10 V Resolution: 10 bits or equivalent	Analog output	○	○	○
Analog monitor 2	MO2	CN6-2	This signal outputs the data set in [Pr. PC15] to between MO2 and LG in terms of voltage. Output voltage: ±10 V Resolution: 10 bits or equivalent	Analog output	○	○	○

(4) Communication

Device	Symbol	Connector pin No.	Function and application	I/O division	Control mode CP	Control mode CL	Control mode PS
RS-422/RS-485 I/F	SDP SDN RDP RDN	CN3-5 CN3-4 CN3-3 CN3-6	These are terminals for RS-422/RS-485 communication.		○	○	○

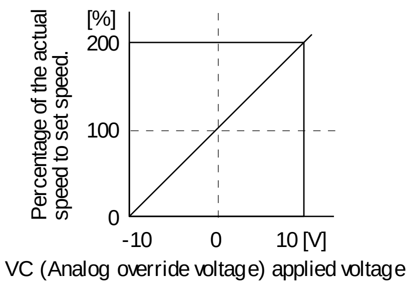
16.2.4 Analog override

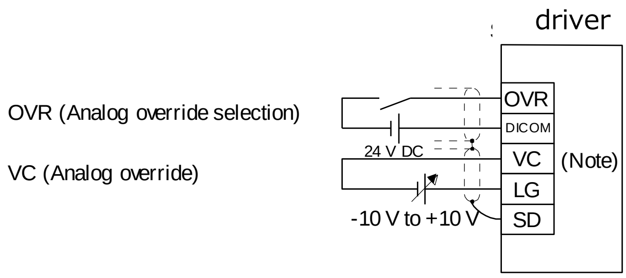
POINT
●The override function has two types. One is analog override by using analog voltage input and another is digital override by using parameter settings. ・Target method of analog override: Point table method/Program method ・Target method of digital override: Indexer method ●OVR (Analog override selection) is for the analog override. The digital override does not depend on OVR (Analog override selection). ●Refer to [Pr. PT38], [Pr. PT42], and [Pr. PT43] for the digital override. ●When using the analog override in the point table method or program method, enable OVR (Analog override selection). ●The following shows functions whether usable or not with the analog override. (1) Analog override usable ・Automatic operation mode (point table method/program method) ・JOG operation in the manual operation mode ・Automatic positioning to home position function in the point table method (2) Analog override unusable ・Manual pulse generator operation in the manual operation mode ・Home position return mode ・Test operation mode using setup software (MR Configurator2™) (positioning operation/JOG operation)

You can change the servo motor speed by using VC (Analog override). The following table shows signals and parameters related to the analog override.

Item	Name	Remark
Analog input signal	VC (Analog override)	
Contact input signal	OVR (Analog override selection)	Turning on OVR will enable VC (Analog override) setting value.
Parameter	[Pr. PC37 Analog override offset]	-9999 to 9999 [mV]

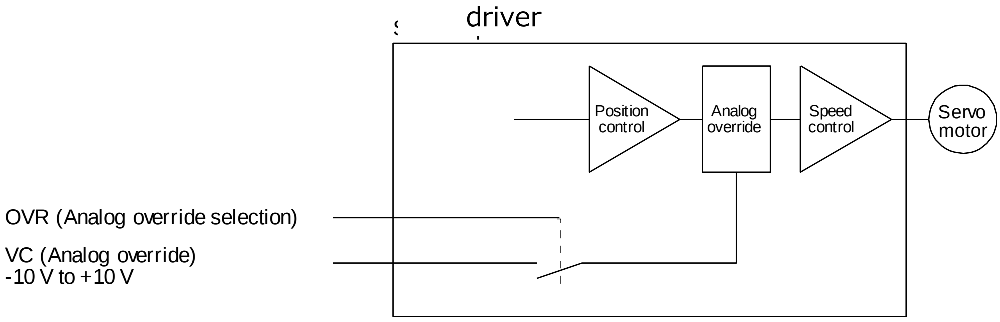
(1) VC (Analog override)
You can continuously set changed values from outside by applying voltage (-10 V to +10 V) to VC (Analog override). The following shows percentage of the actual speed to input voltage and set speed.





Note. This diagram shows sink input interface.

(2) OVR (Analog override selection)
Select enabled/disabled of VC (Analog override).



Select a changed value using OVR (Analog override selection).

(Note) External input signal	Speed change value
0	No change
1	Setting of VC (Analog override) is enabled.

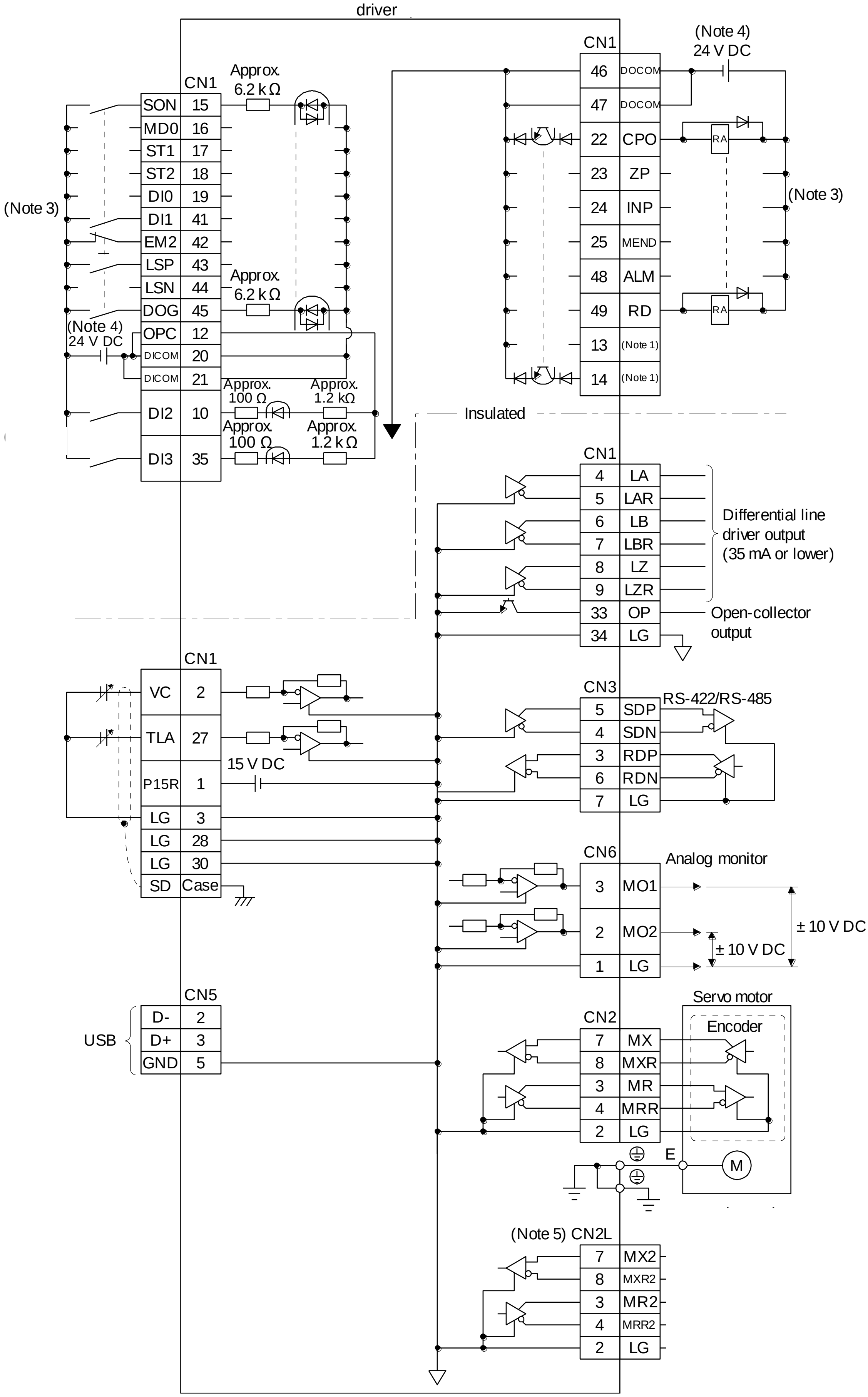
Note. 0: Off
1: On

(3) Analog override offset ([Pr. PC37])
You can set an offset voltage to the input voltage of VC (Analog override) with [Pr. PC37]. The setting value is from -9999 to +9999 [mV].

16.2.5 Internal connection diagram

POINT
●For details of interface and source I/O interface, refer to section 3.9. ●For the CN8 connector, refer to section 13.3.1.

The following shows an example of internal connection diagram of the point table method.



driver
CN1
SON 15
MD0 16
ST1 17
ST2 18
DI0 19
DI1 41
EM2 42
LSP 43
LSN 44
DOG 45
OPC 12
DICOM 20
DICOM 21
DI2 10
DI3 35
Approx. 6.2 kΩ
Approx. 100 Ω
Approx. 1.2 kΩ
(Note 3)
(Note 4)
24 V DC
46 DOCOM
47 DOCOM
22 CPO
23 ZP
24 INP
25 MEND
48 ALM
49 RD
13 (Note 1)
14 (Note 1)
RA
Insulated
4 LA
5 LAR
6 LB
7 LBR
8 LZ
9 LZR
33 OP
34 LG
Differential line driver output (35 mA or lower)
Open-collector output
VC 2
TLA 27
P15R 1
LG 3
LG 28
LG 30
SD Case
15 V DC
CN3
RS-422/RS-485
5 SDP
4 SDN
3 RDP
6 RDN
7 LG
CN6
Analog monitor
3 MO1
2 MO2
1 LG
± 10 V DC
CN5
USB
D- 2
D+ 3
GND 5
CN2
7 MX
8 MXR
3 MR
4 MRR
2 LG
Servo motor
Encoder
E
M
(Note 5) CN2L
7 MX2
8 MXR2
3 MR2
4 MRR2
2 LG

Note 1. Output signals are not assigned by default. Assign the output signals with [Pr. PD47] as necessary.
3. This diagram shows sink I/O interface. For source I/O interface, refer to section 3.9.3.
4. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.
5. Do not use it.

16.2.6 Power-on sequence

POINT
●The voltage of analog monitor output, output signal, etc. may be unstable at power-on.

(1) Power-on procedure

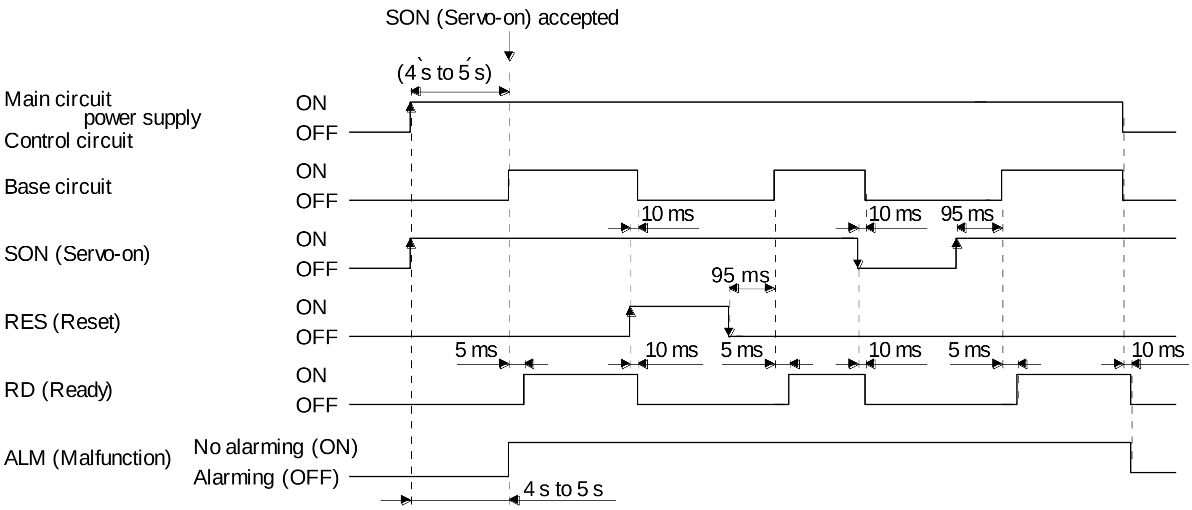
1) Always use a magnetic contactor for the main circuit power supply wiring (L1/L2/L3) as shown in section 3.1. Configure an external sequence to switch off the magnetic contactor as soon as an alarm occurs.

2) Switch on the control circuit power supply (L11 and L21) 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 receives the SON (Servo-on) 4 s to 5 s after the main circuit power supply is switched on. Therefore, when SON (Servo-on) is switched on simultaneously with the main circuit power supply, the base circuit will switch on in about 4 s to 5 s, and the RD (Ready) will switch on in further about 5 ms, making the driver ready to operate. (Refer to (2) of this section.)

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

(2) Timing chart



16.3 DISPLAY AND OPERATION SECTIONS

16.3.1 Display sequence

Press the "MODE" button once to shift to the next display mode. Refer to section 3.1.2 and later for the description of the corresponding display mode.

Display mode transition	Initial screen	Function	Reference
Status display	PoS	Servo status display. For the point table method and program method, "PoS" is displayed at power-on. For the indexer method, "C" is displayed. (Note)	Section 3.1.2
One-touch tuning	AUto	One-touch tuning Select this when performing the one-touch tuning.	section 6.2
Diagnosis	rd-oF	Sequence display, drive recorder enabled/disabled display, external I/O signal display, output signal (DO) forced output, test operation, software version display, VC automatic offset, servo motor series ID display, servo motor type ID display, servo motor encoder ID display, teaching function	Section 3.1.3
Alarm	AL---.	Current alarm display, alarm history display and parameter error No./point table error No. display	Section 3.1.4
Point table setting	Po001	Display and setting of point table data. The screen is displayed only in the point table method, and is not displayed in other control mode.	Section 3.1.5
Basic setting parameters	P A01	Display and setting of basic setting parameters.	Section 3.1.6
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.	
Extension setting 2 parameters	P E01	Display and setting of extension setting 2 parameters.	
Extension setting 3 parameters	P F01	Display and setting of extension setting 3 parameters.	
Linear/DD motor setting parameter	P L01	Display and setting of linear/DD motor setting parameters.	
Option setting parameters	P o01	Display and setting of option setting parameters.	
Positioning control parameters	P r01	Display and setting of positioning control parameters.	

button
MODE

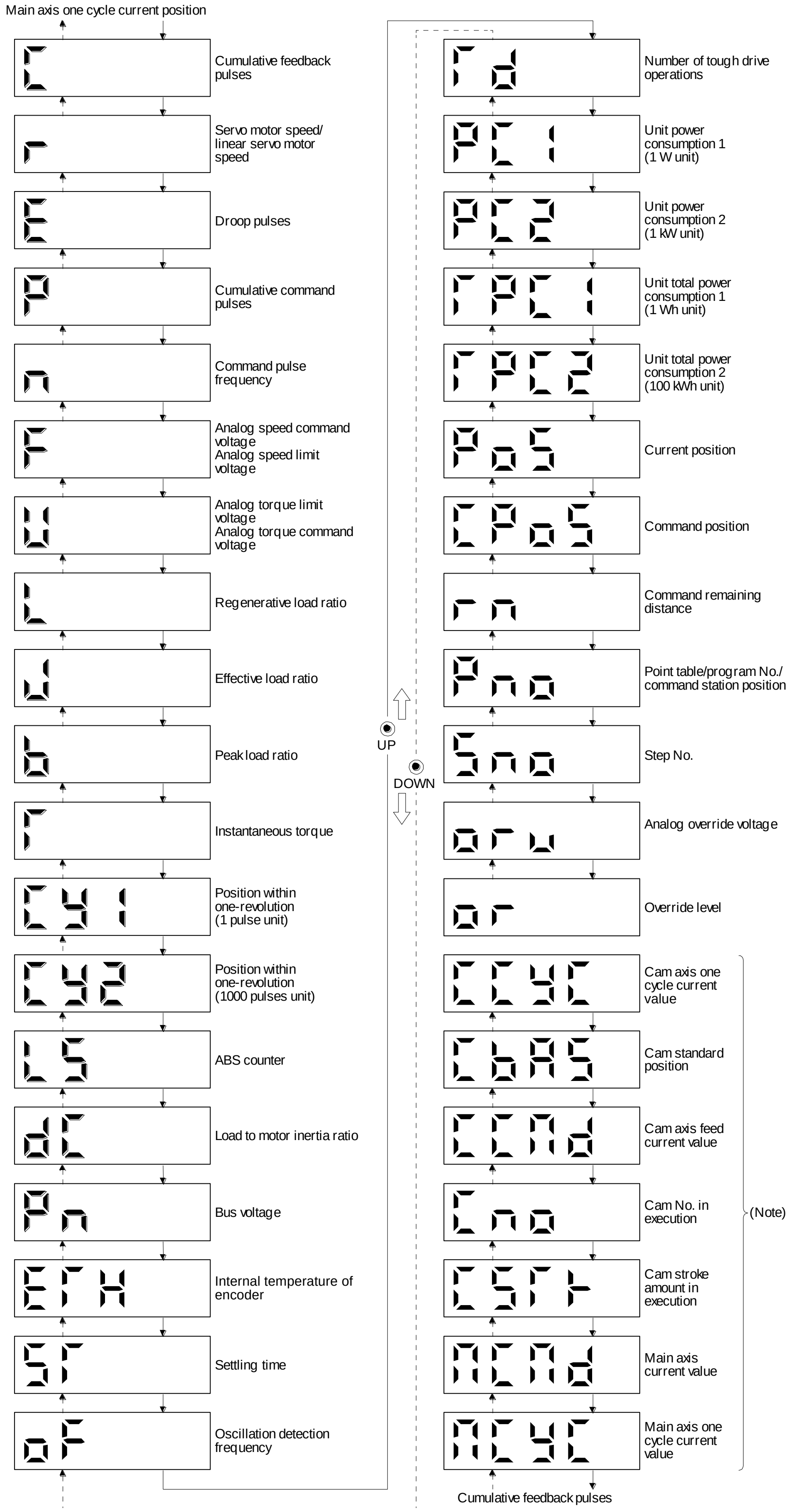
Note. When the axis name is set to the driver using setup software (MR Configurator2™), the axis name is displayed and the servo status is then displayed.

16.3.2 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 is displayed. Press the "SET" button to display that data. At only power-on, however, data appears after the symbol of the status display selected in [Pr. PC36] has been shown for 2 s.

(1) Display transition
After selecting the status display mode with the "MODE" button, pressing the "UP" or "DOWN" button changes the display as shown below.

(a) Standard control mode



(2) Status display list

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

Status display	Symbol	Unit	Description	Control mode (Note 1)			Operation mode (Note 3)
				CP/	CL	PS	Standard
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.	○	○	○	○
Servo motor speed/	r	r/min	The servo motor speed is displayed. It is displayed rounding off 0.1 r/min (0.1 mm/s) unit.	○	○	○	○
Droop pulses	E	pulse	The number of droop pulses in the deviation counter are displayed. The decimal points in the upper four digits are lit for reverse rotation 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. The number of pulses displayed is in the encoder pulse unit.	○	○	○	○
Cumulative command pulses	P	pulse	Not used with the positioning mode. "0" is always displayed.				
Command pulse frequency	n	kpulse/s	Not used with the positioning mode. "0" is always displayed.				
Analog speed command voltage Analog speed limit voltage	F	V	Not used with the positioning mode. An applied voltage to the CN1 connector is displayed.				
Analog torque command voltage	U	V	Not used with the positioning mode. An applied voltage to the CN1 connector is displayed.				
Analog torque limit voltage			Voltage of TLA (Analog torque limit) voltage is displayed.	○	○	○	○
Regenerative load ratio	L	%	The ratio of regenerative power to permissible regenerative power is displayed in %.	○	○	○	○
Effective load ratio	J	%	The continuous effective load current is displayed. The effective value in the past 15 s is displayed relative to the rated current of 100 %.	○	○	○	○
Peak load ratio	b	%	The maximum occurrence torque is displayed. The highest value in the past 15 s is displayed relative to the rated torque of 100 %.	○	○	○	○
Instantaneous torque	T	%	The instantaneous torque is displayed. The value of torque being occurred is displayed in real time considering a rated torque as 100%.	○	○	○	○
Position within one-revolution (1 pulse unit)	Cy1	pulse	Position within one revolution is displayed in encoder 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. When the servo motor rotates in the CCW direction, the value is added.	○	○	○	○
Position within one-revolution (1000 pulses unit)	Cy2	1000 pulses	The within one-revolution position is displayed in 1000 pulse increments of the encoder. When the servo motor rotates in the CCW direction, the value is added.	○	○	○	○
ABS counter	LS	rev	The travel distance from the home position is displayed as multi-revolution counter value of the absolution position encoder in the absolution position detection system.	○	○		○
			The travel distance from the home position is displayed as load side multi-revolution counter value in the absolution position detection system.			○	○
Load to motor inertia ratio	dC	Multiplier	The estimated ratio of the load inertia moment to the servo motor shaft inertia moment is displayed.	○	○	○	○
Bus voltage	Pn	V	The voltage of main circuit converter (between P+ and N-) is displayed.	○	○	○	○
Encoder inside temperature	ETh	°C	Inside temperature of encoder detected by the encoder is displayed.	○	○	○	○

Status display	Symbol	Unit	Description	Control mode (Note 1)			Operation mode (Note 3)
				CP	CL	PS	Standard
Settling time	ST	ms	Settling time is displayed. When it exceeds 1000 ms, "1000" will be displayed.	○	○	○	○
Oscillation detection frequency	oF	Hz	Frequency at the time of oscillation detection is displayed.	○	○	○	○
Number of tough drive operations	Td	times	The number of tough drive functions activated is displayed.	○	○	○	○
Unit power consumption 1 (1 W unit)	PC1	W	Unit power consumption is displayed by increment of 1 W. Positive value indicates power running, and negative value indicates regeneration. 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.	○	○	○	○
Unit power consumption 2 (1 kW unit)	PC2	kW	Unit power consumption is displayed by increment of 1 kW. Positive value indicates power running, and negative value indicates regeneration.	○	○	○	○
Unit total power consumption 1 (1 Wh unit)	TPC1	Wh	Unit total power consumption is displayed by increment of 1 Wh. Positive value is cumulated during power running and negative value during regeneration. 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.	○	○	○	○
Unit total power consumption 2 (100 kWh unit)	TPC2	100 kWh	Unit total power consumption is displayed by increment of 100 kWh. Positive value is cumulated during power running and negative value during regeneration.	○	○	○	○
Load-side encoder Cumulative feedback pulses	FC	pulse	Feedback pulses from the load-side 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.	○	○		
Load-side encoder Droop pulses	FE	pulse	Droop pulses of the deviation counter between a load-side encoder and a command are displayed. When the count exceeds ±99999, it starts from 0. Negative value is indicated by the lit decimal points in the upper four digits. The display shows the average droop pulse value of 128-time sampling at the rate of 444 [s].	○	○		
Load-side encoder information 1 (1 pulse unit)	FCy1	pulse	The Z-phase counter of a load-side encoder is displayed in the encoder pulse unit. For an incremental linear encoder, the Z-phase counter is displayed. The value is counted up from 0 based on the home position (reference mark). For an absolute position linear encoder, the encoder absolute position is displayed. When the count exceeds 99999, it starts from 0.	○	○		
Load-side encoder information 1 (100000 pulses unit)	FCy2	100000 pulses	The Z-phase counter of a load-side encoder is displayed by increments of 100000 pulses. For an incremental linear encoder, the Z-phase counter is displayed. The value is counted up from 0 based on the home position (reference mark). For an absolute position linear encoder, the encoder absolute position is displayed. When the count exceeds 99999, it starts from 0.	○	○		
Load-side encoder information 2	FL5	rev	When an incremental linear encoder is used as the load-side encoder, the display shows 0. When an absolute position linear encoder is used as the load-side encoder, the display shows 0. When a rotary encoder is used as the load-side encoder, the display shows the multi-revolution counter value of the encoder.	○	○		
Z-phase counter low	FCy1	pulse	The Z-phase counter is displayed in the encoder pulse unit. For an incremental linear encoder, the Z-phase counter is displayed. The value is counted up from 0 based on the home position (reference mark). For an absolute position linear encoder, the encoder absolute position is displayed. When the count exceeds 99999, it starts from 0.	○	○	○	

Status display	Symbol	Unit	Description	Control mode (Note 1)			Operation mode (Note 3)
				CP	CL	PS	Standard
Z-phase counter high	FCy2	100000 pulses	The Z-phase counter is displayed by increments of 100000 pulses. When the count exceeds 99999, it starts from 0.	○	○	○	
Electrical angle low	ECy1	pulse	The servo motor electrical angle is displayed.	○	○		
Electrical angle high	ECy2	100000 pulses	The servo motor electrical angle is displayed by increments of 100000 pulses.	○	○		
Current position	PoS	10^{STM} m $10^{(STM-4)}$ inch 10^{-3} degree pulse (Note 2)	When "_ _ 0 _" (positioning display) is set in [Pr. PT26], the current position is displayed as machine home position is 0. When "_ _ 1 _" (roll feed display) is set in [Pr. PT26], the actual current position is displayed as start position is 0. 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.	○	○		○
Command position	CPoS	10^{STM} m $10^{(STM-4)}$ inch 10^{-3} degree pulse (Note 2)	When "_ _ 0 _" (positioning display) is set in [Pr. PT26], the command current position is displayed as machine home position is 0. When "_ _ 1 _" (roll feed display) is set in [Pr. PT26], turning on the start signal starts counting from 0 and a command current position to the target position is displayed in the automatic mode. The command positions of the selected point table are displayed at a stop. At the manual mode, the command positions of the selected point table are 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.	○	○		○
Command remaining distance	rn	10^{STM} m $10^{(STM-4)}$ inch 10^{-3} degree pulse (Note 2)	Indicates the remaining distance to the command position of the currently selected point table, program and station. 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.	○	○	○	○
Point table No./program No./command station position	Pno		For the point table method and program method, the point table and program No. currently being executed are displayed. The selected number is displayed during a temporary stop or manual operation. For the indexer method, the command next station position is displayed.	○	○	○	○
Step No.	Sno		The step No. of the program currently being executed is displayed. At a stop, 0 is displayed.		○		○
Analog override voltage	oru	V	The analog override voltage is displayed.	○	○		○
Override level	or	%	The setting value of the override is displayed. When the override is disabled, 100% is displayed.	○	○	○	○
Cam axis one cycle current value	CCyC	10^{STM} m $10^{(STM-4)}$ inch 10^{-3} degree pulse (Note 4)	The current position in one cycle of CAM axis is displayed with the range of "0 to (cam axis one cycle length - 1)", the cam axis one cycle current value which is calculated from the travel distance inputted to the cam axis. When the simple cam function is disabled, 0 is always 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. Refer to section 12.1.8 for detecting point.	○	○		○
Cam standard position	CbAS	10^{STM} m $10^{(STM-4)}$ inch 10^{-3} degree pulse (Note 2)	A feed current value which is the standard position of the cam operation is displayed. When the simple cam function is disabled, 0 is always 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. Refer to section 12.1.8 for detecting point.	○	○		○

Status display	Symbol	Unit	Description	Control mode (Note 1)			Operation mode (Note 3)
				CP	CL	PS	Standard
Cam axis feed current value	CCMd	10^{STM} m $10^{(STM-4)}$ inch 10^{-3} degree pulse (Note 2)	A feed current value during the cam axis control is displayed. When the simple cam function is disabled, 0 is always 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. Refer to section 12.1.8 for detecting point.	○	○		○
Cam No. in execution	Cno		Cam No. in execution is displayed. When the simple cam function is disabled, 0 is always displayed. Refer to section 12.1.8 for detecting point.	○	○		○
Cam stroke amount in execution	CSTK	10^{STM} m $10^{(STM-4)}$ inch 10^{-3} degree pulse (Note 2)	Cam stroke amount in execution is displayed. When the simple cam function is disabled, 0 is always 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. Refer to section 12.1.8 for detecting point.	○	○		○
Main axis current value	MCMd	10^{STM} m $10^{(STM-4)}$ inch 10^{-3} degree pulse (Note 4)	A current value of the input axis (synchronous encoder axis or servo input axis) is displayed. Unit is increment of input axis position. When the simple cam function is disabled, 0 is always 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. Refer to section 12.1.8 for detecting point.	○	○		○
Main axis one cycle current value	MCyC	10^{STM} m $10^{(STM-4)}$ inch 10^{-3} degree pulse (Note 4)	The input travel amount of the input axis is displayed within the range of "0 and (cam axis one cycle length setting - 1)". Unit is an increment of cam axis one cycle. When the simple cam function is disabled, 0 is always 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. Refer to section 12.1.8 for detecting point.	○	○		○

Note 1. CP: Positioning mode (point table method)
CL: Positioning mode (program method)
PS: Positioning mode (indexer method)
2. The unit can be selected from m/inch/degree/pulse with [Pr. PT01].
4. Depending on the setting of [Cam control data No. 30 Main shaft input axis selection], the parameters used to set the unit and feed length multiplication will change as follows. For details of each parameter, refer to section 7.2.9 and 12.1.7 (3).

Setting of [Cam control data No. 30]	Parameter for the unit setting	Parameter for the feed length multiplication setting
"0" or "1"	[Pr. PT01]	[Pr. PT03]
"2"	[Cam control data No. 14]	[Cam control data No. 14]

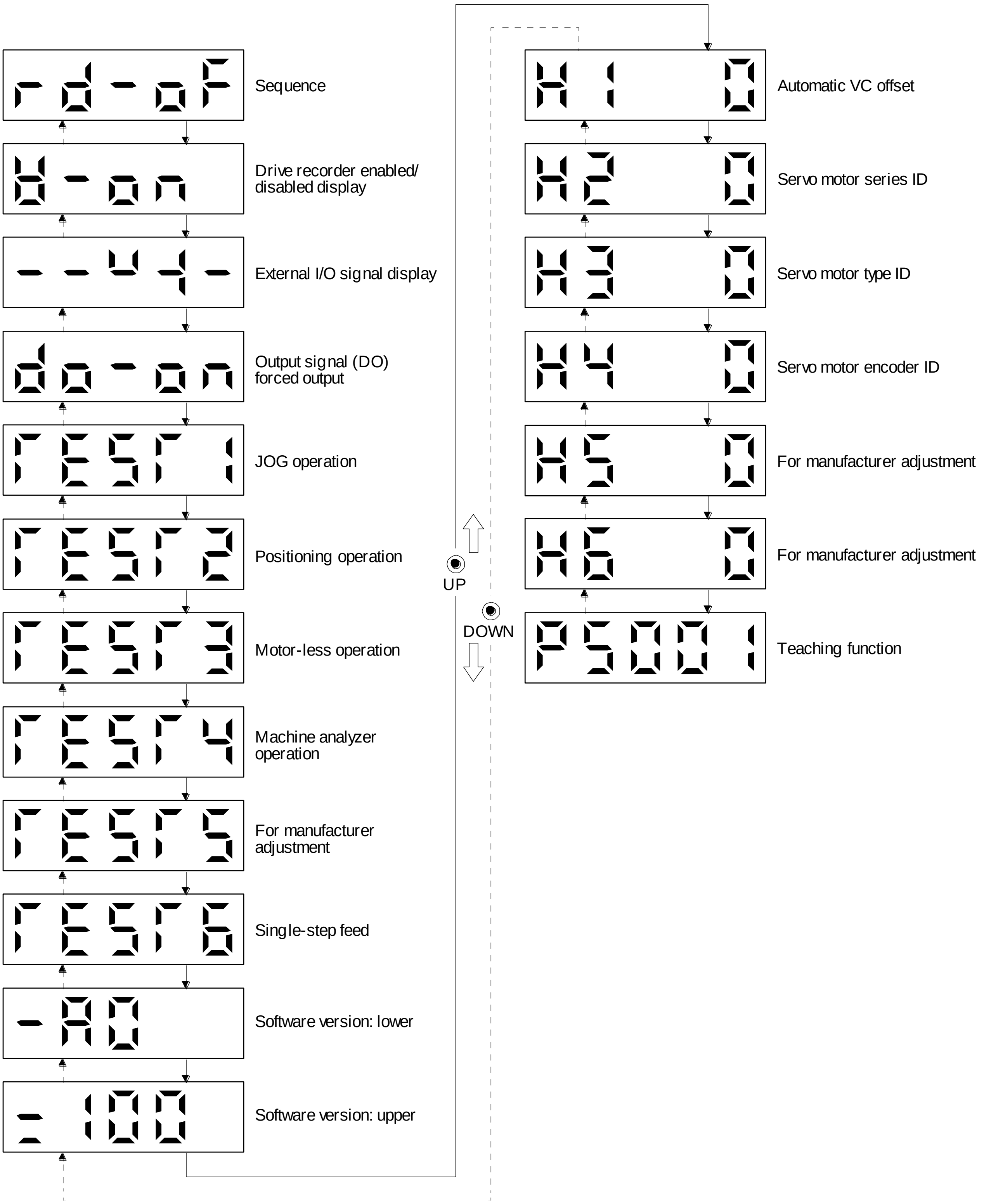
(3) Changing the status display screen
The status display item of the driver display shown at power-on can be changed by changing [Pr. PC36] settings. The item displayed in the initial status changes with the control mode as follows.

Control mode	Status display
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
Positioning (point table method/program method)	Current position
Positioning (indexer method)	Cumulative feedback pulses

16.3.3 Diagnostic mode

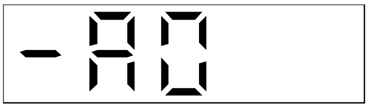
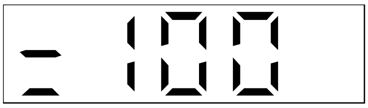
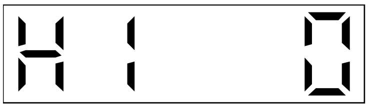
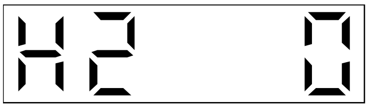
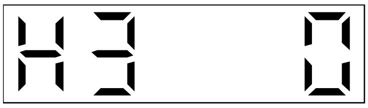
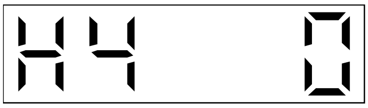
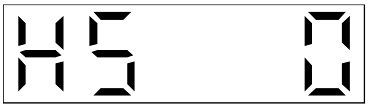
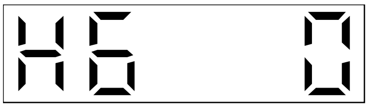
The display can show diagnosis contents. Press the "UP" or "DOWN" button to change display data as desired.

(1) Display transition



(2) Diagnosis display list

Name		Display	Description
Sequence		rd-oF	Not ready Indicates that the driver is being initialized or an alarm has occurred.
		rd-on	Ready Indicates that the servo was switched on after completion of initialization and the driver is ready to operate.
Drive recorder enabled/disabled display		d-on	Drive recorder enabled When an alarm occurs in the status, the drive recorder will operate and write the status of occurrence.
		d-oF	Drive recorder disabled The drive recorder will not operate on the following conditions. 1.You are using the graph function of setup software (MR Configurator2TM). 2.You are using the machine analyzer function. 3.[Pr. PF21] is set to "-1".
External I/O signal display		Refer to section 3.1.7.	This Indicates the on/off status of external I/O signal. The upper segments correspond to the input signals and the lower segments to the output signals.
Output signal (DO) forced output		do-on	This allows digital output signal to be switched on/off forcibly. Refer to section 3.1.8 for details.
Test operation mode	JOG operation	TEST1	JOG operation can be performed when there is no command from an external PC or PLC...etc. For details, refer to section 4.5.9 (2) .
	Positioning operation	TEST2	Positioning operation can be performed when there is no command from an external PC or PLC...etc. setup software (MR Configurator2TM) is required to perform positioning operation. For details, refer to section 4.5.9 (3).
	Motor-less operation	TEST3	Without connecting the servo motor, output signals or status display can be provided in response to the input device as if the servo motor is actually running. For details, refer to section 4.5.9 (4).
	Machine analyzer operation	TEST4	Merely connecting the driver allows the resonance point of the mechanical system to be measured. setup software (MR Configurator2TM) is required to perform machine analyzer operation. For details, refer to section 11.7.
	For manufacturer adjustment	TEST5	This is for manufacturer adjustment.
	Single-step feed	TEST6 d-06	This function is available only in the point table method and program method. When the positioning operation is executed in accordance with the point table or program set by setup software (MR Configurator2TM), the diagnosis display changes to "d-06" during single-step feed. For other control mode, the display does not change to "d-06". Refer to section 3.1.9 for details. The status will be displayed with the "MODE" button. The "UP" and "DOWN" buttons are disabled.

<table>
<tr><th>Name</th><th>Display</th><th>Description</th></tr>
<tr><td>Software version - Lower</td><td></td><td>Indicates the version of the software.</td></tr>
<tr><td>Software version - Upper</td><td></td><td>Indicates the system number of the software.</td></tr>
<tr><td>Automatic VC offset (Note)</td><td></td><td>If offset voltages in the analog circuits inside and outside the driver cause the servo motor setting speed not to be the designated value at VC or OVC of 0 V, a zero-adjustment of offset voltages will be automatically performed. When using the VC automatic offset, enable it in the following procedures.
1) Press the "SET" once.
2) Set the number in the first digit to 1 with "UP"/"DOWN".
3) Press the "SET".
This function cannot be used if the input voltage of VC or OVC is -0.4 V or less, or +0.4 V or more.
When the VC automatic offset is enabled, the following automatic offset voltage is applied according to the setting of [Pr. Po11].
<table>
<tr><th>Pr. Po11</th><th>Offset voltage to be automatically adjusted</th></tr>
<tr><td>_ _ 0 _</td><td>Offset voltage set with [Pr. PC37] (Driver side)</td></tr>
<tr><td>_ _ 1 _</td><td>Offset voltage set with [Pr. Po21] (MR-D01 side)</td></tr>
</table></td></tr>
<tr><td>Servo motor series ID</td><td></td><td>Push the "SET" button to show the series ID of the servo motor currently connected.</td></tr>
<tr><td>Servo motor type ID</td><td></td><td>Push the "SET" button to show the type ID of the servo motor currently connected.</td></tr>
<tr><td>Servo motor encoder ID</td><td></td><td>Push the "SET" button to show the encoder ID of the servo motor currently connected.</td></tr>
<tr><td>For manufacturer adjustment</td><td></td><td>This is for manufacturer adjustment.</td></tr>
<tr><td>For manufacturer adjustment</td><td></td><td>This is for manufacturer adjustment.</td></tr>
<tr><td>Teaching function</td><td>Refer to section 3.1.10.</td><td>After an operation travels to a target position (MEND (Travel completion) is turned on) with a JOG operation or manual pulse generator operation, pushing the "SET" button of the operation part or turning on TCH (Teach) will import position data.
This function is available only in the point table method. For other control mode, the display remains the same.</td></tr>
</table>

Note. Even if VC automatic offset is performed and 0 V is inputted, the speed may not completely be the set value.

16.3.4 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.

Name	Display (Note 1)	Description
Current alarm	AL - - -	Indicates no occurrence of an alarm.
	AL33.1	Indicates the occurrence of [AL. 33.1 Main circuit voltage error]. Flickers at alarm occurrence.
Alarm history	A050.1	Indicates that the last alarm is [AL. 50.1 Thermal overload error 1 during operation].
	A133.1	Indicates the second last alarm is [AL. 33.1 Main circuit voltage error].
	A210.1	Indicates the third last alarm is [AL. 10.1 Voltage drop in the control circuit power].
	⋮	⋮
	A9 - - -	Indicates that there is no tenth alarm in the past.
	AA - - -	Indicates that there is no eleventh alarm in the past.
	Ab - - -	Indicates that there is no twelfth alarm in the past.
	⋮	⋮
	AF - - -	Indicates that there is no sixteenth alarm in the past.
Parameter error No./point table error No. (Note 2)	E - -	This indicates no occurrence of [AL. 37 Parameter error].
	E .A12	The data content error of [Pr. PA12 Reverse rotation torque limit].
	E.002d	The value of the point table is over the setting range. The error point table No. (intermediate digit "2") and item (lower digit "d") are displayed. The following shows the items. P: position data, d: motor speed, A: acceleration time constant, b: deceleration time constant, n: dwell, H: auxiliary function, M: M code

Note 1. If a parameter error and point table error occur simultaneously, the display shows the parameter error.
2. The display shows only when the current alarm is [AL. 37 Parameter error].

The following is additional information of alarm occurrence.

(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. (Refer to chapter 8 for the alarms that can be cleared.)

  (a) Switch power off, then on.

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

  (c) Turn on RES (Reset).

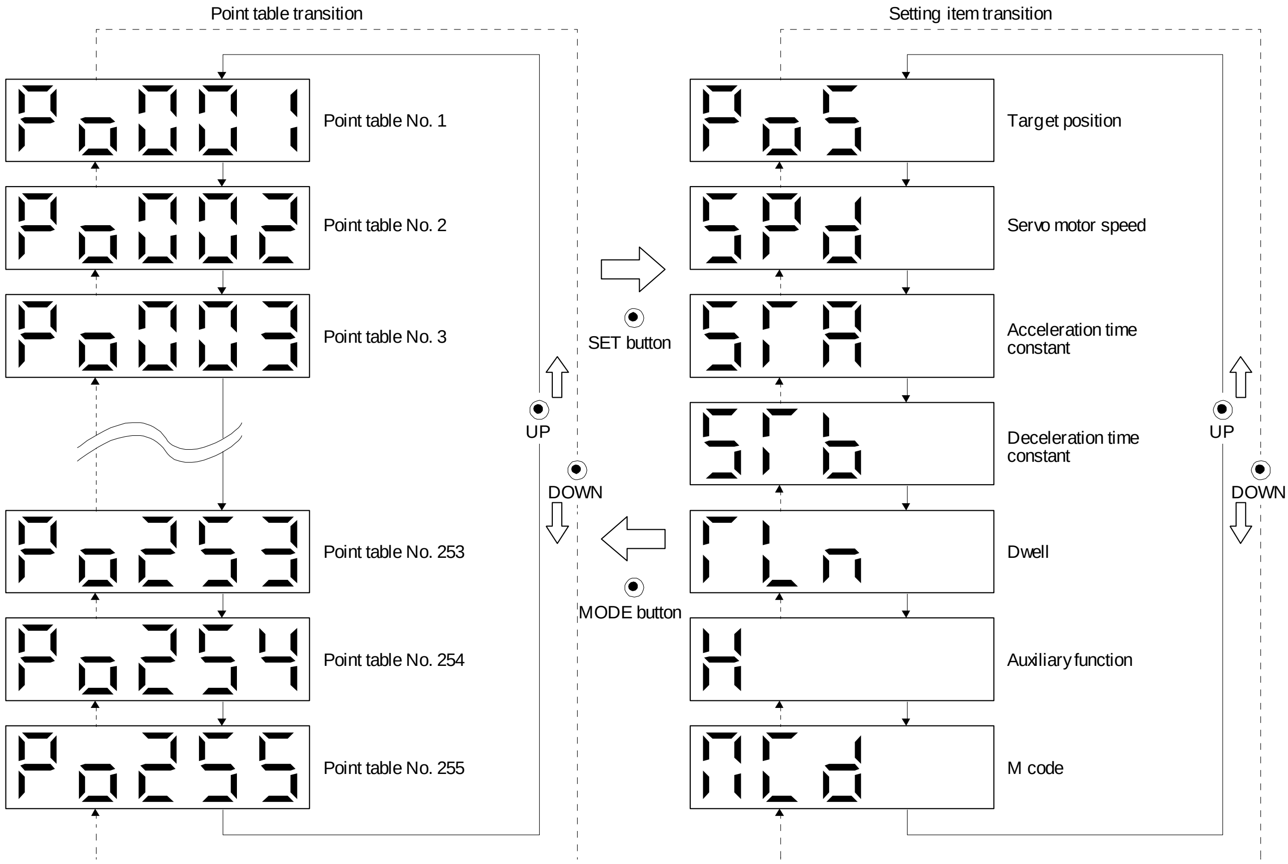
(4) Use [Pr. PC18] to clear the alarm history.

(5) Push "UP" or "DOWN" to move to the next history.

16.3.5 Point table setting

You can set the target position, servo motor speed, acceleration time constant, deceleration time constant, dwell, auxiliary function and M code.

(1) Display transition



(2) Setting list

The following table indicates the point table settings that may be displayed.

Status display	Symbol	Unit	Description	Indication range
Point table No.	Po001		Specify the point table to set the target position, servo motor speed, acceleration time constant, deceleration time constant, dwell, auxiliary function and M code.	1 to 255
Target position	PoS	10^{STM} m $10^{(STM-4)}$ inch 10^{-3} degree pulse (Note 1)	Set the travel distance.	-999999 to 999999
Servo motor speed	SPd	r/min	Set the command speed of the servo motor for execution of positioning. The setting value must be within the permissible speed of the servo motor used. If a value equal to or larger than the permissible speed is set, the value is clamped at the permissible speed.	0 to Permissible speed
Acceleration time constant	STA	ms	Set a time until the servo motor rotates at the rated speed.	0 to 20000
Deceleration time constant	STb	ms	Set a time from when the servo motor rotates at the rated speed until when the motor stops.	0 to 20000
Dwell	TLn	ms	This function is enabled when you select the point table by input signal. To disable the dwell, set "0" or "2" to the auxiliary function. To perform varying-speed operation, set "1", "3", "8", "9", "10", or "11" to the auxiliary function and 0 to the dwell. When the dwell is set, the position command of the selected point table is completed. After the set dwell has elapsed, start the position command of the next point table.	0 to 20000
Auxiliary function	H		This function is enabled when you select the point table by input signal. (1) When using this point table under the absolute value command method 0: Automatic operation is performed in accordance with a single point table selected. 1: Executes automatic continuous operation without stopping for the next point table. 8: Automatic continuous operation is performed to the point table selected at start-up. 9: Automatic continuous operation is performed to point table No. 1. (2) When using this point table under the incremental value command method 2: Automatic operation is performed in accordance with a single point table selected. 3: Executes automatic continuous operation without stopping for the next point table. 10: Automatic continuous operation is performed to the point table selected at start-up. 11: Automatic continuous operation is performed to point table No. 1. When a different rotation direction is set, smoothing zero (command output) is confirmed and then the rotation direction is reversed. When "1" or "3" is set to the point table No. 255, [AL. 61] will occur at the time of point table execution.	0 to 3, 8 to 11
M code	MCd		This is the code output at the completion of positioning. Outputs the first digit and the second digit of the M code in 4-bit binary respectively.	0 to 99

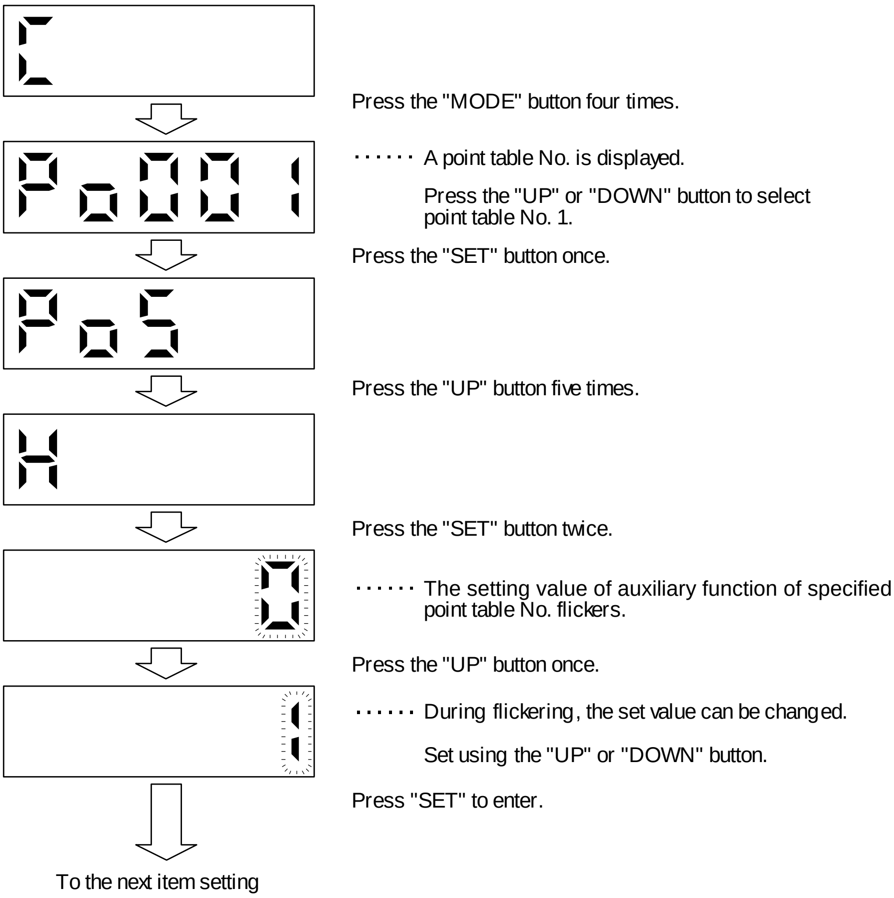
Note 1. The unit can be selected from m/inch/degree/pulse with [Pr. PT01].

(3) Operation method

> POINT
>
> ● After changing and defining the setting values of the specified point table, the defined setting values of the point table are displayed. After defining the values, pressing the "MODE" button for 2 s or more to discard the changed setting values, and the previous setting values are displayed. Keep pressing the "UP" or "DOWN" button to continuously change the most significant digit of the setting values.

(a) Setting of 5 or less digits

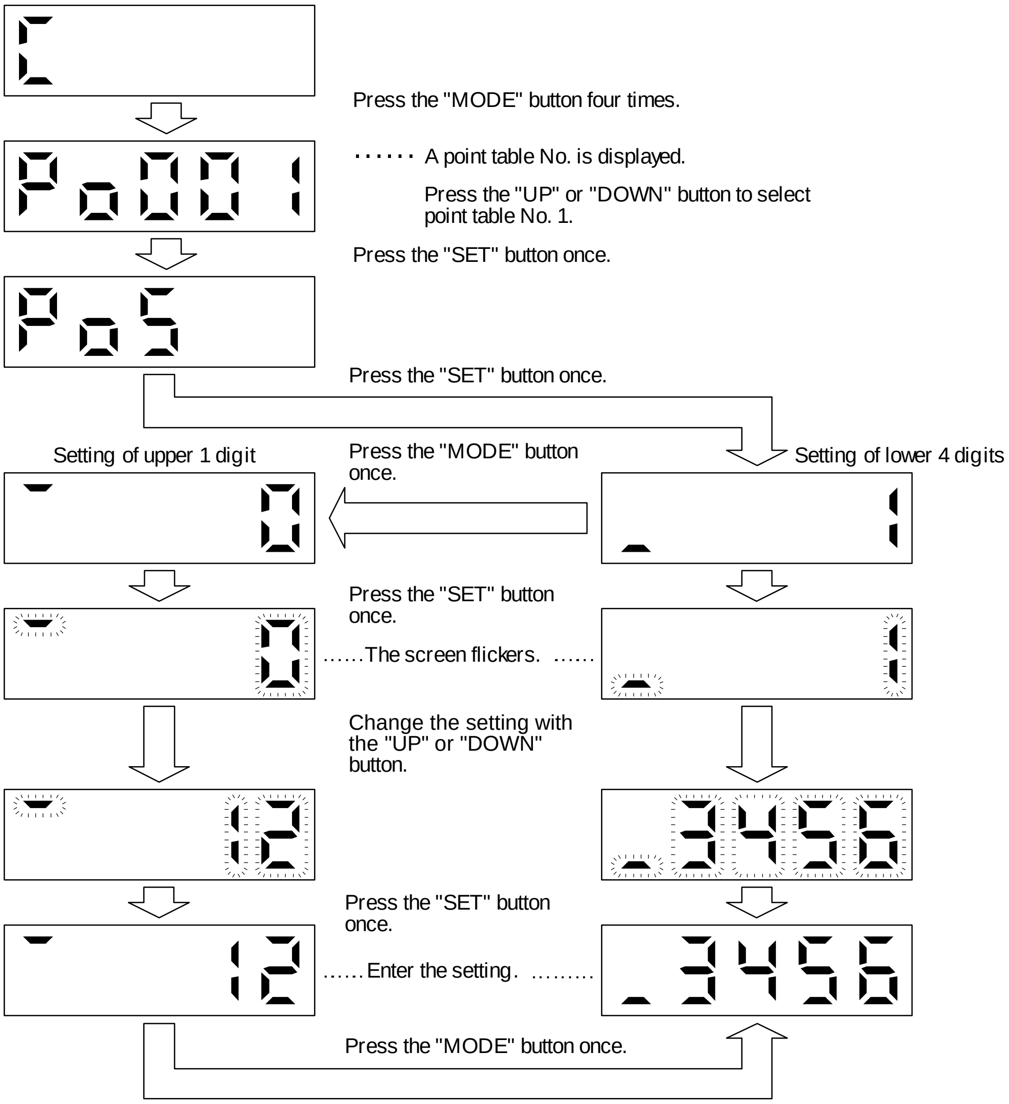
The following example is the operation method at power-on to set "1" to the auxiliary function of the point table No. 1.



Press the "UP" or "DOWN" button to switch to other item of the same point table No.
Press the "MODE" button to switch to the next point table No.

(b) Setting of 6 or more digits

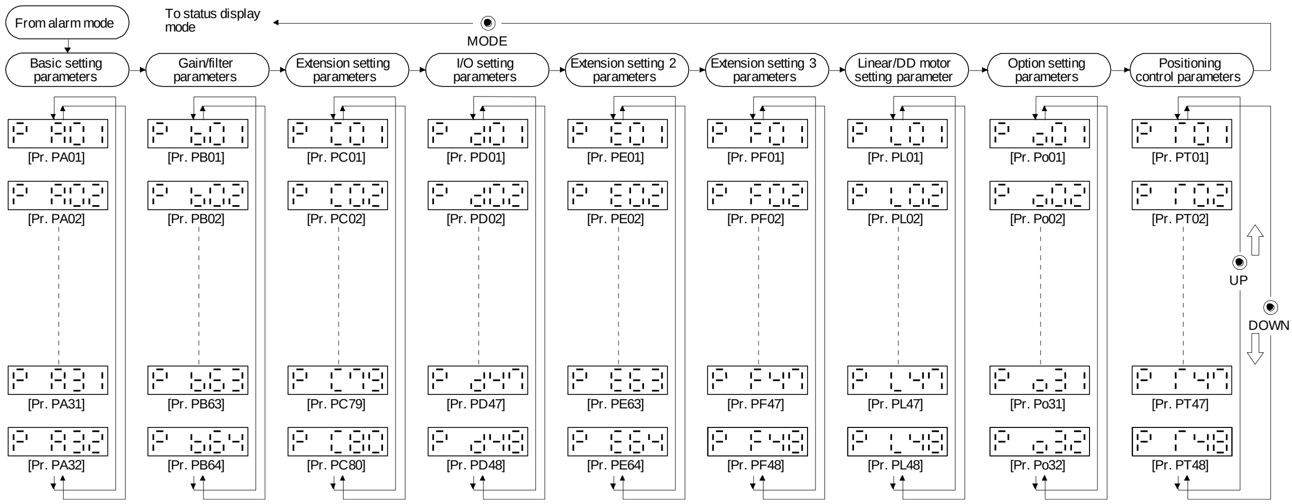
The following example is the operation method to change the position data of the point table No. 1 to "123456".



16.3.6 Parameter mode

(1) Parameter mode transition

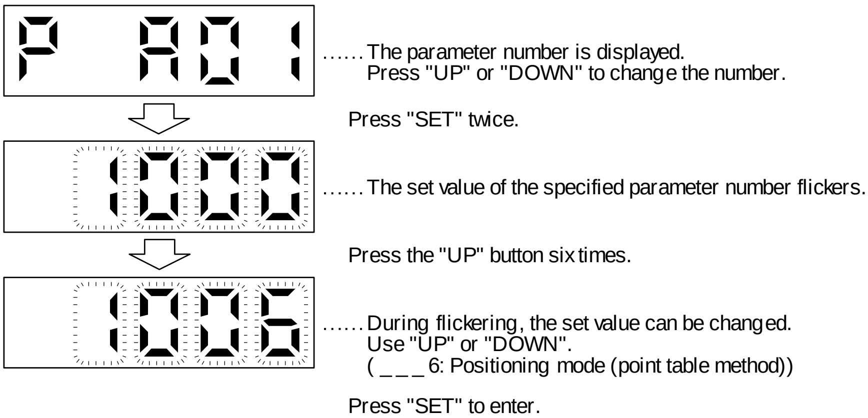
After selecting the corresponding parameter mode with the "MODE" button, pressing the "UP" or "DOWN" button changes the display as shown below.



(2) Operation method

(a) Parameters of 5 or less digits

The following example shows the operation procedure performed after power-on to change the control mode to the positioning mode (point table method) with [Pr. PA01 Operation mode]. Press "MODE" to switch to the basic setting parameter screen.

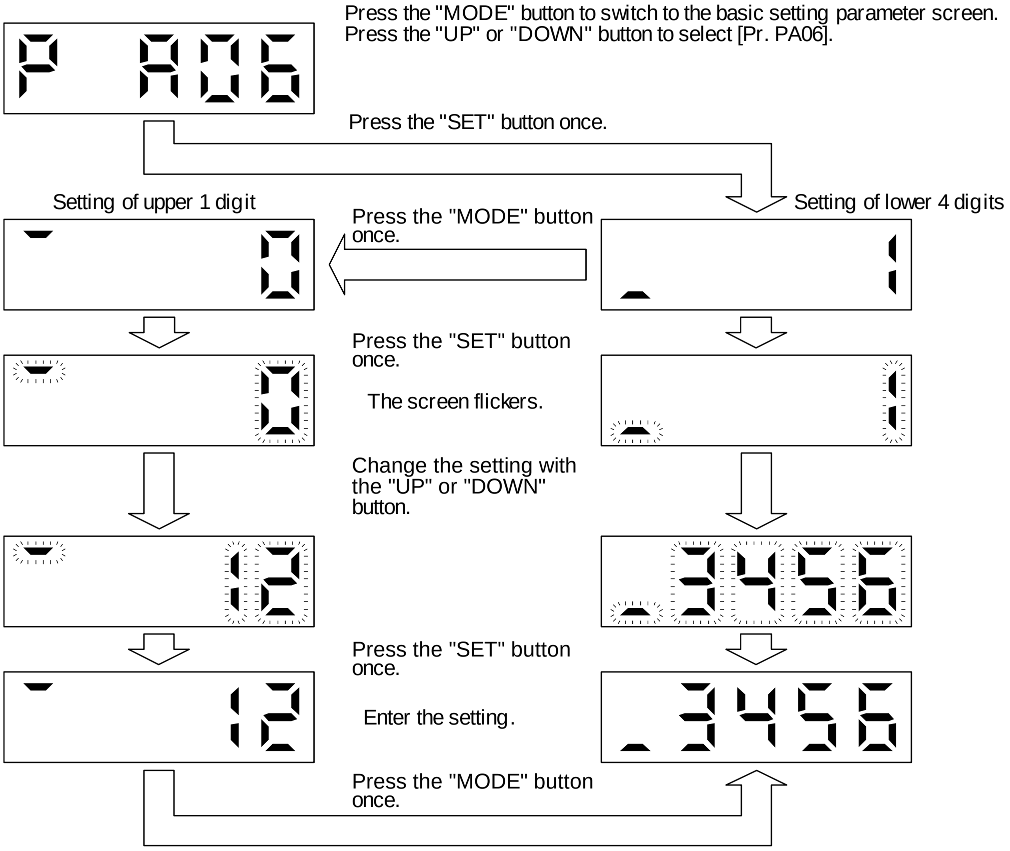


To shift to the next parameter, press the "UP" or "DOWN" button.

When changing the [Pr. PA01] setting, change its setting value, then switch power off once and switch it on again to enable the new value.

(b) Parameters of 6 or more digits

The following example gives the operation procedure to change the electronic gear numerator to "123456" with [Pr. PA06 Electronic gear numerator].



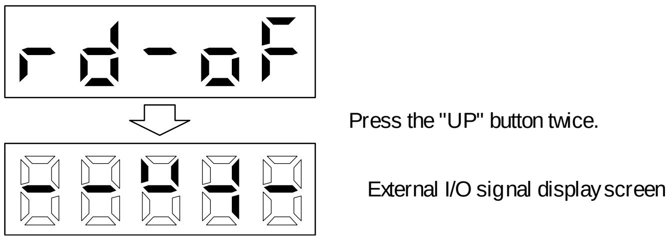
16.3.7 External I/O signal display

POINT
●The I/O signal settings can be changed using the I/O setting parameters [Pr. PD04] to [Pr. PD28].

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

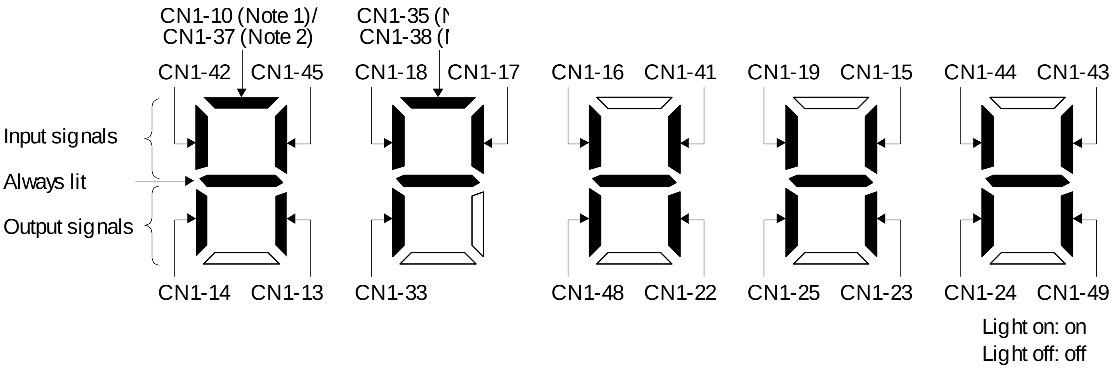
(1) Operation

The display screen at power-on. Using the "MODE" button, display the diagnostic screen.



(2) Display definition

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



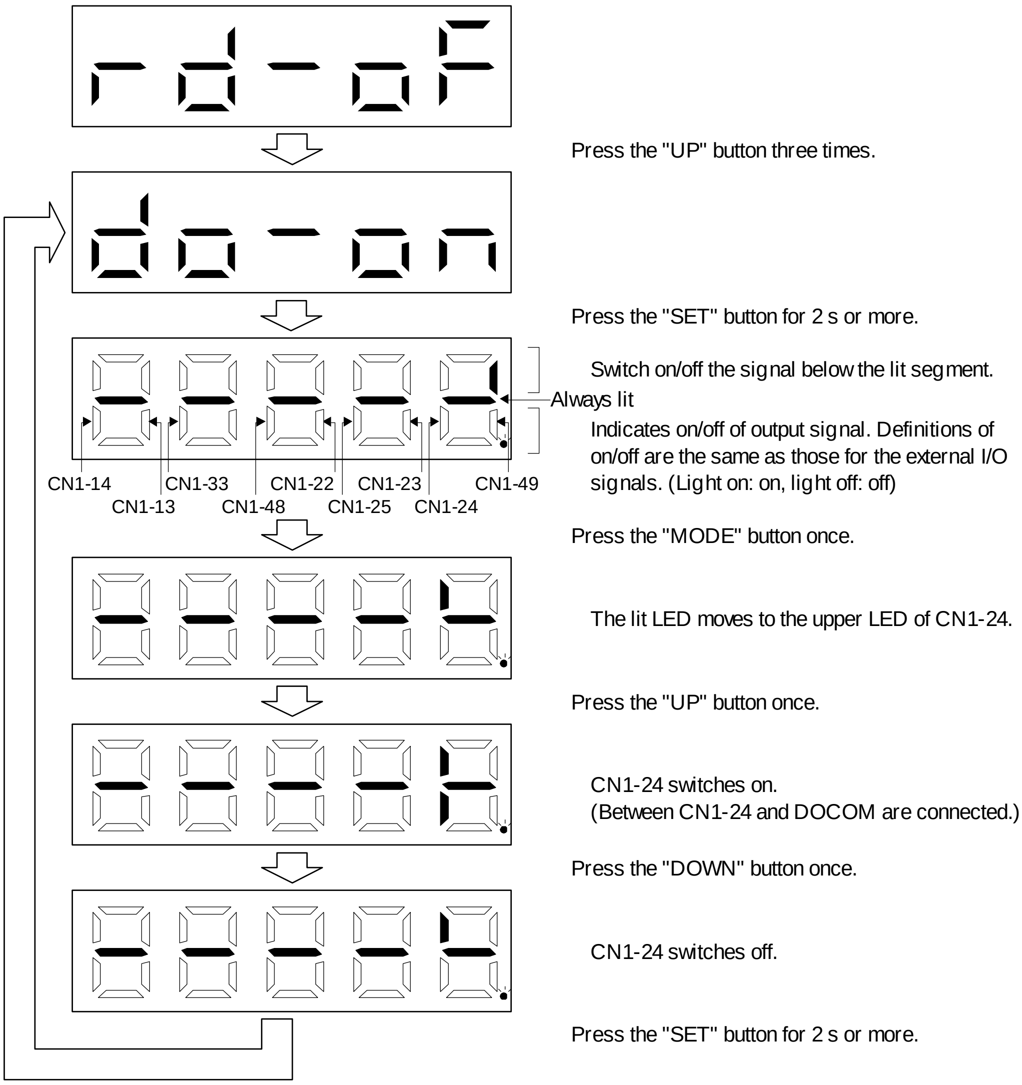
The LED segment corresponding to the pin is lit to indicate on, and is extinguished to indicate off.
For each pin signal in control modes, refer to section 2.2 (1).

16.3.8 Output signal (DO) forced output

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

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

The display screen at power-on. Using the "MODE" button, display the diagnostic screen.

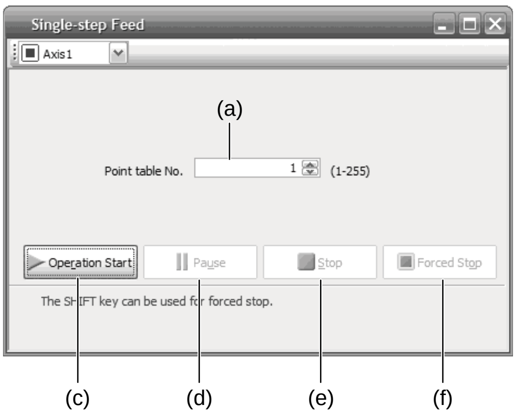


16.3.9 Single-Step feed

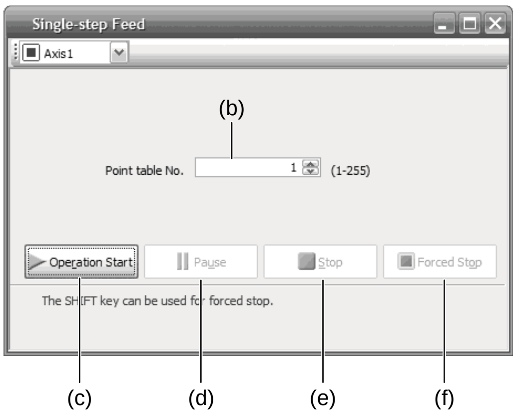
CAUTION	●The test operation mode is designed for checking servo operation. Do not use it for actual operation. ●If the servo motor operates unexpectedly, use EM2 (Forced stop 2) to stop it.

POINT
●Setup software (MR Configurator2TM) is required to perform single-step feed. ●Test operation cannot be performed if SON (Servo-on) is not turned off.

The positioning operation can be performed in accordance with the point table No. or program No. set by Setup software (MR Configurator2TM).
Select the test operation/single-step feed by the menu of Setup software (MR Configurator2TM). When the single-step feed window is displayed, input the following items and operate.



Point table operation



Program operation

(1) Point table No. or program No. setting
Input a point table No. into the input box (a) "Point table No.", or a program No. into the input box (b) "Program No.".

(2) Forward/reverse the servo motor
Click "Operation Start" (c) to rotate the servo motor.

(3) Pause the servo motor
Click "Pause" (d) to temporarily stop the servo motor.
While the servo motor is temporarily stopped, click "Operation Start" (c) to restart the rotation by the amount of the remaining travel distance.
While the servo motor is temporarily stopped, click "Stop" (e) to clear the remaining travel distance.

(4) Stop the servo motor
Click "Stop" (e) to stop the servo motor. At this time, the remaining travel distance is cleared. Click "Operation Start" (c) to restart the rotation.

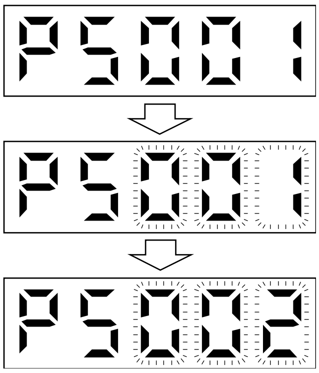
(5) Forced stop of the servo motor software
Click "Forced Stop" (f) to make an instantaneous stop. When "Forced Stop" is enabled, the servo motor does not drive even if "Operation Start" is clicked. Click "Forced Stop" again to enable "Operation Start" to be clicked.

(6) Switch to the normal operation mode
Before switching from the test operation mode to the normal operation mode, turn off the driver.

16.3.10 Teaching function

After an operation travels to a target position (MEND (Travel completion) is turned on) with a JOG operation or manual pulse generator operation, pushing the "SET" button of the operation part or turning on TCH (Teach) will import position data. This function is available only in the point table method. For other control mode, the display remains the same.

(1) Teaching preparation

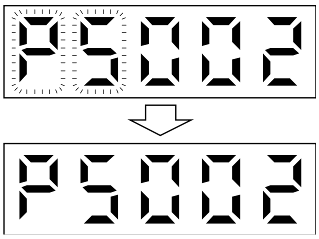


Teaching setting initial screen
Press the "SET" button for approximately 2 s to switch to the teaching setting mode.

When the lower three digits flicker, press the "UP" or "DOWN" button to select the point table.

When the lower three digits flicker, press the "SET" button to complete the teaching setting preparation. The upper two digits on the display will flicker on completion of proper preparation

(2) Position data setting method
After an operation travels to a target position (MEND (Travel completion) is turned on) with a JOG operation or manual pulse generator operation, pushing the "SET" button of the operation part or turning on TCH (Teach) will set the positioning address as position data.



When the upper two digits flicker, the current position is written to the selected point table by pressing the "SET" button.

When the upper two digits or the lower two digits flicker, the display returns to the teaching setting initial screen by pressing the "MODE" button.
The following shows the conditions for when the teaching function operates.

(a) When the "positioning command method" of [Pr. PT01] is set to absolute value command method (_ _ _ 0)

(b) Home position return completion (ZP (Home position return completion) is turned on)

(c) While the servo motor is stopped (command output = 0, MEND (Travel completion) is turned on)

16.4 HOW TO USE THE POINT TABLE

POINT

- For the mark detection function (Current position latch), refer to section 12.2.1.
- For the mark detection function (Interrupt positioning), refer to section 12.2.2.
- For the infinite feed function (setting degree), refer to section 12.3.
- There are the following restrictions on the number of gear teeth on machine side ([Pr. PA06 Number of gear teeth on machine side]) and the servo motor speed (N).
  - When CMX 2000, N < 3076.7 r/min
  - When CMX > 2000, N < (3276.7 - CMX)/10 r/min

  When the servo motor is operated at a servo motor speed higher than the limit value, [AL. E3 Absolute position counter warning] will occur.

16.4.1 Power on and off procedures

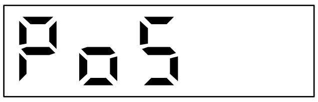
When the driver is powered on for the first time, the control mode is set to position control mode. (Refer to section 4.2.1)
This section provides a case where the driver is powered on after setting the positioning mode.

(1) Power-on
Switch power on in the following procedure. Always follow this procedure at power-on.

1) Switch off SON (Servo-on).

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

3) Switch on the main circuit power supply and control circuit power supply.
The display shows "PoS", and in 2 s later, shows data.



(2) Power-off

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

2) Switch off SON (Servo-on).

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

16.4.2 Stop

If any of the following situations occurs, the driver suspends the running of the servo motor and brings it to a stop.
Refer to section 3.10 for the servo motor with an electromagnetic brake.

Operation/command	Stopping condition
SON (Servo-on) off	The base circuit is shut off and the servo motor coasts.
Alarm occurrence	The servo motor decelerates to a stop with the command. With some alarms, however, the dynamic brake operates to bring the servo motor to a stop. (Refer to chapter 8.)
EM2 (Forced stop 2) off	The servo motor decelerates to a stop with the command. [AL. E6 Servo forced stop warning] occurs. Refer to section 2.3 for EM1.
STO (STO1, STO2) off	The base circuit is shut off and the dynamic brake operates to bring the servo motor to a stop.
LSP (Forward rotation stroke end) off, LSN (Reverse rotation stroke end) off	It will bring the motor to a sudden stop and make it servo-locked. It can be run in the opposite direction.

16.4.3 Test operation

Before starting actual operation, perform test operation to make sure that the machine operates normally.
Refer to section 4.1 for how to power on and off the driver.

Test operation of the 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. For the test operation mode, refer to section 3.1.8, 3.1.9, 3.2.8, and 3.2.9 in this manual, and section 4.5.9 and 18.5.10.

Manual operation of the servo motor alone in test operation mode

In this step, confirm that the servo motor correctly rotates at the slowest speed in the manual operation mode.
Make sure that the servo motor rotates in the following procedure.

1) Switch on EM2 (Forced stop 2) and SON (Servo-on). When the driver is put in a servo-on status, RD (Ready) switches on.
2) Switch on LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end).
3) When MD0 (Operation mode selection 1) is switched off from the PC or PLC...etc and ST1 (Forward rotation start) or ST2 (Reverse rotation start) is switched on in the manual operation mode, the servo motor starts rotating. Set a low speed to the point table at first, make the servo motor operate, and check the rotation direction of the motor, etc. If the motor does not operate in the intended direction, check the input signal.

Test operation with the 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 PC or PLC...etc.
Make sure that the servo motor rotates in the following procedure.

1) Switch on EM2 (Forced stop 2) and SON (Servo-on). When the driver is put in a servo-on status, RD (Ready) switches on.
2) Switch on LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end).
3) When MD0 (Operation mode selection 1) is switched off from the PC or PLC...etc and ST1 (Forward rotation start) or ST2 (Reverse rotation start) is switched on in the manual operation mode, the servo motor starts rotating. Set a low speed to the point table at first, make the servo motor operate, and check the rotation direction of the machine, etc. If the machine does not operate in the intended direction, check the input signal. In the status display, check for any problems of the servo motor speed, load ratio, etc.

Check automatic operation from PC or PLC...etc.

Automatic operation by the point table

16.4.4 Parameter setting

POINT
●Assign the following output devices to the CN1-22, CN1-23, and CN1-25 pins with [Pr. PD23], [Pr. PD24], and [Pr. PD26]. CN1-22: CPO (Rough match) CN1-23: ZP (Home position return completion) CN1-25: MEND (Travel completion)

When you use the servo under the point table method, set [Pr. PA01] to "_ _ _ 6" (Positioning mode (point table method)). Under the point table method, the servo can be used by merely changing the basic setting parameters ([Pr. PA _ _]) and positioning control parameters ([Pr. PT _ _]) mainly.
Set other parameters as necessary.
The following table shows the necessary setting of [Pr. PA _ _] and [Pr. PT _ _] under the point table method.

<table>
<tr><th colspan="3" rowspan="2">Operation mode selection item
Operation mode</th><th colspan="2">Parameter setting</th><th colspan="2">Input device setting</th></tr>
<tr><th>[Pr. PA01]</th><th>[Pr. PT04]</th><th>MD0 (Note)</th><th>DI0 to DI7 (Note)</th></tr>
<tr><td rowspan="3">Automatic operation mode under point table method</td><td colspan="2">Each positioning operation</td><td rowspan="18">_ _ _ 6</td><td rowspan="3"></td><td rowspan="3">On</td><td rowspan="3">Set the point table No. to be reached. (Refer to (2) (b) of 4.2.1.)</td></tr>
<tr><td rowspan="2">Automatic continuous operation</td><td>Varying-speed operation</td></tr>
<tr><td>Automatic continuous positioning operation</td></tr>
<tr><td rowspan="2">Manual operation mode</td><td colspan="2">JOG operation</td><td rowspan="2"></td><td rowspan="2">Off</td><td rowspan="2"></td></tr>
<tr><td colspan="2">Manual pulse generator operation</td></tr>
<tr><td rowspan="11">Home position return mode</td><td colspan="2">Dog type</td><td>_ _ _ 0</td><td rowspan="11">On</td><td rowspan="11">All off</td></tr>
<tr><td colspan="2">Count type</td><td>_ _ _ 1</td></tr>
<tr><td colspan="2">Data set type</td><td>_ _ _ 2</td></tr>
<tr><td colspan="2">Stopper type</td><td>_ _ _ 3</td></tr>
<tr><td colspan="2">Home position ignorance (servo-on position as home position)</td><td>_ _ _ 4</td></tr>
<tr><td colspan="2">Dog type rear end reference</td><td>_ _ _ 5</td></tr>
<tr><td colspan="2">Count type front end reference</td><td>_ _ _ 6</td></tr>
<tr><td colspan="2">Dog cradle type</td><td>_ _ _ 7</td></tr>
<tr><td colspan="2">Dog type last Z-phase reference</td><td>_ _ _ 8</td></tr>
<tr><td colspan="2">Dog type front end reference</td><td>_ _ _ 9</td></tr>
<tr><td colspan="2">Dogless Z-phase reference</td><td>_ _ _ A</td></tr>
</table>

Note. MD0: Operation mode selection 1, DI0 to DI7: Point table No. selection 1 to Point table No. selection 8

16.4.5 Point table setting

Set the data for operation to the point table. The following shows the items to be set.

Item	Main description
Position data	Set the position data for movement.
Servo motor speed	Set the command speed of the servo motor for execution of positioning.
Acceleration time constant	Set the acceleration time constant.
Deceleration time constant	Set the deceleration time constant.
Dwell	Set the waiting time when performing automatic continuous operation.
Auxiliary function	Set when performing automatic continuous operation.
M code	Outputs the first digit and the second digit of the M code in 4-bit binary respectively.

Refer to section 4.2.2 for details of the point table.

16.4.6 Actual operation

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

16.4.7 Troubleshooting at start-up

⚠CAUTION	●Never make a drastic adjustment or change to the parameter values as doing so will make the operation unstable.

POINT

●Using Setup software (MR Configurator2™), you can refer to the reason for rotation failure, 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	・The 7-segment LED display does not turn on. ・The 7-segment LED display flickers.	Not improved even if CN1, CN2, and CN3 connectors are disconnected.	1. Power supply voltage fault 2. The driver is malfunctioning.	
			Improved when CN1 connector is disconnected.	Power supply of CN1 cabling is shorted.	
			Improved when CN2 connector is disconnected.	1. Power supply of encoder cabling is shorted. 2. Encoder is malfunctioning.	
			Improved when CN3 connector is disconnected.	Power supply of CN3 cabling is shorted.	
		Alarm occurs.	Refer to chapter 8 and remove the cause.		Chapter 8 (Note)
2	Switch on SON (Servo-on).	Alarm occurs.	Refer to chapter 8 and remove the cause.		Chapter 8 (Note)
		Servo motor shaft is not servo-locked. (Servo motor shaft is free.)	1. Check the display to see if the driver is ready to operate. 2. Check the external I/O signal indication (section 3.1.7 or 3.2.7) to see if SON (Servo-on) is on.	1. SON (Servo-on) is not input. (wiring mistake) 2. 24 V DC power is not supplied to DICOM.	Section 3.1.7 Section 3.2.7

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
3	Perform a home position return.	Servo motor does not rotate.	Call the external I/O signal display and check the on/off status of the input signal. (Refer to section 3.1.7 or 3.2.7.)	LSP, LSN, and ST1 are off.	Section 3.1.7 Section 3.2.7
			Check [Pr. PA11 Forward rotation torque limit] and [Pr. PA12 Reverse rotation torque limit].	Torque limit level is too low as compared to the load torque.	Section 7.2.1
			When TLA (Analog torque limit) is usable, check the input voltage on the status display.	Torque limit level is too low as compared to the load torque.	Section 3.1.2 Section 3.2.2
		The home position return is not completed.	Call the external I/O signal display and check the on/off status of input signal DOG. (Refer to section 3.1.7 or 3.2.7.)	The proximity dog is set incorrectly.	Section 3.1.7 Section 3.2.7
4	Switch on ST1 (Forward rotation start) or ST2 (Reverse rotation start).	Servo motor does not rotate.	Call the external I/O signal display (section 3.1.7 or 3.2.7) and check the on/off status of the input signal.	LSP, LSN, ST1, and ST2 are off.	Section 3.1.7 Section 3.2.7
			Check [Pr. PA11 Forward rotation torque limit] and [Pr. PA12 Reverse rotation torque limit].	Torque limit level is too low as compared to the load torque.	Section 7.2.1
			When TLA (Analog torque limit) is usable, check the input voltage on the status display.	Torque limit level is too low as compared to the load torque.	Section 3.1.2 Section 3.2.2
5	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/ deceleration more than three times to complete auto tuning.	Gain adjustment fault	Chapter 6
		Large load inertia moment causes the servo motor shaft to oscillate side to side.	If the servo motor may be driven with safety, repeat acceleration and deceleration three times or more to complete the auto tuning.	Gain adjustment fault	Chapter 6

16.5 AUTOMATIC OPERATION MODE

16.5.1 Automatic operation mode

(1) Command method

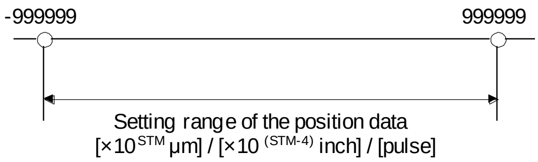
Start operation using ST1 (Forward rotation start) or ST2 (Reverse rotation start). Absolute value command method and incremental value command method are provided in automatic operation mode.

(a) Absolute value command method

As position data, set the target address to be reached.

1) Millimeter, inch, and pulse unit

Setting range: -999999 to 999999 [×10^{STM} m] (STM = Feed length multiplication[Pr. PT03])
-999999 to 999999 [×$10^{(STM-4)}$ inch] (STM = Feed length multiplication [Pr. PT03])
-999999 to 999999 [pulse]

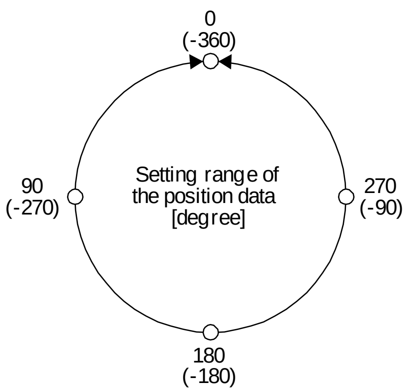


2) Degree unit

Set the target position by indicating the CCW direction with a "+" sign and the CW direction with a "-" sign.

Under the absolute value command method, the rotation direction can be specified with a "+" or "-" sign.

An example of setting is shown below.



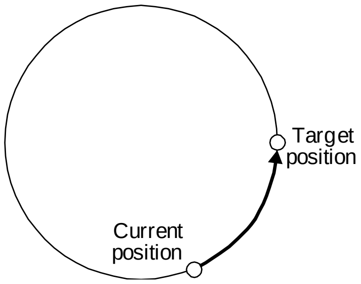
Coordinate system in degrees

- The coordinate is determined by referring to the position of 0 degree.
  + direction: 0 → 90 → 180 → 270 → 0
  - direction: 0 → -90 → -180 → -270 → -360
- The positions of 270 degrees and -90 degrees are the same.
- The positions of 0 degree, 360 degrees and -360 degrees are the same.

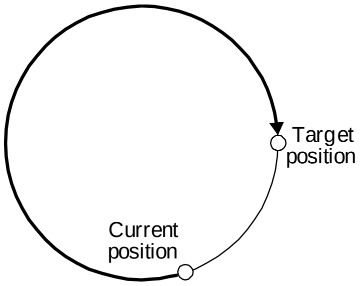
The travel direction to the target position is set with [Pr. PT03].

[Pr. PT03] setting	Servo motor rotation direction
_ 0 _ _	The servo motor rotates to the target position in a direction specified with a sign of the position data.
_ 1 _ _	The servo motor rotates from the current position to the target position in the shorter direction. If the distances from the current position to the target position are the same for CCW and CW, the servo motor rotates in the CCW direction.

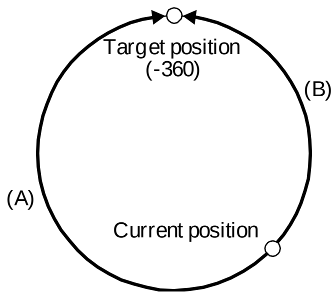
a) When using the Rotation direction specifying ([Pr. PT03] = "_ 0 _ _")
When the position data of 270.000 degrees is specified, the servo motor rotates in the CCW direction.



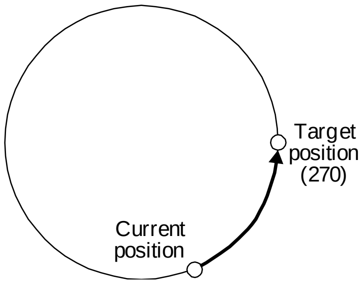
When the position data of -90.000 degrees is specified, the servo motor rotates in the CW direction.



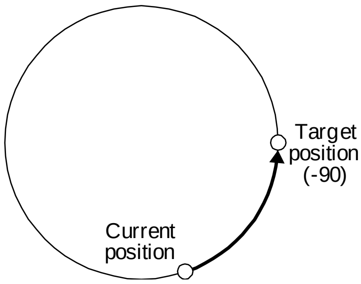
When the position data of -360.000 degrees is specified, the servo motor rotates in the CW direction. (A)
When you specify 360.000 degrees or 0 degree to the position data, the servo motor rotates in the CCW direction. (B)



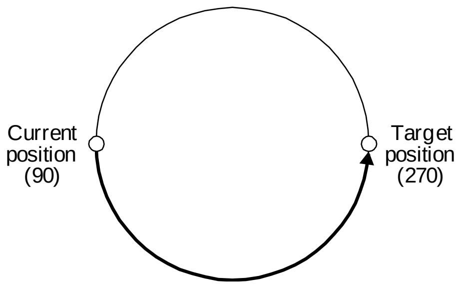
b) When using the shortest rotation specification ([Pr. PT03] = _ 1 _ _)
When the position data of 270.000 degrees is specified, the servo motor rotates in the CCW direction.



When the position data of -90.000 degrees is specified, the servo motor rotates in the CCW direction.



If the position data of 270.000 degrees is specified when the current position is at 90, the distances in the CCW and CW are the same. In such a case, the servo motor rotates in the CCW direction.



(b) Incremental value command method

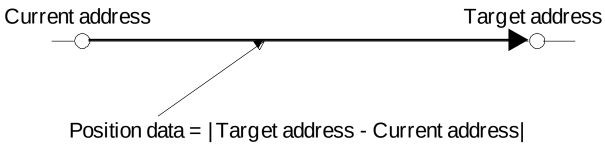
As position data, set the travel distance from the current address to the target address.

1) Millimeter, inch, and pulse unit

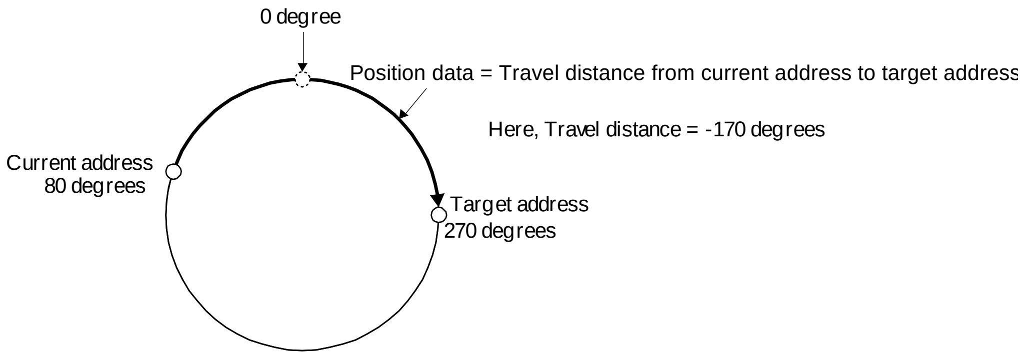
Setting range: 0 to 999999 [$\times 10^{STM}$ m] (STM = Feed length multiplication [Pr. PT03])

0 to 999999 [$\times 10^{(STM-4)}$ inch] (STM = Feed length multiplication [Pr. PT03])

0 to 999999 [pulse]



2) Degree unit



(2) Point table

(a) Point table setting

1 to 255 point tables can be set. To use point table No. 16 to 255, enable DI4 (Point table No. selection 5) to DI7 (Point table No. selection 8) with "Device Setting" on Setup software (MR Configurator2TM).

Set point tables using Setup software (MR Configurator2TM) or the operation section of the driver.

The following table lists what to set. Refer to section 4.2.2 for details of the settings.

Item	Main description
Position data	Set the position data for movement.
Servo motor speed	Set the command speed of the servo motor for execution of positioning.
Acceleration time constant	Set the acceleration time constant.
Deceleration time constant	Set the deceleration time constant.
Dwell	Set the waiting time when performing automatic continuous operation.
Auxiliary function	Set when performing automatic continuous operation.
M code	Outputs the first digit and the second digit of the M code in 4-bit binary respectively.

(b) Selection of point tables

Using the input signal or the communication function, select the point table No. with the communication command from the PC or PLC...etc such as a personal computer.

The following table lists the point table No. selected in response to the input signal and the communication command.

However, when using the input signal to select the point table No., you can only use point table No. 1 to 15 in the initial status.

To use point table No. 16 to 255, enable input signals DI4 (Point table No. selection 5) to DI7 (Point table No. selection 8) with "Device Setting" on Setup software (MR Configurator2TM).

When using the communication function to select the point table No., refer to chapter 10.

Input signal (Note)								Selected point table No.
DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0	
0	0	0	0	0	0	0	0	0 (for home position return)
0	0	0	0	0	0	0	1	1
0	0	0	0	0	0	1	0	2
0	0	0	0	0	0	1	1	3
0	0	0	0	0	1	0	0	4
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
1	1	1	1	1	1	1	0	254
1	1	1	1	1	1	1	1	255

Note. 0: Off
1: On

16.5.2 Automatic operation using point table

(1) Absolute value command method

This method allows to select absolute value command or incremental value command with the auxiliary function of the point table.

(a) Point table

Set the point table values using Setup software (MR Configurator2™) or the operation section.
Set the position data, servo motor speed, acceleration time constant, deceleration time constant, dwell and auxiliary function to the point table.
To use the point table under the absolute value command method, set "0", "1", "8", or "9" to the auxiliary function. To use the point table under the incremental value command method, set "2", "3", "10", or "11" to the auxiliary function.
When you set a value outside this range to the point table, the set value will be clamped with the maximum or minimum value. When changing the command unit or the connected motor results in the set value outside this range, [AL. 37] will occur.

Item	Setting range	Unit	Description
Position data	-999999 to 999999 (Note 1)	$\times 10^{STM}$ m $\times 10^{(STM-4)}$ inch $\times 10^{-3}$ degree pulse	(1) When using this point table under the absolute value command method Set the target address (absolute value). The teaching function is available for setting this value. (2) When using this point table under the incremental value command method Set the travel distance. A "-" sign indicates a reverse rotation command. The teaching function is not available. When teaching is executed, the setting will not be completed.
Servo motor speed	0 to permissible speed	r/min	Set the command speed of the servo motor for execution of positioning. The setting value must be within the permissible instantaneous speed of the servo motor used.
Acceleration time constant	0 to 20000	ms	Set a time until the servo motor rotates at the rated speed.
Deceleration time constant	0 to 20000	ms	Set a time from when the servo motor rotates at the rated speed until when the motor stops.
Dwell	0 to 20000	ms	Set the dwell. To disable the dwell, set "0" or "2" to the auxiliary function. To perform varying-speed operation, set "1", "3", "8", "9", "10" or "11" to the auxiliary function and 0 to the dwell. When the dwell is set, the position command of the selected point table is completed, and after the set dwell has elapsed, the position command of the next point table is started.

Item	Setting range	Unit	Description
Auxiliary function	0 to 3, 8 to 11		Set the auxiliary function. (1) When using this point table under the absolute value command method 0: Automatic operation is performed in accordance with a single point table selected. 1: Automatic continuous operation is performed to the next point table without a stop. 8: Automatic continuous operation is performed without a stop to the point table selected at start-up. 9: Automatic continuous operation is performed without stopping a point table No. 1. (2) When using this point table under the incremental value command method 2: Automatic operation is performed in accordance with a single point table selected. 3: Automatic continuous operation is performed to the next point table without a stop. 10: Automatic continuous operation is performed to the point table selected at start-up. 11: Automatic continuous operation is performed without stopping a point table No. 1. When a different rotation direction is set, smoothing zero (command output) is confirmed and then the rotation direction is reversed. Setting "1" or "3" to point table No. 255 results in an error. Refer to (3) (b) of this section.
M code	0 to 99		Outputs the first digit and the second digit of the M code in 4-bit binary respectively.

Note 1. The setting range of the position data in degrees is -360.000 to 360.000. When the unit of the position data is m or inch, the location of the decimal point is changed according to the STM setting.

(b) Parameter setting

Set the following parameters to perform automatic operation.

1) Command method selection ([Pr. PT01])

Select the absolute value command method as shown below.

[Pr. PT01]

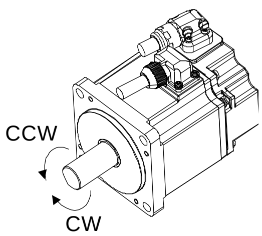
			0

Absolute value command method

2) Rotation direction selection ([Pr. PA14])

Select the servo motor rotation direction when ST1 (Forward rotation start) is switched on.

[Pr. PA14] setting	Servo motor rotation direction when ST1 (Forward rotation start) is switched on
0	CCW rotation with + position data CW rotation with - position data
1	CW rotation with + position data CCW rotation with - position data



3) Position data unit ([Pr. PT01])

Set the unit of the position data.

[Pr. PT01] setting	Position data unit
_ 0 _ _	mm
_ 1 _ _	inch
_ 2 _ _	degree
_ 3 _ _	pulse

4) Feed length multiplication ([Pr. PT03])

Set the feed length multiplication (STM) of the position data.

[Pr. PT03] setting	Position data input range			
	[mm]	[inch]	[degree] (Note 1)	[pulse] (Note 1)
_ _ _ 0	- 999.999 to + 999.999	- 99.9999 to + 99.9999	- 360.000 to + 360.000 (Note 2)	- 999999 to + 999999
_ _ _ 1	- 9999.99 to + 9999.99	- 999.999 to + 999.999		
_ _ _ 2	- 99999.9 to + 99999.9	- 9999.99 to + 9999.99		
_ _ _ 3	- 999999 to + 999999	- 99999.9 to + 99999.9		

Note The feed length multiplication setting ([Pr. PT03]) is not applied to the unit multiplication factor.

1. Adjust the unit multiplication factor in the electronic gear setting ([Pr. PA06] and [Pr. PA07]).
2. The "-" sign has different meanings under the absolute value command method and the incremental value command method. Refer to section 4.2.1 for details.

(c) Operation

Selecting DI0 to DI7 for the point table and switching on ST1 starts positioning to the position data at the set speed, acceleration time constant and deceleration time constant. At this time, ST2 (Reverse rotation start) is invalid.

Item	Used device	Description
Automatic operation mode selection	MD0 (Operation mode selection 1)	Switch on MD0.
Point table selection	DI0 (Point table No. selection 1) DI1 (Point table No. selection 2) DI2 (Point table No. selection 3) DI3 (Point table No. selection 4) DI4 (Point table No. selection 5) DI5 (Point table No. selection 6) DI6 (Point table No. selection 7) DI7 (Point table No. selection 8)	Refer to (2) (b) of 4.2.1.
Start	ST1 (Forward rotation start)	Switch on ST1 to start.

(2) Incremental value command method

(a) Point table

Set the point table values using Setup software (MR Configurator2™) or the operation section.

Set the position data, servo motor speed, acceleration time constant, deceleration time constant, dwell and auxiliary function to the point table.

When you set a value outside the setting range to the point table, the set value will be clamped with the maximum or minimum value. When changing the command unit or the connected motor results in the set value outside the setting range, [AL. 37] will occur.

Item	Setting range	Unit	Description
Position data	0 to 999999 (Note 1)	$\times 10^{STM}$ m $\times 10^{(STM-4)}$ inch $\times 10^{-3}$ degree pulse	Set the travel distance. The teaching function is not available. When teaching is executed, the setting will not be completed. The unit can be changed by [Pr. PT03] (Feed length multiplication).
Servo motor speed	0 to permissible speed	r/min	Set the command speed of the servo motor for execution of positioning. The setting value must be the permissible instantaneous speed or less of the servo motor used.
Acceleration time constant	0 to 20000	ms	Set a time until the servo motor rotates at the rated speed.
Deceleration time constant	0 to 20000	ms	Set a time from when the servo motor rotates at the rated speed until when the motor stops.
Dwell	0 to 20000	ms	Set the dwell. To disable the dwell, set "0" to the auxiliary function. To perform varying-speed operation, set "1", "8" or "9" to the auxiliary function and 0 to the dwell. When the dwell is set, the position command of the selected point table is completed, and after the set dwell has elapsed, the position command of the next point table is started.
Auxiliary function	0, 1, 8 to 9		Set the auxiliary function. 0: Automatic operation is performed in accordance with a single point table selected. 1: Automatic continuous operation is performed to the next point table without a stop. 8: Automatic continuous operation is performed without a stop to the point table selected at start-up. 9: Automatic continuous operation is performed without stopping a point table No. 1. Refer to section 4.2.2 for details.
M code	0 to 99		Outputs the first digit and the second digit of the M code in 4-bit binary respectively.

Note 1. The setting range of the position data in degrees is 0 to 999.999. When the unit of the position data is m or inch, the location of the decimal point is changed according to the STM setting.

(b) Parameter setting

Set the following parameters to perform automatic operation.

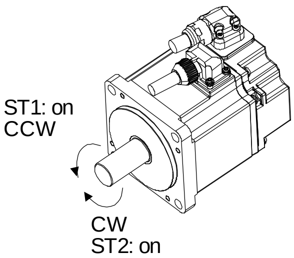
1) Command method selection ([Pr. PT01])

Select the incremental value command method as shown below.

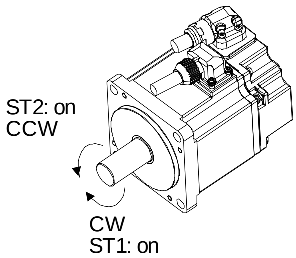
2) Rotation direction selection ([Pr. PA14])

Select the servo motor rotation direction when ST1 (Forward rotation start) or ST2 (Reverse rotation start) is switched on.

[Pr. PA14] setting	Servo motor rotation direction	
	ST1 (Forward rotation start)	ST2 (Reverse rotation start)
0	CCW rotation (address increase)	CW rotation (address decrease)
1	CW rotation (address increase)	CCW rotation (address decrease)



[Pr. PA14]: 0



[Pr. PA14]: 1

3) Position data unit ([Pr. PT01])

Set the unit of the position data.

[Pr. PT01] setting	Position data unit
_ 0 _ _	mm
_ 1 _ _	inch
_ 2 _ _	degree
_ 3 _ _	pulse

4) Feed length multiplication ([Pr. PT03])

Set the feed length multiplication (STM) of the position data.

[Pr. PT03] setting	Position data input range			
	[mm]	[inch]	[degree] (Note)	[pulse] (Note)
_ _ _ 0	0 to + 999.999	0 to + 99.9999	0 to + 999.999	0 to + 999999
_ _ _ 1	0 to + 9999.99	0 to + 999.999		
_ _ _ 2	0 to + 99999.9	0 to + 9999.99		
_ _ _ 3	0 to + 999999	0 to + 99999.9		

Note. The feed length multiplication setting ([Pr. PT03]) is not applied to the unit multiplication factor.
Adjust the unit multiplication factor in the electronic gear setting ([Pr. PA06] and [Pr. PA07]).

(c) Operation

Selecting DI0 to DI7 for the point table and switching on ST1 starts a forward rotation of the motor over the travel distance of the position data at the set speed, acceleration time constant and deceleration time constant.

Switching on ST2 starts a reverse rotation of the motor in accordance with the values set to the selected point table.

When the positioning operation is performed consecutively under the incremental value command method, the servo motor rotates in the same direction only.

To change the travel direction during continuous operation, perform the operation under the absolute value command method.

Item	Used device	Description
Automatic operation mode selection	MD0 (Operation mode selection 1)	Switch on MD0.
Point table selection	DI0 (Point table No. selection 1) DI1 (Point table No. selection 2) DI2 (Point table No. selection 3) DI3 (Point table No. selection 4) DI4 (Point table No. selection 5) DI5 (Point table No. selection 6) DI6 (Point table No. selection 7) DI7 (Point table No. selection 8)	Refer to (2) (b) of 4.2.1.
Start	ST1 (Forward rotation start) ST2 (Reverse rotation start)	Switch on ST1 to start. Switch on ST2 to start.

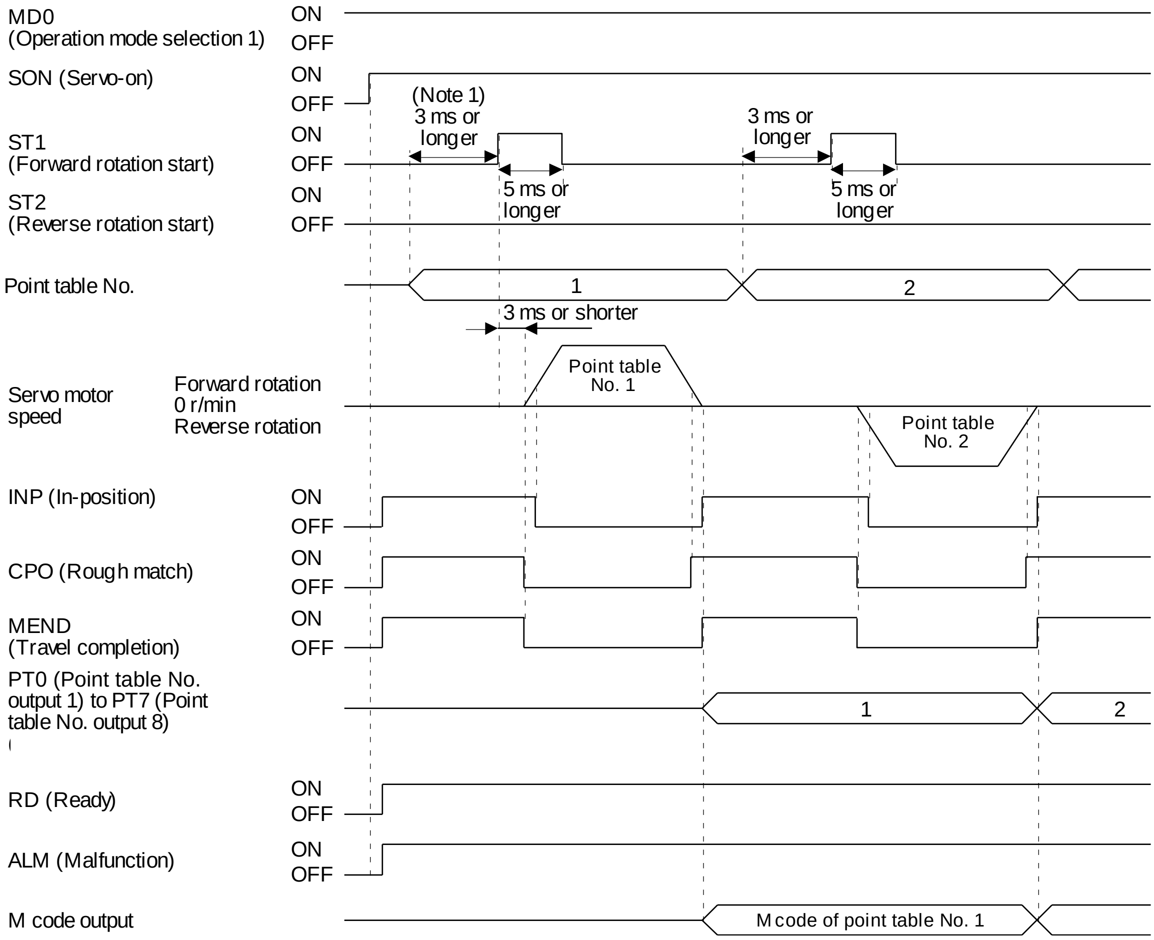
(3) Automatic operation timing chart

(a) Automatic individual positioning operation

1) Absolute value command method ([Pr. PT01] = _ _ _ 0)

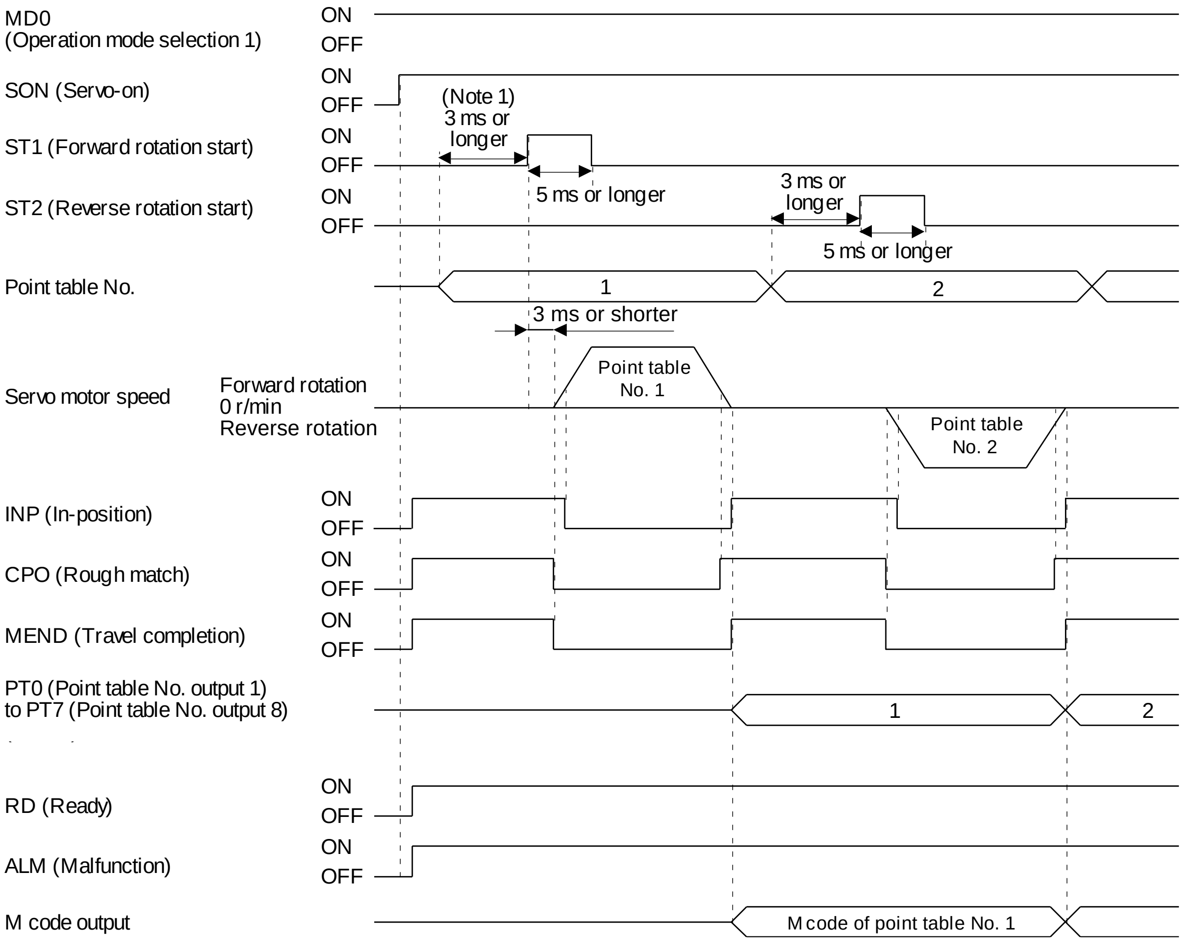
While the servo motor is stopped under servo-on state, switching on ST1 (Forward rotation start) starts the automatic positioning operation.

The following shows a timing chart.



Note 1. The detection of external input signals is delayed by the set time in the input filter setting of [Pr. PD29]. Considering the output signal sequence from the PC or PLC...etc and signal variations due to hardware, configure a sequence that changes the point table selection earlier.

2) Incremental value command method ([Pr. PT01] = _ _ _ 1)
While the servo motor is stopped under servo-on state, switching on ST1 (Forward rotation start) or ST2 (Reverse rotation start) starts the automatic positioning operation.
The following shows a timing chart.



Note 1. The detection of external input signals is delayed by the set time in the input filter setting of [Pr. PD29]. Considering the output signal sequence from the PC or PLC...etc and signal variations due to hardware, configure a sequence that changes the point table selection earlier.

(b) Automatic continuous positioning operation
By merely selecting a point table and switching on ST1 (Forward rotation start) or ST2 (Reverse rotation start), the operation can be performed in accordance with the point tables having consecutive numbers.

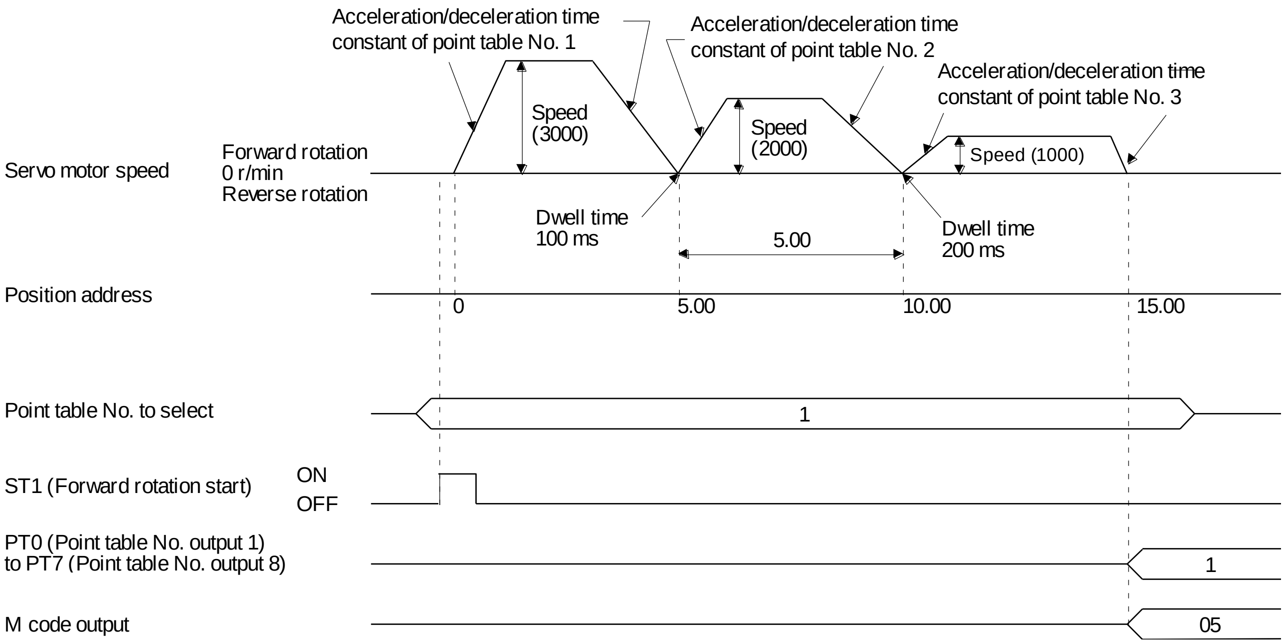
1) Absolute value command method ([Pr. PT01] = _ _ _ 0)
By specifying the absolute value command or the incremental value command in the auxiliary function of the point table, the automatic continuous operation can be performed.
The following shows how to set.

Point table setting		
Dwell	Auxiliary function	
	When position data is absolute value	When position data is incremental value
1 or more	1	3

a) Positioning in a single direction
The following shows an operation example with the set values listed in the table below.
In this example, point table No. 1 and point table No. 3 are under the absolute value command method, and point table No. 2 is under the incremental value command method.

Point table No.	Position data $[10^{STM}$ m]	Servo motor speed [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	Auxiliary function	M code
1	5.00	3000	100	150	100	1	05
2	5.00	2000	150	200	200	3	10
3	15.00	1000	300	100	Disabled	0 (Note)	15

Note. Always set "0" or "2" to the auxiliary function of the last point table among the consecutive point tables.
0: When using the point table under the absolute value command method
2: When using the point table under the incremental value command method



b) Positioning in the reverse direction midway

The following shows an operation example with the set values listed in the table below.

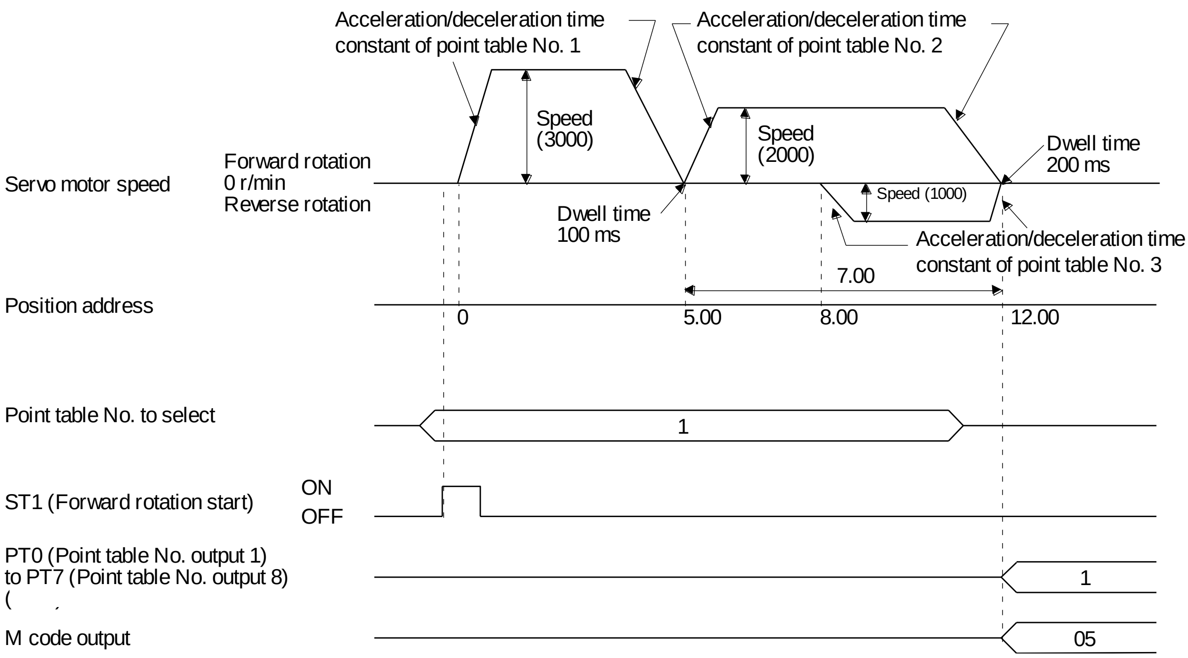
In this example, point table No. 1 and point table No. 3 are under the absolute value command method, and point table No. 2 is under the incremental value command method.

Point table No.	Position data [10^{STM} m]	Servo motor speed [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	Auxiliary function	M code
1	5.00	3000	100	150	100	1	05
2	7.00	2000	150	200	200	3	10
3	8.00	1000	300	100	Disabled	0 (Note)	15

Note. Always set "0" or "2" to the auxiliary function of the last point table among the consecutive point tables.

0: When using the point table under the absolute value command method

2: When using the point table under the incremental value command method



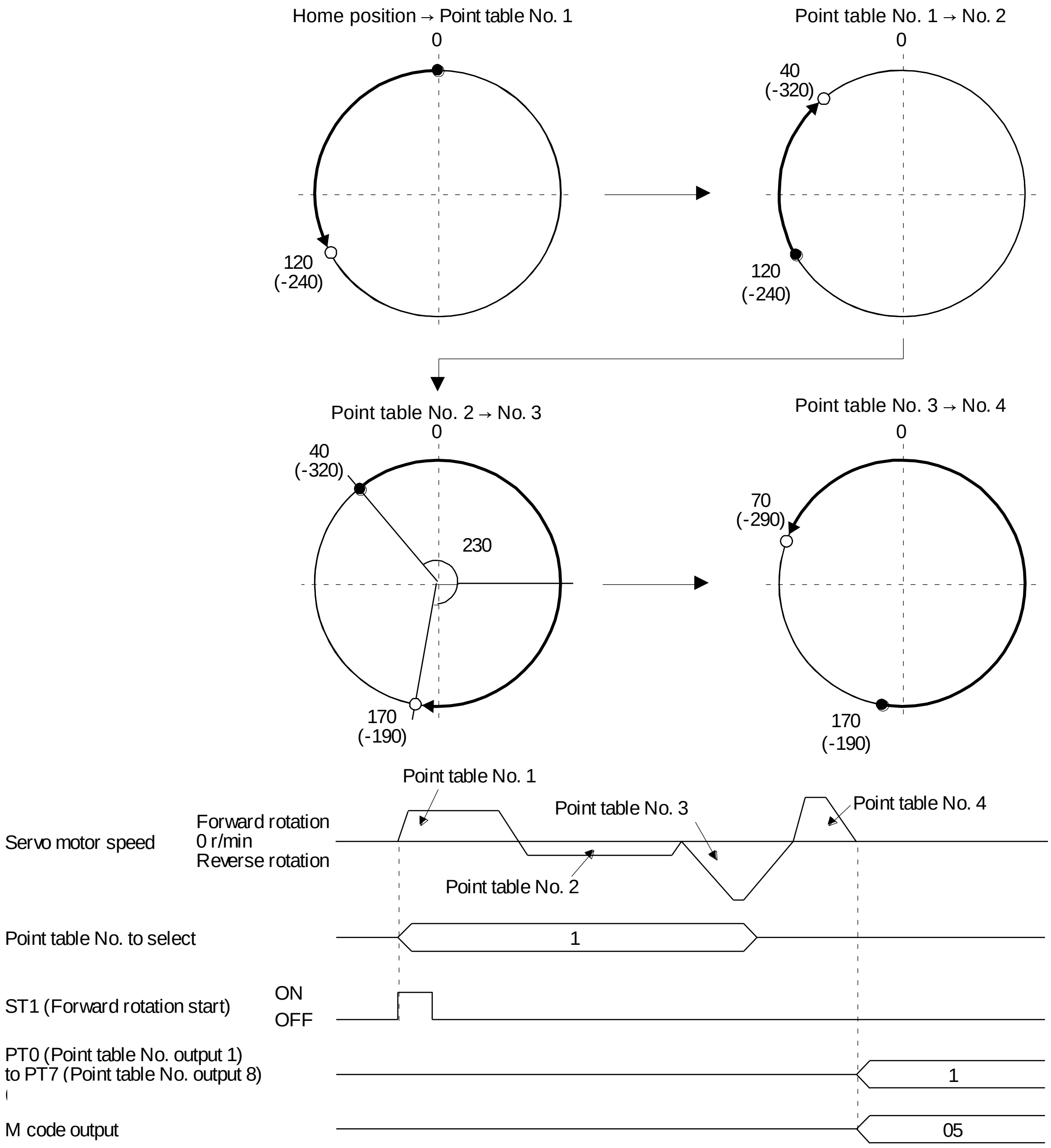
c) Position data in degrees

The following shows an operation example with the set values listed in the table below.

In this example, point table No. 1, point table 2, and point table No. 4 are under the absolute value command method, and point table No. 3 is under the incremental value command method.

Point table No.	Position data [degree]	Servo motor speed [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	Auxiliary function	M code
1	120.000	1000	100	150	100	1	05
2	-320 .000	500	150	100	200	1	10
3	-230.000	3000	200	300	150	3	15
4	70.000	1500	300	100	Disabled	0 (Note)	20

Note. Always set "0" or "2" to the auxiliary function of the last point table among the consecutive point tables.
0: When using the point table under the absolute value command method
2: When using the point table under the incremental value command method



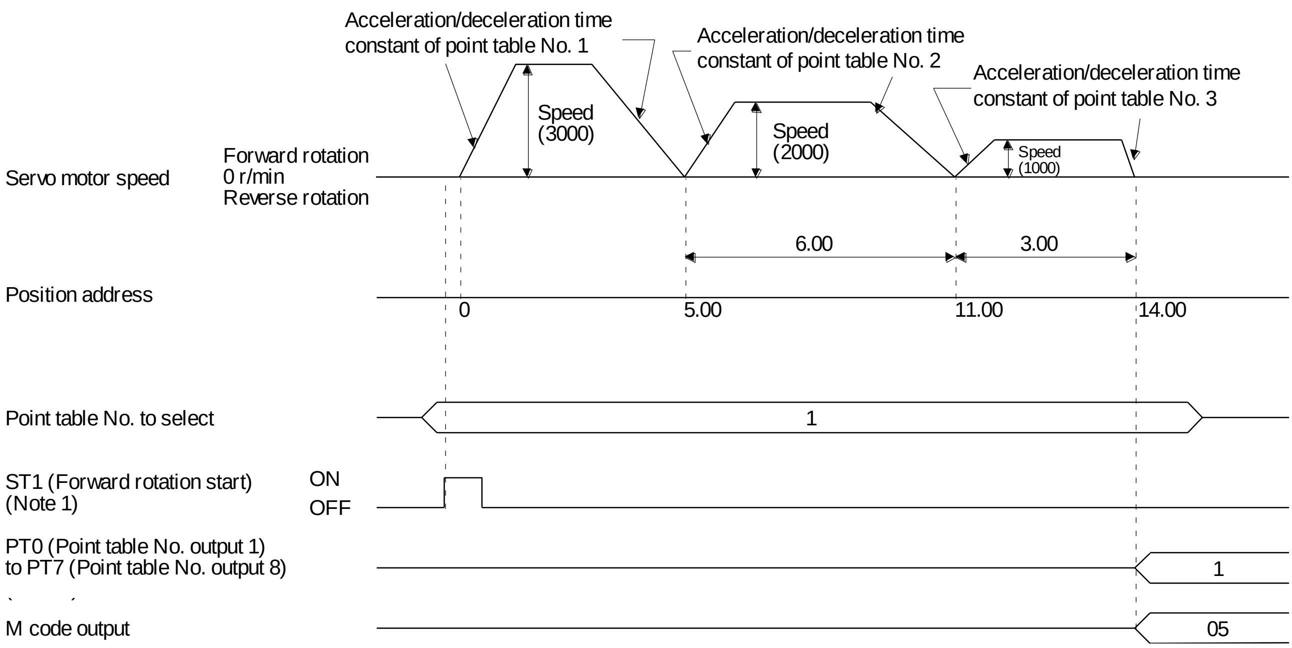
2) Incremental value command method ([Pr. PT01] = _ _ _ 1)
The position data of the incremental value command method is the sum of the position data of consecutive point tables.
The following shows how to set.

Point table setting	
Dwell	Auxiliary function
1 or more	1

a) Positioning in a single direction
The following shows an operation example with the set values listed in the table below.

Point table No.	Position data [10^{STM} m]	Servo motor speed [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	Auxiliary function	M code
1	5.00	3000	100	150	100	1	05
2	6.00	2000	150	200	200	1	10
3	3.00	1000	300	100	Disabled	0 (Note)	15

Note. Always set "0" to the auxiliary function of the last point table among the consecutive point tables.



Note 1. Switching on ST2 (Reverse rotation start) starts positioning in the reverse rotation direction.

b) Position data in degrees

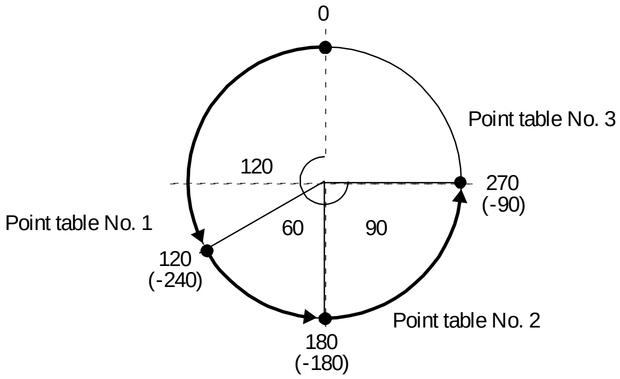
The following shows an operation example with the set values listed in the table below.

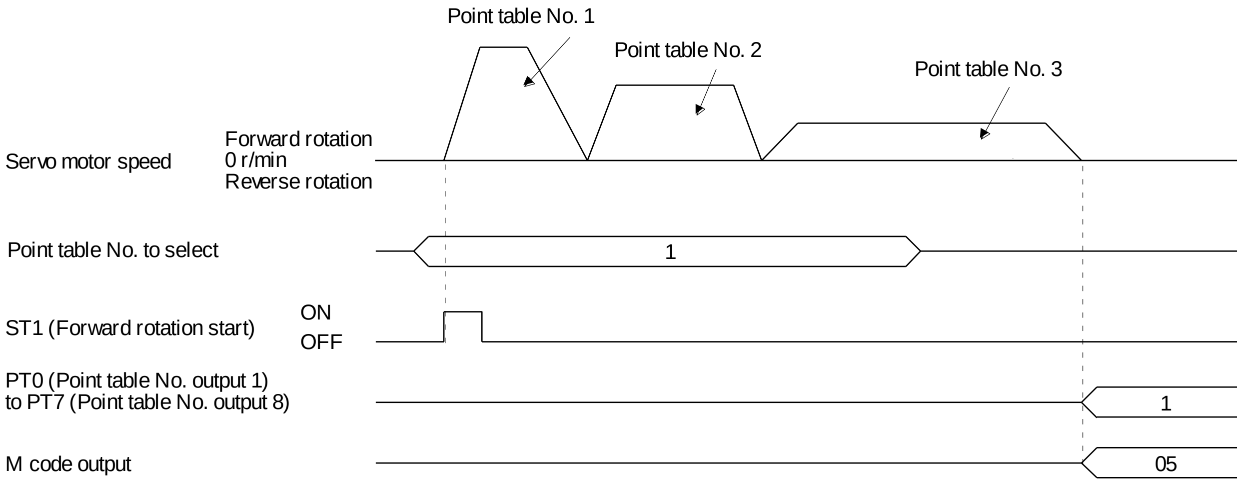
Point table No.	Position data [degree]	Servo motor speed [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	Auxiliary function	M code
1	120 .000	3000	100	150	0	1	05
2	60.000	1500	150	100	0	1	10
3	90 .000	1000	300	100	Disabled	0 (Note)	15

Note. Always set "0" or "2" to the auxiliary function of the last point table among the consecutive point tables.

0: When using the point table under the absolute value command method

2: When using the point table under the incremental value command method





(c) Varying-speed operation

By setting the auxiliary function of the point table, the servo motor speed during positioning can be changed. Point tables are used by the number of the set speed.

1) Absolute value command method ([Pr. PT01] = _ _ _ 0)

Set "1" or "3" to the auxiliary function to execute the positioning at the speed set in the following point table.

At this time, the position data selected at start is valid, and the acceleration/deceleration time constant set in the next and subsequent point tables is invalid.

By setting "1" or "3" to sub functions until point table No. 254, the operation can be performed at maximum 255 speeds.

Always set "0" or "2" to the auxiliary function of the last point table.

To perform varying-speed operation, always set "0" to the dwell.

Setting "1" or more will enables the automatic continuous positioning operation.

The following table shows an example of setting.

Point table No.	Dwell [ms] (Note 1)	Auxiliary function	Varying-speed operation
1	0	1	Consecutive point table data
2	0	3	
3	Disabled	0 (Note 2)	
4	0	3	Consecutive point table data
5	0	1	
6	Disabled	2 (Note 2)	

Note 1. Always set "0".

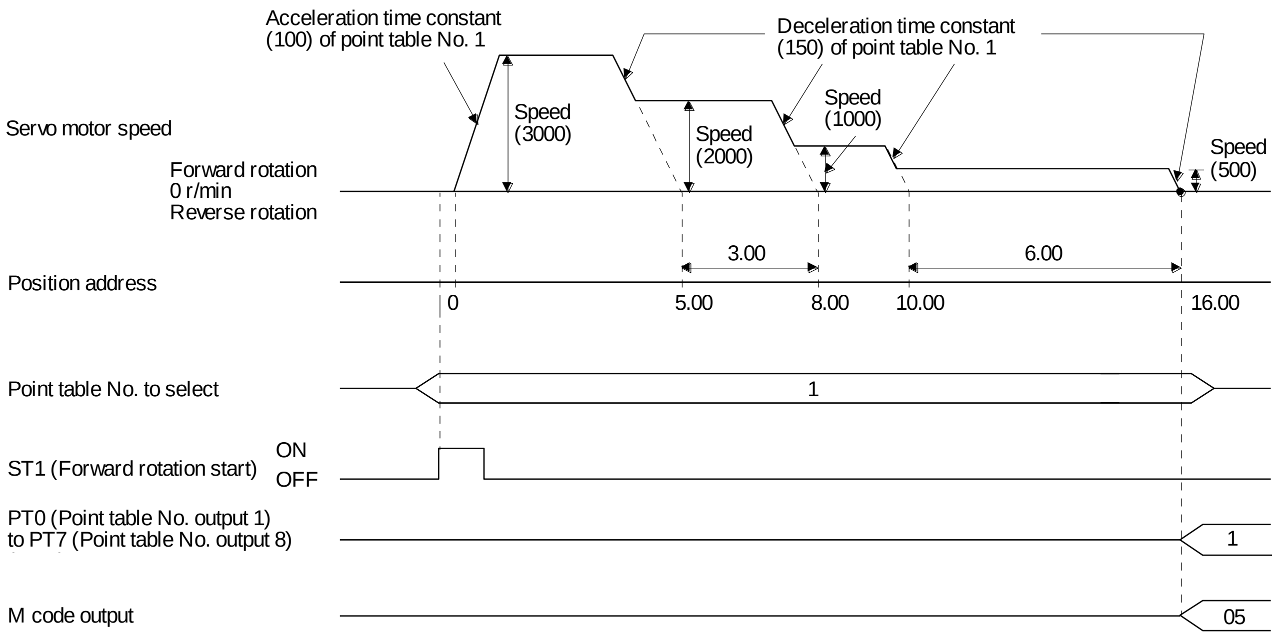
2. Always set "0" or "2" to the auxiliary function of the last point table among the consecutive point tables.

a) Positioning in a single direction

The following shows an operation example with the set values listed in the table below.
In this example, point table No. 1 and point table No. 3 are under the absolute value command method, and point table No. 2 is under the incremental value command method.

Point table No.	Position data [10STM m]	Servo motor speed [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms] (Note 1)	Auxiliary function	M code
1	5.00	3000	100	150	0	1	05
2	3.00	2000	Disabled	Disabled	0	3	10
3	10.00	1000	Disabled	Disabled	0	1	15
4	6.00	500	Disabled	Disabled	Disabled	2 (Note 2)	20

Note 1. Always set "0".
2. Always set "0" or "2" to the auxiliary function of the last point table among the consecutive point tables.
0: When using the point table under the absolute value command method
2: When using the point table under the incremental value command method



b) Positioning in the reverse direction midway

The following shows an operation example with the set values listed in the table below.

In this example, point table No. 1 and point table No. 3 are under the absolute value command method, and point table No. 2 is under the incremental value command method.

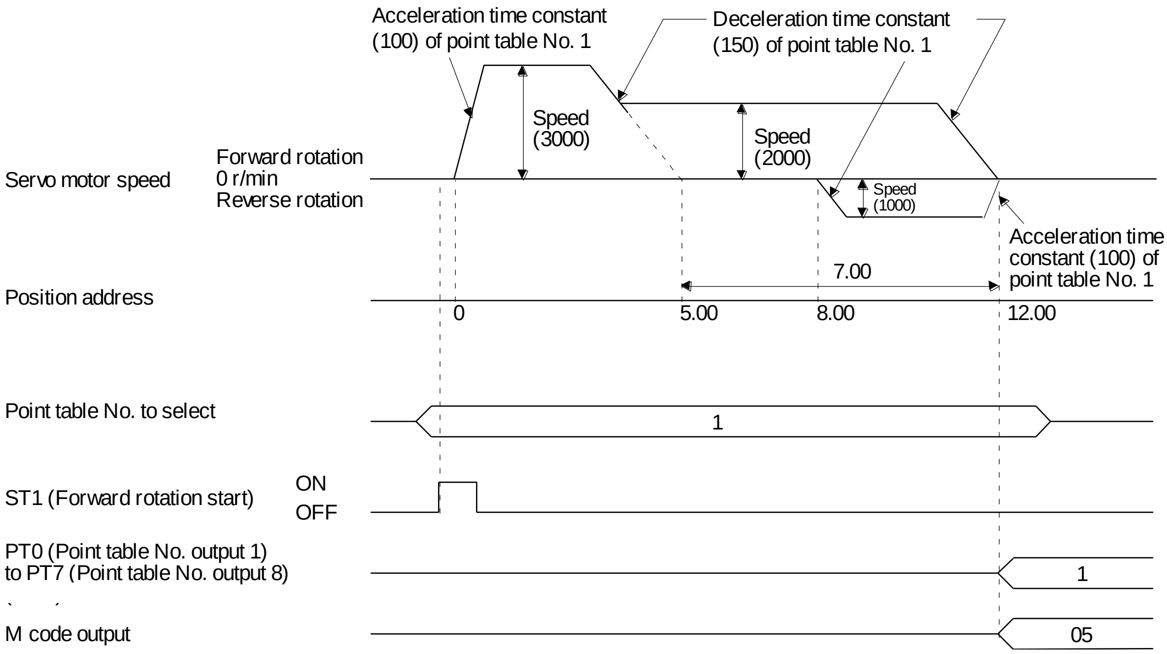
Point table No.	Position data [10STM m]	Servo motor speed [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms] (Note 1)	Auxiliary function	M code
1	5.00	3000	100	150	0	1	05
2	7.00	2000	Disabled	Disabled	0	3	10
3	8.00	1000	Disabled	Disabled	Disabled	0 (Note 2)	15

Note 1. Always set "0".

2. Always set "0" or "2" to the auxiliary function of the last point table among the consecutive point tables.

0: When using the point table under the absolute value command method

2: When using the point table under the incremental value command method



2) Incremental value command method ([Pr. PT01] = _ _ _ 1)
   Setting "1" to the auxiliary function executes positioning at the speed set in the following point table.
   At this time, the position data selected at start is valid, and the acceleration/deceleration time constant set in the next and subsequent point tables is invalid.
   By setting "1" to sub functions until point table No. 254, the operation can be performed at maximum 255 speeds.
   Always set "0" to the auxiliary function of the last point table.
   To perform varying-speed operation, always set "0" to the dwell.
   Setting "1" or more will enables the automatic continuous positioning operation.
   The following table shows an example of setting.

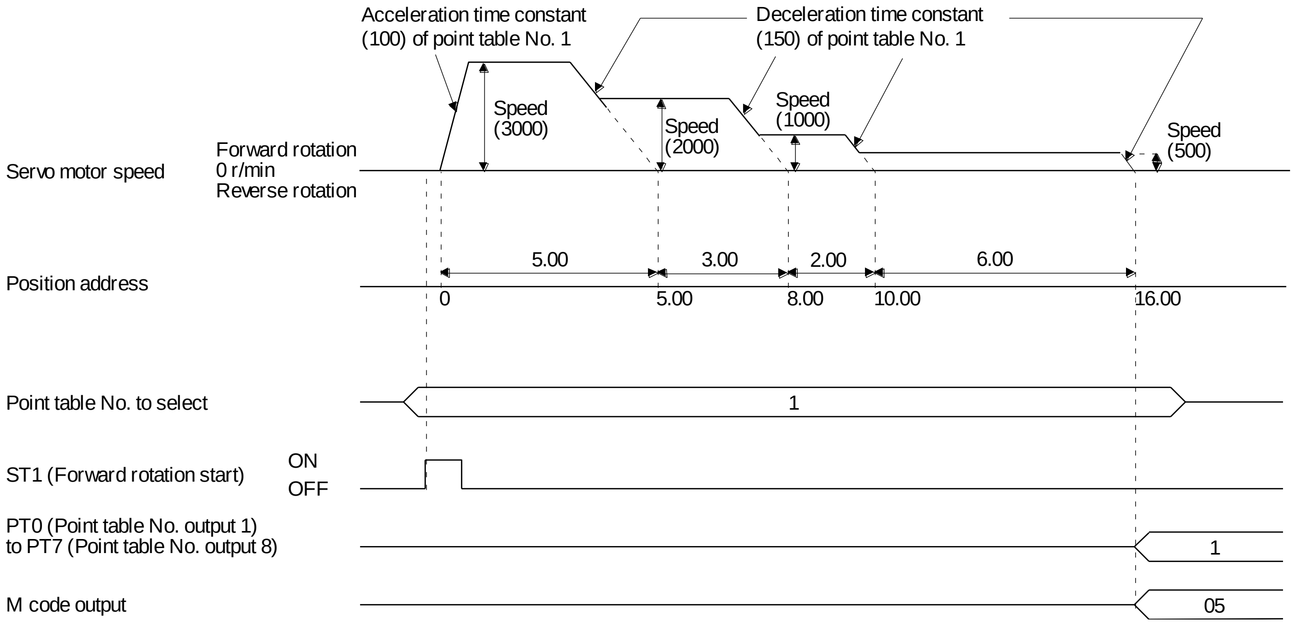
Point table No.	Dwell [ms] (Note 1)	Auxiliary function	Varying-speed operation
1	0	1	Consecutive point table data
2	0	1	
3	Disabled	0 (Note 2)	
4	0	1	Consecutive point table data
5	0	1	
6	Disabled	0 (Note 2)	

Note 1. Always set "0".
2. Always set "0" to the auxiliary function of the last point table among the consecutive point tables.

The following shows an operation example with the set values listed in the table below.

Point table No.	Position data [10^{STM} m]	Servo motor speed [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms] (Note 1)	Auxiliary function	M code
1	5.00	3000	100	150	0	1	05
2	3.00	2000	Disabled	Disabled	0	1	10
3	2.00	1000	Disabled	Disabled	0	1	15
4	6.00	500	Disabled	Disabled	Disabled	0 (Note 2)	20

Note 1. Always set "0".
2. Always set "0" to the auxiliary function of the last point table among the consecutive point tables.



(d) Automatic repeat positioning operation

By setting the auxiliary function of the point table, the operation pattern of the set point table No. can be returned to, and the positioning operation can be performed repeatedly.

1) Absolute value command method ([Pr. PT01] = _ _ _ 0)

Setting "8" or "10" to the auxiliary function performs automatic continuous operation or varying-speed operation until that point table, and after the completion of positioning, performs the operation again from the operation pattern of the point table No. used at start-up.

Setting "9" or "11" to the auxiliary function performs automatic continuous operation or varying-speed operation until that point table, and after the completion of positioning, performs the operation again from the operation pattern of point table No. 1.

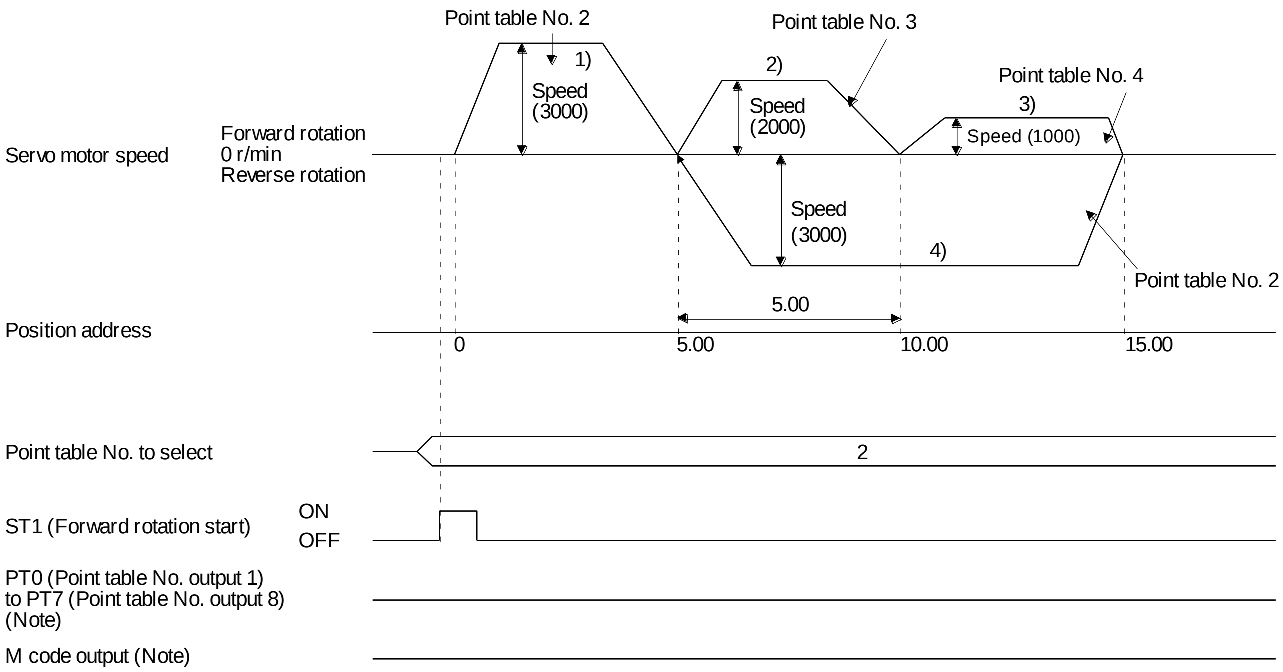
a) Automatic repeat positioning operation by absolute value command method

Example 1. Operations when "8" is set to the auxiliary function of point table No. 4

Point table No.	Position data [10^{STM} m]	Servo motor speed [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	Auxiliary function	M code
1	4.00	1500	200	100	150	1	01
2	5.00	3000	100	150	100	1	05
3	5.00	2000	150	200	200	3	10
4	15.00	1000	300	100	150	8	15

Operation sequence

1) Starting with point table No. 2
2) Executing point table No. 3
3) Executing point table No. 4
4) Executing again point table No. 2 used at start-up when "8" is set to the auxiliary function of point table No. 4
5) Repeating the above execution in the sequence of 2) to 3) to 4) to 2) to 3) to 4)



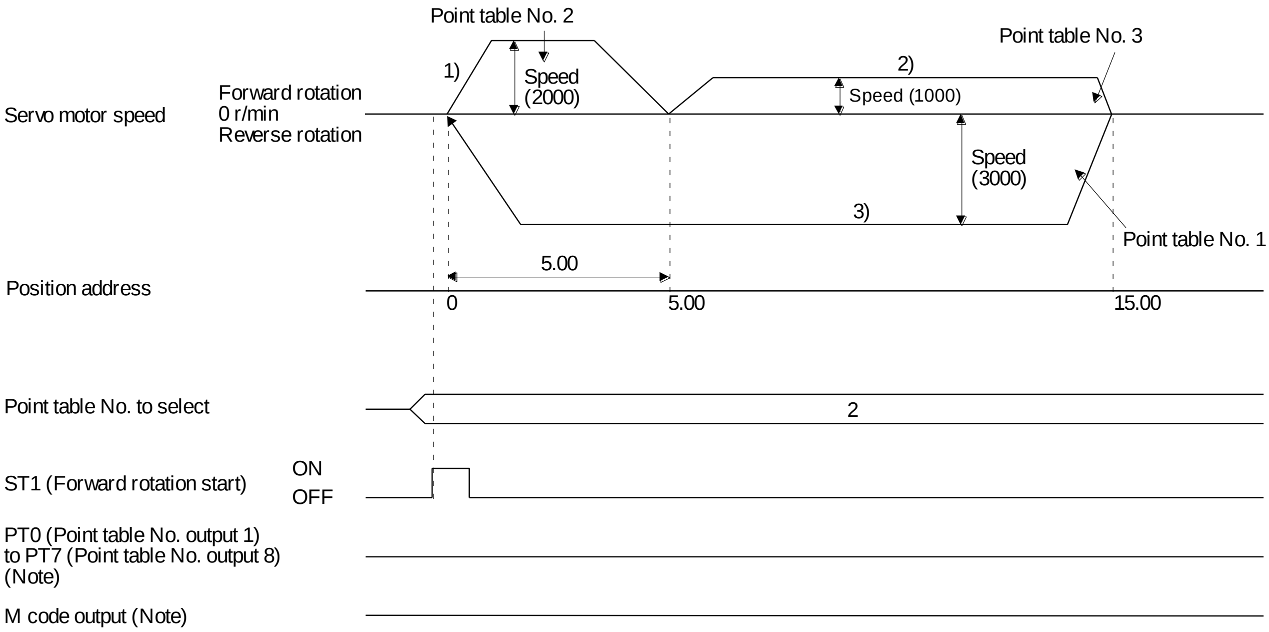
Note. PT0 to PT7 and M code are not outputted in automatic continuous operation.

Example 2. Operations when "9" is set to the auxiliary function of point table No. 3

Point table No.	Position data [10^{STM} m]	Servo motor speed [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	Auxiliary function	M code
1	0.00	3000	100	150	100	1	05
2	5.00	2000	150	200	200	1	10
3	15.00	1000	300	100	150	9	15

Operation sequence

1) Starting with point table No. 2
2) Executing point table No. 3
3) Executing point table No. 1 when "9" is set to the auxiliary function of point table No. 3
4) Repeating the above execution in the sequence of 1) to 2) to 3) to 1) to 2) to 3)



Note. PT0 to PT7 and M code are not outputted in automatic continuous operation.

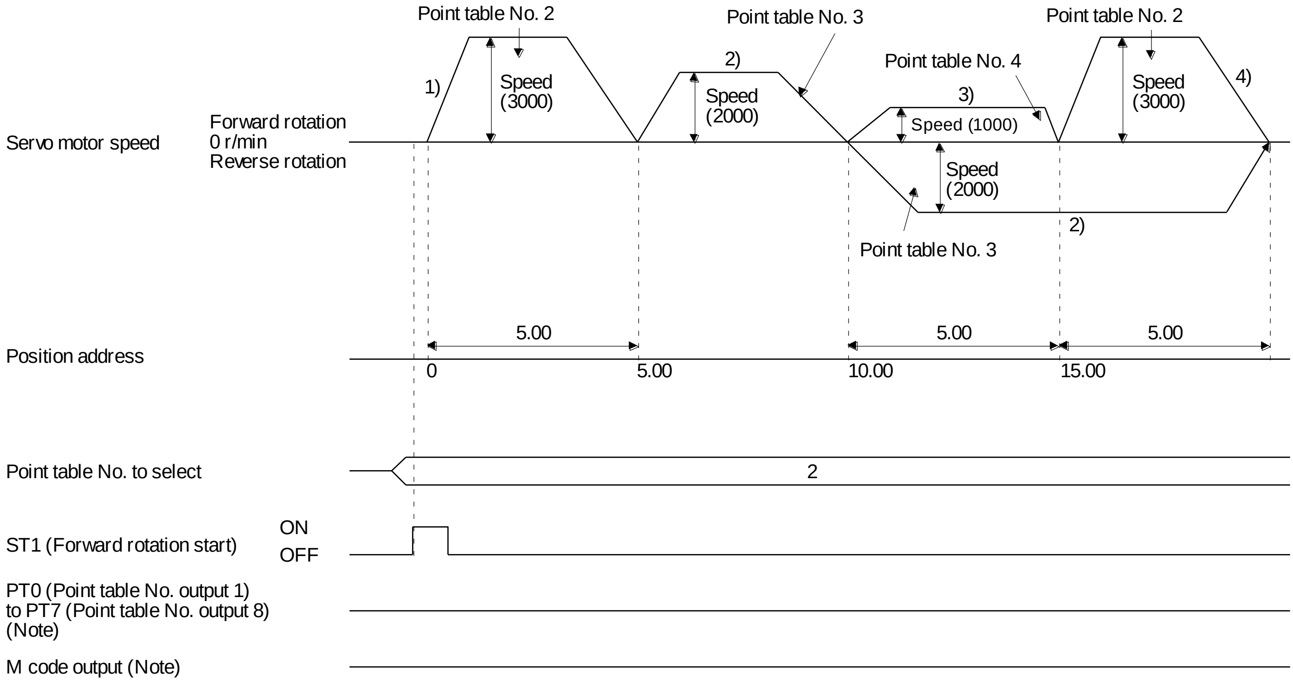
b) Automatic repeat positioning operation by incremental value command method

Example 1. Operations when "10" is set to the auxiliary function of point table No. 4

Point table No.	Position data [10^{STM} m]	Servo motor speed [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	Auxiliary function	M code
1	4.00	1500	200	100	150	1	01
2	5.00	3000	100	150	100	3	05
3	10.00	2000	150	200	200	1	10
4	5.00	1000	300	100	150	10	15

Operation sequence

1) Starting with point table No. 2
2) Executing point table No. 3
3) Executing point table No. 4
4) Executing again point table No. 2 used at start-up when "10" is set to the auxiliary function of point table No. 4
5) Repeating the above execution in the sequence of 1) to 2) to 3) to 4) to 2) to 3) to 4)



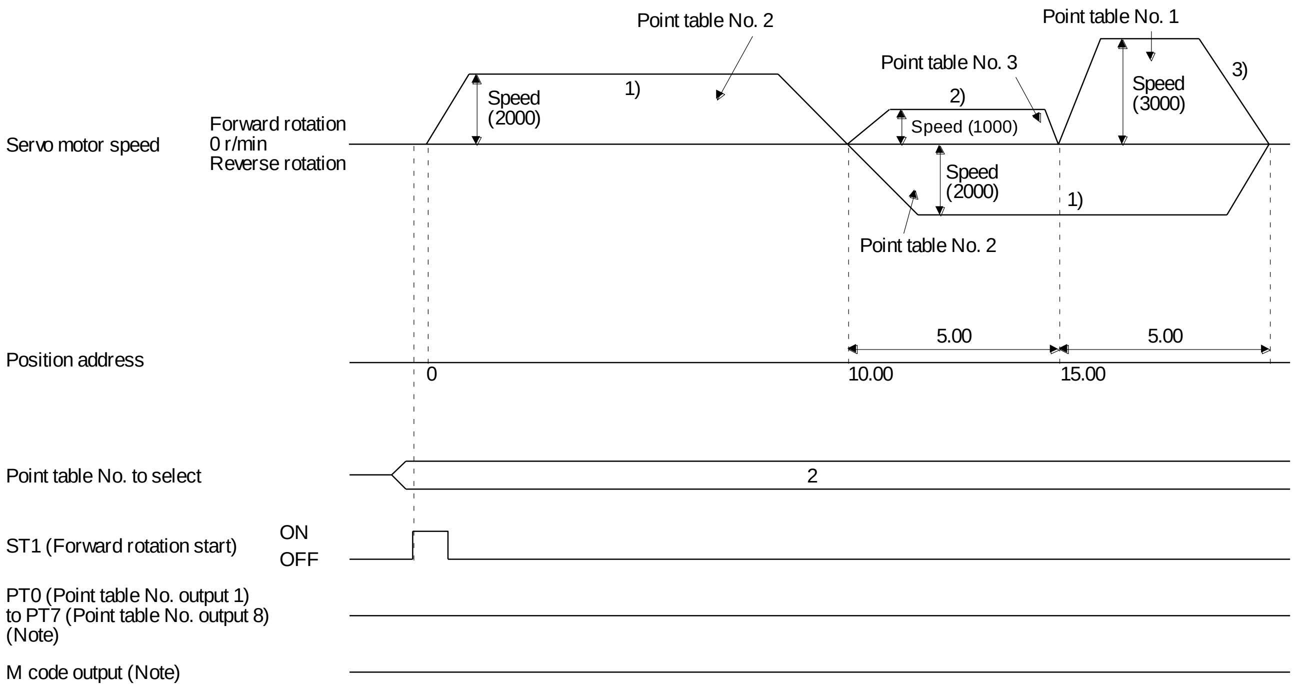
Note. PT0 to PT7 and M code are not outputted in automatic continuous operation.

Example 2. Operations when "11" is set to the auxiliary function of point table No. 3

Point table No.	Position data [10^{STM} m]	Servo motor speed [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	Auxiliary function	M code
1	5.00	3000	100	150	100	3	05
2	10.00	2000	150	200	200	1	10
3	5.00	1000	300	100	150	11	15

Operation sequence

1) Starting with point table No. 2
2) Executing point table No. 3
3) Executing point table No. 1 when "11" is set to the auxiliary function of point table No. 3
4) Repeating the above execution in the sequence of 1) to 2) to 3) to 1) to 2) to 3)



Note. PT0 to PT7 and M code are not outputted in automatic continuous operation.

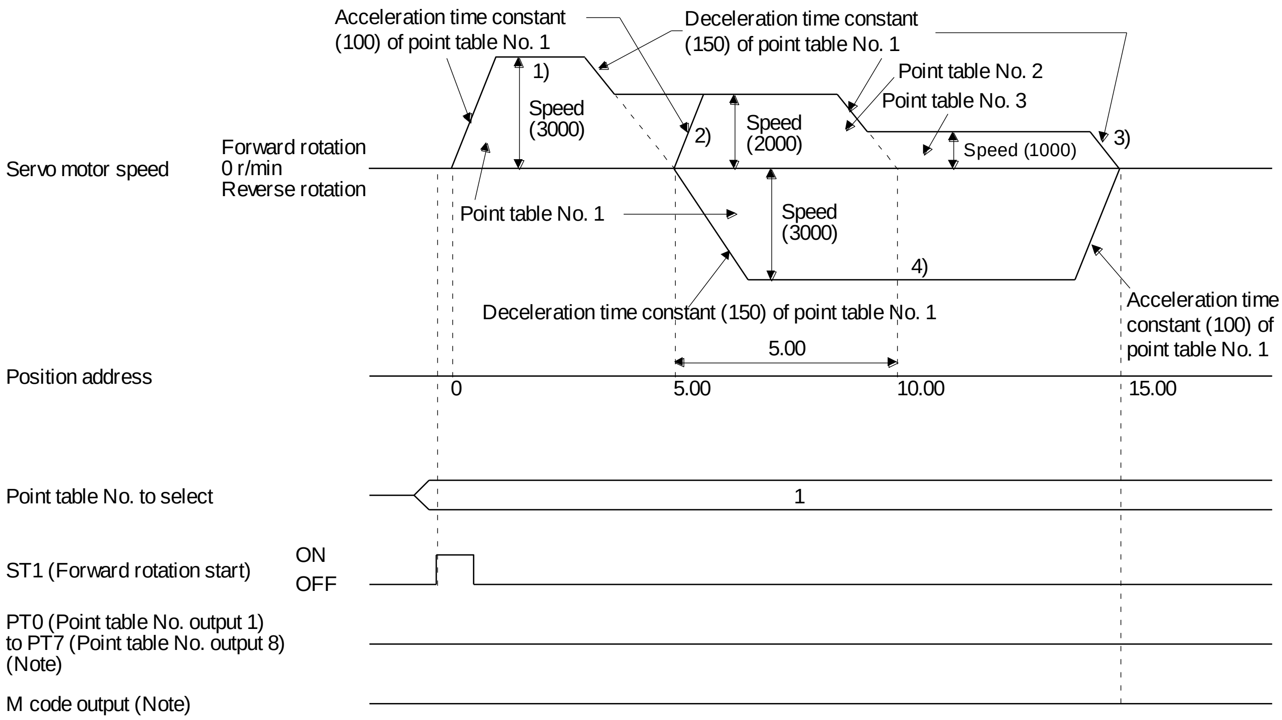
c) Varying-speed operation by absolute value command method

Example. Operations when "8" is set to the auxiliary function of point table No. 3

Point table No.	Position data [10^{STM} m]	Servo motor speed [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	Auxiliary function	M code
1	5.00	3000	100	150	0	1	05
2	5.00	2000	Disabled	Disabled	0	3	10
3	15.00	1000	Disabled	Disabled	0	8	15

Operation sequence

1) Starting with point table No. 1
2) Varying the speed and executing point table No. 2
3) Varying the speed and executing point table No. 3
4) Executing point table No. 1 used at start-up in CW direction when "8" is set to the auxiliary function of point table No. 3
5) Repeating the above execution in the sequence of 1) to 2) to 3) to 4) to 2) to 3) to 4)



Note. PT0 to PT7 and M code are not outputted in automatic continuous operation.

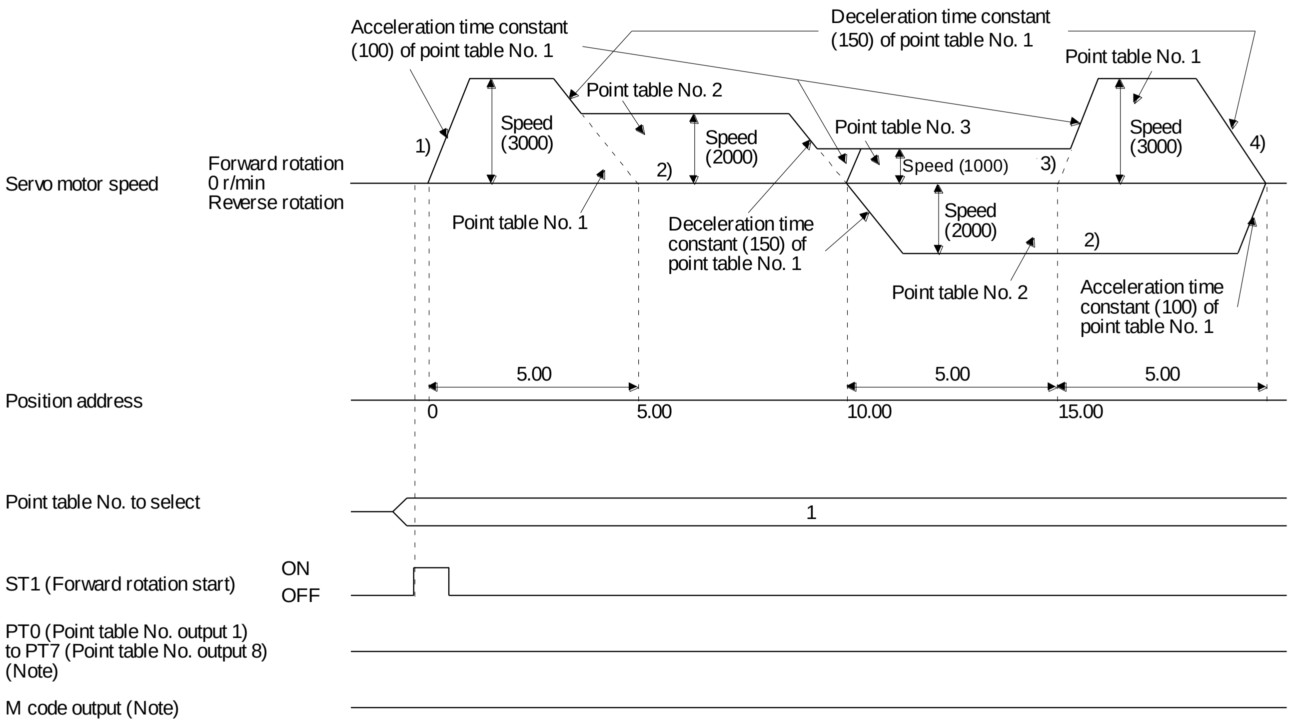
d) Varying-speed operation by incremental value command method

Example. Operations when "10" is set to the auxiliary function of point table No. 3

Point table No.	Position data [10^{STM} m]	Servo motor speed [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	Auxiliary function	M code
1	5.00	3000	100	150	0	3	05
2	10.00	2000	150	200	0	1	10
3	5.00	1000	300	100	0	10	15

Operation sequence

1) Starting with point table No. 1
2) Varying the speed and executing point table No. 2
3) Varying the speed and executing point table No. 3
4) Varying the speed, and executing point table No. 1 when "10" is set to the auxiliary function of point table No. 3
5) Repeating the above execution in the sequence of 1) to 2) to 3) to 4) to 2) to 3) to 4)



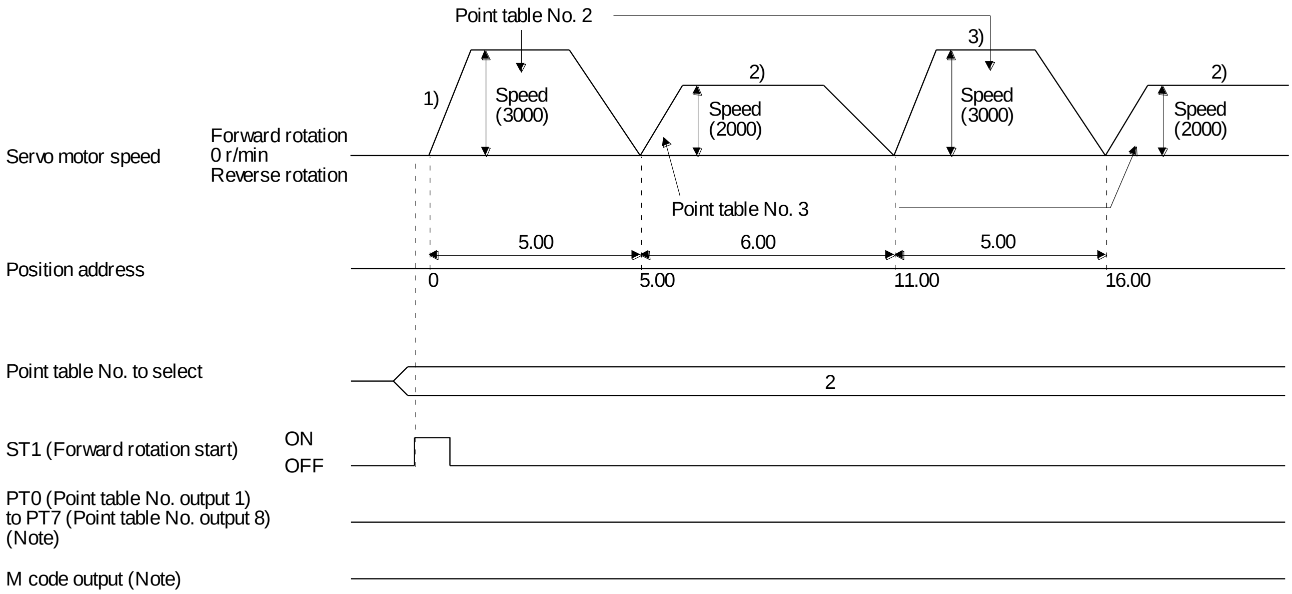
Note. PT0 to PT7 and M code are not outputted in automatic continuous operation.

2) Incremental value command method ([Pr. PT01] = _ _ _ 1)
Setting "8" to the auxiliary function performs automatic continuous operation or varying-speed operation until that point table, and after the completion of positioning, performs the operation again from the operation pattern of the set point table.
Setting "9" to the auxiliary function performs automatic continuous operation or varying-speed operation until that point table, and after the completion of positioning, performs the operation again from the operation pattern of point table No. 1.

a) Automatic repeat positioning operation by incremental value command method
Example 1. Operations when "8" is set to the auxiliary function of point table No. 3

Point table No.	Position data [10^{STM} m]	Servo motor speed [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	Auxiliary function	M code
1	4.00	1500	200	100	150	1	01
2	5.00	3000	100	150	100	1	05
3	6.00	2000	150	200	200	8	10

Operation sequence
1) Starting with point table No. 2
2) Executing point table No. 3
3) Executing again point table No. 2 used at start-up when "8" is set to the auxiliary function of point table No. 3
4) Repeating the above execution in the sequence of 1) to 2) to 3) to 2) to 3)



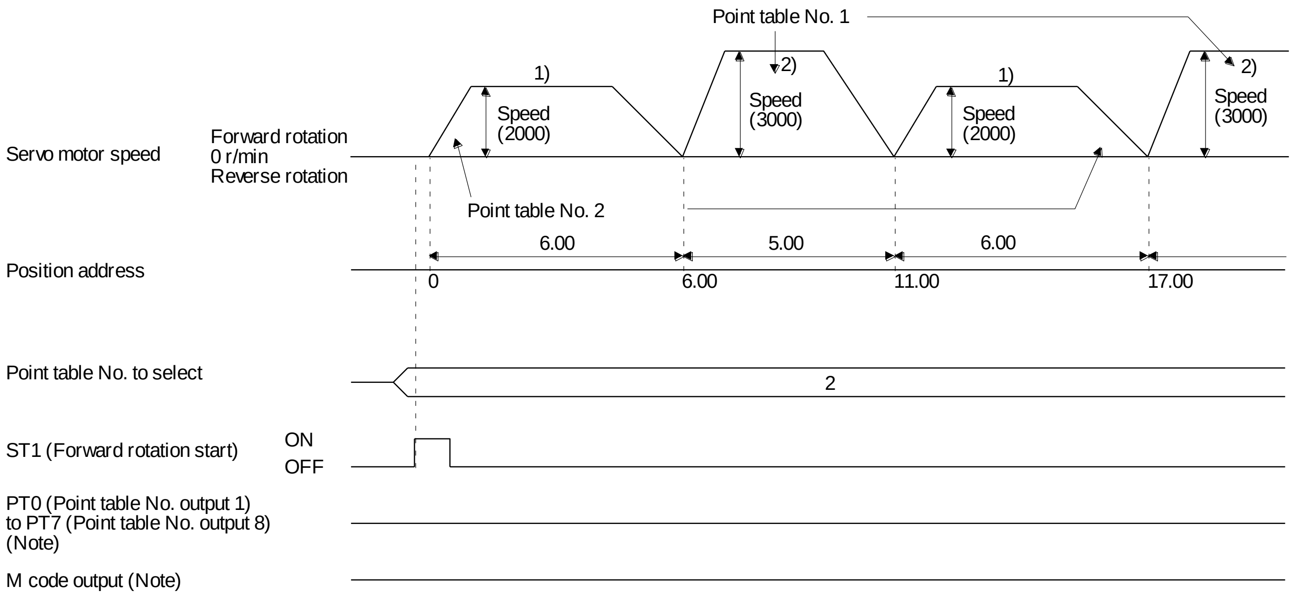
Note. PT0 to PT7 and M code are not outputted in automatic continuous operation.

Example 2. Operations when "9" is set to the auxiliary function of point table No. 2

Point table No.	Position data [10^{STM} m]	Servo motor speed [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	Auxiliary function	M code
1	5.00	3000	100	150	100	1	05
2	6.00	2000	150	200	200	9	10

Operation sequence

1) Starting with point table No. 2
2) Executing point table No. 1 when "9" is set to the auxiliary function of point table No. 2
3) Repeating the above execution in the sequence of 1) to 2) to 1) to 2)



Note. PT0 to PT7 and M code are not outputted in automatic continuous operation.

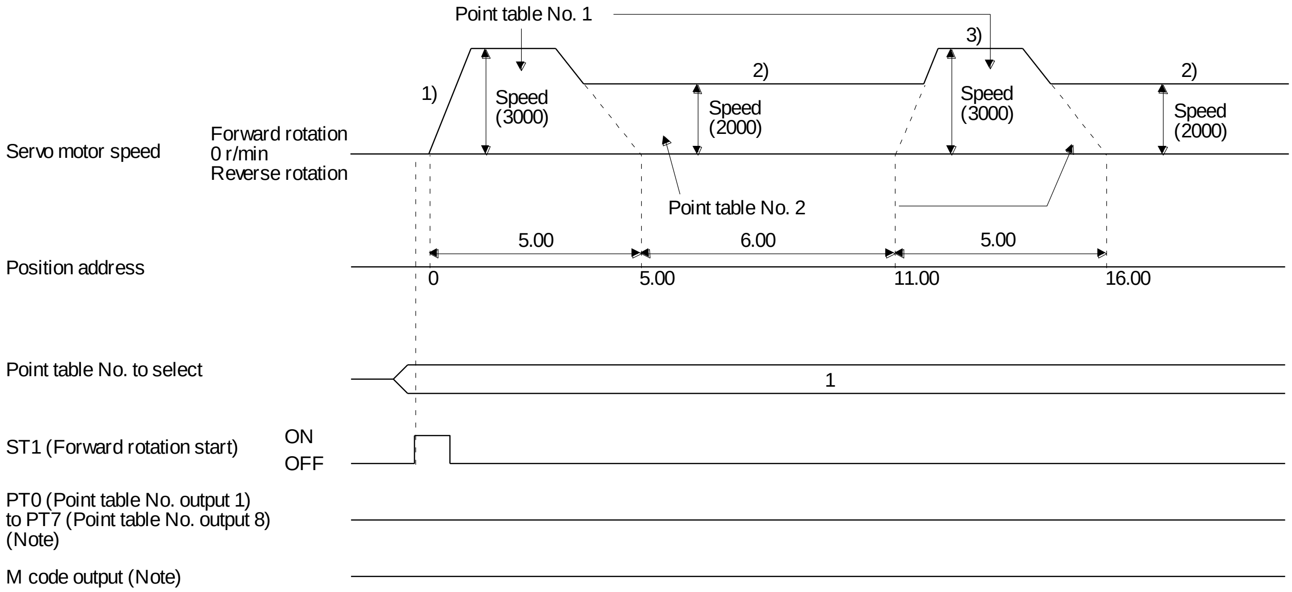
b) Varying-speed operation by incremental value command method

Example. Operations when "8" is set to the auxiliary function of point table No. 2

Point table No.	Position data [10^{STM} m]	Servo motor speed [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	Auxiliary function	M code
1	5.00	3000	100	150	0	1	05
2	6.00	2000	Disabled	Disabled	0	8	10

Operation sequence

1) Starting with point table No. 1
2) Varying the speed and executing point table No. 2
3) Executing again point table No. 1 used at start-up when "8" is set to the auxiliary function of point table No. 2
4) Repeating the above execution in the sequence of 1) to 2) to 3) to 2) to 3)



Note. PT0 to PT7 and M code are not outputted in automatic continuous operation.

(e) Temporary stop/restart

When TSTP (Temporary stop/restart) is switched on during automatic operation, the servo motor decelerates with the deceleration time constant of the point table being executed, and then stops temporarily.

Switching on TSTP (Temporary stop/restart) again starts the servo motor rotation for the remaining travel distance.

During a temporary stop, ST1 (Forward rotation start) or ST2 (Reverse rotation start) does not function even if it is switched on.

When any of the following conditions is satisfied during a temporary stop, the remaining travel distance is cleared.

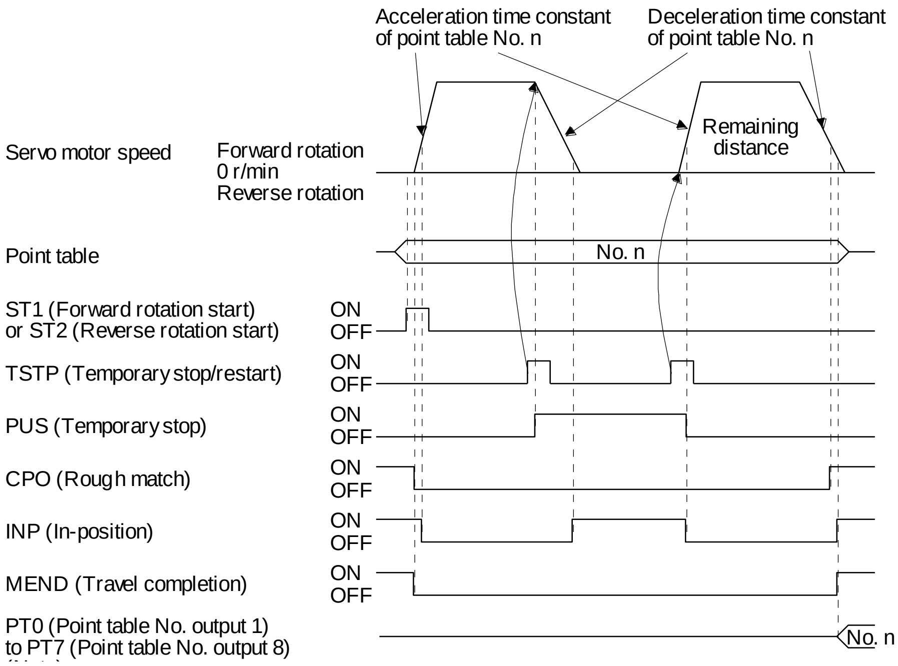
・The operation mode is switched from the automatic mode to the manual mode.
・The servo motor enters the servo-off status.
・The clear signal is input.

The temporary stop/restart input does not function during a home position return or JOG operation.

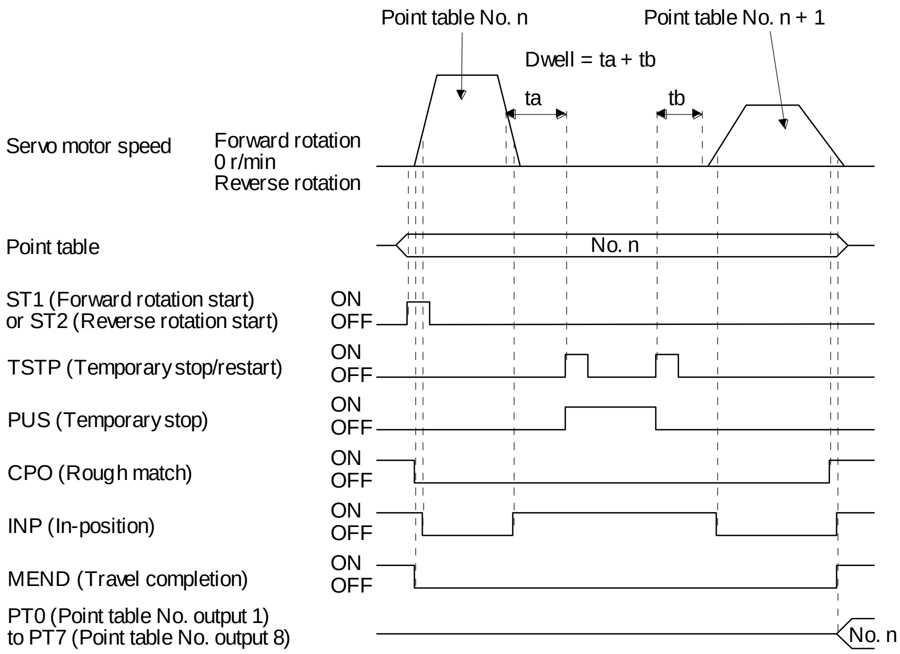
The temporary stop/restart input functions in the following states.

Operation status	Automatic operation	Manual operation	Home position return
During a stop			
During acceleration	Temporary stop		
At a constant speed	Temporary stop		
During deceleration			
During a temporary stop	Restart		

1) When the servo motor is rotating

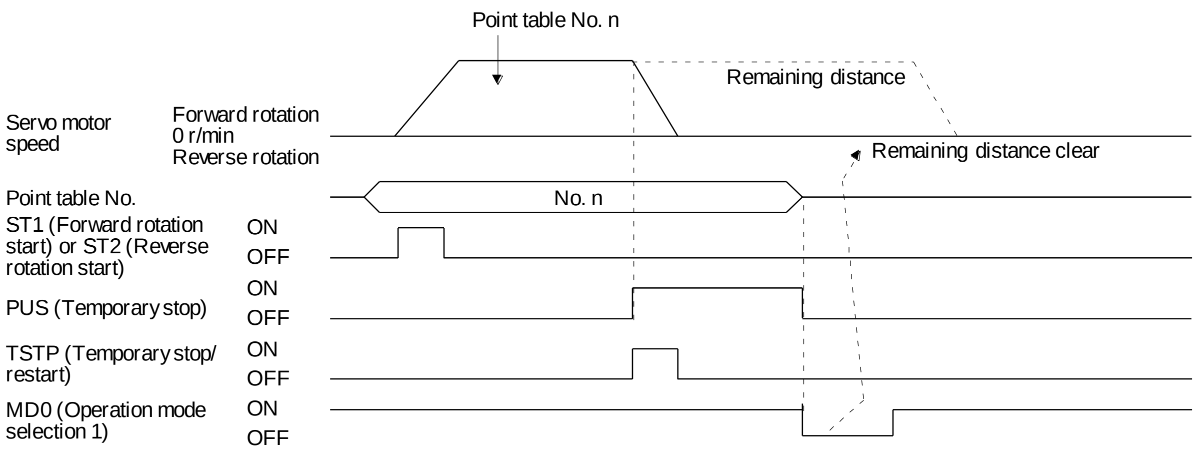


2) During dwell



(f) Suspension of automatic operation

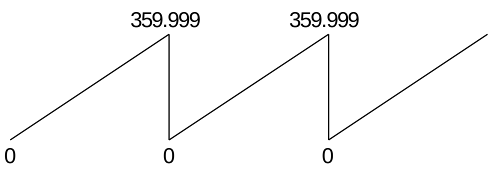
To suspend the automatic operation or change the operation pattern, stop the servo motor with TSTP (Temporary stop/restart), switch off MD0 (Operation mode selection 1), and then set the mode to the manual mode. The remaining travel distance is cleared.



(g) Handling of control unit "degree"

1) Current position/command position address

The current position/command position address is of ring-address type.



2) Software limit activation/deactivation setting

POINT
●After changing the "+" or "-" sign of an axis with the software limit activation setting, perform a home position return.
●When activating the software limit in an incremental system, perform a home position return after power-on.

a) Setting range

When the unit is "degree", the setting range of the software limit is 0 degree (lower limit) to 359.999 degrees (upper limit).

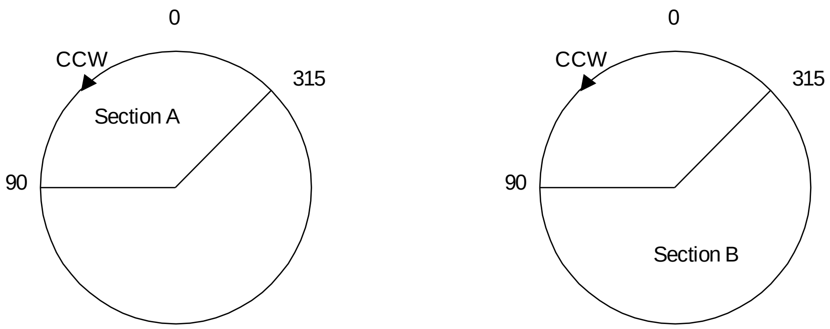
When you set a value other than 0 degree to 359.999 degrees in [Pr. PT15] to [Pr. PT18], the set value is converted as follows. (It will be clamped between 0 degree and 359.999 degrees.)

Software limit value	After conversion
360.000 degrees to 999.999 degrees	The remainder of the set value divided by 360
-0.001 degrees to -359.999 degrees	The sum of the set value and 360
-360.000 degrees to -999.999 degrees	The sum of 360 and the quotient of the set value divided by 360

b) When the software limit is activated

Set the software limit - ([Pr. PT17] and [Pr. PT18]) for the start position and the software limit + ([Pr. PT15] and [Pr. PT16]) for the target position.

The movable range is the section from - to + in the CCW direction.



Set the movable range of section A as follows.

・Software limit - ··· 315.000 degrees

・Software limit + ··· 90.000 degrees

Set the movable range of section B as follows.

・Software limit - ··· 90.000 degrees

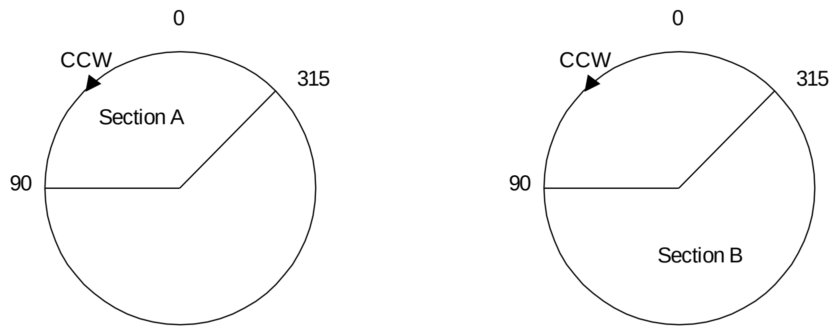
・Software limit + ··· 315.000 degrees

c) When the software limit is deactivated
When deactivating the software limit, set the same values to the software limit - ([Pr. PT17] and [Pr. PT18]) and the software limit + ([Pr. PT15] and [Pr. PT16]).
Control can be performed independently of the software limit setting.

3) Position range output activation/deactivation setting
a) Setting range
When the unit is "degree", the setting range of the position range output is 0 degree (lower limit) to 359.999 degrees (upper limit).
When you set a value other than 0 degree to 359.999 degrees in [Pr. PT19] to [Pr. PT22], the set value is converted as follows. (It will be clamped between 0 degree and 359.999 degrees.)

Position range output address	After conversion
360.000 degrees to 999.999 degrees	The remainder of the set value divided by 360
-0.001 degrees to -359.999 degrees	The sum of the set value and 360
-360.000 degrees to -999.999 degrees	The sum of 360 and the quotient of the set value divided by 360

b) Effective setting of position range output
Set the position range output address - ([Pr. PT21] and [Pr. PT22]) for the start position and the position range output address + ([Pr. PT19] and [Pr. PT20]) for the target position.
The movable range is the section from - to + in the CCW direction.



Set the movable range of section A as follows.
・Position range output address - ··· 315.000 degrees
・Position range output address + ··· 90.000 degrees
Set the movable range of section B as follows.
・Position range output address - ··· 90.000 degrees
・Position range output address + ··· 315.000 degrees

16.6 MANUAL OPERATION MODE

For the machine adjustment, matching of home position, or the like, the JOG operation or the manual pulse generator operation can be used for movement to an arbitrary position.

16.6.1 JOG operation

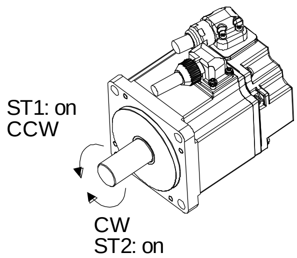
(1) Setting

According to the purpose of use, set input devices and parameters as shown below. In this case, DI0 (Point table No. selection 1) to DI7 (Point table No. selection 8) are invalid.

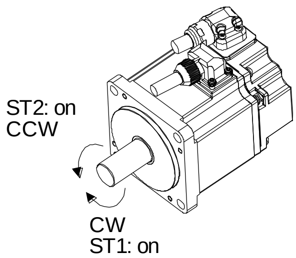
Item	Used device/parameter	Setting
Manual operation mode selection	MD0 (Operation mode selection 1)	Switch off MD0.
Servo motor rotation direction	[Pr. PA14]	Refer to (2) of this section.
JOG speed	[Pr. PT13]	Set the servo motor speed.
Acceleration/deceleration time constant	Point table No. 1	Use the acceleration/deceleration time constant of point table No. 1.

(2) Servo motor rotation direction

[Pr. PA14] setting	Servo motor rotation direction	
	ST1 (Forward rotation start) on	ST2 (Reverse rotation start) on
0	CCW rotation	CW rotation
1	CW rotation	CCW rotation



[Pr. PA14]: 0



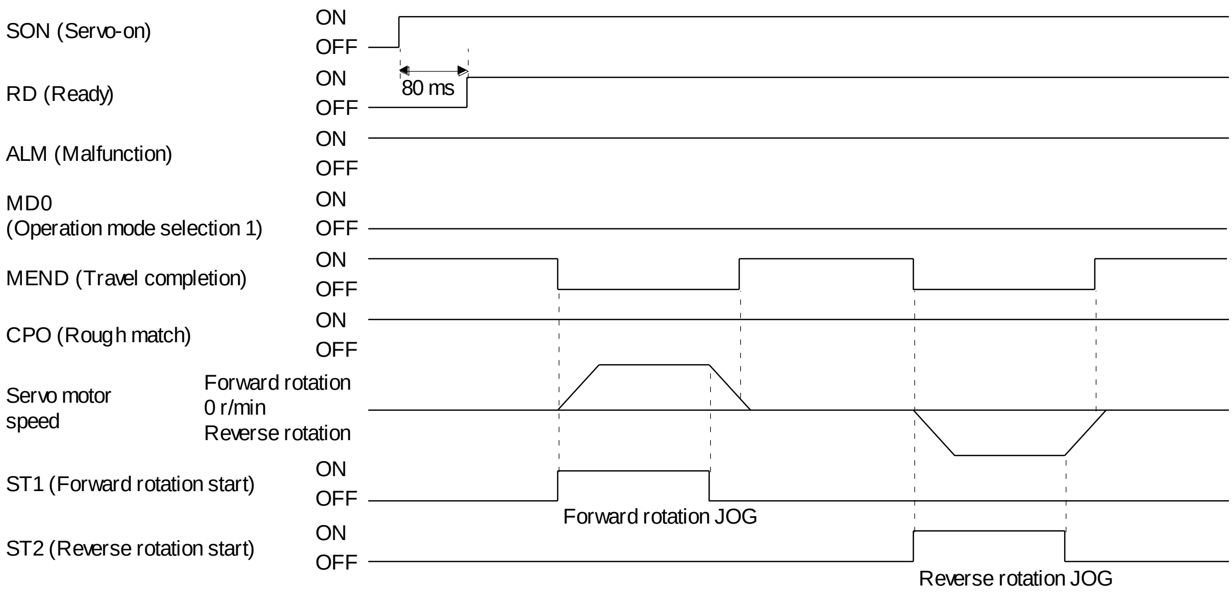
[Pr. PA14]: 1

(3) Operation

Switching on ST1 (Forward rotation start) performs the operation at the JOG speed set by a parameter and the acceleration/deceleration constant of point table No. 1. For the rotation direction, refer to (2) of this section. Switching on ST2 (Reverse rotation start) starts the rotation in the reverse direction of ST1 (Forward rotation start).

Simultaneously switching on or off ST1 (Forward rotation start) and ST2 (Reverse rotation start) stops the operation.

(4) Timing chart



16.7 HOME POSITION RETURN MODE

Point
● Before performing the home position return, make sure that the limit switch operates. ● Check the home position return direction. An incorrect setting will cause a reverse running. ● Check the input polarity of the proximity dog. Otherwise, it may cause an unexpected operation.

16.7.1 Outline of home position return

A home position return is performed to match the command coordinates with the machine coordinates.
Under the incremental method, every time switching on the input power supply, you have to perform the home position return. Contrastingly, in the absolute position detection system, once you have performed the home position return at machine installation, the current position will be retained even if the power supply is shut off. Thereafter, the home position return is unnecessary when the power supply is switched on.
This section shows the home position return methods of the driver. Select the optimum method according to the configuration and uses of the machine.
This driver has a home position return automatic retract function. When the machine stops on or beyond the proximity dog, this function automatically backs the machine to the proper position and then performs the home position return. Manually moving the machine by the JOG operation or others is unnecessary.

(1) Home position return types
Select the optimum home position return type according to the machine type or others.

Type	Home position return method	Feature
Dog type	Deceleration starts at the proximity dog front end. After the rear end is passed, the position specified by the first Z-phase signal, or the position of the first Z-phase signal shifted by the home position shift distance is used as the home position.	・General home position return method using a proximity dog ・The repeatability of the home position return is high. ・The machine is less loaded. ・Used when the width of the proximity dog can be set equal to or greater than the deceleration distance of the servo motor.
Count type	Deceleration starts at the proximity dog front end. After the proximity dog is passed, the motor travels the specified travel distance. Then, the position specified by the first Z-phase signal, or the position of the first Z-phase signal shifted by the home position shift distance is used as the home position.	・Home position return method using a proximity dog ・Used to minimize the length of the proximity dog.
Data set type	An arbitrary position is used as the home position.	・No proximity dog is required.
Stopper type	A workpiece is pressed against a mechanical stopper, and the position where it is stopped is set as the home position.	・The home position return speed must be low enough because of the collision with the mechanical stopper. ・The strength of the machine and its stopper must be increased.
Home position ignorance (servo-on position as home position)	The position where the servo is switched on is used as the home position.	
Dog type rear end reference	Deceleration starts at the proximity dog front end. After the rear end is passed, the position is shifted by the travel distance after proximity dog and the home position shift distance. The position after the shifts is set as the home position.	・The Z-phase signal is not required.
Count type front end reference	Deceleration starts at the proximity dog front end. The position is shifted by the travel distance after proximity dog and the home position shift distance. The position after the shifts is set as the home position.	・The Z-phase signal is not required.
Dog cradle type	After the proximity dog front end is detected, the position specified by the first Z-phase signal is used as the home position.	
Dog type last Z-phase reference	After the proximity dog front end is detected, the position is shifted away from the proximity dog in the reverse direction. Then, the position specified by the first Z-phase signal, or the position of the first Z-phase signal shifted by the home position shift distance is used as the home position.	
Dog type front end reference	From the proximity dog front end, the position is shifted by the travel distance after proximity dog and the home position shift distance. The position after the shifts is set as the home position.	・The Z-phase signal is not required.
Dogless Z-phase reference	The position specified by the first Z-phase signal, or the position of the first Z-phase signal shifted by the home position shift distance is used as the home position.	

(2) Parameters for home position return

To perform the home position return, set each parameter as follows.

(a) Select the home position return type with [Pr. PT04 Home position return type].

[Pr. PT04]

0	0	0	

Home position return type
0: Dog type (rear end detection, Z-phase reference)
1: Count type (front end detection, Z-phase reference)
2: Data set type
3: Stopper type
4: Home position ignorance (servo-on position as home position)
5: Dog type (rear end detection, rear end reference)
6: Count type (front end detection, front end reference)
7: Dog cradle type
8: Dog type (front end detection, Z-phase reference)
9: Dog type (front end detection, front end reference)
A: Dogless type (Z-phase reference)

(b) Select the starting direction for the home position return with [Pr. PT04 Home position return type]. Setting "0" starts the home position return in the address increase direction from the current position. Setting "1" starts the home position return in the address decrease direction from the current position.

[Pr. PT04]

0	0		0

Home position return direction
0: Address increasing direction
1: Address decreasing direction

(c) Select the polarity where the proximity dog is detected with the DOG (Proximity dog) polarity selection of [Pr. PT29 Function selection T-3]. Setting "0" detects the dog when DOG (Proximity dog) is off. Setting "1" detects the dog when DOG (Proximity dog) is on.

[Pr. PT29]

0	0	0	

DOG (Proximity dog) polarity selection
0: Detection with off
1: Detection with on

16.7.2 Dog type home position return

This home position return type uses a proximity dog. Deceleration starts at the proximity dog front end. After the rear end is passed, the position specified by the first Z-phase signal, or the position of the first Z-phase signal shifted by the specified home position shift distance is used as the home position.

(1) Device/parameter

Set input devices and parameters as follows.

Item	Used device/parameter	Setting
Home position return mode selection	MD0 (Operation mode selection 1)	Switch on MD0.
	DI0 (Point table No. selection 1) to DI7 (Point table No. selection 8)	Switch off DI0 to DI7.
Dog type home position return	[Pr. PT04]	_ _ _ 0: Select the dog type.
Home position return direction	[Pr. PT04]	Refer to section 4.4.1 (2) to select the home position return direction.
Dog input polarity	[Pr. PT29]	Refer to section 4.4.1 (2) to select the proximity dog input polarity.
Home position return speed	[Pr. PT05]	Set the rotation speed until the dog is detected.
Creep speed	[Pr. PT06]	Set the rotation speed after the dog is detected.
Home position shift distance	[Pr. PT07]	Set this item to shift the home position specified by the first Z-phase signal after passage of proximity dog rear end.
Home position return acceleration/deceleration time constant	Point table No. 1	Use the acceleration/deceleration time constant of point table No. 1.
Home position return position data	[Pr. PT08]	Set the current position at the home position return completion.

(2) Proximity dog length

To generate the Z-phase signal of the servo motor during the DOG (Proximity dog) detection, the proximity dog length should satisfy formulas (4.1) and (4.2).

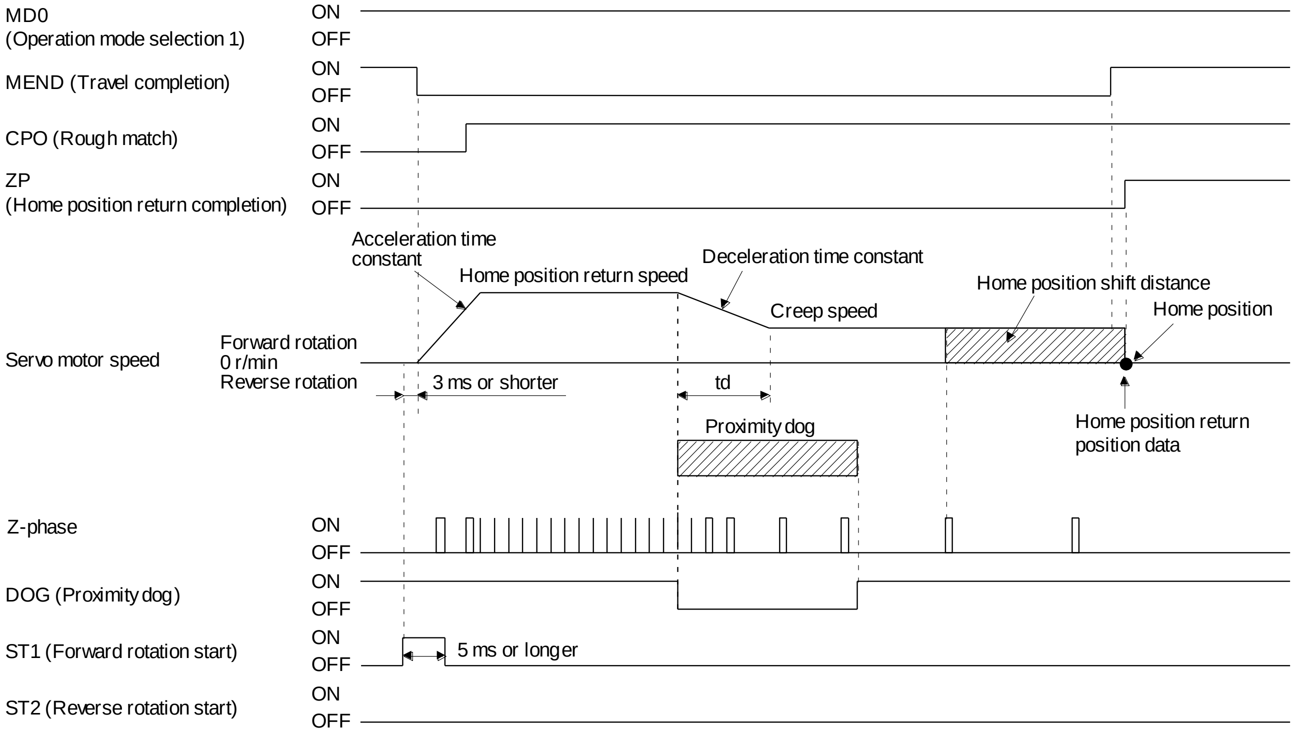
$$L_1 \geq \frac{V}{60} \cdot \frac{td}{2} \quad \cdots\cdots (4.1)$$

L_1: Proximity dog length [mm]
V: Home position return speed [mm/min]
td: Deceleration time [s]

$$L_2 \geq 2 \cdot S \quad \cdots\cdots (4.2)$$

L_2: Proximity dog length [mm]
S: Travel distance per servo motor revolution [mm]

(3) Timing chart

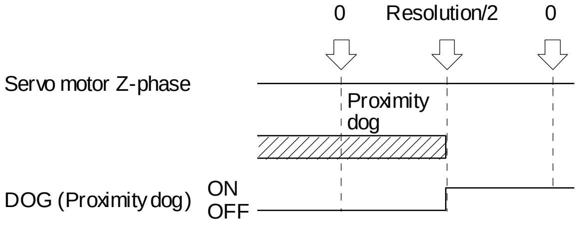


The setting value of [Pr. PT08 Home position return position data] is used as the position address at the home position return completion.

(4) Adjustment

For the dog type home position return, adjust the setting to ensure the Z-phase signal generation during the dog detection. Locate the DOG (Proximity dog) rear end almost at the center between the generation positions of two consecutive Z-phase signals.

The generation position of the Z-phase signal can be checked with "Position within one-revolution" of "Status Display" on Setup software (MR Configurator2™).



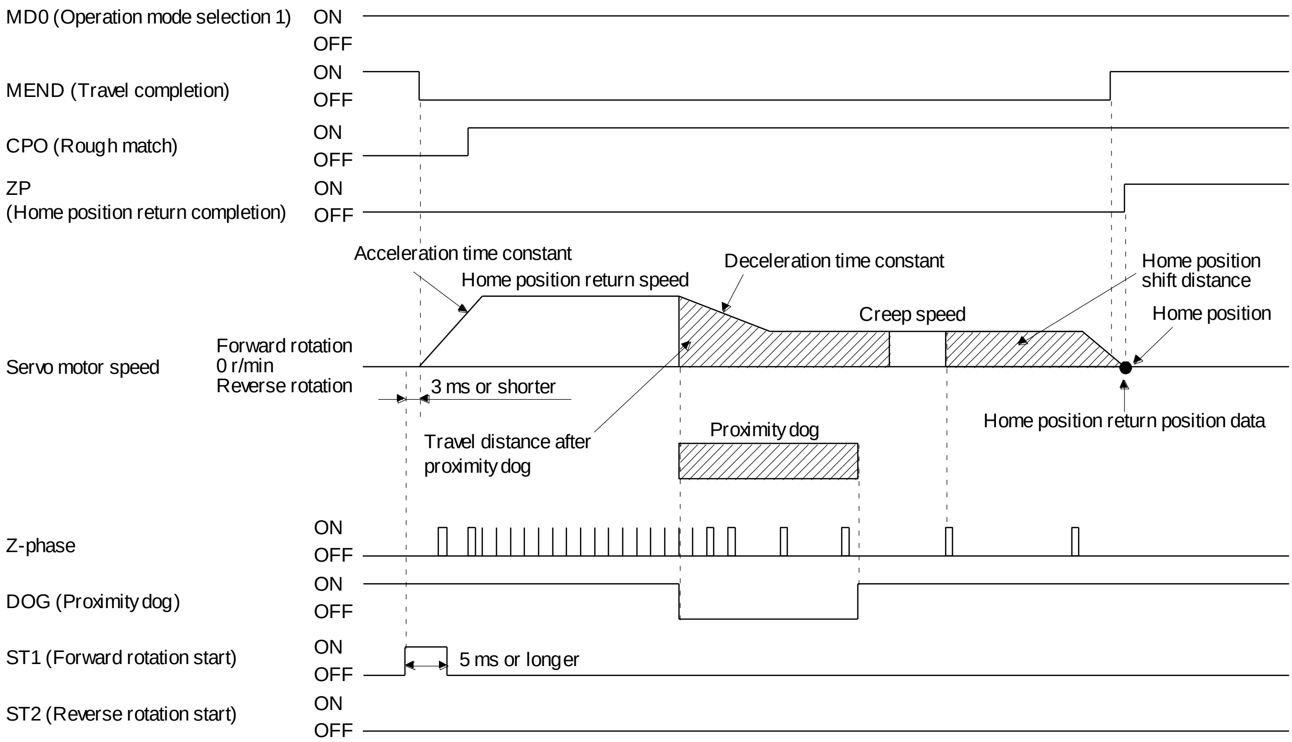
16.7.3 Count type home position return

In the count type home position return, after the proximity dog front end is detected, the motor travels the distance set with [Pr. PT09 Travel distance after proximity dog]. Then, the position specified by the first Z-phase signal is used as the home position. Therefore, when DOG (Proximity dog) is on for 10 ms or longer, the proximity dog length has no restrictions. When the required proximity dog length for using the dog type home position return cannot be reserved, or when DOG (Proximity dog) is entered electrically from PC or PLC...etc or the like, use the count type home position return.

(1) Device/parameter
Set input devices and parameters as follows.

Item	Used device/parameter	Setting
Home position return mode selection	MD0 (Operation mode selection 1)	Switch on MD0.
	DI0 (Point table No. selection 1) to DI7 (Point table No. selection 8)	Switch off DI0 to DI7.
Count type home position return	[Pr. PT04]	_ _ _ 0: Select the count type.
Home position return direction	[Pr. PT04]	Refer to section 4.4.1 (2) to select the home position return direction.
Dog input polarity	[Pr. PT29]	Refer to section 4.4.1 (2) to select the dog input polarity.
Home position return speed	[Pr. PT05]	Set the rotation speed until the dog is detected.
Creep speed	[Pr. PT06]	Set the rotation speed after the dog is detected.
Home position shift distance	[Pr. PT07]	Set this item to shift the home position starting at the first Z-phase signal after passage of proximity dog front end and motion over the specified travel distance.
Travel distance after proximity dog	[Pr. PT09]	Set the travel distance after passage of proximity dog front end.
Home position return acceleration/deceleration time constant	Point table No. 1	Use the acceleration/deceleration time constant of point table No. 1.
Home position return position data	[Pr. PT08]	Set the current position at the home position return completion.

(2) Timing chart



The setting value of [Pr. PT08 Home position return position data] is used as the position address at the home position return completion.

16.7.4 Data set type home position return

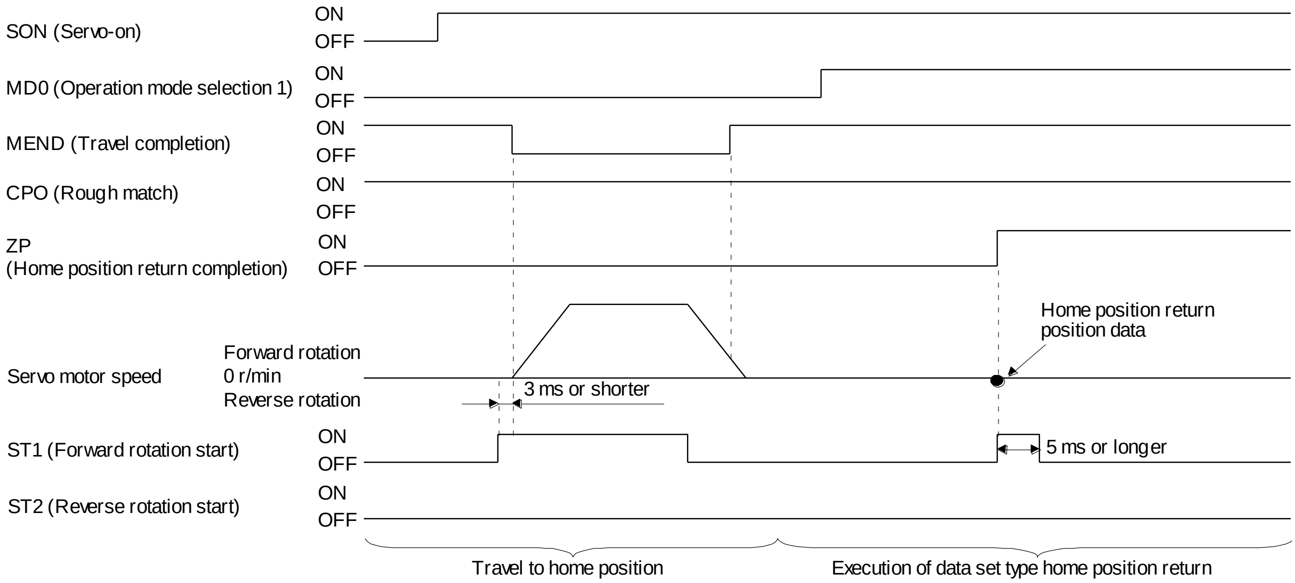
To set an arbitrary position as the home position, use the data set type home position return. The JOG operation, manual pulse generator operation, or the like can be used for movement. You can perform the data set type home position return at servo-on only.

(1) Device/parameter

Set input devices and parameters as follows.

Item	Used device/parameter	Setting
Home position return mode selection	MD0 (Operation mode selection 1)	Switch on MD0.
	DI0 (Point table No. selection 1) to DI7 (Point table No. selection 8)	Switch off DI0 to DI7.
Data set type home position return	[Pr. PT04]	_ _ _ 2: Select the data set type.
Home position return position data	[Pr. PT08]	Set the current position at the home position return completion.

(2) Timing chart



The setting value of [Pr. PT08 Home position return position data] is used as the position address at the home position return completion.

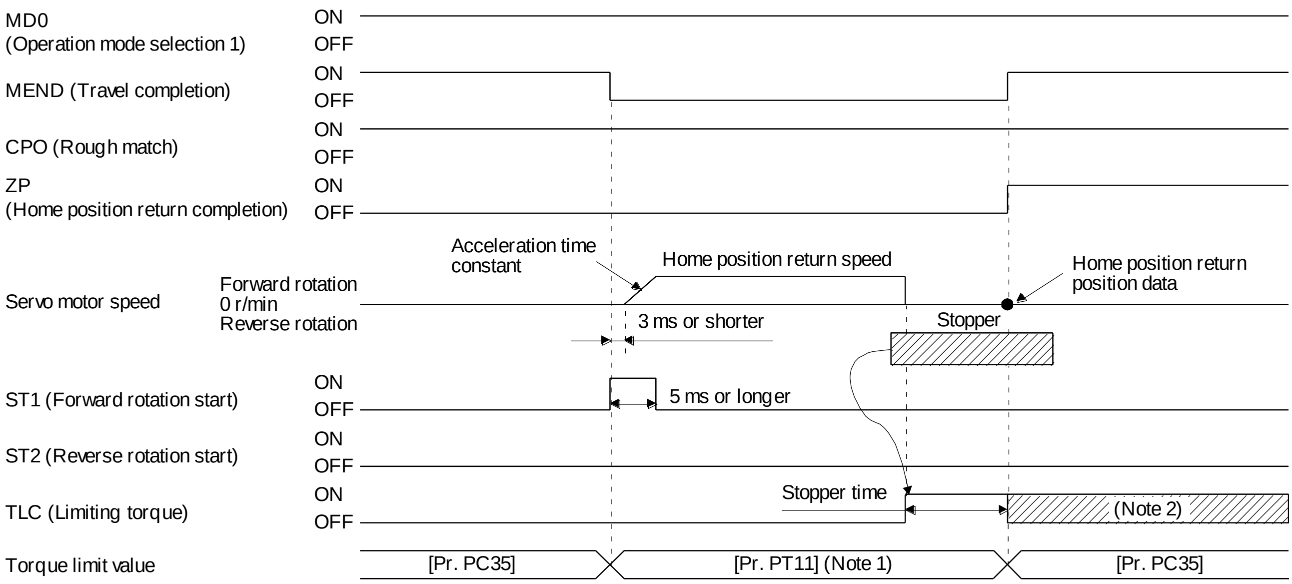
16.7.5 Stopper type home position return

For the stopper type home position return, by using the JOG operation, manual pulse generator operation, or others, a workpiece is pressed against a mechanical stopper, and the position where it is stopped is used as the home position.

(1) Device/parameter
Set input devices and parameters as follows.

Item	Used device/parameter	Setting
Home position return mode selection	MD0 (Operation mode selection 1)	Switch on MD0.
	DI0 (Point table No. selection 1) to DI7 (Point table No. selection 8)	Switch off DI0 to DI7.
Stopper type home position return	[Pr. PT04]	_ _ _ 3: Select the stopper type.
Home position return direction	[Pr. PT04]	Refer to section 4.4.1 (2) to select the home position return direction.
Home position return speed	[Pr. PT05]	Set the rotation speed until the workpiece is pressed against the mechanical stopper.
Stopper time	[Pr. PT10]	Set the time from when the home position data is obtained after the workpiece is pressed against the mechanical stopper until when ZP (home position return completion) is output.
Stopper type home position return torque limit value	[Pr. PT11]	Set the servo motor torque limit value at the execution of the stopper type home position return.
Home position return acceleration time constant	Point table No. 1	The acceleration/deceleration time constant of point table No. 1 is used.
Home position return position data	[Pr. PT08]	Set the current position at the home position return completion.

(2) Timing chart



Note 1. The following torque limits are enabled.

Input device (0: Off, 1: On)		Limit value status			Enabled torque limit value
TL1	TL				
0	0				Pr. PT11
0	1	TLA	>	Pr. PT11	Pr. PT11
		TLA	<	Pr. PT11	TLA
1	0	Pr. PC35	>	Pr. PT11	Pr. PT11
		Pr. PC35	<	Pr. PT11	Pr. PC35
1	1	TLA	>	Pr. PT11	Pr. PT11
		TLA	<	Pr. PT11	TLA

2. TLC turns on when a generated torque reaches a value set with any of [Pr. PA11 Forward rotation torque limit], [Pr. PA12 Reverse rotation torque limit], or [Pr. PC35 Internal torque limit 2].

The setting value of [Pr. PT08 Home position return position data] is used as the position address at the home position return completion.

16.7.6 Home position ignorance (servo-on position as home position)

POINT
●When you perform this home position return, it is unnecessary to switch to the home position return mode.

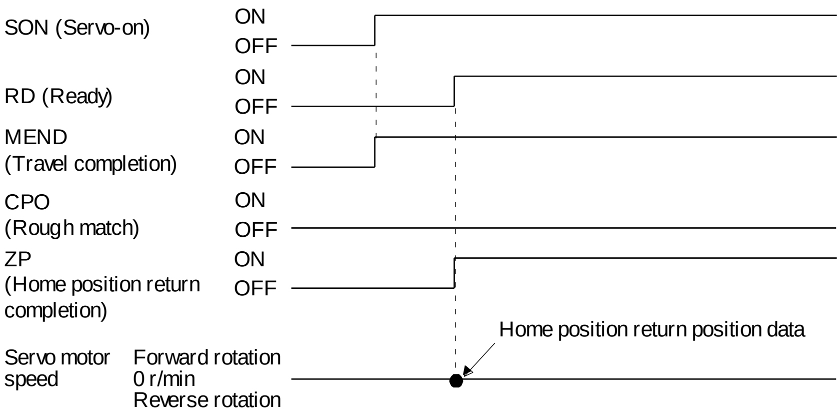
The position at servo-on is used as the home position.

(1) Device/parameter

Set input devices and parameters as follows.

Item	Used parameter	Setting
Home position ignorance	[Pr. PT04]	_ _ _ 4: Select the home position ignorance.
Home position return position data	[Pr. PT08]	Set the current position at the home position return completion.

(2) Timing chart



The setting value of [Pr. PT08 Home position return position data] is used as the position address at the home position return completion.

16.7.7 Dog type rear end reference home position return

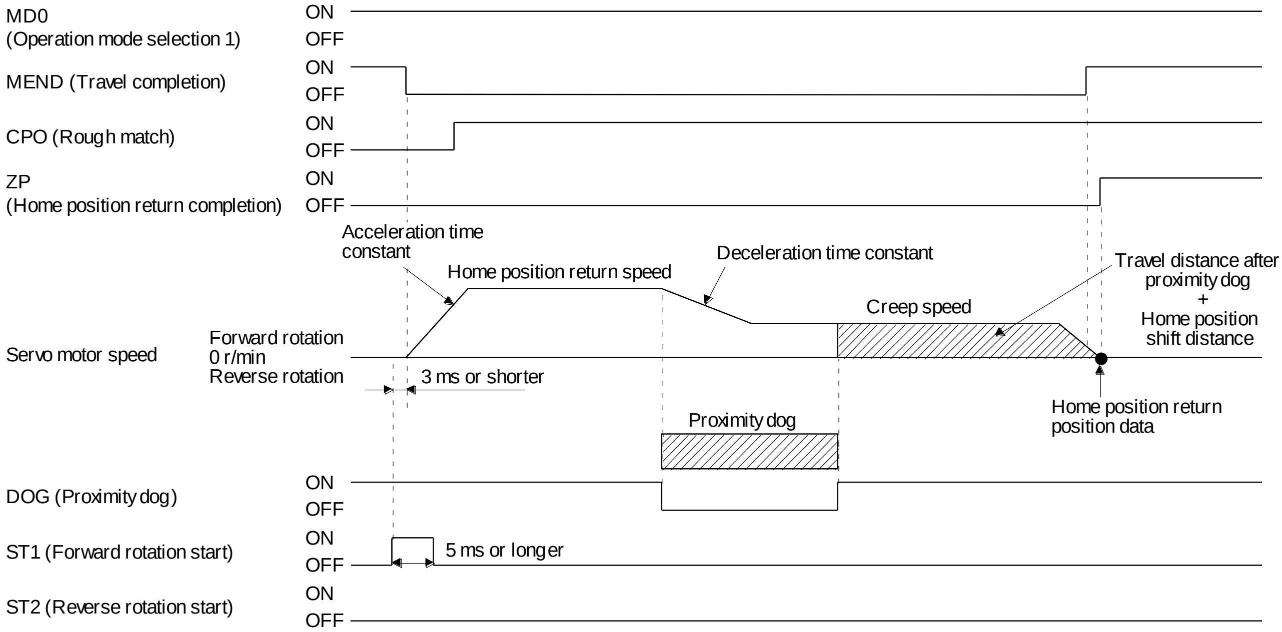
POINT
●This home position return method depends on the timing of reading DOG (Proximity dog) that has detected the rear end of a proximity dog. Therefore, when a home position return is performed at a creep speed of 100 r/min, the home position has an error of 6400 pulses (for HG series servo motor). The higher the creep speed, the greater the error of the home position.

Deceleration starts at the front end of a proximity dog. After the rear end is passed, the position is shifted by the travel distance after proximity dog and the home position shift distance. The position after the shifts is used as the home position. The home position return is available independently of the Z-phase signal. Changing the creep speed may change the home position.

(1) Device/parameter
Set input devices and parameters as follows.

Item	Used device/parameter	Setting
Home position return mode selection	MD0 (Operation mode selection 1)	Switch on MD0.
	DI0 (Point table No. selection 1) to DI7 (Point table No. selection 8)	Switch off DI0 to DI7.
Dog type rear end reference home position return	[Pr. PT04]	_ _ _ 5: Select the dog type (rear end detection/rear end reference).
Home position return direction	[Pr. PT04]	Refer to section 4.4.1 (2) to select the home position return direction.
Dog input polarity	[Pr. PT29]	Refer to section 4.4.1 (2) to select the dog input polarity.
Home position return speed	[Pr. PT05]	Set the rotation speed until the dog is detected.
Creep speed	[Pr. PT06]	Set the rotation speed after the dog is detected.
Home position shift distance	[Pr. PT07]	Set this item to shift the home position, which is specified after the rear end of a proximity dog is passed.
Travel distance after proximity dog	[Pr. PT09]	Set the travel distance specified after the rear end of a proximity dog is passed.
Home position return acceleration/deceleration time constant	Point table No. 1	Use the acceleration/deceleration time constant of point table No. 1.
Home position return position data	[Pr. PT08]	Set the current position at the home position return completion.

(2) Timing chart



The setting value of [Pr. PT08 Home position return position data] is used as the position address at the home position return completion.

16.7.8 Count type front end reference home position return

POINT
● This home position return method depends on the timing of reading DOG (Proximity dog) that has detected the front end of a proximity dog. Therefore, when a home position return is performed with the creep speed of 100 r/min, the home position has an error of 6400 pulses (for HG series servo motor). The higher the creep speed, the greater the error of the home position. ● After the front end of a proximity dog is detected, when a home position return ends without reaching the creep speed, [AL. 90] occurs. Set the travel distance after proximity dog and the home position shift distance enough for deceleration from the home position return speed to the creep speed.

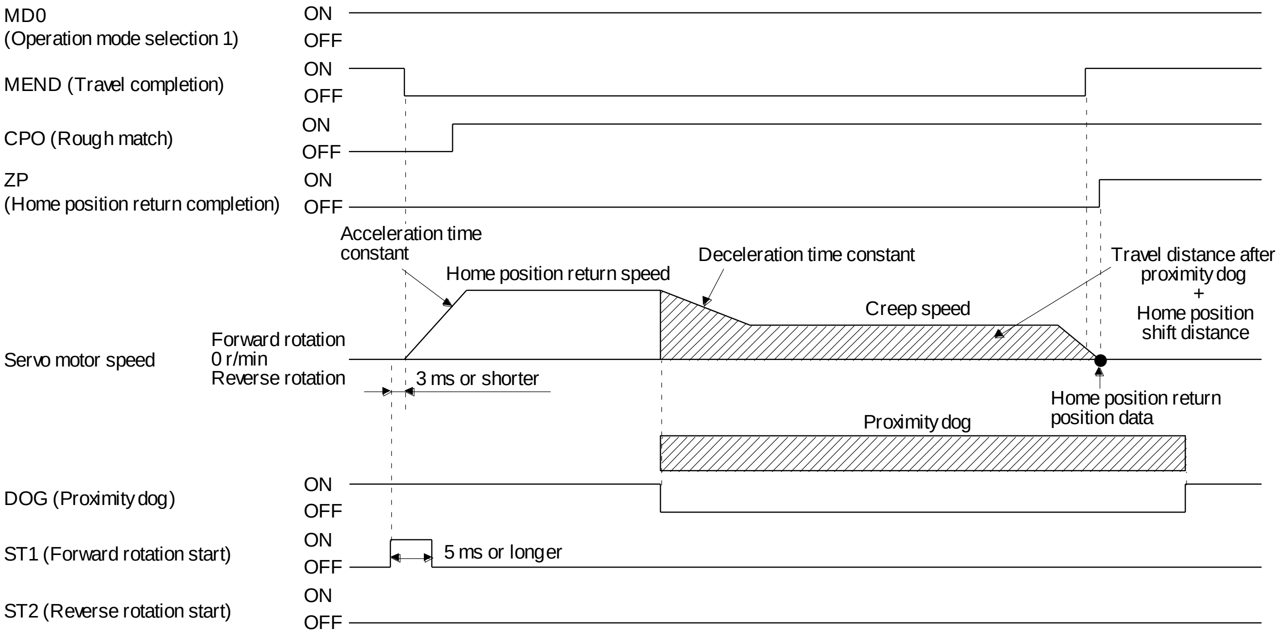
Deceleration starts at the front end of a proximity dog. The position is shifted by the travel distance after proximity dog and the home position shift distance. The position after the shifts is used as the home position. The home position return is available independently of the Z-phase signal. Changing the creep speed may change the home position.

(1) Device/parameter

Set input devices and parameters as follows.

Item	Used device/parameter	Setting
Home position return mode selection	MD0 (Operation mode selection 1)	Switch on MD0.
	DI0 (Point table No. selection 1) to DI7 (Point table No. selection 8)	Switch off DI0 to DI7.
Count type front end reference home position return	[Pr. PT04]	_ _ _ 6: Select the count type (front end detection/front end reference).
Home position return direction	[Pr. PT04]	Refer to section 4.4.1 (2) to select the home position return direction.
Dog input polarity	[Pr. PT29]	Refer to section 4.4.1 (2) to select the dog input polarity.
Home position return speed	[Pr. PT05]	Set the rotation speed until the dog is detected.
Creep speed	[Pr. PT06]	Set the rotation speed after the dog is detected.
Home position shift distance	[Pr. PT07]	Set this to shift the home position, which is specified after the front end of a proximity dog is passed.
Travel distance after proximity dog	[Pr. PT09]	Set the travel distance specified after the front end of the proximity dog is passed.
Home position return acceleration/deceleration time constant	Point table No. 1	Use the acceleration/deceleration time constant of point table No. 1.
Home position return position data	[Pr. PT08]	Set the current position at the home position return completion.

(2) Timing chart



The setting value of [Pr. PT08 Home position return position data] is used as the position address at the home position return completion.

16.7.9 Dog cradle type home position return

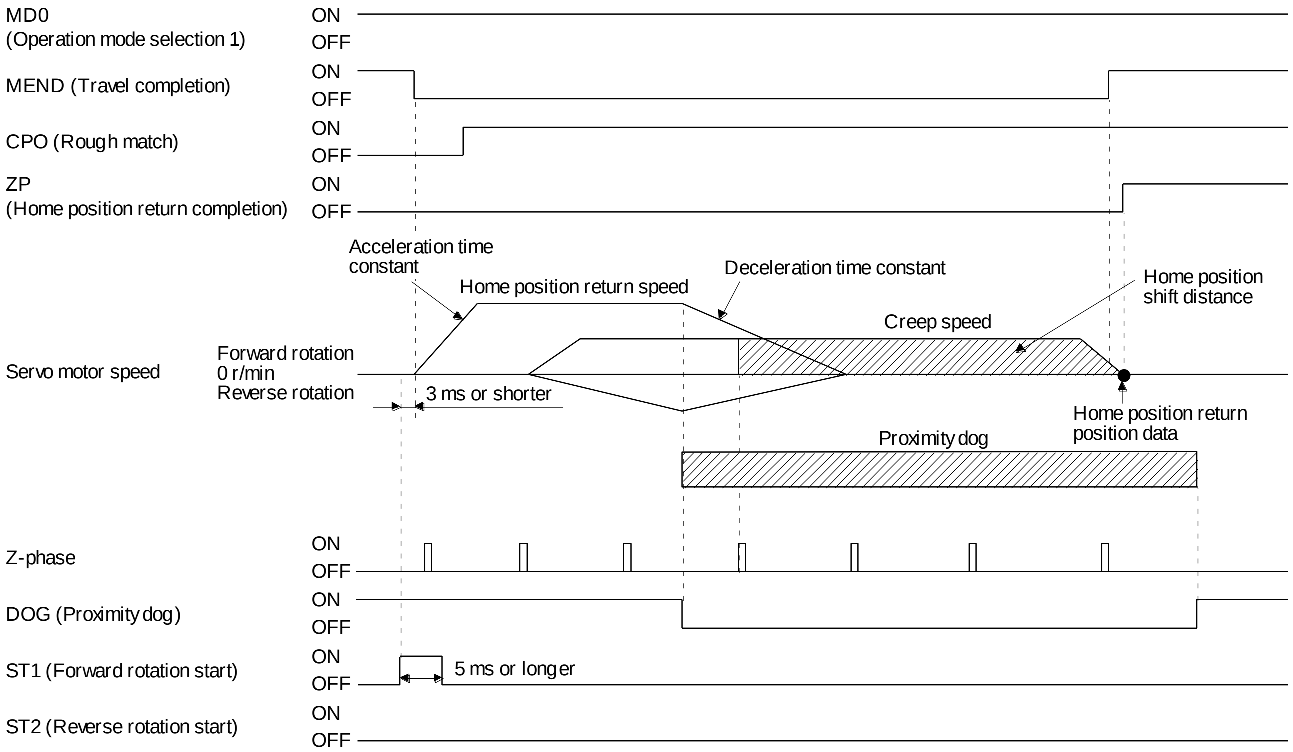
You can use the position, which is specified by the first Z-phase signal after the front end of a proximity dog is detected, as the home position.

(1) Device/parameter

Set input devices and parameters as follows.

Item	Used device/parameter	Setting
Home position return mode selection	MD0 (Operation mode selection 1)	Switch on MD0.
	DI0 (Point table No. selection 1) to DI7 (Point table No. selection 8)	Switch off DI0 to DI7.
Dog cradle type home position return	[Pr. PT04]	_ _ _ 7: Select the dog cradle type.
Home position return direction	[Pr. PT04]	Refer to section 4.4.1 (2) to select the home position return direction.
Dog input polarity	[Pr. PT29]	Refer to section 4.4.1 (2) to select the dog input polarity.
Home position return speed	[Pr. PT05]	Set the rotation speed until the dog is detected.
Creep speed	[Pr. PT06]	Set the rotation speed after the dog is detected.
Home position shift distance	[Pr. PT07]	Set this item to shift the home position, which is specified by the Z-phase signal.
Home position return acceleration/deceleration time constant	Point table No. 1	Use the acceleration/deceleration time constant of point table No. 1.
Home position return position data	[Pr. PT08]	Set the current position at the home position return completion.

(2) Timing chart



The setting value of [Pr. PT08 Home position return position data] is used as the position address at the home position return completion.

16.7.10 Dog type last Z-phase reference home position return

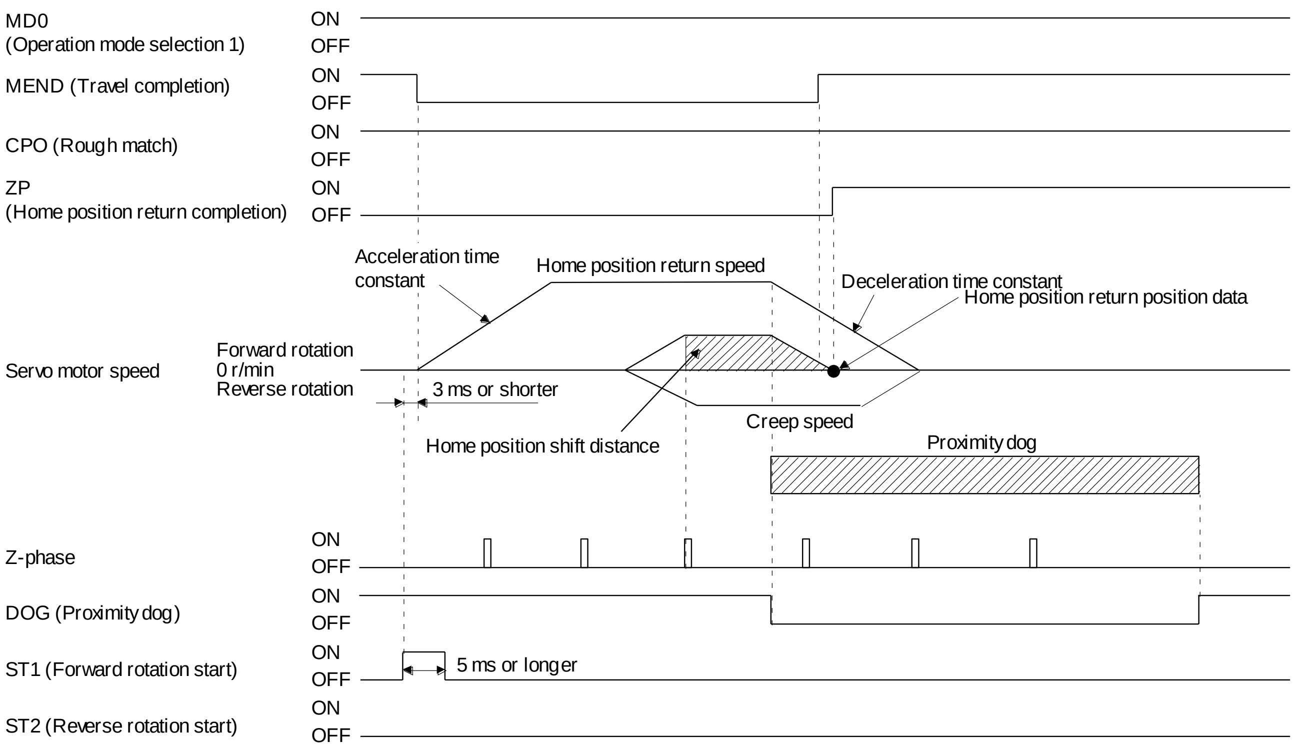
After the front end of a proximity dog is detected, the position is shifted away from the proximity dog at the creep speed in the reverse direction and then specified by the first Z-phase signal. The position of the first Z-phase signal is used as the home position.

(1) Device/parameter

Set input devices and parameters as follows.

Item	Used device/parameter	Setting
Home position return mode selection	MD0 (Operation mode selection 1)	Switch on MD0.
	DI0 (Point table No. selection 1) to DI7 (Point table No. selection 8)	Switch off DI0 to DI7.
Dog type last Z-phase reference home position return	[Pr. PT04]	_ _ _ 8: Select the dog type last Z-phase reference.
Home position return direction	[Pr. PT04]	Refer to section 4.4.1 (2) to select the home position return direction.
Dog input polarity	[Pr. PT29]	Refer to section 4.4.1 (2) to select the dog input polarity.
Home position return speed	[Pr. PT05]	Set the rotation speed until the dog is detected.
Creep speed	[Pr. PT06]	Set the rotation speed after the dog is detected.
Home position shift distance	[Pr. PT07]	Set this item to shift the home position, which is specified by the Z-phase signal.
Home position return acceleration/deceleration time constant	Point table No. 1	Use the acceleration/deceleration time constant of point table No. 1.
Home position return position data	[Pr. PT08]	Set the current position at the home position return completion.

(2) Timing chart



The setting value of [Pr. PT08 Home position return position data] is used as the position address at the home position return completion.

16.7.11 Dog type front end reference home position return type

POINT

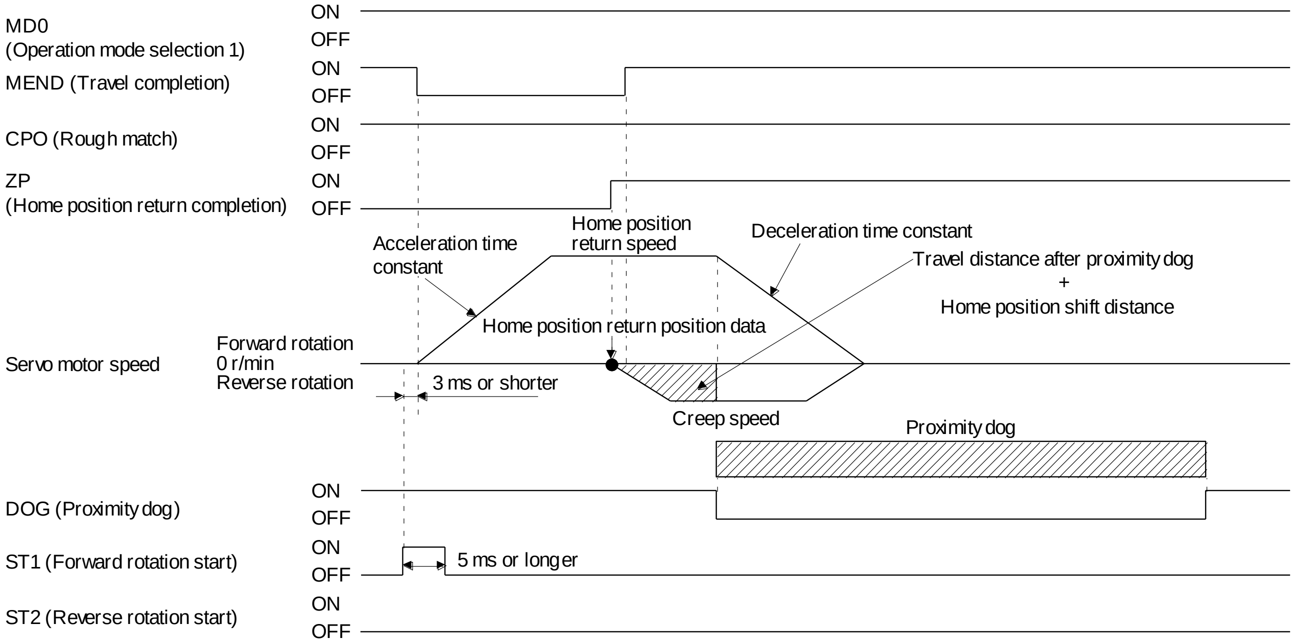
- This home position return method depends on the timing of reading DOG (Proximity dog) that has detected the front end of a proximity dog. Therefore, when a home position return is performed at a creep speed of 100 r/min, the home position has an error of 6400 pulses (for HG series servo motor). The higher the creep speed, the greater the error of the home position.

Starting from the front end of a proximity dog, the position is shifted by the travel distance after proximity dog and the home position shift distance. The position after the shifts is used as the home position.
The home position return is available independently of the Z-phase signal. Changing the creep speed may change the home position.

(1) Device/parameter
Set input devices and parameters as follows.

Item	Used device/parameter	Setting
Home position return mode selection	MD0 (Operation mode selection 1)	Switch on MD0.
	DI0 (Point table No. selection 1) to DI7 (Point table No. selection 8)	Switch off DI0 to DI7.
Dog type front end reference home position return	[Pr. PT04]	_ _ _ 9: Select the dog type front end reference.
Home position return direction	[Pr. PT04]	Refer to section 4.4.1 (2) to select the home position return direction.
Dog input polarity	[Pr. PT29]	Refer to section 4.4.1 (2) to select the dog input polarity.
Home position return speed	[Pr. PT05]	Set the rotation speed until the dog is detected.
Creep speed	[Pr. PT06]	Set the rotation speed after the dog is detected.
Home position shift distance	[Pr. PT07]	Set this item to shift the home position, which is specified by the Z-phase signal.
Home position return acceleration/deceleration time constant	Point table No. 1	Use the acceleration/deceleration time constant of point table No. 1.
Home position return position data	[Pr. PT08]	Set the current position at the home position return completion.

(2) Timing chart



The setting value of [Pr. PT08 Home position return position data] is used as the position address at the home position return completion.

16.7.12 Dogless Z-phase reference home position return type

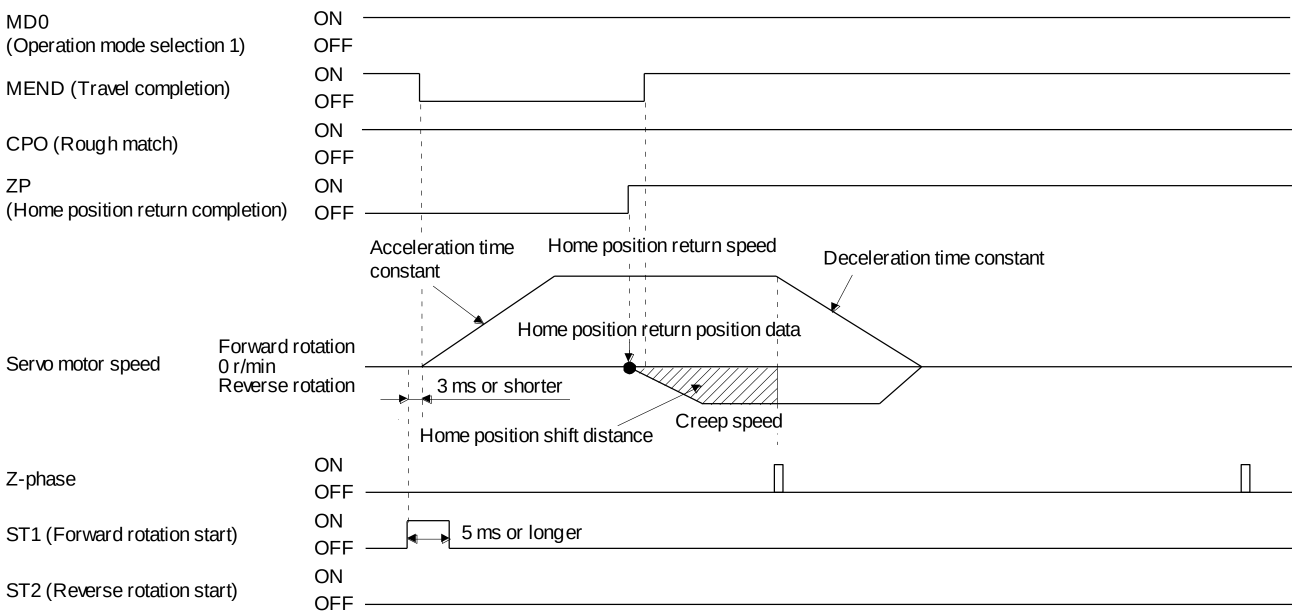
Starting from the Z-phase pulse position after the start of the home position return, the position is shifted by the home position shift distance. The position after the shifts is used as the home position.

(1) Device/parameter

Set input devices and parameters as follows.

Item	Used device/parameter	Setting
Home position return mode selection	MD0 (Operation mode selection 1)	Switch on MD0.
	DI0 (Point table No. selection 1) to DI7 (Point table No. selection 8)	Switch off DI0 to DI7.
Dogless Z-phase reference home position return	[Pr. PT04]	_ _ _ A: Select the dogless type (Z-phase reference).
Home position return direction	[Pr. PT04]	Refer to section 4.4.1 (2) to select the home position return direction.
Home position return speed	[Pr. PT05]	Set the rotation speed specified until the Z-phase is detected.
Creep speed	[Pr. PT06]	Set the rotation speed specified after the Z-phase is detected.
Home position shift distance	[Pr. PT07]	Set this item to shift the home position, which is specified by the Z-phase signal.
Home position return acceleration/deceleration time constant	Point table No. 1	Use the acceleration/deceleration time constant of point table No. 1.
Home position return position data	[Pr. PT08]	Set the current position at the home position return completion.

(2) Timing chart

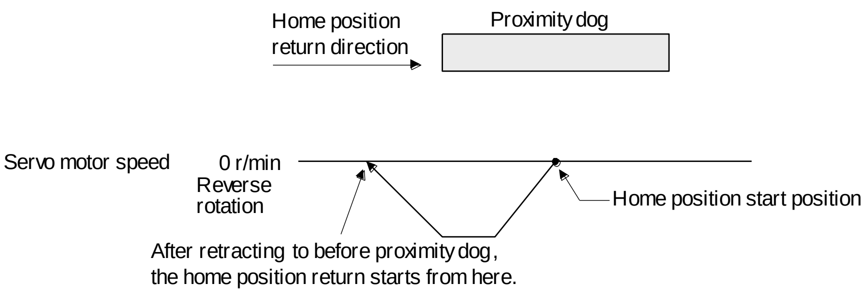


The setting value of [Pr. PT08 Home position return position data] is used as the position address at the home position return completion.

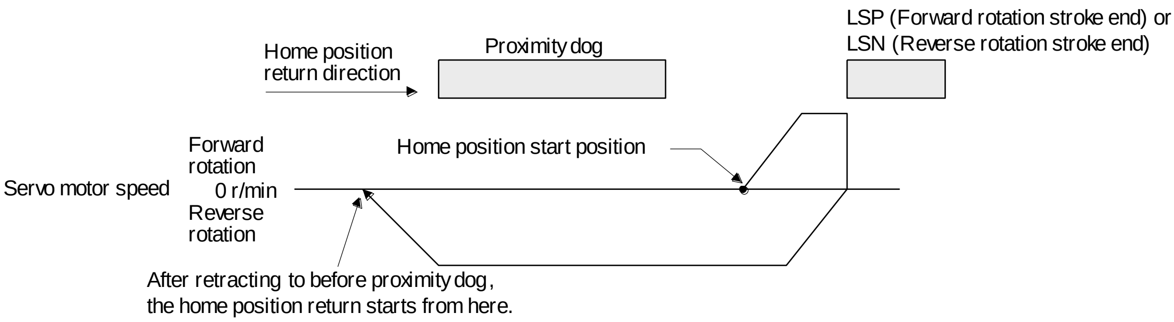
16.7.13 Automatic retract function used for the home position return

For a home position return using the proximity dog, when the home position return is started from the position on or beyond the proximity dog, the home position return is performed after the machine moves back to the position where the home position can be performed.

(1) When the current position is on the proximity dog
When the current position is on the proximity dog, the machine moves backward automatically, and the home position return is performed.



(2) When the current position is beyond the proximity dog
At start-up, the operation is performed in the direction of the home position return. When LSP (Forward rotation stroke end) or LSN (Reverse rotation stroke end) is detected, the machine moves backward automatically. The machine passes and stops before the proximity dog, and the home position return is performed from the position again. If the proximity dog cannot be detected, the machine stops at LSP or LSN on the opposite side, and [AL. 90 Home position return incomplete warning] will occur.



The software limit cannot be used with these functions.

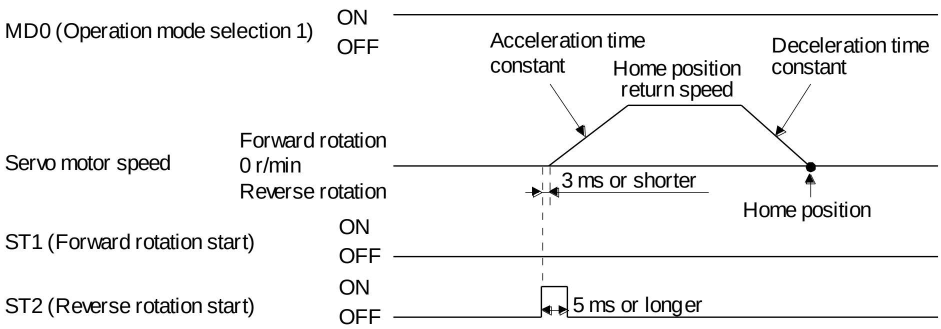
16.7.14 Automatic positioning to home position function

POINT
●The automatic positioning to the home position cannot be performed from outside the setting range of position data. In this case, perform the home position return again using the home position return.

After power-on, if the home position return is performed again after the home position return is performed to define the home position, this function enables automatic positioning to the home position rapidly. For the absolute position detection system, the home position return is unnecessary after the power-on.
When the automatic positioning to the home position is performed at home position return incompletion, [AL. 90.1] will occur.
After the power-on, perform the home position return in advance.
Set input devices and parameters as follows.

Item	Used device/parameter	Setting
Home position return mode selection	MD0 (Operation mode selection 1)	Switch on MD0.
	DI0 (Point table No. selection 1) to DI7 (Point table No. selection 8)	Switch off DI0 to DI7.
Home position return speed	[Pr. PT05]	Set the servo motor speed to travel to the home position.
Home position return acceleration/deceleration time constant	Point table No. 1	Use the acceleration/deceleration time constant of point table No. 1.
Home position return direction	[Pr. PT04]	Set the rotation direction in degrees.

Set the home position return speed of the automatic positioning to home position function with [Pr. PT05]. The data of point table No. 1 is used for acceleration/deceleration time constants. Switching on ST2 (Reverse rotation start) enables high-speed automatic return.
Set the rotation direction at the time of degree unit setting with home position return direction of [Pr. PT04].



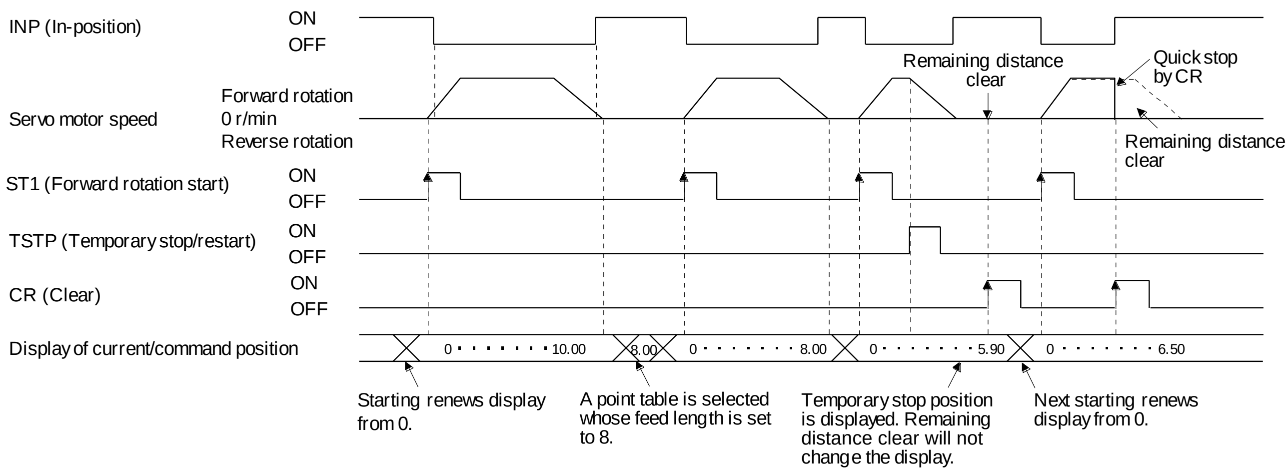
16.8 ROLL FEED MODE USING THE ROLL FEED DISPLAY FUNCTION

The roll feed display function can change the current position of the status monitor and command position display.
Using the roll feed display function can use this driver as the roll feed mode. The roll feed mode can be used in the incremental system. Using the override function can change the feed speed during operation. Refer to section 2.4 for details.

(1) Parameter setting

No.	Name	Setting digit	Setting item	Setting value	Setting
PA03	Absolute position detection system	_ _ _ x	Absolute position detection system	_ _ _ 0 (initial value)	Always set the incremental system. It cannot be used by the absolute position detection system.
PT26	Current position/command position display selection	_ _ x _	Current position/command position display selection	_ _ 1 _	Select the roll feed display.
PT26	Electronic gear fraction clear selection	_ _ _ x	Electronic gear fraction clear selection	_ _ _ 1	Clear a fraction of the previous command by the electronic gear at start of the automatic operation. Always set "_ _ _ 1" (enabled) in the electronic gear fraction clear.

(2) Roll feed display function
When the roll feed display function is used, the status display of the current position and command position at start will be 0.



(3) Position data unit

The display unit is expressed in the unit set in [Pr. PT26], and the feed length multiplication is expressed in the unit set in [Pr. PT03].

When the unit is set in degrees, the roll feed display function is disabled.

Refer to section 4.2.2 for details.

(4) Operation method

Only the status display of the current position and command position changes. The operation method is the same as each operation mode.

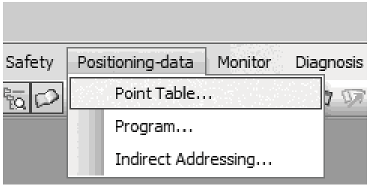
Operation mode		Detailed explanation
Automatic operation	Automatic operation using the point table	Section 4.2.2
Manual operation	JOG operation	Section 4.3.1
	Manual pulse generator operation	Section 4.3.2
Home position return mode		Section 4.4

16.9 POINT TABLE SETTING METHOD

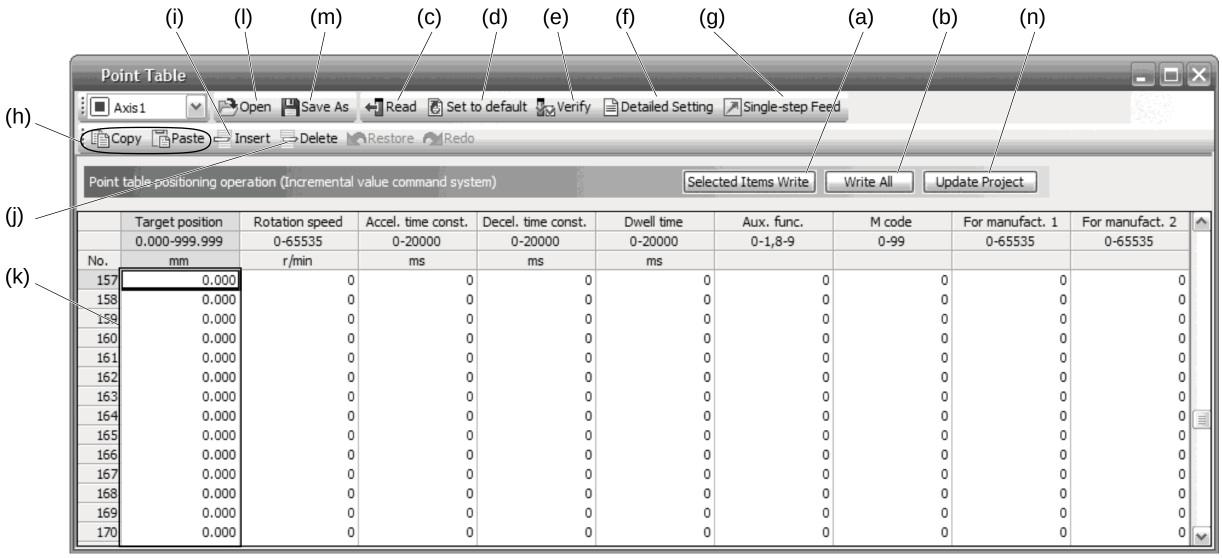
The following shows the setting method of point tables using Setup software (MR Configurator2TM).

16.9.1 Setting procedure

Click "Positioning-data" in the menu bar and click "Point Table" in the menu.



The following window will be displayed by clicking.



(1) Writing point table data (a)
Select changed point table data and click "Selected Items Write" to write the changed point table data to the driver.

(2) Writing all point table data (b)
Click "Write All" to write all the point table data to the driver.

(3) Reading all point table data (c)
Click "Read" to read and display all the point table data from the driver.

(4) Initial setting of point table data (d)
Click "Set to default" to initialize all the data of point table No. 1 to 255. This also initializes data currently being changed.

(5) Verifying point table data (e)
Click "Verify" to verify all the data displayed and data of the driver.

(6) Detailed setting of point table data (f)
Click "Detailed Setting" to change position data range and unit in the point table window. Refer to section 4.6.2 for details.

(7) Single-step feed (g)
Click "Single-step Feed" to perform the single-step feed test operation. Refer to section 3.1.9 or 3.2.9 for details.

(8) Copy and paste of point table data (h)
Click "Copy" to copy the selected point table data. Click "Paste" to paste the copied point table data.

(9) Inserting point table data (i)
Click "Insert" to insert a block to the previous row from the selected point table No. The selected point table No. and lower rows will be shifted down one by one.

(10) Deleting point table data (j)
Click "Delete" to delete all the data of the point table No. selected. The lower rows of the selected point table No. will be shifted up one by one.

(11) Changing point table data (k)
After selecting the data to be changed, enter a new value, and click "Enter". You can change the displayed range and unit with "(6) Detailed setting of point table data" of this section.

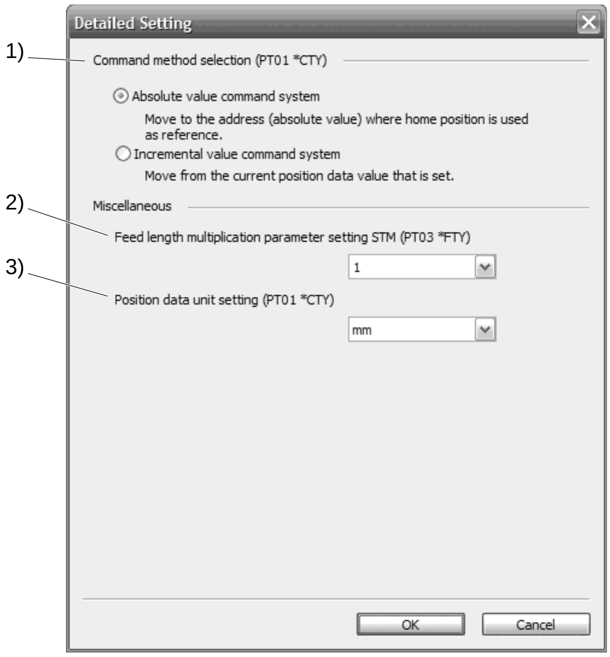
(12) Reading point table data (l)
Click "Open" to read the point table data.

(13) Saving point table data (m)
Click "Save As" to save the point table data.

(14) Updating project (n)
Click "Update Project" to update the point table data to a project.

16.9.2 Detailed setting window

You can change position data range and unit with the detailed setting for the point table window. For the position data range and unit of [Pr. PT01] setting, refer to section 4.2.2. To reflect the setting for the corresponding parameter, click "Update Project" in the point table window.



(1) Command method selection (PT01 *CTY) 1)
Select a positioning command method from the absolute position command method and incremental value command method.

(2) Miscellaneous
(a) Feed length multiplication parameter setting STM (PT03 *FTY) 2)
Select any feed length multiplication from 1/10/100/1000.

(b) Position data unit setting (PT01 *CTY) 3)
Select any unit of position data from mm/inch/degree/pulse. While degree or pulse is selected, setting of feed length multiplication will be disabled.

16.10 HOW TO USE THE PROGRAM

> POINT
> - For the mark detection function (Current position latch), refer to section 12.2.1.
> - For the mark detection function (Interrupt positioning), refer to section 12.2.2.
> - For the infinite feed function (setting degree), refer to section 12.3.

16.10.1 Power on and off procedures

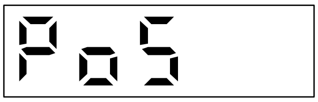
When the driver is powered on for the first time, the driver enters the position control mode. (Refer to section 4.2.1)
This section provides a case where the driver is powered on after the positioning mode setting.

(1) Power-on
Switch power on in the following procedure. Always follow this procedure at power-on.

1) Switch off SON (Servo-on).

2) Make sure that ST1 (Forward rotation start) is off.

3) Switch on the main circuit power supply and control circuit power supply.
The display shows "PoS", and in 2 s later, shows data.



(2) Power-off

1) Switch off ST1 (Forward rotation start).

2) Switch off SON (Servo-on).

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

16.10.2 Stop

If any of the following situations occurs, the driver suspends the running of the servo motor and brings it to a stop.
Refer to section 3.10 for the servo motor with an electromagnetic brake.

Operation/command	Stopping condition
Switch off SON (Servo-on).	The base circuit is shut off and the servo motor coasts.
Alarm occurrence	The servo motor decelerates to a stop with the command. With some alarms, however, the dynamic brake operates to bring the servo motor to a stop. (Refer to chapter 8.)
EM2 (Forced stop 2) off	The servo motor decelerates to a stop with the command. [AL. E6 Servo forced stop warning] occurs. Refer to section 2.3 for EM1.
STO (STO1, STO2) off	The base circuit is shut off and the dynamic brake operates to bring the servo motor to a stop.
LSP (Forward rotation stroke end) off, LSN (Reverse rotation stroke end) off	It will bring the motor to a sudden stop and make it servo-locked. It can be run in the opposite direction.

16.10.3 Test operation

Before starting actual operation, perform test operation to make sure that the machine operates normally.
Refer to section 5.1.1 for how to power on and off the driver.

Test operation of the 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. For the test operation mode, refer to section 3.1.8, 3.1.9, 3.2.8, and 3.2.9 in this manual, and section 4.5.9 and 18.5.10.

Test operation of the servo motor alone

In this step, confirm that the servo motor correctly rotates at the slowest speed in the manual operation mode.
Make sure that the servo motor rotates in the following procedure.

1) Switch on EM2 (Forced stop 2) and SON (Servo-on). When the driver is put in a servo-on status, RD (Ready) is switched on.
2) Switch on LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end).
3) When MD0 (Operation mode selection 1) is switched off from PC or PLC...etc and ST1 (Forward rotation start) or ST2 (Reverse rotation start) is switched on in the manual operation mode, 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 the 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 PC or PLC...etc.
Make sure that the servo motor rotates in the following procedure.

1) Switch on EM2 (Forced stop 2) and SON (Servo-on). When the driver is put in a servo-on status, RD (Ready) is switched on.
2) Switch on LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end).
3) When MD0 (Operation mode selection 1) is switched off from the PC or PLC...etc and ST1 (Forward rotation start) or ST2 (Reverse rotation start) is switched on in the manual operation mode, 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, check for any problems of the servo motor speed, load ratio, etc.

Select a program from PC or PLC...etc, and check automatic operation.

Automatic operation with programming

16.10.4 Parameter setting

POINT
● Assign the following output devices to the CN1-22, CN1-23, and CN1-25 pins with [Pr. PD23], [Pr. PD24], and [Pr. PD26]. CN1-22: CPO (Rough match) CN1-23: ZP (Home position return completion) CN1-25: MEND (Travel completion)

When using this servo by the program method, set [Pr. PA01] to "_ _ _ 7" (Positioning mode (program method)). For the program method, the servo can be used by merely changing the basic setting parameters ([Pr. PA _ _]) and positioning control parameters ([Pr. PT _ _]) mainly.
As necessary, set other parameters.
The following table shows [Pr. PA _ _] and [Pr. PT _ _] settings required for the program method.

Operation mode \ Operation mode selection item		Parameter setting [Pr. PA01]	Parameter setting [Pr. PT04]	Input device setting MD0 (Note 1)	Input device setting DI0 to DI7 (Note 1)
Automatic operation mode of the program method		_ _ _ 7		On	Any
Manual operation mode	JOG operation			Off	
	Manual pulse generator operation				
Home position return	Dog type		_ _ _ 0	On	Any (Note 2)
	Count type		_ _ _ 1		
	Data set type		_ _ _ 2		
	Stopper type		_ _ _ 3		
	Home position ignorance (servo-on position as home position)		_ _ _ 4		
	Dog type rear end reference		_ _ _ 5		
	Count type front end reference		_ _ _ 6		
	Dog cradle type		_ _ _ 7		
	Dog type last Z-phase reference		_ _ _ 8		
	Dog type front end reference		_ _ _ 9		
	Dogless Z-phase reference		_ _ _ A		

Note 1. MD0: Operation mode selection 1, DI0 to DI7: Program No. selection 1 to Program No. selection 8
2. Select a program containing a "ZRT" command, which performs the home position return.

16.10.5 Actual operation

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

16.10.6 Troubleshooting at start-up

CAUTION	●Never make a drastic adjustment or change to the parameter values as doing so will make the operation unstable.

POINT
●Using Setup software (MR Configurator2™), you can refer to the reason for rotation failure, 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	・The 7-segment LED display does not turn on. ・The 7-segment LED display flickers.	Not improved even if CN1, CN2, and CN3 connectors are disconnected.	1. Power supply voltage fault 2. The driver is malfunctioning.	
			Improved when CN1 connector is disconnected.	Power supply of CN1 cabling is shorted.	
			Improved when CN2 connector is disconnected.	1. Power supply of encoder cabling is shorted. 2. Encoder is malfunctioning.	
			Improved when CN3 connector is disconnected.	Power supply of CN3 cabling is shorted.	
		Alarm occurs.	Refer to chapter 8 and remove the cause.		Chapter 8
2	Switch on SON (Servo-on).	Alarm occurs.	Refer to chapter 8 and remove the cause.		Chapter 8
		Servo motor shaft is not servo-locked. (Servo motor shaft is free.)	1. Check the display to see if the driver is ready to operate. 2. Check the external I/O signal indication (section 3.1.7 or 3.2.7) to see if SON (Servo-on) is on.	1. SON (Servo-on) is not input. (wiring mistake) 2. 24 V DC power is not supplied to DICOM.	Section 3.1.7 Section 3.2.7
3	Perform a home position return.	Servo motor does not rotate.	Call the external I/O signal display and check the on/off status of the input signal. (Refer to section 3.1.7 or 3.2.7.)	LSP, LSN, and ST1 are off.	Section 3.1.7 Section 3.2.7
			Check [Pr. PA11 Forward rotation torque limit] and [Pr. PA12 Reverse rotation torque limit].	Torque limit level is too low as compared to the load torque.	Section 7.2.1
			When TLA (Analog torque limit) is usable, check the input voltage on the status display.	Torque limit level is too low as compared to the load torque.	Section 3.1.2 Section 3.2.2
		The home position return is not completed.	Call the external I/O signal display and check the on/off status of input signal DOG. (Refer to section 3.1.7 or 3.2.7.)	The proximity dog is set incorrectly.	Section 3.1.7 Section 3.2.7

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
4	Switch on ST1 (Forward rotation start).	Servo motor does not rotate.	Call the external I/O signal display (Section 3.1.7 or 3.2.7) and check the on/off status of the input signal.	LSP, LSN, and ST1 are off.	Section 3.1.7 Section 3.2.7
			Check [Pr. PA11 Forward rotation torque limit] and [Pr. PA12 Reverse rotation torque limit].	Torque limit level is too low as compared to the load torque.	Section 7.2.1
			When TLA (Analog torque limit) is usable, check the input voltage on the status display.	Torque limit level is too low as compared to the load torque.	Section 3.1.2 Section 3.2.2
5	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/ deceleration more than three times to complete auto tuning.	Gain adjustment fault	Chapter 6
		Large load inertia moment causes the servo motor shaft to oscillate side to side.	If the servo motor may be driven with safety, repeat acceleration and deceleration three times or more to complete the auto tuning.	Gain adjustment fault	Chapter 6

16.11 PROGRAM OPERATION METHOD

16.11.1 Program operation method

In advance, select a program created on Setup software (MR Configurator2™) by using an input signal or communication to start operation with ST1 (Forward rotation start).
This driver is factory set to the absolute value command method.
For the position data, you can set the absolute value travel command ("MOV" command), which specifies the target address, and the incremental value travel command ("MOVI" command), which specifies the travel distance. Refer to section 4.2.1 (1) and 5.2.3 (1) (a) for the movable range and the setting unit.

16.11.2 Program language

The maximum number of steps of a program is 640. Up to 256 programs can be created; however, the total number of the steps of all programs must be 640 or less.
A set program is selectable by using DI0 (Program No. selection 1) to DI7 (Program No. selection 8).

(1) Command list

<table>
<tr><th>Command</th><th>Name</th><th>Setting</th><th>Setting range</th><th>Unit</th><th>Indirect specif-ication (Note 7)</th><th>Description</th></tr>
<tr><td>SPN
(Note 2)</td><td>Servo motor speed</td><td>SPN
(Setting value)</td><td>0 to permissible instantaneous speed</td><td>r/min
or
mm/s
(Note 9)</td><td>○</td><td>Set the servo motor speed for positioning using this command.
The setting value must be the permissible instantaneous speed or less of the servo motor used.
If the setting value is unspecified, the servo motor rotates at 50 r/min.</td></tr>
<tr><td>STA
(Note 2)</td><td>Acceleration time constant</td><td>STA
(Setting value)</td><td>0 to 20000</td><td>ms</td><td>○</td><td>Set the acceleration time constant. The setting value is the time from when the used servo motor stops until when its speed reaches the rated speed.
The value cannot be changed during a command output.
If the setting value is unspecified, 1000 ms is applied.</td></tr>
<tr><td>STB
(Note 2)</td><td>Deceleration time constant</td><td>STB
(Setting value)</td><td>0 to 20000</td><td>ms</td><td>○</td><td>Set the deceleration time constant. The setting value is the time from when the used servo motor rotates at the rated speed until when the motor stops.
The value cannot be changed during a command output.
If the setting value is unspecified, 1000 ms is applied.</td></tr>
<tr><td>STC
(Note 2)</td><td>Acceleration/ deceleration time constant</td><td>STC
(Setting value)</td><td>0 to 20000</td><td>ms</td><td>○</td><td>Set the acceleration/deceleration time constants.
The setting value is a time period that the servo motor reaches the rated speed from a stop, and stops from the rated speed.
When this command is used, the acceleration time constant and the deceleration time constant become the same.
To set the acceleration/deceleration time constants individually, use the "STA" and "STB" commands.
The value cannot be changed during a command output.
If the setting value is unspecified, 1000 ms is applied.</td></tr>
<tr><td>STD
(Note 2, 5)</td><td>S-pattern acceleration/ deceleration time constant</td><td>STD
(Setting value)</td><td>0 to 1000</td><td>ms</td><td>○</td><td>Set the S-pattern acceleration/deceleration time constants.
Set this command to insert S-pattern acceleration/deceleration time constants against the acceleration/deceleration time constants of the program.</td></tr>
<tr><td>MOV</td><td>Absolute value travel command</td><td>MOV
(Setting value)</td><td>-999999
to 999999
(Note 6)</td><td>$\times 10^{STM}$ m
(Note 6)</td><td>○</td><td>The servo motor rotates using the set value as the absolute value.</td></tr>
<tr><td>MOVA</td><td>Absolute value continuous travel command</td><td>MOV
(Setting value)</td><td>-999999
to 999999
(Note 6)</td><td>$\times 10^{STM}$ m
(Note 6)</td><td>○</td><td>The servo motor rotates continuously using the set value as the absolute value. Make sure to describe this command after the "MOV" command.</td></tr>
<tr><td>MOVI</td><td>Incremental value travel command</td><td>MOVI
(Setting value)</td><td>-999999
to 999999
(Note 6)</td><td>$\times 10^{STM}$ m
(Note 6)</td><td>○</td><td>The servo motor rotates using the set value as the incremental value.
When a negative value is set, the servo motor rotates in the reverse rotation direction.
For the reverse rotation, the servo motor rotates in the address decreasing direction.</td></tr>
<tr><td>MOVIA</td><td>Incremental value continuous travel command</td><td>MOVIA
(Setting value)</td><td>-999999
to 999999
(Note 6)</td><td>$\times 10^{STM}$ m
(Note 6)</td><td>○</td><td>The servo motor rotates continuously using the set value as the incremental value. Make sure to describe this command after the "MOVI" command.</td></tr>
<tr><td>SYNC
(Note 1)</td><td>External signal on wait</td><td>SYNC
(Setting value)</td><td>1 to 3</td><td></td><td></td><td>The following steps stop after SOUT (SYNC synchronous output) is output until PI1 (Program input 1) to PI3 (Program input 3) are switched on.<table><tr><th>Setting value</th><th>Input signal</th></tr><tr><td>1</td><td>PI1 (Program input 1)</td></tr><tr><td>2</td><td>PI2 (Program input 2)</td></tr><tr><td>3</td><td>PI3 (Program input 3)</td></tr></table></td></tr>
</table>

<table>
<tr><th>Command</th><th>Name</th><th>Setting</th><th>Setting range</th><th>Unit</th><th>Indirect specif-ication (Note 7)</th><th>Description</th></tr>
<tr><td>OUTON
(Note 1, 3)</td><td>External signal on output</td><td>OUTON
(Setting value)</td><td>1 to 3</td><td></td><td></td><td>Switch on OUT1 (Program output 1) to OUT3 (Program output 3).
By setting the on time by using [Pr. PT23] to [Pr. PT25], you can switch off the input signals after the set time elapses.<table><tr><th>Setting value</th><th>Input signal</th></tr><tr><td>1</td><td>OUT1 (Program output 1)</td></tr><tr><td>2</td><td>OUT2 (Program output 2)</td></tr><tr><td>3</td><td>OUT3 (Program output 3)</td></tr></table></td></tr>
<tr><td>OUTOF
(Note 1)</td><td>External signal off output</td><td>OUTOF
(Setting value)</td><td>1 to 3</td><td></td><td></td><td>Switch off OUT1 (Program output 1) to OUT3 (Program output 3), which have been on by the "OUTON" command.<table><tr><th>Setting value</th><th>Input signal</th></tr><tr><td>1</td><td>OUT1 (Program output 1)</td></tr><tr><td>2</td><td>OUT2 (Program output 2)</td></tr><tr><td>3</td><td>OUT3 (Program output 3)</td></tr></table></td></tr>
<tr><td>TRIP
(Note 1)</td><td>Absolute value trip point specification</td><td>TRIP
(Setting value)</td><td>-999999
to 999999
(Note 6)</td><td>$\times 10^{STM}$ m
(Note 6)</td><td></td><td>When the servo motor rotates for the travel distance set by the "TRIP" command after the "MOV" or "MOVA" command is initiated, the next step is executed. Make sure to describe this command after the "MOV" or "MOVA" command.</td></tr>
<tr><td>TRIPI
(Note 1)</td><td>Incremental value trip point specification</td><td>TRIPI
(Setting value)</td><td>-999999
to 999999
(Note 6)</td><td>$\times 10^{STM}$ m
(Note 6)</td><td></td><td>When the servo motor rotates for the travel distance set by the "TRIPI" command after the "MOVI" or "MOVIA" command is initiated, the next step is executed. Make sure to describe this command after the "MOVI" or "MOVIA" command.</td></tr>
<tr><td>ITP
(Note 1, 4)</td><td>Interrupt positioning</td><td>ITP
(Setting value)</td><td>0 to 999999
(Note 6)</td><td>$\times 10^{STM}$ m
(Note 6)</td><td></td><td>An interrupt signal stops the servo motor when the motor rotates the set travel distance. Make sure to describe this command after the "SYNC" command.</td></tr>
<tr><td>COUNT
(Note 1)</td><td>External pulse count</td><td>COUNT (Setting value)</td><td>-999999
to 999999</td><td>pulse</td><td></td><td>When the pulse counter value becomes larger than the count value set for the "COUNT" command, the next step is executed. "COUNT (0)" clears the pulse counter to 0.</td></tr>
<tr><td>FOR
NEXT</td><td>Step repeat instruction</td><td>FOR
(Setting value)
NEXT</td><td>0, 1 to 10000</td><td>times</td><td></td><td>The steps between the "FOR (Setting value)" and the "NEXT" commands are repeated for the set number of times.
Setting "0" repeats the operation endlessly.
Do not describe a "FOR" instruction between the "FOR" and "NEXT" commands. Otherwise, an error occurs.</td></tr>
<tr><td>LPOS
(Note 1)</td><td>Current position latch</td><td>LPOS</td><td></td><td></td><td></td><td>Latch the current position at the rising edge of LPS (Current position latch).
The latched current position data can be read with communication commands.
When the servo motor starts rotating, the latched position varies according to the motor speed and the sampling of input signals.</td></tr>
<tr><td>TIM</td><td>Dwell</td><td>TIM
(Setting value)</td><td>1 to 20000</td><td>ms</td><td>○</td><td>Wait for the next step until the set time elapses.</td></tr>
<tr><td>ZRT</td><td>Home position return</td><td>ZRT</td><td></td><td></td><td></td><td>Perform a home position return.</td></tr>
<tr><td>TIMES</td><td>Number of program executions command</td><td>TIMES
(Setting value)</td><td>0, 1 to 10000</td><td>times</td><td>○</td><td>Position a "TIMES (Setting value)" command at the start of the program, and set the number of program executions. To execute the program only one time, no setting is required. Setting "0" repeats the operation endlessly.</td></tr>
<tr><td>STOP</td><td>Program stop</td><td>STOP</td><td></td><td></td><td></td><td>Stop the running program.
Make sure to describe this command in the final row.</td></tr>
</table>

Command	Name	Setting	Setting range	Unit	Indirect specif-ication (Note 7)	Description
TLP (Note 8)	Forward rotation torque limit	TLP (Setting value)	0, 1 to 1000	0.1 %		Using the maximum torque as 100%, limit the generated torque of the servo motor in the CCW power running or CW regeneration. The setting value is valid until the program stops. Specifying the setting value to "0" enables the [Pr. PA11] setting.
TLN (Note 8)	Reverse rotation torque limit	TLN (Setting value)	0, 1 to 1000	0.1 %		Using the maximum torque as 100%, limit the generated torque of the servo motor in the CW power running or CCW regeneration. The setting value is valid until the program stops. Specifying the setting value to "0" enables the [Pr. PA12] setting.
TQL (Note 8)	Torque limit	TQL (Setting value)	0, 1 to 1000	0.1 %		Using the maximum torque as 100%, limit the generated torque of the servo motor. The setting value is valid until the program stops. Specifying the setting value to "0" enables the [Pr. PA11] and [Pr. PA12] settings.

Note
1. The "SYNC", "OUTON", "OUTOF", "TRIP", "TRIPI", "COUNT", "LPOS", and "ITP" commands are valid even during a command output.
2. The "SPN" command is valid while the "MOV", "MOVA", "MOVI", or "MOVIA" command is executed. The "STA", "STB", "STC", and "STD" commands are valid while the "MOV" or "MOVI" command is executed.
3. When the on time is set using [Pr. PT23] to [Pr. PT25], the next command is executed after the set time elapses.
4. When the remaining distance is the set value or less, or while the servo motor stops or decelerates, the program skips the "ITP" command and proceeds to the next step.
5. The parameter value is valid normally. However, the value set for the command is valid after the command is executed until the program stops.
6. The unit of the position command data input can be changed with [Pr. PT01]. For the setting range for each unit, refer to section 5.2.3 (1) (a).
7. For the explanation of the indirect specification, refer to section 5.2.2 (2) (j).
8. The parameter value is valid normally. However, the value set for the command is valid after the command is executed until the program stops.

(2) Detailed explanations of commands

(a) Positioning conditions (SPN/STA/STB/STC/STD)

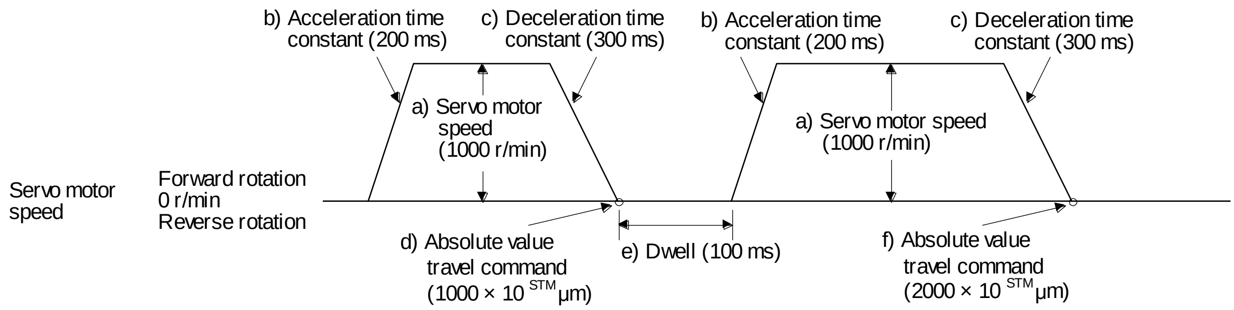
POINT
- Once values are set for the "SPN", "STA", "STB" and "STC" commands, the values are valid without resetting them. (The values are not initialized at the program startup.) The settings are valid in the other programs.
- The value set for the "STD" command is valid in the same program only. The value is initialized to the setting value of [Pr. PC03] at the program startup, and therefore the value is invalid in the other programs.

The "SPN", "STA", "STB", "STC", and "STD" commands are valid while the "MOV" or "MOVA" command is executed.

1) Program example 1

When executing two operations where the servo motor speeds, acceleration time constants, and deceleration time constants are the same and the travel commands are different

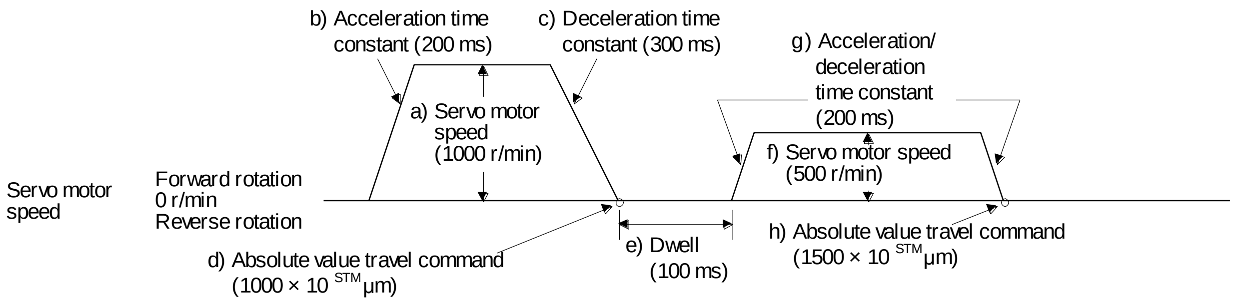
Command	Description		
SPN (1000)	Servo motor speed	1000 [r/min]	a)
STA (200)	Acceleration time constant	200 [ms]	b)
STB (300)	Deceleration time constant	300 [ms]	c)
MOV (1000)	Absolute value travel command	1000 [$\times 10^{STM}$ m]	d)
TIM (100)	Dwell	100 [ms]	e)
MOV (2000)	Absolute value travel command	2000 [$\times 10^{STM}$ m]	f)
STOP	Program stop		



2) Program example 2

When executing two operations where the servo motor speeds, acceleration time constants, deceleration time constants, and travel commands are different

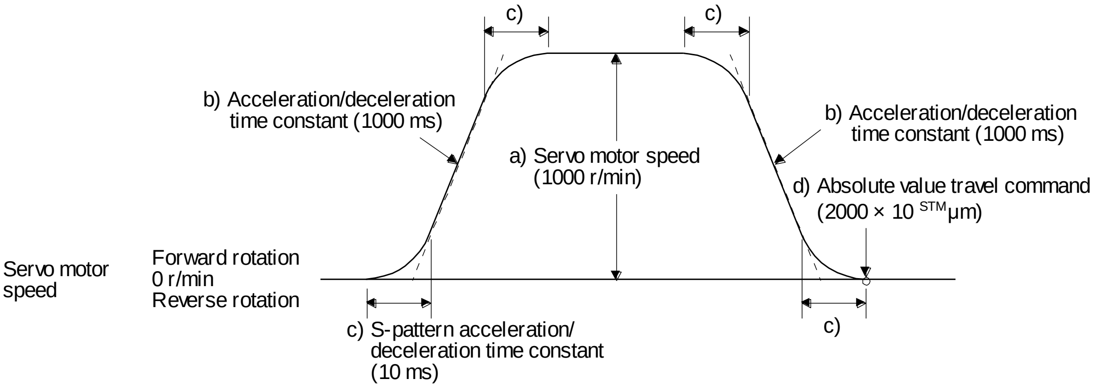
Command	Description		
SPN (1000)	Servo motor speed	1000 [r/min]	a)
STA (200)	Acceleration time constant	200 [ms]	b)
STB (300)	Deceleration time constant	300 [ms]	c)
MOV (1000)	Absolute value travel command	1000 [$\times 10^{STM}$ m]	d)
TIM (100)	Dwell	100 [ms]	e)
SPN (500)	Servo motor speed	500 [r/min]	f)
STC (200)	Acceleration/deceleration time constant	200 [ms]	g)
MOV (1500)	Absolute value travel command	1500 [$\times 10^{STM}$ m]	h)
STOP	Program stop		



3) Program example 3

Using the S-pattern acceleration/deceleration time constants reduces abrupt movements at acceleration or deceleration. When the "STD" command is used, [Pr. PC03 S-pattern acceleration/deceleration time constant] does not function.

Command	Description		
SPN (1000)	Servo motor speed	1000 [r/min]	a)
STC (100)	Acceleration/deceleration time constant	1000 [ms]	b)
STD (10)	S-pattern acceleration/deceleration time constant	10 [ms]	c)
MOV (2000)	Absolute value travel command	2000 [×10^{STM} m]	d)
STOP	Program stop		



(b) Continuous travel commands (MOVA/MOVIA)

POINT
●You cannot use a combination of "MOV" and "MOVIA" commands and a combination of "MOVI" and "MOVA" commands.

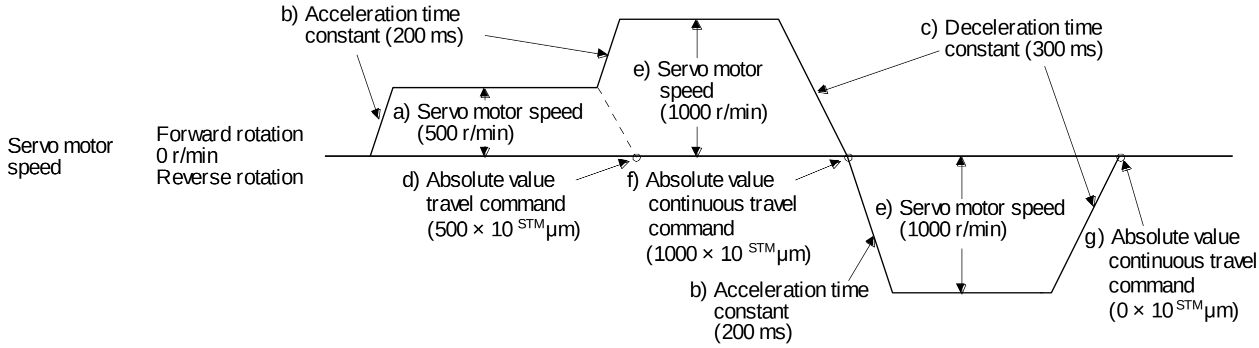
The "MOVA" command is a continuous travel command against the "MOV" command. Upon executing the travel command by the "MOV" command, the travel command by the "MOVA" command is executed continuously without a stop.
The varying speed point under the "MOVA" command is at the deceleration start position of the operation by the preceding "MOV" or "MOVA" command.
The acceleration/deceleration time constants of the "MOVA" command are set to the values at the execution of the preceding "MOV" command.
The "MOVIA" command is a continuous travel command against the "MOVI" command. Upon executing the travel command by the "MOVI" command, the travel command by the "MOVIA" command is executed continuously without a stop.
The varying speed point under the "MOVIA" command is at the deceleration start position of the operation by the preceding "MOVI" or "MOVIA" command.
The acceleration/deceleration time constants of the "MOVIA" command are set to the values at the execution of the preceding "MOVI" command.

Command	Name	Setting	Unit	Description
MOV	Absolute value travel command	MOV (Setting value)	$\times 10^{STM}$ m	Absolute value travel command
MOVA	Absolute value continuous travel command	MOVA (Setting value)	$\times 10^{STM}$ m	Absolute value continuous travel command
MOVI	Incremental value travel command	MOVI (Setting value)	$\times 10^{STM}$ m	Incremental value travel command
MOVIA	Incremental value continuous travel command	MOVIA (Setting value)	$\times 10^{STM}$ m	Incremental value continuous travel command

1) Program example 1

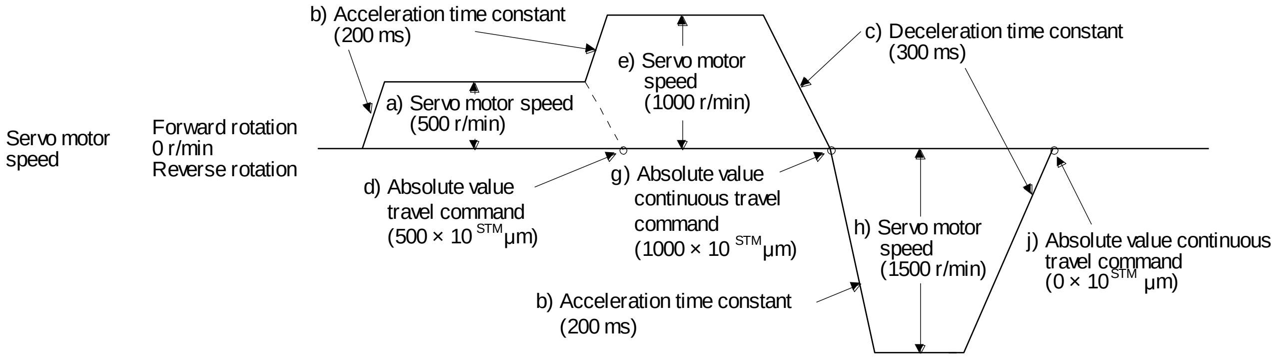
When using the absolute value travel command under the absolute value command method

Command	Description		
SPN (500)	Servo motor speed	500 [r/min]	a)
STA (200)	Acceleration time constant	200 [ms]	b)
STB (300)	Deceleration time constant	300 [ms]	c)
MOV (500)	Absolute value travel command	500 [×10^{STM} m]	d)
SPN (1000)	Servo motor speed	1000 [r/min]	e)
MOVA (1000)	Absolute value continuous travel command	1000 [×10^{STM} m]	f)
MOVA (0)	Absolute value continuous travel command	0 [×10^{STM} m]	g)
STOP	Program stop		



2) Program example 2 (Incorrect usage)
For continuous operations, the acceleration time constant and the deceleration time constant cannot be changed at each change of the servo motor speed. Therefore, even if you insert an "STA", "STB", or "STD" command at a speed change, the command is invalid.

Command	Description			
SPN (500)	Servo motor speed	500 [r/min]	a)	
STA (200)	Acceleration time constant	200 [ms]	b)	
STB (300)	Deceleration time constant	300 [ms]	c)	
MOV (500)	Absolute value travel command	500 [×10^{STM} m]	d)	
SPN (1000)	Servo motor speed	1000 [r/min]	e)	
STC (500)	Acceleration/deceleration time constant	500 [ms]	f)	Disabled
MOVA (1000)	Absolute value continuous travel command	1000 [×10^{STM} m]	g)	
SPN (1500)	Servo motor speed	1500 [r/min]	h)	Disabled
STC (100)	Acceleration/deceleration time constant	100 [ms]	i)	
MOVA (0)	Absolute value continuous travel command	0 [×10^{STM} m]	j)	
STOP	Program stop			



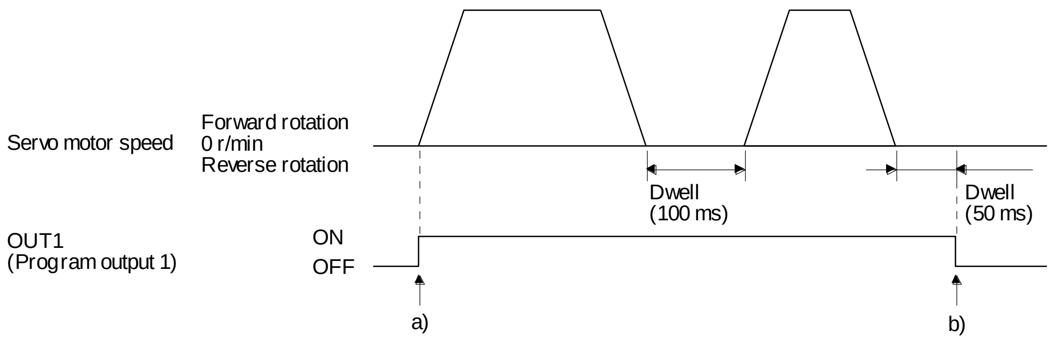
(c) Input/output commands (OUTON/OUTOF) and trip point commands (TRIP/TRIPI)

POINT
●Using [Pr. PT23] to [Pr. PT25], you can set the time until OUT1 (Program output 1) to OUT3 (Program output 3) are switched off. The commands are switched off under the following conditions. ・The commands are switched off by the OUTOF command. ・The commands are switched off by a program stop. ●The "TRIP" and "TRIPI" commands have the following restrictions. ・The "MOV" or "MOVA" command cannot be used in combination with the "TRIPI" command. ・The "MOVI" or "MOVIA" command cannot be used in combination with the "TRIP" command. ・The "TRIP" and "TRIPI" commands do not execute the next step until the servo motor passes the set address or travel distance. Set the commands within the travel command range. ・Determine whether the servo motor has passed the set address or travel distance by checking the actual position (for each command). Additionally, determine whether the servo motor has passed the set address or travel distance by checking both edges of the address increasing/decreasing directions.

1) Program example 1

OUT1 (Program output 1) is switched on upon a program execution. When the program ends, OUT1 (Program output 1) is switched off.

Command	Description		
SPN (1000)	Servo motor speed	1000 [r/min]	
STA (200)	Acceleration time constant	200 [ms]	
STB (300)	Deceleration time constant	300 [ms]	
MOV (500)	Absolute value travel command	500 [×10^{STM} m]	
OUTON (1)	Switch on OUT1 (Program output 1).		a)
TIM (100)	Dwell	100 [ms]	
MOV (250)	Absolute value travel command	250 [×10^{STM} m]	
TIM (50)	Dwell	50 [ms]	
STOP	Program stop		b)

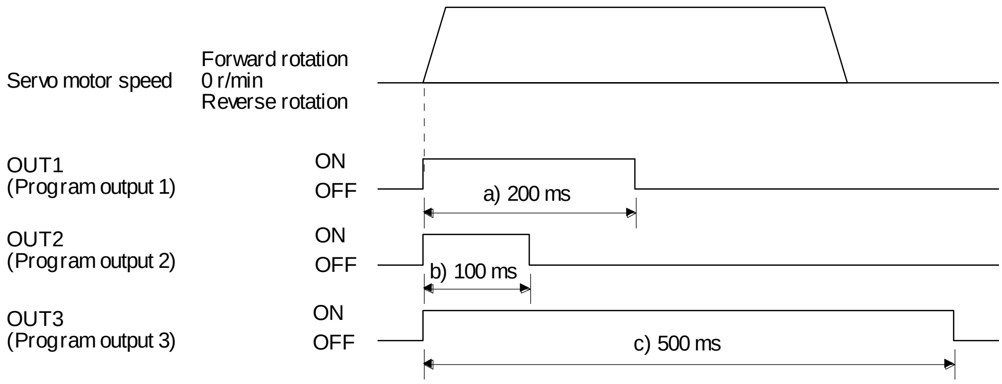


2) Program example 2

Using [Pr. PT23] to [Pr. PT25], you can switch off OUT1 (Program output 1) to OUT3 (Program output 3) automatically.

Parameter	Name	Setting value	Description
Pr. PT23	OUT1 output setting time	20	Switch off OUT1 200 [ms] later. a)
Pr. PT24	OUT2 output setting time	10	Switch off OUT2 100 [ms] later. b)
Pr. PT25	OUT3 output setting time	50	Switch off OUT3 500 [ms] later. c)

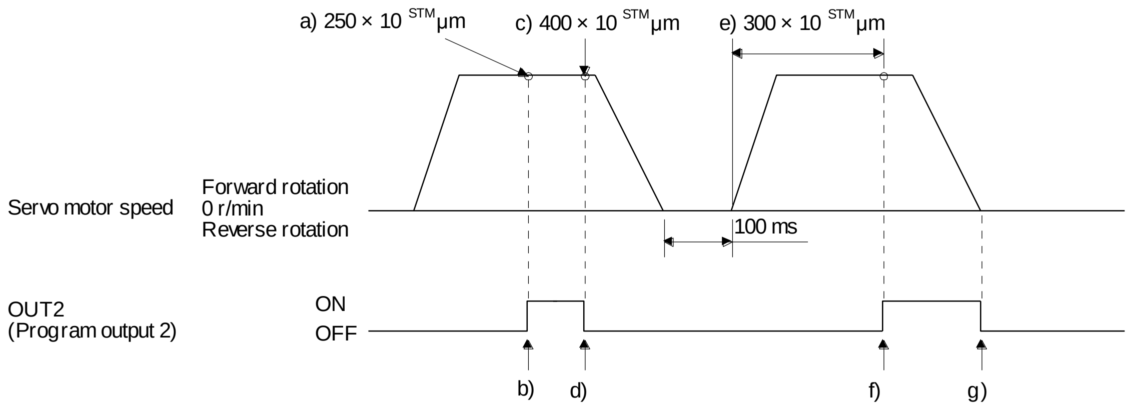
Command	Description	
SPN (500)	Servo motor speed	500 [r/min]
STA (200)	Acceleration time constant	200 [ms]
STB (300)	Deceleration time constant	300 [ms]
MOV (1000)	Absolute value travel command	1000 [×10^{STM} m]
OUTON (1)	Switch on OUT1 (Program output 1).	
OUTON (2)	Switch on OUT2 (Program output 2).	
OUTON (3)	Switch on OUT3 (Program output 3).	
STOP	Program stop	



3) Program example 3

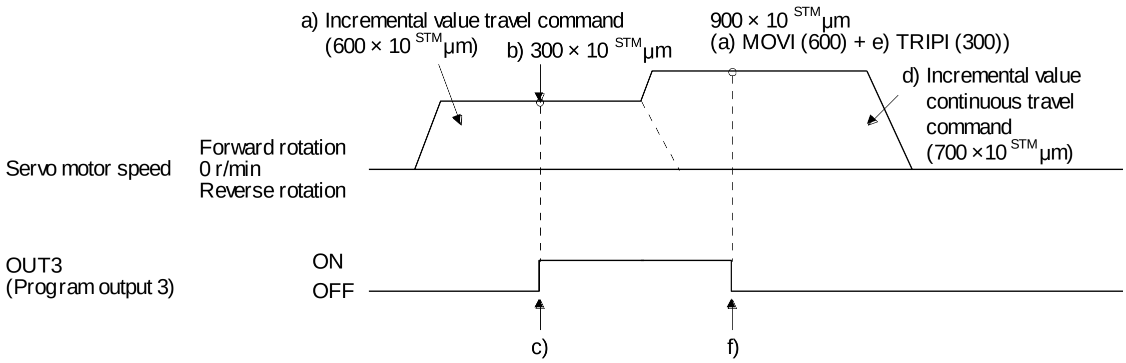
When setting the position address where the "OUTON" or "OUTOF" command is executed by using the "TRIP" or "TRIPI" command

Command	Description		
SPN (1000)	Servo motor speed	1000 [r/min]	
STA (200)	Acceleration time constant	200 [ms]	
STB (300)	Deceleration time constant	300 [ms]	
MOV (500)	Absolute value travel command	500 [×10^{STM} m]	
TRIP (250)	Absolute value trip point specification	250 [×10^{STM} m]	a)
OUTON (2)	Switch on OUT2 (Program output 2).		b)
TRIP (400)	Absolute value trip point specification	400 [×10^{STM} m]	c)
OUTOF (2)	Switch off OUT2 (Program output 2).		d)
TIM (100)	Dwell	100 [ms]	
MOVI (500)	Incremental value travel command	500 [×10^{STM} m]	
TRIPI (300)	Incremental value trip point specification	300 [×10^{STM} m]	e)
OUTON (2)	Switch on OUT2 (Program output 2).		f)
STOP	Program stop		g)



4) Program example 4

Command	Description		
SPN (500)	Servo motor speed	500 [r/min]	
STA (200)	Acceleration time constant	200 [ms]	
STB (300)	Deceleration time constant	300 [ms]	
MOVI (600)	Incremental value travel command	600 [$\times 10^{STM}$ m]	a)
TRIPI (300)	Incremental value trip point specification	300 [$\times 10^{STM}$ m]	b)
OUTON (3)	Switch on OUT3 (Program output 3).		c)
SPN (700)	Servo motor speed	700 [r/min]	
MOVIA (700)	Incremental value continuous travel command	700 [$\times 10^{STM}$ m]	d)
TRIPI (300)	Incremental value trip point specification	300 [$\times 10^{STM}$ m]	e)
OUTOF (3)	Switch off OUT3 (Program output 3).		f)
STOP	Program stop		



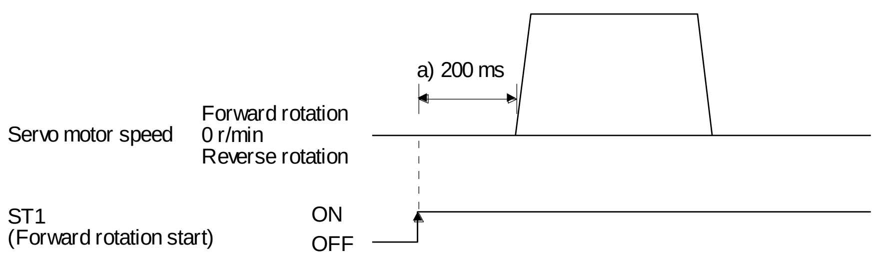
(d) Dwell (TIM)

Using the "TIM (setting value)" command, set the time from when the remaining distance under the command is "0" until when the next step is executed.

The following shows operation examples of using this command in combination with the other commands for reference.

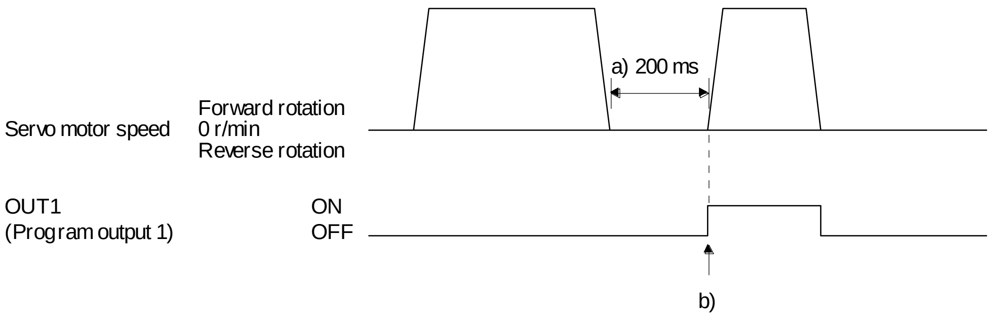
1) Program example 1

Command	Description		
TIM (200)	Dwell	200 [ms]	a)
SPN (1000)	Servo motor speed	1000 [r/min]	
STC (20)	Acceleration/deceleration time constant	20 [ms]	
MOV (1000)	Absolute value travel command	1000 [$\times 10^{STM}$ m]	
STOP	Program stop		



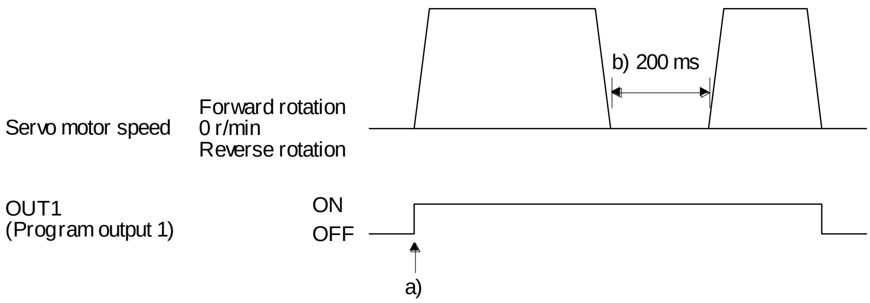
2) Program example 2

Command	Description		
SPN (1000)	Servo motor speed	1000 [r/min]	
STC (20)	Acceleration/deceleration time constant	20 [ms]	
MOVI (1000)	Incremental value travel command	1000 [×10^{STM} m]	
TIM (200)	Dwell	200 [ms]	a)
OUTON (1)	Switch on OUT1 (Program output 1).		b)
MOVI (500)	Incremental value travel command	500 [×10^{STM} m]	
STOP	Program stop		



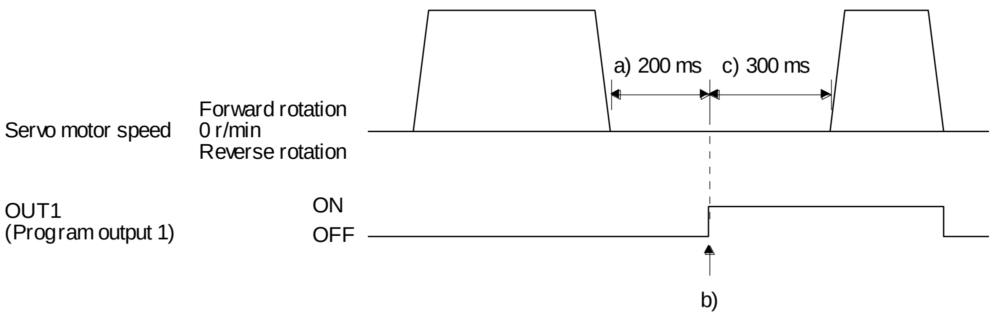
3) Program example 3

Command	Description		
SPN (1000)	Servo motor speed	1000 [r/min]	
STC (20)	Acceleration/deceleration time constant	20 [ms]	
MOVI (1000)	Incremental value travel command	1000 [×10^{STM} m]	
OUTON (1)	Switch on OUT1 (Program output 1).		a)
TIM (200)	Dwell	200 [ms]	b)
MOVI (500)	Incremental value travel command	500 [×10^{STM} m]	
STOP	Program stop		



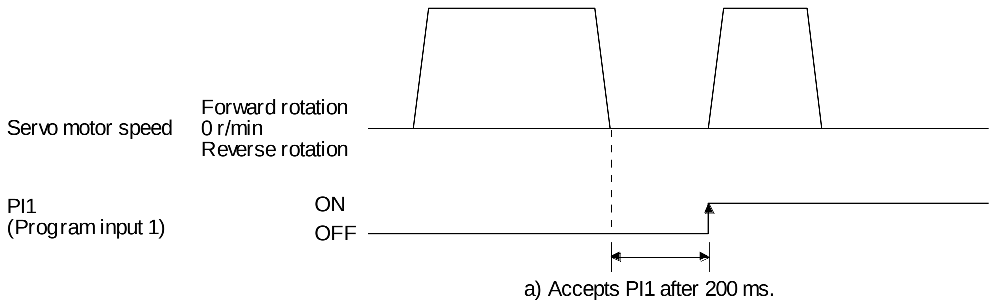
4) Program example 4

Command	Description		
SPN (1000)	Servo motor speed	1000 [r/min]	
STC (20)	Acceleration/deceleration time constant	20 [ms]	
MOVI (1000)	Incremental value travel command	1000 [$\times 10^{STM}$ m]	
TIM (200)	Dwell	200 [ms]	a)
OUTON (1)	Switch on OUT1 (Program output 1).		b)
TIM (300)	Dwell	300 [ms]	c)
MOVI (500)	Incremental value travel command	500 [$\times 10^{STM}$ m]	
STOP	Program stop		



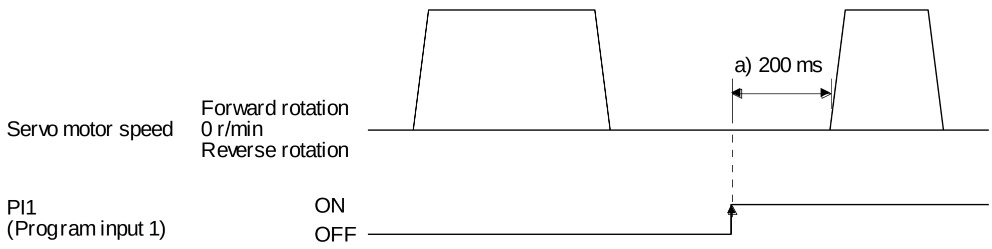
5) Program example 5

Command	Description		
SPN (1000)	Servo motor speed	1000 [r/min]	
STC (20)	Acceleration/deceleration time constant	20 [ms]	
MOVI (1000)	Incremental value travel command	1000 [$\times 10^{STM}$ m]	
TIM (200)	Dwell	200 [ms]	a)
SYNC (1)	Suspend the step until PI1 (Program input 1) is switched on.		
MOVI (500)	Incremental value travel command	500 [$\times 10^{STM}$ m]	
STOP	Program stop		



6) Program example 6

Command	Description		
SPN (1000)	Servo motor speed	1000 [r/min]	
STC (20)	Acceleration/deceleration time constant	20 [ms]	
MOVI (1000)	Incremental value travel command	1000 [$\times 10^{STM}$ m]	
SYNC (1)	Suspend the step until PI1 (Program input 1) is switched on.		
TIM (200)	Dwell	200 [ms]	a)
MOVI (500)	Incremental value travel command	500 [$\times 10^{STM}$ m]	
STOP	Program stop		



(e) Interrupt positioning (ITP)

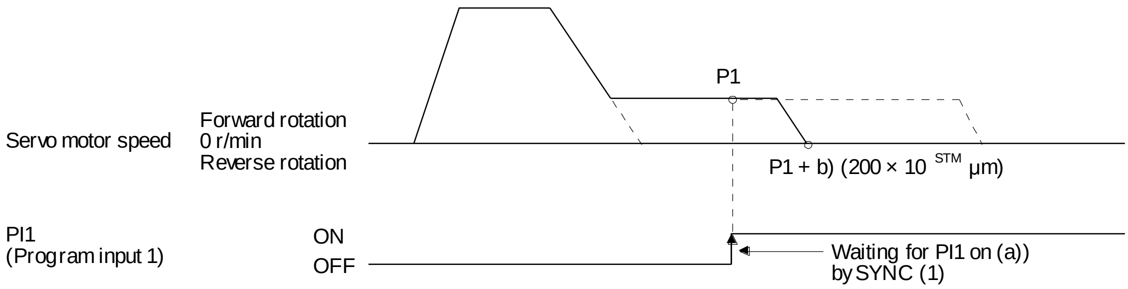
POINT

- For positioning with the "ITP" command, the stop position varies depending on the servo motor speed when the "ITP" command becomes enabled.
- In the following cases, the program does not execute the "ITP" command and proceeds to the next step.
  - When the setting value of the "ITP" command is smaller than that of the travel command set by the "MOV", "MOVI", or "MOVA" command
  - When the remaining distance under the "ITP" command is equal to or less than the travel distance under the "ITP" command
  - While the servo motor decelerates

When an "ITP" command is used in the program, starting from the position where PI1 (Program input 1) to PI3 (Program input 3) are switched on, the servo motor rotates a distance of the set value and stops.
When using the "ITP" command, make sure to position the command preceding a "SYNC" command.

1) Program example 1

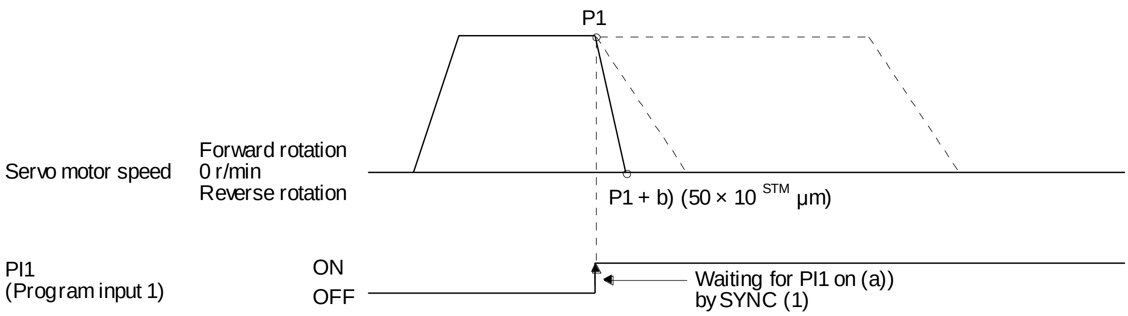
Command	Description		
SPN (500)	Servo motor speed	500 [r/min]	
STA (200)	Acceleration time constant	200 [ms]	
STB (300)	Deceleration time constant	300 [ms]	
MOV (600)	Absolute value travel command	600 [×10^{STM} m]	
SPN (100)	Servo motor speed	100 [r/min]	
MOVA (600)	Continuous travel command	600 [×10^{STM} m]	
SYNC (1)	Suspend the step until PI1 (Program input 1) is switched on.		a)
ITP (200)	Interrupt positioning	200 [×10^{STM} m]	b)
STOP	Program stop		



2) Program example 2

When the travel distance set by the "ITP" command is smaller than the travel distance required for deceleration, the actual deceleration time constant becomes smaller than the setting value of the "STB" command.

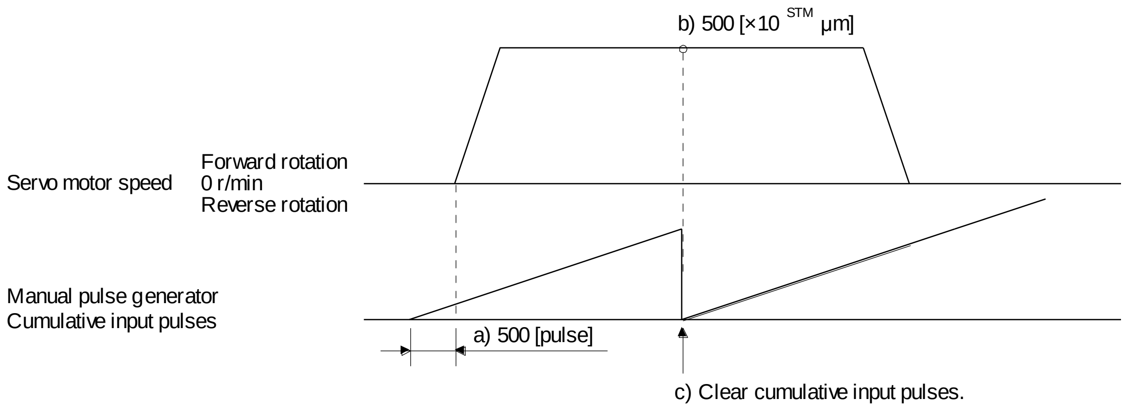
Command	Description		
SPN (500)	Servo motor speed	500 [r/min]	
STA (200)	Acceleration time constant	200 [ms]	
STB (300)	Deceleration time constant	300 [ms]	
MOV (1000)	Absolute value travel command	1000 [×10^{STM} m]	
SYNC (1)	Suspend the step until PI1 (Program input 1) is switched on.		a)
ITP (50)	Interrupt positioning	50 [×10^{STM} m]	b)
STOP	Program stop		



(f) External pulse count (COUNT)

When the number of input pulses of the manual pulse generator becomes larger than the value set for the "COUNT" command, the next step is executed. Setting "0" clears cumulative input pulses.

Command	Description		
COUNT (500)	Wait for the next step until the number of input pulses of the manual pulse generator reaches 500 [pulse]. a)		
SPN (500)	Servo motor speed	500 [r/min]	
STA (200)	Acceleration time constant	200 [ms]	
STB (300)	Deceleration time constant	300 [ms]	
MOV (1000)	Absolute value travel command	1000 [$\times 10^{STM}$ m]	
TRIP (500)	Trip point specification	500 [$\times 10^{STM}$ m]	b)
COUNT (0)	Clear cumulative input pulses.		c)
STOP	Program stop		

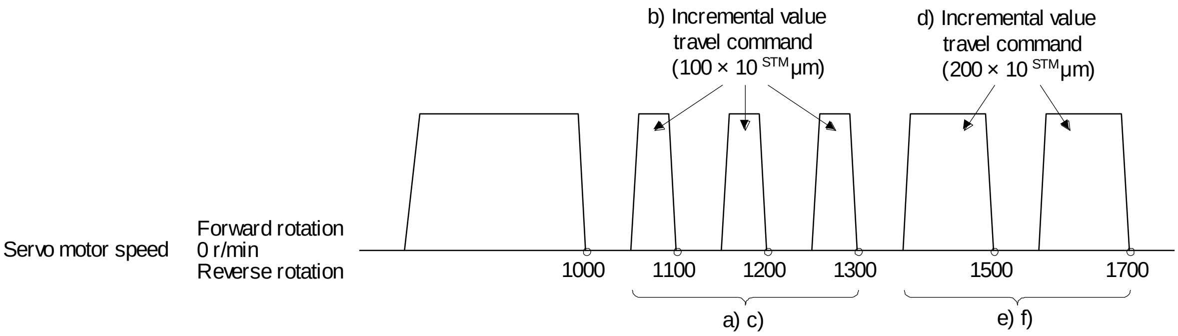


(g) Step repeat instruction (FOR...NEXT)

POINT
●You cannot insert "FOR...NEXT" commands between a "FOR" command and a "NEXT" command.

The steps between the "FOR (Setting value)" and the "NEXT" commands are repeated for the set number of times. Setting "0" repeats the operation endlessly.
For how to stop the program in this status, refer to section 5.2.4 (4).

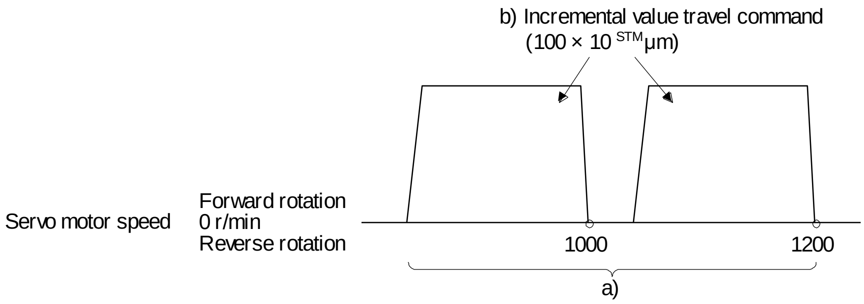
Command	Description		
SPN (1000)	Servo motor speed	1000 [r/min]	
STC (20)	Acceleration/deceleration time constant	20 [ms]	
MOV (1000)	Absolute value travel command	1000 [$\times 10^{STM}$ m]	
TIM (100)	Dwell	100 [ms]	
FOR (3)	Start of step repeat instruction	3 [time]	a)
MOVI (100)	Incremental value travel command	100 [$\times 10^{STM}$ m]	b)
TIM (100)	Dwell	100 [ms]	
NEXT	End of step repeat instruction		c)
FOR (2)	Start of step repeat instruction	2 [time]	d)
MOVI (200)	Incremental value travel command	200 [$\times 10^{STM}$ m]	e)
TIM (100)	Dwell	100 [ms]	
NEXT	End of step repeat instruction		f)
STOP	Program stop		



(h) Number of program executions command (TIMES)

By setting the number of program executions for the "TIMES (Setting value)" command, which is positioned at the start of the program, you can repeat the execution of the program. To execute the program one time, the "TIMES" command is not required. Setting "0" repeats the operation endlessly. For how to stop the program in this status, refer to section 5.2.4 (4).

Command	Description		
TIMES (2)	Number of program executions command	2 [time]	a)
SPN (1000)	Servo motor speed	1000 [r/min]	
STC (20)	Acceleration/deceleration time constant	20 [ms]	
MOVI (1000)	Incremental value travel command	1000 [×10^{STM} m]	b)
TIM (100)	Dwell	100 [ms]	
STOP	Program stop		

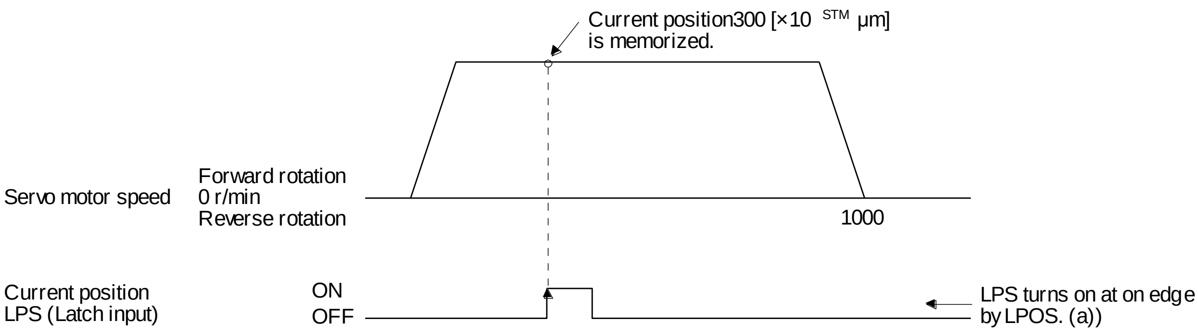


(i) Current position latch (LPOS)

POINT
●When the current position is stored using LPS (Current position latch input), the value varies depending on the servo motor speed at switch-on of LPS. ●The program does not proceeds to the next step until LPS (Current position latch input) is switched on. ●The stored data is not cleared without power-off of the driver. ●After the input of LPS (Current position latch input) becomes valid by the "LPOS" command, the input is cleared in the following conditions. ・When the rising edge of LPS (Current position latch input) is detected ・When the program ends ・When the operation mode is changed ・When the servo motor forcibly stops ・When an alarm occurs ・When the servo motor enters the servo-off status

The current position at switch-on of LPS (Current position latch input) is stored. The stored position data can be read with the communication function.
The current position latch function, which is set during the execution of the program, is reset when the program ends. The function is also reset at an operation mode change, forced stop, alarm occurrence, or servo-off. The function is not reset at a temporary stop only.

Command	Description		
SPN (500)	Servo motor speed	500 [r/min]	
STA (200)	Acceleration time constant	200 [ms]	
STB (300)	Deceleration time constant	300 [ms]	
MOV (1000)	Absolute value travel command	1000 [×10^{STM} m]	
LPOS	Set a current position latch.		a)
STOP	Program stop		



(j) Indirect specification with general purpose registers (R1 to R4, D1 to D4)

You can indirectly specify the setting values of the "SPN", "STA", "STB", "STC", "STD", "MOV", "MOVI", "MOVA", "MOVIA", "TIM", and "TIMES" commands.

The value, which is stored in each general purpose register (R1 to R4, D1 to D4), is used as the setting value of each command.

While the program is not executed by a communication command, you can change the general purpose registers by using Setup software (MR Configurator2™) or a communication command.

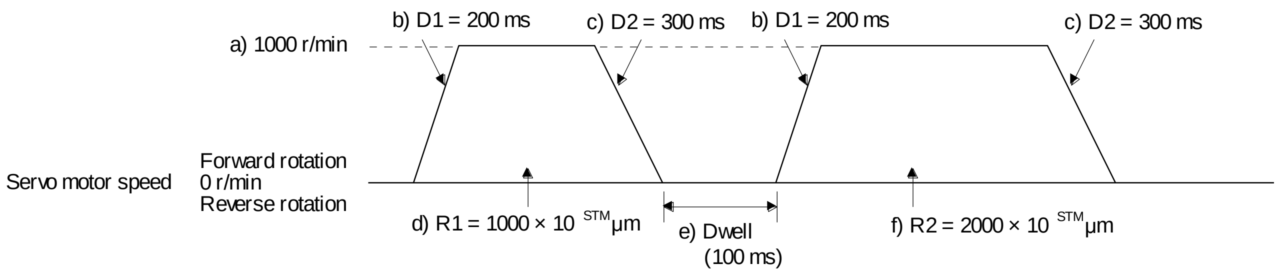
The data of the general purpose registers is erased at power-off of the driver. Note that you can store the data of the general purpose registers (R1 to R4) in EEP-ROM.

The setting range of each general purpose register is that of the instruction for which each register is used.

The following explains a case where the general purpose registers are set as shown below before the execution of the program.

General purpose register	Setting
R1	1000
R2	2000
D1	200
D2	300

Command	Description		
SPN (1000)	Servo motor speed	1000 [r/min]	a)
STA (D1)	Acceleration time constant	D1 = 200 [ms]	b)
STB (D2)	Deceleration time constant	D2 = 300 [ms]	c)
MOVI (R1)	Incremental value travel command	R1 = 1000 [×10^STM m	d)
TIM (100)	Dwell	100 [ms]	e)
MOVI (R2)	Incremental value travel command	R2 = 2000 [×10^STM m	f)
STOP	Program stop		

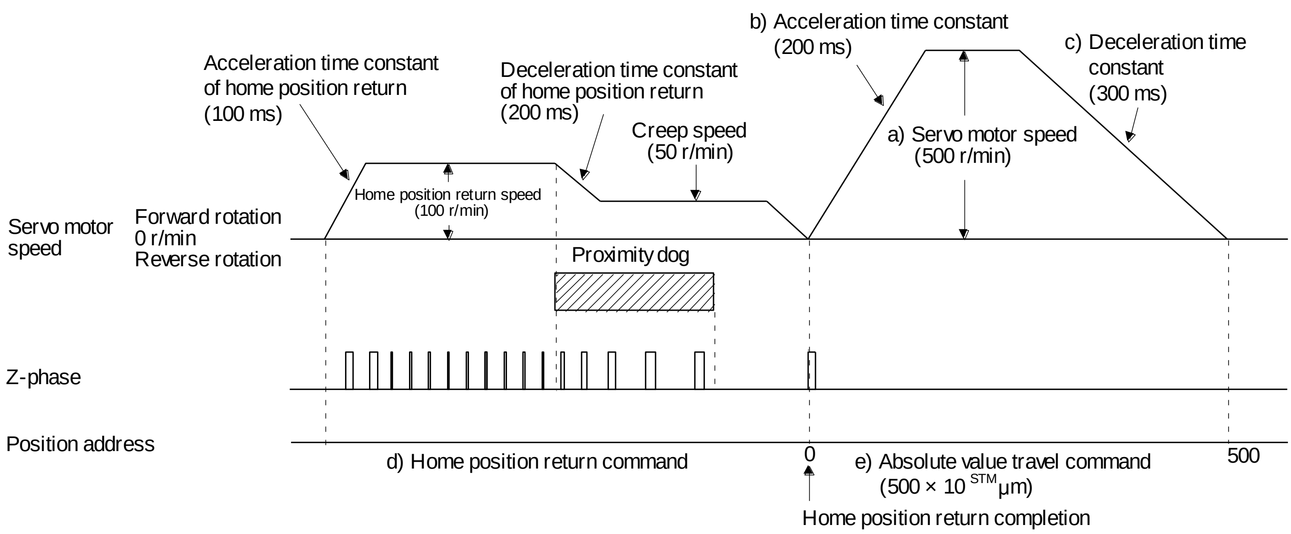


(k) Home position return command (ZRT)
Perform a home position return.
Set the home position with a parameter. (Refer to section 5.4.)
With the "ZRT" command, the program proceeds to the next step after the home position return completion.

POINT
●If the home position return has not completed successfully, [AL. 96 Home position return incomplete warning] occurs. In this case, the program proceeds to the next step without a stop. Since the home position return is incomplete, the travel command is invalid.

Command	Description		
SPN (500)	Servo motor speed	500 [r/min]	a)
STA (200)	Acceleration time constant	200 [ms]	b)
STB (300)	Deceleration time constant	300 [ms]	c)
ZRT	Home position return		d)
MOV (500)	Absolute value travel command	500 [$\times 10^{STM}$ m]	e)
STOP	Program stop		

Item	Used parameter	Setting
Dog type home position return	[Pr. PT04]	"_ _ _ 0"
Home position return direction	[Pr. PT04]	"_ _ 0 _" (Address increasing direction)
Dog input polarity	[Pr. PT29]	"_ _ _ 1" (Detects dog when DOG (proximity dog) is on.)
Home position return speed	[Pr. PT05]	100 [r/min]
Creep speed	[Pr. PT06]	50 [r/min]
Home position shift distance	[Pr. PT07]	0 [$\times 10^{STM}$ m]
Home position return acceleration time constant	[Pr. PC30]	100 [ms]
Home position return deceleration time constant	[Pr. PC31]	200 [ms]
Home position return position data	[Pr. PT08]	0

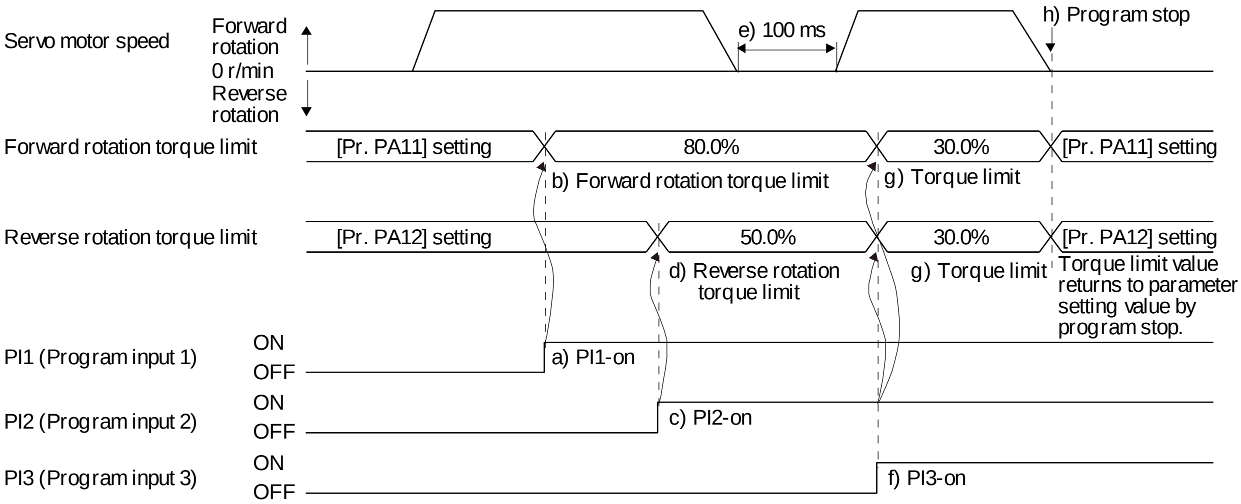


(l) Torque limit value switching (TLP/TLN/TQL)

Using the maximum torque as 100.0%, limit the generated torque of the servo motor.

1) Program example

Command	Description		
SPN (1500)	Servo motor speed	1500 [r/min]	
STA (100)	Acceleration time constant	100 [ms]	
STB (200)	Deceleration time constant	200 [ms]	
MOV (1000)	Absolute value travel command	1000 [×10^{STM} m]	
SYNC (1)	Suspend the step until PI1 (Program input 1) is switched on.		a)
TLP (800)	Forward rotation torque limit	800 [0.1%]	b)
SYNC (2)	Suspend the step until PI2 (Program input 2) is switched on.		c)
TLN (500)	Reverse rotation torque limit	500 [0.1%]	d)
TIM (100)	Dwell	100 [ms]	e)
MOV (500)	Absolute value travel command	1000 [×10^{STM} m]	
SYNC (3)	Suspend the step until PI3 (Program input 3) is switched on.		f)
TQL (300)	Torque limit	300 [0.1%]	g)
STOP	Program stop		h)



16.11.3 Basic settings of signals and parameters

(1) Parameter

(a) Setting range of the position data

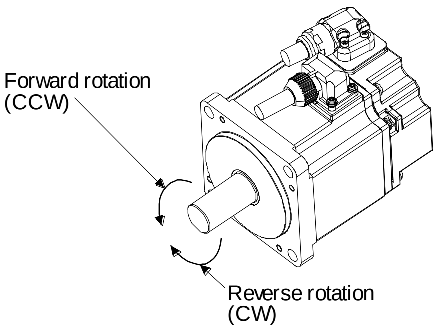
The following shows the setting of [Pr. PA01].

Command method	Travel command	[Pr. PT01] Positioning command method	[Pr. PT01] Position data unit		Position data input range
Absolute value command method	Absolute value travel command ("MOV", "MOVA")	_ _ _ 0	_ 0 _ _	[mm]	-999999 to 999999 [$\times10^{STM}$ m]
			_ 1 _ _	[inch]	-999999 to 999999 [$\times10^{(STM-4)}$ inch]
			_ 2 _ _	[degree]	-360.000 to 360.000
			_ 3 _ _	[pulse]	-999999 to 999999
	Incremental value travel command ("MOVI", "MOVIA")		_ 0 _ _	[mm]	-999999 to 999999 [$\times10^{STM}$ m]
			_ 1 _ _	[inch]	-999999 to 999999 [$\times10^{(STM-4)}$ inch]
			_ 2 _ _	[degree]	-999.999 to 999.999
			_ 3 _ _	[pulse]	-999999 to 999999
Incremental value command method	Incremental value travel command ("MOVI", "MOVIA")	_ _ _ 1	_ 0 _ _	[mm]	-999999 to 999999 [$\times10^{STM}$ m]
			_ 1 _ _	[inch]	-999999 to 999999 [$\times10^{(STM-4)}$ inch]
			_ 2 _ _	[degree]	-999.999 to 999.999
			_ 3 _ _	[pulse]	-999999 to 999999

(b) Rotation direction selection/travel direction selection ([Pr. PA14])

Select the servo motor rotation direction when ST1 (Forward rotation start) is switched on.

[Pr. PA14] setting	Servo motor rotation direction when ST1 (Forward rotation start) is switched on
0 (Initial value)	CCW rotation with + position data CW rotation with - position data
1	CW rotation with + position data CCW rotation with - position data



(c) Feed length multiplication ([Pr. PT03])

Set the feed length multiplication factor (STM) of the position data.

[Pr. PT03] setting	Position data input range			
	[mm]	[inch]	[degree] (Note)	[pulse] (Note)
_ _ _ 0 (Initial value)	-999.999 to 999.999	-99.9999 to 99.9999	-360.000 to 360.000	-999999 to 999999
_ _ _ 1	-9999.99 to 9999.99	-999.999 to 999.999		
_ _ _ 2	-99999.9 to 99999.9	-9999.99 to 9999.99		
_ _ _ 3	-999999 to 999999	-99999.9 to 99999.9		

Note. The feed length multiplication setting ([Pr. PT03]) is not applied to the unit multiplication factor. Adjust the unit multiplication factor in the electronic gear setting ([Pr. PA06] and [Pr. PA07]).

(2) Signal

Select a program with DI0 to DI7 and switch on ST1 to perform the positioning operation according to the set program. At this time, ST2 (Reverse rotation start) is invalid.

Item	Used device	Setting
Program operation method selection	MD0 (Operation mode selection 1)	Switch on MD0.
Program selection	DI0 (Program No. selection 1) DI1 (Program No. selection 2) DI2 (Program No. selection 3) DI3 (Program No. selection 4) DI4 (Program No. selection 5) DI5 (Program No. selection 6) DI6 (Program No. selection 7) DI7 (Program No. selection 8)	Refer to section 2.3 (1).
Start	ST1 (Forward rotation start)	Switch on ST1 to execute the program operation.

16.11.4 Timing chart of the program operation

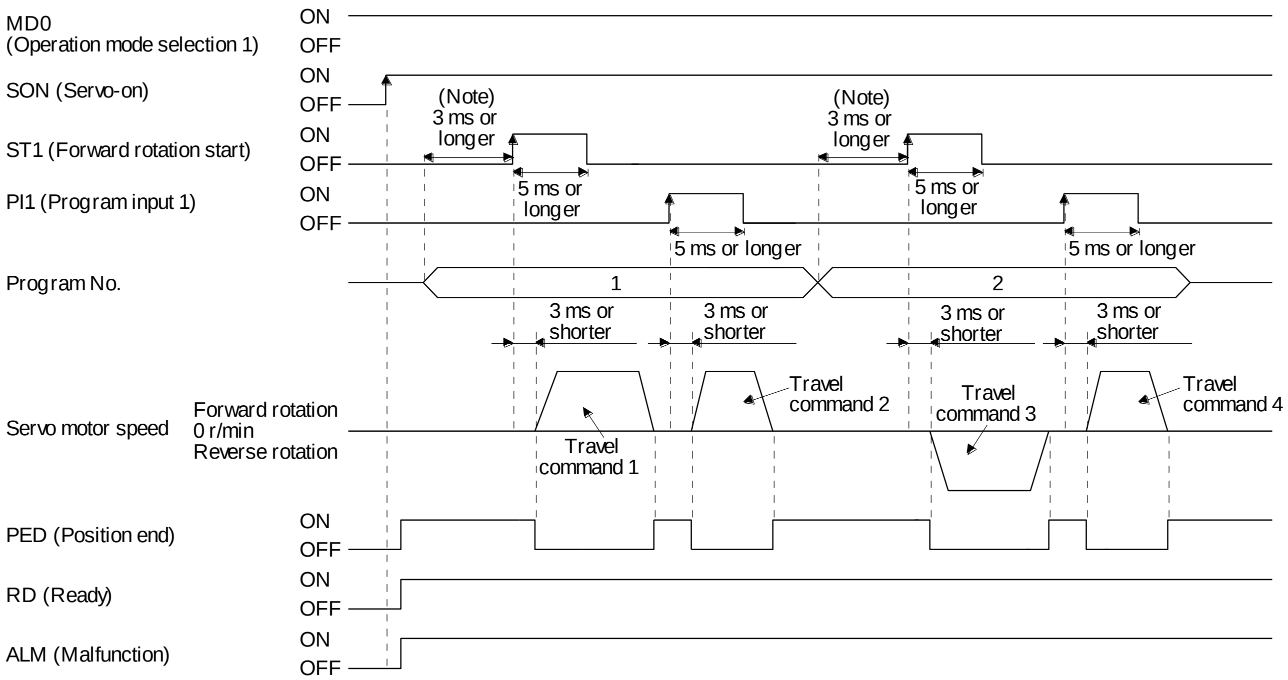
(1) Operation condition

The following shows a timing chart when the program below is executed after the home position return completion under the absolute value command method.

Program No.	Description		
SPN (1000)	Servo motor speed	1000 [r/min]	
STC (100)	Acceleration/deceleration time constant	100 [ms]	
MOV (5000)	Absolute value travel command	5000 [$\times 10^{STM}$ m]	Travel command 1
SYNC (1)	Suspend the step until PI1 (Program input 1) is switched on.		
STC (50)	Acceleration/deceleration time constant	50 [ms]	
MOV (7500)	Absolute value travel command	7500 [$\times 10^{STM}$ m]	Travel command 2
STOP	Program stop		

Program No.	Description		
SPN (1000)	Servo motor speed	1000 [r/min]	
STC (100)	Acceleration/deceleration time constant	100 [ms]	
MOV (2500)	Absolute value travel command	2500 [$\times 10^{STM}$ m]	Travel command 3
SYNC (1)	Suspend the step until PI1 (Program input 1) is switched on.		
STC (50)	Acceleration/deceleration time constant	50 [ms]	
MOV (5000)	Absolute value travel command	5000 [$\times 10^{STM}$ m]	Travel command 4
STOP	Program stop		

(2) Timing chart



Note. The detection of external input signals is delayed by the set time in the input filter setting of [Pr. PD29]. Considering the output signal sequence from PC or PLC...etc and signal variations due to hardware, configure a sequence that changes the program selection earlier.

(3) Temporary stop/restart

When TSTP is switched on during the automatic operation, deceleration is performed using the deceleration time constant under the executing travel command to make a temporary stop. An operation for the remaining travel distance will be started by switching TSTP off and on (on-edge detection).
This function will not operate even if ST1 (Forward rotation start) is switched on during the temporary stop. When the operation mode is changed from the automatic mode to the manual mode during the temporary stop, the remaining travel distance is cleared and the program ends. Switching on TSTP again will not restart the program. To start the program, switch on ST1 (Forward rotation start) again.
The temporary stop/restart input does not function during a home position return or JOG operation.
The timing chart is the same as that of the point table operation mode. Refer to 4.2.2 (3) (e).

(4) How to stop the program

To stop the executing program, switch on TSTP (Temporary stop/restart) to stop the positioning operation, and then switch on CR (Clear). At this time, the remaining distance under the command is cleared, and the program ends.
Switching on TSTP again will not restart the positioning operation.
To start the program, switch on ST1 (Forward rotation start) again.

(5) Program termination condition

The following shows the conditions for terminating the executing program.

Termination condition	Restart condition
Execution of STOP (Program stop)	Switch on ST1 (Forward rotation start). The program starts from the beginning.
When switching the automatic operation mode to the manual operation mode	After switching the mode to the automatic operation mode, switch on ST1. The program starts from the beginning.
When the hardware stroke limit is detected	After LSP and LSN are switched on, switch on ST1. The program starts from the beginning.
When the software stroke limit is detected ([Pr. PT15] to [Pr. PT18])	After the machine travels to the software stroke limit range, switch on ST1. The program starts from the beginning.
At base circuit shut-off	After resetting the base circuit shut-off, switch on ST1. The program starts from the beginning.

16.12 MANUAL OPERATION MODE

For the machine adjustment, home position adjustment, and others, you can shift the position to any position with a JOG operation or manual pulse generator.

16.12.1 JOG operation

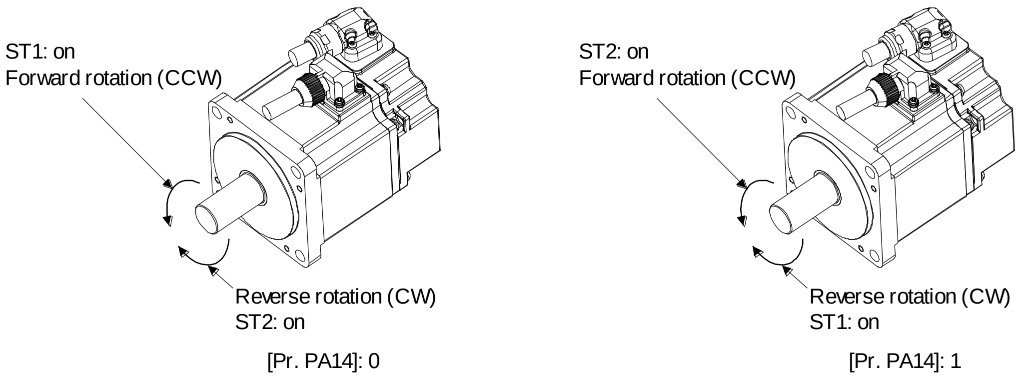
(1) Setting

According to the purpose of use, set input signals and parameters as shown below. In this case, DI0 (Program No. selection 1) to DI7 (Program No. selection 8) are invalid.

Item	Used device/parameter	Setting
Manual operation mode selection	MD0 (Operation mode selection 1)	Switch off MD0.
Servo motor rotation direction	[Pr. PA14]	Refer to (2) of this section.
JOG speed	[Pr. PT13]	Set the servo motor speed.
Acceleration time constant	[Pr. PC01]	Set the acceleration time constant.
Deceleration time constant	[Pr. PC02]	Set the deceleration time constant.
S-pattern acceleration	[Pr. PC03]	Set the S-pattern acceleration.

(2) Servo motor rotation direction

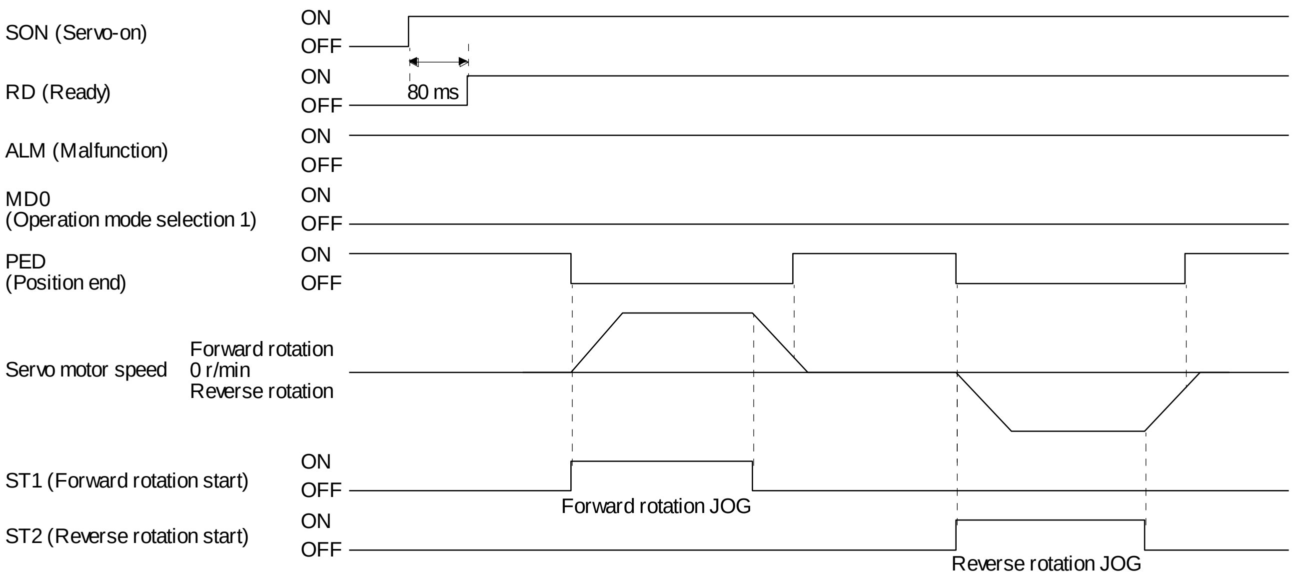
[Pr. PA14] setting	Servo motor rotation direction	
	ST1 (Forward rotation start) on	ST2 (Reverse rotation start) on
0	CCW rotation	CW rotation
1	CW rotation	CCW rotation



(3) Operation

When ST1 is switched on, the servo motor rotates using the JOG speed set in [Pr. PT13] and the acceleration/deceleration constants set with [Pr. PC02] and [Pr. PC03]. For the rotation direction, refer to (2) of this section. Switching on ST2 rotates the servo motor opposite to the direction of ST1 (Forward rotation start).

(4) Timing chart



16.12.2 Summary of home position return

CAUTION
- Check the proximity dog input polarity. Doing so may cause overrun and failure.

POINT
- Before performing the home position return, make sure that the limit switch operates.
- Check the home position return direction. An incorrect setting will cause a reverse running.

A home position return is performed to match the command coordinates with the machine coordinates. Under the incremental method, each power-on of the input power supply requires the home position return. In the absolute position detection system, once you have performed the home position return at machine installation, the current position will be retained even if the power supply is shut off. Therefore, the home position return is unnecessary when the power supply is switched on again.
This section shows the home position return methods of the driver. Select the optimum method according to the configuration and uses of the machine.
This driver has the home position return automatic retract function. When the machine stops beyond or on a proximity dog, this function automatically moves the machine back to the proper position to perform the home position return. Manually moving the machine by the JOG operation or others is unnecessary.

(1) Home position return type
Select the optimum home position return type according to the machine type or others.

Type	Home position return method	Feature
Dog type	Deceleration starts at the front end of a proximity dog. After the rear end is passed, the position specified by the first Z-phase signal or the position of the first Z-phase signal shifted by the specified home position shift distance is used as the home position. The driver internally recognizes the Z-phase signal one time per servo motor revolution. The Z-phase signal cannot be used as an output signal.	・General home position return method using a proximity dog ・The repeatability of the home position return is high. ・The machine is less loaded. ・Used when the width of the proximity dog can be set equal to or greater than the deceleration distance of the servo motor.
Count type	Deceleration starts at the front end of a proximity dog. After the rear end is passed, the position is shifted by the travel distance. Then, the position specified by the first Z-phase signal or the position of the Z-phase signal shifted by the specified home position shift distance is used as the home position.	・Home position return method using a proximity dog ・Used to minimize the length of the proximity dog.
Data set type	The position shifted by any distance manually is used as the home position.	・No proximity dog is required.
Stopper type	A workpiece is pressed against a mechanical stopper, and the position where it is stopped is used as the home position.	・Since the workpiece collides with the mechanical stopper, the home position return speed must be low enough. ・The strength of the machine and stopper must be increased.
Home position ignorance (servo-on position as home position)	The position at servo-on is used as the home position.	
Dog type rear end reference	Deceleration starts at the front end of a proximity dog. After the rear end is passed, the position is shifted by the travel distance after proximity dog and the home position shift distance. The position after the shifts is used as the home position.	・The Z-phase signal is not required.
Count type front end reference	Deceleration starts at the front end of a proximity dog. The position is shifted by the travel distance after proximity dog and the home position shift distance. The position after the shifts is used as the home position.	・The Z-phase signal is not required.
Dog cradle type	After the front end of a proximity dog is detected, the position specified by the first Z-phase signal is used as the home position.	
Dog type last Z-phase reference	After the front end of a proximity dog is detected, the position is shifted away from the proximity dog in the reverse direction. Then, the position specified by the first Z-phase signal or the position of the first Z-phase signal shifted by the home position shift distance is used as the home position.	
Dog type front end reference	Starting from the front end of a proximity dog, the position is shifted by the travel distance after proximity dog and the home position shift distance. The position after the shifts is used as the home position.	・The Z-phase signal is not required.
Dogless Z-phase reference	The position specified by the first Z-phase signal, or the position of the first Z-phase signal shifted by the home position shift distance is used as the home position.	

(2) Parameters for home position return
To perform the home position return, set each parameter as follows.

(a) Select the home position return type with [Pr. PT04 Home position return type].

[Pr. PT04]

0	0	0	

Home position return type
0: Dog type (rear end detection, Z-phase reference)
1: Count type (front end detection, Z-phase reference)
2: Data set type
3: Stopper type
4: Home position ignorance (servo-on position as home position)
5: Dog type (rear end detection, rear end reference)
6: Count type (front end detection, front end reference)
7: Dog cradle type
8: Dog type (front end detection, Z-phase reference)
9: Dog type (front end detection, front end reference)
A: Dogless type (Z-phase reference)

(b) Select the starting direction for the home position return with [Pr. PT04 Home position return type]. Setting "0" starts the home position return in the address increase direction from the current position. Setting "1" starts the home position return in the address decrease direction from the current position.

[Pr. PT04]

0	0		0

Home position return direction
0: Address increasing direction
1: Address decreasing direction

(c) Select the polarity where the proximity dog is detected with the DOG (Proximity dog) polarity selection of [Pr. PT29 Function selection T-3]. Setting "0" detects the dog when DOG (Proximity dog) is off. Setting "1" detects the dog when DOG (Proximity dog) is on.

[Pr. PT29]

0	0	0	

DOG (Proximity dog) polarity selection
0: Detection with off
1: Detection with on

(3) Program
Select a program containing a "ZRT" command, which performs the home position return.

16.12.3 Dog type home position return

This is a home position return method using a proximity dog. Deceleration starts at the front end of the proximity dog. After the rear end is passed, the position specified by the first Z-phase signal, or the position of the first Z-phase signal shifted by the specified home position shift distance is used as the home position.

(1) Device/parameter

Set input devices and parameters as shown below.

Item	Used device/parameter	Setting
Automatic operation mode of the program method	MD0 (Operation mode selection 1)	Switch on MD0.
Dog type home position return	[Pr. PT04]	_ _ _ 0: Select the dog type (rear end detection/Z-phase reference).
Home position return direction	[Pr. PT04]	Refer to (2) of section 5.4.1 to select the home position return direction.
Dog input polarity	[Pr. PT29]	Refer to (2) of section 5.4.1 to select the dog input polarity.
Home position return speed	[Pr. PT05]	Set the rotation speed specified until a dog is detected.
Creep speed	[Pr. PT06]	Set the rotation speed specified after a dog is detected.
Home position shift distance	[Pr. PT07]	Set this item to shift the home position, which is specified by the first Z-phase signal after the rear end of a proximity dog is passed.
Home position return acceleration time constant	[Pr. PC30]	The acceleration time constant set for [Pr. PC30] is used.
Home position return deceleration time constant	[Pr. PC31]	The deceleration time constant set for [Pr. PC31] is used.
Home position return position data	[Pr. PT08]	Set the current position at the home position return completion.
Program	DI0 (Program No. selection 1) to DI7 (Program No. selection 8)	Select a program containing a "ZRT" command, which performs the home position return.

(2) Length of the proximity dog

To generate the Z-phase signal of the servo motor during the detection of DOG (Proximity dog), set the length of the proximity dog that satisfies equations (5.1) and (5.2).

$$L_1 \geq \frac{V}{60} \quad \frac{td}{2} \quad \cdots\cdots (5.1)$$

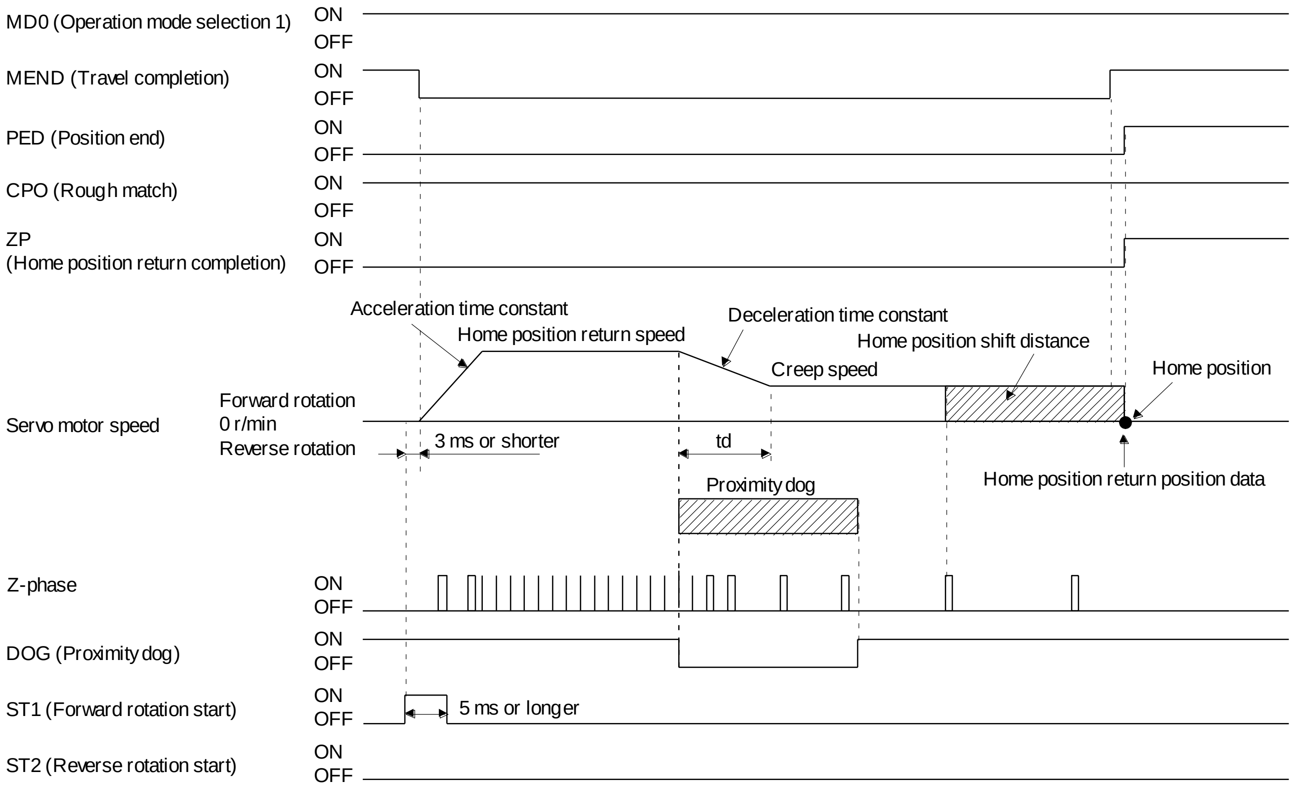
L_1: Length of the proximity dog [mm]
V: Home position return speed [mm/min]
td: Deceleration time [s]

$$L_2 \geq 2 \quad S \quad \cdots\cdots (5.2)$$

L_2: Length of the proximity dog [mm]
S:Travel distance per servo motor revolution [mm]

(3) Timing chart

The following shows a timing chart after a program containing a "ZRT" command is selected.

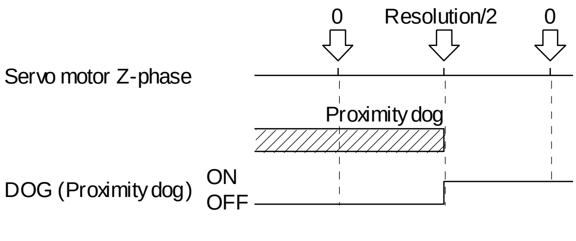


The setting value of [Pr. PT08 Home position return position data] is used as the position address at the home position return completion.

(4) Adjustment

For the dog type home position return, adjust the setting so that the Z-phase signal is always generated during the detection of a dog. Make an adjustment so that the rear end of DOG (Proximity dog) is positioned almost at the center between the position specified by a Z-phase signal and the position specified by the next Z-phase signal.

The generation position of the Z-phase signal can be checked with "Position within one-revolution" of "Status Display" on Setup software (MR Configurator2^{TM}).



16.12.4 Count type home position return

For the count type home position return, after the front end of a proximity dog is detected, the position is shifted by the distance set for [Pr. PT09 Travel distance after proximity dog]. Then, the position specified by the first Z-phase signal is used as the home position. Therefore, when the on time of DOG (Proximity dog) is 10 ms or more, the length of the proximity dog has no restrictions. Use the count type home position return when you cannot use the dog type home position return because the length of the proximity dog cannot be reserved, when you input DOG (Proximity dog) electrically from the PC or PLC...etc, or other cases.

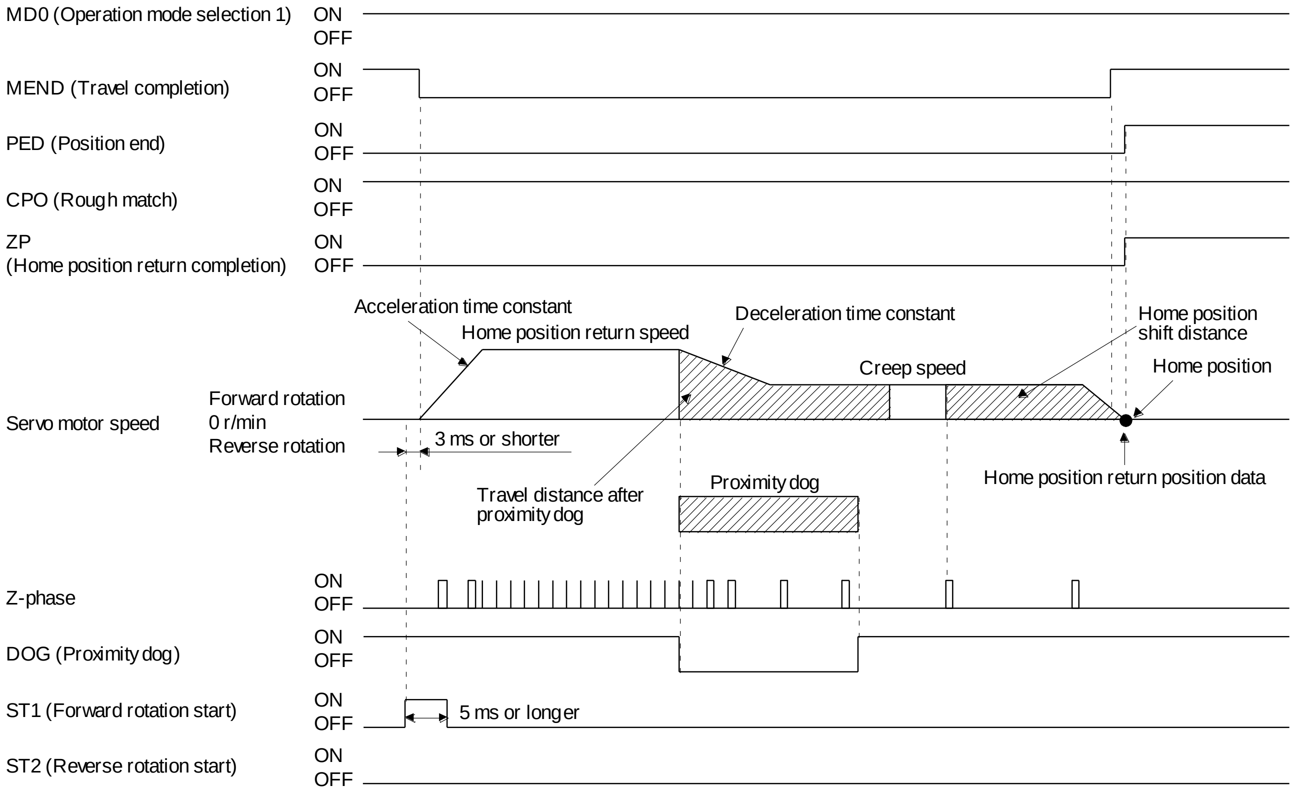
(1) Device/parameter

Set input devices and parameters as shown below.

Item	Used device/parameter	Setting
Automatic operation mode of the program method	MD0 (Operation mode selection 1)	Switch on MD0.
Count type home position return	[Pr. PT04]	_ _ _ 1: Select the count type (front end detection Z-phase reference).
Home position return direction	[Pr. PT04]	Refer to (2) of section 5.4.1 to select the home position return direction.
Dog input polarity	[Pr. PT29]	Refer to (2) of section 5.4.1 to select the dog input polarity.
Home position return speed	[Pr. PT05]	Set the rotation speed specified until a dog is detected.
Creep speed	[Pr. PT06]	Set the rotation speed specified after a dog is detected.
Home position shift distance	[Pr. PT07]	After the front end of a proximity dog is passed, the position is shifted by the travel distance and then is specified by the first Z-phase signal. Set this item to shift the position of the first Z-phase signal.
Travel distance after proximity dog	[Pr. PT09]	Set the travel distance specified after the front end of the proximity dog is passed.
Home position return acceleration time constant	[Pr. PC30]	The acceleration time constant set for [Pr. PC30] is used.
Home position return deceleration time constant	[Pr. PC31]	The deceleration time constant set for [Pr. PC31] is used.
Home position return position data	[Pr. PT08]	Set the current position at the home position return completion.
Program	DI0 (Program No. selection 1) to DI7 (Program No. selection 8)	Select a program containing a "ZRT" command, which performs the home position return.

(2) Timing chart

The following shows a timing chart after a program containing a "ZRT" command is selected.



The setting value of [Pr. PT08 Home position return position data] is used as the position address at the home position return completion.

16.12.5 Data set type home position return

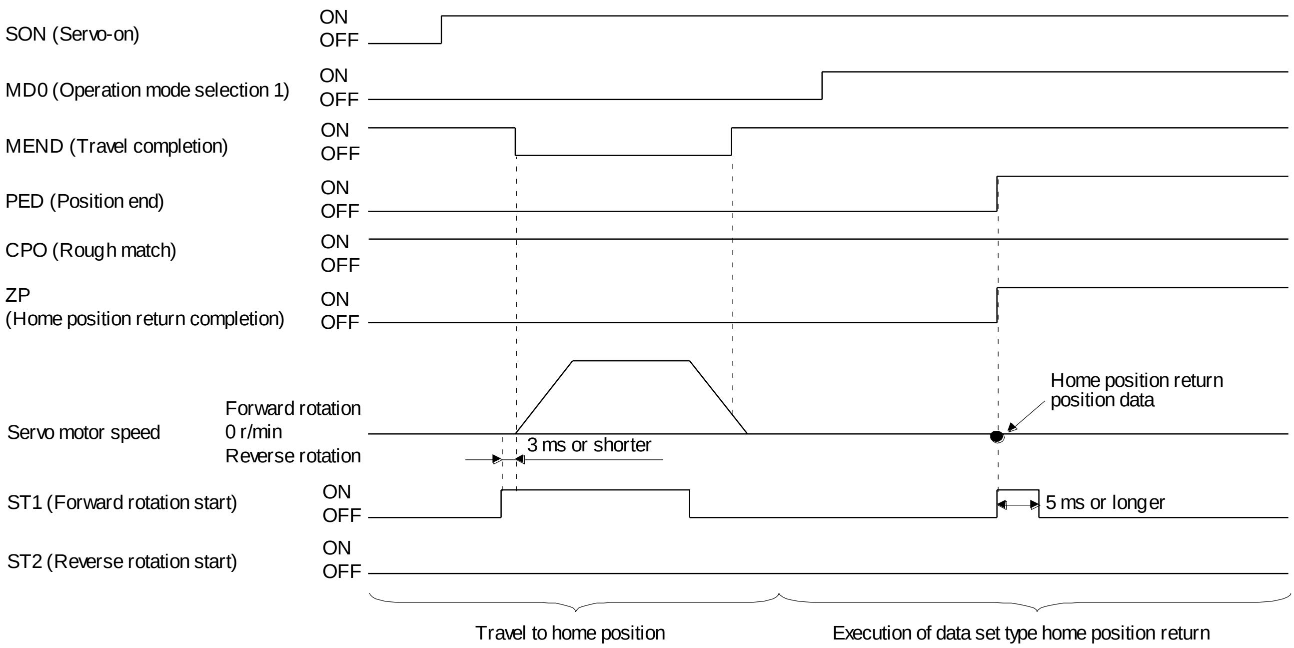
To specify any position as the home position, use the data set type home position return. To shift the position, you can use the JOG operation, the manual pulse generator operation, or others. The data set type home position return can be performed only at servo-on.

(1) Device/parameter

Set input devices and parameters as shown below.

Item	Used device/parameter	Setting
Automatic operation mode of the program method	MD0 (Operation mode selection 1)	Switch on MD0.
Data set type home position return	[Pr. PT04]	_ _ _ 2: Select the data set type.
Home position return position data	[Pr. PT08]	Set the current position at the home position return completion.
Program	DI0 (Program No. selection 1) to DI7 (Program No. selection 8)	Select a program containing a "ZRT" command, which performs the home position return.

(2) Timing chart



The setting value of [Pr. PT08 Home position return position data] is used as the position address at the home position return completion.

16.12.6 Stopper type home position return

For the stopper type home position return, by using the JOG operation, manual pulse generator operation, or others, a workpiece is pressed against a mechanical stopper, and the position where it is stopped is used as the home position.

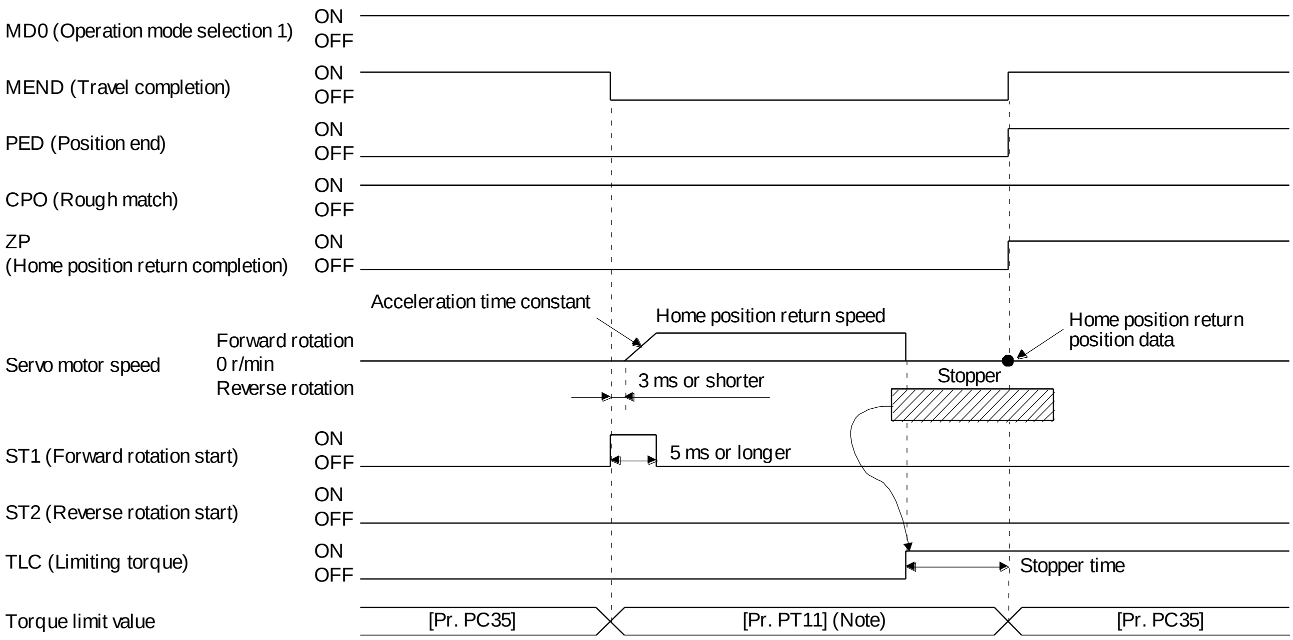
(1) Device/parameter

Set input devices and parameters as shown below.

Item	Used device/parameter	Setting
Automatic operation mode of the program method	MD0 (Operation mode selection 1)	Switch on MD0.
Stopper type home position return	[Pr. PT04]	_ _ _ 3: Select the stopper type.
Home position return direction	[Pr. PT04]	Refer to (2) of section 5.4.1 to select the home position return direction.
Home position return speed	[Pr. PT05]	Set the rotation speed until the workpiece is pressed against the mechanical stopper.
Stopper time	[Pr. PT10]	Set the time from when the home position data is obtained after the workpiece is pressed against the stopper until when ZP (home position return completion) is outputted.
Stopper type home position return torque limit value	[Pr. PT11]	Set the servo motor torque limit value at the execution of the stopper type home position return.
Home position return acceleration time constant	[Pr. PC30]	The acceleration time constant set for [Pr. PC30] is used.
Home position return deceleration time constant	[Pr. PC31]	The deceleration time constant set for [Pr. PC31] is used.
Home position return position data	[Pr. PT08]	Set the current position at the home position return completion.
Program	DI0 (Program No. selection 1) to DI7 (Program No. selection 8)	Select a program containing a "ZRT" command, which performs the home position return.

(2) Timing chart

The following shows a timing chart after a program containing a "ZRT" command is selected.



Note. The following torque limits are enabled.

Input device (0: Off, 1: On)		Limit value status			Enabled torque limit value
TL1	TL				
0	0				Pr. PT11
0	1	TLA	>	Pr. PT11	Pr. PT11
		TLA	<	Pr. PT11	TLA
1	0	Pr. PC35	>	Pr. PT11	Pr. PT11
		Pr. PC35	<	Pr. PT11	Pr. PC35
1	1	TLA	>	Pr. PT11	Pr. PT11
		TLA	<	Pr. PT11	TLA

The setting value of [Pr. PT08 Home position return position data] is used as the position address at the home position return completion.

16.12.7 Home position ignorance (servo-on position as home position)

POINT

- To perform a home position return by using the home position ignorance, selecting a program containing a "ZRT" command is not required.

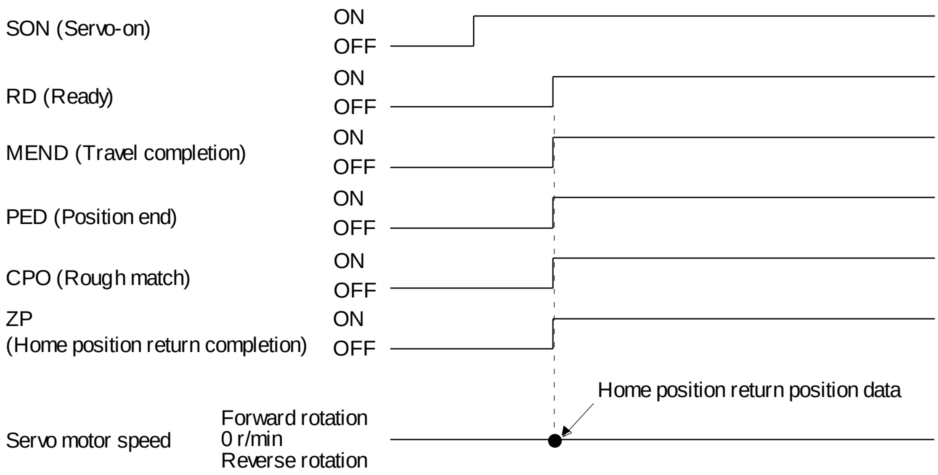
The position at servo-on is used as the home position.

(1) Device/parameter

Set input devices and parameters as shown below.

Item	Used device/parameter	Setting
Home position ignorance	[Pr. PT04]	_ _ _ 4: Select the home position ignorance (servo-on position as home position).
Home position return position data	[Pr. PT08]	Set the current position at the home position return completion.

(2) Timing chart



The setting value of [Pr. PT08 Home position return position data] is used as the position address at the home position return completion.

16.12.8 Dog type rear end reference home position return

POINT
●This home position return method depends on the timing of reading DOG (Proximity dog) that has detected the rear end of a proximity dog. Therefore, when a home position return is performed at a creep speed of 100 r/min, the home position has an error of 6400 pulses. The higher the creep speed, the greater the error of the home position.

Deceleration starts at the front end of a proximity dog. After the rear end is passed, the position is shifted by the travel distance after proximity dog and the home position shift distance. The position after the shifts is used as the home position. The home position return is available independently of the Z-phase signal.

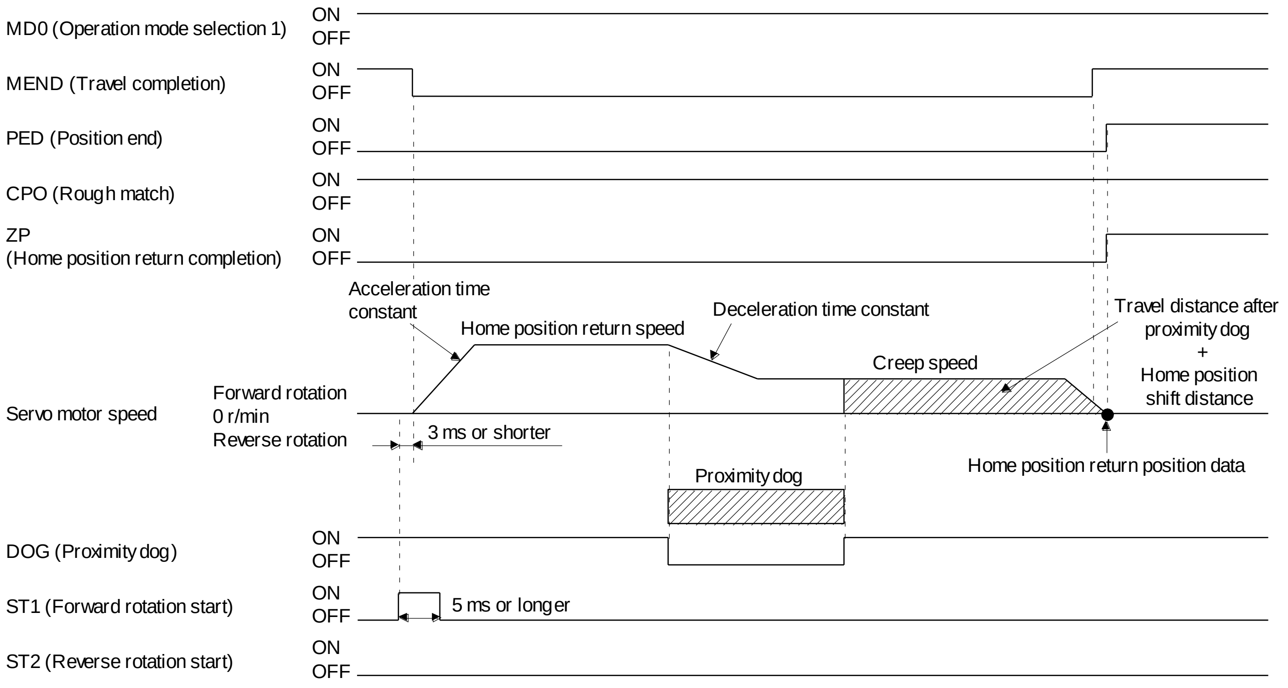
(1) Device/parameter

Set input devices and parameters as shown below.

Item	Used device/parameter	Setting
Automatic operation mode of the program method	MD0 (Operation mode selection 1)	Switch on MD0.
Dog type rear end reference home position return	[Pr. PT04]	_ _ _ 5: Select the dog type (rear end detection/rear end reference).
Home position return direction	[Pr. PT04]	Refer to (2) of section 5.4.1 to select the home position return direction.
Dog input polarity	[Pr. PT29]	Refer to (2) of section 5.4.1 to select the dog input polarity.
Home position return speed	[Pr. PT05]	Set the rotation speed specified until a dog is detected.
Creep speed	[Pr. PT06]	Set the rotation speed specified after a dog is detected.
Home position shift distance	[Pr. PT07]	Set this item to shift the home position, which is specified after the rear end of a proximity dog is passed.
Travel distance after proximity dog	[Pr. PT09]	Set the travel distance specified after the rear end of a proximity dog is passed.
Home position return acceleration time constant	[Pr. PC30]	The acceleration time constant set for [Pr. PC30] is used.
Home position return deceleration time constant	[Pr. PC31]	The deceleration time constant set for [Pr. PC31] is used.
Home position return position data	[Pr. PT08]	Set the current position at the home position return completion.
Program	DI0 (Program No. selection 1) to DI7 (Program No. selection 8)	Select a program containing a "ZRT" command, which performs the home position return.

(2) Timing chart

The following shows a timing chart after a program containing a "ZRT" command is selected.



The setting value of [Pr. PT08 Home position return position data] is used as the position address at the home position return completion.

16.12.9 Count type front end reference home position return

POINT

- This home position return method depends on the timing of reading DOG (Proximity dog) that has detected the front end of a proximity dog. Therefore, when a home position return is performed at a creep speed of 100 r/min, the home position has an error of 6400 pulses. The higher the creep speed, the greater the error of the home position.
- After the front end of a proximity dog is detected, when a home position return ends without reaching the creep speed, [AL. 90.2] occurs. Set the travel distance after proximity dog and the home position shift distance enough for deceleration from the home position return speed to the creep speed.

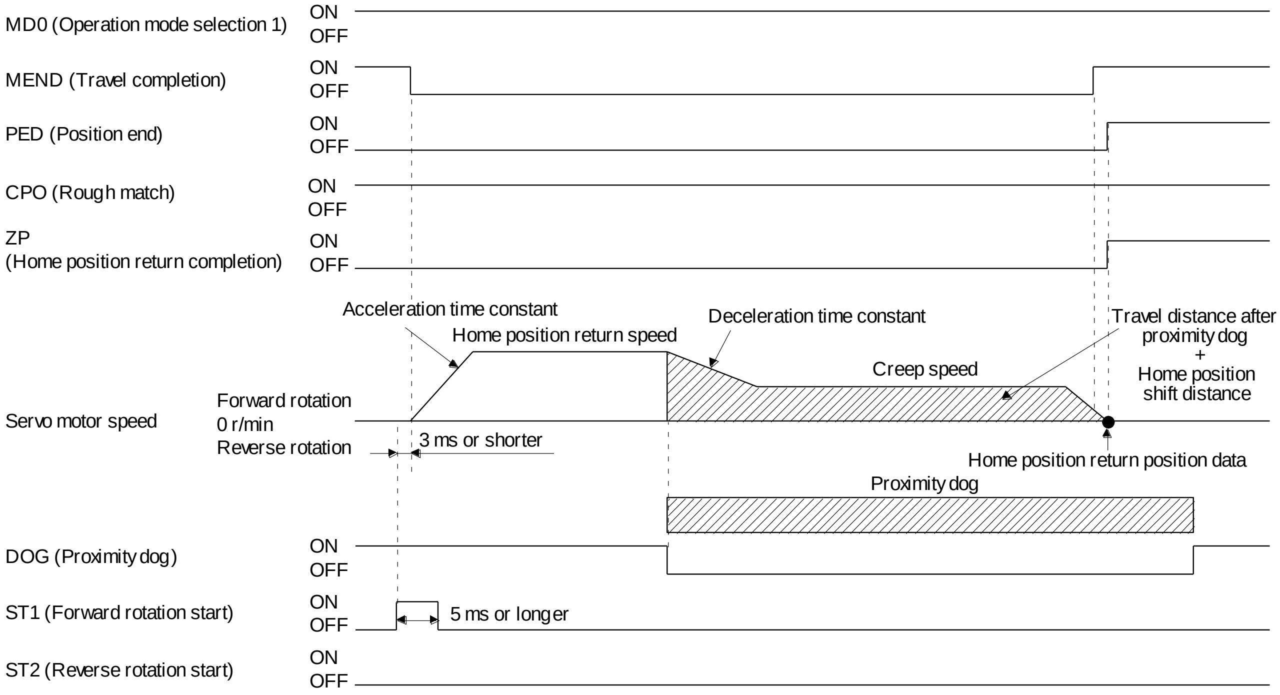
(1) Device/parameter

Set input devices and parameters as shown below.

Item	Used device/parameter	Setting
Automatic operation mode of the program method	MD0 (Operation mode selection 1)	Switch on MD0.
Count type front end reference home position return	[Pr. PT04]	_ _ _ 6: Select the count type (front end detection/ front end reference).
Home position return direction	[Pr. PT04]	Refer to (2) of section 5.4.1 to select the home position return direction.
Dog input polarity	[Pr. PT29]	Refer to (2) of section 5.4.1 to select the dog input polarity.
Home position return speed	[Pr. PT05]	Set the rotation speed specified until a dog is detected.
Creep speed	[Pr. PT06]	Set the rotation speed specified after a dog is detected.
Home position shift distance	[Pr. PT07]	Set this to shift the home position, which is specified after the front end of a proximity dog is passed.
Travel distance after proximity dog	[Pr. PT09]	Set the travel distance specified after the front end of the proximity dog is passed.
Home position return acceleration time constant	[Pr. PC30]	The acceleration time constant set for [Pr. PC30] is used.
Home position return deceleration time constant	[Pr. PC31]	The deceleration time constant set for [Pr. PC31] is used.
Home position return position data	[Pr. PT08]	Set the current position at the home position return completion.
Program	DI0 (Program No. selection 1) to DI7 (Program No. selection 8)	Select a program containing a "ZRT" command, which performs the home position return.

(2) Timing chart

The following shows a timing chart after a program containing a "ZRT" command is selected.



The setting value of [Pr. PT08 Home position return position data] is used as the position address at the home position return completion.

16.12.10 Dog cradle type home position return

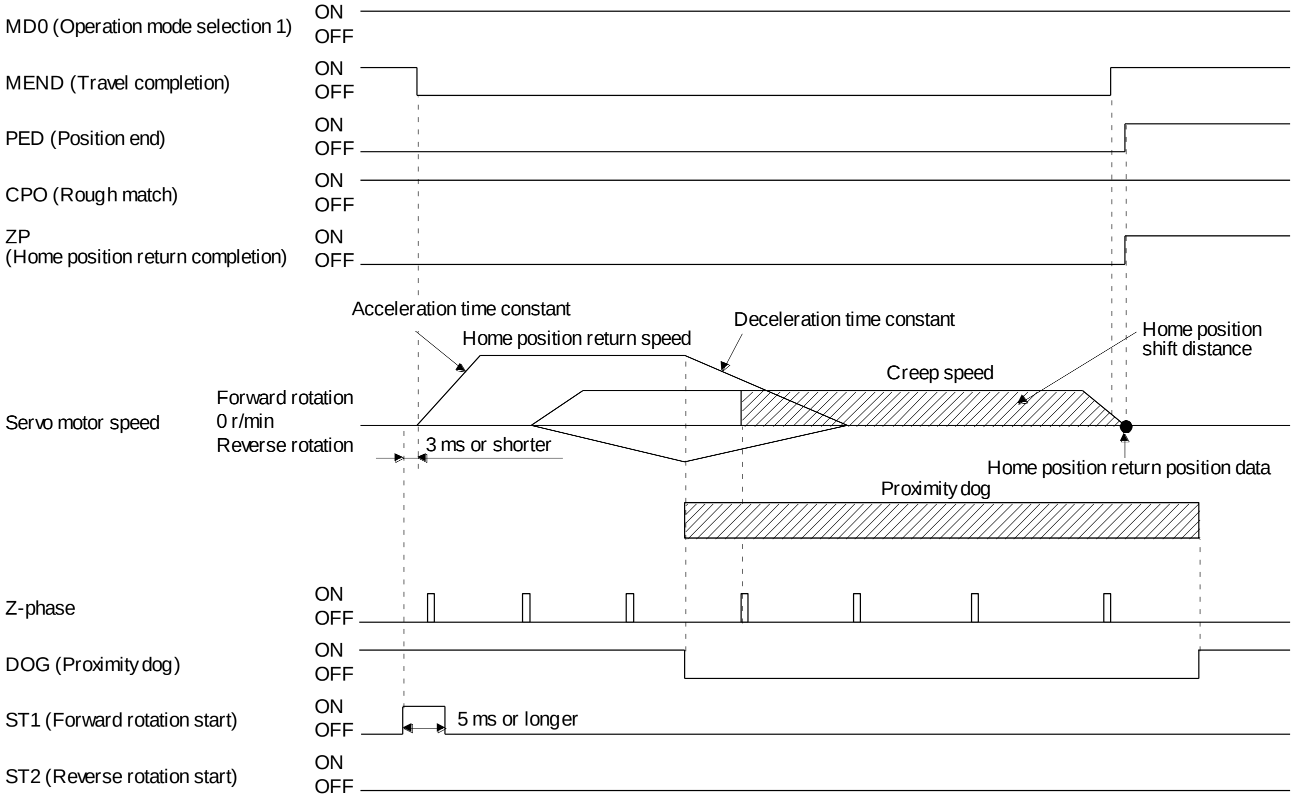
You can use the position, which is specified by the first Z-phase signal after the front end of a proximity dog is detected, as the home position.

(1) Device/parameter
Set input devices and parameters as shown below.

Item	Used device/parameter	Setting
Automatic operation mode of the program method	MD0 (Operation mode selection 1)	Switch on MD0.
Dog cradle type home position return	[Pr. PT04]	_ _ _ 7: Select the dog cradle type.
Home position return direction	[Pr. PT04]	Refer to (2) of section 5.4.1 to select the home position return direction.
Dog input polarity	[Pr. PT29]	Refer to (2) of section 5.4.1 to select the dog input polarity.
Home position return speed	[Pr. PT05]	Set the rotation speed specified until a dog is detected.
Creep speed	[Pr. PT06]	Set the rotation speed specified after a dog is detected.
Home position shift distance	[Pr. PT07]	Set this item to shift the home position, which is specified by the Z-phase signal.
Home position return acceleration time constant	[Pr. PC30]	The acceleration time constant set for [Pr. PC30] is used.
Home position return deceleration time constant	[Pr. PC31]	The deceleration time constant set for [Pr. PC31] is used.
Home position return position data	[Pr. PT08]	Set the current position at the home position return completion.
Program	DI0 (Program No. selection 1) to DI7 (Program No. selection 8)	Select a program containing a "ZRT" command, which performs the home position return.

(2) Timing chart

The following shows a timing chart after a program containing a "ZRT" command is selected.



The setting value of [Pr. PT08 Home position return position data] is used as the position address at the home position return completion.

16.12.11 Dog type last Z-phase reference home position return

After the front end of a proximity dog is detected, the position is shifted away from the proximity dog at the creep speed in the reverse direction and then specified by the first Z-phase signal. The position of the first Z-phase signal is used as the home position.

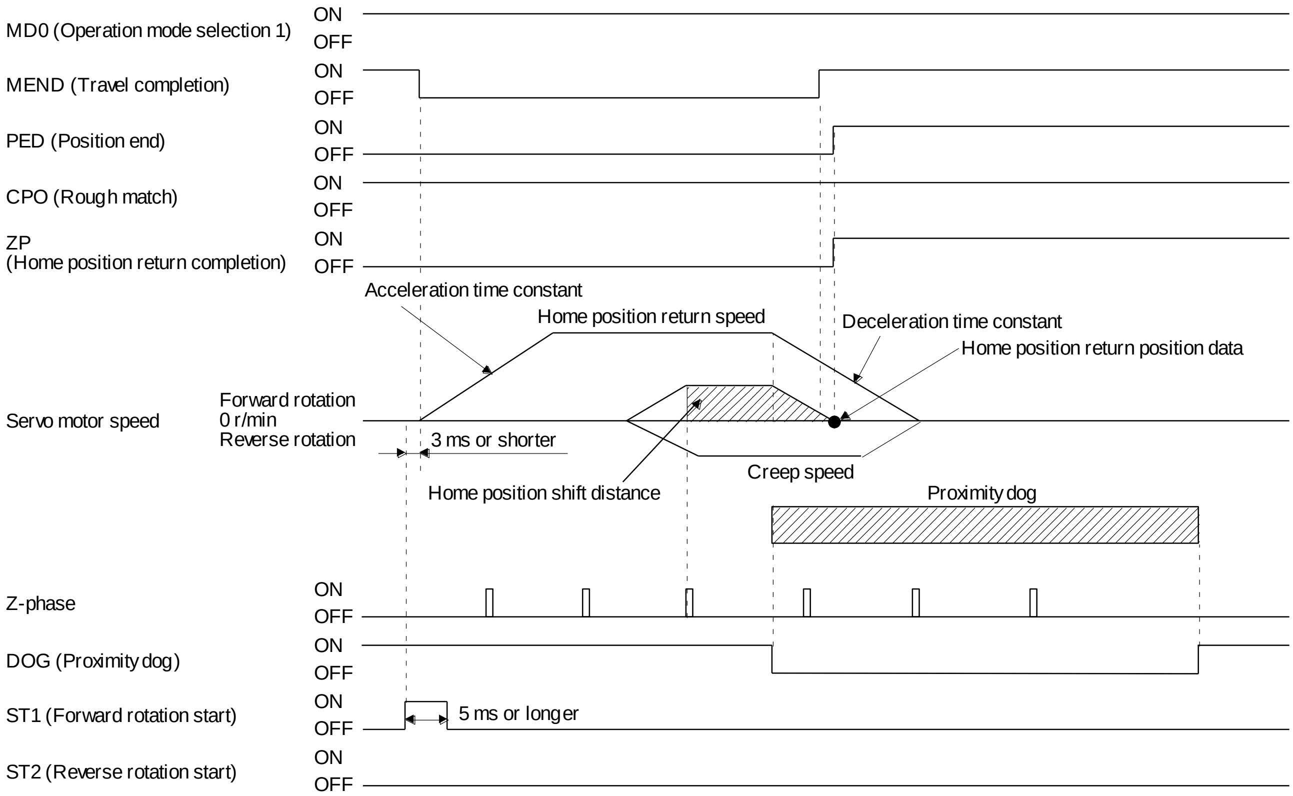
(1) Device/parameter

Set input devices and parameters as shown below.

Item	Used device/parameter	Setting
Automatic operation mode of the program method	MD0 (Operation mode selection 1)	Switch on MD0.
Dog type last Z-phase reference home position return	[Pr. PT04]	_ _ _ 8: Select the dog type (front end detection/Z-phase reference).
Home position return direction	[Pr. PT04]	Refer to (2) of section 5.4.1 to select the home position return direction.
Dog input polarity	[Pr. PT29]	Refer to (2) of section 5.4.1 to select the dog input polarity.
Home position return speed	[Pr. PT05]	Set the rotation speed specified until a dog is detected.
Creep speed	[Pr. PT06]	Set the rotation speed specified after a dog is detected.
Home position shift distance	[Pr. PT07]	Set this item to shift the home position, which is specified by the Z-phase signal.
Home position return acceleration time constant	[Pr. PC30]	The acceleration time constant set for [Pr. PC30] is used.
Home position return deceleration time constant	[Pr. PC31]	The deceleration time constant set for [Pr. PC31] is used.
Home position return position data	[Pr. PT08]	Set the current position at the home position return completion.
Program	DI0 (Program No. selection 1) to DI7 (Program No. selection 8)	Select a program containing a "ZRT" command, which performs the home position return.

(2) Timing chart

The following shows a timing chart after a program containing a "ZRT" command is selected.



The setting value of [Pr. PT08 Home position return position data] is used as the position address at the home position return completion.

16.12.12 Dog type front end reference home position return type

POINT
●This home position return method depends on the timing of reading DOG (Proximity dog) that has detected the front end of a proximity dog. Therefore, when a home position return is performed at a creep speed of 100 r/min, the home position has an error of 6400 pulses. The higher the creep speed, the greater the error of the home position.

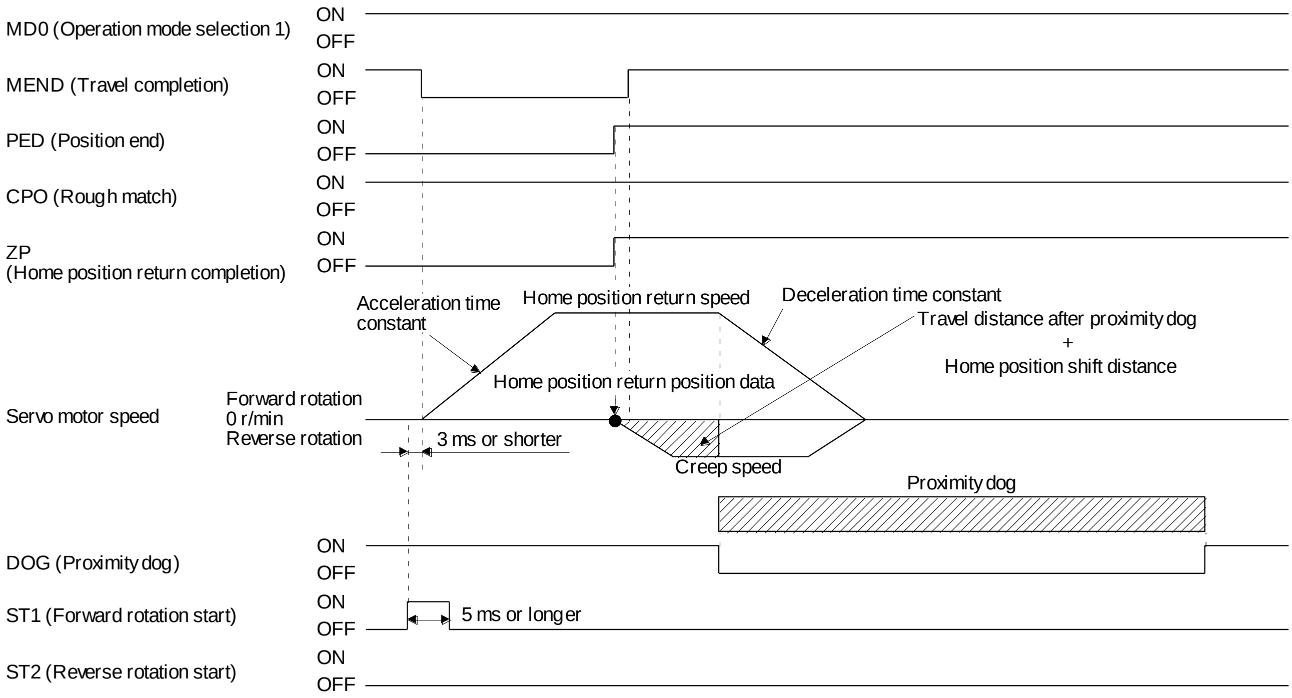
The home position is where the machine moves the travel distance after proximity dog and the home position shift distance from the front end of a proximity dog.
The home position return is available independently of the Z-phase signal. Changing the creep speed may change the home position.

(1) Device/parameter
Set input devices and parameters as follows.

Item	Used device/parameter	Setting
Automatic operation mode of the program method	MD0 (Operation mode selection 1)	Switch on MD0.
Dog type front end reference home position return	[Pr. PT04]	_ _ _ 9: Select the dog type (front end detection/ front end reference).
Home position return direction	[Pr. PT04]	Refer to section 5.4.1 (2) to select the home position return direction.
Dog input polarity	[Pr. PT29]	Refer to section 5.4.1 (2) to select the dog input polarity.
Home position return speed	[Pr. PT05]	Set the rotation speed until a dog is detected.
Creep speed	[Pr. PT06]	Set the rotation speed after a dog is detected.
Home position shift distance	[Pr. PT07]	Set this item to move the home position set when the Z-phase signal is given.
Travel distance after proximity dog	[Pr. PT09]	Set the travel distance specified after the front end of the proximity dog is passed.
Home position return acceleration time constant	[Pr. PC30]	The acceleration time constant set for [Pr. PC30] is used.
Home position return deceleration time constant	[Pr. PC31]	The deceleration time constant set for [Pr. PC31] is used.
Home position return position data	[Pr. PT08]	Set a current position at home position return completion.
Program	DI0 (Program No. selection 1) to DI7 (Program No. selection 8)	Select a program containing "ZRT" command that performs a home position return.

(2) Timing chart

The following shows a timing chart after a program containing a "ZRT" command is selected.



The setting value of [Pr. PT08 Home position return position data] is used as the position address at the home position return completion.

16.12.13 Dogless Z-phase reference home position return type

Starting from the Z-phase pulse position after the start of the home position return, the position is shifted by the home position shift distance. The position after the shifts is used as the home position.

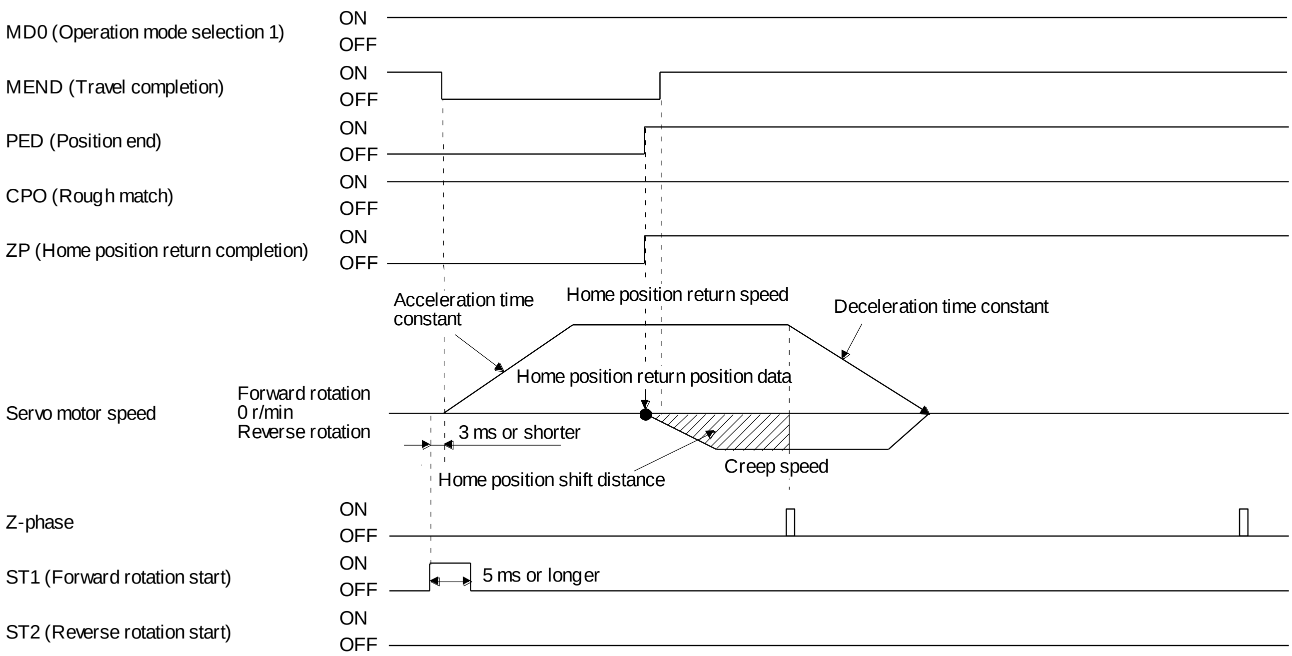
(1) Device/parameter

Set input devices and parameters as follows.

Item	Used device/parameter	Setting
Automatic operation mode of the program method	MD0 (Operation mode selection 1)	Switch on MD0.
Dogless Z-phase reference home position return	[Pr. PT04]	_ _ _ A: Select the dogless type (Z-phase reference).
Home position return direction	[Pr. PT04]	Refer to section 5.4.1 (2) to select the home position return direction.
Dog input polarity	[Pr. PT29]	Refer to section 5.4.1 (2) to select the dog input polarity.
Home position return speed	[Pr. PT05]	Set the rotation speed until a dog is detected.
Creep speed	[Pr. PT06]	Set the rotation speed after a dog is detected.
Home position shift distance	[Pr. PT07]	Set this item to move the home position set when the Z-phase signal is given.
Home position return acceleration time constant	[Pr. PC30]	The acceleration time constant set for [Pr. PC30] is used.
Home position return deceleration time constant	[Pr. PC31]	The deceleration time constant set for [Pr. PC31] is used.
Home position return position data	[Pr. PT08]	Set a current position at home position return completion.
Program	DI0 (Program No. selection 1) to DI7 (Program No. selection 8)	Select a program containing "ZRT" command that performs a home position return.

(2) Timing chart

The following shows a timing chart after a program containing a "ZRT" command is selected.

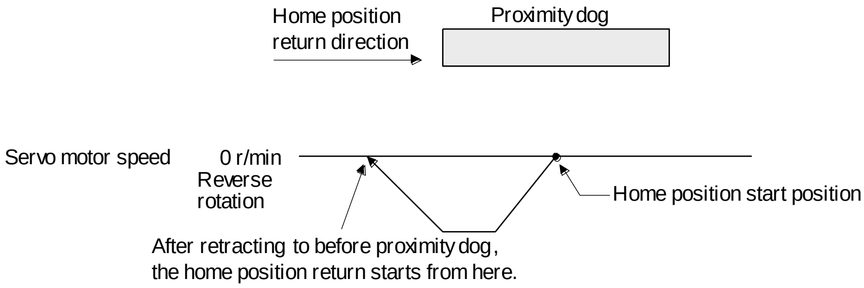


The setting value of [Pr. PT08 Home position return position data] is used as the position address at the home position return completion.

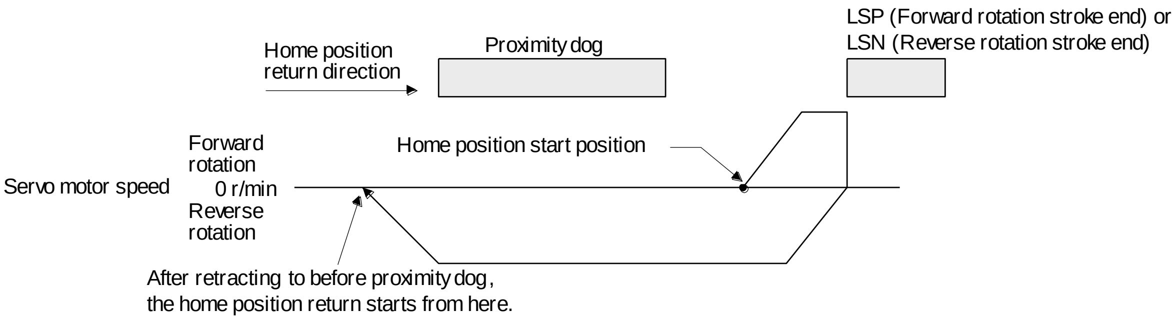
16.12.14 Automatic retract function used for the home position return

For a home position return using the proximity dog, when the home position return is started from the position on or beyond the proximity dog, the home position return is performed after the machine moves back to the position where the home position can be performed.

(1) When the current position is on the proximity dog
When the current position is on the proximity dog, the machine moves backward automatically, and the home position return is performed.



(2) When the current position is beyond the proximity dog
At start-up, the operation is performed in the direction of the home position return. When LSP (Forward rotation stroke end) or LSN (Reverse rotation stroke end) is detected, the machine moves backward automatically. The machine passes and stops before the proximity dog, and the home position return is performed from the position again. If the proximity dog cannot be detected, the machine stops at LSP or LSN on the opposite side, and [AL. 90 Home position return incomplete warning] will occur.



The software limit cannot be used with these functions.

16.13 SERIAL COMMUNICATION OPERATION

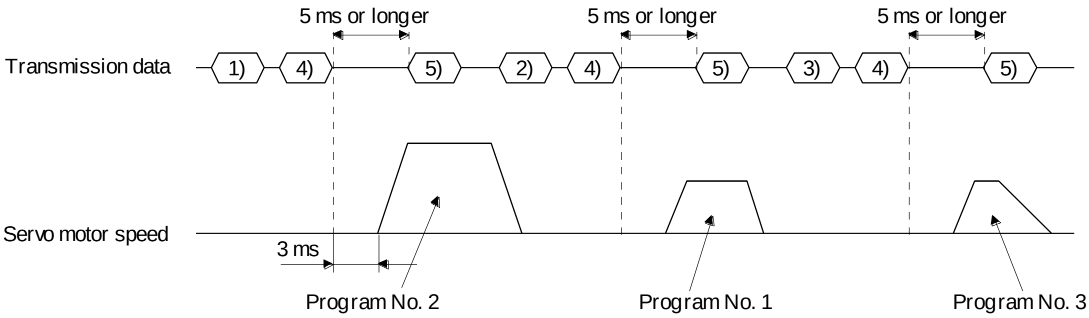
Using the RS-422 communication function, you can use to operate a driver from the PC or PLC...etc such as a personal computer.
This section explains the data communication procedure. Refer to chapter 10 for details of the connection between PC or PLC...etc and driver and of communication data.

16.13.1 Positioning operation using the program

Using the communication function can select program Nos., perform the positioning operation using the program by switching on ST1 (Forward rotation start).

(1) Program selection
Select program No. 1 to 256 using the forced output of the device from the PC or PLC...etc (command [9] [2] and data No. [6] [0]).

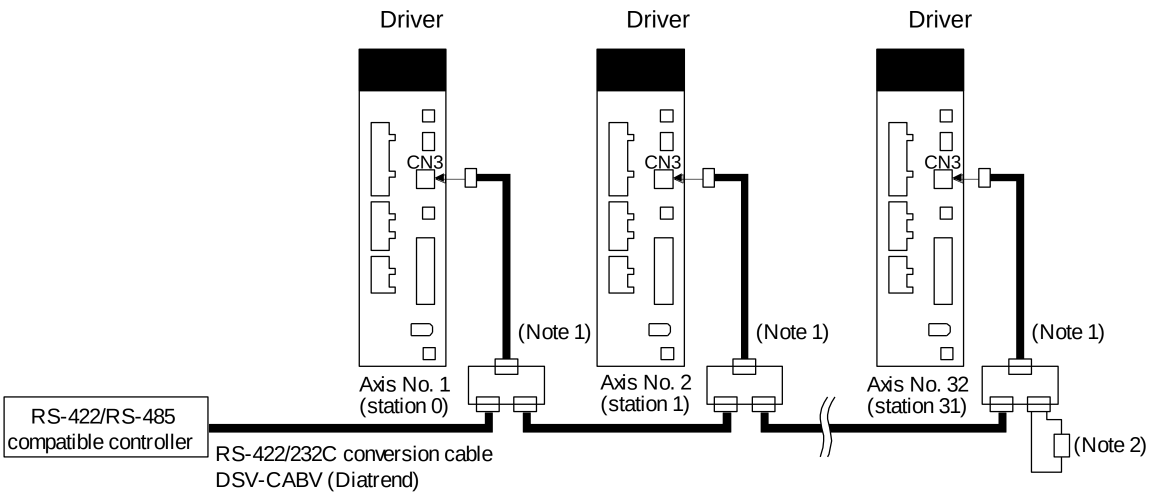
(2) Timing chart



No.	Transmission data description	Command	Data No.
1)	Select Program No. 2.	[9] [2]	[6] [0]
2)	Select Program No. 1.	[9] [2]	[6] [0]
3)	Select Program No. 3.	[9] [2]	[6] [0]
4)	Switch on ST1 (Forward rotation start).	[9] [2]	[6] [0]
5)	Switch off ST1 (Forward rotation start).	[9] [2]	[6] [0]

16.13.2 Multi-drop method (RS-422 communication)

Using the RS-422 communication function can use to operate multiple driver on the same bus. In this case, set station numbers to the driver because the PC or PLC...etc recognizes that the data currently being sent is for which driver. Set station Nos. with [Pr. PC20 Station number setting].
Always set one station No. to one driver. Setting one station number to multiple driver will disable a normal communication. When you use to operate multiple drivers under one command, use the group specification function in section 5.5.3.



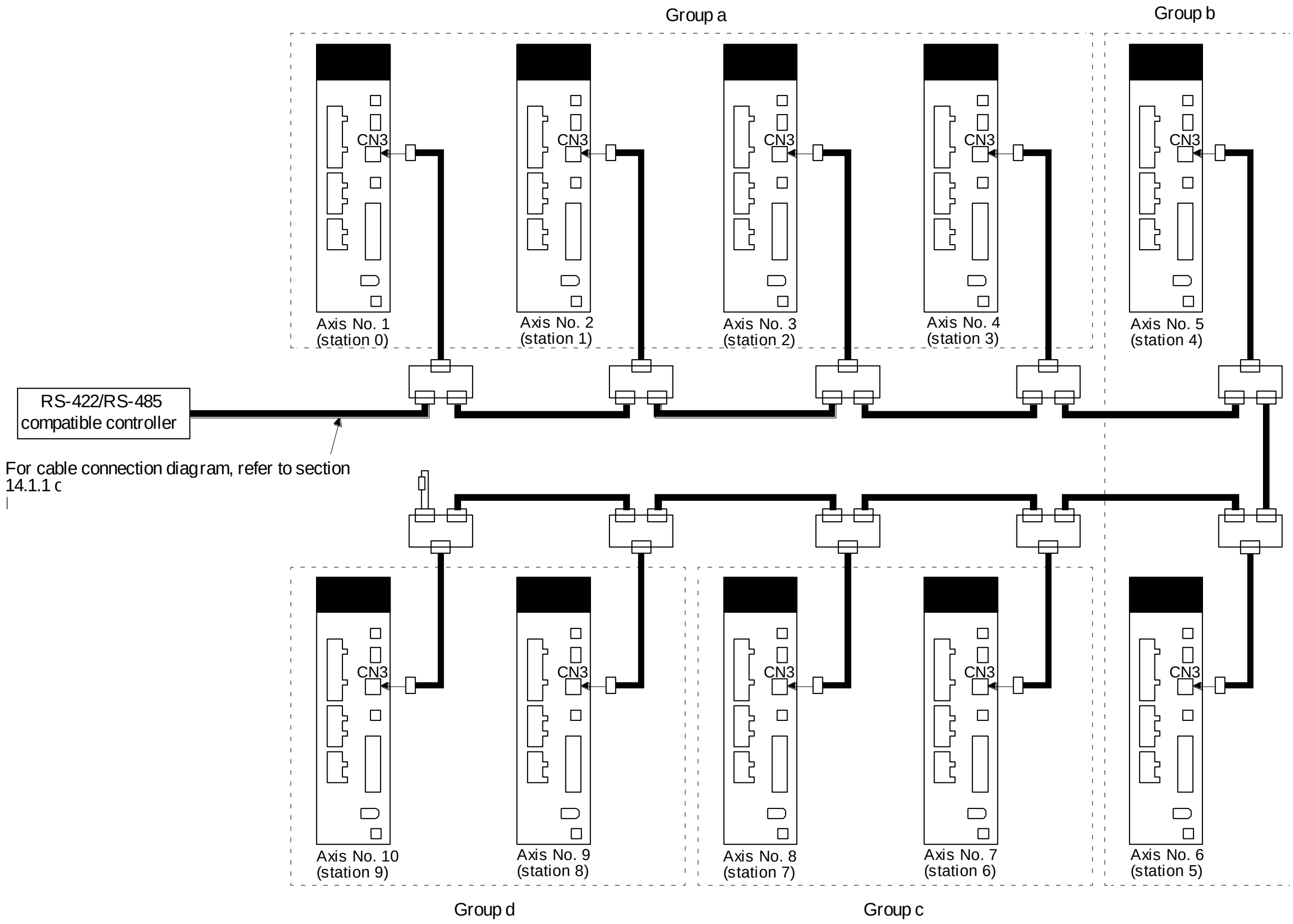
Note 1. The BMJ-8 (Hachiko Electric) is recommended as the branch connector.
2. The final axis must be terminated between RDP (pin No. 3) and RDN (pin No. 6) on the receiving side (driver) with a 150 Ω resistor.

16.13.3 Group specification

CAUTION	●Set only one driver capable of returning data in a group. If multiple driver return data under commands from the PC or PLC...etc, the driver may malfunction.

When using multiple driver, you can set parameters with commands per group.
Up to 6 groups of a to f can be set. Set groups for each station with the communication commands of Mitsubishi general-purpose AC servo protocol.

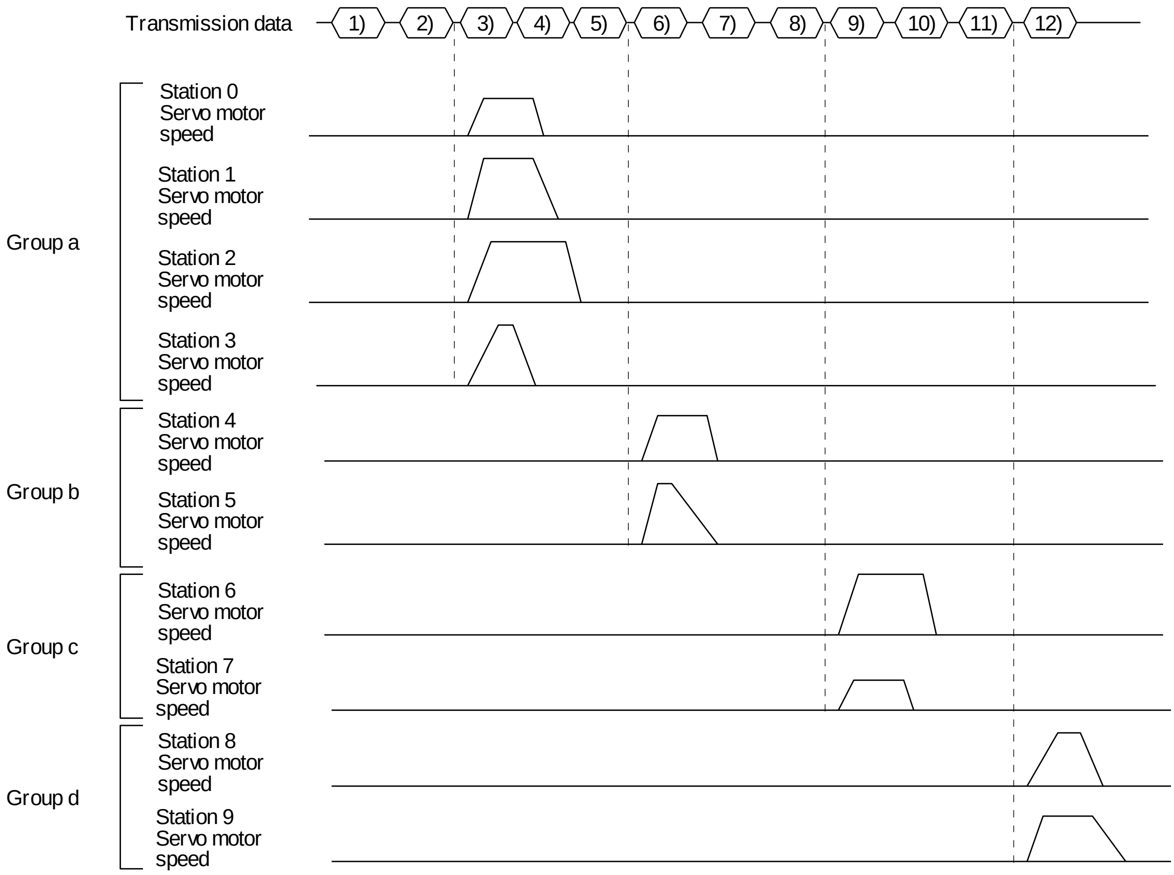
(1) Group setting example



Driver station No.	Group setting
Station 0	a
Station 1	
Station 2	
Station 3	
Station 4	b
Station 5	
Station 6	c
Station 7	
Station 8	d
Station 9	

(2) Timing chart

The following shows a timing chart of operation for each group performed with setting values set in program No. 1.



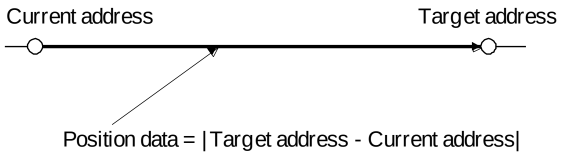
No.	Transmission data description	Command	Data No.
1)	Select Program No. 1 in group a.	[9] [2]	[6] [0]
2)	Switch on ST1 (Forward rotation start).	[9] [2]	[6] [0]
3)	Switch off ST1 (Forward rotation start).	[9] [2]	[6] [0]
4)	Select Program No. 1 in group b.	[9] [2]	[6] [0]
5)	Switch on ST1 (Forward rotation start).	[9] [2]	[6] [0]
6)	Switch off ST1 (Forward rotation start).	[9] [2]	[6] [0]
7)	Select Program No. 1 in group c.	[9] [2]	[6] [0]
8)	Switch on ST1 (Forward rotation start).	[9] [2]	[6] [0]
9)	Switch off ST1 (Forward rotation start).	[9] [2]	[6] [0]
10)	Select Program No. 1 in group d.	[9] [2]	[6] [0]
11)	Switch on ST1 (Forward rotation start).	[9] [2]	[6] [0]
12)	Switch off ST1 (Forward rotation start).	[9] [2]	[6] [0]

Besides this, you can perform simultaneous writing of parameters common to stations of each group, reset alarms, etc.

16.14 INCREMENTAL VALUE COMMAND METHOD

When using this driver under the incremental value command method, you must change the setting of [Pr. PT01].
As position data, set the travel distance from the current address to the target address. The incremental value command method enables infinitely long constant rate of feeding.

Setting range: -999999 to 999999 [×10^{STM} m] (STM = Feed length multiplication [Pr. PT03])
-999999 to 999999 [×10$^{(STM-4)}$ inch] (STM = Feed length multiplication [Pr. PT03])
-999999 to 999999 [pulse]



This section indicates contents different from the absolute value command method (factory setting) when this driver is used under the incremental value command method.

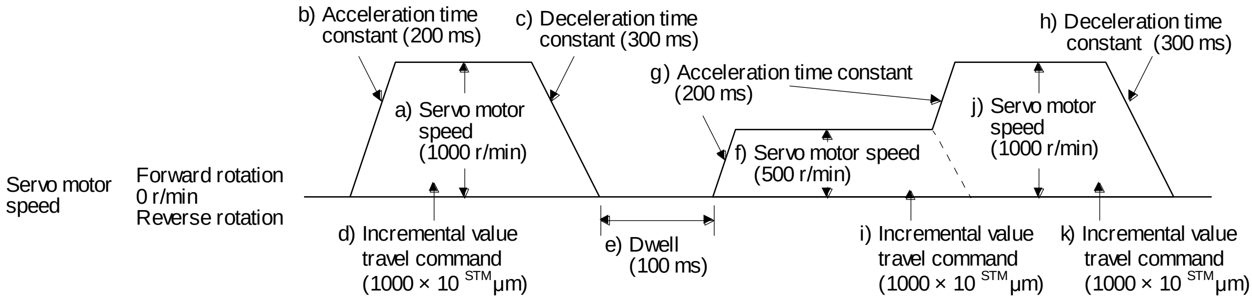
(1) Parameter setting
Set [Pr. PT01] to select the incremental value command method as shown below.

(2) Command
The command contents of "MOV" and "MOVA" are changed as follows. There are no changes in other command. Thus, the command contents are the same between "MOV" and "MOVI", and between "MOVA" and "MOVIA".

Command	Name	Setting	Setting range	Unit	Indirect specification	Description
MOV	Incremental value travel command	MOV (setting value)	-999999 to 999999	×10^{STM} m	○	The servo motor rotates using the set value as the incremental value. The same as "MOVI" command
MOVA	Incremental value continuous travel command	MOVA (setting value)	-999999 to 999999	×10^{STM} m	○	The servo motor rotates continuously as the set incremental value. Make sure to describe this command after the "MOV" command. If this command is described after other command, an error will occur. The same as "MOVIA" command

(3) Program example

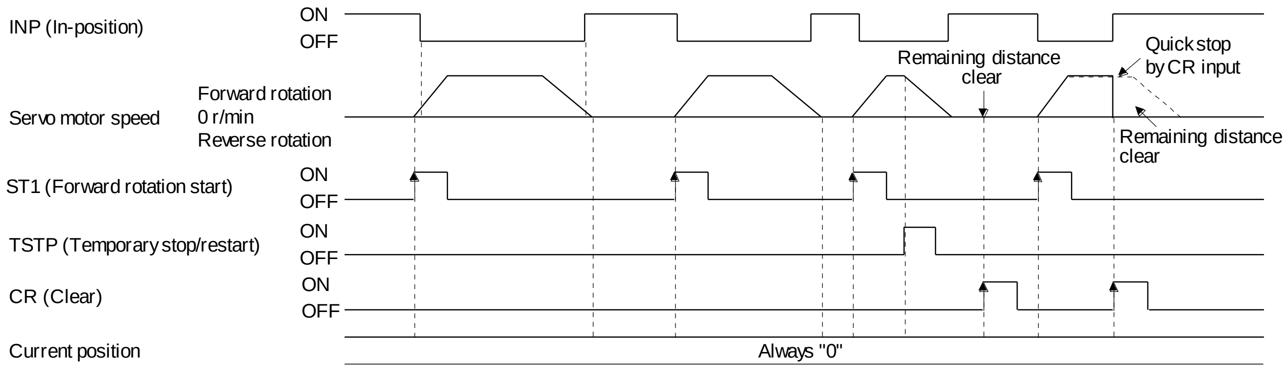
Command	Description		
SPN (1000)	Servo motor speed	1000 [r/min]	a)
STA (200)	Acceleration time constant	200 [ms]	b)
STB (300)	Deceleration time constant	300 [ms]	c)
MOVI (1000)	Incremental value travel command	1000 [$\times 10^{STM}$ m]	d)
TIM (100)	Dwell	100 [ms]	e)
SPN (500)	Servo motor speed	500 [r/min]	f)
STA (200)	Acceleration/deceleration time constant	200 [ms]	g)
STB (300)	Deceleration time constant	300 [ms]	h)
MOVI (1000)	Incremental value travel command	1000 [$\times 10^{STM}$ m]	i)
SPN (1000)	Servo motor speed	1000 [r/min]	j)
MOVIA (1000)	Incremental value continuous travel command	1000 [$\times 10^{STM}$ m]	k)
STOP	Program stop		



16.15 ROLL FEED MODE USING THE ROLL FEED DISPLAY FUNCTION

Refer to section 4.5 for parameter settings of roll feed display function, position data unit and operation method.

When the roll feed display function is used, the status display of the current position at start will be 0.

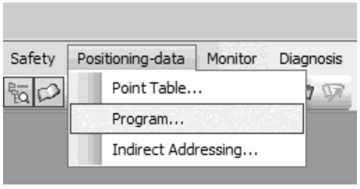


16.16 PROGRAM SETTING METHOD

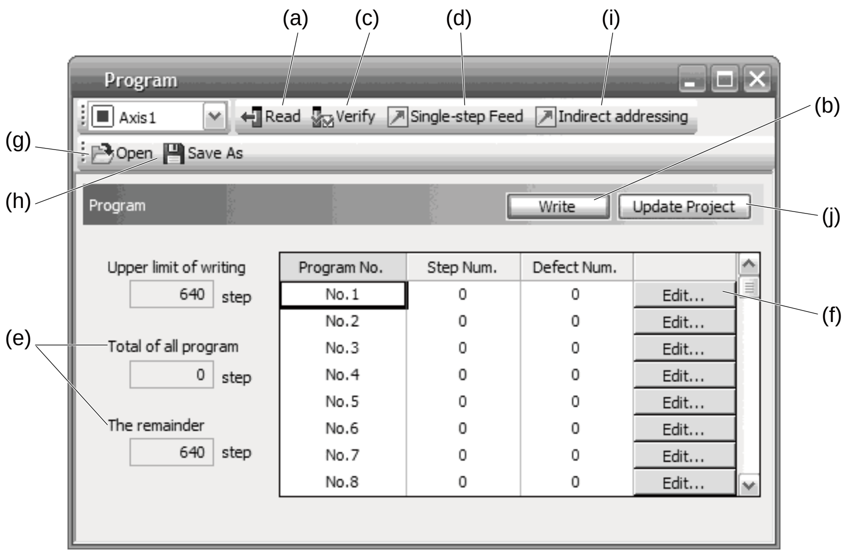
The following shows the setting method of programs using setup software (MR Configurator2™).

16.16.1 Setting procedure

Click "Positioning-data" in the menu bar and click "Program" in the menu.



The following window will be displayed by clicking.



(1) Reading program (a)
Click "Read" to read and display programs stored in the driver.
(2) Writing program (b)
Click "Write" to write the changed programs to the driver.
(3) Verifying program (c)
Click "Verify" to verify the contents of programs in the personal computer with contents of programs of the driver.
(4) Single-step feed (d)
Click "Single-step Feed" to perform the single-step feed test operation. Refer to section 3.1.9 or 3.2.9 for details.
(5) Number of steps (e)
Used number of steps in all programs and remained steps are displayed.
(6) Editing program (f)
You can edit any program. Click "Edit" to open the window for program edit. For the rotation direction, refer to section 5.8.2.

(7) Reading program file (g)
Click "Open" to read the point table data.

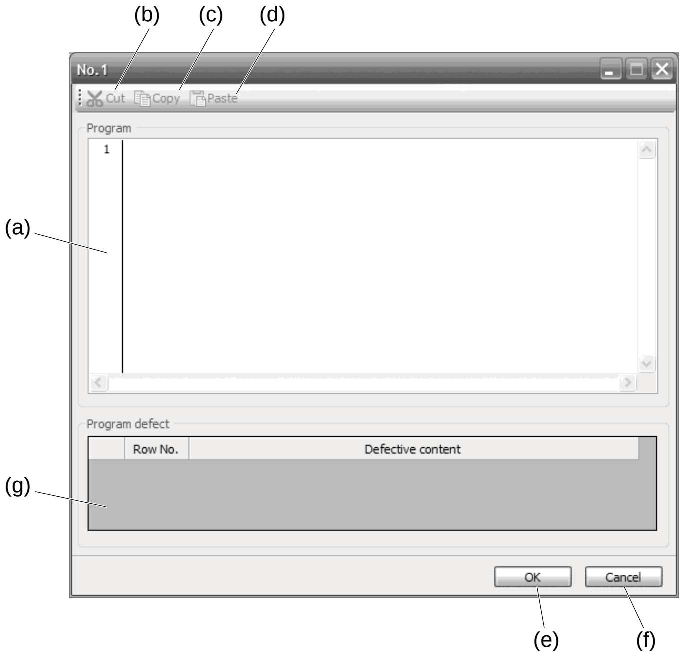
(8) Saving program file (h)
Click "Save As" to save the program.

(9) Indirect addressing (i)
Click "Indirect addressing" to open the indirect addressing window. Refer to section 5.8.3 for details.

(10) Updating project (j)
Click "Update Project" to update the program to a project.

16.16.2 Window for program edit

You can create programs with the window for program edit.



(1) Program edit (a)
Input commands to the program edit area (a) in text format.

(2) Cutting text (b)
Select any text of the program edit area and click "Cut" to cut the selected text.

(3) Copying text (c)
Select any text of the program edit area and click "Copy" to copy the selected text to the clipboard.

(4) Pasting text (d)
Click "Paste" to paste the copied text on the clipboard to a specified place of the program edit area.

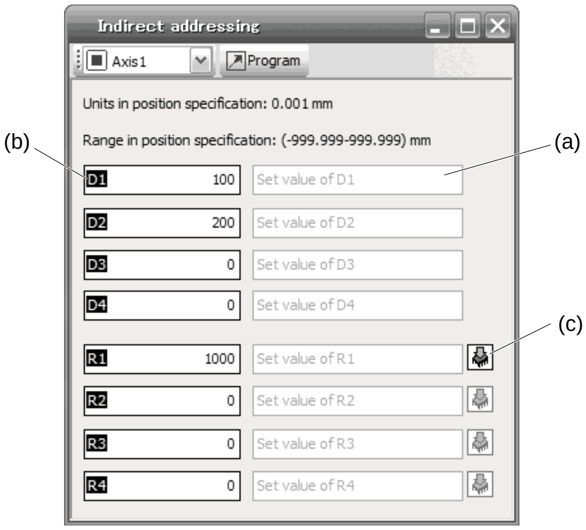
(5) Ending window for program (e)
Click "OK" to execute the edit check. When the edit check completes with no error, the edit will finish and the window for program edit will be closed. When the edit check detects an error in the program, it will be displayed.

(6) Canceling window for program edit (f)
Click "Cancel" to close the window for program edit without saving the program currently being edited.

(7) Displaying error (g)
When the edit check of (5) detects an error in the program, the row No. and content of the error will be displayed. Click the error content, the cursor will move to the row of the corresponding program.

16.16.3 Indirect addressing window

Set general purpose registers (D1 to D4 and R1 to R4) in this screen.



(1) Register edit field (a)
Set general purpose register values of D1 to D4 and R1 to R4.

(2) Register reference field (b)
The last register value read from the driver is displayed.

(3) ROM writing (c)
You can write register values (D1 to D4 and R1 to R4) stored in the driver to the driver.

16.17 HOW TO USE INDEXER

POINT

- In the absolute position detection system, rotating the shaft one revolution or more during power-off may erase a home position. Therefore, do not rotate the shaft one revolution or more during power-off. When a home position is erased, [AL. 90 Home position return incomplete warning] will occur. Then, execute the home position return again.
- There are the following restrictions on the number of gear teeth on machine side ([Pr. PA06 Number of gear teeth on machine side]) and the servo motor speed (N).
  - When CMX   2000, N < 3076.7 r/min
  - When CMX > 2000, N < (3276.7 - CMX)/10 r/min

  When the servo motor is operated at a servo motor speed higher than the limit value, [AL. E3 Absolute position counter warning] will occur.

16.17.1 Power on and off procedures

When the driver is powered on for the first time, the control mode is set to position control mode. (Refer to section 4.2.1.)
This section provides a case where the driver is powered on after setting the positioning mode.

(1) Power-on
Switch power on in the following procedure. Always follow this procedure at power-on.

1) Switch off SON (Servo-on).

2) Make sure that ST1 (Forward rotation start) is off.

3) Switch on the main circuit power supply and control circuit power supply.
The display shows "C", and in 2 s later, shows data.

(2) Power-off

1) Switch off ST1 (Forward rotation start).

2) Switch off SON (Servo-on).

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

16.17.2 Stop

If any of the following situations occurs, the driver suspends the running of the servo motor and brings it to a stop.
Refer to section 3.10 for the servo motor with an electromagnetic brake.

Operation/command	Stopping condition
Switch off SON (Servo-on).	The base circuit is shut off and the servo motor coasts.
Alarm occurrence	The servo motor decelerates to a stop with the command. With some alarms, however, the dynamic brake operates to bring the servo motor to a stop. (Refer to chapter 8.)
EM2 (Forced stop 2) off	The servo motor decelerates to a stop with the command. [AL. E6 Servo forced stop warning] occurs. Refer to section 2.3 for EM1.
STO (STO1, STO2) off	The base circuit is shut off and the dynamic brake operates to bring the servo motor to a stop.
LSP (Forward rotation stroke end) off, LSN (Reverse rotation stroke end) off	It will bring the motor to a sudden stop and make it servo-locked. It can be run in the opposite direction.

16.17.3 Test operation

Before starting actual operation, perform test operation to make sure that the machine operates normally.
Refer to section 6.1.1 for how to power on and off the driver.

Test operation of the 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. For the test operation mode, refer to section 3.1.8 and 3.2.8 in this manual, and section 4.5.9 and 18.5.10.

Manual operation of the servo motor alone in test operation mode

In this step, confirm that the servo motor correctly rotates at the slowest speed in the manual operation mode.
Make sure that the servo motor rotates in the following procedure.

1) Switch on EM2 (Forced stop 2) and SON (Servo-on). When the driver is put in a servo-on status, RD (Ready) switches on.
2) Switch on LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end).
3) To rotate the servo motor, turn on ST1 (Forward rotation start) in the manual operation mode with the PC or PLC...etc. Set a low speed to [Pr. PT13] at first, make the servo motor operate, and check the rotation direction of the motor, etc. If the machine does not operate in the intended direction, check the input signal.

Test operation with the 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 PC or PLC...etc.
Make sure that the servo motor rotates in the following procedure.

1) Switch on EM2 (Forced stop 2) and SON (Servo-on). When the driver is put in a servo-on status, RD (Ready) switches on.
2) Switch on LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end).
3) To rotate the servo motor, turn on ST1 (Forward rotation start) in the manual operation mode with the PC or PLC...etc. Set a low speed to [Pr. PT13] at first, make the servo motor operate, and check the operation direction of the machine, etc. If the machine does not operate in the intended direction, check the input signal. In the status display, check for any problems of the servo motor speed, load ratio, etc.

Automatic operation by indexer

Check automatic operation from the PC or PLC...etc.

16.17.4 Parameter setting

POINT
● In the indexer method, assign the following input device to CN1-18 pin with [Pr. PD10]. CN1-18: MD1 (Operation mode selection 2) ● Assign the following output devices to the CN1-22, CN1-23, and CN1-25 pins with [Pr. PD23], [Pr. PD24], and [Pr. PD26]. CN1-22: CPO (Rough match) CN1-23: ZP (Home position return completion) CN1-25: MEND (Travel completion)

When using this servo in the indexer method, set [Pr. PA01] to "_ _ _ 8" (Positioning mode (indexer method)). For the indexer method, the servo can be used by merely changing the basic setting parameters ([Pr. PA _ _]) and positioning control parameters ([Pr. PT _ _]) mainly.
As necessary, set other parameters.
The following table shows [Pr. PA _ _] and [Pr. PT _ _] settings required for the indexer method.

Operation mode selection item / Operation mode		Parameter setting			Input device setting		
		[Pr. PA01]	[Pr. PT04] (Note 2)	[Pr. PT27]	MD0 (Note 1)	MD1 (Note 1, 3)	DI0 to DI7 (Note 1)
Automatic operation mode	Automatic operation mode 1 (Rotation direction specifying indexer)	_ _ _ 8			Off	On	Set any next station No. (Refer to section 6.2.2 (3).)
	Automatic operation mode 2 (Shortest rotating indexer)				On	On	
Manual operation mode	Station JOG operation			_ _ 0 _	On	Off	Any
	JOG operation			_ _ 1 _			
Home position return mode	Dog type/Torque limit changing dog type		_ _ _ 0		Off	Off	Any
	Data set type/torque limit changing data set type		_ _ _ 2				

Note 1. MD0: Operation mode selection 1, MD1: Operation mode selection 2, DI0 to DI7: Next station No. selection 1 to 8
2. Setting other than "_ _ _ 0" and "_ _ _ 2" will trigger [AL. 37 Parameter error].
3. In the indexer method, assign the following input device to CN1-18 pin with [Pr. PD10].
CN1-18: MD1 (Operation mode selection 2)

16.17.5 Actual operation

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

16.17.6 Troubleshooting at start-up

CAUTION	●Never make a drastic adjustment or change to the parameter values as doing so will make the operation unstable.

POINT

- Using Setup software (MR Configurator2™), you can refer to reason for rotation failure, etc.

The following faults may occur at start-up.

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
1	Power on	・The 7-segment LED display does not turn on. ・The 7-segment LED display flickers.	Not improved even if CN1, CN2, and CN3 connectors are disconnected.	1. Power supply voltage fault 2. The driver is malfunctioning.	
			Improved when CN1 connector is disconnected.	Power supply of CN1 cabling is shorted.	
			Improved when CN2 connector is disconnected.	1. Power supply of encoder cabling is shorted. 2. Encoder is malfunctioning.	
			Improved when CN3 connector is disconnected.	Power supply of CN3 cabling is shorted.	
		Alarm occurs.	Refer to chapter 8 and remove the cause.		Chapter 8
2	Switch on SON (Servo-on).	Alarm occurs.	Refer to chapter 8 and remove the cause.		Chapter 8
		Servo motor shaft is not servo-locked. (Servo motor shaft is free.)	1. Check the display to see if the driver is ready to operate. 2. Check the external I/O signal indication (section 3.1.7 or 3.2.7) to see if SON (Servo-on) is on.	1. SON (Servo-on) is not input. (wiring mistake) 2. 24 V DC power is not supplied to DICOM.	Section 3.1.7 Section 3.2.7
3	Perform a home position return.	Servo motor does not rotate.	Call the external I/O signal display and check the on/off status of the input signal. (Refer to section 3.1.7 or 3.2.7.)	LSP, LSN, and ST1 are off.	Section 3.1.7 Section 3.2.7
			Check [Pr. PA11 Forward rotation torque limit] and [Pr. PA12 Reverse rotation torque limit].	Torque limit level is too low as compared to the load torque.	Section 7.2.1
			When TLA (Analog torque limit) is usable, check the input voltage on the status display.	Torque limit level is too low as compared to the load torque.	Section 3.1.2 Section 3.2.2
		The home position return is not completed.	Call the external I/O signal display and check the on/off status of DOG. (Refer to section 3.1.7 or 3.2.7.)	The proximity dog is set incorrectly.	Section 3.1.7 Section 3.2.7

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
4	Switch on ST1 (Forward rotation start).	Servo motor does not rotate.	Call the external I/O signal display (Section 3.1.7 or 3.2.7) and check the on/off status of the input signal.	LSP, LSN, and ST1 are off.	Section 3.1.7 Section 3.2.7
			Check [Pr. PA11 Forward rotation torque limit] and [Pr. PA12 Reverse rotation torque limit].	Torque limit level is too low as compared to the load torque.	Section 7.2.1
			When TLA (Analog torque limit) is usable, check the input voltage on the status display.	Torque limit level is too low as compared to the load torque.	Section 3.1.2 Section 3.2.2
5	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/ deceleration more than three times to complete auto tuning.	Gain adjustment fault	Chapter 6
		Large load inertia moment causes the servo motor shaft to oscillate side to side.	If the servo motor may be driven with safety, repeat acceleration and deceleration three times or more to complete the auto tuning.	Gain adjustment fault	Chapter 6

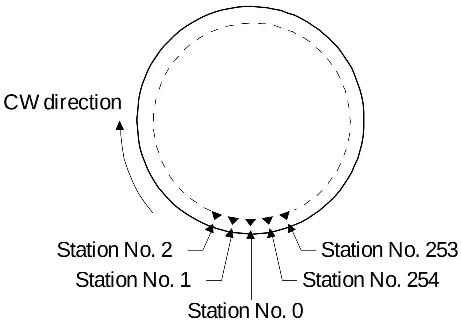
16.18 AUTOMATIC OPERATION MODE

> **POINT**
>
> ●There are the following conditions between the number of gear teeth on machine side ([Pr. PA06 Number of gear teeth on machine side]) and servo motor speed (N).
>
> ・When CMX   2000, N < 3076.7 r/min
>
> ・When CMX > 2000, N < 3276.7 - CMX r/min
>
> When the servo motor is operated at servo motor speed higher than the limit value, [AL. E3 Absolute position counter warning] occurs.
>
> ●When the same next station No. is specified as station No. of the current position and a positioning operation is executed, the motor does not start because the travel distance is decided as "0".

16.18.1 Automatic operation mode

(1) Logic of indexer

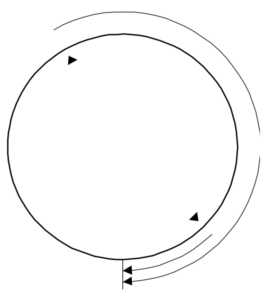
The positioning is executed like this. A station, which one of the divided circumference (360 degrees) into 255 at most on the machine side, is selected by using 8-bit devices of the DI0 (Next station No. selection 1) to DI7 (Next station No. selection 8). The following diagram is an example for when [Pr. PA14] is set to "0".



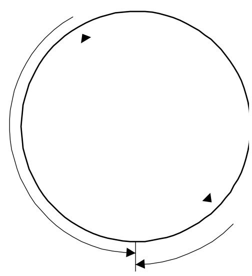
The station No. 0 is set as a home position. The number of divisions is set with [Pr. PT28].

(2) Rotation direction

There are two operation methods: Rotation direction specifying indexer, which always rotates in a fixed direction and execute positioning to a station; Shortest rotating indexer, which automatically changes a rotation direction to the shortest distance and execute positioning to a station



Rotation direction specifying indexer



Shortest rotating indexer

16.18.2 Automatic operation mode 1 (rotation direction specifying indexer)

In this operation mode, the servo motor rotates in a fixed direction to execute positioning to a station.
The positioning is executed by selecting a station No. using 8-bit devices of the DI0 (Next station No. selection 1) to DI7 (Next station No. selection 8). For the servo motor speed and acceleration/deceleration time constant during operation, the values set in the point tables are used.

(1) Device/parameter

Set input devices and parameters as follows.

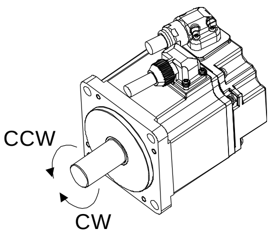
Item	Used device/parameter	Setting
Selecting indexer method	Control mode selection of [Pr. PA01]	Select "_ _ _ 8" (positioning mode (indexer method)).
Next station position	DI0 (Next station No. selection 1) to DI7 (Next station No. selection 8)	Set any next station No. (Refer to (3) of this section.)
Selecting automatic operation mode 1 (rotation direction specifying indexer)	MD0 (Operation mode selection 1)	Switch off MD0.
	MD1 (Operation mode selection 2)	Switch on MD1.
Rotation direction selection	SIG (External limit/Rotation direction decision/Automatic speed selection)	The rotation direction to a station No. will be as follows. Off: Station No. decreasing direction On: Station No. increasing direction
Servo motor speed	[Pr. PC05]	Set a servo motor speed.
Acceleration time constant/Deceleration time constant	RT (Second acceleration/deceleration selection)	1. When RT is turned off Acceleration time constant: setting value of [Pr. PC01 Acceleration time constant 1] Deceleration time constant: setting value of [Pr. PC02 Deceleration time constant 1] 2. When RT is turned on Acceleration time constant: setting value of [Pr. PC30 Acceleration time constant 2] Deceleration time constant: setting value of [Pr. PC31 Deceleration time constant 2]
Torque limit (Note)	[Pr. PA11] [Pr. PA12]	Set a torque limit value for during operation.
	[Pr. PC35]	Set a torque limit value for during stop.
	[Pr. PT39]	Set time to switch the torque limit value from during operation until during stop.

Note. The torque limit will change from [Pr. PC35 Internal torque limit 2] to the setting value of [Pr. PA11 Forward rotation torque limit] or [Pr. PA12 Reverse rotation torque limit] when ST1 (Forward rotation start) is inputted. After MEND (Travel completion) is outputted, the time has passed set with [Pr. PT39] and the torque limit will change from [Pr. PA11 Forward rotation torque limit] or [Pr. PA12 Reverse rotation torque limit] to the setting value of [Pr. PC35 Internal torque limit 2].

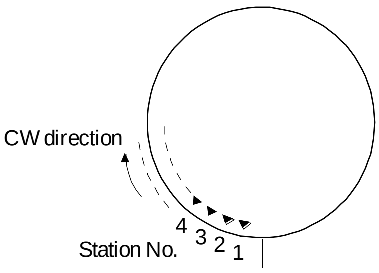
(2) Other parameter settings

(a) Setting assignment direction of station No.

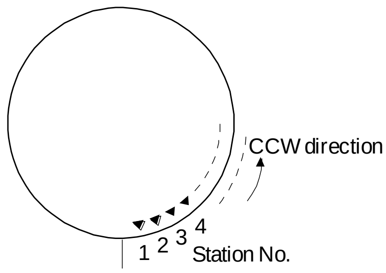
Select an assignment direction of station No. with [Pr. PA14].



[Pr. PA14] setting	Servo motor rotation direction ST1 (Forward rotation start) is on.
0	Next station No. will be assigned in CW direction in order of 1, 2, 3
1	Next station No. will be assigned in CCW direction in order of 1, 2, 3



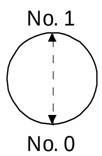
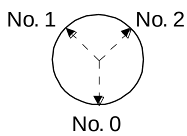
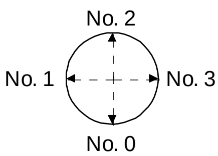
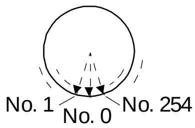
[Pr. PA14]: 0 (initial value)



[Pr. PA14]: 1

(b) Setting number of stations

Set a number of stations to [Pr. PT28].

	[Pr. PT28] setting				
Number of stations	2	3	4	. . .	255
Station No.				. . .	

(3) Operation

Select a target station No. using 8-bit devices of the DI0 (Next station No. selection 1) to DI7 (Next station No. selection 8) for positioning.

Device (Note 1)								Selection contents
DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0	
0	0	0	0	0	0	0	0	Next station No. 0
0	0	0	0	0	0	0	1	Next station No. 1
0	0	0	0	0	0	1	0	Next station No. 2
0	0	0	0	0	0	1	1	Next station No. 3
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
1	1	1	1	1	1	1	0	Next station No. 254
1	1	1	1	1	1	1	1	Setting inhibited (Note 2)

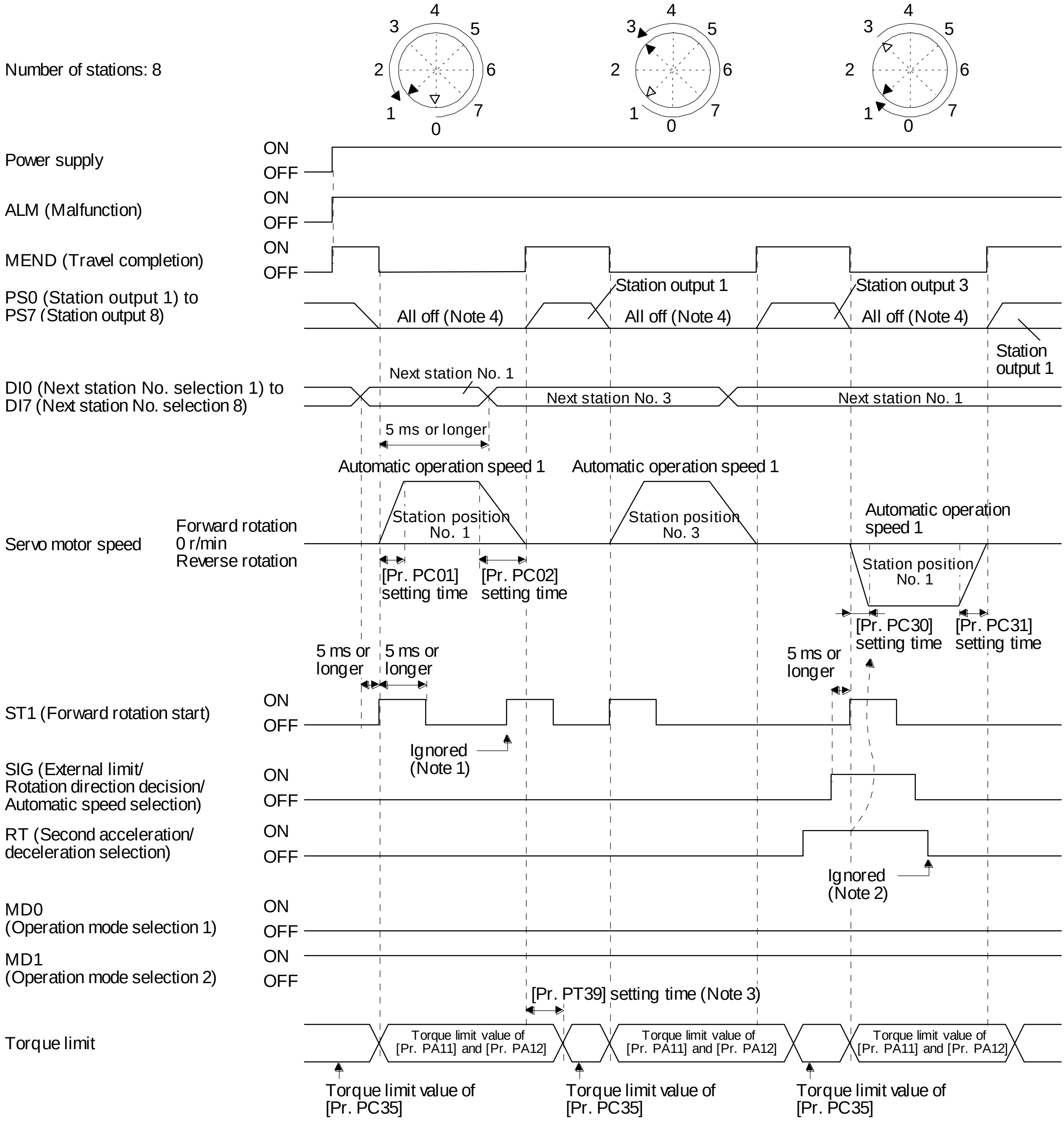
Note 1. 0: Off
1: On
2. [AL. 97.2 Next station position warning] will occur.

(4) Timing chart

POINT

- Always perform a home position return. Executing positioning operation without home position return will trigger [AL. 90 Home position return incomplete warning] and ST1 (Forward rotation start) will be disabled.
- When a next station position is over the setting value of [Pr. PT28 Number of stations per rotation], [AL. 97 Next station position warning] will occur and ST1 (Forward rotation start) will be disabled.

The following timing chart shows that an operation is performed at a stop of the station No. 0 when servo-on.



Note 1. When the rest of command travel distance is other than "0", ST1 (Forward rotation start) will not be accepted. Refer to section 6.4.5 (1).

2. RT (Second acceleration/deceleration selection) will not be accepted during operation. Selection of the servo motor speed and acceleration/deceleration time constants will be enabled by on-edge of ST1 (Forward rotation start). However, when the rest of command travel distance is other than "0", turning on ST1 (Forward rotation start) will not be enabled.

3. Counting will start when the rest of command travel distance becomes "0".

4. When MEND (Travel completion) is off, the station position outputs will be "0" (all off).

16.18.3 Automatic operation mode 2 (shortest rotating indexer)

This operation mode automatically changes a rotation direction to the shortest distance to execute positioning to a station.
The positioning is executed by selecting a station No. using 8-bit devices of the DI0 (Next station No. selection 1) to DI7 (Next station No. selection 8). For the servo motor speed and acceleration/deceleration time constant during operation, the values set in the point tables are used.

(1) Device/parameter
Set input devices and parameters as follows.

Item	Used device/parameter	Setting
Selecting indexer method	Control mode selection of [Pr. PA01]	Select "_ _ _ 8" (positioning mode (indexer method)).
Next station position	DI0 (Next station No. selection 1) to DI7 (Next station No. selection 8)	Set any next station No. (Refer to (3) of this section.)
Automatic operation mode 2 (shortest rotating indexer) selection	MD0 (Operation mode selection 1)	Switch on MD0.
	MD1 (Operation mode selection 2)	Switch on MD1.
Servo motor speed	SIG (External limit/Rotation direction decision/Automatic speed selection)	The servo motor speed will be as follows. Off: setting value of [Pr. PC05 Automatic operation speed 1] On: setting value of [Pr. PC06 Automatic operation speed 2]
Acceleration time constant/Deceleration time constant	RT (Second acceleration/deceleration selection)	1. When RT is turned off Acceleration time constant: setting value of [Pr. PC01 Acceleration time constant 1] Deceleration time constant: setting value of [Pr. PC02 Deceleration time constant 1] 2. When RT is turned on Acceleration time constant: setting value of [Pr. PC30 Acceleration time constant 2] Deceleration time constant: setting value of [Pr. PC31 Deceleration time constant 2]

(2) The other parameter setting (number of stations)
Set a number of stations to [Pr. PT28]. The setting is the same as that of automatic operation mode 1.
Refer to section 6.2.2 (2) (b).
[Pr. PA14 Rotation direction selection] is not used in the automatic operation mode 2.

(3) Operation
Select a target station No. using 8-bit devices of the DI0 (Next station No. selection 1) to DI7 (Next station No. selection 8) for positioning.

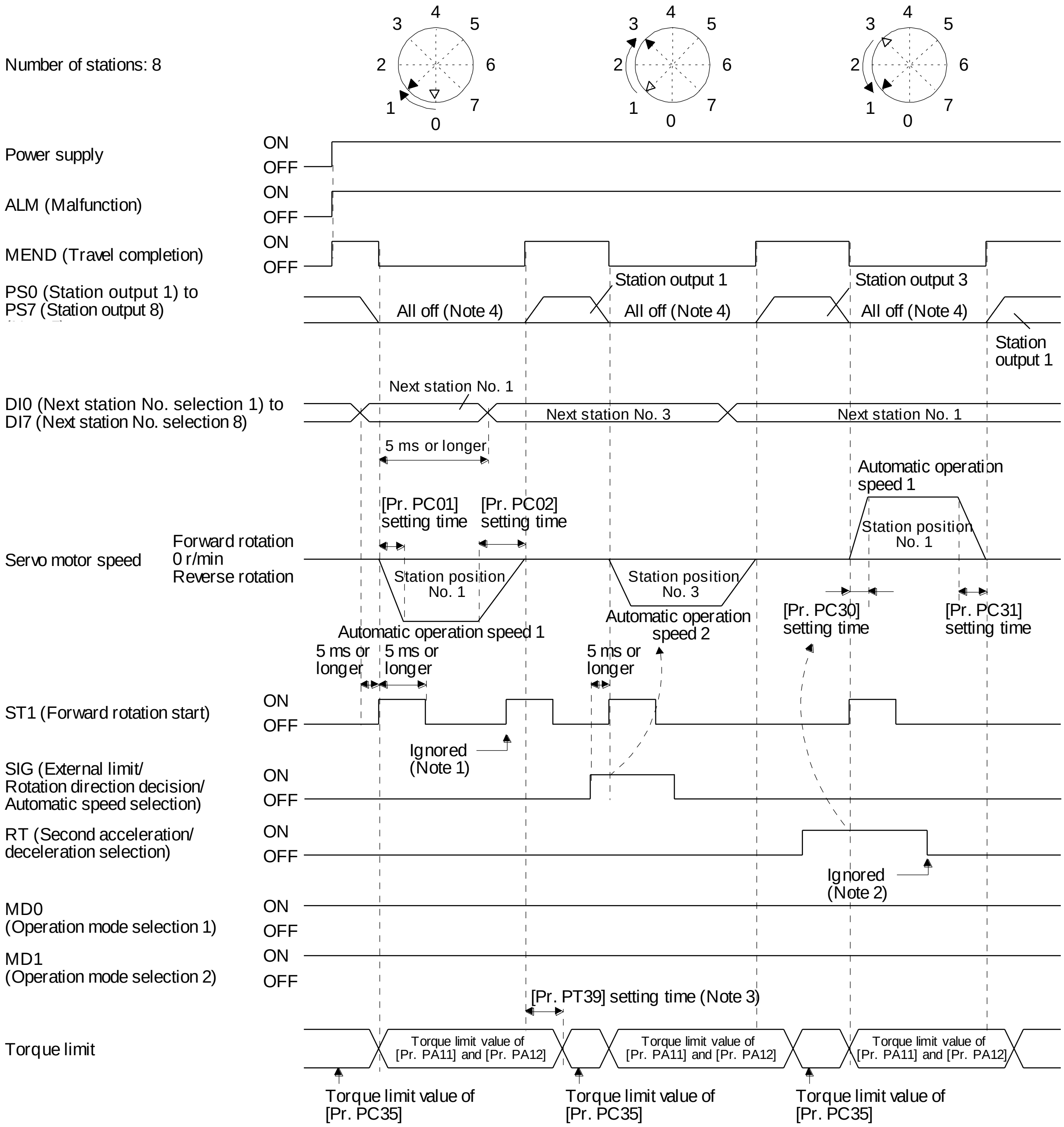
Device (Note 1)								Selection contents
DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0	
0	0	0	0	0	0	0	0	Next station No. 0
0	0	0	0	0	0	0	1	Next station No. 1
0	0	0	0	0	0	1	0	Next station No. 2
0	0	0	0	0	0	1	1	Next station No. 3
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
1	1	1	1	1	1	1	0	Next station No. 254
1	1	1	1	1	1	1	1	Setting inhibited (Note 2)

Note 1. 0: Off
1: On
2. [AL. 97.2 Next station position warning] will occur.

(4) Timing chart

POINT
●Always perform a home position return. Executing positioning operation without home position return will trigger [AL. 90 Home position return incomplete warning] and ST1 (Forward rotation start) will be disabled. ●When travel distances are the same to a target station position from CCW and from CW, the shaft will rotate to the station No. increasing direction.

The following timing chart shows that an operation is performed at a stop of the station No. 0 when servo-on.



Note 1. When the rest of command travel distance is other than "0", ST1 (Forward rotation start) will not be accepted. Refer to section 6.4.5 (1).
2. RT (Second acceleration/deceleration selection) will not be accepted during operation. Selection of the servo motor speed and acceleration/deceleration time constants will be enabled by on-edge of ST1 (Forward rotation start). However, when the rest of command travel distance is other than "0", turning on ST1 (Forward rotation start) will not be enabled.
3. Counting will start when the rest of command travel distance becomes "0".
4. When MEND (Travel completion) is off, the station position outputs will be "0" (all off).

16.19 MANUAL OPERATION MODE

POINT

- When the operation mode is changed during operation, inputting ST1 (Forward rotation start) is disabled until the operation stops. Switch on ST1 (Forward rotation start) after the operation stops.

For the machine adjustment, home position adjustment, and others, you can shift the position to any position with the station JOG operation or JOG operation.

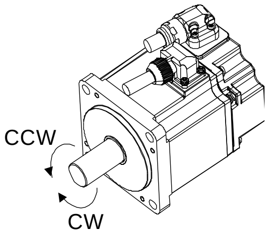
16.19.1 Station JOG operation

(1) Setting

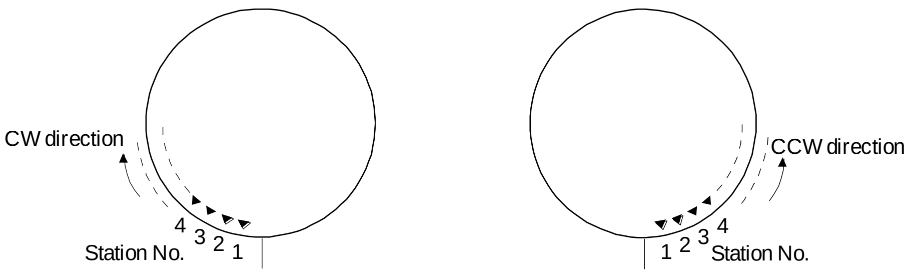
According to the purpose of use, set devices and parameters as shown below. With this operation, DI0 (Next station No. selection 1) to DI7 (Next station No. selection 8) are disabled.

Item	Used device/parameter	Setting
Selecting indexer method	Control mode selection of [Pr. PA01]	Select "_ _ _ 8" (positioning mode (indexer method)).
Manual operation mode selection	MD0 (Operation mode selection 1)	Switch on MD0.
	MD1 (Operation mode selection 2)	Switch off MD1.
Station JOG operation selection	[Pr. PT27]	Select "_ _ 0 _" (Station JOG operation).
Rotation direction selection	SIG (External limit/Rotation direction decision/Automatic speed selection)	The rotation direction to a station No. will be as follows. Off: Station No. decreasing direction On: Station No. increasing direction
Servo motor speed	[Pr. PC07]	Set a servo motor speed.
Acceleration time constant/Deceleration time constant	RT (Second acceleration/deceleration selection)	1. When RT is turned off Acceleration time constant: setting value of [Pr. PC01 Acceleration time constant 1] Deceleration time constant: setting value of [Pr. PC02 Deceleration time constant 1] 2. When RT is turned on Acceleration time constant: setting value of [Pr. PC30 Acceleration time constant 2] Deceleration time constant: setting value of [Pr. PC31 Deceleration time constant 2]

(2) Setting assignment direction of station No.
Select an assignment direction of station No. with [Pr. PA14].



[Pr. PA14] setting	Servo motor rotation direction ST1 (Forward rotation start) is on.
0	Next station No. will be assigned in CW direction in order of 1, 2, 3
1	Next station No. will be assigned in CCW direction in order of 1, 2, 3



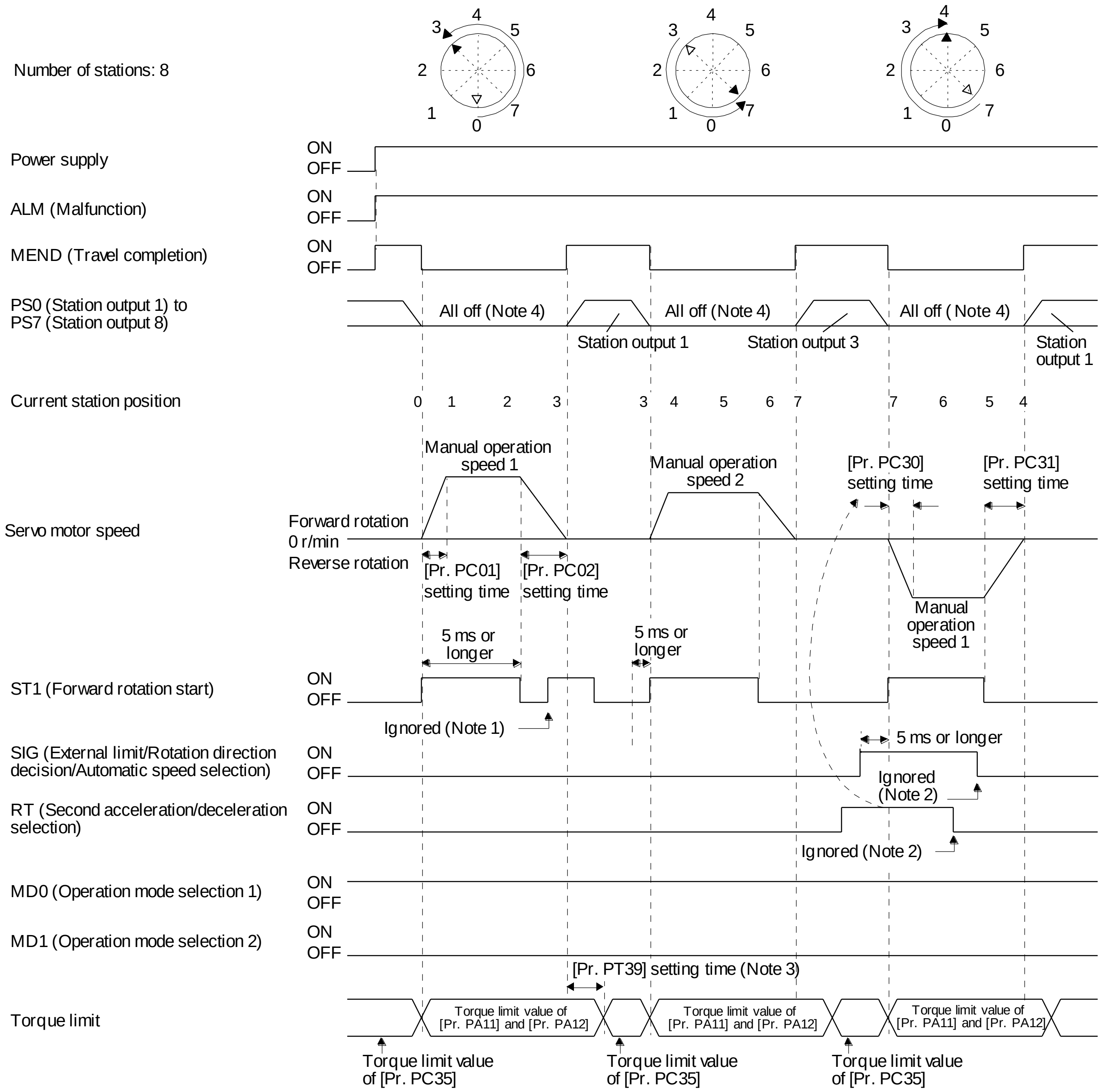
[Pr. PA14]: 0 (initial value)

[Pr. PA14]: 1

(3) Operation
Turning on ST1 (Forward rotation start) will start rotation to a direction specified with the rotation direction decision and turning off it will execute a positioning to the closest station position which is possible to decelerate to a stop. However, the shaft stops based on a set time constant depending on the setting value of deceleration time constant. The speed may not reach the specified speed.

(4) Timing chart

The following timing chart shows that a JOG operation is performed at a stop of the station No. 0 when servo-on.



Note 1. When the rest of command travel distance is other than "0", ST1 (Forward rotation start) will not be accepted. Refer to section 6.4.5 (1).

2. SIG and RT (Second acceleration/deceleration selection) will not be accepted during operation. Selection of the servo motor speed and acceleration/deceleration time constants will be enabled by on-edge of ST1 (Forward rotation start). However, when the rest of command travel distance is other than "0", turning on ST1 (Forward rotation start) will not be enabled.

3. Counting will start when the rest of command travel distance becomes "0".

4. When MEND (Travel completion) is off, the station position outputs will be "0" (all off).

16.19.2 JOG operation

(1) Setting

According to the purpose of use, set devices and parameters as shown below. With this operation, DI0 (Next station No. selection 1) to DI7 (Next station No. selection 8) are disabled.

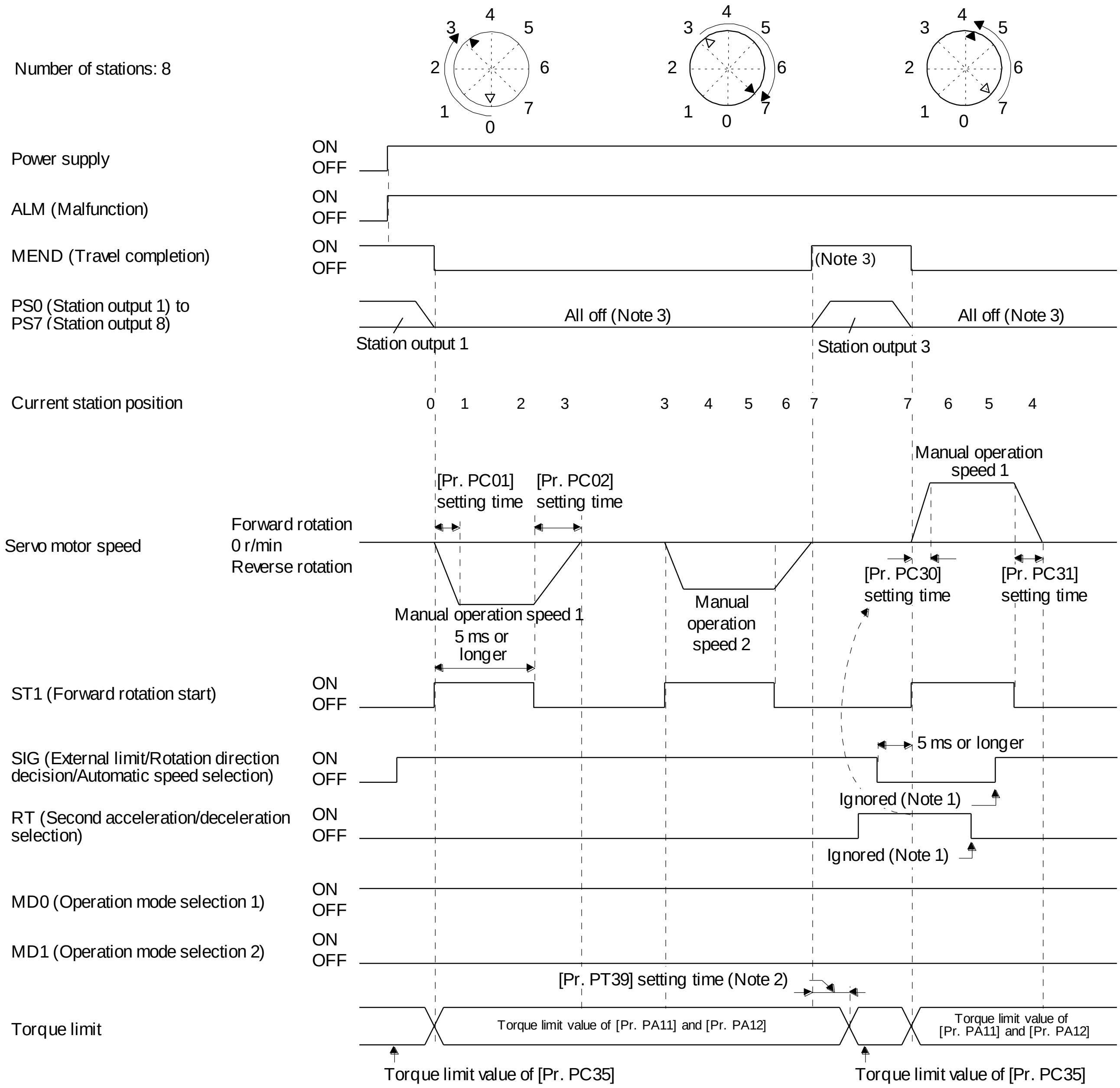
Item	Used device/parameter	Setting
Selecting indexer method	Control mode selection of [Pr. PA01]	Select "_ _ _ 8" (positioning mode (indexer method)).
Manual operation mode selection	MD0 (Operation mode selection 1)	Switch on MD0.
	MD1 (Operation mode selection 2)	Switch off MD1.
JOG operation selection	[Pr. PT27]	Select "_ _ 1 _" (JOG operation).
Rotation direction selection	SIG (External limit/Rotation direction decision/Automatic speed selection)	The rotation direction to a station No. will be as follows. Off: Station No. decreasing direction On: Station No. increasing direction
Servo motor speed	[Pr. PC07]	Set a servo motor speed.
Acceleration time constant/Deceleration time constant	RT (Second acceleration/deceleration selection)	1. When RT is turned off Acceleration time constant: setting value of [Pr. PC01 Acceleration time constant 1] Deceleration time constant: setting value of [Pr. PC02 Deceleration time constant 1] 2. When RT is turned on Acceleration time constant: setting value of [Pr. PC30 Acceleration time constant 2] Deceleration time constant: setting value of [Pr. PC31 Deceleration time constant 2]

(2) Operation

Turning on ST1 (Forward rotation start) will start rotation to a direction specified with the rotation direction decision and turning off it will decelerate to a stop regardless of the station position.

(3) Timing chart

The following timing chart shows that a JOG operation is performed at a stop of the station No. 0 when servo-on.



Note 1. SIG and RT (Second acceleration/deceleration selection) will not be accepted during operation. Selection of the servo motor speed and acceleration/deceleration time constants will be enabled by on-edge of ST1 (Forward rotation start). However, when the rest of command travel distance is other than "0", turning on ST1 (Forward rotation start) will not be enabled.

2. Counting will start when the rest of command travel distance becomes "0".

3. MEND (Travel completion) is off because the shaft does not stop within the in-position range of each next station position. When MEND (Travel completion) turns off, PS0 (Station output 1) to PS7 (Station output 8) will not be outputted. Additionally, the station position outputs will be "0" (all off) during home position return incompletion.

16.20 HOME POSITION RETURN MODE

POINT
●Before performing the home position return, make sure that the limit switch operates. ●Check the home position return direction. An incorrect setting will cause a reverse running. ●Check the input polarity of the external limit. Otherwise, it may cause an unexpected operation.

16.20.1 Outline of home position return

A home position return is performed to match the command coordinates with the machine coordinates. Under the incremental method, each power-on of the input power supply requires the home position return. Contrastingly, in the absolute position detection system, once you have performed the home position return at machine installation, the current position will be retained even if the power supply is shut off. Therefore, the home position return is unnecessary when the power supply is switched on again.
This section shows the home position return methods of the driver. Select the optimum method according to the configuration and uses of the machine.

(1) Home position return types
Select the optimum home position return type according to the machine type or others.

System	Home position return method	Feature
Torque limit changing dog type	Deceleration starts at the external limit detection. The position specified by the first Z-phase signal, or the position of the first Z-phase signal shifted by the home position shift distance is used as the home position.	・This is a typical home position return method using an external limit. ・The repeatability of the home position return is high. ・The machine is less loaded. ・Used when the width of the external limit can be set equal to or greater than the deceleration distance of the servo motor.
Torque limit changing data set type	An arbitrary position is used as the home position.	・An external limit is not required.

(2) Parameters for home position return

To perform the home position return, set each parameter as follows.

(a) Select the home position return type with [Pr. PT04 Home position return type].

[Pr. PT04]

0	0	0	

Home position return method
0: Torque limit changing dog type
1: Not for indexer method
2: Torque limit changing data set type
3:
4:
5:
6:
7:
8:
9:
A:
(3 to A) Not for indexer method

(b) Select the starting direction for the home position return with [Pr. PT04 Home position return type]. Setting "0" starts the home position return in the address increasing direction from the current position. Setting "1" starts the home position return in the address decreasing direction from the current position.

[Pr. PT04]

0	0		0

Home position return direction
0: Address increasing direction
1: Address decreasing direction

(c) Select the polarity where the external limit is detected with the SIG polarity selection of [Pr. PT29 Function selection T-3].
Setting "0" is for detection with normally open contact and setting "1" is for detection with normally closed contact.

[Pr. PT29]

0	0	0	

SIG (External limit/Rotation direction decision/Automatic speed selection) polarity selection
0: Normally open contact
1: Normally closed contact

16.20.2 Torque limit changing dog type home position return

This is a home position return method using an external limit. Deceleration starts at the external limit detection. The position specified by the first Z-phase signal, or the position of the first Z-phase signal shifted by the specified home position shift distance is used as the home position.

(1) Device/parameter

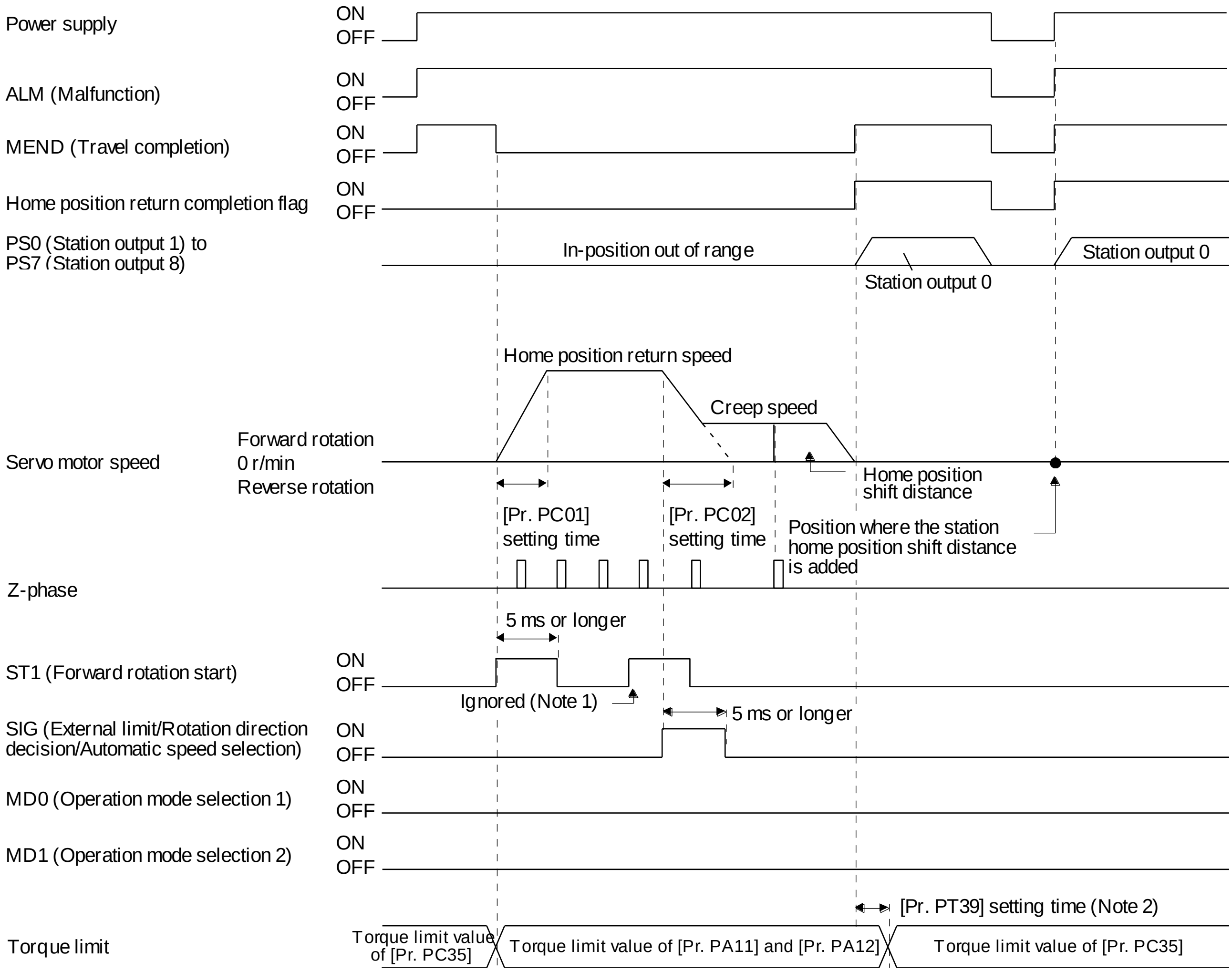
Set input devices and parameters as follows.

Item	Used device/parameter	Setting
Home position return mode selection	MD0 (Operation mode selection 1)	Switch off MD0.
	MD1 (Operation mode selection 2)	Switch off MD1.
Torque limit changing dog type home position return	[Pr. PT04]	Select "_ _ _ 0" (Torque limit changing dog type).
Home position return speed	[Pr. PT05]	Set the rotation speed specified until an external limit is detected.
Creep speed	[Pr. PT06]	Set the rotation speed specified after an external limit is detected.
Home position shift distance	[Pr. PT07]	Set this item to shift the home position, which is specified by the first Z-phase signal after the external limit is detected.
Acceleration time constant/Deceleration time constant	RT (Second acceleration/deceleration selection)	1. When RT is turned off Acceleration time constant: setting value of [Pr. PC01 Acceleration time constant 1] Deceleration time constant: setting value of [Pr. PC02 Deceleration time constant 1] 2. When RT is turned on Acceleration time constant: setting value of [Pr. PC30 Acceleration time constant 2] Deceleration time constant: setting value of [Pr. PC31 Deceleration time constant 2]
Station home position shift distance (Note 1, 2)	[Pr. PT40]	Set a shift distance of the station home position (station No. 0) for the home position return completion.

Note 1. The setting of the station home position shift distance is disabled at home position return. Cycling the power will enable the setting.

2. [Pr. PT40 Station home position shift distance] is enabled as an offset to the position that the home position return is performed. If a larger value than the in-position range is set to [Pr. PT40], the completion output of positioning will not turn on (short circuit) at the first power on after home position return.

(2) Timing chart



Note 1. When the rest of command travel distance is other than "0", turning on ST1 (Forward rotation start) will not be enabled.

2. Counting will start when the rest of command travel distance becomes "0".

16.20.3 Torque limit changing data set type

POINT

- When the data set type home position return is selected, [AL. 52] and [AL. 42] will not be detected.
- If the servo motor is rotated in the home position return mode and the mode is changed to automatic mode without home position return, the following may occur.
  1. [AL. 42] or [AL. 52] can occur.
  2. Even though [AL. 42] or [AL. 52] does not occur, the motor will try to compensate a position gap to the command position at start signal input because the current position is out of position with the command position. Watch out for the servo motor rotation due to the compensation the gap to zero between command position and current position.
- When [AL. 90] is occurring, performing home position return will automatically cancel the alarm.
- When [AL. 25] is occurring, cycling the power will cancel the alarm.

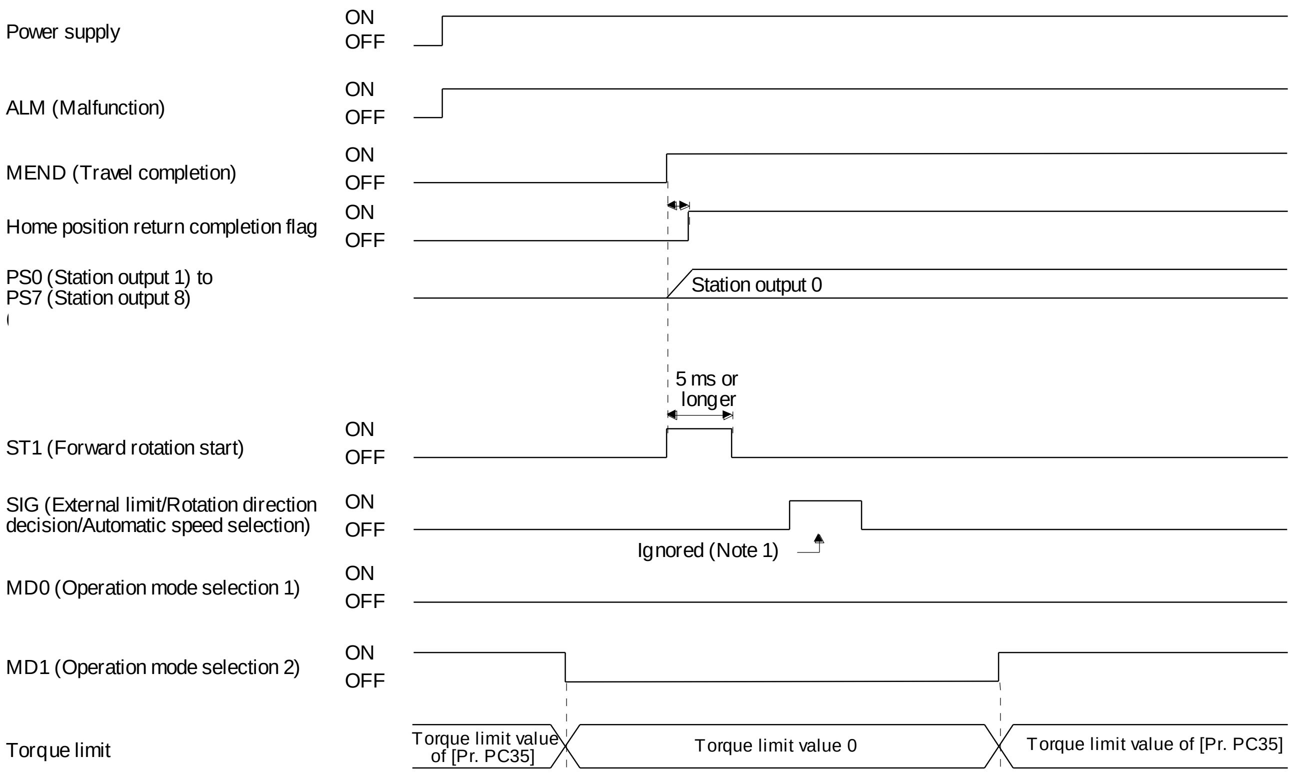
When setting any position as home, use the torque limit changing data set type home position return. The JOG operation, manual pulse generator operation, and others can be used for the travel. With this home position return, torque will not be generated simultaneously at switching to the home position return mode. The shaft can be rotated with an external force to set any home position.
Additionally, SIG is not used. SIG is disabled even if turn off.

(1) Device/parameter
Set input devices and parameters as follows.

Item	Used device/parameter	Setting
Home position return mode selection	MD0 (Operation mode selection 1)	Switch off MD0.
	MD1 (Operation mode selection 2)	Switch off MD1.
Data set type home position return	[Pr. PT04]	Select "_ _ _ 2" (Select the torque limit changing data set type.).
Station home position shift distance (Note 1, 2)	[Pr. PT40]	Set a shift distance of the station home position (station No. 0) for the home position return completion.

Note 1. The setting of the station home position shift distance is disabled at home position return. Cycling the power will enable the setting.
2. [Pr. PT40 Station home position shift distance] is enabled as an offset to the position that the home position return is performed. If a larger value than the in-position range is set to [Pr. PT40], the completion output of positioning will not turn on (short circuit) at the first power on after home position return.

(2) Timing chart



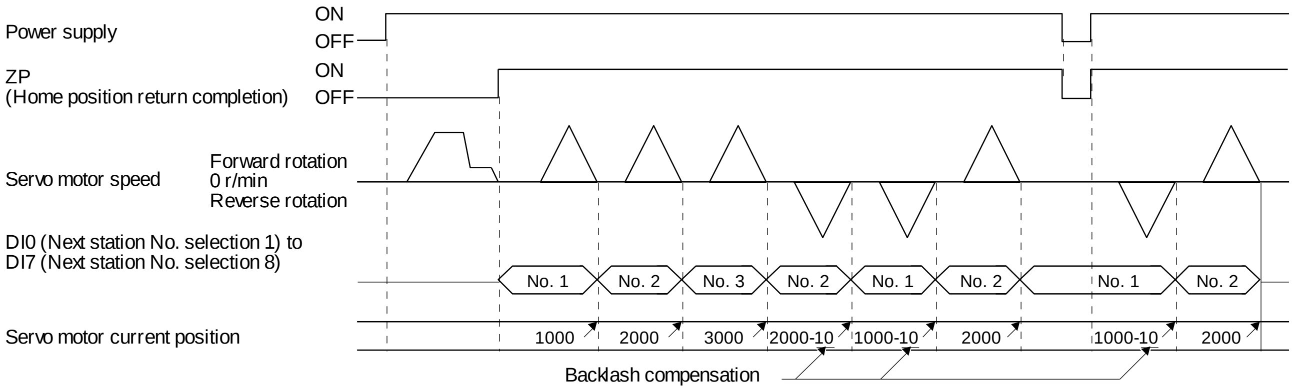
Note 1. When a data set type home position return is performed, SIG will be disabled.

16.20.4 Backlash compensation and digital override

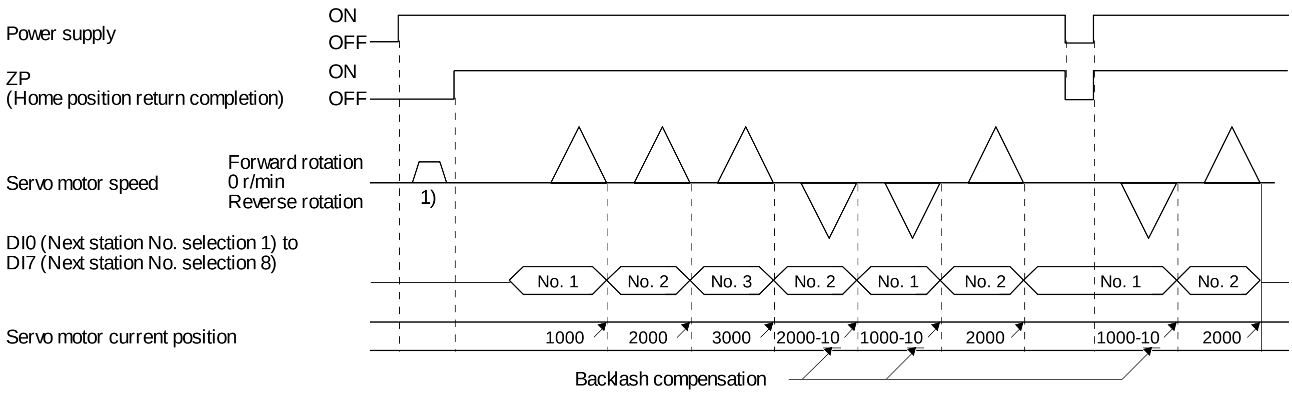
(1) Backlash compensation

When executing a positioning reversely to the direction to the home position return, set [Pr. PT14 Backlash compensation] to stop the shaft at the compensated position for the setting value.
When the travel distance between stations is set to 1000 and the backlash compensation is set to 10 in the absolute position detection system, the timing chart is as follows.

(a) Torque limit changing dog type home position return



(b) Torque limit changing data set type



Backlash is compensated to the direction set with [Pr. PT38] regardless of a JOG operation (1)) or disturbance after power-on.

[Pr. PT38] setting	Backlash compensation
"0 _ _ _"	Executes backlash compensation assuming a command to the CW rotation direction before home position return.
"1 _ _ _"	Executes backlash compensation assuming a command to the CCW rotation direction before home position return.

(2) Digital override

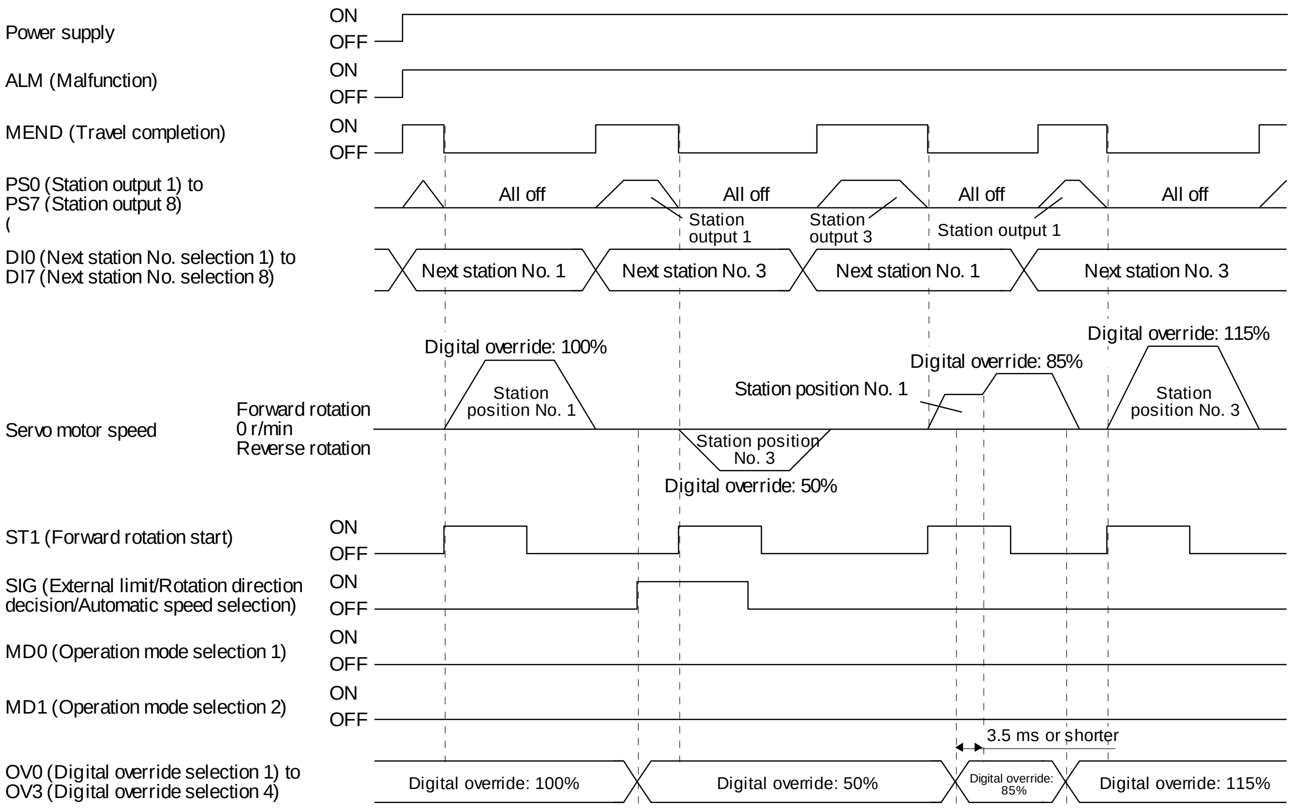
Setting [Pr. PT38] to "_ _ 1 _" enables the digital override function.
Actual servo motor speed will be the value multiplying the command speed by the digital override selected with OV0 (Digital override selection 1) to OV3 (Digital override selection 4). This is enabled with all the operation modes.

Example) [Pr. PT42]: 50, [Pr. PT43]: 5

(Note) Device				Description
OV3	OV2	OV1	OV0	
0	0	0	0	100 [%] of parameter setting speed
0	0	0	1	50 [%] of parameter setting speed
0	0	1	0	55 [%] of parameter setting speed
0	0	1	1	60 [%] of parameter setting speed
. . .	. . .	. . .	. . .	. . .
1	1	0	1	110 [%] of parameter setting speed
1	1	1	0	115 [%] of parameter setting speed
1	1	1	1	0 [%] of parameter setting speed

Note. 0: Off
1: On

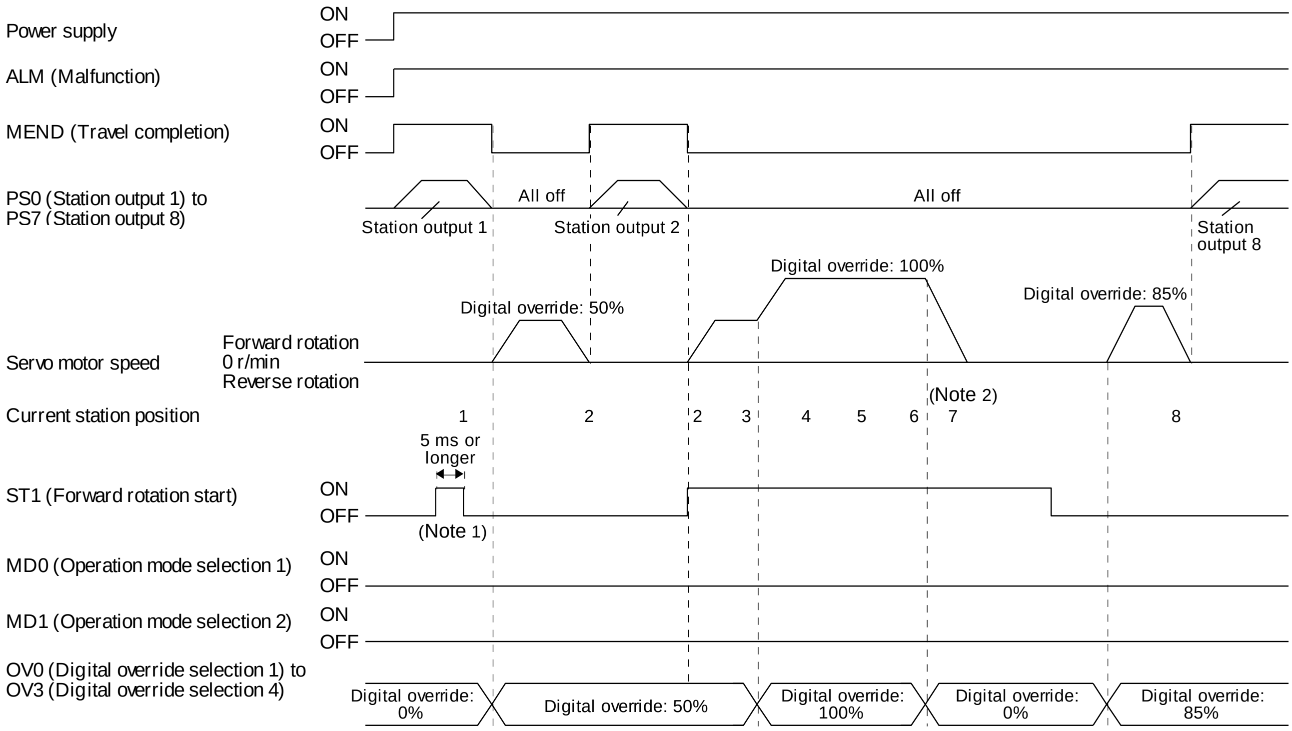
(a) When [Pr. PT42] is set to 50 and [Pr. PT43] to 5 in the automatic operation mode 1 (Rotation direction specifying indexer), the chart will be as follows.



POINT

●Speed changes with the digital override function are enabled with the following conditions.
- Automatic operation mode
- Manual operation mode
- Home position return is in progress.

(b) When [Pr. PT42] is set to 50 and [Pr. PT43] to 5 in the station JOG operation, the chart will be as follows.



Note 1. In the manual operation mode, when turning on/off ST1 (Forward rotation start) with 0% digital override and change the digital override to other than 0%, the shaft will stop at the closest station regardless of ST1 (Forward rotation start) off.

2. Changing the digital override to 0% during operation will decelerate to a stop. Then, the digital override is changed to 0%, JOG operation will start again. In that case, the shaft stops at the closest station regardless of ST1 (Forward rotation start) off.

16.20.5 Safety precautions

(1) I/O signal

(a) When a home position return is not executed in the absolute position detection system and incremental system...
The station output signals will not be outputted (all off).

(b) When one or more home position returns is completed...

1) At power-on and forced stop, corresponding station output signal will be outputted if only it is within the in-position range of each next station position.

2) After power-on or during servo motor driving after forced stop, PS0 (Station output 1) to PS7 (Station output 8) will be off without change with a command travel distance other than "0" even if it is within the in-position range of target next station.

3) After power-on or after servo motor driving after forced stop canceled, corresponding station output signal will be outputted if only it is within the in-position range of target next station to stop with the rest of command travel distance "0".

(2) Torque limit
The torque limit will change from the setting value of [Pr. PC35 Internal torque limit 2] to the setting value of [Pr. PA11 Forward rotation torque limit] or [Pr. PA12 Reverse rotation torque limit] at inputting ST1 (Forward rotation start) of the automatic operation mode 1, automatic operation mode 2, manual operation, and torque limit changing dog type home position return. Additionally, after positioning completed signal is outputted, the time has passed set with [Pr. PT39] and the torque limit will change from [Pr. PA11 Forward rotation torque limit] or [Pr. PA12 Reverse rotation torque limit] to the setting value of [Pr. PC35 Internal torque limit 2].

(3) Test operation
Always turn off the power after the JOG test operation, positioning test operation, and machine analyzer function operation. The shaft cannot stop at the next station position because the coordinate system has a gap for the shaft control.

(4) Deceleration to a stop function
When the operation is stopped with the deceleration to a stop function during each operation mode of the rotation direction specifying indexer, shortest rotating indexer, and station JOG, the shaft will stop regardless of the station position.

16.21 PARAMETERS

CAUTION	
⚠CAUTION	● Never make a drastic adjustment or change to the parameter values as doing so will make the operation unstable. ● If a fixed value is described for each digit of the parameter, never change the value of that digit. ● Do not change the parameters for manufacturer settings. ● Do not set a value other than those described for each parameter.

POINT

- To enable a parameter whose symbol is preceded by *, cycle the power after setting it.
- The symbols in the control mode column mean as follows.
  CP: Positioning mode (point table method)
  CL: Positioning mode (program method)
  PS: Positioning mode (indexer method)
- Setting a value out of the setting range in each parameter will trigger [AL. 37 Parameter error].

16.21.1 Basic setting parameters ([Pr. PA_ _])

POINT

- To enable the following parameters in a positioning mode, cycle the power after setting.
  - [Pr. PA06 Electronic gear numerator (command pulse multiplication numerator)/Number of gear teeth on machine side]
  - [Pr. PA06 Electronic gear denominator (command pulse multiplication denominator)/Number of gear teeth on servo motor side]
- The following parameter cannot be used in the positioning mode.
  - [Pr. PA05 Number of command input pulses per revolution]

No.	Symbol	Name	Initial value	Unit	Operation mode	Control mode		
					Standard	CP	CL	PS
PA01	*STY	Operation mode	1000h		○	○	○	○
PA02	*REG	Regenerative option	0000h		○	○	○	○
PA03	*ABS	Absolute position detection system	0000h		○	○	○	○
PA04	*AOP1	Function selection A-1	2000h		○	○	○	○
PA05	*FBP	Number of command input pulses per revolution	10000					
PA06	*CMX	Electronic gear numerator (command pulse multiplication numerator)	1		○	○	○	
		Number of gear teeth on machine side	1		○			○
PA07	*CDV	Electronic gear denominator (command pulse multiplication denominator)	1		○	○	○	
		Number of gear teeth on servo motor side	1		○			○
PA08	ATU	Auto tuning mode	0001h		○	○	○	○
PA09	RSP	Auto tuning response	16		○	○	○	○
PA10	INP	In-position range	100	[m]	○	○	○	○
PA11	TLP	Forward rotation torque limit/positive direction thrust limit	100.0	[%]	○	○	○	○
PA12	TLN	Reverse rotation torque limit/negative direction thrust limit	100.0	[%]	○	○	○	○
PA13	*PLSS	Command pulse input form	0100h		○	○	○	
PA14	*POL	Rotation direction selection/travel direction selection	0		○	○	○	○
PA15	*ENR	Encoder output pulses	4000	[pulse/rev]	○	○	○	○
PA16	*ENR2	Encoder output pulses 2	1		○	○	○	○
PA17	*MSR	Servo motor series setting	0000h			○	○	○
PA18	*MTY	Servo motor type setting	0000h			○	○	○
PA19	*BLK	Parameter writing inhibit	00AAh		○	○	○	○
PA20	*TDS	Tough drive setting	0000h		○	○	○	○
PA21	*AOP3	Function selection A-3	0001h		○	○	○	
PA22	*PCS	Position control composition selection	0000h		○	○	○	○
PA23	DRAT	Drive recorder arbitrary alarm trigger setting	0000h		○	○	○	○
PA24	AOP4	Function selection A-4	0000h		○	○	○	○
PA25	OTHOV	One-touch tuning - Overshoot permissible level	0	[%]	○	○	○	○
PA26	*AOP5	Function selection A-5	0000h		○	○	○	○
PA27		For manufacturer setting	0000h					
PA28			0000h					
PA29			0000h					
PA30			0000h					
PA31			0000h					
PA32			0000h					

16.21.2 Gain/filter setting parameters ([Pr. PB_ _])

No.	Symbol	Name	Initial value	Unit	Operation mode	Control mode		
					Standard	CP	CL	PS
PB01	FILT	Adaptive tuning mode (adaptive filter II)	0000h		○	○	○	○
PB02	VRFT	Vibration suppression control tuning mode (advanced vibration suppression control II)	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	Load to motor inertia ratio/load to motor mass ratio	7.00	[Multiplier]	○	○	○	○
PB07	PG1	Model loop gain	15.0	[rad/s]	○	○	○	○
PB08	PG2	Position loop gain	37.0	[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	NHF	Shaft resonance suppression filter	0000h		○	○	○	○
PB18	LPF	Low-pass filter setting	3141	[rad/s]	○	○	○	○
PB19	VRF11	Vibration suppression control 1 - Vibration frequency	100.0	[Hz]	○	○	○	○
PB20	VRF12	Vibration suppression control 1 - Resonance frequency	100.0	[Hz]	○	○	○	○
PB21	VRF13	Vibration suppression control 1 - Vibration frequency damping	0.00		○	○	○	○
PB22	VRF14	Vibration suppression control 1 - Resonance frequency damping	0.00		○	○	○	○
PB23	VFBF	Low-pass filter selection	0000h		○	○	○	○
PB24	*MVS	Slight vibration suppression control	0000h		○	○	○	○
PB25	*BOP1	Function selection B-1	0000h		○	○	○	○
PB26	*CDP	Gain switching function	0000h		○	○	○	○
PB27	CDL	Gain switching condition	10	[kpulse/s]/ [pulse]/ [r/min]	○	○	○	○
PB28	CDT	Gain switching time constant	1	[ms]	○	○	○	○
PB29	GD2B	Load to motor inertia ratio after gain switching	7.00	[Multiplier]	○	○	○	○
PB30	PG2B	Position loop gain after gain switching	0.0	[rad/s]	○	○	○	○
PB31	VG2B	Speed loop gain after gain switching	0	[rad/s]	○	○	○	○
PB32	VICB	Speed integral compensation after gain switching	0.0	[ms]	○	○	○	○
PB33	VRF1B	Vibration suppression control 1 - Vibration frequency after gain switching	0.0	[Hz]	○	○	○	○
PB34	VRF2B	Vibration suppression control 1 - Resonance frequency after gain switching	0.0	[Hz]	○	○	○	○
PB35	VRF3B	Vibration suppression control 1 - Vibration frequency damping after gain switching	0.00		○	○	○	○
PB36	VRF4B	Vibration suppression control 1 - Resonance frequency damping after gain switching	0.00		○	○	○	○

No.	Symbol	Name	Initial value	Unit	Operation mode	Control mode		
					Standard	CP	CL	PS
PB37		For manufacturer setting	1600					
PB38			0.00					
PB39			0.00					
PB40			0.00					
PB41			0000h					
PB42			0000h					
PB43			0000h					
PB44			0.00					
PB45	CNHF	Command notch filter	0000h		○	○	○	○
PB46	NH3	Machine resonance suppression filter 3	4500	[Hz]	○	○	○	○
PB47	NHQ3	Notch shape selection 3	0000h		○	○	○	○
PB48	NH4	Machine resonance suppression filter 4	4500	[Hz]	○	○	○	○
PB49	NHQ4	Notch shape selection 4	0000h		○	○	○	○
PB50	NH5	Machine resonance suppression filter 5	4500	[Hz]	○	○	○	○
PB51	NHQ5	Notch shape selection 5	0000h		○	○	○	○
PB52	VRF21	Vibration suppression control 2 - Vibration frequency	100.0	[Hz]	○	○	○	○
PB53	VRF22	Vibration suppression control 2 - Resonance frequency	100.0	[Hz]	○	○	○	○
PB54	VRF23	Vibration suppression control 2 - Vibration frequency damping	0.00		○	○	○	○
PB55	VRF24	Vibration suppression control 2 - Resonance frequency damping	0.00		○	○	○	○
PB56	VRF21B	Vibration suppression control 2 - Vibration frequency after gain switching	0.0	[Hz]	○	○	○	○
PB57	VRF22B	Vibration suppression control 2 - Resonance frequency after gain switching	0.0	[Hz]	○	○	○	○
PB58	VRF23B	Vibration suppression control 2 - Vibration frequency damping after gain switching	0.00		○	○	○	○
PB59	VRF24B	Vibration suppression control 2 - Resonance frequency damping after gain switching	0.00		○	○	○	○
PB60	PG1B	Model loop gain after gain switching	0.0	[rad/s]	○	○	○	○
PB61		For manufacturer setting	0.0					
PB62			0000h					
PB63			0000h					
PB64			0000h					

16.21.3 Extension setting parameters ([Pr. PC_ _])

POINT

- To enable the following parameters in a positioning mode, cycle the power after setting.
  - [Pr. PC03 S-pattern acceleration/deceleration time constant]
- The following parameter cannot be used in the positioning mode.
  - [Pr. PC04 Torque command time constant/thrust command time constant]
  - [Pr. PC08 Internal speed command 4/internal speed limit 4]
  - [Pr. PC09 Internal speed command 5/internal speed limit 5]
  - [Pr. PC10 Internal speed command 6/internal speed limit 6]
  - [Pr. PC11 Internal speed command 7/internal speed limit 7]
  - [Pr. PC12 Analog speed command - Maximum speed/Analog speed limit - Maximum speed]
  - [Pr. PC13 Analog torque/thrust command maximum output]
  - [Pr. PC23 Function selection C-2]
  - [Pr. PC32 Command input pulse multiplication numerator 2]
  - [Pr. PC33 Command input pulse multiplication numerator 3]
  - [Pr. PC34 Command input pulse multiplication numerator 4]

No.	Symbol	Name	Initial value	Unit	Operation mode	Control mode		
					Standard	CP	CL	PS
PC01	STA	JOG operation acceleration time constant	0	[ms]	○		○	
		Acceleration time constant 1			○			○
PC02	STB	JOG operation deceleration time constant	0	[ms]	○		○	
		Deceleration time constant 1			○			○
PC03	*STC	S-pattern acceleration/deceleration time constant	0	[ms]	○	○	○	
PC04	TQC	Torque command time constant/thrust command time constant	0					
PC05	SC1	Automatic operation speed 1	100	[r/min]	○			○
PC06	SC2	Automatic operation speed 2	500	[r/min]	○			○
PC07	SC3	Manual operation speed 1	1000	[r/min]	○			○
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/thrust command maximum output	100.0	[%]				

No.	Symbol	Name	Initial value	Unit	Operation mode	Control mode		
					Standard	CP	CL	PS
PC14	MOD1	Analog monitor 1 output	0000h		○	○	○	○
PC15	MOD2	Analog monitor 2 output	0001h		○	○	○	○
PC16	MBR	Electromagnetic brake sequence output	0	[ms]	○	○	○	○
PC17	ZSP	Zero speed	50	[r/min]	○	○	○	○
PC18	*BPS	Alarm history clear	0000h		○	○	○	○
PC19	*ENRS	Encoder output pulse selection	0000h		○	○	○	○
PC20	*SNO	Station No. setting	0	[station]	○	○	○	○
PC21	*SOP	RS-422 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	*COP7	Function selection C-7	0000h			○	○	
PC29		For manufacturer setting	0000h					
PC30	STA2	Home position return acceleration time constant	0	[ms]	○		○	
		Acceleration time constant 2			○			○
PC31	STB2	Home position return deceleration time constant	0	[ms]	○		○	
		Deceleration time constant 2			○			○
PC32	CMX2	Command input pulse multiplication numerator 2	1					
PC33	CMX3	Command input pulse multiplication numerator 3	1					
PC34	CMX4	Command input pulse multiplication numerator 4	1					
PC35	TL2	Internal torque limit 2/internal thrust limit 2	100.0	[%]	○	○	○	○
PC36	*DMD	Status display selection	0000h		○	○	○	○
PC37	VCO	Analog override offset	0	[mV]	○	○	○	
PC38	TPO	Analog torque limit offset	0	[mV]	○	○	○	○
PC39	MO1	Analog monitor 1 offset	0	[mV]	○	○	○	○
PC40	MO2	Analog monitor 2 offset	0	[mV]	○	○	○	○
PC41		For manufacturer setting	0					
PC42			0					
PC43	ERZ	Error excessive alarm detection level	0	[rev]	○	○	○	○
PC44	*COP9	Function selection C-9	0000h			○	○	
PC45	*COPA	Function selection C-A	0000h			○	○	
PC46		For manufacturer setting	0					
PC47			0					
PC48			0					
PC49			0					
PC50			0000h					
PC51	RSBR	Forced stop deceleration time constant	100	[ms]	○	○	○	○
PC52		For manufacturer setting	0					
PC53			0					
PC54	RSUP1	Vertical axis freefall prevention compensation amount	0	[0.0001rev]	○	○	○	○
PC55		For manufacturer setting	0					
PC56			100					
PC57			0000h					
PC58			0					
PC59			0000h					
PC60	*COPD	Function selection C-D	0000h		○	○	○	

No.	Symbol	Name	Initial value	Unit	Operation mode	Control mode		
					Standard	CP	CL	PS
PC61		For manufacturer setting	0000h					
PC62			0000h					
PC63			0000h					
PC64			0000h					
PC65			0000h					
PC66	LPSPL	Mark detection range + (lower three digits)	0	10^{STM} [μm]	○	○	○	
PC67	LPSPH	Mark detection range + (upper three digits)	0	10^{STM} [μm]	○	○	○	
PC68	LPSNL	Mark detection range - (lower three digits)	0	10^{STM} [μm]	○	○	○	
PC69	LPSNH	Mark detection range - (upper three digits)	0	10^{STM} [μm]	○	○	○	
PC70	*SNOM	Modbus-RTU communication station number setting	0		○	○	○	○
PC71	*COPF	Function selection C-F	0040h		○	○	○	○
PC72	*COPG	Function selection C-G	0000h		○	○	○	○
PC73	ERW	Error excessive warning level	0		○	○	○	○
PC74		For manufacturer setting	0000h					
PC75			0000h					
PC76			0000h					
PC77			0000h					
PC78			0000h					
PC79			0000h					
PC80			0000h					

16.21.4 I/O setting parameters ([Pr. PD_ _])

POINT

- The following parameter cannot be used in the positioning mode.
  - [Pr. PD03 Input device selection 1L]
  - [Pr. PD05 Input device selection 2L]
  - [Pr. PD07 Input device selection 3L]
  - [Pr. PD09 Input device selection 4L]
  - [Pr. PD11 Input device selection 5L]
  - [Pr. PD13 Input device selection 6L]
  - [Pr. PD17 Input device selection 8L]
  - [Pr. PD19 Input device selection 9L]
  - [Pr. PD21 Input device selection 10L]
  - [Pr. PD43 Input device selection 11L]
  - [Pr. PD45 Input device selection 12L]

No.	Symbol	Name	Initial value	Unit	Operation mode	Control mode		
					Standard	CP	CL	PS
PD01	*DIA1	Input signal automatic on selection 1	0000h		○	○	○	○
PD02		For manufacturer setting	0000h					
PD03	*DI1L	Input device selection 1L	0202h					
PD04	*DI1H	Input device selection 1H	0202h		○	○	○	○
PD05	*DI2L	Input device selection 2L	2100h					
PD06	*DI2H	Input device selection 2H	2021h		○	○	○	○
PD07	*DI3L	Input device selection 3L	0704h					
PD08	*DI3H	Input device selection 3H	0707h		○	○	○	○
PD09	*DI4L	Input device selection 4L	0805h					
PD10	*DI4H	Input device selection 4H	0808h		○	○	○	○
PD11	*DI5L	Input device selection 5L	0303h					
PD12	*DI5H	Input device selection 5H	3803h		○	○	○	○
PD13	*DI6L	Input device selection 6L	2006h					
PD14	*DI6H	Input device selection 6H	3920h		○	○	○	○
PD15		For manufacturer setting	0000h					
PD16			0000h					
PD17	*DI8L	Input device selection 8L	0A0Ah					
PD18	*DI8H	Input device selection 8H	0A00h		○	○	○	○
PD19	*DI9L	Input device selection 9L	0B0Bh					
PD20	*DI9H	Input device selection 9H	0B00h		○	○	○	○
PD21	*DI10L	Input device selection 10L	2323h					
PD22	*DI10H	Input device selection 10H	2B23h		○	○	○	○
PD23	*DO1	Output device selection 1	0004h		○	○	○	○
PD24	*DO2	Output device selection 2	000Ch		○	○	○	○
PD25	*DO3	Output device selection 3	0004h		○	○	○	○
PD26	*DO4	Output device selection 4	0007h		○	○	○	○
PD27		For manufacturer setting	0003h					
PD28	*DO6	Output device selection 6	0002h		○	○	○	○
PD29	*DIF	Input filter setting	0004h		○	○	○	○
PD30	*DOP1	Function selection D-1	0000h		○	○	○	○
PD31	*DOP2	Function selection D-2	0000h		○	○	○	○
PD32	*DOP3	Function selection D-3	0000h		○	○	○	○
PD33	*DOP4	Function selection D-4	0000h		○	○	○	○
PD34	DOP5	Function selection D-5	0000h		○	○	○	○

No.	Symbol	Name	Initial value	Unit	Operation mode	Control mode		
					Standard	CP	CL	PS
PD35		For manufacturer setting	0000h					
PD36			0000h					
PD37			0000h					
PD38			0					
PD39			0					
PD40			0					
PD41	*DIA3	Input signal automatic on selection 3	0000h		○	○	○	○
PD42	*DIA4	Input signal automatic on selection 4	0000h		○	○	○	○
PD43	*DI11L	Input device selection 11L	0000h					
PD44	*DI11H	Input device selection 11H	3A00h		○	○	○	○
PD45	*DI12L	Input device selection 12L	0000h					
PD46	*DI12H	Input device selection 12H	3B00h		○	○	○	○
PD47	*DO7	Output device selection 7	0000h		○	○	○	○
PD48		For manufacturer setting	0000h					

16.21.5 Extension setting 2 parameters ([Pr. PE_ _])

POINT

- The following parameter cannot be used in the positioning mode.
  - [Pr. PE01 Fully closed loop function selection 1]

No.	Symbol	Name	Initial value	Unit	Operation mode	Control mode		
					Standard	CP	CL	PS
PE01	*FCT1	Fully closed loop function selection 1	0000h					
PE02		For manufacturer setting	0000h					
PE03	*FCT2	Fully closed loop function selection 2	0003h			○	○	
PE04	*FBN	Fully closed loop control - Feedback pulse electronic gear 1 - Numerator	1			○	○	
PE05	*FBD	Fully closed loop control - Feedback pulse electronic gear 1 - Denominator	1			○	○	
PE06	BC1	Fully closed loop control - Speed deviation error detection level	400	[r/min]		○	○	
PE07	BC2	Fully closed loop control - Position deviation error detection level	100	[kpulse]		○	○	
PE08	DUF	Fully closed loop dual feedback filter	10	[rad/s]		○	○	
PE09		For manufacturer setting	0000h					
PE10	FCT3	Fully closed loop function selection 3	0000h			○	○	
PE11		For manufacturer setting	0000h					
PE12			0000h					
PE13			0000h					
PE14			0111h					
PE15			20					
PE16			0000h					
PE17			0000h					
PE18			0000h					
PE19			0000h					
PE20			0000h					

No.	Symbol	Name	Initial value	Unit	Operation mode	Control mode		
					Standard	CP	CL	PS
PE21		For manufacturer setting	0000h					
PE22			0000h					
PE23			0000h					
PE24			0000h					
PE25			0000h					
PE26			0000h					
PE27			0000h					
PE28			0000h					
PE29			0000h					
PE30			0000h					
PE31			0000h					
PE32			0000h					
PE33			0000h					
PE34	*FBN2	Fully closed loop control - Feedback pulse electronic gear 2 - Numerator	1			○	○	
PE35	*FBD2	Fully closed loop control - Feedback pulse electronic gear 2 - Denominator	1			○	○	
PE36		For manufacturer setting	0.0					
PE37			0.00					
PE38			0.00					
PE39			20					
PE40			0000h					
PE41	EOP3	Function selection E-3	0000h		○	○	○	○
PE42		For manufacturer setting	0					
PE43			0.0					
PE44	LMCP	Lost motion compensation positive-side compensation value selection	0	[0.01%]	○	○	○	○
PE45	LMCN	Lost motion compensation negative-side compensation value selection	0	[0.01%]	○	○	○	○
PE46	LMFLT	Lost motion filter setting	0	[0.1 ms]	○	○	○	○
PE47	TOF	Torque offset	0	[0.01%]	○	○	○	○
PE48	*LMOP	Lost motion compensation function selection	0000h		○	○	○	○
PE49	LMCD	Lost motion compensation timing	0	[0.1 ms]	○	○	○	○
PE50	LMCT	Lost motion compensation non-sensitive band	0	[pulse]/ [kpulse]	○	○	○	○
PE51		For manufacturer setting	0000h					
PE52			0000h					
PE53			0000h					
PE54			0000h					
PE55			0000h					
PE56			0000h					
PE57			0000h					
PE58			0000h					
PE59			0000h					
PE60			0000h					
PE61			0.00					
PE62			0.00					
PE63			0.00					
PE64			0.00					

16.21.6 Extension setting 3 parameters ([Pr. PF_ _])

No.	Symbol	Name	Initial value	Unit	Operation mode	Control mode		
					Standard	CP	CL	PS
PF01		For manufacturer setting	0000h					
PF02			0000h					
PF03			0000h					
PF04			0					
PF05			0					
PF06			0000h					
PF07			1					
PF08			1					
PF09	*FOP5	Function selection F-5	0000h		○	○	○	○
PF10		For manufacturer setting	0000h					
PF11			0000h					
PF12			10000					
PF13			100					
PF14			100					
PF15	DBT	Electronic dynamic brake operating time	2000	[ms]	○	○	○	○
PF16		For manufacturer setting	0000h					
PF17			10					
PF18			0000h					
PF19			0000h					
PF20			0000h					
PF21	DRT	Drive recorder switching time setting	0	[s]	○	○	○	○
PF22		For manufacturer setting	200					
PF23	OSCL1	Vibration tough drive - Oscillation detection level	50	[%]	○	○	○	○
PF24	*OSCL2	Vibration tough drive function selection	0000h		○	○	○	○
PF25	CVAT	SEMI-F47 function - Instantaneous power failure detection time	200	[ms]	○	○	○	○
PF26		For manufacturer setting	0					
PF27			0					
PF28			0					
PF29			0000h					
PF30			0					
PF31	FRIC	Machine diagnosis function - Friction judgment speed	0	[r/min]	○	○	○	○
PF32		For manufacturer setting	50					
PF33			0000h					
PF34	*SOP3	RS-422 communication function selection 3	0000h		○	○	○	○
PF35		For manufacturer setting	0000h					
PF36			0000h					
PF37			0000h					
PF38			0000h					
PF39			0000h					
PF40			0					
PF41			0					
PF42			0					
PF43			0					
PF44			0					
PF45	*FOP12	Function selection F-12	0000h					
PF46	MIC	Modbus-RTU communication time out selection	0					
PF47		For manufacturer setting	0000h					
PF48			0000h					

16.21.7 Positioning control parameters ([Pr. PT_ _])

No.	Symbol	Name	Initial value	Unit	Operation mode	Control mode		
					Standard	CP	CL	PS
PT01	*CTY	Command mode selection	0000h		○	○	○	○
PT02	*TOP1	Function selection T-1	0000h		○	○	○	○
PT03	*FTY	Feeding function selection	0000h		○	○	○	
PT04	*ZTY	Home position return type	0010h		○	○	○	○
PT05	ZRF	Home position return speed	100	[r/min]	○	○	○	○
PT06	CRF	Creep speed	10	[r/min]	○	○	○	○
PT07	ZST	Home position shift distance	0	[m]	○	○	○	○
PT08	*ZPS	Home position return position data	0	10^{STM} [m]	○	○	○	
PT09	DCT	Travel distance after proximity dog	1000	10^{STM} [m]	○	○	○	
PT10	ZTM	Stopper type home position return stopper time	100	[ms]	○	○	○	
PT11	ZTT	Stopper type home position return torque limit value	15.0	[%]	○	○	○	
PT12	CRP	Rough match output range	0	10^{STM} [m]	○	○	○	○
PT13	JOG	JOG operation	100	[r/min]	○	○	○	○
PT14	*BKC	Backlash compensation	0	[pulse]	○	○	○	○
PT15	LMPL	Software limit +	0	10^{STM} [m]	○	○	○	
PT16	LMPH							
PT17	LMNL	Software limit -	0	10^{STM} [m]	○	○	○	
PT18	LMNH							
PT19	*LPPL	Position range output address +	0	10^{STM} [m]	○	○	○	
PT20	*LPPH							
PT21	*LNPL	Position range output address -	0	10^{STM} [m]	○	○	○	
PT22	*LNPH							
PT23	OUT1	OUT1 output setting time	0	[ms]	○		○	
PT24	OUT2	OUT2 output setting time	0	[ms]	○		○	
PT25	OUT3	OUT3 output setting time	0	[ms]	○		○	
PT26	*TOP2	Function selection T-2	0000h		○	○	○	
PT27	*ODM	Operation mode selection	0000h		○			○
PT28	*STN	Number of stations per rotation	8	[stations]	○			○
PT29	*TOP3	Function selection T-3	0000h		○	○	○	○
PT30	MSTL	Mark sensor stop travel distance	0	10^{STM} [μm]	○	○	○	
PT31	MSTH		0		○	○	○	
PT32		For manufacturer setting	0000h					
PT33			0000h					
PT34	*PDEF	Point table/program default	0000h		○	○	○	
PT35	*TOP5	Function selection T-5	0000h		○	○	○	
PT36		For manufacturer setting	0000h					
PT37			10					
PT38	*TOP7	Function selection T-7	0000h		○			○
PT39	INT	Torque limit delay time	100	[ms]	○			○
PT40	*SZS	Station home position shift distance	0	[pulse]	○			○
PT41	ORP	Home position return inhibit function selection	0000h		○	○	○	○
PT42	*OVM	Digital override minimum multiplication	0	[%]	○			○
PT43	*OVS	Digital override pitch width	0	[%]	○			○
PT44		For manufacturer setting	0000h					
PT45	*CZTY	Home position return type 2	0000h					
PT46		For manufacturer setting	0000h					
PT47			0000h					
PT48			0000h					

16.22 DETAILED LIST OF PARAMETERS

POINT
● Set a value to each "x" in the "Setting digit" columns.

16.22.1 Basic setting parameters ([Pr. PA_ _])

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PA01 *STY Operation mode	_ _ _ x	Control mode selection Select a control mode. 0 to 5: Not used for positioning mode. 6: Positioning mode (point table method) 7: Positioning mode (program method) 8: Positioning mode (indexer method)	0h	○	○	○
	_ _ x _	Do not change this value	0h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		1h			
PA02 *REG Regenerative option	_ _ x x	Regenerative option Select a regenerative option. Incorrect setting may cause the regenerative option to burn. If a selected regenerative option is not for use with the driver [AL. 37 Parameter error] occurs. 00: Regenerative option is not used. ・For the drivers of 100 W, a regenerative resistor is not used. 02: LEC-MR-RB-032 03: LEC-MR-RB-12	00h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PA03 *ABS Absolute position detection system	_ _ _ x	Absolute position detection system selection Set this digit when using the absolute position detection system. 0: Disabled (incremental system) 1:Enabled (absolute position detection system) 2: Not used for positioning mode. Setting a value other than "0" and "1" will trigger [AL. 37 Parameter error].	0h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			
PA04 *AOP1 Function selection A-1	_ _ _ x	For manufacturer setting	0h			
	_ _ x _		0h			
	_ x _ _		0h			
	x _ _ _	Forced stop deceleration function selection 0: Forced stop deceleration function disabled (EM1) 2: Forced stop deceleration function enabled (EM2) Refer to table 7.1 for details.	2h	○	○	○

Table 7.1 Deceleration method

Setting value	EM2/EM1	Deceleration method: EM2 or EM1 is off	Deceleration method: Alarm occurred
0 _ _ _	EM1	MBR (Electromagnetic brake interlock) turns off without the forced stop deceleration.	MBR (Electromagnetic brake interlock) turns off without the forced stop deceleration.
2 _ _ _	EM2	MBR (Electromagnetic brake interlock) turns off after the forced stop deceleration.	MBR (Electromagnetic brake interlock) turns off after the forced stop deceleration.

<table>
<tr><th rowspan="2">No./
symbol/name</th><th rowspan="2">Setting digit</th><th rowspan="2">Function</th><th rowspan="2">Initial value [unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>CP</th><th>CL</th><th>PS</th></tr>
<tr><td>PA06
*CMX
Electronic gear numerator (command pulse multiplication numerator)</td><td></td><td>Set an electronic gear numerator. (Refer to section 7.3.1.)
To enable the parameter values in the positioning mode, cycle the power after setting.
To enable the parameter, select "Electronic gear (0 _ _ _)", "J3 electronic gear setting value compatibility mode (2 _ _ _)", of "Electronic gear selection" in [Pr. PA21].
Set the electronic gear within the following range. Setting out of the range will trigger [AL. 37 Parameter error].
<table><tr><th>Pr. PA21</th><th>Electronic gear setting range</th></tr><tr><td>0 _ _ _</td><td>1/865 < CMX/CDV < 271471</td></tr><tr><td>2 _ _ _</td><td>1/13825 < CMX/CDV < 16967</td></tr><tr><td>3 _ _ _</td><td>1/27649 < CMX/CDV < 8484</td></tr></table>Setting range: 1 to 16777215</td><td>1</td><td>○</td><td>○</td><td></td></tr>
<tr><td>PA06
*CMX
Number of gear teeth on machine side</td><td></td><td>Set the number of gear teeth on machine side. (Refer to section 7.3.2.)
To enable the parameter values in the positioning mode, cycle the power after setting.
Set the electronic gear within the following range.

(1) 1 CMX 16384, 1 CDV 16384

(2) $\frac{1}{9999}$ $\frac{CMX}{CDV}$ 9999

(3) CDV × STN 32767 (STN: Number of stations per rotation [Pr. PT28])

(4) CMX × CDV 100000

Setting out of the range will trigger [AL. 37 Parameter error].
When a small value is set to the electronic gear ratio with the manual operation mode, the servo motor may not drive at the set servo motor speed.

Travel distance of 1 station = Pt (servo motor resolution) × $\frac{1}{STN}$ × $\frac{CMX}{CDV}$

Setting range: 1 to 16777215</td><td>1</td><td></td><td></td><td>○</td></tr>
<tr><td>PA07
*CDV
Electronic gear denominator (command pulse multiplication denominator)</td><td></td><td>Set an electronic gear denominator. (Refer to section 7.3.1.)
To enable the parameter values in the positioning mode, cycle the power after setting.
To enable the parameter, select "Electronic gear (0 _ _ _)", "J3 electronic gear setting value compatibility mode (2 _ _ _)", of "Electronic gear selection" in [Pr. PA21].
Set the electronic gear within the range of [Pr. PA06].
Setting out of the range will trigger [AL. 37 Parameter error].

Setting range: 1 to 16777215</td><td>1</td><td>○</td><td>○</td><td></td></tr>
<tr><td>PA07
*CDV
Number of gear teeth on servo motor side</td><td></td><td>Set the number of gear teeth on servo motor side. (Refer to section 7.3.2.)
To enable the parameter values in the positioning mode, cycle the power after setting.
Set the electronic gear within the range of [Pr. PA06].
Setting out of the range will trigger [AL. 37 Parameter error].

Setting range: 1 to 16777215</td><td>1</td><td></td><td></td><td>○</td></tr>
</table>

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PA08 ATU Auto tuning mode	_ _ _ x	Gain adjustment mode selection Select the gain adjustment mode. 0: 2 gain adjustment mode 1 (interpolation mode) 1: Auto tuning mode 1 2: Auto tuning mode 2 3: Manual mode 4: 2 gain adjustment mode 2 Refer to table 7.2 for details.	1h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			

Table 7.2 Gain adjustment mode selection

Setting value	Gain adjustment mode	Automatically adjusted parameter
_ _ _ 0	2 gain adjustment mode 1 (interpolation mode)	[Pr. PB06 Load to motor inertia ratio] [Pr. PB08 Position loop gain] [Pr. PB09 Speed loop gain] [Pr. PB10 Speed integral compensation]
_ _ _ 1	Auto tuning mode 1	[Pr. PB06 Load to motor inertia ratio] [Pr. PB07 Model loop gain] [Pr. PB08 Position loop gain] [Pr. PB09 Speed loop gain] [Pr. PB10 Speed integral compensation]
_ _ _ 2	Auto tuning mode 2	[Pr. PB07 Model loop gain] [Pr. PB08 Position loop gain] [Pr. PB09 Speed loop gain] [Pr. PB10 Speed integral compensation]
_ _ _ 3	Manual mode	
_ _ _ 4	2 gain adjustment mode 2	[Pr. PB08 Position loop gain] [Pr. PB09 Speed loop gain] [Pr. PB10 Speed integral compensation]

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PA09 RSP Auto tuning response	Set the auto tuning response. (see table below) Setting range: 1 to 40		16	○	○	○

Set the auto tuning response.

Setting value	Machine characteristic: Response	Machine characteristic: Guideline for machine resonance frequency [Hz]
1	Low response	2.7
2	↑	3.6
3		4.9
4		6.6
5		10.0
6		11.3
7		12.7
8		14.3
9		16.1
10		18.1
11		20.4
12		23.0
13		25.9
14		29.2
15		32.9
16		37.0
17		41.7
18		47.0
19	↓	52.9
20	Middle response	59.6

Setting value	Machine characteristic: Response	Machine characteristic: Guideline for machine resonance frequency [Hz]
21	Middle response	67.1
22	↑	75.6
23		85.2
24		95.9
25		108.0
26		121.7
27		137.1
28		154.4
29		173.9
30		195.9
31		220.6
32		248.5
33		279.9
34		315.3
35		355.1
36		400.0
37		446.6
38		501.2
39	↓	571.5
40	High response	642.7

Setting range: 1 to 40

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PA10 INP In-position range		Set an in-position range per command. (see below) Setting range: 0 to 65535	100 Refer to Function column for unit.	○	○	○

Set an in-position range per command.

To change it to the servo motor encoder pulse unit, set [Pr. PC24].

Pr. PA01	In-position setting range
_ _ _ 6 (positioning mode (point table method))	The range where MEND (Travel completion), PED (Position end) and INP (In-position) are inputted.
_ _ _ 7 (Positioning mode (program method))	The range where MEND (Travel completion), PED (Position end) and INP (In-position) are inputted.
_ _ _ 8 (Positioning mode (indexer method))	The range where MEND (Travel completion) and INP (In-position) are inputted.

The unit will be as follows depending on the positioning mode.

・Point table method or program method
When [Pr. PC24] is set to "_ _ _ 0", the unit can be changed to [µm], 10-4 [inch], 10-3 [degree], or [pulse] with the setting of [Pr. PT01]. When [Pr. PC24] is set to "_ _ _ 1", the unit is fixed to [pulse].

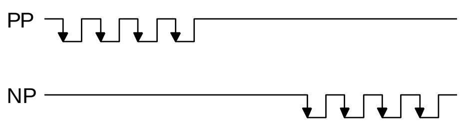
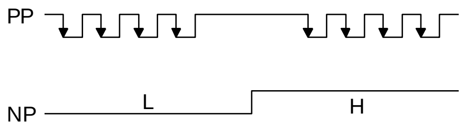
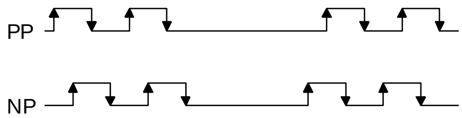
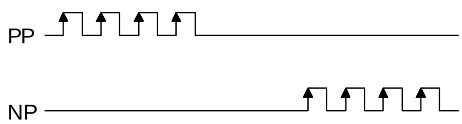
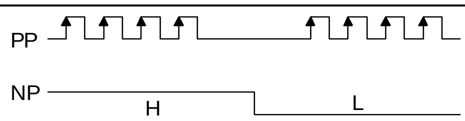
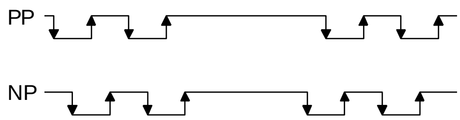
・Indexer method
Command unit [pulse] (a load-side rotation expressed by the number of encoder resolution pulses)
For example, when making an in-position range "± 1 degree" for the rotation angle on the load side, set 4194304 × (1/360) = 11650 pulses.

Setting range: 0 to 65535

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PA11 TLP Forward rotation torque limit/positive direction thrust limit		You can limit the torque or thrust generated by the servo motor. Set the parameter referring to section 3.6.1 (5). When you output torque with analog monitor output, the larger value of [Pr. PA11 Forward rotation torque limit/positive direction thrust limit value] or [Pr. PA12 Reverse rotation torque limit/negative direction thrust limit value] will be the maximum output voltage (8 V). Set the parameter on the assumption that the maximum torque is 100.0 [%]. The parameter is for limiting the torque of the servo motor in the CCW power running or CW regeneration. Set this parameter to "0.0" to generate no torque or thrust. Setting range: 0.0 to 100.0	100.0 [%]	○	○	○
PA12 TLN Reverse rotation torque limit/negative direction thrust limit		You can limit the torque or thrust generated by the servo motor. Set the parameter referring to section 3.6.1 (5). When you output torque with analog monitor output, the larger value of [Pr. PA11 Forward rotation torque limit/positive direction thrust limit value] or [Pr. PA12 Reverse rotation torque limit/negative direction thrust limit value] will be the maximum output voltage (8 V). Set the parameter on the assumption that the maximum torque is 100.0 [%]. The parameter is for limiting the torque of the servo motor in the CW power running or CCW regeneration. Set this parameter to "0.0" to generate no torque or thrust. Setting range: 0.0 to 100.0	100.0 [%]	○	○	○
PA13 *PLSS Command pulse input form	_ _ _ x	Command input pulse train form selection 0: Forward/reverse rotation pulse train 1: Signed pulse train 2: A-phase/B-phase pulse train (The driver imports input pulses after multiplying by four.) When connecting the manual pulse generator MR-HDP01 in the positioning mode, set "2" to this digit. Refer to table 7.3 for settings.	0h	○	○	
	_ _ x _	Pulse train logic selection 0: Positive logic 1: Negative logic Select the same one as logic of command pulse train from PC or PLC...etc to connect. Refer to POINT of section 3.6.1 for logic of MELSEC iQ-R series/MELSEC-Q series/MELSEC-L series/MELSEC-F series. Refer to table 7.3 for settings.	0h	○	○	

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PA13 *PLSS Command pulse input form	_ x _ _	Command input pulse train filter selection Selecting proper filter enables to enhance noise tolerance. 0: Command input pulse train is 4 Mpulses/s or less. 1: Command input pulse train is 1 Mpulse/s or less. 2: Command input pulse train is 500 kpulses/s or less. 3: Command input pulse train is 200 kpulses/s or less. 1 Mpulse/s or lower commands are supported by "1". When inputting commands over 1 Mpulse/s and 4 Mpulses/s or lower, set "0". Incorrect setting may cause the following malfunctions. ・Setting a value higher than actual command will lower noise tolerance. ・Setting a value lower than actual command will cause a position mismatch.	1h	○	○	
	x _ _ _	For manufacturer setting	0h			

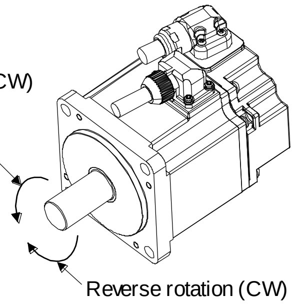
Table 7.3 Command input pulse train form selection

Setting value		Pulse train form	Forward rotation (positive direction) command	Reverse rotation (negative direction) command
_ _ 1 0	Negative logic	Forward rotation pulse train (positive direction pulse train) Reverse rotation pulse train (negative direction pulse train)		
_ _ 1 1	Negative logic	Signed pulse train		
_ _ 1 2	Negative logic	A-phase pulse train B-phase pulse train		
_ _ 0 0	Positive logic	Forward rotation pulse train (positive direction pulse train) Reverse rotation pulse train (negative direction pulse train)		
_ _ 0 1	Positive logic	Signed pulse train		
_ _ 0 2	Positive logic	A-phase pulse train B-phase pulse train		

Arrows in the table indicate the timing of importing pulse trains. A-phase/B-phase pulse trains are imported after they have been multiplied by 4.

<table>
<tr><th rowspan="2">No./
symbol/name</th><th rowspan="2">Setting digit</th><th rowspan="2">Function</th><th rowspan="2">Initial value [unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>CP</th><th>CL</th><th>PS</th></tr>
<tr><td>PA14
*POL
Rotation direction selection/travel direction selection</td><td></td><td>Select a rotation direction of the servo motor for when turning on ST1 (Forward rotation start) or ST2 (Reverse rotation start)

<table>
<tr><th rowspan="2">Setting value</th><th colspan="2">Servo motor rotation direction/linear servo motor travel direction</th></tr>
<tr><th>When positioning address increases</th><th>When positioning address decreases</th></tr>
<tr><td>0</td><td>CCW or positive direction</td><td>CW or negative direction</td></tr>
<tr><td>1</td><td>CW or negative direction</td><td>CCW or positive direction</td></tr>
</table>

The following shows the servo motor rotation directions.


Setting range: 0,1</td><td>0</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PA15
*ENR
Encoder output pulses</td><td></td><td>Set the encoder output pulses from the driver by using the number of output pulses per revolution, dividing ratio, or electronic gear ratio. (after multiplication by 4)
Set a numerator of the electronic gear, for when selecting "A-phase/B-phase pulse electronic gear setting (_ _ 3 _)" of "Encoder output pulse setting selection" in [Pr. PC19].
The maximum output frequency is 4.6 Mpulses/s. Set the parameter within this range.

Setting range: 1 to 4194304</td><td>4000
[pulse/rev]</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PA16
*ENR2
Encoder output pulses 2</td><td></td><td>Set a denominator of the electronic gear for the A/B-phase pulse output.
Set a denominator of the electronic gear, for when selecting "A-phase/B-phase pulse electronic gear setting (_ _ 3 _)" of "Encoder output pulse setting selection" in [Pr. PC19].

Setting range: 1 to 4194304</td><td>1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PA17
*MSR
Servo motor series setting</td><td></td><td>Do not change this value.</td><td>0000h</td><td>○</td><td>○</td><td></td></tr>
<tr><td>PA18
*MTY
Servo motor type setting</td><td></td><td>Do not change this value.</td><td>0000h</td><td>○</td><td>○</td><td></td></tr>
</table>

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PA19 *BLK Parameter writing inhibit		Select a reference range and writing range of the parameter. To enable read/write the positioning control parameters ([Pr. PT_ _]), set [Pr. PA19] to "0 0 A B" in the positioning mode. Refer to table 7.4 for settings.	00AAh	○	○	○

Table 7.4 [Pr. PA19] setting value and reading/writing range

PA19	Setting operation	PA	PB	PC	PD	PE	PF	PL	Po	PT
Other than below	Reading	○								
	Writing	○								
000Ah	Reading	Only 19								
	Writing	Only 19								
000Bh	Reading	○	○	○						
	Writing	○	○	○						
000Ch	Reading	○	○	○	○					
	Writing	○	○	○	○					
00AAh (initial value)	Reading	○	○	○	○	○	○			
	Writing	○	○	○	○	○	○			
00ABh	Reading	○	○	○	○	○	○	○	○	○
	Writing	○	○	○	○	○	○	○	○	○
100Bh	Reading	○								
	Writing	Only 19								
100Ch	Reading	○	○	○	○					
	Writing	Only 19								
10AAh	Reading	○	○	○	○	○	○			
	Writing	Only 19								
10ABh	Reading	○	○	○	○	○	○	○	○	○
	Writing	Only 19								

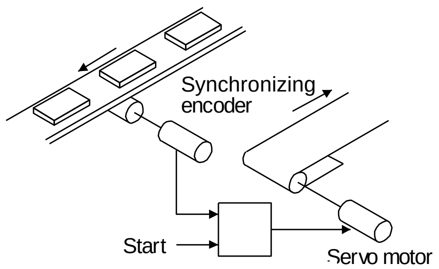
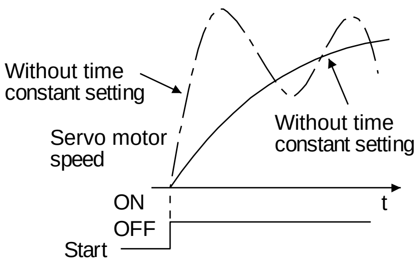
No./symbol/name	Setting digit	Function	Initial value [unit]	CP	CL	PS
PA20 *TDS Tough drive setting		Alarms may not be avoided with the tough drive function depending on the situations of the power supply and load fluctuation. You can assign MTTR (During tough drive) to pins CN1-13, CN1-14, CN1-22 to CN1-25, and CN1-49 with [Pr. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47].				
	_ _ _ x	For manufacturer setting	0h			
	_ _ x _	Vibration tough drive selection 0: Disabled 1: Enabled Selecting "1" enables to suppress vibrations by automatically changing setting values of [Pr. PB13 Machine resonance suppression filter 1] and [Pr. PB15 Machine resonance suppression filter 2] in case that the vibration exceed the value of the oscillation level set in [Pr. PF23]. To output the oscillation detection alarm as a warning, set [Pr. PF24 Vibration tough drive function selection].	0h	○	○	○
	_ x _ _	SEMI-F47 function selection 0: Disabled 1: Enabled Selecting "1" enables to avoid triggering [AL. 10 Undervoltage] using the electrical energy charged in the capacitor in case that an instantaneous power failure occurs during operation. In [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time], set the time until the occurrence of [AL. 10.1 Voltage drop in the control circuit power].	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PA21 *AOP3 Function selection A-3	_ _ _ x	One-touch tuning function selection 0: Disabled 1: Enabled When the digit is "0", the one-touch tuning is not available.	1h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _	Electronic gear selection When this digit is changed, the home position will be changed. Execute the home position return again. Electronic gear ([Pr. PA06] and [Pr. PA07]) Not used for positioning mode. Setting this will trigger [AL. 37 Parameter error]. J3 electronic gear setting value compatibility mode (Electronic gear ([Pr. PA06] and [Pr. PA07] × 16)) The electronic gear setting value can be used set with LECSB□-S□.	0h	○	○	
PA22 *PCS Position control composition selection	_ _ _ x	For manufacturer setting	0h			
	_ _ x _	Super trace control selection 0: Disabled 2: Enabled	0h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PA23 DRAT Drive recorder arbitrary alarm trigger setting	_ _ x x	Alarm detail No. setting Set the digits when you execute the trigger with arbitrary alarm detail No. for the drive recorder function. When these digits are "0 0", only the arbitrary alarm No. setting will be enabled.	00h	○	○	○
	x x _ _	Alarm No. setting Set the digits when you execute the trigger with arbitrary alarm No. for the drive recorder function. When "0 0" are set, arbitrary alarm trigger of the drive recorder will be disabled.	00h	○	○	○
	Setting example: To activate the drive recorder when [AL. 50 Overload 1] occurs, set "5 0 0 0". To activate the drive recorder when [AL. 50.3 Thermal overload error 4 during operation] occurs, set "5 0 0 3".					
PA24 AOP4 Function selection A-4	_ _ _ x	Vibration suppression mode selection 0: Standard mode 1: 3 inertia mode 2: Low response mode When you select the standard mode or low response mode, "Vibration suppression control 2" is not available. When you select the 3 inertia mode, the feed forward gain is not available.	0h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			
PA25 OTHOV One-touch tuning - Overshoot permissible level		Set a permissible value of overshoot amount for one-touch tuning as a percentage of the in-position range. However, setting "0" will be 50%. Setting range: 0 to 100	0 [%]	○	○	○

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PA26 *AOP5 Function selection A-5	_ _ _ x	Torque limit function selection at instantaneous power failure (instantaneous power failure tough drive selection) 0: Disabled 1: Enabled When an instantaneous power failure occurs during operation, you can save electric energy charged in the capacitor in the driver by limiting torque at acceleration. You can also delay the time until [AL. 10.2 Voltage drop in the main circuit power] occurs with instantaneous power failure tough drive function. Doing this will enable you to set a longer time in [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time]. The torque limit function at instantaneous power failure is enabled when "SEMI-F47 function selection" in [Pr. PA20] is "Enabled (_ 1 _ _)".	0h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			

16.22.2 Gain/filter setting parameters ([Pr. PB_ _])

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode		
				CP	CL	PS
PB01 FILT Adaptive tuning mode (adaptive filter II)	_ _ _ x	Filter tuning mode selection Set the adaptive tuning. Select the adjustment mode of the machine resonance suppression filter 1. For details, refer to section 7.1.2 . 0: Disabled 1: Automatic setting 2: Manual setting	0h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _	Tuning accuracy selection 0: Standard 1: High accuracy The frequency is estimated more accurately in the high accuracy mode compared to the standard mode. However, the tuning sound may be larger in the high accuracy mode. For details, refer to section 7.1.2 .	0h	○	○	○
PB02 VRFT Vibration suppression control tuning mode (advanced vibration suppression control II)	_ _ _ x	Vibration suppression control 1 tuning mode selection Select the tuning mode of the vibration suppression control 1. For details, refer to section 7.1.5. 0: Disabled 1: Automatic setting 2: Manual setting	0h	○	○	○
	_ _ x _	Vibration suppression control 2 tuning mode selection Select the tuning mode of the vibration suppression control 2. To enable the digit, select "3 inertia mode (_ _ _ 1)" of "Vibration suppression mode selection" in [Pr. PA24]. For details, refer to section 7.1.5. 0: Disabled 1: Automatic setting 2: Manual setting	0h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PB03 PST Position command acceleration/deceleration time constant (position smoothing)		This is used to set the constant of a primary delay to the position command. You can select a control method from "Primary delay" or "Linear acceleration/deceleration" in [Pr. PB25 Function selection B-1]. The setting range of "Linear acceleration/deceleration" is 0 ms to 10 ms. Setting of longer than 10 ms will be recognized as 10 ms. (Example) When a command is given from a synchronizing encoder, synchronous operation will start smoothly even if it starts during line operation.   Setting range: 0 to 65535	0 [ms]	○	○	○
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 1 s or more as the acceleration time constant up to the rated speed. Setting range: 0 to 100	0 [%]	○	○	○
PB06 GD2 Load to motor inertia ratio/load to motor mass ratio		This is used to set the load to motor inertia ratio. Setting a value considerably different from the actual load moment of inertia may cause an unexpected operation such as an overshoot. The setting of the parameter will be the automatic setting or manual setting depending on the [Pr. PA08] setting. Refer to the following table for details. When the parameter is automatic setting, the value will vary between 0.00 and 100.00. Setting range: 0.00 to 300.00	7.00 [Multiplier]	○	○	○

Pr. PA08	This parameter
_ _ _ 0 (2 gain adjustment mode 1 (interpolation mode))	Automatic setting
_ _ _ 1 (Auto tuning mode 1)	
_ _ _ 2 (Auto tuning mode 2)	Manual setting
_ _ _ 3 (Manual mode)	
_ _ _ 4 (2 gain adjustment mode 2)	

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PB07 PG1 Model loop gain		Set the response gain up to the target position. Increasing the setting value will also increase the response level to the position command but will be liable to generate vibration and noise. The setting of the parameter will be the automatic setting or manual setting depending on the [Pr. PA08] setting. Refer to the following table for details. Setting range: 1.0 to 2000.0	15.0 [rad/s]	○	○	○

Pr. PA08	This parameter
_ _ _ 0 (2 gain adjustment mode 1 (interpolation mode))	Manual setting
_ _ _ 1 (Auto tuning mode 1)	Automatic setting
_ _ _ 2 (Auto tuning mode 2)	
_ _ _ 3 (Manual mode)	Manual setting
_ _ _ 4 (2 gain adjustment mode 2)	

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PB08 PG2 Position loop gain		This is used to set the gain of the position loop. Set this parameter to increase the position response to level load disturbance. Increasing the setting value will also increase the response level to the load disturbance but will be liable to generate vibration and noise. The setting of the parameter will be the automatic setting or manual setting depending on the [Pr. PA08] setting. Refer to the following table for details. Setting range: 1.0 to 2000.0	37.0 [rad/s]	○	○	○

Pr. PA08	This parameter
_ _ _ 0 (2 gain adjustment mode 1 (interpolation mode))	Automatic setting
_ _ _ 1 (Auto tuning mode 1)	
_ _ _ 2 (Auto tuning mode 2)	
_ _ _ 3 (Manual mode)	Manual setting
_ _ _ 4 (2 gain adjustment mode 2)	Automatic setting

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PB09 VG2 Speed loop gain		This is used to set the gain of the speed loop. Set this parameter when vibration occurs on machines of low rigidity or large backlash. Increasing the setting value will also increase the response level but will be liable to generate vibration and noise. The setting of the parameter will be the automatic setting or manual setting depending on the [Pr. PA08] setting. Refer to the table of [Pr. PB08] for details. Setting range: 20 to 65535	823 [rad/s]	○	○	○
PB10 VIC Speed integral compensation		Set the integral time constant of the speed loop. Decreasing the setting value will increase the response level but will be liable to generate vibration and noise. The setting of the parameter will be the automatic setting or manual setting depending on the [Pr. PA08] setting. Refer to the table of [Pr. PB08] for details. Setting range: 0.1 to 1000.0	33.7 [ms]	○	○	○
PB11 VDC Speed differential compensation		Set the differential compensation. To enable the setting value, turn on PC (proportional control). Setting range: 0 to 1000	980	○	○	○

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PB12 OVA Overshoot amount compensation		Set a percentage of viscous friction torque against the servo motor rated value or thrust against the linear servo motor rated value. When the response level is low or when the torque/thrust is limited, the efficiency of the parameter may be lower. Setting range: 0 to 100	0 [%]	○	○	○
PB13 NH1 Machine resonance suppression filter 1		Machine resonance suppression filter 1 Set the notch frequency of the machine resonance suppression filter 1. When "Filter tuning mode selection" is set to "Automatic setting (_ _ _ 1)" in [Pr. PB01], this parameter will be adjusted automatically by adaptive tuning. When "Filter tuning mode selection" is set to "Manual setting (_ _ _ 2)" in [Pr. PB01], the setting value will be enabled. Setting range: 10 to 4500	4500 [Hz]	○	○	○
PB14 NHQ1 Notch shape selection 1		Set forms of the machine resonance suppression filter 1. When "Filter tuning mode selection" is set to "Automatic setting (_ _ _ 1)" in [Pr. PB01], this parameter will be adjusted automatically by adaptive tuning. When "Filter tuning mode selection" is set to "Manual setting (_ _ _ 2)" in [Pr. PB01], the setting value will be enabled.				
	_ _ _ x	For manufacturer setting	0h			
	_ _ x _	Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB	0h	○	○	○
	_ x _ _	Notch width selection 0: = 2 1: = 3 2: = 4 3: = 5	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PB15 NH2 Machine resonance suppression filter 2		Set the notch frequency of the machine resonance suppression filter 2. To enable the setting value, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 2 selection" in [Pr. PB16]. Setting range: 10 to 4500	4500 [Hz]	○	○	○
PB16 NHQ2 Notch shape selection 2		Set forms of the machine resonance suppression filter 2.				
	_ _ _ x	Machine resonance suppression filter 2 selection 0: Disabled 1: Enabled	0h	○	○	○
	_ _ x _	Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB	0h	○	○	○
	_ x _ _	Notch width selection 0: = 2 1: = 3 2: = 4 3: = 5	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PB17 NHF Shaft resonance suppression filter	Set the shaft resonance suppression filter. This is used to suppress a low-frequency machine vibration. When "Shaft resonance suppression filter selection" is set to "Automatic setting (_ _ _ 0)" in [Pr. PB23], the value will be calculated automatically from the servo motor you use and load to motor inertia ratio. Set manually for "Manual setting (_ _ _ 1)". When "Shaft resonance suppression filter selection" is set to "Disabled (_ _ _ 2)" in [Pr. PB23], the setting value of this parameter will be disabled. When "Machine resonance suppression filter 4 selection" is set to "Enabled (_ _ _ 1)" in [Pr. PB49], the shaft resonance suppression filter is not available.					
	_ _ x x	Shaft resonance suppression filter setting frequency selection Refer to table 7.5 for settings. Set the value closest to the frequency you need.	00h	○	○	○
	_ x _ _	Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			

Table 7.5 Shaft resonance suppression filter setting frequency selection

Setting value	Frequency [Hz]	Setting value	Frequency [Hz]
_ _ 0 0	Disabled	_ _ 1 0	562
_ _ 0 1	Disabled	_ _ 1 1	529
_ _ 0 2	4500	_ _ 1 2	500
_ _ 0 3	3000	_ _ 1 3	473
_ _ 0 4	2250	_ _ 1 4	450
_ _ 0 5	1800	_ _ 1 5	428
_ _ 0 6	1500	_ _ 1 6	409
_ _ 0 7	1285	_ _ 1 7	391
_ _ 0 8	1125	_ _ 1 8	375
_ _ 0 9	1000	_ _ 1 9	360
_ _ 0 A	900	_ _ 1 A	346
_ _ 0 B	818	_ _ 1 B	333
_ _ 0 C	750	_ _ 1 C	321
_ _ 0 D	692	_ _ 1 D	310
_ _ 0 E	642	_ _ 1 E	300
_ _ 0 F	600	_ _ 1 F	290

No./ symbol/name	Setting digit	Function	Initial value [unit]	CP	CL	PS
PB18 LPF Low-pass filter setting		Set the low-pass filter. The following shows a relation of a required parameter to this parameter. Setting range: 100 to 18000	3141 [rad/s]	○	○	○

[Pr. PB23]	[Pr. PB18]
_ _ 0 _ (Initial value)	Automatic setting
_ _ 1 _	Setting value enabled
_ _ 2 _	Setting value disabled

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PB19 VRF11 Vibration suppression control 1 - Vibration frequency		Set the vibration frequency for vibration suppression control 1 to suppress low-frequency machine vibration. When "Vibration suppression control 1 tuning mode selection" is set to "Automatic setting (_ _ _ 1)" in [Pr. PB02], this parameter will be set automatically. When "Manual setting (_ _ _ 2)" is selected, the setting written to the parameter is used. For details, refer to section 7.1.5. Setting range: 0.1 to 300.0	100.0 [Hz]	○	○	○
PB20 VRF12 Vibration suppression control 1 - Resonance frequency		Set the resonance frequency for vibration suppression control 1 to suppress low-frequency machine vibration. When "Vibration suppression control 1 tuning mode selection" is set to "Automatic setting (_ _ _ 1)" in [Pr. PB02], this parameter will be set automatically. When "Manual setting (_ _ _ 2)" is selected, the setting written to the parameter is used. For details, refer to section 7.1.5. Setting range: 0.1 to 300.0	100.0 [Hz]	○	○	○
PB21 VRF13 Vibration suppression control 1 - Vibration frequency damping		Set a damping of the vibration frequency for vibration suppression control 1 to suppress low-frequency machine vibration. When "Vibration suppression control 1 tuning mode selection" is set to "Automatic setting (_ _ _ 1)" in [Pr. PB02], this parameter will be set automatically. When "Manual setting (_ _ _ 2)" is selected, the setting written to the parameter is used. For details, refer to section 7.1.5. Setting range: 0.00 to 0.30	0.00	○	○	○
PB22 VRF14 Vibration suppression control 1 - Resonance frequency damping		Set a damping of the resonance frequency for vibration suppression control 1 to suppress low-frequency machine vibration. When "Vibration suppression control 1 tuning mode selection" is set to "Automatic setting (_ _ _ 1)" in [Pr. PB02], this parameter will be set automatically. When "Manual setting (_ _ _ 2)" is selected, the setting written to the parameter is used. For details, refer to section 7.1.5. Setting range: 0.00 to 0.30	0.00	○	○	○
PB23 VFBF Low-pass filter selection	_ _ _ x	Shaft resonance suppression filter selection Select the shaft resonance suppression filter. 0: Automatic setting 1: Manual setting 2: Disabled When you select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 4 selection" in [Pr. PB49], the shaft resonance suppression filter is not available.	0h	○	○	○
	_ _ x _	Low-pass filter selection Select the low-pass filter. 0: Automatic setting 1: Manual setting 2: Disabled	0h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PB24 *MVS Slight vibration suppression control	_ _ _ x	Slight vibration suppression control selection Select the slight vibration suppression control. 0: Disabled 1: Enabled To enable the slight vibration suppression control, select "Manual mode (_ _ _ 3)" of "Gain adjustment mode selection" in [Pr. PA08].	0h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PB25 *BOP1 Function selection B-1	_ _ _ x	For manufacturer setting	0h			
	_ _ x _	Position acceleration/deceleration filter type selection Select the position acceleration/deceleration filter type. 0: Primary delay 1: Linear acceleration/deceleration	0h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PB26 *CDP Gain switching function	Select the gain switching condition. Set conditions to enable the gain switching values set in [Pr. PB29] to [Pr. PB36] and [Pr. PB56] to [Pr. PB60].					
	_ _ _ x	Gain switching selection 0: Disabled 1: Input device (gain switching (CDP)) 2: Command frequency (Note) 3: Droop pulses 4: Servo motor speed/linear servo motor speed Note. This will be a frequency of the servo motor side command pulse unit.	0h	○	○	○
	_ _ x _	Gain switching condition selection 0: Gain after switching is enabled with gain switching condition or more 1: Gain after switching is enabled with gain switching condition or less	0h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PB27 CDL Gain switching condition		This is used to set the value of gain switching (command frequency, droop pulses, and servo motor speed) selected in [Pr. PB26]. The set value unit differs depending on the switching condition item. (Refer to section 7.2.3.) The unit "r/min" will be "mm/s" for linear servo motors. Setting range: 0 to 9999	10 [kpulse/s]/ [pulse]/ [r/min]	○	○	○
PB28 CDT Gain switching time constant		Set the time constant at which the gains will change in response to the conditions set in [Pr. PB26] and [Pr. PB27]. Setting range: 0 to 100	1 [ms]	○	○	○
PB29 GD2B Load to motor inertia ratio after gain switching		Set the load to motor inertia ratio for when gain switching is enabled. This parameter is enabled only when you select "Manual mode (_ _ _ 3)" of "Gain adjustment mode selection" in [Pr. PA08]. Setting range: 0.00 to 300.00	7.00 [Multiplier]	○	○	○
PB30 PG2B Position loop gain after gain switching		Set the position loop gain for when the gain switching is enabled. When you set a value less than 1.0 rad/s, the value will be the same as [Pr. PB08]. This parameter is enabled only when you select "Manual mode (_ _ _ 3)" of "Gain adjustment mode selection" in [Pr. PA08]. Setting range: 0.0 to 2000.0	0.0 [rad/s]	○		○
PB31 VG2B Speed loop gain after gain switching		Set the speed loop gain for when the gain switching is enabled. When you set a value less than 20 rad/s, the value will be the same as [Pr. PB09]. This parameter is enabled only when you select "Manual mode (_ _ _ 3)" of "Gain adjustment mode selection" in [Pr. PA08]. Setting range: 0 to 65535	0 [rad/s]	○	○	○

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode		
				CP	CL	PS
PB32 VICB Speed integral compensation after gain switching		Set the speed integral compensation for when the gain switching is enabled. When you set a value less than 0.1 ms, the value will be the same as [Pr. PB10]. This parameter is enabled only when you select "Manual mode (_ _ _ 3)" of "Gain adjustment mode selection" in [Pr. PA08]. Setting range: 0.0 to 5000.0	0.0 [ms]	○	○	○
PB33 VRF1B Vibration suppression control 1 - Vibration frequency after gain switching		Set the vibration frequency for vibration suppression control 1 for when the gain switching is enabled. When you set a value less than 0.1 Hz, the value will be the same as [Pr. PB19]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (_ _ _ 3)". ・"Vibration suppression control 1 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ _ 2)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.0 to 300.0	0.0 [Hz]	○	○	○
PB34 VRF2B Vibration suppression control 1 - Resonance frequency after gain switching		Set the resonance frequency for vibration suppression control 1 for when the gain switching is enabled. When you set a value less than 0.1 Hz, the value will be the same as [Pr. PB20]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (3)". ・"Vibration suppression control 1 tuning mode selection" in [Pr. PB02] is "Manual setting (2)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.0 to 300.0	0.0 [Hz]	○	○	○
PB35 VRF3B Vibration suppression control 1 - Vibration frequency damping after gain switching		Set a damping of the vibration frequency for vibration suppression control 1 when the gain switching is enabled. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (3)". ・"Vibration suppression control 1 tuning mode selection" in [Pr. PB02] is "Manual setting (2)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.00 to 0.30	0.00	○	○	○
PB36 VRF4B Vibration suppression control 1 - Resonance frequency damping after gain switching		Set a damping of the resonance frequency for vibration suppression control 1 when the gain switching is enabled. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (3)". ・"Vibration suppression control 1 tuning mode selection" in [Pr. PB02] is "Manual setting (2)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.00 to 0.30	0.00	○	○	○

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PB45 CNHF Command notch filter	Set the command notch filter.					
	_ _ x x	Command notch filter setting frequency selection Refer to table 7.6 for the relation of setting values to frequency.	00h	○	○	○
	_ x _ _	Notch depth selection Refer to table 7.7 for details.	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			

Table 7.6 Command notch filter setting frequency selection

Setting value	Frequency [Hz]	Setting value	Frequency [Hz]	Setting value	Frequency [Hz]
_ _ 0 0	Disabled	_ _ 2 0	70	_ _ 4 0	17.6
_ _ 0 1	2250	_ _ 2 1	66	_ _ 4 1	16.5
_ _ 0 2	1125	_ _ 2 2	62	_ _ 4 2	15.6
_ _ 0 3	750	_ _ 2 3	59	_ _ 4 3	14.8
_ _ 0 4	562	_ _ 2 4	56	_ _ 4 4	14.1
_ _ 0 5	450	_ _ 2 5	53	_ _ 4 5	13.4
_ _ 0 6	375	_ _ 2 6	51	_ _ 4 6	12.8
_ _ 0 7	321	_ _ 2 7	48	_ _ 4 7	12.2
_ _ 0 8	281	_ _ 2 8	46	_ _ 4 8	11.7
_ _ 0 9	250	_ _ 2 9	45	_ _ 4 9	11.3
_ _ 0 A	225	_ _ 2 A	43	_ _ 4 A	10.8
_ _ 0 B	204	_ _ 2 B	41	_ _ 4 B	10.4
_ _ 0 C	187	_ _ 2 C	40	_ _ 4 C	10
_ _ 0 D	173	_ _ 2 D	38	_ _ 4 D	9.7
_ _ 0 E	160	_ _ 2 E	37	_ _ 4 E	9.4
_ _ 0 F	150	_ _ 2 F	36	_ _ 4 F	9.1
_ _ 1 0	140	_ _ 3 0	35.2	_ _ 5 0	8.8
_ _ 1 1	132	_ _ 3 1	33.1	_ _ 5 1	8.3
_ _ 1 2	125	_ _ 3 2	31.3	_ _ 5 2	7.8
_ _ 1 3	118	_ _ 3 3	29.6	_ _ 5 3	7.4
_ _ 1 4	112	_ _ 3 4	28.1	_ _ 5 4	7.0
_ _ 1 5	107	_ _ 3 5	26.8	_ _ 5 5	6.7
_ _ 1 6	102	_ _ 3 6	25.6	_ _ 5 6	6.4
_ _ 1 7	97	_ _ 3 7	24.5	_ _ 5 7	6.1
_ _ 1 8	93	_ _ 3 8	23.4	_ _ 5 8	5.9
_ _ 1 9	90	_ _ 3 9	22.5	_ _ 5 9	5.6
_ _ 1 A	86	_ _ 3 A	21.6	_ _ 5 A	5.4
_ _ 1 B	83	_ _ 3 B	20.8	_ _ 5 B	5.2
_ _ 1 C	80	_ _ 3 C	20.1	_ _ 5 C	5.0
_ _ 1 D	77	_ _ 3 D	19.4	_ _ 5 D	4.9
_ _ 1 E	75	_ _ 3 E	18.8	_ _ 5 E	4.7
_ _ 1 F	72	_ _ 3 F	18.2	_ _ 5 F	4.5

Table 7.7 Notch depth selection

Setting value	Depth [dB]	Setting value	Depth [dB]
_ 0 _ _	-40.0	_ 8 _ _	-6.0
_ 1 _ _	-24.1	_ 9 _ _	-5.0
_ 2 _ _	-18.1	_ A _ _	-4.1
_ 3 _ _	-14.5	_ B _ _	-3.3
_ 4 _ _	-12.0	_ C _ _	-2.5
_ 5 _ _	-10.1	_ D _ _	-1.8
_ 6 _ _	-8.5	_ E _ _	-1.2
_ 7 _ _	-7.2	_ F _ _	-0.6

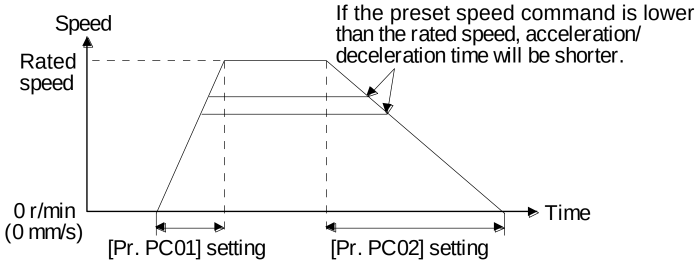
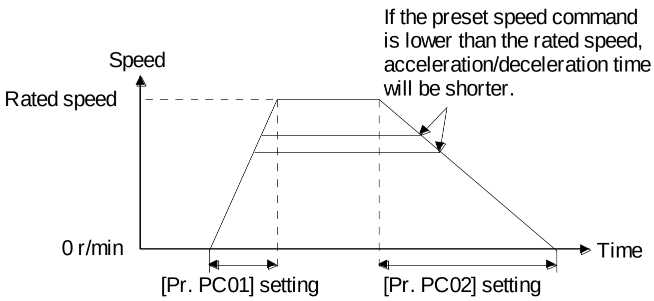
No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode		
				CP	CL	PS
PB46 NH3 Machine resonance suppression filter 3		Set the notch frequency of the machine resonance suppression filter 3. To enable the setting value, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 3 selection" in [Pr. PB47]. Setting range: 10 to 4500	4500 [Hz]	○	○	○
PB47 NHQ3 Notch shape selection 3	Set forms of the machine resonance suppression filter 3.					
	_ _ _ x	Machine resonance suppression filter 3 selection 0: Disabled 1: Enabled	0h	○	○	○
	_ _ x _	Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB	0h	○	○	○
	_ x _ _	Notch width selection 0: = 2 1: = 3 2: = 4 3: = 5	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PB48 NH4 Machine resonance suppression filter 4		Set the notch frequency of the machine resonance suppression filter 4. To enable the setting value, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 4 selection" in [Pr. PB49]. Setting range: 10 to 4500	4500 [Hz]	○	○	○
PB49 NHQ4 Notch shape selection 4	Set forms of the machine resonance suppression filter 4.					
	_ _ _ x	Machine resonance suppression filter 4 selection 0: Disabled 1: Enabled When you select "Enabled" of this digit, [Pr. PB17 Shaft resonance suppression filter] is not available.	0h	○	○	○
	_ _ x _	Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB	0h	○	○	○
	_ x _ _	Notch width selection 0: = 2 1: = 3 2: = 4 3: = 5	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PB50 NH5 Machine resonance suppression filter 5		Set the notch frequency of the machine resonance suppression filter 5. To enable the setting value, select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 5 selection" in [Pr. PB51]. Setting range: 10 to 4500	4500 [Hz]	○	○	○

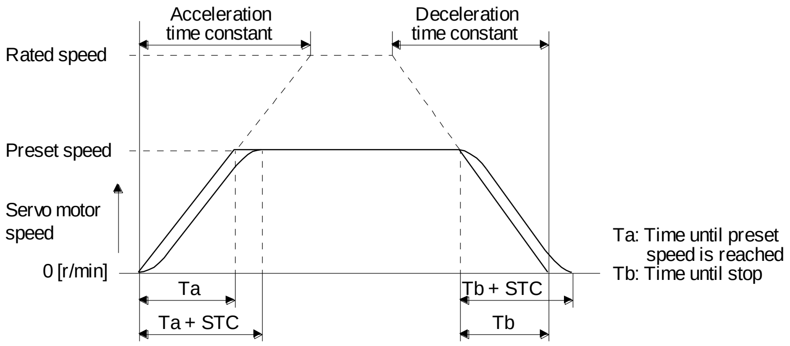
No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PB51 NHQ5 Notch shape selection 5		Set forms of the machine resonance suppression filter 5. When you select "Enabled (_ _ _ 1)" of "Robust filter selection" in [Pr. PE41], the machine resonance suppression filter 5 is not available.				
	_ _ _ x	Machine resonance suppression filter 5 selection 0: Disabled 1: Enabled	0h	○	○	○
	_ _ x _	Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB	0h	○	○	○
	_ x _ _	Notch width selection 0: = 2 1: = 3 2: = 4 3: = 5	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PB52 VRF21 Vibration suppression control 2 - Vibration frequency		Set the vibration frequency for vibration suppression control 2 to suppress low-frequency machine vibration. When "Vibration suppression control 2 tuning mode selection" is set to "Automatic setting (_ _ 1 _)" in [Pr. PB02], this parameter will be set automatically. When "Manual setting (_ _ 2 _)" is selected, the setting written to the parameter is used. To enable the setting value, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PA24]. Setting range: 0.1 to 300.0	100.0 [Hz]	○	○	○
PB53 VRF22 Vibration suppression control 2 - Resonance frequency		Set the resonance frequency for vibration suppression control 2 to suppress low-frequency machine vibration. When "Vibration suppression control 2 tuning mode selection" is set to "Automatic setting (_ _ 1 _)" in [Pr. PB02], this parameter will be set automatically. When "Manual setting (_ _ 2 _)" is selected, the setting written to the parameter is used. To enable the setting value, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PA24]. Setting range: 0.1 to 300.0	100.0 [Hz]	○	○	○
PB54 VRF23 Vibration suppression control 2 - Vibration frequency damping		Set a damping of the vibration frequency for vibration suppression control 2 to suppress low-frequency machine vibration. When "Vibration suppression control 2 tuning mode selection" is set to "Automatic setting (_ _ 1 _)" in [Pr. PB02], this parameter will be set automatically. When "Manual setting (_ _ 2 _)" is selected, the setting written to the parameter is used. To enable the setting value, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PA24]. Setting range: 0.00 to 0.30	0.00	○	○	○
PB55 VRF24 Vibration suppression control 2 - Resonance frequency damping		Set a damping of the resonance frequency for vibration suppression control 2 to suppress low-frequency machine vibration. When "Vibration suppression control 2 tuning mode selection" is set to "Automatic setting (_ _ 1 _)" in [Pr. PB02], this parameter will be set automatically. When "Manual setting (_ _ 2 _)" is selected, the setting written to the parameter is used. To enable the setting value, set "Vibration suppression mode selection" to "3 inertia mode (_ _ _ 1)" in [Pr. PA24]. Setting range: 0.00 to 0.30	0.00	○	○	○

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PB56 VRF21B Vibration suppression control 2 - Vibration frequency after gain switching		Set the vibration frequency for vibration suppression control 2 for when the gain switching is enabled. When you set a value less than 0.1 Hz, the value will be the same as [Pr. PB52]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (3)". ・"Vibration suppression mode selection" in [Pr. PA24] is "3 inertia mode (1)" ・"Vibration suppression control 2 tuning mode selection" in [Pr. PB02] is "Manual setting (2)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.0 to 300.0	0.0 [Hz]	○	○	○
PB57 VRF22B Vibration suppression control 2 - Resonance frequency after gain switching		Set the resonance frequency for vibration suppression control 2 for when the gain switching is enabled. When you set a value less than 0.1 Hz, the value will be the same as [Pr. PB53]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (3)". ・"Vibration suppression mode selection" in [Pr. PA24] is "3 inertia mode (1)" ・"Vibration suppression control 2 tuning mode selection" in [Pr. PB02] is "Manual setting (2)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.0 to 300.0	0.0 [Hz]	○	○	○
PB58 VRF23B Vibration suppression control 2 - Vibration frequency damping after gain switching		Set a damping of the vibration frequency for vibration suppression control 2 when the gain switching is enabled. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (3)". ・"Vibration suppression mode selection" in [Pr. PA24] is "3 inertia mode (.1)" ・"Vibration suppression control 2 tuning mode selection" in [Pr. PB02] is "Manual setting (2)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.00 to 0.30	0.00	○	○	○
PB59 VRF24B Vibration suppression control 2 - Resonance frequency damping after gain switching		Set a damping of the resonance frequency for vibration suppression control 2 when the gain switching is enabled. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (3)". ・"Vibration suppression mode selection" in [Pr. PA24] is "3 inertia mode (1)" ・"Vibration suppression control 2 tuning mode selection" in [Pr. PB02] is "Manual setting (2)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.00 to 0.30	0.00	○	○	○

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PB60 PG1B Model loop gain after gain switching		Set the model loop gain for when the gain switching is enabled. When you set a value less than 1.0 rad/s, the value will be the same as [Pr. PB07]. This parameter will be enabled only when the following conditions are fulfilled. ・"Gain adjustment mode selection" in [Pr. PA08] is "Manual mode (3)". ・"Gain switching selection" in [Pr. PB26] is "Input device (gain switching (CDP)) (1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops. Setting range: 0.0 to 2000.0	0.0 [rad/s]	○	○	○

16.22.3 Extension setting parameters ([Pr. PC_ _])

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PC01 STA JOG operation acceleration time constant		Set an acceleration time constant for the JOG operation of the program method. Set an acceleration time from 0 r/min to the rated speed.  For example for the servo motor of 3000 r/min rated speed, set 3000 (3 s) to increase speed from 0 r/min to 1000 r/min in 1 s. Additionally, when 20000 ms or more value is set, it will be clamped to 20000 ms. Setting range: 0 to 50000	0 [ms]		○	
PC01 STA Acceleration time constant 1		Set an acceleration time constant for the automatic operation of the indexer method. Set an acceleration time from 0 r/min to the rated speed.  For example for the servo motor of 3000 r/min rated speed, set 3000 (3 s) to increase speed from 0 r/min to 1000 r/min in 1 s. Additionally, when 20000 ms or more value is set, it will be clamped to 20000 ms. Setting range: 0 to 50000	0 [ms]			○
PC02 STB JOG operation deceleration time constant		Set a deceleration time constant for the JOG operation of the program method. Set a deceleration time from the rated speed to 0 r/min or 0 mm/s. Additionally, when 20000 ms or more value is set, it will be clamped to 20000 ms. Setting range: 0 to 50000	0 [ms]		○	

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PC02 STB Deceleration time constant 1		Set a deceleration time constant for the automatic operation of the indexer method. Set a deceleration time from the rated speed to 0 r/min. Additionally, when 20000 ms or more value is set, it will be clamped to 20000 ms. Setting range: 0 to 50000	0 [ms]			○
PC03 *STC S-pattern acceleration/ deceleration time constant		This enables to start/stop the servo motor smoothly. Set the time of the arc part for S-pattern acceleration/deceleration. Setting "0" will make it linear acceleration/deceleration. Servo is usually operated with linear acceleration and deceleration; however, smooth start and stop are enabled by setting [Pr. PC03 S-pattern acceleration/deceleration time constants]. When the S-pattern acceleration/deceleration time constants are set, smooth positioning is enabled as shown in the following figure. Note that when it is set, a time period from the start to output of MEND (Travel completion) is longer by the S-pattern acceleration/deceleration time constants.  When the STC value is set longer than the constant speed time, the speed may not reach to the command speed. Additionally, when a value of 1000 ms or more is set, it will be clamped to 1000 ms. Setting range: 0 to 5000	0 [ms]	○	○	
PC05 SC1 Automatic operation speed 1		Set a positioning speed for the automatic operation speed 1, 2 of the indexer method. Setting range: 0 to permissible instantaneous speed	100 [r/min]			○
PC06 SC2 Automatic operation speed 2		Set a positioning speed for the automatic operation speed 1, 2 of the indexer method. Setting range: 0 to permissible instantaneous speed	500 [r/min]			○
PC07 SC3 Manual operation speed 1		Set a JOG speed of the manual operation mode, JOG operation, and home position return mode of the indexer method. Setting range: 0 to permissible instantaneous speed	1000 [r/min]			○

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PC14 MOD1 Analog monitor 1 output	_ _ x x	Analog monitor 1 output selection Select a signal to output to MO1 (Analog monitor 1). Refer to app. 8.3 for detection points of output selection. Refer to table 7.8 or 7.9 for settings.	00h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			

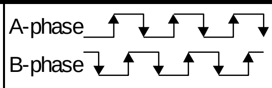
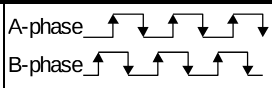
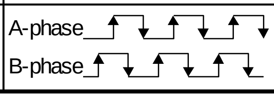
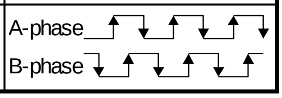
Table 7.8 Analog monitor setting value

Setting value	Item	Operation mode (Note 1) Standard	Full.	Lin.	DD
_ _ 0 0	Servo motor speed (±8 V/max. speed)	○	○	○	○
_ _ 0 1	Torque (±8 V/max. torque or max. thrust) (Note 3)	○	○	○	○
_ _ 0 2	Servo motor speed (+8 V/max. speed)	○	○	○	○
_ _ 0 3	Torque (+8 V/max. torque or max. thrust) (Note 3)	○	○	○	○
_ _ 0 4	Current command (±8 V/max. current command)	○	○	○	○
_ _ 0 5	Command pulse frequency (±10 V/±4 Mpulses/s)	○	○	○	○
_ _ 0 6	Servo motor-side droop pulses (±10 V/100 pulses) (Note 2)	○	○	○	○
_ _ 0 7	Servo motor-side droop pulses (±10 V/1000 pulses) (Note 2)	○	○	○	○
_ _ 0 8	Servo motor-side droop pulses (±10 V/10000 pulses) (Note 2)	○	○	○	○
_ _ 0 9	Servo motor-side droop pulses (±10 V/100000 pulses) (Note 2)	○	○	○	○
_ _ 0 A	Feedback position (±10 V/1 Mpulses) (Note 2)	○			
_ _ 0 B	Feedback position (±10 V/10 Mpulses) (Note 2)	○			
_ _ 0 C	Feedback position (±10 V/100 Mpulses) (Note 2)	○			
_ _ 0 D	Bus voltage (200 V class and 100 V class: +8 V/400 V, 400 V class: +8 V/800 V)	○	○	○	○
_ _ 0 E	Speed command 2 (±8 V/max. speed)	○	○	○	○
_ _ 1 0	Load-side droop pulses (±10 V/100 pulses) (Note 2)		○		
_ _ 1 1	Load-side droop pulses (±10 V/1000 pulses) (Note 2)		○		
_ _ 1 2	Load-side droop pulses (±10 V/10000 pulses) (Note 2)		○		
_ _ 1 3	Load-side droop pulses (±10 V/100000 pulses) (Note 2)		○		
_ _ 1 4	Load-side droop pulses (±10 V/1 Mpulses) (Note 2)		○		
_ _ 1 5	Servo motor-side/load-side position deviation (±10 V/100000 pulses)		○		
_ _ 1 6	Servo motor-side/load-side speed deviation (±8 V/max. speed)		○		
_ _ 1 7	Internal temperature of encoder (±10 V/±128 ˚C)	○	○		○

Note 2. Encoder pulse unit

3. The value in [Pr. PA11] or [Pr. PA12] whichever is higher is applied for the maximum torque.

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PC15 MOD2 Analog monitor 2 output	_ _ x x	Analog monitor 2 output selection Select a signal to output to MO2 (Analog monitor 2). Refer to app. 8.3 for detection points of output selection. Refer to [Pr. PC14] for settings.	01h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PC16 MBR Electromagnetic brake sequence output		Set the delay time between MBR (Electromagnetic brake interlock) and the base drive circuit is shut-off. Setting range: 0 to 1000	0 [ms]	○	○	○
PC17 ZSP Zero speed		Set an output range of ZSP (Zero speed detection). ZSP (Zero speed detection) has hysteresis of 20 r/min. Setting range: 0 to 10000	50 [r/min]	○	○	○
PC18 *BPS Alarm history clear	_ _ _ x	Alarm history clear selection Used to clear the alarm history. 0: Disabled 1: Enabled When "Enabled" is set, the alarm history will be cleared at the next power-on. After the alarm history is cleared, the setting is automatically disabled.	0h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			

<table>
<tr><th rowspan="2">No./
symbol/name</th><th rowspan="2">Setting
digit</th><th rowspan="2">Function</th><th rowspan="2">Initial
value
[unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>CP</th><th>CL</th><th>PS</th></tr>
<tr><td rowspan="4">PC19
*ENRS
Encoder
output pulse
selection</td><td>_ _ _ x</td><td>Encoder output pulse phase selection
Select an encoder pulse direction.
0: Increasing A-phase 90° in CCW or positive direction
1: Increasing A-phase 90° in CW or negative direction
<table>
<tr><th rowspan="2">Setting
value</th><th colspan="2">Servo motor rotation direction/linear servo motor travel direction</th></tr>
<tr><th>CCW or positive direction</th><th>CW or negative direction</th></tr>
<tr><td>0</td><td></td><td></td></tr>
<tr><td>1</td><td></td><td></td></tr>
</table></td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>_ _ x _</td><td>Encoder output pulse setting selection
0: Output pulse setting
1: Division ratio setting
2: The same output pulse setting as command pulse
3: A-phase/B-phase pulse electronic gear setting
4: A/B-phase pulse through output setting
5: Command pulse input through output setting
When you select "1", the settings of [Pr. PA16 Encoder output pulses 2] will be disabled.
When you select "2", the settings of [Pr. PA15 Encoder output pulses] and [Pr. PA16 Encoder output pulses 2] will be disabled. Additionally, it will be the servo motor side pulse unit for the indexer method. When you select the setting, do not change the settings in [Pr. PA06] and [Pr. PA07] after the power-on.
When "5" is set, the settings of [Pr. PA15 Encoder output pulses] and [Pr. PA16 Encoder output pulses 2] will be disabled. "Encoder output pulse phase selection (_ _ _ x)" and "Encoder selection for encoder output pulse (_ x _ _)" will be also disabled. When [Pr. PA01] is set to other than "Point table method (_ _ _ 6)" and "Program method (_ _ _ 7)", [AL. 37 Parameter error] occurs. When "5" is set, assign PP/PP2 with [Pr. PD44] and NP/NP2 with [Pr. PD46].</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>_ x _ _</td><td>Selection of the encoders for encoder output pulse
Select an encoder used the encoder output pulses which the driver outputs.
0: Servo motor encoder
1: Load-side encoder
When "_ 1 0 _" is set to this parameter, [AL. 37 Parameter error] will occur.
This is only for the fully closed loop system.
If "1" is set other than in the fully closed loop system, [AL. 37 Parameter error] will occur.</td><td>0h</td><td>○</td><td></td><td></td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>PC20
*SNO
Station No.
setting</td><td></td><td>Specify a station No. of the driver for RS-422 and USB communication.
Always set one station to one axis of the driver Setting one station number to two or more stations will disable a normal communication.

Setting range: 0 to 31</td><td>0
[Station]</td><td>○</td><td>○</td><td>○</td></tr>
</table>

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PC21 *SOP RS-422 communication function selection		Select the details of RS-422 communication function.				
	_ _ _ x	For manufacturer setting	0h			
	_ _ x _	RS-422 communication baud rate selection When using the parameter unit, set "1 _ _ _" in [Pr. PF34]. 0: 9600 [bps] 1: 19200 [bps] 2: 38400 [bps] 3: 57600 [bps] 4: 115200 [bps]	0h	○	○	○
	_ x _ _	RS-422 communication response delay time selection 0: Disabled 1: Enabled (responding after 800 s or longer delay time)	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PC22 *COP1 Function selection C-1	_ _ _ x	For manufacturer setting	0h			
	_ _ x _		0h			
	_ x _ _		0h			
	x _ _ _	Encoder cable communication method selection Select the encoder cable communication method. 0: Two-wire type 1: Four-wire type When using an encoder of A/B/Z-phase differential output method, set "0". If the setting is incorrect, [AL. 16 Encoder initial communication error 1] or [AL. 20 Encoder normal communication error 1] occurs.	0h	○	○	○
PC24 *COP3 Function selection C-3	_ _ _ x	In-position range unit selection Select a unit of in-position range. 0: Command unit 1: Servo motor encoder pulse unit	0h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _	Error excessive alarm level unit selection Select a setting unit of the error excessive alarm level set in [Pr. PC43]. 0: Per 1 rev or 1 mm 1: Per 0.1 rev or 0.1 mm 2: Per 0.01 rev or 0.01 mm 3: Per 0.001 rev or 0.001 mm	0h	○	○	○
PC26 *COP5 Function selection C-5	_ _ _ x	[AL. 99 Stroke limit warning] selection Enable or disable [AL. 99 Stroke limit warning]. 0: Enabled 1: Disabled	0h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PC27 *COP6 Function selection C-6	_ _ _ x	[AL. 10 Undervoltage] detection method selection Set this parameter when [AL. 10 Undervoltage] occurs due to distorted power supply voltage waveform while using FR-RC-(H) or FR-CV-(H). 0: [AL. 10] not occurrence 1: [AL. 10] occurrence	0h	○	○	○
	_ _ x _	Do not change this value	0h	○	○	○
	_ x _ _	Undervoltage alarm selection Select the alarm and warning that occurs when the bus voltage drops to the undervoltage alarm level. 0: [AL. 10] regardless of servo motor speed 1: [AL. E9] at servo motor speed 50 r/min (50 mm/s) or less, [AL. 10] at over 50 r/min (50 mm/s)	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PC28 *COP7 Function selection C-7	_ _ _ x	For manufacturer setting	0h			
	_ _ x _		0h			
	_ x _ _		0h			
	x _ _ _	Do not change this value	0h	○	○	
PC30 STA2 Home position return acceleration time constant		This parameter is used when a home position return is executed with the program method. Set the acceleration time constant at the home position return. Set an acceleration time from 0 r/min. Additionally, when 20000 ms or more value is set, it will be clamped to 20000 ms. Setting range: 0 to 50000	0 [ms]		○	
PC30 STA2 Acceleration time constant 2		Set an second acceleration time constant for the automatic operation of the indexer method. Set an acceleration time from 0 r/min to the rated speed. Additionally, when 20000 ms or more value is set, it will be clamped to 20000 ms. Setting range: 0 to 50000	0 [ms]			○
PC31 STB2 Home position return deceleration time constant		This parameter is used when a home position return is executed with the program method. Set the deceleration time constant at the home position return. Set a deceleration time from the rated speed to 0 r/min or 0 mm/s. Additionally, when 20000 ms or more value is set, it will be clamped to 20000 ms. Setting range: 0 to 50000	0 [ms]		○	
PC31 STB2 Deceleration time constant 2		Set an second deceleration time constant for the automatic operation of the indexer method. Set a deceleration time from the rated speed to 0 r/min. Additionally, when 20000 ms or more value is set, it will be clamped to 20000 ms. Setting range: 0 to 50000	0 [ms]			○
PC35 TL2 Internal torque limit 2/internal thrust limit 2		Set the parameter on the assumption that the maximum torque is 100.0 %. The parameter is set for limiting the torque of the servo motor No torque or thrust is generated when this parameter is set to "0.0". When TL1 (Internal torque limit selection) is turned on, Internal torque limit 1 and Internal torque limit 2 are compared and the lower value will be enabled. Set the parameter referring to section 3.6.1 (5) and section 11.5.3 (6) of this Instruction Manual. Setting range: 0.0 to 100.0	100.0 [%]	○	○	○

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PC36 *DMD Status display selection	_ _ x x	Status display selection at power-on Select a status display shown at power-on. 00: Cumulative feedback pulse 01: Servo motor speed/linear servo motor speed 02: Droop pulses 03: Cumulative command pulses 04: Command pulse frequency 05: Analog speed command voltage (not used for the positioning mode) 06: Analog torque limit voltage 07: Regenerative load ratio 08: Effective load ratio 09: Peak load ratio 0A: Instantaneous torque/instantaneous thrust 0B: Position within one-revolution/virtual position within one-revolution (1 pulse unit) 0C: Position within one-revolution/virtual position within one-revolution (1000 pulses unit) 0D: ABS counter/virtual ABS counter 0E: Load to motor inertia ratio/load to motor mass ratio 0F: Bus voltage 10: Internal temperature of encoder 11: Settling time 12: Oscillation detection frequency 13: Number of tough drives 14: Unit power consumption (1 W unit) 15: Unit power consumption (1 kW unit) 16: Unit total power consumption (1 Wh unit) 17: Unit total power consumption (100 kWh unit) 18: Load-side cumulative feedback pulses 19: Load-side droop pulses 1A: Load-side encoder information 1 (1 pulse unit) 1B: Load-side encoder information 1 (100000 pulses unit) 1C: Load-side encoder ABS counter. 1D: Z-phase counter (1 pulse unit) 1E: Z-phase counter (100000 pulses unit) 1F: Electrical angle (1 pulse unit) 20: Electrical angle (100000 pulses unit) 21: Current position 22: Command position 23: Command remaining distance 24: Point table No./Program No./Station position No. 25: Step No. 26: Override voltage 27: Override level 28: Cam axis one cycle current value 29: Cam standard position 2A: Cam axis feed current value 2B: Cam No. in execution 2C: Cam stroke amount in execution 2D: Main axis current value 2E: Main axis one cycle current value	00h	○	○	○

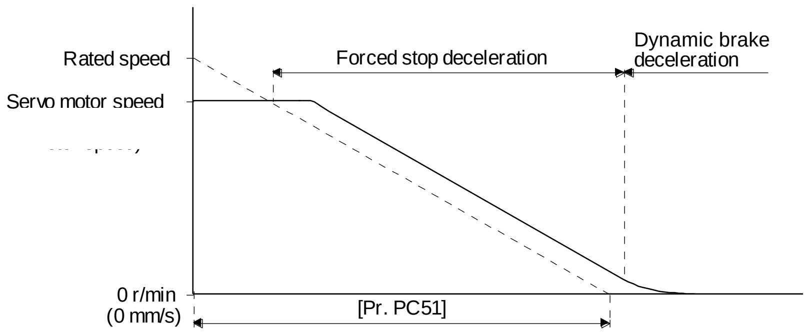
<table>
<tr><th rowspan="2">No./
symbol/name</th><th rowspan="2">Setting
digit</th><th rowspan="2">Function</th><th rowspan="2">Initial
value
[unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>CP</th><th>CL</th><th>PS</th></tr>
<tr><td rowspan="2">PC36
*DMD
Status display selection</td><td>_ x _ _</td><td>Status display at power-on in corresponding control mode
0: Depends on the control mode
<table><tr><th>Control mode</th><th>Status display at power-on</th></tr><tr><td>Positioning (point table method)</td><td>Current position</td></tr><tr><td>Positioning (program method)</td><td>Current position</td></tr><tr><td>Positioning (indexer method)</td><td>Cumulative feedback pulses</td></tr></table>1: Depends on the last two digit setting of the parameter</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>PC37
VCO
Analog override Offset</td><td></td><td>Set an offset voltage of VC (Override input).
This will be automatic setting by executing VC automatic offset.

Setting range: -9999 to 9999</td><td>0
[mV]</td><td>○</td><td>○</td><td></td></tr>
<tr><td>PC38
TPO
Analog torque limit offset</td><td></td><td>Set the offset voltage of TLA (Analog torque limit).

Setting range: -9999 to 9999</td><td>0
[mV]</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PC39
MO1
Analog monitor 1 offset</td><td></td><td>Set the offset voltage of MO1 (Analog monitor 1).

Setting range: -9999 to 9999</td><td>0
[mV]</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PC40
MO2
Analog monitor 2 offset</td><td></td><td>Set the offset voltage of MO2 (Analog monitor 2).

Setting range: -9999 to 9999</td><td>0
[mV]</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PC43
ERZ
Error excessive alarm level</td><td></td><td>Set an error excessive alarm level.
You can change the setting unit with "Error excessive alarm level" in [Pr. PC24].
Setting "0" will be "3 rev" for rotary servo motors and direct drive motors. Setting over 200 rev will be clamped with 200 rev.
Setting range: 0 to 1000</td><td>0
[rev]</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td rowspan="4">PC44
*COP9
Function selection C-9</td><td>_ _ _ x</td><td rowspan="3">For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ _ x _</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ x _ _</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>x _ _ _</td><td>Do not change this value.</td><td>0h</td><td>○</td><td>○</td><td></td></tr>
<tr><td rowspan="4">PC45
*COPA
Function selection C-A</td><td>_ _ _ x</td><td>Do not change this value</td><td>0h</td><td>○</td><td>○</td><td></td></tr>
<tr><td>_ _ x _</td><td>For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ x _ _</td><td>Do not change this value</td><td>0h</td><td>○</td><td>○</td><td></td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
</table>

<table>
<tr><th rowspan="2">No./
symbol/name</th><th rowspan="2">Setting
digit</th><th rowspan="2">Function</th><th rowspan="2">Initial
value
[unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>CP</th><th>CL</th><th>PS</th></tr>
<tr><td>PC51
RSBR
Forced stop deceleration time constant</td><td></td><td>Set a deceleration time constant when you use the forced stop deceleration function.
Set the time per ms from the rated speed to 0 r/min.
Setting "0" will be 100 ms.


[Precautions]
· If the servo motor torque is saturated at the maximum value during forced stop deceleration because the set time is too short, the time to stop will be longer than the set time constant.
· [AL. 50 Overload alarm 1] or [AL. 51 Overload alarm 2] may occur during forced stop deceleration, depending on the set value.
· After an alarm that leads to a forced stop deceleration, if an alarm that does not lead to a forced stop deceleration occurs or if the control circuit power supply is cut, dynamic braking will start regardless of the deceleration time constant setting.

Setting range: 0 to 20000</td><td>100
[ms]</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PC54
RSUP1
Vertical axis freefall prevention compensation amount</td><td></td><td>Set the compensation amount of the vertical axis freefall prevention function.
Set it per servo motor rotation amount.
When setting a positive value, the servo motor will pull in the direction of the servo motor rotation direction at positioning address increasing with the servo motor rotation amount.
For example, if a positive compensation amount is set when the [Pr. PA14 Rotation direction selection] setting is "1", the axis will be pulled to the CW direction.
The vertical axis freefall prevention function is performed when all of the following conditions are met.
1) The value of the parameter is other than "0".
2) The forced stop deceleration function is enabled.
3) Alarm occurs or EM2 turns off when the servo motor speed is zero speed or less.
4) MBR (Electromagnetic brake interlock) was enabled in [Pr. PD23] to [Pr. PD26], [Pr. PD28], and [Pr. PD47], and the base circuit shut-off delay time was set in [Pr. PC16].

Setting range: -25000 to 25000</td><td>0
[0.0001
rev]</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td rowspan="4">PC60
*COPD
Function selection C-D</td><td>_ _ _ x</td><td>Motor-less operation selection
Set the motor-less operation.
0: Disabled
1: Enabled</td><td>0h</td><td>○</td><td>○</td><td></td></tr>
<tr><td>_ _ x _</td><td>High-resolution analog input selection
Select the resolution of VC (Analog override).
When you change parameters, perform offset adjustment with [Pr. PC37 Analog override offset]. The offset adjustment can be performed by executing VC automatic offset.
0: Disabled
1: Enabled</td><td>0h</td><td>○</td><td>○</td><td></td></tr>
<tr><td>_ x _ _</td><td>For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>x _ _ _</td><td>[AL. 9B Error excessive warning] selection
0: [AL. 9B Error excessive warning] is disabled.
1: [AL. 9B Error excessive warning] is enabled.</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
</table>

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode		
				CP	CL	PS
PC66 LPSPL Mark detection range + (lower three digits) PC67 LPSPH Mark detection range + (upper three digits)		Set the upper limit of the mark detection. Upper and lower are a set. When the roll feed display is enabled, set this value with the travel distance from the starting position. Setting address: _ _ _ _ _ _ Upper 3 digits: [Pr. PC67] Lower 3 digits: [Pr. PC66] The unit will be changed to 10^{STM} [m], $10^{(STM-4)}$ [inch], 10^{-3} [degree], or [pulse] with the setting of [Pr. PT01]. Set a same sign for [Pr. PC66] and [Pr. PC67]. A different sign will be recognized as minus sign data. When changing the direction to address decreasing, change it from the - side of the mark detection ([Pr. PC68] and [Pr. PC69]). An incorrect order of the setting will trigger [AL. 37]. Therefore, cycling power may be required after [Pr. PC66] to [Pr. PC69] are all set. Setting range: -999 to 999	0 Refer to Function column for unit.	○	○	
PC68 LPSNL Mark detection range - (lower three digits) PC69 LPSNH Mark detection range - (upper three digits)		Set the lower limit of the mark detection. Upper and lower are a set. When the roll feed display is enabled, set this value with the travel distance from the starting position. Setting address: _ _ _ _ _ _ Upper 3 digits: [Pr. PC69] Lower 3 digits: [Pr. PC68] The unit will be changed to 10^{STM} [m], $10^{(STM-4)}$ [inch], 10^{-3} [degree], or [pulse] with the setting of [Pr. PT01]. Set a same sign for [Pr. PC68] and [Pr. PC69]. A different sign will be recognized as minus sign data. When changing the direction to address increasing, change it from the + side of the mark detection ([Pr. PC66] and [Pr. PC67]). An incorrect order of the setting will trigger [AL. 37]. Therefore, cycling power may be required after [Pr. PC66] to [Pr. PC69] are all set. Setting range: -999 to 999	0 Refer to Function column for unit.	○	○	
PC73 ERW Error excessive warning level		Set an error excessive warning level. To enable the parameter, set "[AL. 9B Error excessive warning] selection" to "Enabled (1 _ _ _)" in [Pr. PC60]. The setting unit can be changed with "Error excessive alarm/error excessive warning level unit selection" in [Pr. PC24]. Set this per rev. for rotary servo motors and direct drive motors. When "0" is set, 1 rev will be applied. Setting over 200 rev will be clamped to 200 rev. When an error reaches the set value, [AL. 9B Error excessive warning] will occur. When the error decreases lower than the set value, the warning will be canceled automatically. The minimum pulse width of the warning signal is 100 [ms]. Set as follows: [Pr. PC73 Error excessive warning level] < [Pr. PC43 Error excessive alarm level] When you set as [Pr. PC73 Error excessive warning level] ≥ [Pr. PC43 Error excessive alarm level], [AL. 52 Error excessive] will occur earlier than the warning. Setting range: 0 to 1000	0 [rev]/ [mm]	○	○	○

16.22.4 I/O setting parameters ([Pr. PD_ _])

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PD01 *DIA1 Input signal automatic on selection 1	Select input devices to turn on them automatically.					
	_ _ _ x (HEX)	_ _ _ x (BIN): For manufacturer setting	0h			
		_ _ x _ (BIN): For manufacturer setting				
		_ x _ _ (BIN): SON (Servo-on) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)		○	○	○
		x _ _ _ (BIN): For manufacturer setting				
	_ _ x _ (HEX)	_ _ _ x (BIN): PC (Proportional control) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)	0h	○	○	○
		_ _ x _ (BIN): TL (External torque/external thrust limit selection) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)		○	○	○
		_ x _ _ (BIN): For manufacturer setting				
		x _ _ _ (BIN): For manufacturer setting				
	_ x _ _ (HEX)	_ _ _ x (BIN): For manufacturer setting	0h			
		_ _ x _ (BIN): For manufacturer setting				
		_ x _ _ (BIN): LSP (Forward rotation stroke end) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)		○	○	○
		x _ _ _ (BIN): LSN (Reverse rotation stroke end) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)		○	○	○
	x _ _ _ (HEX)	_ _ _ x (BIN): EM2 (Forced stop 2)/EM1 (Forced stop 1) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)	0h	○	○	○
		_ _ x _ (BIN): For manufacturer setting				
		_ x _ _ (BIN): For manufacturer setting				
		x _ _ _ (BIN): For manufacturer setting				

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PD01 *DIA1 Input signal automatic on selection 1	Convert the setting value into hexadecimal as follows.					

Signal name	Initial value BIN	Initial value HEX
	0	0
	0	
SON (Servo-on)	0	
	0	

Signal name	Initial value BIN	Initial value HEX
PC (Proportional control)	0	0
TL (External torque/external thrust limit selection)	0	
	0	
	0	

Signal name	Initial value BIN	Initial value HEX
	0	0
	0	
LSP (Forward rotation stroke end)	0	
LSN (Reverse rotation stroke end)	0	

Signal name	Initial value BIN	Initial value HEX
EM2 (Forced stop 2)/EM1 (Forced stop 1)	0	0
	0	
	0	
	0	

BIN 0: Use for an external input signal.
BIN 1: Automatic on

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PD04 *DI1H Input device selection 1H		Any input device can be assigned to the CN1-15 pin.				
	_ _ x x	Not used with the positioning mode.	02h			
	x x _ _	Positioning mode - Device selection Refer to table 7.10 for settings.	02h	○	○	○

Table 7.10 Selectable input devices

Setting value	Input device (Note 1) CP	CL	PS
0 2 _ _	SON	SON	SON
0 3 _ _	RES	RES	RES
0 4 _ _	PC	PC	PC
0 5 _ _	TL	TL	TL
0 6 _ _	CR	CR	CR
0 7 _ _	ST1	ST1	ST1
0 8 _ _	ST2	ST2	
0 9 _ _	TL1	TL1	TL1
0 A _ _	LSP	LSP	LSP
0 B _ _	LSN	LSN	LSN
0 D _ _	CDP	CDP	CDP
0 F _ _ (Note 2)	MECR	MECR	
1 2 _ _	MSD	MSD	
1 E _ _	CLTC	CLTC	
1 F _ _	CPCD	CPCD	
2 0 _ _	MD0	MD0	MD0
2 1 _ _	CAMC	CAMC	MD1
2 3 _ _	TCH		
2 4 _ _	TP0	TP0	
2 5 _ _	TP1	TP1	
2 6 _ _	OVR	OVR	
2 7 _ _	TSTP	TSTP	
2 9 _ _	CI0	CI0	
2 A _ _	CI1	CI1	
2 B _ _	DOG	DOG	SIG
2 C _ _	SPD1		
2 D _ _	SPD2		
2 E _ _	SPD3		
2 F _ _	SPD4		
3 0 _ _		LPS	
3 1 _ _	CI2	CI2	RT
3 2 _ _			RTCDP
3 4 _ _		PI1	OV0
3 5 _ _		PI2	OV1

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PD04 *DI1H Input device selection 1H		Table 7.10 Selectable input devices (continued below)				

Table 7.10 Selectable input devices

Setting value	Input device (Note 1)		
	CP	CL	PS
3 6 _ _		PI3	OV2
3 7 _ _	CI3	CI3	OV3
3 8 _ _	DI0	DI0	DI0
3 9 _ _	DI1	DI1	DI1
3 A _ _	DI2	DI2	DI2
3 B _ _	DI3	DI3	DI3
3 C _ _	DI4	DI4	DI4
3 D _ _	DI5	DI5	DI5
3 E _ _	DI6	DI6	DI6
3 F _ _	DI7	DI7	DI7

Note 1. CP: Positioning mode (point table method)
CL: Positioning mode (program method)
PS: Positioning mode (indexer method)
The diagonal lines indicate manufacturer settings. Never change the setting.

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PD06 *DI2H Input device selection 2H	Any input device can be assigned to the CN1-16 pin.					
	_ _ x x	Not used with the positioning mode.	21h			
	x x _ _	Positioning mode - Device selection Refer to table 7.10 in [Pr. PD04] for settings.	20h	○	○	○
PD08 *DI3H Input device selection 3H	Any input device can be assigned to the CN1-17 pin.					
	_ _ x x	Not used with the positioning mode.	07h			
	x x _ _	Positioning mode - Device selection Refer to table 7.10 in [Pr. PD04] for settings.	07h	○	○	○
PD10 *DI4H Input device selection 4H	Any input device can be assigned to the CN1-18 pin.					
	_ _ x x	Not used with the positioning mode.	08h			
	x x _ _	Positioning mode - Device selection Refer to table 7.10 in [Pr. PD04] for settings.	08h	○	○	○
PD12 *DI5H Input device selection 5H	Any input device can be assigned to the CN1-19 pin.					
	_ _ x x	Not used with the positioning mode.	03h			
	x x _ _	Positioning mode - Device selection Refer to table 7.10 in [Pr. PD04] for settings.	38h	○	○	○
PD14 *DI6H Input device selection 6H	Any input device can be assigned to the CN1-41 pin.					
	_ _ x x	Not used with the positioning mode.	20h			
	x x _ _	Positioning mode - Device selection Refer to table 7.10 in [Pr. PD04] for settings.	39h	○	○	○
PD18 *DI8H Input device selection 8H	Any input device can be assigned to the CN1-43 pin.					
	_ _ x x	Not used with the positioning mode.	00h			
	x x _ _	Positioning mode - Device selection Refer to table 7.10 in [Pr. PD04] for settings.	0Ah	○	○	○
PD20 *DI9H Input device selection 9H	Any input device can be assigned to the CN1-44 pin.					
	_ _ x x	Not used with the positioning mode.	00h			
	x x _ _	Positioning mode - Device selection Refer to table 7.10 in [Pr. PD04] for settings.	0Bh	○	○	○
PD22 *DI10H Input device selection 10H	Any input device can be assigned to the CN1-45 pin.					
	_ _ x x	Not used with the positioning mode.	23h			
	x x _ _	Positioning mode - Device selection Refer to table 7.10 in [Pr. PD04] for settings.	2Bh	○	○	○

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PD23 *DO1 Output device selection 1	_ _ x x	Device selection Any output device can be assigned to the CN1-22 pin. Refer to table 7.11 for settings.	04h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			

Table 7.11 Selectable output devices

Setting value	Output device CP	CL	PS
_ _ 0 0	Always off	Always off	Always off
_ _ 0 2	RD	RD	RD
_ _ 0 3	ALM	ALM	ALM
_ _ 0 4	INP	INP	INP
_ _ 0 5	MBR	MBR	MBR
_ _ 0 6	DB	DB	DB
_ _ 0 7	TLC	TLC	TLC
_ _ 0 8	WNG	WNG	WNG
_ _ 0 9	BWNG	BWNG	BWNG
_ _ 0 A	SA	SA	Always off
_ _ 0 B	Always off	Always off	Always off
_ _ 0 C	ZSP	ZSP	ZSP
_ _ 0 D	MTTR	MTTR	MTTR
_ _ 0 F	CDPS	CDPS	CDPS
_ _ 1 0	CLDS	CLDS	CLDS
_ _ 1 1	ABSV	ABSV	ABSV
_ _ 1 F	CPCC	CPCC	
_ _ 2 3	CPO	CPO	CPO
_ _ 2 4	ZP	ZP	ZP
_ _ 2 5	POT	POT	Always off
_ _ 2 6	PUS	PUS	Always off
_ _ 2 7	MEND	MEND	MEND
_ _ 2 9	CLTS	CLTS	
_ _ 2 B	CLTSM	CLTSM	
_ _ 2 C	PED	PED	
_ _ 2 D		SOUT	
_ _ 2 E		OUT1	
_ _ 2 F		OUT2	
_ _ 3 0		OUT3	
_ _ 3 1	ALMWNG	ALMWNG	ALMWNG
_ _ 3 2	BW9F	BW9F	BW9F
_ _ 3 3	MSDH	MSDH	
_ _ 3 4	MSDL	MSDL	
_ _ 3 7	CAMS	CAMS	

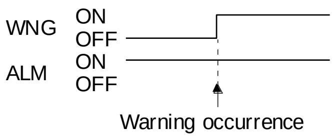
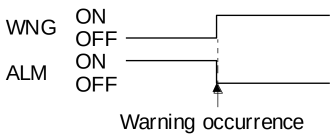
No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PD23 *DO1 Output device selection 1		(see table below)				
PD24 *DO2 Output device selection 2	_ _ x x	Device selection Any output device can be assigned to the CN1-23 pin. Refer to table 7.11 in [Pr. PD23] for settings.	0Ch	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PD25 *DO3 Output device selection 3	_ _ x x	Device selection Any output device can be assigned to the CN1-24 pin. Refer to table 7.11 in [Pr. PD23] for settings.	04h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PD26 *DO4 Output device selection 4	_ _ x x	Device selection Any output device can be assigned to the CN1-25 pin. Refer to table 7.11 in [Pr. PD23] for settings.	07h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PD28 *DO6 Output device selection 6	_ _ x x	Device selection Any output device can be assigned to the CN1-49 pin. Refer to table 7.11 in [Pr. PD23] for settings.	02h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PD29 *DIF Input filter setting		Select a filter for the input signal.				
	_ _ _ x	Input signal filter selection If external input signal causes chattering due to noise, etc., input filter is used to suppress it. 0: None 1: 0.888 [ms] 2: 1.777 [ms] 3: 2.666 [ms] 4: 3.555 [ms] 5: 4.444 [ms] 6: 5.333 [ms]	4h	○	○	○
	_ _ x _	RES (Reset) dedicated filter selection 0: Disabled 1: Enabled (50 [ms])	0h	○	○	○
	_ x _ _	CR (Clear) dedicated filter selection 0: Disabled 1: Enabled (50 [ms])	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			

PD23 (continued):

Setting value	Output device (Note 1) CP	CL	PS
_ _ 3 8	PT0		PS0
_ _ 3 9	PT1		PS1
_ _ 3 A	PT2		PS2
_ _ 3 B	PT3		PS3
_ _ 3 C	PT4		PS4
_ _ 3 D	PT5		PS5
_ _ 3 E	PT6		PS6
_ _ 3 F	PT7		PS7

Note 1. CP: Positioning mode (point table method)
CL: Positioning mode (program method)
PS: Positioning mode (indexer method)
The diagonal lines indicate manufacturer settings. Never change the setting.

<table>
<tr><th rowspan="2">No./
symbol/name</th><th rowspan="2">Setting
digit</th><th rowspan="2">Function</th><th rowspan="2">Initial
value
[unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>CP</th><th>CL</th><th>PS</th></tr>
<tr><td rowspan="4">PD30
*DOP1
Function
selection D-1</td><td>_ _ _ x</td><td>Stop method selection for LSP (Forward rotation stroke end) off or LSN (Reverse rotation stroke end) off
Select a stop method for LSP (Forward rotation stroke end) off or LSN (Reverse rotation stroke end) off. (Refer to section 7.5.)
<table>
<tr><th rowspan="2">Setting
value</th><th colspan="2">Control mode</th></tr>
<tr><th>CP/CL</th><th>PS</th></tr>
<tr><td>0</td><td colspan="2">Quick stop (home position erased)</td></tr>
<tr><td>1</td><td colspan="2">Slow stop (home position erased)</td></tr>
<tr><td>2</td><td>Slow stop (deceleration to a stop by deceleration time constant)</td><td>Slow stop (home position erased)</td></tr>
<tr><td>3</td><td>Quick stop (stop by clearing remaining distance)</td><td>Quick stop (home position erased)</td></tr>
</table></td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>_ _ x _</td><td>Base circuit status selection for RES (Reset) on
0: Base circuit shut-off
1: No base circuit shut-off</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>_ x _ _</td><td>Stop method selection at software limit detection
Select a stop method selection at software limit detection. (Refer to section 7.6.)
0: Quick stop (home position erased)
1: Slow stop (home position erased)
2: Slow stop (deceleration to a stop by deceleration time constant)
3: Quick stop (stop by clearing remaining distance)</td><td>0h</td><td>○</td><td>○</td><td></td></tr>
<tr><td>x _ _ _</td><td>Enabled/disabled selection for a thermistor of servo motor or linear servo motor
0: Enabled
1: Disabled
The setting in this digit will be disabled when using a servo motor or linear servo motor without thermistor.</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td rowspan="4">PD31
*DOP2
Function
selection D-2</td><td>_ _ _ x</td><td rowspan="2">For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ _ x _</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ x _ _</td><td>INP (In-position) on condition selection
Select a condition that INP (In-position) is turned on.
0: Droop pulses are within the in-position range.
1: The command pulse frequency is 0, and droop pulses are within the in-position range.
When the position command is not inputted for about 1 ms, the command pulse frequency is decided as 0.</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>x _ _ _</td><td>Mark detection fast input signal filter selection
0: Standard 0.166 [ms]
1: 0.055 [ms]
2: 0.111 [ms]
3: 0.166 [ms]
4: 0.222 [ms]
5: 0.277 [ms]
6: 0.333 [ms]
7: 0.388 [ms]
8: 0.444 [ms]
9 to E: Disabled (Setting this will be the same as "F".)
F: Non-filter
This digit will be enabled when MSD (Mark detection) is assigned to the CN1-10 pin with [Pr. PD44].</td><td>0h</td><td>○</td><td>○</td><td></td></tr>
</table>

<table>
<tr><th rowspan="2">No./
symbol/name</th><th rowspan="2">Setting
digit</th><th rowspan="2">Function</th><th rowspan="2">Initial
value
[unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>CP</th><th>CL</th><th>PS</th></tr>
<tr><td rowspan="4">PD32
*DOP3
Function
selection D-3</td><td>_ _ _ x</td><td>CR (Clear) selection
This is used to set CR (Clear).
0: Deleting droop pulses by turning on the device
1: Continuous deleting of droop pulses during the device on
2: Disabled</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>_ _ x _</td><td rowspan="3">For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ x _ _</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>x _ _ _</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td rowspan="4">PD33
*DOP4
Function
selection D-4</td><td>_ _ _ x</td><td rowspan="2">For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ _ x _</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ x _ _</td><td>Rotation direction selection to enable torque limit/travel direction selection to enable thrust limit
Select a direction which enables internal torque limit 2 or external torque limit.
0: Both of "CCW or positive direction" and "CW or negative direction" are enabled.
1: Enabled with "CCW or positive direction"
2: Enabled with "CW or negative direction"</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td rowspan="4">PD34
*DOP5
Function
selection D-5</td><td>_ _ _ x</td><td>Alarm code output
Select an output alarm codes.
When an alarm occurs, the alarm code is outputted to CN1-22, CN1-23, and CN1-24 pins.
0: Disabled
1: Enabled
For details of the alarm codes, refer to chapter 8.
When "1" is set for this digit, setting the following will trigger [AL. 37 Parameter error].
・" 1" is set[Pr. PA03] and the absolute position detection system by DIO is selected.
・MBR, DB, or ALM is assigned to the CN1-22 pin, CN1-23 pin, or CN1-24 pin.</td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>_ _ x _</td><td>Selection of output device at warning occurrence
Select ALM (Malfunction) output status for when an warning occurs.
<table><tr><th>Setting value</th><th>Device status</th></tr><tr><td>0</td><td></td></tr><tr><td>1</td><td></td></tr></table></td><td>0h</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>_ x _ _</td><td rowspan="2">For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>x _ _ _</td><td>0h</td><td></td><td></td><td></td></tr>
</table>

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PD41 *DIA3 Input signal automatic on selection 3		Select input devices to turn on them automatically.				
	_ _ _ x (HEX)	_ _ _ x (BIN): MD0 (operation mode selection 1) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)	0h	○	○	○
		_ _ x _ (BIN): MD1 (operation mode selection 2) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)				○
		_ x _ _ (BIN): For manufacturer setting				
		x _ _ _ (BIN): For manufacturer setting				
	_ _ x _ (HEX)	_ _ _ x (BIN): For manufacturer setting	0h			
		_ _ x _ (BIN): For manufacturer setting				
		_ x _ _ (BIN): OVR (Analog override selection) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)		○	○	
		x _ _ _ (BIN): For manufacturer setting				
	_ x _ _ (HEX)	_ _ _ x (BIN): For manufacturer setting	0h			
		_ _ x _ (BIN): For manufacturer setting				
		_ x _ _ (BIN): For manufacturer setting				
		x _ _ _ (BIN): For manufacturer setting				
	x _ _ _ (HEX)	_ _ _ x (BIN): For manufacturer setting	0h			
		_ _ x _ (BIN): For manufacturer setting				
		_ x _ _ (BIN): For manufacturer setting				
		x _ _ _ (BIN): For manufacturer setting				

Convert the setting value into hexadecimal as follows.

0 0 _ _

Input device	Initial value BIN	Initial value HEX
MD0 (Operation mode selection 1)	0	0
MD1 (Operation mode selection 2)	0	
	0	
	0	

Input device	Initial value BIN	Initial value HEX
	0	0
	0	
OVR (Analog override selection)	0	
	0	

BIN 0: Use for an external input signal.
BIN 1: Automatic on

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PD42 *DIA4 Input signal automatic on selection 4		Select input devices to turn on them automatically.				
	_ _ _ x (HEX)	_ _ _ x (BIN): For manufacturer setting	0h			
		_ _ x _ (BIN): RT (Second acceleration/deceleration selection) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)				○
		_ x _ _ (BIN): RTCDP (Second acceleration/deceleration gain selection) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)				○
		x _ _ _ (BIN): For manufacturer setting				
	_ _ x _ (HEX)	_ _ _ x (BIN): For manufacturer setting	0h			
		_ _ x _ (BIN): For manufacturer setting				
		_ x _ _ (BIN): For manufacturer setting				
		x _ _ _ (BIN): For manufacturer setting				

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode		
				CP	CL	PS
PD42 *DIA4 Input signal automatic on selection 4	_ x _ _ (HEX)	_ _ _ x (BIN): DI0 (point table No/Program No./next station No. selection 1) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)	0h	○	○	○
		_ _ x _ (BIN): DI1 (point table No/program No./next station No. selection 2) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)		○	○	○
		_ x _ _ (BIN): DI2 (point table No/program No./next station No. selection 3) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)		○	○	○
		x _ _ _ (BIN): DI3 (point table No/program No./next station No. selection 4) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)		○	○	○
	x _ _ _ (HEX)	_ _ _ x (BIN): DI4 (point table No/Program No./next station No. selection 5) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)	0h	○	○	○
		_ _ x _ (BIN): DI5 (point table No/program No./next station No. selection 6) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)		○	○	○
		_ x _ _ (BIN): DI6 (point table No/program No./next station No. selection 7) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)		○	○	○
		x _ _ _ (BIN): DI7 (point table No/program No./next station No. selection 8) 0: Disabled (Use for an external input signal.) 1: Enabled (automatic on)		○	○	○

Convert the setting value into hexadecimal as follows.

		0	

Input device	Initial value BIN	Initial value HEX
	0	0
RT (Second acceleration/deceleration selection)	0	
RTCDP (Second acceleration/deceleration gain selection)	0	
	0	

Input device	Initial value BIN	Initial value HEX
DI0 (Point table No/Program No./Next station No. selection 1)	0	0
DI1 (Point table No/Program No./Next station No. selection 2)	0	
DI2 (Point table No/Program No./Next station No. selection 3)	0	
DI3 (Point table No/Program No./Next station No. selection 4)	0	

Input device	Initial value BIN	Initial value HEX
DI4 (Point table No/Program No./Next station No. selection 5)	0	0
DI5 (Point table No/Program No./Next station No. selection 6)	0	
DI6 (Point table No/Program No./Next station No. selection 7)	0	
DI7 (Point table No/Program No./Next station No. selection 8)	0	

BIN 0: Use for an external input signal.
BIN 1: Automatic on

No./symbol/name	Setting digit	Function	Initial value [unit]	CP	CL	PS
PD44 *DI11H Input device selection 11H	Any input device can be assigned to the CN1-10 pin/CN1-37 pin.					
	_ _ x x	Not used with the positioning mode.	00h			
	x x _ _	Positioning mode - Device selection Refer to table 7.10 in [Pr. PD04] for setting values. When "00" is set, PP/PP2 (Forward rotation pulse/Manual pulse generator) will be assigned.	3Ah	○	○	

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PD46 *DI12H Input device selection 12H	Any input device can be assigned to the CN1-35 pin and the CN1-38 pin.					
	_ _ x x	Not used with the positioning mode.	00h			
	x x _ _	Positioning mode - Device selection Refer to table 7.10 in [Pr. PD04] for setting values. When "00" is set, NP/NP2 (Reverse rotation pulse/Manual pulse generator) will be assigned.	3Bh	○	○	
PD47 *DO7 Output device selection 7	Any output device can be assigned to the CN1-13 pin and CN1-14 pin.					
	_ _ x x	Device selection Any output device can be assigned to the CN1-13 pin. Refer to table 7.11 in [Pr. PD23] for setting values.	00h	○	○	○
	x x _ _	Device selection Any output device can be assigned to the CN1-14 pin. Refer to table 7.11 in [Pr. PD23] for setting values.	00h	○	○	○

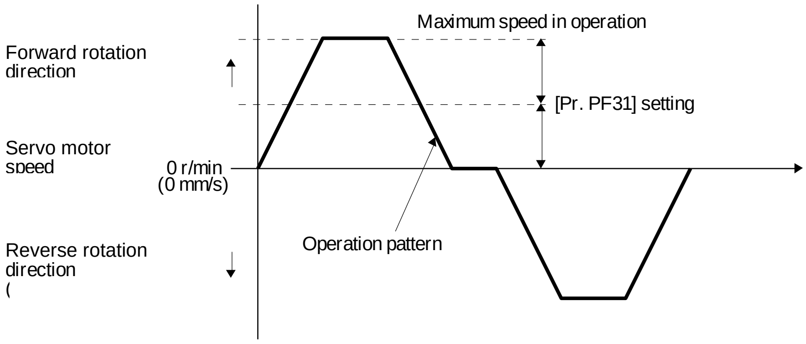
16.22.5 Extension setting 2 parameters ([Pr. PE_ _])

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PE03 *FCT2	_ _ x x	Do not change this value。	03h	○	○	
	_ x _ _	For manufacturer setting	0h			
	x _ _ _	Do not change this value。	0h	○	○	
PE04 *FBN		Do not change this value。	1	○	○	
PE05 *FBD		Do not change this value。	1	○	○	
PE06 BC1		Do not change this value。	400 [r/min]	○	○	
PE07 BC2		Do not change this value。	100 [kpulse]	○	○	
PE08 DUF		Do not change this value。	10 [rad/s]	○	○	
PE10 FCT3	_ _ _ x	For manufacturer setting	0h			
	_ _ x _	Do not change this value。	0h	○	○	
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PE34 *FBN2		Do not change this value。	1	○	○	
PE35 *FBD2		Do not change this value。	1	○	○	
PE41 EOP3 Function selection E-3	_ _ _ x	Robust filter selection 0: Disabled 1: Enabled When you select "Enabled" of this digit, the machine resonance suppression filter 5 set in [Pr. PB51] is not available.	0h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			
PE44 LMCP Lost motion compensation positive-side compensation value selection		Set the lost motion compensation for when reverse rotation (CW) switches to forward rotation (CCW) in increments of 0.01% assuming the rated torque as 100%. Setting range: 0 to 30000	0 [0.01%]	○	○	○

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PE45 LMCN Lost motion compensation negative-side compensation value selection		Set the lost motion compensation for when forward rotation (CCW) switches to reverse rotation (CW) in increments of 0.01% assuming the rated torque as 100%. Setting range: 0 to 30000	0 [0.01%]	○	○	○
PE46 LMFLT Lost motion filter setting		Set the time constant of the lost motion compensation filter in increments of 0.1 ms. If the time constant is "0", the torque is compensated with the value set in [Pr. PE44] and [Pr. PE45]. If the time constant is other than "0", the torque is compensated with the high-pass filter output value of the set time constant, and the lost motion compensation will continue. Setting range: 0 to 30000	0 [0.1 ms]	○	○	○
PE47 TOF Torque offset		Set this when canceling unbalanced torque of vertical axis. Set this assuming the rated torque of the servo motor as 100%. The torque offset does not need to be set for a machine not generating unbalanced torque. The torque offset cannot be used for linear servo motors and direct drive motors. Set 0.00%. Setting range: -10000 to 10000	0 [0.01%]	○	○	○
PE48 *LMOP Lost motion compensation function selection	_ _ _ x	Lost motion compensation selection 0: Disabled 1: Enabled	0h	○	○	○
	_ _ x _	Unit setting of lost motion compensation non-sensitive band 0: 1 pulse unit 1: 1 kplulse unit	0h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PE49 LMCD Lost motion compensation timing		Set the lost motion compensation timing in increments of 0.1 ms. You can delay the timing to perform the lost motion compensation for the set time. Setting range: 0 to 30000	0 [0.1 ms]	○	○	○
PE50 LMCT Lost motion compensation non-sensitive band		Set the lost motion compensation non-sensitive band. When the fluctuation of the droop pulse is the setting value or less, the speed will be 0. Setting can be changed in [Pr. PE48]. Set the parameter per encoder unit. Setting range: 0 to 65535	0 [pulse]/ [kpulse]	○	○	○

16.22.6 Extension setting 3 parameters ([Pr. PF_ _])

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PF09 *FOP5 Function selection F-5	_ _ _ x	Electronic dynamic brake selection 0: Enabled only for specified servo motors 2: Disabled Refer to the following table for the specified servo motors. Series: LE-□-□ / Servo motor: LE-T5-□, LE-T6-□, LE-T7-□, LE-T8-□	0h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			
PF15 DBT Electronic dynamic brake operating time		Set an operating time for the electronic dynamic brake. Setting range: 0 to 10000	2000 [ms]	○	○	○
PF21 DRT Drive recorder switching time setting		Set a drive recorder switching time. When a graph function is terminated or a USB communication is cut during using a graph function, the function will be changed to the drive recorder function after the setting time of this parameter. When a value from "1" to "32767" is set, it will switch after the setting value. However, when "0" is set, it will switch after 600 s. When "-1" is set, the drive recorder function is disabled. Setting range: -1 to 32767	0 [s]	○	○	○
PF23 OSCL1 Vibration tough drive - Oscillation detection level		Set a filter readjustment sensitivity of [Pr. PB13 Machine resonance suppression filter 1] and [Pr. PB15 Machine resonance suppression filter 2] while the vibration tough drive is enabled. However, setting "0" will be 50%. Example: When you set "50" to the parameter, the filter will be readjusted at the time of 50% or more oscillation level. Setting range: 0 to 100	50 [%]	○	○	○
PF24 *OSCL2 Vibration tough drive function selection	_ _ _ x	Oscillation detection alarm selection Select alarm or warning when an oscillation continues at a filter readjustment sensitivity level of [Pr. PF23]. The digit is continuously enabled regardless of the vibration tough drive in [Pr. PA20]. 0: [AL. 54 Oscillation detection] will occur at oscillation detection. 1: [AL. F3.1 Oscillation detection warning] will occur at oscillation detection. 2: Oscillation detection function disabled	0h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			
PF25 CVAT SEMI-F47 function - Instantaneous power failure detection time		Set the time of the [AL. 10.1 Voltage drop in the control circuit power] occurrence. To disable the parameter, set "Disabled (_ 0 _ _)" of "SEMI-F47 function selection" in [Pr. PA20]. Setting range: 30 to 200	200 [ms]	○	○	○

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PF31 FRIC Machine diagnosis function - Friction judgment speed		Set a servo motor speed that divides a friction estimation area into high and low during the friction estimation process of the machine diagnosis. Setting "0" will set a value half of the rated speed. When your operation pattern is under the rated speed, we recommend that you set a half value of the maximum speed.  Setting range: 0 to permissible speed	0 [r/min]/ [mm/s]	○	○	○
PF34 *SOP3 RS-422 communication function selection 3	_ _ _ x	For manufacturer setting	0h			
	_ _ x _		0h			
	_ x _ _		0h			
	x _ _ _	MR-PRU03 selection Select this if using an MR-PRU03. 0: Disabled 1: Enabled.	0h	○	○	○

16.22.7 Positioning control parameters ([Pr. PT_ _])

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode		
				CP	CL	PS
PT01 *CTY Command mode selection	_ _ _ x	Positioning command method selection 0: Absolute value command method 1: Incremental value command method	0h	○	○	
	_ _ x _	For manufacturer setting	0h			
	_ x _ _	Position data unit 0: mm 1: inch 2: degree 3: pulse	0h	○	○	
	x _ _ _	RS-422 communication - Previous model equivalent selection 0: Disabled (LECSB□-T□) 1: Enabled (equivalent to LECSB□-S□) For the communication command of the Mitsubishi general-purpose AC servo protocol, the status display and read/write commands of input/output devices can be used with the data Nos. and bit assignment of the same as previous models. When this digit is "1" or "2", setup software (MR Configurator2™) cannot be used with the USB communication.	0h	○	○	○
PT02 *TOP1 Function selection T-1	_ _ _ x	Follow-up of SON (Servo-on) off/EM2 (Forced stop 2) off with absolute value command method in incremental system 0: Disabled (Home position is erased at servo-off or EM2 off.) 1: Enabled (Home position is not erased even if servo-off, EM2 off, or alarm occurrence which can be canceled with reset. The operation can be continued.)	0h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _	Point table/program writing inhibit 0: Allow 1: Inhibit	0h	○	○	
PT03 *FTY Feeding function selection	_ _ _ x	Feed length multiplication [STM] 0: × 1 1: × 10 2: × 100 3: × 1000 This digit will be disabled when [degree] or [pulse] of "Position data unit" is set in [Pr. PT01].	0h	○	○	
	_ _ x _	Manual pulse generator multiplication 0: × 1 1: × 10 2: × 100	0h	○	○	
	_ x _ _	Shortest rotation selection per degree 0: Rotation direction specifying 1: Shortest rotation	0h	○	○	
	x _ _ _	For manufacturer setting	0h			

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PT04 *ZTY Home position return type	_ _ _ x	Home position return method 0: Dog type (rear end detection, Z-phase reference)/torque limit changing dog type 1: Count type (front end detection, Z-phase reference) (Note 1) 2: Data set type/torque limit changing data set type 3: Stopper type (Note 1) 4: Home position ignorance (servo-on position as home position) (Note 1) 5: Dog type (rear end detection, rear end reference) (Note 1) 6: Count type (front end detection, front end reference) (Note 1) 7: Dog cradle type (Note 1) 8: Dog type (front end detection, Z-phase reference) (Note 1, 2) 9: Dog type (front end detection, front end reference) (Note 1) A: Dogless type (Z-phase reference) (Note 1, 2) Note 1. Setting "1" and "3" to "A" will trigger [AL. 37 Parameter error] for the indexer method.	0h	○	○	○
	_ _ x _	Home position return direction 0: Address increasing direction 1: Address decreasing direction d Setting "2" or more to this digit will be recognized as "1: Address decreasing direction".	1h	○	○	○
	_ x _ _	Home position shift distance multiplication Set a multiplication of [Pr. PT07 Home position shift distance]. 0: × 1 1: × 10 2: × 100 3: × 1000 "0" to "3" can be used for the indexer method. When [degree] of "Position data unit" is set in [Pr. PT01] in the point table method or program method, only "0" and "1" are enabled. ("2" or more will be recognized as "1".)	0h	○	○	○
	x _ _ _	For manufacturer setting	0h			
PT05 ZRF Home position return speed		Set a (linear) servo motor speed at home position return. Setting range: 0 to permissible instantaneous speed	100 [r/min]	○	○	○
PT06 CRF Creep speed		Set a creep speed after proximity dog at home position return. Setting range: 0 to permissible instantaneous speed	10 [r/min]	○	○	○

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PT07 ZST Home position shift distance		Set a shift distance from the Z-phase pulse detection position in the encoder. The unit will be as follows depending on the positioning mode. ・Point table method or program method It will be change to [m], 10^{-4} [inch], 10^{-3} [degree], or [pulse] with [Pr. PT01]. ・Indexer method It will be command unit [pulse]. (unit of a load-side rotation expressed by the number of encoder resolution pulses) Refer to the Function column of [Pr. PA10] for the command unit [pulse]. Additionally, when "Home position shift distance multiplication" is set in [Pr. PT04], it is used with "$\times 10^{n}$". Setting range: 0 to 65535	0 Refer to Function column for unit.	○	○	○
PT08 *ZPS Home position return position data		Set a current position at home position return completion. The unit will be changed to 10^{STM} [m], $10^{(STM-4)}$ [inch], 10^{-3} [degree], or [pulse] with the setting of [Pr. PT01]. Additionally, when the following parameters are changed, the home position return position data will be changed. Execute the home position return again. ・"Position data unit" in [Pr. PT01] ・"Feed length multiplication (STM)" in [Pr. PT03] ・"Home position return type" in [Pr. PT04] Setting range: -32768 to 32767	0 Refer to Function column for unit.	○	○	
PT09 DCT Travel distance after proximity dog		Set a travel distance after proximity dog at home position return for the count type, dog type rear end reference, count type front end reference, and dog type front end reference. The unit will be changed to 10^{STM} [m], $10^{(STM-4)}$ [inch], 10^{-3} [degree], or [pulse] with the setting of [Pr. PT01]. Setting range: 0 to 65535	1000 Refer to Function column for unit.	○	○	
PT10 ZTM Stopper type home position return stopper time		Set time from a moving part touches the stopper and torques reaches to the torque limit of [Pr. PT10 Stopper type home position return - Torque limit value] to a home position set for the stopper type home position return. Setting range: 0 to 1000	100 [ms]	○	○	
PT11 ZTT Stopper type home position return torque limit value		Set a torque limit value with [%] to the maximum torque at stopper type home position return. Setting range: 0.0 to 100.0	15.0 [%]	○	○	
PT12 CRP Rough match output range		Set a range of the command remaining distance which outputs CPO (Rough match). The unit will be as follows depending on the positioning mode. ・Point table method or program method The unit will be changed to 10^{STM} [m], $10^{(STM-4)}$ [inch], 10^{-3} [degree], or [pulse] with the setting of [Pr. PT01]. ・Indexer method It will be command unit [pulse]. (unit of a load-side rotation expressed by the number of encoder resolution pulses) Refer to the Function column of [Pr. PA10] for the command unit [pulse]. Setting range: 0 to 65535	0 Refer to Function column for unit.	○	○	○
PT13 JOG Jog speed		Set a JOG speed. Setting range: 0 to permissible instantaneous speed	100 [r/min]/ [mm/s]	○	○	○

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PT14 *BKC Backlash compensation		Set a backlash compensation for reversing command direction. This parameter compensates backlash pulses against the home position return direction. For the home position ignorance (servo-on position as home position), this turns on SON (Servo-on) and decides a home position, and compensates backlash pulses against the first rotation direction. Setting range: 0 to 65535	0 [pulse]	○	○	○
PT15 LMPL Software limit + (third least significant digit) PT16 LMPH Software limit + (third most significant digit)		Set an address increasing side of the software stroke limit Upper and lower are a set. Setting address: _ _ _ _ _ _ Upper 3 digits → [Pr. PT16] Lower 3 digits → [Pr. PT15] The stop method depends on "Stop method selection at software limit detection" of [Pr. PD30]. The initial value is "Quick stop (home position erased)". Setting a same value with "Software limit -" will disable the software stroke limit. (Refer to section 7.4.) Set a same sign for [Pr. PT15] and [Pr. PT16]. A different sign will be recognized as minus sign data. When changing the direction to address decreasing, change it from the - side of the software limit ([Pr. PT17] and [Pr. PT18]). An incorrect order of the setting will trigger [AL. 37]. Therefore, cycling power may be required after [Pr. PT15] to [Pr. PT18] are all set. The unit will be changed to 10^{STM} [m], $10^{(STM-4)}$ [inch], 10^{-3} [degree], or [pulse] with the setting of [Pr. PT01]. Setting range: -999999 to 999999	0 Refer to Function column for unit.	○	○	
PT17 LMNL Software limit - (third least significant digit) PT18 LMNH Software limit - (third most significant digit)		Set an address decreasing side of the software stroke limit. Upper and lower are a set. Setting address: _ _ _ _ _ _ Upper 3 digits → [Pr. PT18] Lower 3 digits → [Pr. PT17] The stop method depends on "Stop method selection at software limit detection" of [Pr. PD30]. The initial value is "Quick stop (home position erased)". Setting a same value with "Software limit +" will disable the software stroke limit. (Refer to section 7.4.) Set a same sign for [Pr. PT17] and [Pr. PT18]. A different sign will be recognized as minus sign data. When changing the direction to the address increasing direction, change it from the + side of the software limit ([Pr. PT15] and [Pr. PT16]). An incorrect order of the setting will trigger [AL. 37]. Therefore, cycling power may be required after [Pr. PT15] to [Pr. PT18] are all set. The unit will be changed to 10^{STM} [m], $10^{(STM-4)}$ [inch], 10^{-3} [degree], or [pulse] with the setting of [Pr. PT01]. Setting range: -999999 to 999999	0 Refer to Function column for unit.	○	○	

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode		
				CP	CL	PS
PT19 *LPPL Position range output address + (third least significant digit) PT20 *LPPH Position range output address + (third most significant digit)		Set an address increasing side of the position range output address. Upper and lower are a set. Set a range which POT (Position range) turns on with [Pr. PT19] to [Pr. PT22]. Setting address: _ _ _ _ _ _ Upper 3 digits → [Pr. PT20] Lower 3 digits → [Pr. PT19] The unit will be changed to 10^{STM} [m], $10^{(STM-4)}$ [inch], 10^{-3} [degree], or [pulse] with the setting of [Pr. PT01]. Set a same sign for [Pr. PT19] and [Pr. PT20]. Setting a different sign will trigger [AL. 37 Parameter error]. When changing a setting, always set the third least significant digit before setting the third most significant digit. When changing the direction to address decreasing, change it from the - side of the position range output address ([Pr. PT21] and [Pr. PT22]). An incorrect order of the setting will trigger [AL. 37]. Therefore, cycling power may be required after [Pr. PT19] to [Pr. PT22] are all set. Setting range: -999999 to 999999	0 Refer to Function column for unit.	○	○	
PT21 *LNPL Position range output address - (third least significant digit) PT22 *LNPH Position range output address - (third most significant digit)		Set an address decreasing side of the position range output address. Upper and lower are a set. Set a range which POT (Position range) turns on with [Pr. PT19] to [Pr. PT22]. Setting address: _ _ _ _ _ _ Upper 3 digits → [Pr. PT22] Lower 3 digits → [Pr. PT21] The unit will be changed to 10^{STM} [m], $10^{(STM-4)}$ [inch], 10^{-3} [degree], or [pulse] with the setting of [Pr. PT01]. Set a same sign for [Pr. PT21] and [Pr. PT22]. Setting a different sign will trigger [AL. 37 Parameter error]. When changing a setting, always set the third least significant digit before setting the third most significant digit. When changing the direction to address increasing, change it from the + side of the position range output address ([Pr. PT19] and [Pr. PT20]). An incorrect order of the setting will trigger [AL. 37]. Therefore, cycling power may be required after [Pr. PT19] to [Pr. PT22] are all set. Setting range: -999999 to 999999	0 Refer to Function column for unit.	○	○	
PT23 OUT1 OUT1 output setting time		Set an output time for when OUT1 (Program output 1) is turned on with the OUTON command. Setting "0" will keep on-state. To turn it off, use the OUTOF command. Setting range: 0 to 20000	0 [ms]		○	
PT24 OUT2 OUT2 output setting time		Set an output time for when OUT2 (Program output 2) is turned on with the OUTON command. Setting "0" will keep on-state. To turn it off, use the OUTOF command. Setting range: 0 to 20000	0 [ms]		○	
PT25 OUT3 OUT3 output setting time		Set an output time for when OUT3 (Program output 3) is turned on with the OUTON command. Setting "0" will keep on-state. To turn it off, use the OUTOF command. Setting range: 0 to 20000	0 [ms]		○	

<table>
<tr><th rowspan="2">No./ symbol/name</th><th rowspan="2">Setting digit</th><th rowspan="2">Function</th><th rowspan="2">Initial value [unit]</th><th colspan="3">Control mode</th></tr>
<tr><th>CP</th><th>CL</th><th>PS</th></tr>
<tr><td rowspan="4">PT26
*TOP2
Function selection T-2</td><td>_ _ _ x</td><td>Electronic gear fraction clear selection
0: Disabled
1: Enabled
Selecting "Enabled" will clear a fraction of the previous command by the electronic gear at start of the automatic operation.
Setting "2" or more to this digit will be "Disabled".</td><td>0h</td><td>○</td><td>○</td><td></td></tr>
<tr><td>_ _ x _</td><td>Current position/command position display selection
Select how to display a current position and command position.
<table>
<tr><th rowspan="2">Setting value</th><th rowspan="2">Displayed data</th><th rowspan="2">Operation mode</th><th colspan="2">Status display</th></tr>
<tr><th>Current position</th><th>Command position</th></tr>
<tr><td>_ _ 0 _</td><td>Positioning display</td><td>Auto/Manual</td><td>Actual current position will be displayed as machine home position is 0.</td><td>Command current position will be displayed as machine home position is 0.</td></tr>
<tr><td rowspan="2">_ _ 1 _</td><td rowspan="2">Roll feed display</td><td>Auto</td><td rowspan="2">Actual current position will be displayed as automatic operation start position is 0.</td><td>When ST1 (Forward rotation start) or ST2 (Reverse rotation start) is turned on, counting starts from 0 and a command current position to the target position will be displayed. When a stop, a point table command position for the point table method will be displayed and 0 will be continuously displayed for the program method.</td></tr>
<tr><td>Manual</td><td>0 will be continuously displayed.</td></tr>
</table>
This digit will be disabled when [degree] of "Position data unit" is set in [Pr. PT01].
Additionally, setting "2" or more will be "positioning display".</td><td>0h</td><td>○</td><td>○</td><td></td></tr>
<tr><td>_ x _ _</td><td>For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>x _ _ _</td><td>Mark detection function selection
0: Current position latch function
1: Interrupt positioning function</td><td>0h</td><td>○</td><td>○</td><td></td></tr>
<tr><td rowspan="4">PT27
*ODM
Operation mode selection</td><td>_ _ _ x</td><td>For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>_ _ x _</td><td>Manual operation method selection
0: Station JOG operation
1: JOG operation</td><td>0h</td><td></td><td></td><td>○</td></tr>
<tr><td>_ x _ _</td><td rowspan="2">For manufacturer setting</td><td>0h</td><td></td><td></td><td></td></tr>
<tr><td>x _ _ _</td><td>0h</td><td></td><td></td><td></td></tr>
</table>

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PT28 *STN Number of stations per rotation		Set the number of stations per rotation (number of indexer stations). Setting "2" or less will be "2". Setting range: 0 to 255	8 [Stations]			○
PT29 *TOP3 Function selection T-3	Set a polarity of DOG, SIG, PI1, PI2, and PI3.					
	_ _ _ x (HEX)	_ _ _ x (BIN): DOG (Proximity dog) polarity selection 0: Dog detection with off 1: Dog detection with on	0h	○	○	
		_ _ _ x (BIN): SIG (External limit/Rotation direction decision/Automatic speed selection) polarity selection 0: Normally open contact 1: Normally closed contact				○
		_ _ x _ (BIN): For manufacturer setting				
		_ x _ _ (BIN): For manufacturer setting				
		x _ _ _ (BIN): Mark detection input polarity Select MSD (Mark detection) input polarity. 0: Normally closed contact 1: Normally open contact		○	○	
	_ _ x _ (HEX)	_ _ _ x (BIN): PI1 (Program input 1) polarity selection 0: Positive logic 1: Negative logic	0h		○	
		_ _ x _ (BIN): PI2 (Program input 2) polarity selection 0: Positive logic 1: Negative logic			○	
		_ x _ _ (BIN): PI3 (Program input 3) polarity selection 0: Positive logic 1: Negative logic			○	
		x _ _ _ (BIN): For manufacturer setting				
	_ x _ _	For manufacturer setting	0h			
	x _ _ _	For manufacturer setting	0h			

Convert the setting value into hexadecimal as follows.

0 0

Setting	Initial value BIN	Initial value HEX
DOG (Proximity dog) polarity selection or SIG (External limit/Rotation direction decision/ Automatic speed selection) polarity selection	0	0
	0	
	0	
Mark detection input polarity	0	

Setting	Initial value BIN	Initial value HEX
PI1 (Program input 1) polarity selection	0	0
PI2 (Program input 2) polarity selection	0	
PI3 (Program input 3) polarity selection	0	
	0	

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode		
				CP	CL	PS
PT30 MSTL Mark sensor stop travel distance (lower three digits) PT31 MSTH Mark sensor stop travel distance (upper three digits)		Set a mark sensor stop travel distance. Upper and lower are a set. When MSD (Mark detection) is on, the remaining distance will be changed to the travel distance that is set with this parameter. Setting address: _ _ _ _ _ _ Upper 3 digits → [Pr. PT31] Lower 3 digits → [Pr. PT30] When changing the setting, be sure to set the lower three digits first. Then, set the upper three digits. An incorrect order of the setting will trigger [AL. 37]. Therefore, cycling power may be required after [Pr. PT30] to [Pr. PT31] are all set. The unit will be changed to 10^{STM} [m], $10^{(STM-4)}$ [inch], 10^{-3} [degree], or [pulse] with the setting of [Pr. PT01]. Setting range: 0 to 999	0 Refer to Function column for unit.	○	○	
PT34 *PDEF Point table/program default		Use this parameter when initializing point tables, programs, and cam data. The point tables, the programs, and the cam data will be the following status by being initialized. Point table: All "0" Program: Erased Cam data: Erased Initialize the point tables and the programs with the following procedures: 1) Set "5001h" to this parameter. 2) Cycle the power of the driver. After the driver power is on, the initialization completes in about 20 s. "dEF" will be displayed on the display (five-digit, seven-segment LED) during the initialization. After the initialization, the setting of this parameter will be "0000h" automatically. Initialize the cam data with the following procedures: 1) Set "5010h" to this parameter. 2) Cycle the power of the driver. After the initialization, the setting of this parameter will be "0000h" automatically. Initialize the point tables, the programs and the cam data with the following procedures: 1) Set "5011h" to this parameter. 2) Cycle the power of the driver. After the driver power is on, the initialization completes in about 20 s. "dEF" will be displayed on the display (five-digit, seven-segment LED) during the initialization. After the initialization, the setting of this parameter will be "0000h" automatically.	0000h	○	○	
PT35 *TOP5 Function selection T-5	_ _ _ x	For manufacturer setting	0h			
	_ _ x _		0h			
	_ x _ _	Simple cam function selection 0: Disabled 1: Enabled This digit is enabled when the control mode is in the point table method or the program method. Enabling this digit in other control modes will trigger [AL. 37 Parameter error].	0h	○	○	
	x _ _ _	For manufacturer setting	0h			

No./ symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PT38 *TOP7 Function selection T-7	_ _ _ x	For manufacturer setting	0h			
	_ _ x _	Digital override selection 0: Override function is disabled with DI input 1: Override function is enabled with DI input	0h			○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _	Backlash compensation direction selection at data set type home position return 0: Executes backlash compensation assuming a command to the CW rotation direction before home position return. 1: Executes backlash compensation assuming a command to the CCW rotation direction before home position return. When setting this digit, execute a home position return again.	0h			○
PT39 INT Torque limit delay time		Set delay time from outputting INP (In-position) to enabling [Pr. PC35 Internal torque limit 2/internal thrust limit 2]. Setting range: 0 to 1000	100 [ms]			○
PT40 *SZS Station home position shift distance		Set a shift distance of the station home position with encoder pulse unit at home position return. Setting this parameter enables to shift the station home position (station No. 0) to the position for home position return. The following shows cautions for the setting. ・The setting of the station home position shift distance is disabled at home position return. Cycling the power will enable the setting. ・When a home position shift distance is longer than the in-position range, INP (In-position) will not be on regardless of cycle of the power after home position return. Setting range: -32000 to 32000	0 [pulse]			○
PT41 ORP Home position return inhibit function selection	_ _ _ x	Home position return inhibit selection 0: Disabled (home position return allowed) 1: Enabled (home position return inhibited) Selecting "1" for this digit will disable the home position return regardless of turning on ST1 in the home position return mode.	0h	○	○	○
	_ _ x _	For manufacturer setting	0h			
	_ x _ _		0h			
	x _ _ _		0h			

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PT42 *OVM Digital override minimum multiplication		Set a minimum speed for when the digital override function is enabled. When you use the digital override function, multiplication can be set with [Pr. PT42] and [Pr. PT43]. Set this and [Pr. PT43] at a time. Refer to the following table for how to calculate multiplication value. Setting "0" will be recognized as "1". Setting range: 0 to 100	0 [%]			○

(Note) Input device				Multiplication [%]
OV3	OV2	OV1	OV0	
0	0	0	0	Fixed to 100
0	0	0	1	[Pr. PT42]
0	0	1	0	[Pr. PT42] + [Pr. PT43] × 1
0	0	1	1	[Pr. PT42] + [Pr. PT43] × 2
0	1	0	0	[Pr. PT42] + [Pr. PT43] × 3
0	1	0	1	[Pr. PT42] + [Pr. PT43] × 4
0	1	1	0	[Pr. PT42] + [Pr. PT43] × 5
0	1	1	1	[Pr. PT42] + [Pr. PT43] × 6
1	0	0	0	[Pr. PT42] + [Pr. PT43] × 7
1	0	0	1	[Pr. PT42] + [Pr. PT43] × 8
1	0	1	0	[Pr. PT42] + [Pr. PT43] × 9
1	0	1	1	[Pr. PT42] + [Pr. PT43] × 10
1	1	0	0	[Pr. PT42] + [Pr. PT43] × 11
1	1	0	1	[Pr. PT42] + [Pr. PT43] × 12
1	1	1	0	[Pr. PT42] + [Pr. PT43] × 13
1	1	1	1	Fixed to 0

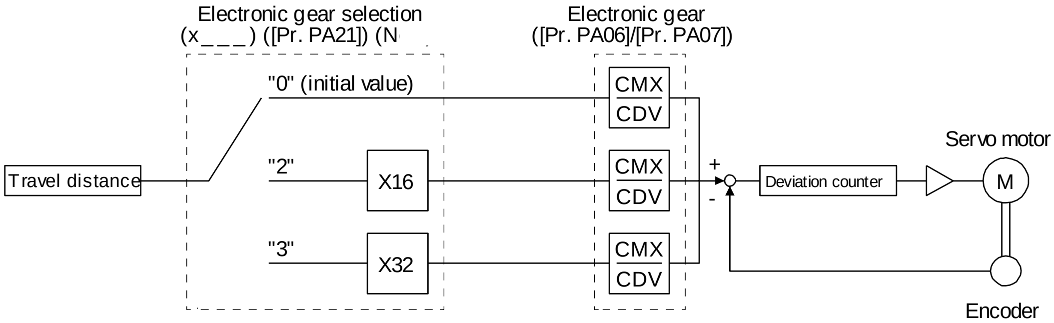
Note. 0: Off
1: On

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PT43 *OVS Digital override pitch width		Set an override pitch width for when the digital override function is enabled. When you use the digital override function, multiplication can be set with [Pr. PT42] and [Pr. PT43]. Set this and [Pr. PT42] at a time. Refer to the table of [Pr. PT42] for settings. Setting "0" will be recognized as "1". Setting range: 0 to 20	0 [%]			○

16.23 HOW TO SET THE ELECTRONIC GEAR

16.23.1 Electronic gear settings in the point table method and program method

(1) Setting [mm], [inch], or [pulse] with "Position data unit" of [Pr. PT01].
Adjust [Pr. PA06] and [Pr. PA07] so that the driver setting matches with the travel distance of the machine.



P_t: Servo motor encoder resolution: 4194304 [pulse/rev]
S: Travel distance per servo motor revolution [mm/rev]/[inch/rev]/[pulse/rev]
CMX/CDV = P_t/ S

Set the electronic gear within the following range. Setting out of the range will trigger [AL. 37 Parameter error].

Pr. PA21	Electronic gear setting range
0 _ _ _	1/865 < CMX/CDV < 271471
2 _ _ _	1/13825 < CMX/CDV < 16967
3 _ _ _	1/27649 < CMX/CDV < 8484

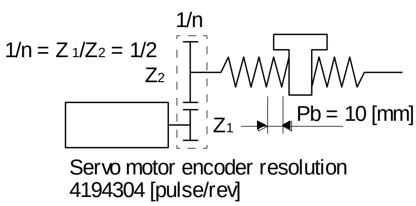
The following setting example explains how to calculate the electronic gear.

POINT
- To calculate the electronic gear, the following specification symbols are required.
  Pb: Ball screw lead [mm]
  1/n: Reduction ratio
  Pt: Servo motor encoder resolution [pulse/rev]
  S: Travel distance per servo motor revolution [mm/rev]

(a) Setting example of a ball screw

Machine specifications

Ball screw lead Pb = 10 [mm]
Reduction ratio: 1/n = Z_1/Z_2 = 1/2
Z_1: Number of gear teeth on servo motor side
Z_2: Number of gear teeth on load gear



Servo motor encoder resolution Pt = 4194304 [pulse/rev]

$$\frac{CMX}{CDV} = \frac{P_t}{\Delta S} = \frac{P_t}{n \cdot Pb \cdot \alpha \text{ (Note)}} = \frac{4194304}{1/2 \cdot 10 \cdot 1000} = \frac{4194304}{5000} = \frac{524288}{625}$$

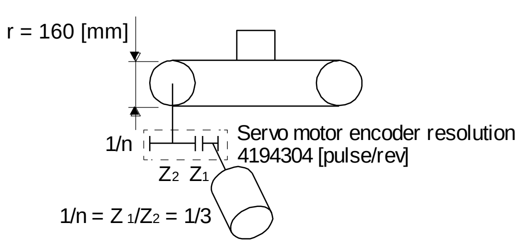
Note. Because the command unit is "mm",   = 1000 is set. When the unit is "inch", convert the setting into   = 10000. When the unit is "pulse", convert the setting into   = 1.

Therefore, set CMX = 524288 and CDV = 625.

(b) Setting example of a conveyor

Machine specifications

Pulley diameter: r = 160 [mm]
Reduction ratio: $1/n = Z_1/Z_2 = 1/3$
Z_1: Number of gear teeth on servo motor side
Z_2: Number of gear teeth on load gear



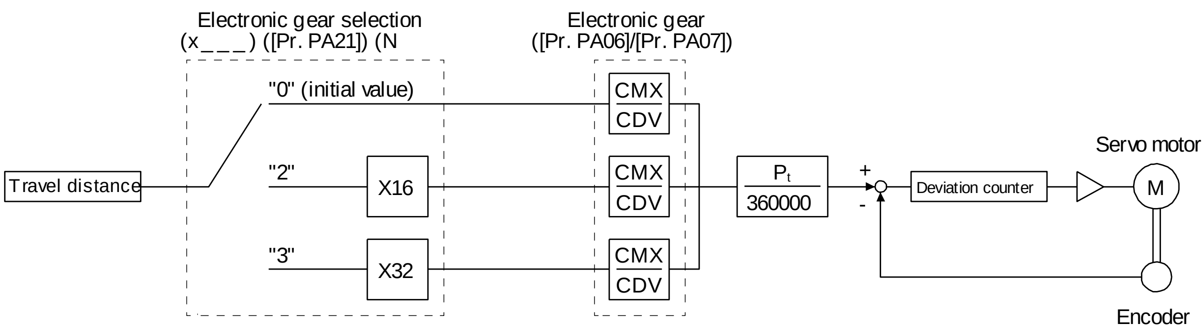
Servo motor encoder resolution Pt = 4194304 [pulse/rev]

$$\frac{CMX}{CDV} = \frac{P_t}{\Delta S} = \frac{P_t}{n \cdot r \cdot \pi \cdot \alpha \text{ (Note)}} = \frac{4194304}{1/3 \cdot 160 \cdot \pi \cdot 1000} = \frac{4194304}{167551.61} \approx \frac{524288}{20944}$$

Note. Because the command unit is "mm",   = 1000 is set. When the unit is "inch", convert the setting into   = 10000. When the unit is "pulse", convert the setting into   = 1.

Reduce CMX and CDV to within the setting range or lower and round off each value to the closest whole number.
Therefore, set CMX = 524288 and CDV = 20944.

(2) Setting [degree] with "Position data unit" of [Pr. PT01].
Set the number of gear teeth on machine side to [Pr. PA06] and number of gear teeth on servo motor side to [Pr. PA07].

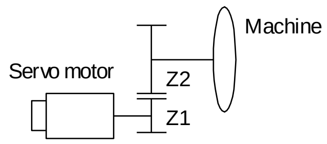


P_t: Servo motor encoder resolution: 4194304 [pulse/rev]

Set the electronic gear within the following range. Setting out of the range will trigger [AL. 37 Parameter error].

(a) Set values to make numerator and denominator 16384 or lower if the electronic gear (CMX/CDV) is reduced to its lowest terms.
(b) Set values to make numerator and denominator 16777216 or lower if (CMX × Pt)/(CDV × 360000) is reduced to its lowest terms.

The following shows a setting example of the electronic gear.
Number of gear teeth on machine side: 25, number of gear teeth on servo motor side: 11
Set [Pr. PA06] = 25 and [Pr. PA07] = 11.

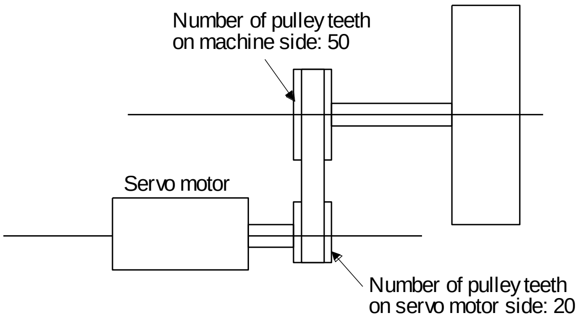


P_t (Servo motor resolution): 4194304 pulses/rev
Z1: Number of gear teeth on servo motor side
Z2: Number of gear teeth on machine side
Z1: Z2 = 11:25

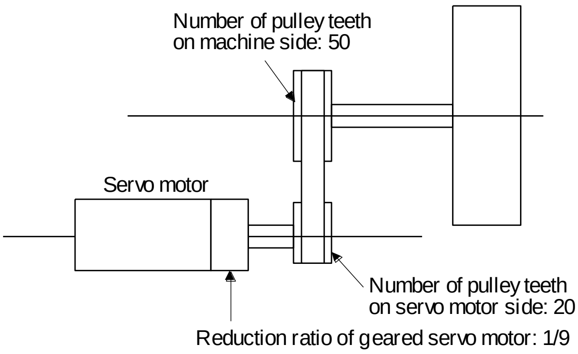
16.23.2 Electronic gear setting in the indexer method

Adjust [Pr. PA06] and [Pr. PA07] to align the rotation amount "m" of the servo motor shaft necessary to rotate the load side for "n" times. The following shows a setting example of the electronic gear.

(1) Number of pulley teeth on machine side: 50, number of pulley teeth on servo motor side: 20
Set [Pr. PA06] = 50 and [Pr. PA07] = 20.



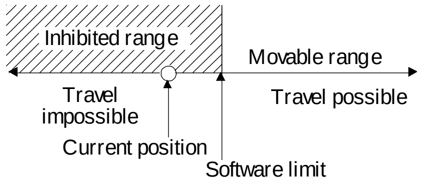
(2) Number of pulley teeth on machine side: 50, number of pulley teeth on servo motor side: 20, with geared servo motor of 1/9
Set [Pr. PA06] = 450 and [Pr. PA07] = 20.



$$\frac{50}{20} \times \frac{9}{1} = \frac{450}{20}$$

16.24 SOFTWARE LIMIT

The limit stop with the software limit ([Pr. PT15] to [Pr. PT18]) is the same as the motion of the stroke end. Exceeding a setting range will stop and servo-lock the shaft. This will be enabled at power-on and will be disabled at home position return. Setting a same value to "Software limit +" and "Software limit -" will disable this function. Setting a larger value to "Software limit -" than "Software limit +" will trigger [AL. 37.2 Parameter combination error].



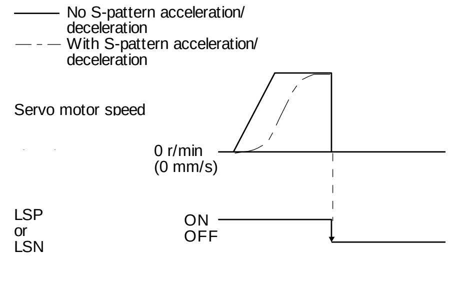
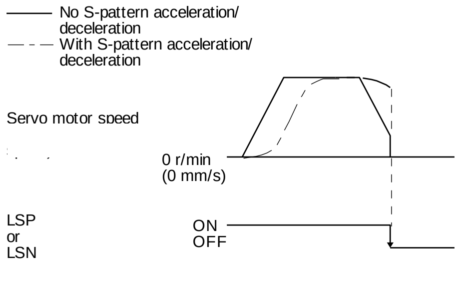
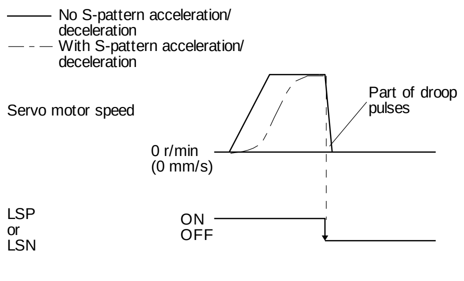
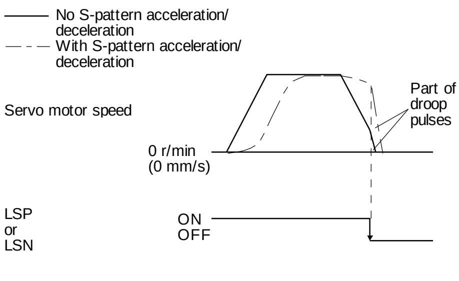
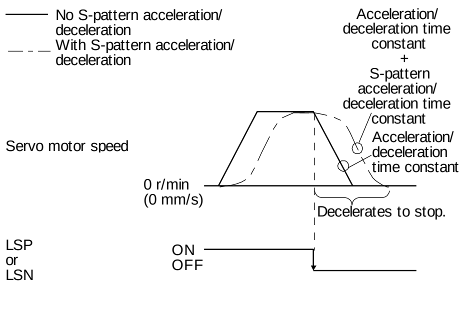
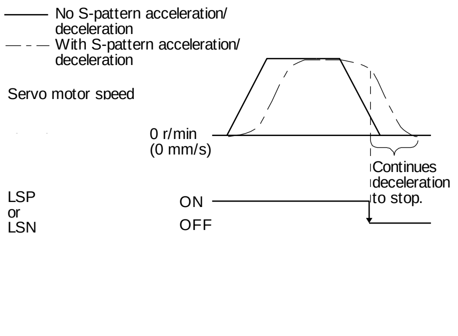
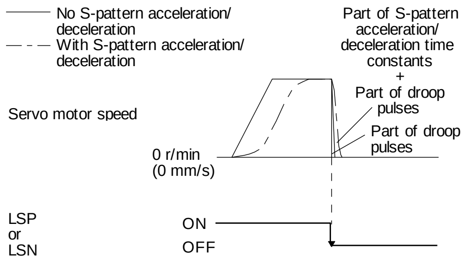
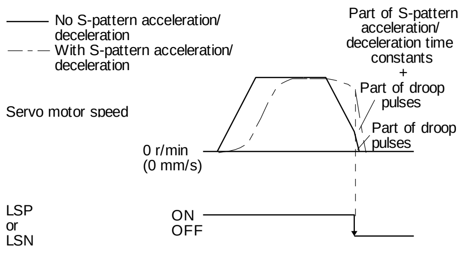
The software limit is disabled in the indexer method.

16.25 STOP METHOD FOR LSP （FORWARD ROTATION STROKE END） OFF OR LSN (REVERSE ROTATION STROKE END) OFF

Select a servo motor stop method for when LSP (Forward rotation stroke end) or LSN (Reverse rotation stroke end) is off with the first digit of [Pr. PD30].

[Pr. PD30]

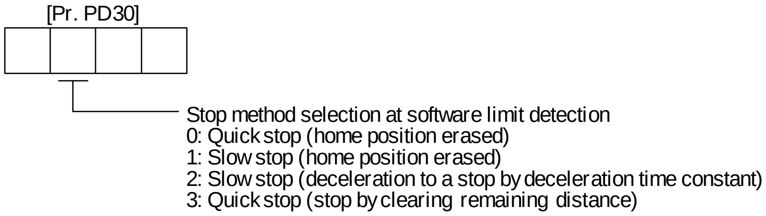
Stop method selection for LSP (Forward rotation stroke end) off or LSN (Reverse rotation stroke end) off
0: Quick stop (home position erased)
1: Slow stop (home position erased)
2: Slow stop (deceleration to a stop by deceleration time constant)
3: Quick stop (stop by clearing remaining distance)

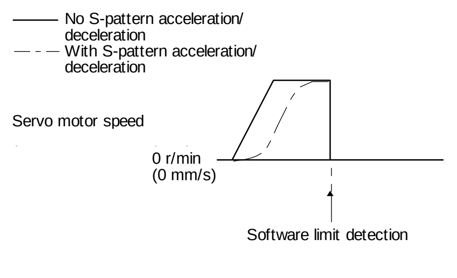
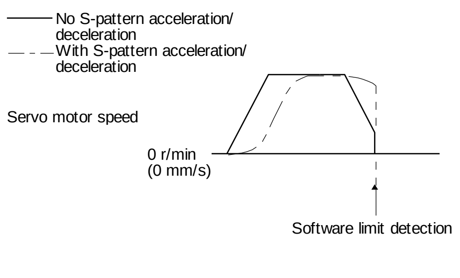
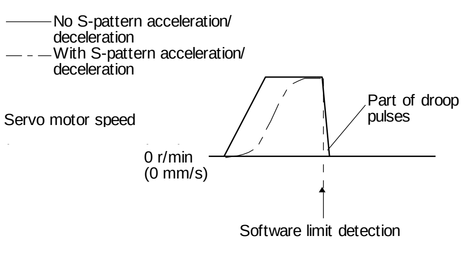
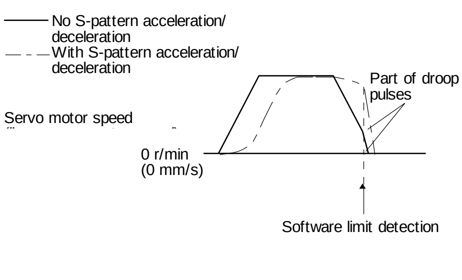
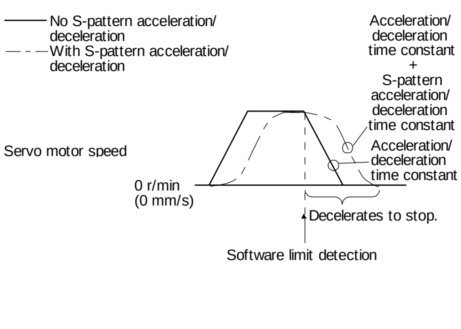
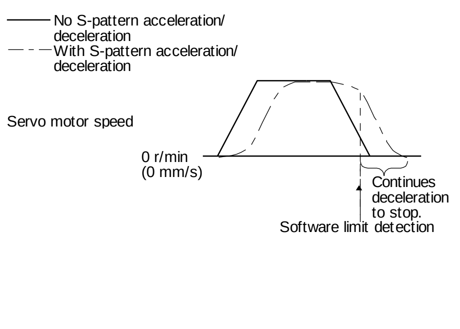
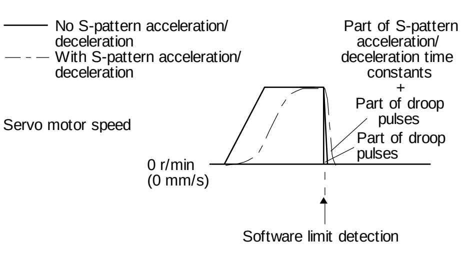
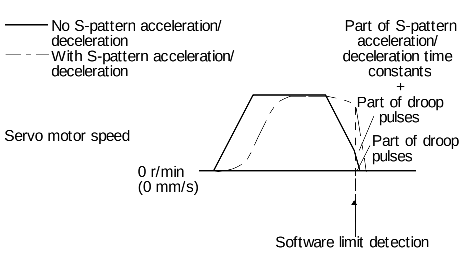
[Pr. PD30] setting	Operation status		Remark
	During rotation at constant speed	During deceleration to a stop	
_ _ _ 0 (initial value)			Erases the droop pulses and stops the motor. Erases the home position. A difference will be generated between command position and current position. Perform a home position return again.
_ _ _ 1			Erases the droop pulse portion and stops the motor. Erases the home position. A difference will be generated between command position and current position. Perform a home position return again.
_ _ _ 2 (Note 1)			Decelerates to a stop with the deceleration time constant currently selected with the point table or the program. Continues operation for a delay portion of the S-pattern acceleration/deceleration time constants. Maintains the home position.
_ _ _ 3 (Note 2)			Erases the droop pulse portion and stops the motor. Continues operation for a delay portion of the S-pattern acceleration/deceleration time constants. Maintains the home position.

Note 1. This will be the same motion as setting "_ _ _ 1" to [Pr. PD30] in the indexer method.
2. This will be the same motion as setting "_ _ _ 0" to [Pr. PD30] in the indexer method.

16.26 STOP METHOD AT SOFTWARE LIMIT DETECTION

Select a stop method of the servo motor for when a software limit ([Pr. PT15] to [Pr. PT18]) is detected with the setting of the third digit in [Pr. PD30]. The software limit limits a command position controlled in the driver. Therefore, actual stop position will not reach the set position of the software limit.
The software limit is disabled in the indexer method.



<table>
<tr><th rowspan="2">[Pr. PD30] setting</th><th colspan="2">Operation status</th><th rowspan="2">Remark</th></tr>
<tr><th>During rotation at constant speed</th><th>During deceleration to a stop</th></tr>
<tr><td>_ 0 _ _
(initial value)</td><td></td><td></td><td>Erases the droop pulses and stops the motor.
Erases the home position.
A difference will be generated between command position and current position.
Perform a home position return again.</td></tr>
<tr><td>_ 1 _ _</td><td></td><td></td><td>Erases the droop pulse portion and stops the motor.
Erases the home position.
A difference will be generated between command position and current position.
Perform a home position return again.</td></tr>
<tr><td>_ 2 _ _</td><td></td><td></td><td>Decelerates to a stop with the deceleration time constant currently selected with the point table or the program.
Continues operation for a delay portion of the S-pattern acceleration/deceleration time constants.
Keeps the home position.</td></tr>
<tr><td>_ 3 _ _</td><td></td><td></td><td>Erases the droop pulse portion and stops the motor.
Continues operation for a delay portion of the S-pattern acceleration/deceleration time constants.
Keeps the home position.</td></tr>
</table>

16.27 COMMUNICATION FUNCTION (MITSUBISHI GENERAL-PURPOSE AC SERVO PROTOCOL)

POINT

- Creating and reading programs are not available with Mitsubishi general-purpose AC servo protocol (RS-422 communication). Use Setup software (MR Configurator2TM).

16.27.1 Reading command

POINT

- Even if a command or data No. is the same between different model drivers, its description may differ.
- The symbols in the control mode column mean as follows.
  CP: Positioning mode (point table method)
  CL: Positioning mode (program method)
  PS: Positioning mode (indexer method)

(1) Status display (command [0] [1])

Command	Data No.	Description	Status display	Control mode			Frame length
				CP	CL	PS	
[0] [1]	[0] [0]	Status display symbol and unit	Cumulative feedback pulses Servo motor-side cumulative feedback pulses (after gear)	○	○	○	16
	[0] [1]		Servo motor speed Servo motor speed	○	○	○	
	[0] [2]		Droop pulses Servo motor-side droop pulses	○	○	○	
	[0] [3]		Cumulative command pulses				
	[0] [4]		Command pulse frequency				
	[0] [5]		Analog speed command voltage Analog speed limit voltage				
	[0] [6]		Analog torque limit voltage Analog torque command voltage				
	[0] [7]		Regenerative load ratio	○	○	○	
	[0] [8]		Effective load ratio	○	○	○	
	[0] [9]		Peak load ratio	○	○	○	
	[0] [A]		Instantaneous torque Instantaneous thrust	○	○	○	
	[0] [B]		Position within one-revolution Servo motor encoder position within one-revolution Virtual position within one-revolution	○	○	○	
	[0] [C]		ABS counter Servo motor encoder ABS counter Virtual ABS counter	○	○	○	
	[0] [D]		Load to motor inertia ratio Load to motor mass ratio	○	○	○	
	[0] [E]		Bus voltage	○	○	○	
	[0] [F]		Load-side cumulative feedback pulses	○	○	○	
	[1] [0]		Load-side droop pulses	○	○	○	
	[1] [1]		Load-side encoder information 1 Z-phase counter	○	○	○	
	[1] [2]		Load-side encoder information 2	○	○	○	
	[1] [6]		Temperature of servo motor thermistor	○	○	○	
	[1] [7]		Servo motor-side cumulative feedback pulses (before gear)	○	○	○	
	[1] [8]		Electrical angle	○	○	○	
	[1] [E]		Servo motor-side/load-side position deviation	○	○	○	
	[1] [F]		Servo motor-side/load-side speed deviation	○	○	○	
	[2] [0]		Internal temperature of encoder	○	○	○	
	[2] [1]		Settling time	○	○	○	
	[2] [2]		Oscillation detection frequency	○	○	○	
	[2] [3]		Number of tough drive operations	○	○	○	
	[2] [8]		Unit power consumption	○	○	○	
	[2] [9]		Unit total power consumption	○	○	○	
	[2] [A]		Current position	○	○		
	[2] [B]		Command position	○	○		
	[2] [C]		Command remaining distance	○	○	○	
	[2] [D]		Point table No./Program No./Station position No.	○	○	○	

Command	Data No.	Description	Status display	Control mode CP	Control mode CL	Control mode PS	Frame length
[0] [1]	[2] [E]	Status display symbol and unit	Step No.		○		16
	[2] [F]		Analog override voltage	○	○	○	
	[3] [0]		Override level	○	○	○	
	[3] [3]		Cam axis one cycle current value	○	○		
	[3] [4]		Cam standard position	○	○		
	[3] [5]		Cam axis feed current value	○	○		
	[3] [6]		Cam No. in execution	○	○		
	[3] [7]		Cam stroke amount in execution	○	○		
	[3] [8]		Main axis current value	○	○		
	[3] [9]		Main axis one cycle current value	○	○		
	[8] [0]	Status display data value and processing information	Cumulative feedback pulses Servo motor-side cumulative feedback pulses (after gear)	○	○	○	12
	[8] [1]		Servo motor speed	○	○	○	
	[8] [2]		Droop pulses	○	○	○	
	[8] [3]		Cumulative command pulses				
	[8] [4]		Command pulse frequency				
	[8] [5]		Analog speed command voltage Analog speed limit voltage				
	[8] [6]		Analog torque limit voltage Analog torque command voltage				
	[8] [7]		Regenerative load ratio	○	○	○	
	[8] [8]		Effective load ratio	○	○	○	
	[8] [9]		Peak load ratio	○	○	○	
	[8] [A]		Instantaneous torque Instantaneous thrust	○	○	○	
	[8] [B]		Position within one-revolution Servo motor encoder position within one-revolution Virtual position within one-revolution	○	○	○	
	[8] [C]		ABS counter Servo motor encoder ABS counter Virtual ABS counter	○	○	○	
	[8] [D]		Load to motor inertia ratio	○	○	○	
	[8] [E]		Bus voltage	○	○	○	
	[8] [F]		Load-side cumulative feedback pulses	○	○	○	
	[9] [0]		Load-side droop pulses	○	○	○	
	[9] [1]		Load-side encoder information 1 Z-phase counter	○	○	○	
	[9] [2]		Load-side encoder information 2	○	○	○	
	[9] [6]		Temperature of servo motor thermistor	○	○	○	
	[9] [7]		Servo motor-side cumulative feedback pulses (before gear)	○	○	○	
	[9] [8]		Electrical angle	○	○	○	
	[9] [E]		Servo motor-side/load-side position deviation	○	○	○	
	[9] [F]		Servo motor-side/load-side speed deviation	○	○	○	
	[A] [0]		Internal temperature of encoder	○	○	○	
	[A] [1]		Settling time	○	○	○	
	[A] [2]		Oscillation detection frequency	○	○	○	

Command	Data No.	Description	Status display	Control mode CP	Control mode CL	Control mode PS	Frame length
[0] [1]	[A] [3]	Status display data value and processing information	Number of tough drive operations	○	○	○	12
	[A] [8]		Unit power consumption	○	○	○	
	[A] [9]		Unit total power consumption	○	○	○	
	[A] [A]		Current position	○	○		
	[A] [B]		Command position	○	○		
	[A] [C]		Command remaining distance	○	○	○	
	[A] [D]		Point table No./Program No./ Station position No.	○	○	○	
	[A] [E]		Step No.		○		
	[A] [F]		Analog override voltage	○	○	○	
	[B] [0]		Override level	○	○	○	
	[B] [3]		Cam axis one cycle current value	○	○		
	[B] [4]		Cam standard position	○	○		
	[B] [5]		Cam axis feed current value	○	○		
	[B] [6]		Cam No. in execution	○	○		
	[B] [7]		Cam stroke amount in execution	○	○		
	[B] [8]		Main axis current value	○	○		
	[B] [9]		Main axis one cycle current value	○	○		

(2) Parameter (command [0] [4], [1] [5], [1] [6], [1] [7], [0] [8], and [0] [9])

Command	Data No.	Description	Control mode CP	Control mode CL	Control mode PS	Frame length
[0] [4]	[0] [1]	Reading parameter group 0000: Basic setting parameters ([Pr. PA_ _]) 0001: Gain/filter parameters ([Pr. PB_ _]) 0002: Extension setting parameters ([Pr. PC_ _]) 0003: I/O setting parameters ([Pr. PD_ _]) 0004: Extension setting 2 parameters ([Pr. PE_ _]) 0005: Extension setting 3 parameters ([Pr. PF_ _]) 0009: Option setting parameters ([Pr. Po_ _]) 000B: Linear servo motor/DD motor setting parameters ([Pr. PL_ _]) 000C: Positioning control parameters ([Pr. PT_ _]) Reads 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].	○	○	○	4
[1] [5]	[0] [1] to [F] [F]	Current value of each parameter 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. (hexadecimal) value corresponds to the parameter No.	○	○	○	12
[1] [6]	[0] [1] to [F] [F]	Upper limit value of each parameter setting range 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. (hexadecimal) value corresponds to the parameter No.	○	○	○	

Command	Data No.	Description	Control mode CP	Control mode CL	Control mode PS	Frame length
[1] [7]	[0] [1] to [F] [F]	Lower limit value of each parameter setting range 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. (hexadecimal) value corresponds to the parameter No.	○	○	○	12
[0] [8]	[0] [1] to [F] [F]	Each parameter symbol Reads the symbols of the parameters in the parameter group specified with the command [8] [5] + data No. [0] [0]. Before reading the symbols, therefore, always specify the parameter group with the command [8] [5] + data No. [0] [0]. The decimal equivalent of the data No. (hexadecimal) value corresponds to the parameter No.	○	○	○	
[0] [9]	[0] [1] to [F] [F]	Writing enable/disable of parameters Reads writing enable/disable of the parameters in the parameter group specified with the command [8] [5] + data No. [0] [0]. Before reading writing enable/disable, therefore, always specify the parameter group with the command [8] [5] + data No. [0] [0]. 0000: Writing enabled 0001: Writing disabled	○	○	○	4

(3) External I/O signals (command [1] [2])

Command	Data No.	Description	Control mode CP	Control mode CL	Control mode PS	Frame length
[1] [2]	[0] [0] to [0] [2]	Input device status	○	○	○	8
	[4] [0]	External input pin status	○	○	○	
	[6] [0] to [6] [2]	Status of input device turned on by communication	○	○	○	
	[8] [0] to [8] [3]	Output device status	○	○	○	
	[C] [0]	External output pin status	○	○	○	

(4) Current position latch display (command [1] [A])

Command	Data No.	Description	Control mode CP	Control mode CL	Control mode PS	Frame length
[1] [A]	[0] [0]	MSD (Mark detection) rising latch data (data part)	○	○		8
	[0] [1]	MSD (Mark detection) falling latch data (data part)	○	○		
	[0] [2]	MSD (Mark detection) rising latch data (data part + additional information)	○	○		12 or less
	[0] [3]	MSD (Mark detection) falling latch data (data part + additional information)	○	○		

(5) Alarm history (command [3] [3])

Command	Data No.	Description	Alarm occurrence sequence	Control mode CP/	CL	PS	Frame length
[3] [3]	[1] [0]	Alarm No. 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	○	○	○	
	[1] [6]		Sixth alarm in past	○	○	○	
	[1] [7]		Seventh alarm in past	○	○	○	
	[1] [8]		Eighth alarm in past	○	○	○	
	[1] [9]		Ninth alarm in past	○	○	○	
	[1] [A]		Tenth alarm in past	○	○	○	
	[1] [B]		Eleventh alarm in past	○	○	○	
	[1] [C]		Twelfth alarm in past	○	○	○	
	[1] [D]		Thirteenth alarm in past	○	○	○	
	[1] [E]		Fourteenth alarm in past	○	○	○	
	[1] [F]		Fifteenth 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	○	○	○	
	[2] [6]		Sixth alarm in past	○	○	○	
	[2] [7]		Seventh alarm in past	○	○	○	
	[2] [8]		Eighth alarm in past	○	○	○	
	[2] [9]		Ninth alarm in past	○	○	○	
	[2] [A]		Tenth alarm in past	○	○	○	
	[2] [B]		Eleventh alarm in past	○	○	○	
	[2] [C]		Twelfth alarm in past	○	○	○	
	[2] [D]		Thirteenth alarm in past	○	○	○	
	[2] [E]		Fourteenth alarm in past	○	○	○	
	[2] [F]		Fifteenth alarm in past	○	○	○	

(6) Current alarm (command [0] [2])

Command	Data No.	Description	Control mode CP	CL	PS	Frame length
[0] [2]	[0] [0]	Current alarm No.	○	○	○	4

(7) Status display at alarm occurrence (command [3] [5])

Command	Data No.	Description	Status display	Control mode			Frame length
				CP	CL	PS	
[3] [5]	[0] [0]	Status display symbol and unit	Cumulative feedback pulses Servo motor-side cumulative feedback pulses (after gear)	○	○	○	16
	[0] [1]		Servo motor speed	○	○	○	
	[0] [2]		Droop pulses	○	○	○	
	[0] [3]		Cumulative command pulses				
	[0] [4]		Command pulse frequency				
	[0] [5]		Analog speed command voltage Analog speed limit voltage				
	[0] [6]		Analog torque limit voltage Analog torque command voltage				
	[0] [7]		Regenerative load ratio	○	○	○	
	[0] [8]		Effective load ratio	○	○	○	
	[0] [9]		Peak load ratio	○	○	○	
	[0] [A]		Instantaneous torque Instantaneous thrust	○	○	○	
	[0] [B]		Position within one-revolution Servo motor encoder position within one-revolution Virtual position within one-revolution	○	○	○	
	[0] [C]		ABS counter Servo motor encoder ABS counter Virtual ABS counter	○	○	○	
	[0] [D]		Load to motor inertia ratio Load to motor mass ratio	○	○	○	
	[0] [E]		Bus voltage	○	○	○	
	[0] [F]		Load-side cumulative feedback pulses	○	○	○	
	[1] [0]		Load-side droop pulses	○	○	○	
	[1] [1]		Load-side encoder information 1 Z-phase counter	○	○	○	
	[1] [2]		Load-side encoder information 2	○	○	○	
	[1] [6]		Temperature of servo motor thermistor	○	○	○	
	[1] [7]		Servo motor-side cumulative feedback pulses (before gear)	○	○	○	
	[1] [8]		Electrical angle	○	○	○	
	[1] [E]		Servo motor-side/load-side position deviation	○	○	○	
	[1] [F]		Servo motor-side/load-side speed deviation	○	○	○	
	[2] [0]		Internal temperature of encoder	○	○	○	
	[2] [1]		Settling time	○	○	○	
	[2] [2]		Oscillation detection frequency	○	○	○	
	[2] [3]		Number of tough drive operations	○	○	○	
	[2] [8]		Unit power consumption	○	○	○	
	[2] [9]		Unit total power consumption	○	○	○	
	[2] [A]		Current position	○	○		
	[2] [B]		Command position	○	○		
	[2] [C]		Command remaining distance	○	○	○	
	[2] [D]		Point table No./Program No./ Station position No.	○	○	○	

Command	Data No.	Description	Status display	Control mode CP	Control mode CL	Control mode PS	Frame length
[3] [5]	[2] [E]	Status display symbol and unit	Step No.		○		16
	[2] [F]		Analog override voltage	○	○	○	
	[3] [0]		Override level	○	○	○	
	[3] [3]		Cam axis one cycle current value	○	○		
	[3] [4]		Cam standard position	○	○		
	[3] [5]		Cam axis feed current value	○	○		
	[3] [6]		Cam No. in execution	○	○		
	[3] [7]		Cam stroke amount in execution	○	○		
	[3] [8]		Main axis current value	○	○		
	[3] [9]		Main axis one cycle current value	○	○		
	[8] [0]	Status display data value and processing information	Cumulative feedback pulses Servo motor-side cumulative feedback pulses (after gear)	○	○	○	12
	[8] [1]		Servo motor speed	○	○	○	
	[8] [2]		Droop pulses	○	○	○	
	[8] [3]		Cumulative command pulses				
	[8] [4]		Command pulse frequency				
	[8] [5]		Analog speed command voltage Analog speed limit voltage				
	[8] [6]		Analog torque limit voltage Analog torque command voltage				
	[8] [7]		Regenerative load ratio	○	○	○	
	[8] [8]		Effective load ratio	○	○	○	
	[8] [9]		Peak load ratio	○	○	○	
	[8] [A]		Instantaneous torque Instantaneous thrust	○	○	○	
	[8] [B]		Position within one-revolution Servo motor encoder position within one-revolution Virtual position within one-revolution	○	○	○	
	[8] [C]		ABS counter Servo motor encoder ABS counter Virtual ABS counter	○	○	○	
	[8] [D]		Load to motor inertia ratio	○	○	○	
	[8] [E]		Bus voltage	○	○	○	
	[8] [F]		Load-side cumulative feedback pulses	○	○	○	
	[9] [0]		Load-side droop pulses	○	○	○	
	[9] [1]		Load-side encoder information 1 Z-phase counter	○	○	○	
	[9] [2]		Load-side encoder information 2	○	○	○	
	[9] [6]		Temperature of servo motor thermistor	○	○	○	
	[9] [7]		Servo motor-side cumulative feedback pulses (before gear)	○	○	○	
	[9] [8]		Electrical angle	○	○	○	
	[9] [E]		Servo motor-side/load-side position deviation	○	○	○	
	[9] [F]		Servo motor-side/load-side speed deviation	○	○	○	
	[A] [0]		Internal temperature of encoder	○	○	○	
	[A] [1]		Settling time	○	○	○	

Command	Data No.	Description	Status display	Control mode CP	CL	PS	Frame length
[3] [5]	[A] [2]	Status display data value and processing information	Oscillation detection frequency	○	○	○	12
	[A] [3]		Number of tough drive operations	○	○	○	
	[A] [8]		Unit power consumption	○	○	○	
	[A] [9]		Unit total power consumption	○	○	○	
	[A] [A]		Current position	○	○		
	[A] [B]		Command position	○	○		
	[A] [C]		Command remaining distance	○	○	○	
	[A] [D]		Point table No./Program No./ Station position No.	○	○	○	
	[A] [E]		Step No.		○		
	[A] [F]		Analog override voltage	○	○	○	
	[B] [0]		Override level	○	○	○	
	[B] [3]		Cam axis one cycle current value	○	○		
	[B] [4]		Cam standard position	○	○		
	[B] [5]		Cam axis feed current value	○	○		
	[B] [6]		Cam No. in execution	○	○		
	[B] [7]		Cam stroke amount in execution	○	○		
	[B] [8]		Main axis current value	○	○		
	[B] [9]		Main axis one cycle current value	○	○		

(8) Point table setting data (command [4] [0], [4] [5], [5] [0], [5] [4], [5] [8], [6] [0], [6] [4])

Command	Data No.	Description	Control mode CP	CL	PS	Frame length
[4] [0]	[0] [0] to [F] [F]	Reading position data of each point table The decimal equivalent of the data No. value (hexadecimal) corresponds to the point table No.	○			8
[4] [5]	[0] [0] to [F] [F]	Reading M code of each point table The decimal equivalent of the data No. value (hexadecimal) corresponds to the point table No.	○			
[5] [0]	[0] [0] to [F] [F]	Reading speed data of each point table The decimal equivalent of the data No. value (hexadecimal) corresponds to the point table No.	○			
[5] [4]	[0] [0] to [F] [F]	Reading acceleration time constant of each point table The decimal equivalent of the data No. value (hexadecimal) corresponds to the point table No.	○			
[5] [8]	[0] [0] to [F] [F]	Reading deceleration time constant of each point table The decimal equivalent of the data No. value (hexadecimal) corresponds to the point table No.	○			
[6] [0]	[0] [0] to [F] [F]	Reading dwell of each point table The decimal equivalent of the data No. value (hexadecimal) corresponds to the point table No.	○			
[6] [4]	[0] [0] to [F] [F]	Reading auxiliary function of each point table The decimal equivalent of the data No. value (hexadecimal) corresponds to the point table No.	○			

(9) Position data unit/Current position latch data (command [6] [C])

Command	Data No.	Description	Control mode CP	CL	PS	Frame length
[6] [C]	[0] [0]	Reading position data unit _ _ _ x 0: mm, 1: inch, 2: pulse, 3: degree _ _ x _ 0: Enabled, 1: Disabled	○	○	○	4
	[0] [1]	Reading current position latch data Reads data latched at rising edge of LPS signal using LPOS command in the program operation.		○		12

(10) General purpose register (Rx) value (command [6] [D])

Command	Data No.	Description	Control mode CP	CL	PS	Frame length
[6] [D]	[0] [1]	Reading general purpose register (R1) value		○		8
	[0] [2]	Reading general purpose register (R2) value		○		
	[0] [3]	Reading general purpose register (R3) value		○		
	[0] [4]	Reading general purpose register (R4) value		○		

(11) General purpose register (Dx) value (command [6] [E])

Command	Data No.	Description	Control mode CP	CL	PS	Frame length
[6] [E]	[0] [1]	Reading general purpose register (D1) value		○		8
	[0] [2]	Reading general purpose register (D2) value		○		
	[0] [3]	Reading general purpose register (D3) value		○		
	[0] [4]	Reading general purpose register (D4) value		○		

(12) General purpose register number (command [6] [F])

Command	Data No.	Description	Control mode CP	CL	PS	Frame length
[6] [F]	[0] [0]	Reading general purpose register (Rx) number		○		8
	[0] [1]	Reading general purpose register (Dx) number		○		

(13) Others (command [0] [0], [0] [2])

Command	Data No.	Description	Control mode CP/	CL	PS	Frame length
[0] [0]	[1] [2]	Reading test operation mode 0000: Normal mode (not test operation mode) 0001: JOG operation 0002: Positioning operation 0004: Output signal (DO) forced output 0005: Single-step feed operation	○	○	○ (Note)	4
	[1] [D]	Reading EEP-ROM stored data type 0000: Initial state 0001: Point table method 0002: Program method	○	○		
	[1] [E]	Reading control mode 0006: Positioning mode (point table method) 0007: Positioning mode (program method) 0008: Positioning mode (indexer method)	○	○	○	
[0] [2]	[9] [0]	Servo motor-side pulse unit absolute position	○	○	○	8
	[9] [1]	Command unit absolute position	○	○	○	
	[7] [0]	Software version	○	○	○	16

Note. "0005 (single-step feed operation)" is not available in the indexer method.

16.27.2 Writing commands

(1) Status display (command [8] [1])

Command	Data No.	Description	Setting range	Control mode			Frame length
				CP	CL	PS	
[8] [1]	[0] [0]	Status display data deletion	1EA5	○	○	○	4

(2) Parameter (command [9] [4], [8] [5])

Command	Data No.	Description	Setting range	Control mode			Frame length
				CP	CL	PS	
[9] [4]	[0] [1] to [F] [F]	Writing each parameter 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. (hexadecimal) value corresponds to the parameter No.	Depending on the parameter	○	○	○	12
[8] [5]	[0] [0]	Parameter group writing 0000: Basic setting parameters ([Pr. PA_ _]) 0001: Gain/filter parameters ([Pr. PB_ _]) 0002: Extension setting parameters ([Pr. PC_ _]) 0003: I/O setting parameters ([Pr. PD_ _]) 0004: Extension setting 2 parameters ([Pr. PE_ _]) 0005: Extension setting 3 parameters ([Pr. PF_ _]) 0009: Option setting parameters ([Pr. Po_ _]) 000B: Linear servo motor/DD motor setting parameters ([Pr. PL_ _]) 000C: Positioning control parameters ([Pr. PT_ _])	0000 to 000C	○	○	○	4

(3) External I/O signals (command [9] [2])

Command	Data No.	Description	Setting range	Control mode			Frame length
				CP	CL	PS	
[9] [2]	[6] [0] to [6] [2]	Communication input device signal	Refer to section 10.2.2.	○	○	○	8

(4) Alarm history (command [8] [2])

Command	Data No.	Description	Setting range	Control mode			Frame length
				CP	CL	PS	
[8] [2]	[2] [0]	Alarm history clear	1EA5	○	○	○	4

(5) Current alarm (command [8] [2])

Command	Data No.	Description	Setting range	Control mode CP	CL	PS	Frame length
[8] [2]	[0] [0]	Alarm clear	1EA5	○	○	○	4

(6) I/O device prohibition (command [9] [0])

Command	Data No.	Description	Setting range	Control mode CP	CL	PS	Frame length
[9] [0]	[0] [0]	Turns off the input device, external analog input signal, and pulse train input, except EM2, LSP and LSN, independently of the external on/off statuses.	1EA5	○	○	○	4
	[0] [3]	Prohibits all output devices (DO).	1EA5	○	○	○	
	[1] [0]	Cancels the prohibition of the input device, external analog input signal and pulse train input, except EM2, LSP and LSN.	1EA5	○	○	○	
	[1] [3]	Cancels the prohibition of the output device.	1EA5	○	○	○	

(7) Operation mode selection (command [8] [B])

Command	Data No.	Description	Setting range	Control mode CP	CL	PS	Frame length
[8] [B]	[0] [0]	Selection of test operation mode 0000: Test operation mode cancel 0001: JOG operation 0002: Positioning operation 0004: Output signal (DO) forced output 0005: Single-step feed operation	0000 to 0002, 0004, 0005	○	○	○ (Note)	4

Note. "0005 (single-step feed operation)" is not available in the indexer method.

(8) Test operation mode data (command [9] [2], [A] [0])

Command	Data No.	Description	Setting range	Control mode CP	CL	PS	Frame length
[9] [2]	[0] [0] to [0] [2]	Input signal for test operation	(Refer to section 14.5.7 .)	○	○	○	8
	[A] [0]	Forced output of signal pin	(Refer to section 14.5.9.)	○	○	○	

Command	Data No.	Description	Setting range	Control mode CP	Control mode CL	Control mode PS	Frame length
[A] [0]	[1] [0]	Writes the servo motor speed in the test operation mode (JOG operation and positioning operation).	0000 to 7FFF	○	○	○	4
	[1] [1]	Writes the acceleration/deceleration time constant in the test operation mode (JOG operation and positioning operation).	00000000 to 7FFFFFFF	○	○	○	8
	[2] [0]	Set the travel distance of the test operation mode (positioning operation).	00000000 to 7FFFFFFF	○	○	○	
	[2] [1]	Select the positioning direction of the test operation (positioning operation). 0 □ 0 □ 0: Forward rotation direction 1: Reverse rotation direction 0: Command pulse unit 1: Encoder pulse unit	0000 to 0101	○	○	○	4
	[4] [0]	This is a start command of the test operation (positioning operation).	1EA5	○	○	○	
	[4] [1]	This is 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□	○	○	○	

(9) Point table setting data (command [C] [0], [C] [2], [C] [6], [C] [7], [C] [8], [C] [A], [C] [B])

Command	Data No.	Description	Setting range	Control mode CP	Control mode CL	Control mode PS	Frame length
[C] [0]	[0] [0] to [F] [F]	Writing position data of each point table The decimal equivalent of the data No. value (hexadecimal) corresponds to the point table No.	-999999 to 999999	○			8
[C] [2]	[0] [0] to [F] [F]	Writing M code of each point table The decimal equivalent of the data No. value (hexadecimal) corresponds to the point table No.	0 to 99	○			
[C] [6]	[0] [0] to [F] [F]	Writing speed data of each point table The decimal equivalent of the data No. value (hexadecimal) corresponds to the point table No.	0 to permissible speed	○			
[C] [7]	[0] [0] to [F] [F]	Writing acceleration time constant of each point table The decimal equivalent of the data No. value (hexadecimal) corresponds to the point table No.	0 to 20000	○			
[C] [8]	[0] [0] to [F] [F]	Writing deceleration time constant of each point table The decimal equivalent of the data No. value (hexadecimal) corresponds to the point table No.	0 to 20000	○			
[C] [A]	[0] [0] to [F] [F]	Writing dwell of each point table The decimal equivalent of the data No. value (hexadecimal) corresponds to the point table No.	0 to 20000	○			
[C] [B]	[0] [0] to [F] [F]	Writing auxiliary function of each point table The decimal equivalent of the data No. value (hexadecimal) corresponds to the point table No.	0 to 3, 8 to 11	○			

(10) General purpose register (Rx) value (command [B] [9])

Command	Data No.	Description	Setting range	Control mode CP	Control mode CL	Control mode PS	Frame length
[B] [9]	[0] [1]	Writing general purpose register (R1) value	Depends on instructions to use. Refer to section 5.2.2.		○		8
	[0] [2]	Writing general purpose register (R2) value			○		
	[0] [3]	Writing general purpose register (R3) value			○		
	[0] [4]	Writing general purpose register (R4) value			○		

(11) General purpose register (Dx) value (command [B] [A])

Command	Data No.	Description	Setting range	Control mode CP	Control mode CL	Control mode PS	Frame length
[B] [A]	[0] [1]	Writing general purpose register (D1) value	Depends on instructions to use. Refer to section 5.2.2.		○		8
	[0] [2]	Writing general purpose register (D2) value			○		
	[0] [3]	Writing general purpose register (D3) value			○		
	[0] [4]	Writing general purpose register (D4) value			○		

16.28 DETAILED EXPLANATIONS OF COMMANDS

16.28.1 External I/O signal status (DIO diagnosis)

(1) Reading input device status

The current input device status can be read.

(a) Transmission

Transmit command [1] [2] + data No. [0] [0] to [0] [3].

Command	Data No.
[1] [2]	[0] [0] to [0] [3]

(b) Return

The slave station returns the status of the input devices.

b31 - - - - - - - - - - b1 b0

1: On
0: Off

Command of each bit is transmitted to the master station as hexadecimal data.

Bit	Symbol			
	Data No. [0] [0]	Data No. [0] [1]	Data No. [0] [2]	Data No. [0] [3]
0	SON		MD0	POS00
1	LSP	ABSM	MD1	POS01
2	LSN	ABSR		POS02
3	TL		TCH	POS03
4	TL1		TP0	POS10
5	PC		TP1	POS11
6	RES		OVR	POS12
7	CR			POS13
8	SP1		STAB	POS20
9	SP2		DOG/SIG	POS21
10	SP3		SPD1	POS22
11	ST1/RS2		SPD2	POS23
12	ST2/RS1		SPD3	POSP
13	CMX1		SPD4	POSN
14	CMX2			STRB
15	LOP			
16		MSD	LPS	
17		PI1	RT	
18	EM2/EM1	PI2	RTCDP	
19		PI3		
20	STAB2	CAMC	OV0	
21		CI0	OV1	
22		CI1	OV2	
23		CI2	OV3	
24	TSTP	CI3	DI0	
25		CLTC	DI1	
26		CPCD	DI2	
27	CDP		DI3	
28	CLD		DI4	
29	MECR		DI5	
30			DI6	
31			DI7	

(2) Reading external input pin status

Reads the on/off statuses of the external input pins.

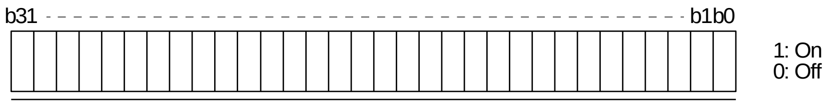
(a) Transmission

Transmit command [1] [2] + data No. [4] [0], [4] [1].

Command	Data No.
[1] [2]	[4] [0], [4] [1]

(b) Return

The on/off statuses of the input pins are returned.



Command of each bit is transmitted to the master station as hexadecimal data.

Bit	CN1 connector pin	CN10 connector pin
0	43	1
1	44	2
2	42	3
3	15	4
4	19	5
5	41	6
6	16	7
7	17	8
8	18	9
9	45	10
10	10 (Note)	11
11	35 (Note)	12
12		15
13		16
14		17
15		18

Bit	CN1 connector pin	CN10 connector pin
16		19
17		20
18		21
19		26
20		27
21		28
22		29
23		30
24		31
25		32
26		33
27		34
28		35
29		36
30		
31		

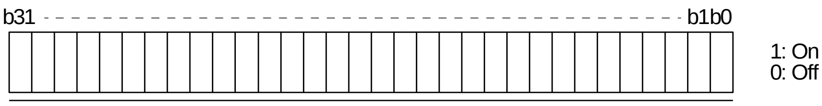
Note. When the pulse train input is selected with [Pr. PD44] or [Pr. PD46], this bit will continuously be "0" (off).

(3) Reading the status of input devices switched on with communication
Reads the on/off statuses of the input devices switched on with communication.

(a) Transmission
Transmit command [1] [2] + data No. [6] [0] to [6] [3].

Command	Data No.
[1] [2]	[6] [0] to [6] [3]

(b) Return
The slave station returns the status of the input devices.



Command of each bit is transmitted to the master station as hexadecimal data.

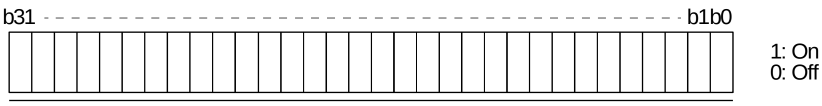
Bit	Symbol			
	Data No. [6] [0]	Data No. [6] [1]	Data No. [6] [2]	Data No. [6] [3]
0	SON		MD0	POS00
1	LSP	ABSM	MD1	POS01
2	LSN	ABSR		POS02
3	TL		TCH	POS03
4	TL1		TP0	POS10
5	PC		TP1	POS11
6	RES		OVR	POS12
7	CR			POS13
8	SP1		STAB	POS20
9	SP2		DOG/SIG	POS21
10	SP3		SPD1	POS22
11	ST1/RS2		SPD2	POS23
12	ST2/RS1		SPD3	POSP
13	CMX1		SPD4	POSN
14	CMX2			STRB
15	LOP			
16		MSD	LPS	
17		PI1	RT	
18	EM2/EM1	PI2	RTCDP	
19		PI3		
20	STAB2	CAMC	OV0	
21		CI0	OV1	
22		CI1	OV2	
23		CI2	OV3	
24	TSTP	CI3	DI0	
25		CLTC	DI1	
26		CPCD	DI2	
27	CDP		DI3	
28	CLD		DI4	
29	MECR		DI5	
30			DI6	
31			DI7	

(4) Reading external output pin status
Reads the on/off statuses of the external output pins.

(a) Transmission
Transmit command [1] [2] + data No. [C] [0], [C] [1].

Command	Data No.
[1] [2]	[C] [0], [C] [1]

(b) Return
The slave station returns the status of the output devices.



Command of each bit is transmitted to the master station as hexadecimal data.

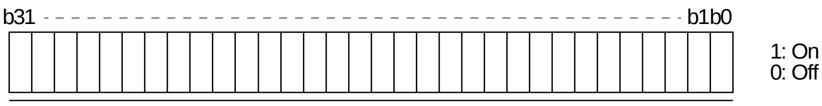
Bit	CN1 connector pin	CN10 connector pin	Bit	CN1 connector pin	CN10 connector pin
0	49	22	16		
1	24	23	17		
2	23	24	18		
3	25	25	19		
4	22	38	20		
5	48	39	21		
6	33	40	22		
7	13	41	23		
8	14	42	24		
9		43	25		
10		44	26		
11		45	27		
12		46	28		
13		47	29		
14		48	30		
15		49	31		

(5) Reading output device status
Reads the on/off statuses of the output devices.

(a) Transmission
Transmit command [1] [2] + data No. [8] [0] to [8] [3].

Command	Data No.
[1] [2]	[8] [0] to [8] [3]

(b) Return
The slave station returns the status of the input/output devices.



Command of each bit is transmitted to the master station as hexadecimal data.

Bit	Symbol			
	Data No. [8] [0]	Data No. [8] [1]	Data No. [8] [2]	Data No. [8] [3]
0	RD			MCD00
1	SA			MCD01
2	ZSP			MCD02
3	TLC		CPO	MCD03
4	VLC		ZP	MCD10
5	INP		POT	MCD11
6			PUS	MCD12
7	WNG		MEND	MCD13
8	ALM			ACD0
9	OP			ACD1
10	MBR			ACD2
11	DB			ACD3
12	ALCD0		PED	PRQ0
13	ALCD1			PRQ1
14	ALCD2			
15	BWNG			
16				
17			ALMWNG	
18			BW9F	
19		MSDH		
20		MSDL		
21		SOUT		
22		OUT1		
23		OUT2		
24		OUT3	PT0/PS0	
25	CDPS	CAMS	PT1/PS1	
26	CLDS	CLTS	PT2/PS2	
27	ABSV	CLTSM	PT3/PS3	
28		CLTS	PT4/PS4	
29			PT5/PS5	
30			PT6/PS6	
31	MTTR		PT7/PS7	

16.28.2 Input device on/off

POINT
●The on/off statuses of all devices in the driver are the status of the data received at last. Therefore, when there is a device which must be kept on, transmit data which turns the device on every time.

Each input device can be switched on/off. However, when the device to be switched off is in the external input signal, also switch off the input signal.

Transmit command [9] [2] + data No. [6] [0] to [6] [3].

Command	Data No.	Setting data
[9] [2]	[6] [0] to [6] [3]	See below.

b31 - b1b0

1: On
0: Off

Command of each bit is transmitted to the master station as hexadecimal data.

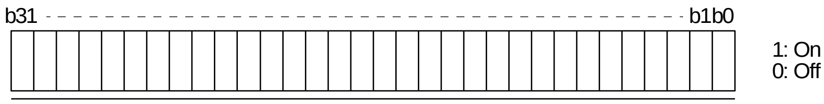
Bit	Symbol			
	Data No. [6] [0]	Data No. [6] [1]	Data No. [6] [2]	Data No. [6] [3]
0	SON		MD0	POS00
1	LSP	ABSM	MD1	POS01
2	LSN	ABSR		POS02
3	TL		TCH	POS03
4	TL1		TP0	POS10
5	PC		TP1	POS11
6	RES		OVR	POS12
7	CR			POS13
8	SP1		STAB	POS20
9	SP2		DOG/SIG	POS21
10	SP3		SPD1	POS22
11	ST1/RS2		SPD2	POS23
12	ST2/RS1		SPD3	POSP
13	CMX1		SPD4	POSN
14	CMX2			STRB
15	LOP			
16		MSD	LPS	
17		PI1	RT	
18	EM2/EM1	PI2	RTCDP	
19		PI3		
20	STAB2	CAMC	OV0	
21		CI0	OV1	
22		CI1	OV2	
23		CI2	OV3	
24	TSTP	CI3	DI0	
25		CLTC	DI1	
26		CPCD	DI2	
27	CDP		DI3	
28	CLD		DI4	
29	MECR		DI5	
30			DI6	
31			DI7	

16.28.3 Input device on/off (for test operation)

Each input devices can be turned on/off for test operation. However, when the device to be switched off is in the external input signal, also switch off the input signal.

Transmit command [9] [2] + data No. [0] [0] to [0] [3].

Command	Data No.	Setting data
[9] [2]	[0] [0] to [0] [3]	See below.



Command of each bit is transmitted to the master station as hexadecimal data.

Bit	Symbol			
	Data No. [0] [0]	Data No. [0] [1]	Data No. [0] [2]	Data No. [0] [3]
0	SON		MD0	POS00
1	LSP	ABSM	MD1	POS01
2	LSN	ABSR		POS02
3	TL		TCH	POS03
4	TL1		TP0	POS10
5	PC		TP1	POS11
6	RES		OVR	POS12
7	CR			POS13
8	SP1		STAB	POS20
9	SP2		DOG/SIG	POS21
10	SP3		SPD1	POS22
11	ST1/RS2		SPD2	POS23
12	ST2/RS1		SPD3	POSP
13	CMX1		SPD4	POSN
14	CMX2			STRB
15	LOP			
16		MSD	LPS	
17		PI1	RT	
18	EM2/EM1	PI2	RTCDP	
19		PI3		
20	STAB2	CAMC	OV0	
21		CI0	OV1	
22		CI1	OV2	
23		CI2	OV3	
24	TSTP	CI3	DI0	
25		CLTC	DI1	
26		CPCD	DI2	
27	CDP		DI3	
28	CLD		DI4	
29	MECR		DI5	
30			DI6	
31			DI7	

16.28.4 Test operation mode

> **POINT**
>
> - The test operation mode is used to check operation. Do not use it for actual operation.
> - If communication stops for longer than 0.5 s during test operation, the driver decelerates to a stop, resulting in servo-lock. To prevent this, keep the communication all the time by checking the status display, etc.
> - Even during operation, you can switch the driver to the test operation mode. In this case, switching to the test operation mode will shut off the base circuit to coast the motor.

(1) How to prepare and cancel the test operation mode

(a) Preparing the test operation mode

Set the test operation mode type with the following procedure.

1) Selection of test operation mode

Transmit the command [8] [B] + data No. [0] [0] + data to select the test operation mode.

Command	Data No.	Transmission data	Selection of test operation mode
[8] [B]	[0] [0]	0004	Output signal (DO) forced output (Note)
		0005	Single-step feed

Note. Refer to section 10.2.5 for the output signal (DO) forced output.

2) Check of test operation mode

Read the test operation mode set for the slave station, and check that it is set correctly.

a) Transmission

Transmit command [0] [0] + data No. [1] [2].

Command	Data No.
[0] [0]	[1] [2]

b) Return

The slave station returns the preset operation mode.

0	0	0	

Reading test operation mode
0: Normal mode (not test operation mode)
1: JOG operation
2: Positioning operation
3: Motor-less operation
4: Output signal (DO) forced output
5: Single-step feed

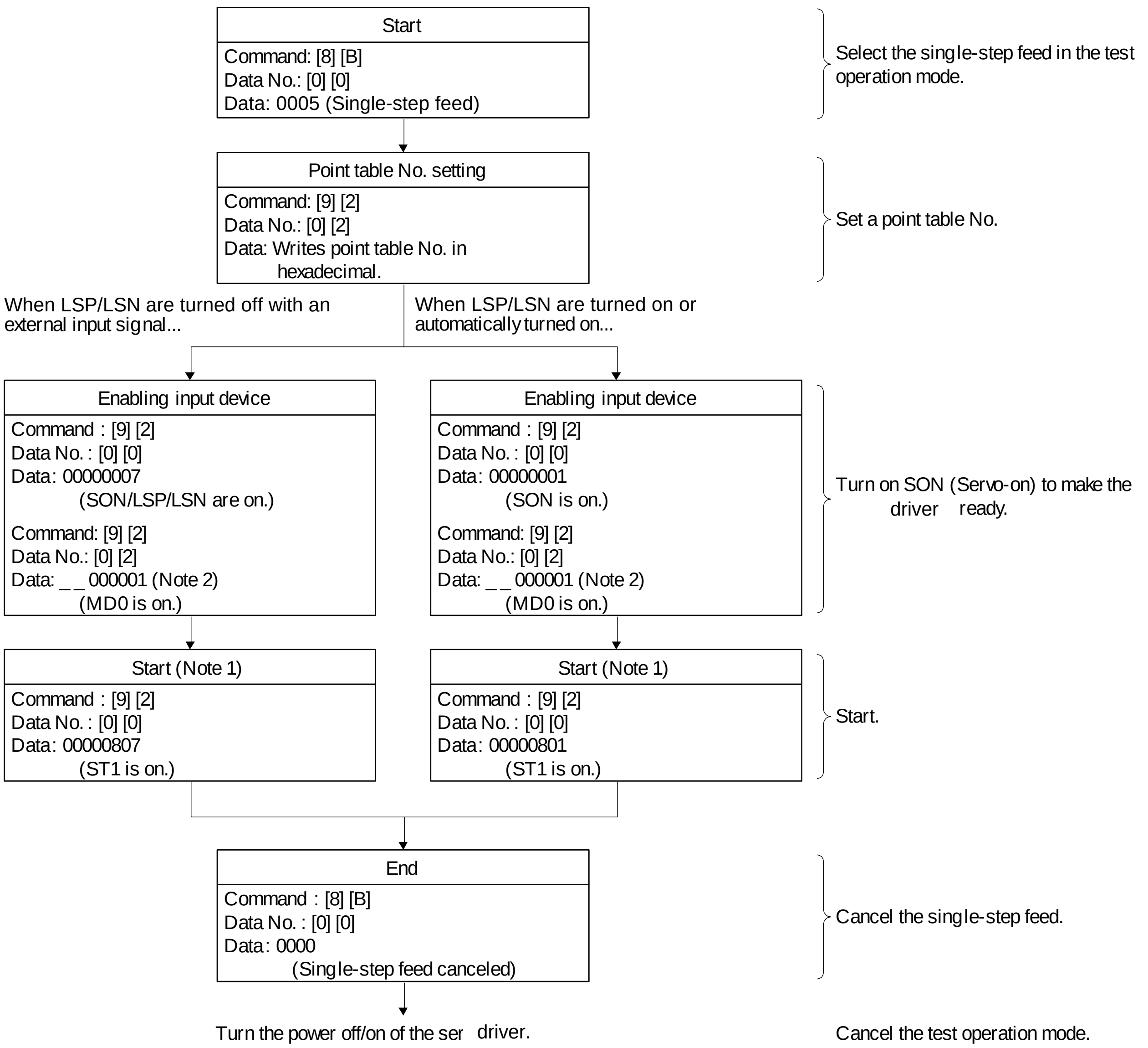
(b) Cancel of test operation mode

To stop the test operation mode, transmit the command [8] [B] + data No. [0] [0] + data. Before switching from the test operation mode to the normal operation mode, turn off the driver once.

Command	Data No.	Transmission data	Selection of test operation mode
[8] [B]	[0] [0]	0000	Test operation mode canceled

(2) Single-step feed

Set each value of target point tables for the single-step feed before executing single-step feed. Transmit command and data No. to execute single-step feed.



Note 1 After checking ZP (Home position return completion), start it. See the 4 bit of the read data with the command [1] [2] and data No. [8] [2].

2. A point table No. in hexadecimal will be entered to "_ _".

16.28.5 Output signal pin on/off (output signal (DO) forced output)

In the test operation mode, the output signal pins can be turned on/off regardless of the servo status. Disable the external input signals in advance with command [9] [0].

(1) Selecting the output signal (DO) forced output of the test operation mode

Transmit command + [8] [B] + data No. [0] [0] + data "0004" to select the output signal (DO) forced output.

0	0	0	4

Selection of test operation mode
4: Output signal (DO) forced output

(2) External output signal on/off

Transmit the following communication commands.

Command	Data No.	Setting data
[9] [2]	[A] [0], [A] [1]	See below.

b31 - b1 b0

1: On
0: Off

Command of each bit is transmitted to the master station as hexadecimal data.

Bit	CN1 connector pin	CN10 connector pin	Bit	CN1 connector pin	CN10 connector pin
0	49	22	16		
1	24	23	17		
2	23	24	18		
3	25	25	19		
4	22	38	20		
5	48	39	21		
6	33	40	22		
7	13	41	23		
8	14	42	24		
9		43	25		
10		44	26		
11		45	27		
12		46	28		
13		47	29		
14		48	30		
15		49	31		

(3) Output signal (DO) forced output

To stop the output signal (DO) forced output, transmit command [8] [B] + data No. [0] [0] + data. Before switching from the test operation mode to the normal operation mode, turn off the driver once.

Command	Data No.	Transmission data	Selection of test operation mode
[8] [B]	[0] [0]	0000	Test operation mode canceled

16.28.6 Point table

(1) Reading data

(a) Position data

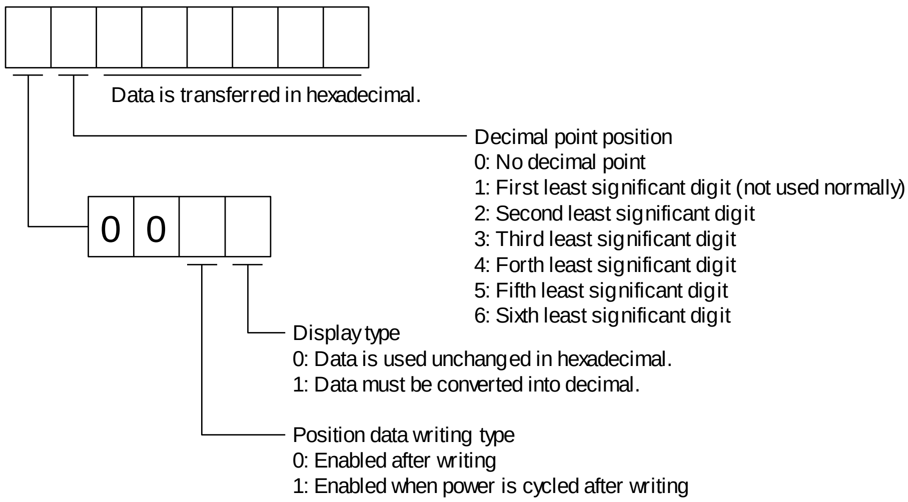
Reads position data of point tables.

1) Transmission

Transmits the command [4] [0] + the data No. [0] [1] to [F] [F] corresponding to the point tables to read. Refer to section 10.1.1.

2) Return

The slave station returns the position data of point table requested.



(b) Speed data

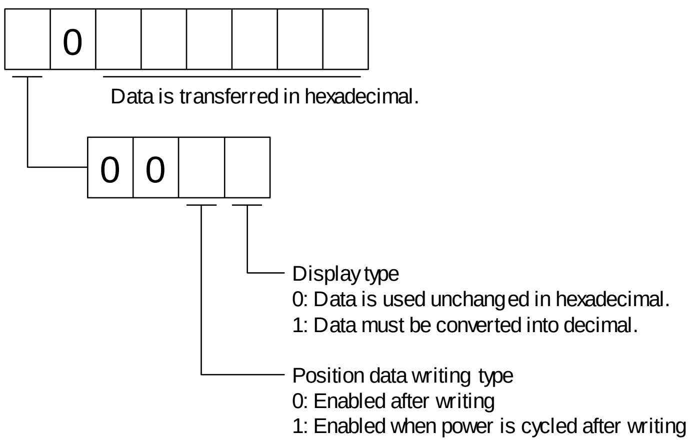
Reads speed data of point tables.

1) Transmission

Transmits the command [5] [0] + the data No. [0] [1] to [F] [F] corresponding to the point tables to read. Refer to section 10.1.1.

2) Return

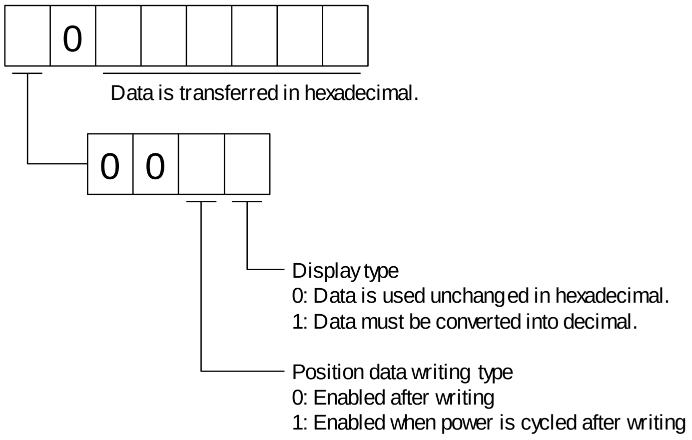
The slave station returns the speed data of point table requested.



(c) Acceleration time constant
Reads acceleration time constant of point tables.

1) Transmission
Transmits the command [5] [4] + the data No. [0] [1] to [F] [F] corresponding to the point tables to read. Refer to section 10.1.1.

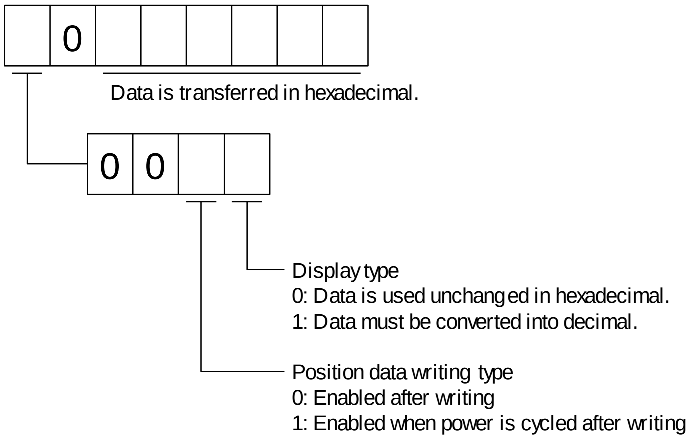
2) Return
The slave station returns the acceleration time constant of point table requested.



(d) Deceleration time constant
Reads deceleration time constant of point tables.

1) Transmission
Transmits the command [5] [8] + the data No. [0] [1] to [F] [F] corresponding to the point tables to read. Refer to section 10.1.1.

2) Return
The slave station returns the deceleration time constant of point table requested.



(e) Dwell

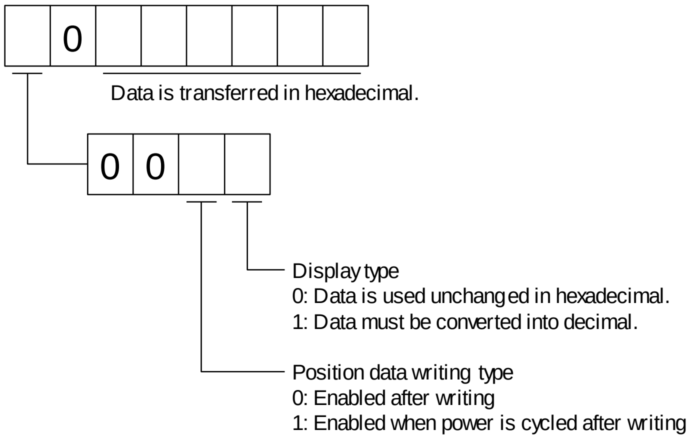
Reads dwell of point tables.

1) Transmission

Transmits the command [6] [0] + the data No. [0] [1] to [F] [F] corresponding to the point tables to read. Refer to section 10.1.1.

2) Return

The slave station returns the dwell of point table requested.



(f) Auxiliary function

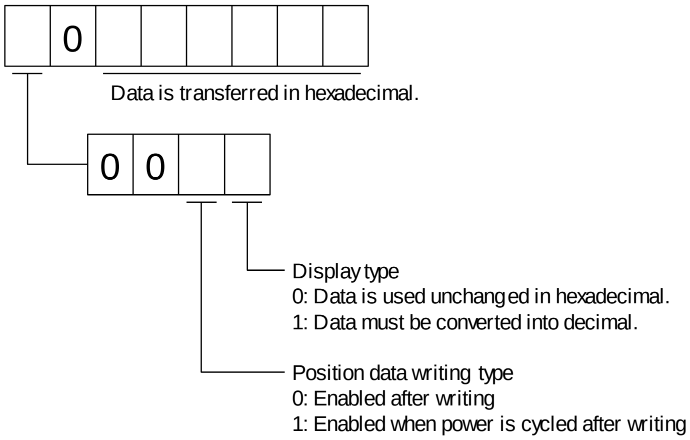
Reads auxiliary function of point tables.

1) Transmission

Transmits the command [6] [4] + the data No. [0] [1] to [F] [F] corresponding to the point tables to read. Refer to section 10.1.1.

2) Return

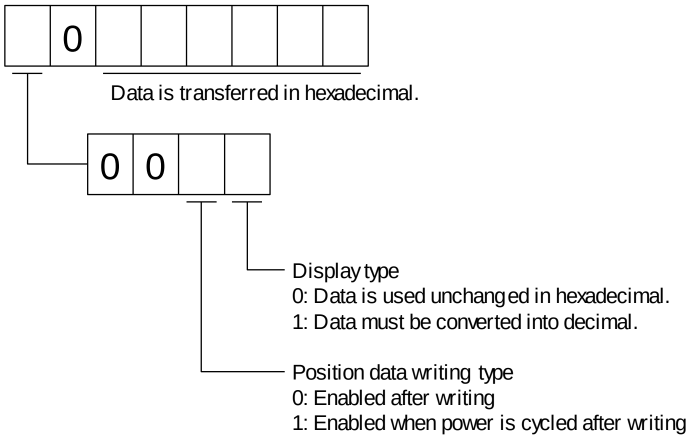
The slave station returns the auxiliary function of point table requested.



(g) M code
Reads M code of point tables.

1) Transmission
Transmits the command [4] [5] + the data No. [0] [1] to [F] [F] corresponding to the point tables to read. Refer to section 10.1.1.

2) Return
The slave station returns the M code of point table requested.



(2) Writing data

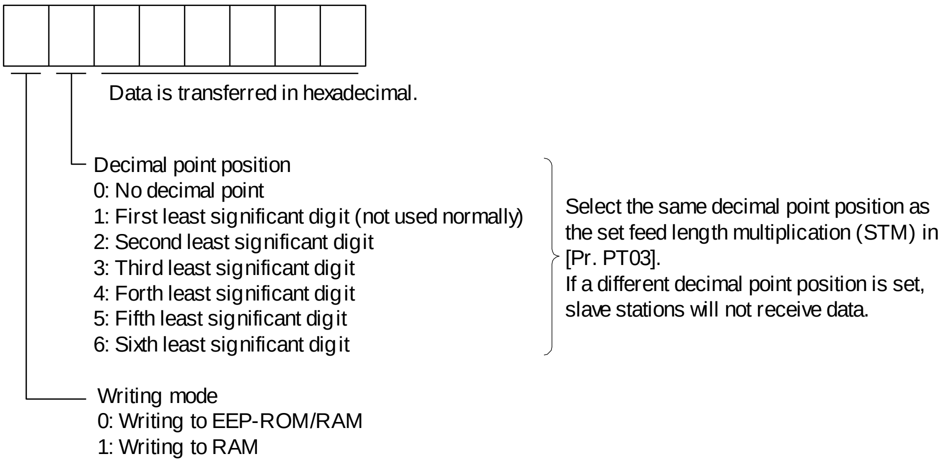
⚠CAUTION	●If setting values need to be changed with a high frequency (i.e. once or more per one hour), write the setting values to the RAM, not to the EEP-ROM. The EEP-ROM has a limitation in the number of write times and exceeding this limitation causes the driver to malfunction. Note that the number of write times to the EEP-ROM is limited to approximately 100,000.

(a) Position data

Writes position data of point tables.

Transmits the command [C] [0] + the data No. [0] [1] to [F] [F] corresponding to the point tables to write + data. Refer to section 10.1.1.

Command	Data No.	Data
[C] [0]	[0] [1] to [F] [F]	Refer to the following diagram.



When the position data is changed frequently using communication, set "1" to the mode to change only the RAM data in the driver.

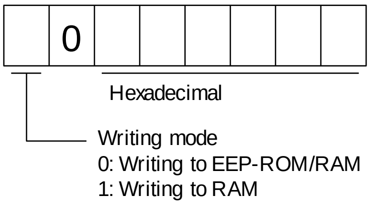
When changing data once or more within an hour, do not write it to the EEP-ROM.

(b) Speed data

Writes speed data of point tables.

Transmits the command [C] [6] + the data No. [0] [1] to [F] [F] corresponding to the point tables to write + data. Refer to section 10.1.1.

Command	Data No.	Data
[C] [6]	[0] [1] to [F] [F]	Refer to the following diagram.



When the speed data is changed frequently using communication, set "1" to the mode to change only the RAM data in the driver.

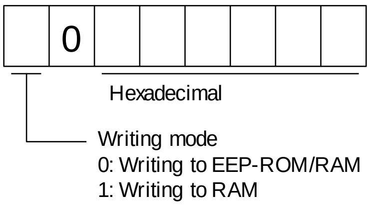
When changing data once or more within an hour, do not write it to the EEP-ROM.

(c) Acceleration time constant

Writes acceleration time constant of point tables.

Transmits the command [C] [7] + the data No. [0] [1] to [F] [F] corresponding to the point tables to write + data. Refer to section 10.1.1.

Command	Data No.	Data
[C] [7]	[0] [1] to [F] [F]	Refer to the following diagram.



When the acceleration time constant is changed frequently using communication, set "1" to the mode to change only the RAM data in the driver.

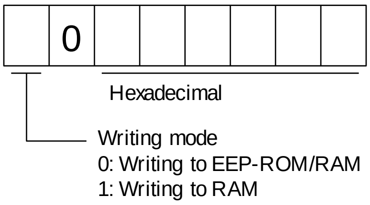
When changing data once or more within an hour, do not write it to the EEP-ROM.

(d) Deceleration time constant

Writes deceleration time constant of point tables.

Transmits the command [C] [8] + the data No. [0] [1] to [F] [F] corresponding to the point tables to write + data. Refer to section 10.1.1.

Command	Data No.	Data
[C] [8]	[0] [1] to [F] [F]	Refer to the following diagram.



When the deceleration time constant is changed frequently using communication, set "1" to the mode to change only the RAM data in the driver.

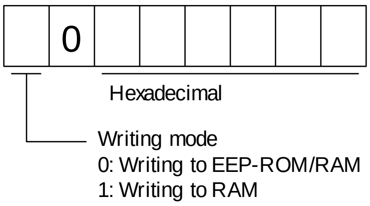
When changing data once or more within an hour, do not write it to the EEP-ROM.

(e) Dwell

Writes dwell of point tables.

Transmits the command [C] [A] + the data No. [0] [1] to [F] [F] corresponding to the point tables to write + data. Refer to section 10.1.1.

Command	Data No.	Data
[C] [A]	[0] [1] to [F] [F]	Refer to the following diagram.



When the dwell is changed frequently using communication, set "1" to the mode to change only the RAM data in the driver.

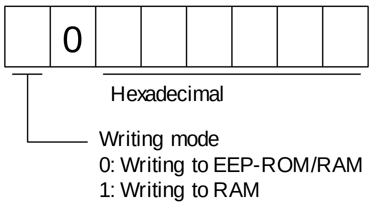
When changing data once or more within an hour, do not write it to the EEP-ROM.

(f) Auxiliary function

Writes auxiliary function of point tables.

Transmits the command [C] [B] + the data No. [0] [1] to [F] [F] corresponding to the point tables to write + data. Refer to section 10.1.1.

Command	Data No.	Data
[C] [B]	[0] [1] to [F] [F]	Refer to the following diagram.



When the auxiliary function is changed frequently using communication, set "1" to the mode to change only the RAM data in the driver.

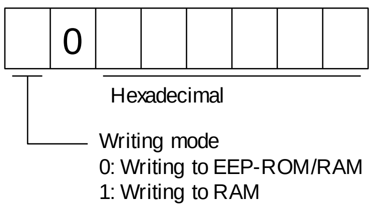
When changing data once or more within an hour, do not write it to the EEP-ROM.

(g) M code

Writes M code of point tables.

Transmits the command [C] [2] + the data No. [0] [1] to [F] [F] corresponding to the point tables to write + data. Refer to section 10.1.1.

Command	Data No.	Data
[C] [2]	[0] [1] to [F] [F]	Refer to the following diagram.



When the M code is changed frequently using communication, set "1" to the mode to change only the RAM data in the driver.

When changing data once or more within an hour, do not write it to the EEP-ROM.

16.29 APPLICATION OF FUNCTIONS

16.29.1 Current position latch function

POINT

- The current position latch function can be used with the point table method and the program method. However, the current position latch function is disabled in the following condition.
  - Home position return
  - Manual operation (excluding home position return)
- The latched actual current position data can be read with communication commands.
- The read latched position data is equal to the travel distance as the starting point is set to "0" when the roll reed display function is enabled. The output value is the same as the current position of the state monitor.

When the mark detection signal turns on, the current position is latched. The latched data can be read with communication commands.

(1) Communication command
Reads mark detection data.

Command	Data No.	Description	Control mode CP	Control mode CL	Control mode PS	Frame length
[1] [A]	[0] [0]	MSD (Mark detection) rising latch data (data part)	○	○		8
	[0] [1]	MSD (Mark detection) falling latch data (data part)	○	○		
	[0] [2]	MSD (Mark detection) rising latch data (data part + additional information)	○	○		12
	[0] [3]	MSD (Mark detection) falling latch data (data part + additional information)	○	○		

(2) Reading data

(a) Rising latch data or falling latch data (data part)

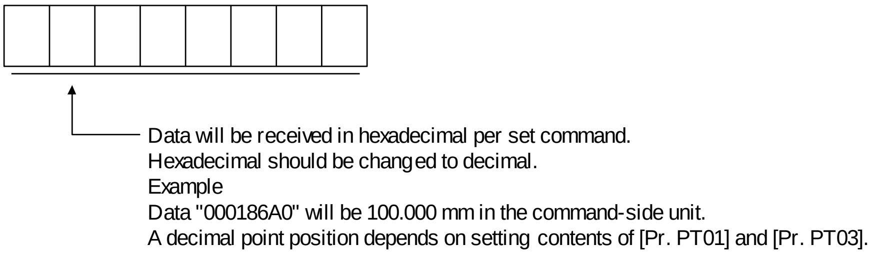
Reads MSD (Mark detection) rising latch data or MSD (Mark detection) falling latch data.

1) Transmission

Transmit command [1] [A] and latch data No. to be read [0] [0] or [0] [1]. Refer to section 10.1.1.

2) Return

The slave station returns the requested latch data.



(b) Rising latch data or falling latch data (data part + additional information)

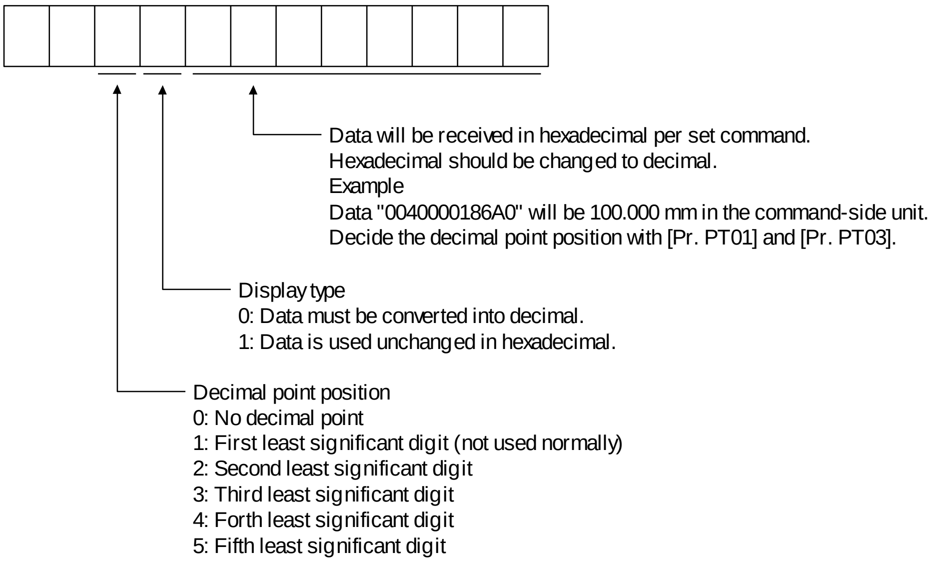
Reads MSD (Mark detection) rising latch data or MSD (Mark detection) falling latch data.

1) Transmission

Transmit command [1] [A] and latch data No. to be read [0] [2] or [0] [3]. Refer to section 10.1.1.

2) Return

The slave station returns the requested latch data.



(3) Parameter

Set the parameters as follows:

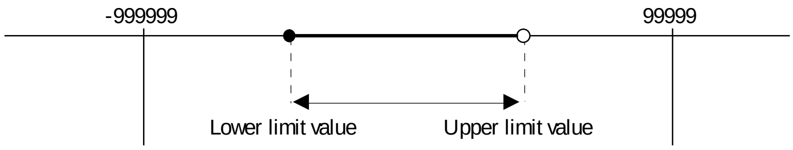
Item	Parameter to be used	Setting
Mark detection function selection	[Pr. PT26]	Set the mark detection function selection as follows: 0 _ _ _: Current position latch function
Mark detection range + (lower three digits)	[Pr. PC66]	Set the upper limit of the latch data in the current position latch function. When the roll feed display is enabled, set this value with the travel distance from the starting position. Set the same sign for [Pr. PC66] and [Pr. PC67]. A different sign will be recognized as minus sign data. When changing the direction to address decreasing, change it from the - side of the mark detection ([Pr. PC68] and [Pr. PC69]). An incorrect order of the setting will trigger [AL. 37]. Therefore, cycling power may be required after [Pr. PC66] to [Pr. PC69] are all set.
Mark detection range + (upper three digits)	[Pr. PC67]	
Mark detection range - (lower three digits)	[Pr. PC68]	Set the lower limit of the latch data in the current position latch function. When the roll feed display is enabled, set this value with the travel distance from the starting position. Set the same sign for [Pr. PC68] and [Pr. PC69]. A different sign will be recognized as minus sign data. When changing the direction to address increasing, change it from the + side of the mark detection ([Pr. PC66] and [Pr. PC67]). An incorrect order of the setting will trigger [AL. 37]. Therefore, cycling power may be required after [Pr. PC66] to [Pr. PC69] are all set.
Mark detection range - (upper three digits)	[Pr. PC69]	

(4) Latch data range setting

The current position is latched only within the range set in [Pr. PC66] to [Pr. PC69].
When a same value is set for the upper and lower limits, the current value will be latched for a whole range.

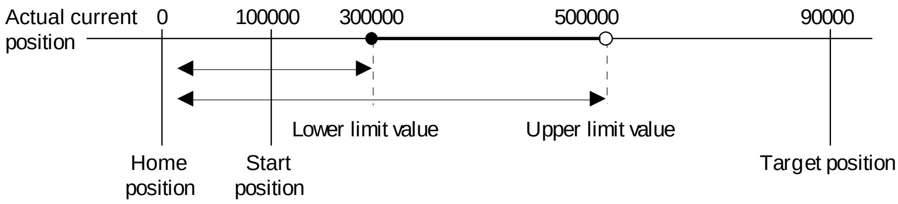
(a) mm, inch, and pulse unit

The current position latch function is enabled when Upper limit value > Lower limit value. The valid range is the same for the absolute value command method ([Pr. PT01]: _ _ _ 0) and the incremental value command method ([Pr. PT01]: _ _ _ 1).
[AL. 37 occurs] when Upper limit value < Lower limit value.



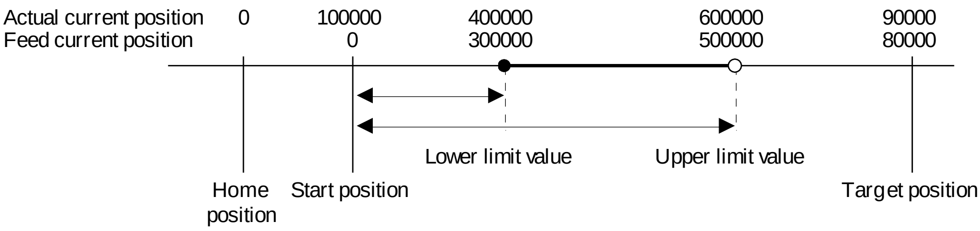
1) When the roll feed display is disabled ([Pr. PT26]: _ _ 0 _)

Set the valid range with the distance from the home position.
When the starting position is at 100000, [Pr. PC66] and [Pr. PC67] are set to 500000, and [Pr. PC68] and [Pr. PC69] are set to 300000, the valid range is between the actual current position of 300000 and 500000 as set in the parameters.



2) When the roll feed display is enabled ([Pr. PT26]: _ _ 1 _)

When the roll feed display is enabled, the valid range is calculated as the starting position is "0".
Set the valid range with the travel distance from the starting position.
When the starting position is at 100000, [Pr. PC66] and [Pr. PC67] are set to 500000, and [Pr. PC68] and [Pr. PC69] are set to 300000, the valid range is between the feed current position of 300000 and 500000 from the start position (between the actual current position of 400000 and 600000).



(b) Degree unit

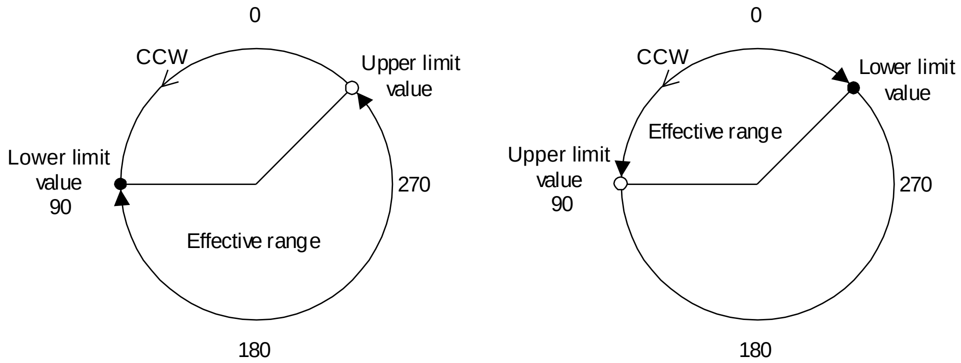
When the unit is set to [degree], the setting range of the current position latch is from 0 degree (upper limit) to 359.999 degrees (lower limit).

When you set a value other than 0 degree to 359.999 degrees in the current position latch +/- [Pr. PC66] to [Pr. PC69], the set value is converted as follows.

Current position latch range	After conversion
360.000 degrees to 999.999 degrees	(Setting value) % 360
-0.001 degrees to -359.999 degrees	360 + (setting value)
-360.000 degrees to -999.999 degrees	(setting value) % 360 + 360

The valid range of the current position latch varies depending on the setting of the upper and lower limits.

The valid range remains unchanged even if the rotation direction is reversed.



Upper limit value > Lower limit value   Lower limit value > Upper limit value

To enable the current position latch function of section A in the figure, set the parameters as follows:

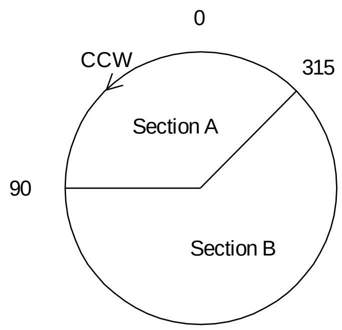
Current position latch range -: 315.000 degrees ([Pr. PC68]: 0, [Pr. PC69]: 315)

Current position latch range +: 90.000 degrees ([Pr. PC66]: 0, [Pr. PC67]: 90)

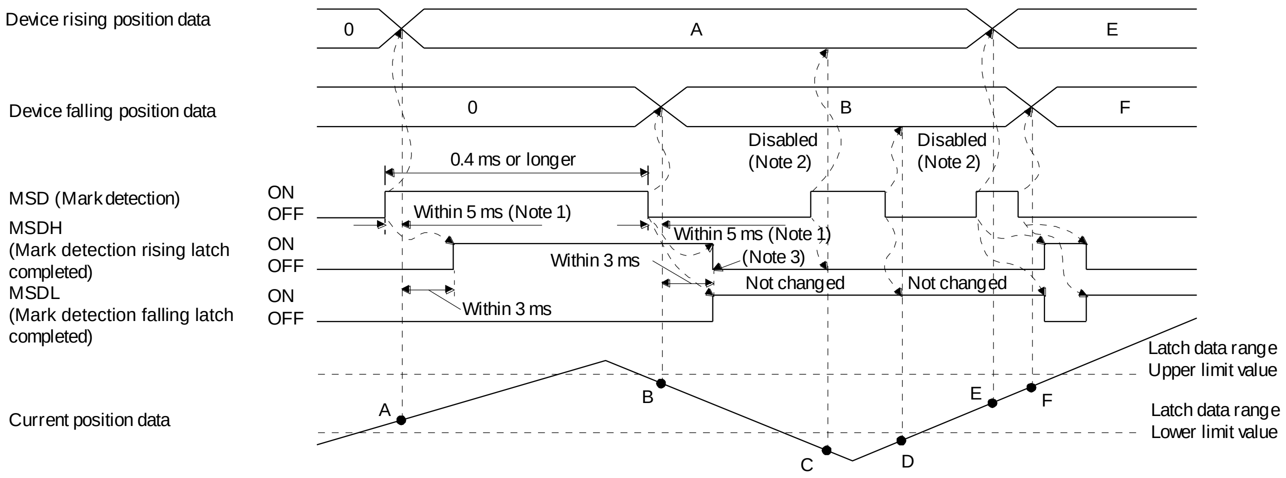
To enable the current position latch function of section B in the figure, set the parameter as follows:

Current position latch range -: 90.000 degrees ([Pr. PC68]: 0, [Pr. PC69]: 90)

Current position latch range +: 315.000 degrees ([Pr. PC66]: 0, [Pr. PC67]: 315)



(5) Timing chart

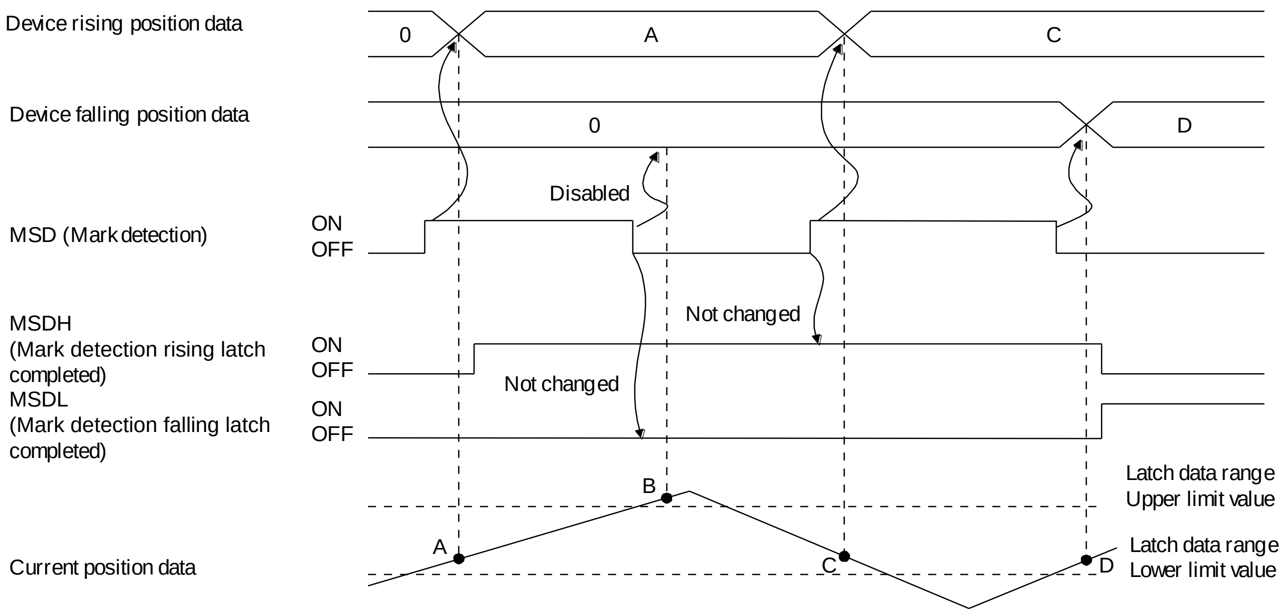


Note 1. When MSD (Mark detection) is assigned to the CN1-10 pin with [Pr. PD44], current position data can be obtained in high speed (within 0.4 ms). When assigning MSD (Mark detection) to the CN1-10 pin, set "Mark detection fast input signal filter selection" in [Pr. PD31].

2. The position data will not be changed from the previous value.

3. MSDH (Latch completed at rising edge of mark detection) turns off at the same timing as MSDL (Latch completed at falling edge of mark detection) turns on. Set as MSDL turns on/off within the range of the latch data.

If MSD (Mark detection) was turned on again when the previous falling was out of the valid range, MSDH (Latch completed at rising edge of mark detection) will not change, but the position data will be updated. Refer to the following timing chart.



16.29.2 Interrupt positioning function

The interrupt positioning function executes an operation by changing the remaining distance to the travel distance that is set with [Pr. PT30] and [Pr. PT31] (Mark sensor stop travel distance) when MSD (Mark detection) is turned on. The interrupt positioning function is enabled by setting [Pr. PT26] to "1 _ _ _".

POINT
●The interrupt positioning function can be used with the point table method and the program method. However, the interrupt positioning function is disabled in the following condition. ・During home position return ・During manual operation ・During stop ・During deceleration or stop with TSTP (Temporary stop/restart) ●An error may occur at the mark sensor stop position depending on the droop pulses of when MSD (Mark detection) is turned on and a minimum stopping distance required for deceleration.

(1) Parameter

Set the parameters as follows:

Item	Parameter to be used	Setting
Control mode selection	[Pr. PA01]	Select a control mode. _ _ _ 6: Positioning mode (point table method) _ _ _ 7: Positioning mode (program method)
Mark detection function selection	[Pr. PT26]	Set the mark detection function selection as follows: 1 _ _ _: Interrupt positioning function Starts the interrupt positioning function at rising of MSD (Mark detection).
PI1 (Program input 1) Polarity selection to PI3 (Program input 3) Polarity selection	[Pr. PT29]	The polarity of MSD (Mark detection) can be changed with [Pr. PT29]. ・Starts the interrupt positioning function at rising of MSD (Mark detection) if "_ _ x_" bit 3 of [Pr. PT29] is off. ・Starts the interrupt positioning function at falling of MSD (Mark detection) if "_ _ x_" bit 3 of [Pr. PT29] is on.
Mark sensor stop travel distance (lower three digits)	[Pr. PT30]	Set the lower three digits of the travel distance after the mark detection. The travel distance starts from the current position regardless of the setting of absolute value command method or incremental value command method.
Mark sensor stop travel distance (upper three digits)	[Pr. PT31]	Set the upper three digits of the travel distance after the mark detection. The travel distance starts from the current position regardless of the setting of absolute value command method or incremental value command method.
Mark detection range + (lower three digits)	[Pr. PC66]	Set the upper and lower limits of the interrupt positioning function. If a sign for the upper and lower differ, [AL. 37] occurs. When the roll feed display is enabled, set this value with the travel distance from the starting position.
Mark detection range + (upper three digits)	[Pr. PC67]	
Mark detection range - (lower three digits)	[Pr. PC68]	
Mark detection range - (upper three digits)	[Pr. PC69]	

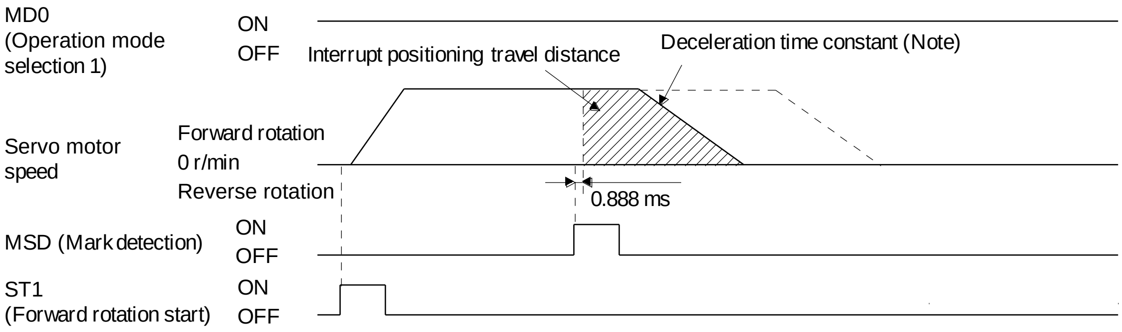
(2) Rotation direction

[Pr. PA14] setting	Servo motor rotation direction ST1 (Forward rotation start) on
_ _ _ 0	CCW rotation with + position data CW rotation with - position data
_ _ _ 1	CW rotation with + position data CCW rotation with - position data

(3) Operation

Travels for the interrupt positioning travel distance ([Pr. PT30] and [Pr. PT31]) starting from the position where MSD (Mark detection) is turned on. The operation after a stop complies with the operation mode and the operation pattern.

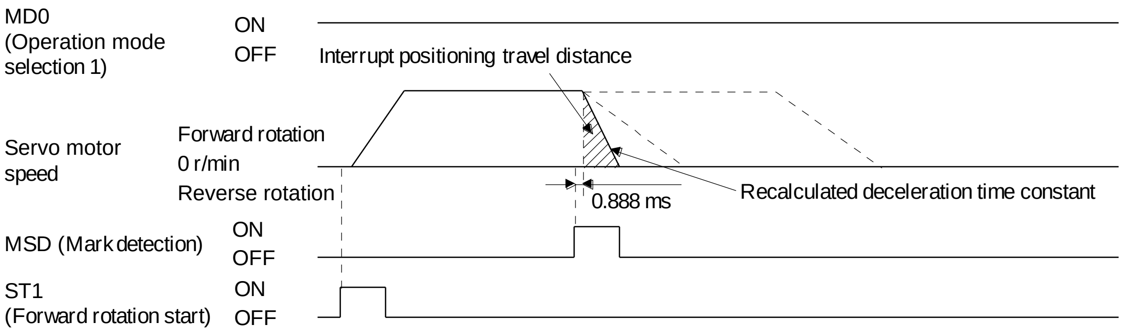
(4) Timing chart



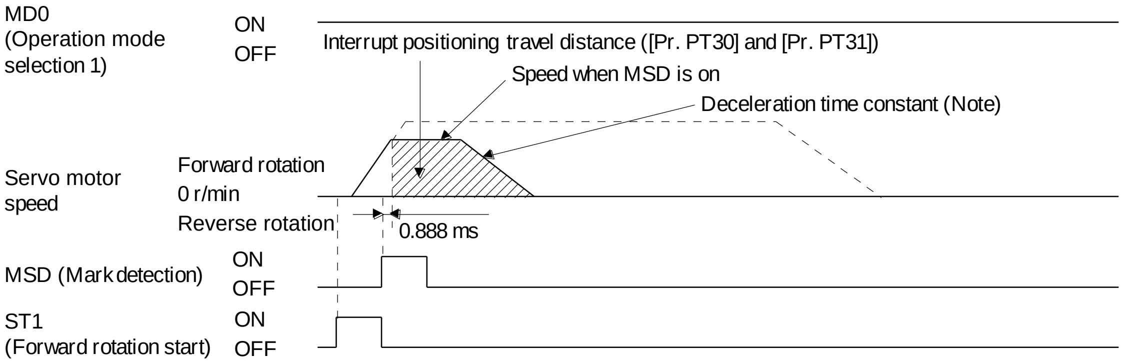
Note. Deceleration time constant of the point table at the time of start is applied for the point table method, and deceleration time constant set by the program in execution is applied for the program method.

The movement other than above is as follows:

(a) When the interrupt positioning travel distance is smaller than the travel distance required for the deceleration, the actual deceleration time constant will be shorter than the set time constant.

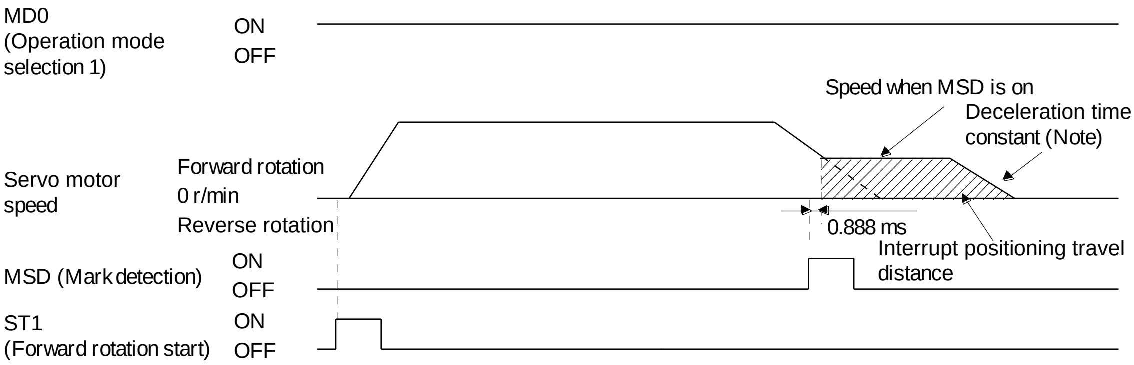


(b) When the interrupt travel distance is large during acceleration, the servo motor stops with the deceleration time constant after rotating with the command speed at which MSD (Mark detection) turned on.



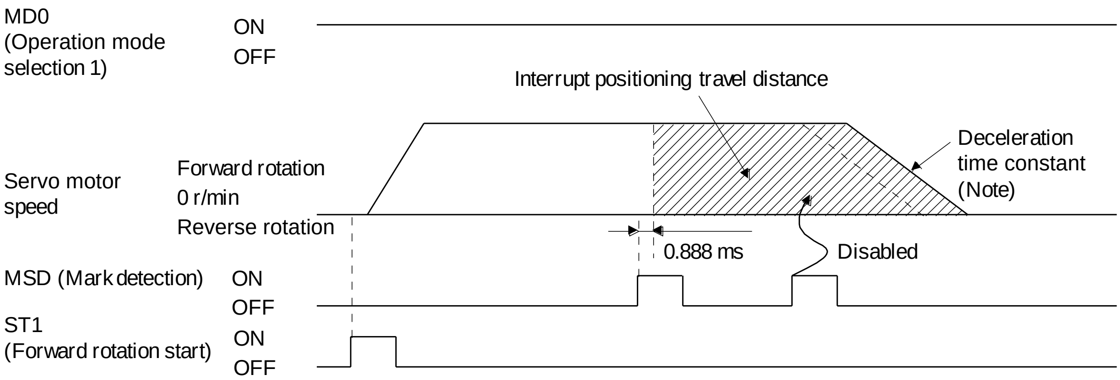
Note. Deceleration time constant of the point table at the time of start is applied for the point table method, and deceleration time constant set by the program in execution is applied for the program method.

(c) When the interrupt travel distance is large during deceleration, the servo motor stops with the deceleration time constant after rotating with the command speed at which MSD (Mark detection) turned on.



Note. Deceleration time constant of the point table at the time of start is applied for the point table method, and deceleration time constant set by the program in execution is applied for the program method.

(d) When MSD (Mark detection) is turned on again during the interrupt positioning, the input will be disabled.



Note. Deceleration time constant of the point table at the time of start is applied for the point table method, and deceleration time constant set by the program in execution is applied for the program method.

(5) Using together with other functions

Availability of other functions during the interrupt positioning is as follows:

Function	Availability (Note 1)
S-pattern acceleration/deceleration	○
Stroke limit	○
Software limit	○
Temporary stop/restart	×
Speed change value	×
Analog override	△ (Note 2)
Backlash	×
Rough match	○
Electronic gear	○
Roll feed display function	×
Mark detection function (current position latch function)	×

Note 1. ○: enabled, ×: disabled, △: enabled with condition

2. Enabled only in a constant speed

ITP (Interrupt positioning) is available in the program method.

Because the interrupt positioning function with MSD (Mark detection) input signal is prioritized, the interrupt positioning function with MSD (Mark detection) can be used during the interrupt positioning function with ITP (Interrupt positioning). However, ITP (Interrupt positioning) cannot be used during the interrupt positioning with MSD (Mark detection).

17 Positioning mode (pushing operation)

17.1 Setup software (MR Configurator2™)

In point table type pushing operation, it is necessary to set parameters and point table data from the setup software (MR Configurator2™). It is necessary to add a file (extension file for pushing operation).
Please download the extension file from SMC homepage. https://www.smcworld.com/

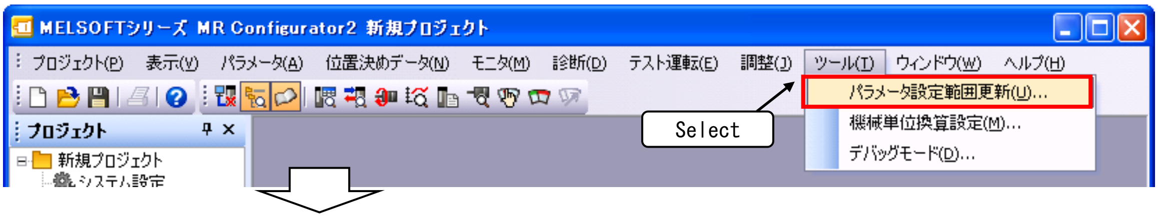
To add model information, use the pushing operation extension file (rng file and xml file) provided by SMC.

Point
This function is enabled when the setup software (MR Configurator2™) and the driver are connected directly with a USB cable. Check that the version of the setup software (MR Configurator2™) is 1.100E or later, and then add model information.

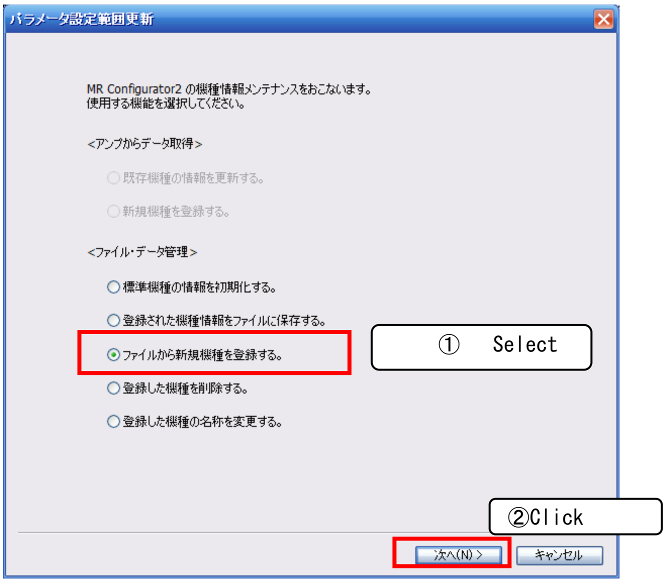
17.1.1 Model information addition procedure

(1) Check that "MR-J4-A-S099.xml" and "MR-J4-A-S099 (□).xml" are not in the storage directory of the PC to be used, and delete them if they exist. (□: xml file sub number)
*The storage directory differs depending on the display language.
English:「C:\Melservo\MR2\dat\en」
Japanese:「C:\Melservo\MR2\dat\ja」
Simplified Chinese:「C:\Melservo\MR2\dat\zh_cn」
(2) Copy MR-J4-A-S099 (□).rng provided by SMC into the storage directory. (□: rng file sub number)
(3) Start the setup software (MR Configurator2™).
(4) Select [Tool(T)]→[Parameter setting range update(U)].
(5) Select [Register new model from file.] and click [Next] button.
(6) Select the file copied in (2) from [Browse] and click [Next] button.
(7) Check the model MR-J4-A-S099 (□) and the S/W number BC-B46W118 , and click [Save] button.
(8) Exit the setup software (MR Configurator2™).
(9) Confirm the "MR-J4-A-S099.xml" is added in the storage directory, and delete the rng file and "MR-J4-A-S099.xml".
(10) Copy MR-J4-A-S099 (□) .xml provided by SMC into the storage directory.
(11) Start the setup software (MR Configurator2™).
(12) On the new project creation screen, select the added model "MR-J4-A-S099 (□)".

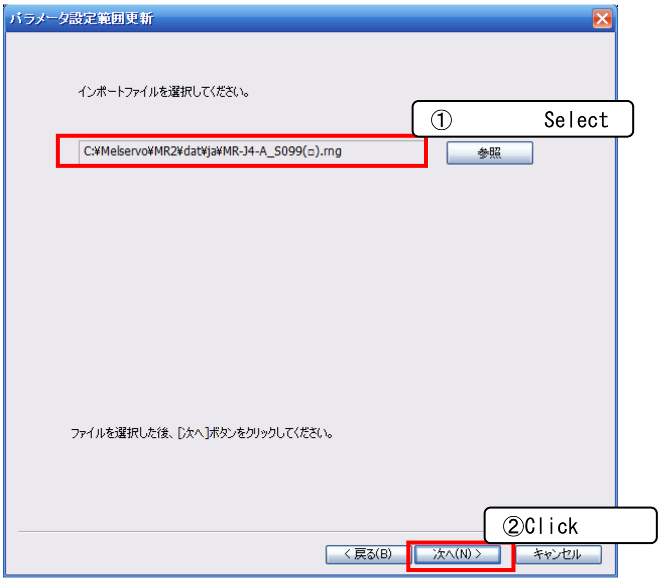
(4) Select [Parameter Setting Range Update (U)].



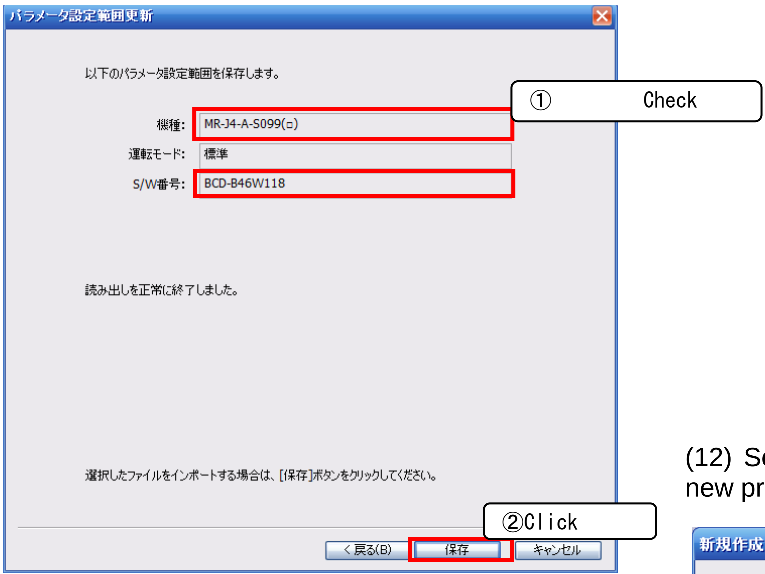
(5) Select [Register a new model from a file.] and click [Next] button.



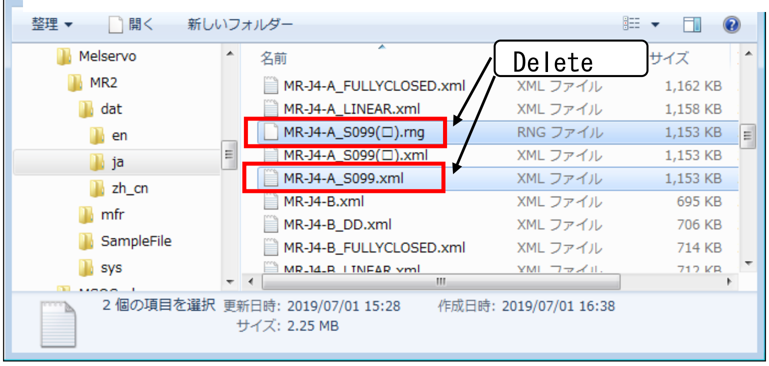
(6) Select the file copied in (2) from [Browse] and click [Next] button.



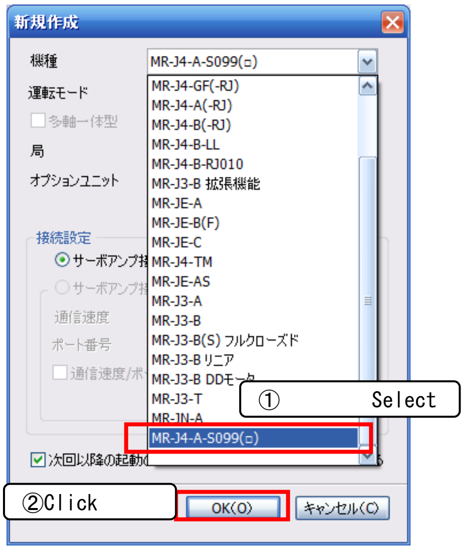
(7) Check the model and S/W number, and click [Save] button.



(9) Delete MR-J4-A-S099 (□).rng and MR-J4-A-S099.xml in the storage directory



(12) Select "MR-J4-A-S099 (□)" on the new project creation screen

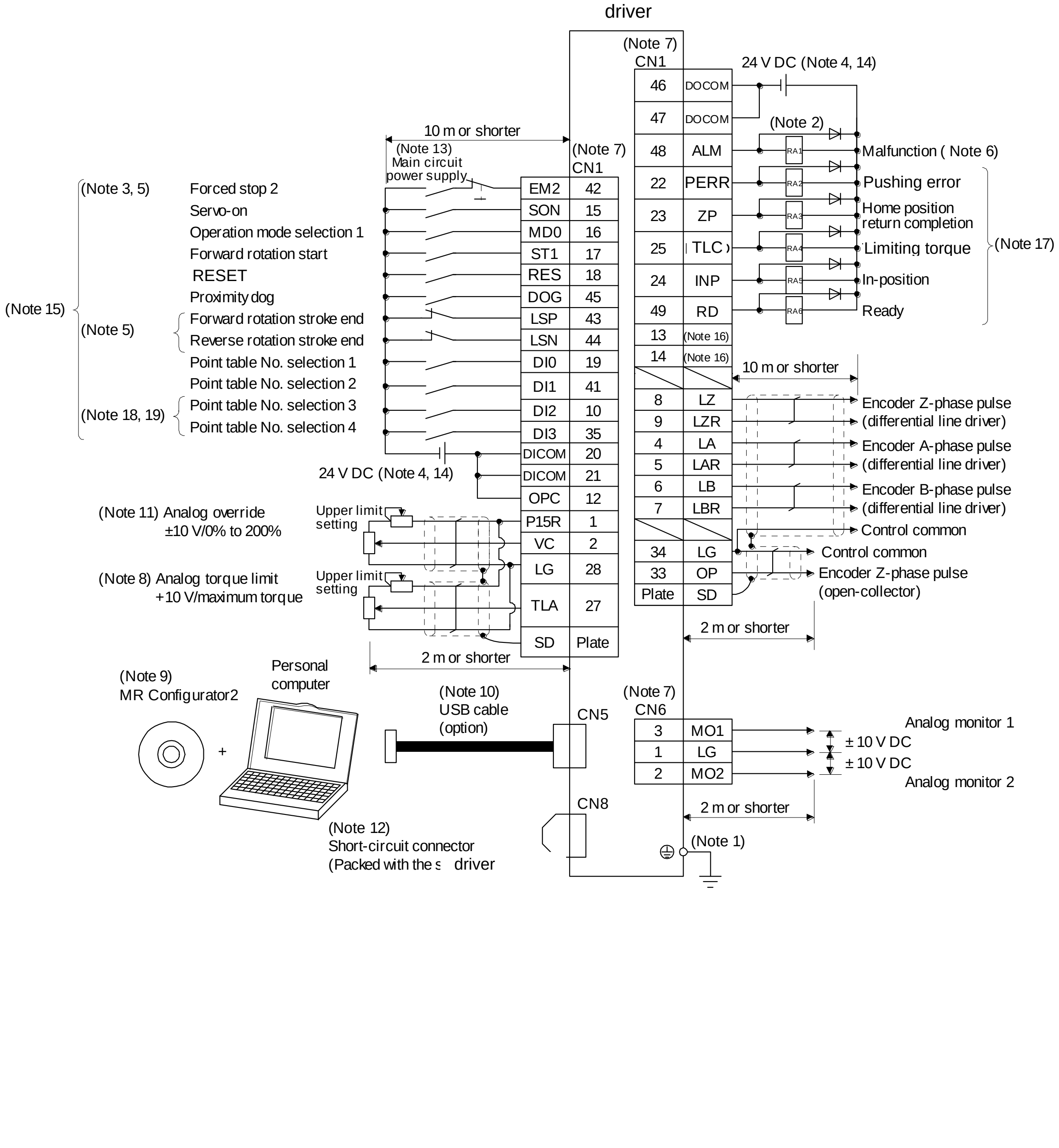


17.2 I/O signal connection example

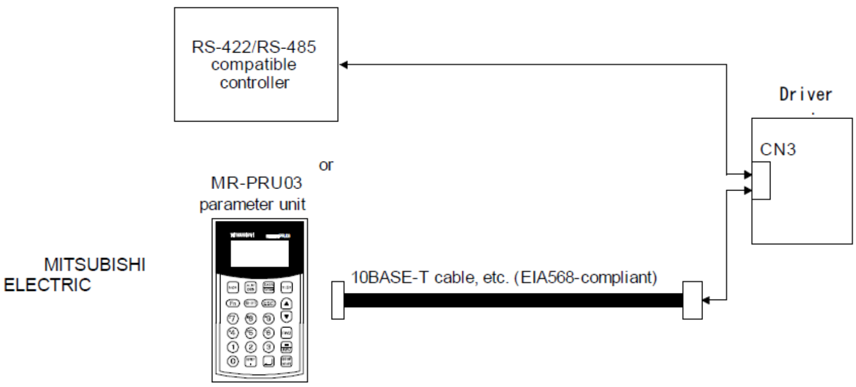
Positioning mode Point table method Describes the items required to use the pushing operation.

(1) Point table method During pushing operation

POINT
[Pr.PD10], [Pr.PD23] and [Pr.PD23] are assigned to CN1-18 pin, CN1-22 pin and CN1-23 pin. Assign the following input / output device with [Pr.PD24]. CN1-18: RES (reset) CN1-22: PERR (Pushing error) CN1-23: ZP (Home return completed)



Note 1.	To prevent electric shock, be sure to connect the protective earth (PE) terminal (marked terminal) of the driver to the protective earth (PE) of the control panel.
2.	Do not mistake the direction of the diode. If it is connected in reverse, the driver will break down and no signal will be output, and the protection circuit such as EM2 (forced stop 2) may not operate.
3.	Be sure to install a forced stop switch (B contact).
4.	Supply 24 VDC ± 10% power from the outside for the interface. Set the current capacity of these power supplies to 500 mA in total. 500 mA is the value when all input / output signals are used. The current capacity can be reduced by reducing the number of input / output points. Refer to the current required for the interface described in Section 3.9.2 (1). The 24 V DC power supply can be used for both input and output signals.
5.	During operation, be sure to turn on EM2 (forced stop 2), LSP (forward stroke end) and LSN (reverse stroke end). (B contact)
6.	ALM (failure) is turned on when no alarm is generated. (B contact)
7.	Signals with the same name are connected inside the driver.
8.	[Pr. PD04], [Pr. PD06], [Pr. PD08], [Pr. PD10], [Pr. PD12], [Pr. PD14], [Pr. PD18], [Pr. PD20], [Pr. PD22], [Pr. PD44], and [Pr. PD46] enable TL (external torque limit selection) to be used. (Refer to Section 3.6.1 (5))
9.	Use the setup software (MR Configurator2TM). (See section 11.7)
10.	The upper side or parameter unit can be connected using RS-422 / RS-485 communication of CN3 connector. However, the USB communication function (CN5 connector) and the RS-422 / RS-485 communication function (CN3 connector) are exclusive functions. They cannot be used at the same time. The parameter unit MR-PRU03 cannot read or write the pushing torque of the point table setting data in the point table pushing operation.



11.	When inputting negative voltage, use an external power supply.
12.	When not using the STO function, attach the short-circuit connector provided with the driver.
13.	To prevent an unexpected restart of the driver, configure a circuit that turns off EM2 when the main circuit power is turned off.
14.	In case of sink I / O interface.
15.	[Pr. PD04], [Pr. PD06], [Pr. PD08], [Pr. PD10], [Pr. PD12], [Pr. PD14], [Pr. PD18], [Pr. PD20], [Pr. The device can be changed using [PD22], [Pr. PD44] and [Pr. PD46].
16.	No output device is assigned in the initial state. Assign output devices as required with [Pr. PD47].
17.	The listed devices are the recommended assignments. The device can be changed using [Pr. PD23] to [Pr. PD26] and [Pr. PD28].
18.	DI2 and DI3 are assigned to the CN1-10 pin and CN1-35 pin in the initial state.
19.	When input devices are assigned to the CN1-10 and CN1-35 pins, use the sink input interface and supply 24 V DC + to the OPC (open collector sink interface power supply input). Not available for source input interface. In the positioning mode, input devices (DI2 and DI3) are assigned in the initial state.

17.3 Connector and signal arrangement

For devices not described in this section, Refer to section 2.2.

Pin No.	(Note1) I/O	(Note2) Input/output signal in Control mode			Related parameters
		CP (Note7)	CL	PS	
1		P15R	P15R	P15R	
2	I	VC	VC		
3		LG	LG	LG	
4	O	LA	LA	LA	
5	O	LAR	LAR	LAR	
6	O	LB	LB	LB	
7	O	LBR	LBR	LBR	
8	O	LZ	LZ	LZ	
9	O	LZR	LZR	LZR	
10	(Note8) I	(Note10)	(Note10)	(Note10)	Pr. PD44
11	I	PG	PG	PG	
12		OPC	OPC	OPC	
13	O	(Note4)	(Note4)	(Note4)	Pr. PD47
14	O	(Note4)	(Note4)	(Note4)	Pr. PD47
15	I	SON	SON	SON	Pr. PD04
16	I	MD0	MD0	MD0	Pr. PD06
17	I	ST1	ST1	ST1	Pr. PD08
18	I	(Note9) ST2	ST2	(Note5) MD1	Pr. PD10
19	I	DI0	DI0	DI0	Pr. PD12
20		DICOM	DICOM	DICOM	
21		DICOM	DICOM	DICOM	
22	O	(Note6,9) CPO	(Note6) CPO	(Note6) CPO	Pr. PD23
23	O	(Note6) ZP	(Note6) ZP	(Note6) ZP	Pr. PD24
24	O	INP	INP	INP	Pr. PD25
25	O	(Note6,9) MEND	(Note6) MEND	(Note6) MEND	Pr. PD26
26					
27	I	(Note3) TLA	(Note3) TLA	(Note3) TLA	
28		LG	LG	LG	
29					
30		LG	LG	LG	
31					
32					
33	O	OP	OP	OP	
34		LG	LG	LG	
35	(Note8) I	(Note10)	(Note10)	(Note10)	Pr. PD46
36	I	NG	NG	NG	
37	I	(Note11)	(Note11)	(Note11)	Pr. PD44
38	I	(Note11)	(Note11)	(Note11)	Pr. PD46
39					
40					
41	I	DI1	DI1	DI1	Pr. PD14
42	I	EM2	EM2	EM2	
43	I	LSP	LSP	LSP	Pr. PD18
44	I	LSN	LSN	LSN	Pr. PD20
45	I	DOG	DOG	SIG	Pr. PD22
46		DOCOM	DOCOM	DOCOM	
47		DOCOM	DOCOM	DOCOM	
48	O	ALM	ALM	ALM	
49	O	RD	RD	RD	Pr. PD28
50					

Note1.	I: input signal, O: output signal
2.	CP: Positioning mode (point table method) CL: Positioning mode (program method) PS: Positioning mode (equal indexing method)
3.	[Pr. PD04], [Pr. PD06], [Pr. PD08], [Pr. PD10], [Pr. PD12], [Pr. PD14], [Pr. PD18], [Pr. PD20], [Pr. PD22], [Pr. PD44], and [Pr. PD46] enable TL (external torque limit selection) to be used.
4.	Assign an arbitrary device with [Pr. PD47].
5.	In the equal division indexing method, assign the following input device to CN1-18 pins with [Pr. PD10]. CN1-18: MD1 (Operation mode selection 2)
6.	Assign the following output devices to [Pr.PD23], [Pr.PD24] and [Pr.PD26] to the CN1-22, CN1-23 and CN1-25 pins. CN1-22: CPO (rough match) CN1-23: ZP (Home return completed) CN1-25: MEND (movement completed)
8.	When using the CN1-10 and CN1-35 pins for DI, supply 24 V DC + to the OPC (open collector sink interface power supply input).
9.	Positioning mode Point table method When using the pushing operation, input the following data to CN1-18, CN1-22 and CN1-25 pins with [Pr.PD10], [Pr.PD23] and [Pr.PD26]. Assign an output device. CN1-18: RES (reset) CN1-22: PERR (Pushing error) CN1-25: TLC (torque limited)
10.	Used for the sink interface. No input devices are assigned in the initial state. When using, allocate devices as required in [Pr. PD44] and [Pr. PD46]. At that time, supply +24 V DC to the CN1-12 pins of the OPC (open collector sink interface power supply input).
11.	Used in source interface. No input devices are assigned in the initial state. When using, allocate devices as required in [Pr. PD44] and [Pr. PD46].

17.4 Signal (device) explanations

For devices not described in this section, Refer to section 2.3.

The pin numbers in the connector pin number column are for the initial state. For the I / O interface (symbol in the I / O division column in the table), see section 3.9.2.

The Control mode symbols in the table indicate the following:

CP: Positioning mode (Point table method) Positioning operation / Pushing operation

CL: Positioning mode (program method)

PS: Positioning mode (Equal division indexing method)

○ and △ in the table indicate the following.

○: Devices that can be used as shipped

△: Devices that can be used with the following parameter settings

[Pr. PD04], [Pr. PD06], [Pr. PD08], [Pr. PD10], [Pr. PD12], [Pr. PD14], [Pr. PD18], [Pr. PD20], [Pr. PD22] to [Pr. PD26], [Pr. PD28], [Pr. PD44], [Pr. PD46] および [Pr. PD47]

(1) I / O device

(a) Input device

<table>
<tr><th rowspan="2">Device name</th><th rowspan="2">symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Functions and uses</th><th rowspan="2">I/O Classification</th><th colspan="3">Control mode</th></tr>
<tr><th>CP</th><th>CL</th><th>PS</th></tr>
<tr><td>Forced stop 2</td><td>EM2</td><td>CN1-42</td><td>When EM2 is turned off (open between commons), the servo motor is decelerated and stopped by a command. The forced stop state can be released by turning EM2 on (short between commons) from the forced stop state.
If EM2 is turned off during the pushing operation of the positioning mode point table method, the pushing operation will be interrupted and stopped.
The settings for [Pr.PA04] are shown below.
<table>
<tr><th rowspan="2">[Pr.PA04] setting value</th><th rowspan="2">EM2 / EM1 selection</th><th colspan="2">Deceleration method</th></tr>
<tr><th>EM2 or EM1 is off</th><th>Alarm occurs</th></tr>
<tr><td>0 _ _ _</td><td>EM1</td><td>MBR (Electromagnetic brake interlock) turns off without performing forced stop deceleration.</td><td>MBR (Electromagnetic brake interlock) turns off without performing forced stop deceleration.</td></tr>
<tr><td>2 _ _ _</td><td>EM2</td><td>MBR (Electromagnetic brake interlock) turns off after forced stop deceleration.</td><td>MBR (Electromagnetic brake interlock) turns off after forced stop deceleration.</td></tr>
</table>
EM2 and EM1 are exclusive functions.</td><td>DI-1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Forced stop</td><td>EM1</td><td>(CN1-44)</td><td>When using EM1, set [Pr. PA04] to "0 _ _ _" to enable use.
When EM1 is turned off (open between the commons), the base is shut off and the dynamic brake operates to decelerate and stop the servomotor.
The forced stop state can be released by turning EM1 on (short between commons) from the forced stop state.
If EM1 is turned off during the pushing operation of the positioning table point table method, the pushing operation will be interrupted and stopped.</td><td>DI-1</td><td>△</td><td>△</td><td>△</td></tr>
<tr><td>Servo on</td><td>SON</td><td>CN1-15</td><td>When SON is turned on, the power is turned on to the base circuit, and it is ready for operation. (Servo ON state)
When turned off, the base is shut off and the servo motor enters the free-run state.
If [Pr. PD01] is set to "_ _ _ 4", it can be internally turned on automatically (always on).
Positioning mode If SON is turned off during the pushing operation of the point table method, the pushing operation is interrupted and stopped.</td><td>DI-1</td><td>○</td><td>○</td><td>○</td></tr>
</table>

<table>
<tr><th rowspan="2">Device name</th><th rowspan="2">symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Functions and uses</th><th rowspan="2">I/O Classification</th><th colspan="3">Control mode</th></tr>
<tr><th>CP</th><th>CL</th><th>PS</th></tr>
<tr><td>Reset</td><td>RES</td><td></td><td>Turn RES on for at least 50 ms to reset the alarm.
Some alarms cannot be cleared by RES (reset).
If RES is turned on while no alarm is occurring, the base will be shut off.
Positioning mode If RES is turned on during the pushing operation of the point table method, the pushing operation is interrupted by the base shutoff and stopped.
If RES is turned on while PERR (Pushing error) is on, PERR (Pushing error) turns off.
If [Pr. PD30] is set to "_ _ 1 _", the base will not be shut off.
This device is not for shutdown. Do not turn on while driving.</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">When operating, turn on LSP and LSN. When turned off, it stops suddenly and locks the servo.
If [Pr. PD30] is set to "_ _ _ 1", slow stop will be performed.
<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 / Positive direction</th><th>CW direction / Negative 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

If [Pr. PD01] is set as follows, it can be internally turned on automatically (always short-circuited).
<table>
<tr><th rowspan="2">[Pr.PD01]</th><th colspan="2">Status</th></tr>
<tr><th>LSP</th><th>LSN</th></tr>
<tr><td>_ 4 _ _</td><td>Auto on</td><td></td></tr>
<tr><td>_ 8 _ _</td><td></td><td>Auto on</td></tr>
<tr><td>_ C _ _</td><td>Auto on</td><td>Auto on</td></tr>
</table>
When LSP or LSN is turned off, [AL.99 Stroke limit warning] occurs and WNG (warning) turns on. When using WNG, enable it by setting [Pr. PD23] to [Pr. PD26], [Pr. PD28] and [Pr. PD47].
This device cannot be used for normal operation during the torque control mode or positioning mode during point table type pushing operation.</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>
<tr><td rowspan="3">Operation mode selection 1</td><td rowspan="3">MD0</td><td rowspan="3">CN1-16</td><td>Point table method
Turning MD0 on sets the automatic operation mode, and turning it off sets the manual operation mode.
If the operation mode is changed during operation, the specified remaining distance will be cleared and the axis will decelerate to a stop.
Positioning mode If the operation mode is changed during the pushing operation of the point table method, the pushing operation is interrupted and stopped.</td><td>DI-1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Program method
Same specifications as standard.</td><td>DI-1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Equal indexing method
Same specifications as standard.</td><td>DI-1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td rowspan="3">Operation mode selection 2</td><td rowspan="3">MD1</td><td rowspan="3"></td><td>Point table method
MD1 cannot be used.</td><td>DI-1</td><td></td><td></td><td></td></tr>
<tr><td>Program method
MD1 cannot be used.</td><td>DI-1</td><td></td><td></td><td></td></tr>
<tr><td>Equal indexing method
Same specifications as standard.</td><td>DI-1</td><td></td><td></td><td>△</td></tr>
</table>

Device name	symbol	Connector pin No.	Functions and uses	I/O Classification	Control mode		
					CP	CL	PS
Start signal	ST1	CN1-17	point table method 1.In case of absolute value command method When ST1 is turned on during automatic operation, one operation is executed based on the positioning data and pushing operation data set in the point table. Positioning mode During the pushing operation of the point table method, the pushing operation is continued until ON of ST1 is detected. When ST1 is turned on during home return, home return starts at the same time. If ST1 is turned on during JOG operation, the motor will rotate in the forward direction while it is on. Forward rotation indicates the direction of address increase. If both ST1 and ST2 are turned on during JOG operation, the servo motor will stop. 2.Increment value command method When ST1 is turned on during automatic operation, one positioning operation is performed in the forward direction based on the positioning data set in the point table. Pushing operation cannot be performed. When ST1 is turned on during home return, home return starts at the same time. If ST1 is turned on during JOG operation, the motor will rotate in the forward direction while it is on. Forward rotation indicates the direction of address increase. If both ST1 and ST2 are turned on during JOG operation, the servo motor will stop.	DI-1	○		
			Program method Same specifications as standard.			○	
			Equal indexing method Same specifications as standard.				○
Reverse rotation start	ST2	CN1-18	point table method Same specifications as standard. This device is not used during the point table method pushing operation.	DI-1	○		
			Program method Same specifications as standard.			○	
			Equal indexing method Do not use this device.				

<table>
<tr><th rowspan="2">Device name</th><th rowspan="2">symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Functions and uses</th><th rowspan="2">I/O Classification</th><th colspan="3">Control mode</th></tr>
<tr><th>CP</th><th>CL</th><th>PS</th></tr>
<tr><td>Pause / Restart</td><td>TSTP</td><td></td><td>If you turn on TSTP during automatic operation, it will pause.
Turn on TSTP again to restart.
It does not operate even if ST1 (forward rotation start) or ST2 (reverse rotation start) is turned on during a pause.
If the mode is changed from automatic operation mode to manual operation mode during a pause, the remaining travel distance is deleted.
The pause / restart input does not function during homing, JOG operation, and positioning mode point table type pushing operation.</td><td>DI-1</td><td>△</td><td>△</td><td></td></tr>
<tr><td>Point table Number / Program number selection 1</td><td>DI0</td><td>CN1-19</td><td rowspan="8">Point table method
Select the point table and origin return mode with DI0toDI7.
ST1 (start signal) cannot be turned ON by selecting the point table for which pushing operation is selected in the auxiliary function of the point table data.
Single pushing operation cannot be used. Be sure to use it together with the positioning operation.
<table>
<tr><th colspan="8">Dvice (Note)</th><th rowspan="2">Selection</th></tr>
<tr><th>DI7</th><th>DI6</th><th>DI5</th><th>DI4</th><th>DI3</th><th>DI2</th><th>DI1</th><th>DI0</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>Home return mode</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>Point table No. 1</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>Point table No. 2</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>Point table No. 3</td></tr>
<tr><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>Point table No. 254</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>Point table No. 255</td></tr>
</table>
Note. 0 : Off
1 : On

program method
Same specifications as standard.</td><td rowspan="8">DI-1</td><td>○</td><td>○</td><td></td></tr>
<tr><td>Point table Number / Program number selection 2</td><td>DI1</td><td>CN1-41</td><td>○</td><td>○</td><td></td></tr>
<tr><td>Point table Number / Program number selection 3</td><td>DI2</td><td>CN1-10</td><td>○</td><td>○</td><td></td></tr>
<tr><td>Point table Number / Program number selection 4</td><td>DI3</td><td>CN1-35</td><td>○</td><td>○</td><td></td></tr>
<tr><td>Point table Number / Program number selection 5</td><td>DI4</td><td></td><td>△</td><td>△</td><td></td></tr>
<tr><td>Point table Number / Program number selection 6</td><td>DI5</td><td></td><td>△</td><td>△</td><td></td></tr>
<tr><td>Point table Number / Program number selection 7</td><td>DI6</td><td></td><td>△</td><td>△</td><td></td></tr>
<tr><td>Point table Number / Program number selection 8</td><td>DI7</td><td></td><td>△</td><td>△</td><td></td></tr>
<tr><td>clear</td><td>CR</td><td></td><td>When CR is turned on, the droop pulse of the position control counter is erased at the rising edge. Pulse width should be 10ms or more.
The delay amount set in [Pr.PB03 Position command acceleration / deceleration time constant] is also deleted.
When [Pr.PD32] is set to 1 , data is always erased while CR is on.
Positioning mode The clear input does not function during the point table type pushing operation.
Positioning mode Do not set [Pr.PD32] to "_ _ _ 2" during the pushing operation of the point table method.</td><td>DI-1</td><td>△</td><td>△</td><td>△</td></tr>
</table>

(b) Output device

<table>
<tr><th rowspan="2">Device name</th><th rowspan="2">symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Functions and uses</th><th rowspan="2">I/O Classification</th><th colspan="3">Control mode</th></tr>
<tr><th>CP</th><th>CL</th><th>PS</th></tr>
<tr><td>In position</td><td>INP</td><td>CN1-24</td><td>During position control mode, INP turns on when the droop pulse is within the set in-position range. The in-position range can be changed with [Pr.PA10]. If the in-position range is increased, it may be always on during low-speed rotation.
It is always off during speed control mode and torque control mode.
Positioning mode During point table type pushing operation, INP turns on when TLC turns on continuously for 100 ms. The continuous detection time of TLC can be changed with [Pr.PS03].
INP turns off when the servo is off.
INP turns on when PERR (Pushing error) is off.
<table>
<tr><th>RD</th><th>PERR</th><th>Operating state</th><th>conditions</th><th>INP</th></tr>
<tr><td>0</td><td></td><td></td><td></td><td>0</td></tr>
<tr><td rowspan="4">1</td><td>1</td><td>Positioning operation</td><td></td><td>1</td></tr>
<tr><td rowspan="3">0</td><td rowspan="2">Positioning operation</td><td>When the droop pulse is within the set in position range</td><td>1</td></tr>
<tr><td>When the droop pulse is out of the set in position range</td><td>0</td></tr>
<tr><td>Pushing operation</td><td>At the start of pushing, INP turns off. After TLC is turned on continuously for 100ms, INP is turned on.</td><td>Refer to left</td></tr>
</table>
Note. 0：Off
1：On</td><td>DO-1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>During torque limit /
Pushing torque reached</td><td>TLC</td><td></td><td>In position control mode, TLC turns on when the torque set in [Pr. PA11 forward rotation torque limit], [Pr. PA12 reverse rotation torque limit] or TLA (analog torque limit) is reached during torque generation. .
Positioning mode During point table type pushing operation, [Pr. PA11 forward rotation torque limit], [Pr. PA12 reverse rotation torque limit], TLA (analog torque limit), pushing torque set in the point table, or [Pr. .PS04 Pushing torque upper limit value], the TLC turns on. It turns off when the pushing torque falls below the value.
TLC turns off in the servo off state.</td><td>DO-1</td><td>△</td><td>△</td><td>△</td></tr>
<tr><td>Move complete</td><td>MEND</td><td></td><td>MEND turns on when the droop pulse is the in-position output range set in [Pr.PA10] and the command remaining distance is "0".
MEND turns on when the servo is turned on.
MEND turns off when the servo is off. However, in the equal division indexing method, MEND does not turn off even when the servo is off.
Positioning mode MEND turns off during the pushing operation of the point table method.
Also, when servo lock stop at pushing error is selected in [Pr.PS01] 1 [Pr.PS01] 1 , PERR is turned off by turning on ST1 (start signal). Beco</td><td>DO-1</td><td>△</td><td>△</td><td>△</td></tr>
<tr><td>Position end</td><td>PED</td><td></td><td>The PED turns on when the droop pulse is in the in-position output range set in [Pr.PA10] and the command remaining distance is "" 0 ".
PED turns on when MEND (movement complete) is on and ZP (home return complete) is on.
PED turns on when ZP (home return complete) is on and servo is on.
The PED turns off when the servo is off.
Positioning mode PED is turned off during the pushing operation of the point table method.</td><td>DO-1</td><td>△</td><td>△</td><td></td></tr>
<tr><td>Pushing error</td><td>PERR</td><td></td><td>Positioning mode Turns ON when the pushing operation cannot be continued or the pushing operation cannot be started during the pushing operation of the point table method.
When RES (reset) turns on, PERR turns off.
Also, when servo lock stop at pushing error is selected in [Pr.PS01] 1 and [Pr.PS01] 1 , PERR is turned off by turning on ST1 (start signal). Beco</td><td>DO-1</td><td>△</td><td></td><td></td></tr>
<tr><td>During pushing operation</td><td>TFBL</td><td></td><td>Positioning mode TFBL turns on during the pushing operation of the point table method.
When the pushing operation is completed, TFBL turns off.</td><td>DO-1</td><td>△</td><td></td><td></td></tr>
</table>

17.5 Explanation of forced stop deceleration function

Refer to section 3.7 for items not described in this chapter.

POINT
● For alarms that are not subject to the forced stop deceleration function, forced stop deceleration does not function. (See Chapter 8) ●Torque control mode and positioning mode The forced stop deceleration function cannot be used during the pushing operation of the point table method. ● For machines with multiple axes connected in a tandem configuration, set the forced stop deceleration function to disabled. If an alarm occurs while the forced stop deceleration function is disabled, the servo motor will stop dynamic braking. ● Keep SON (servo on) on when EM2 (forced stop 2) is off. When SON (servo-on) is off, forced stop deceleration, base cutoff delay, and vertical axis pull up do not function.

17.5.1 Forced stop deceleration function

When EM2 is turned off, the dynamic brake operates after the forced stop deceleration, and the servo motor stops. At this time, [AL. E6 Servo forced stop warning] is displayed on the display.
Do not use EM2 (Forced stop 2) to stop and run during normal operation. The life of the driver may be shortened.
This function is enabled when [Pr. PA04] is "2 _ _ _" (initial value). The forced stop deceleration is also performed when an alarm for the forced stop deceleration function occurs.
By setting [Pr. PA04] to "0 _ _ _", the forced stop deceleration function can be disabled.

(1) Connection diagram

Refer to section 3.7.1 (1).

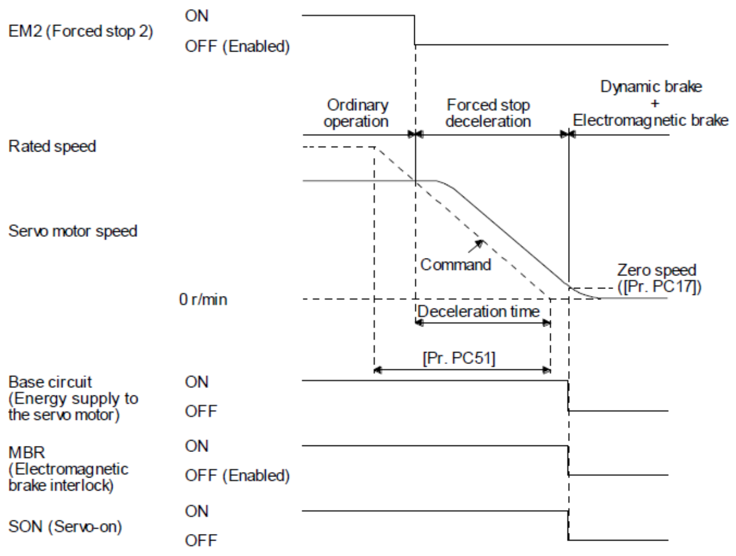
(2) Timing chart

POINT

- If LSP / LSN is turned off during forced stop deceleration, the motor stops as shown below according to the [Pr.PD30] setting.

[Pr.PD30]	How to stop
_ _ _ 0	Shift to sudden stop.
_ _ _ 1	Continue forced stop deceleration.

When EM2 (Forced stop 2) is turned off, the motor decelerates according to the value of [Pr. PC51 Deceleration time constant at forced stop].
When the deceleration command is completed and the speed of the servo motor falls below [Pr. PC17 zero speed], the base is shut off and the dynamic brake operates.



This function can be used in the position control mode and speed control mode.
During the torque control mode and positioning mode during point table type pushing operation, the dynamic brake is activated and the servo motor stops at the same time as EM2 turns off.

17.6 Explanation of torque limiting function

For devices not described in this section, refer to Section 3.6.1 (5).

17.6.1 Torque limit and torque

Refer to section 3.6.1 (5) (b).

17.6.2 Selection of torque limit value

When TL1 (internal torque limit selection) is enabled with [Pr. PD03] to [Pr. PD22], [Pr. PC35 Internal torque limit 2 / internal thrust limit 2] can be selected.
[Pr.PS04 Pushing torque upper limit value] is valid during the pushing operation of the positioning mode point table method.
However, if the value of [Pr. PA11] or [Pr. PA12] is smaller than the limit value selected in TL, TL1, and [Pr. PS04], the value of [Pr. PA11] or [Pr. Will be enabled.

(1) Positioning mode Point table type pushing operation

Input device (Note1)		Torque limit value status (Note4)					Effective torque limit value	
TL1	TL						CCW Power running・CW Regeneration	CW Power running・CCW Regeneration
0	0	Pr.PS04		>		Pr.PA11 Pr.PA12	Pr.PA11	Pr.PA12
		Pr.PA11 Pr.PA12		>		Pr.PS04	Pr.PS04	Pr.PS04
0	1	Pr.PS04	>	TLA	>	Pr.PA11 Pr.PA12	Pr.PA11	Pr.PA12
		TLA	>	Pr.PS04	>	Pr.PA11 Pr.PA12		
		TLA	>	Pr.PA11 Pr.PA12	>	Pr.PS04	Pr.PS04	Pr.PS04
		Pr.PA11 Pr.PA12	>	TLA	>	Pr.PS04		
		Pr.PA11 Pr.PA12	>	Pr.PS04	>	TLA	TLA (Note2)	TLA (Note3)
		Pr.PS04	>	Pr.PA11 Pr.PA12	>	TLA		
1	0	Pr.PS04	>	Pr.PC35	>	Pr.PA11 Pr.PA12	Pr.PA11	Pr.PA12
		Pr.PC35	>	Pr.PS04	>	Pr.PA11 Pr.PA12		
		Pr.PC35	>	Pr.PA11 Pr.PA12	>	Pr.PS04	Pr.PS04	Pr.PS04
		Pr.PA11 Pr.PA12	>	Pr.PC35	>	Pr.PS04		
		Pr.PA11 Pr.PA12	>	Pr.PS04	>	Pr.PC35	Pr. PC35 (Note2)	Pr. PC35 (Note3)
		Pr.PS04	>	Pr.PA11 Pr.PA12	>	Pr.PC35		
1	1	Pr.PS04	>	TLA	>	Pr.PC35	Pr. PC35 (Note2)	Pr. PC35 (Note3)
		TLA	>	Pr.PS04	>	Pr.PC35		
		TLA	>	Pr.PC35	>	Pr.PS04	Pr.PS04	Pr.PS04
		Pr.PC35	>	TLA	>	Pr.PS04		
		Pr.PC35	>	Pr.PS04	>	TLA	TLA (Note2)	TLA (Note3)
		Pr.PS04	>	Pr.PC35	>	TLA		

Note1. 0: Off,1: On
Note2. When [Pr. PD33] is set to "_ 2 _ _", it becomes [Pr. PA11].
Note3. When [Pr. PD33] is set to "_ 1 _ _", it becomes [Pr. PA12].
Note4. [Pr. PS04] is enabled when a value other than "0.0" is set. When "0.0" is set, it operates as the maximum torque of 100.0 [%].

(2) Positioning mode Except during pushing operation of point table method

Input device (Note1)		Torque limit value status			Effective torque limit value	
TL1	TL				CCW Power running・CW Regeneration	CW Power running・CCW Regeneration
0	0				Pr.PA11	Pr.PA12
0	1	TLA	>	Pr.PA11 Pr.PA12	Pr.PA11	Pr.PA12
		Pr.PA11 Pr.PA12	>	TLA	TLA (Note2)	TLA (Note3)
1	0	Pr.PC35	>	Pr.PA11 Pr.PA12	Pr.PA11	Pr.PA12
		Pr.PA11 Pr.PA12	>	Pr.PC35	Pr. PC35 (Note2)	Pr. PC35 (Note3)
1	1	TLA	>	Pr.PC35	Pr. PC35 (Note2)	Pr. PC35 (Note3)
		Pr.PC35	>	TLA	TLA (Note2)	TLA (Note3)

Note1. 0: Off, 1: On
Note2. When [Pr. PD33] is set to "_ 2 _ _", it becomes [Pr. PA11].
Note3. When [Pr. PD33] is set to "_ 1 _ _", it becomes [Pr. PA12].

17.6.3 TLC (Torque limited)

Refer to section 3.6.1 (5) (c).

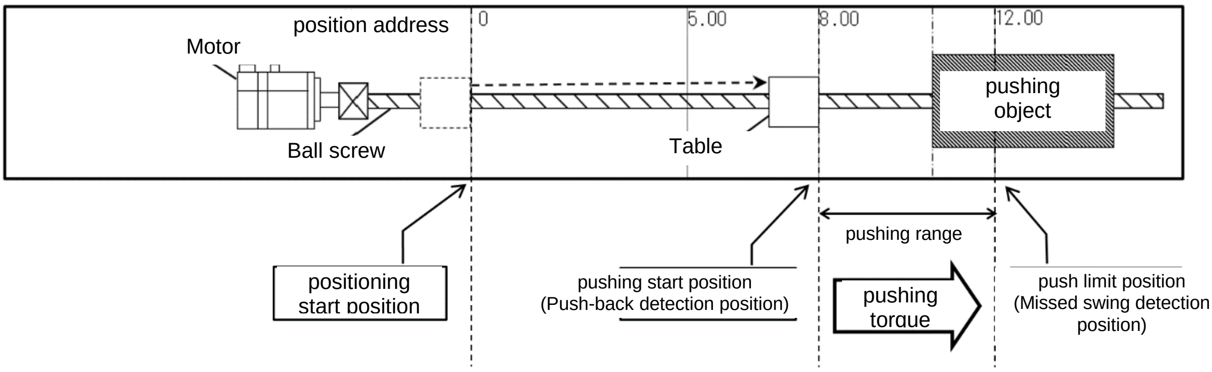
17.7 Point table type pushing operation

17.7.1 About Point table type pushing operation

Pushing operation is a function that generates a pushing torque in the direction from Pushing start position to Push limit position within the pushing range (between Pushing start position and Push limit position).

Point table method In the pushing operation, positioning operation or pushing operation can be selected with the auxiliary function of the point table data.

Positioning start position to Pushing start position, and data of pushing operation by pushing torque ([0.1%] unit) within the pushing range are managed by point table data, and a series of operations are executed. This can be done by turning on ST1 (start signal).



17.7.2 Parameter setting

Point table method when using the pushing operation, set the parameters as follows.

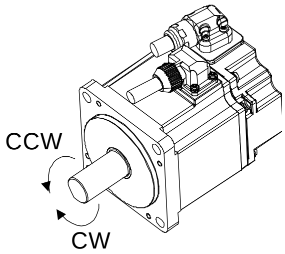
(1)Control mode selection ([Pr.PA01] x)
Set the positioning mode (point table method) (6).

(2) Operation mode selection ([Pr.PA01] x)
Set the standard Control mode (0).

(3) Command method selection ([Pr.PT01]) x
Set the absolute value command method (0).

(4) Selection of rotation direction ([Pr.PA14])
Select the servo motor rotation direction when ST1 is turned on.

[Pr.PA14] setting	Servo motor rotation direction ST1 (start signal) ON
0	+ Rotate in CCW direction with position data -Rotate in CW direction with position data
1	+ Rotate in CW direction with position data -Rotate in CCW direction with position data



(5) Position data unit ([Pr.PT01] x)
Set the unit of position data.

[Pr.PT01] setting (Note1)	Position data unit
_ 0 _ _	mm
_ 1 _ _	inch
_ 3 _ _	pulse

Note1 : [Pr.PT01] In the case of 2 (degree setting), it is not possible to select the pushing operation using the point table data auxiliary functions 16 and 18 .
[AL.37.3] is generated when the auxiliary function goes out of range due to the change of the unit of position data.

(6) Feed length magnification ([Pr.PT03])
Set the feed length magnification of the position data.

[Pr.PT03]setting	Position data input unit (Note1)		
	[mm]	[inch]	[pulse](Note2)
_ _ _ 0	0 to + 999.999	0 to + 99.9999	0 to + 999999
_ _ _ 1	0 to + 9999.99	0 to + 999.999	
_ _ _ 2	0 to + 99999.9	0 to + 9999.99	
_ _ _ 3	0 to + 999999	0 to + 99999.9	

Note1 : [Pr.PT01] [Pr.PT01] In the case of 2 (degree setting), it is not possible to select the pushing operation using the point table data auxiliary functions 16 and 18 .

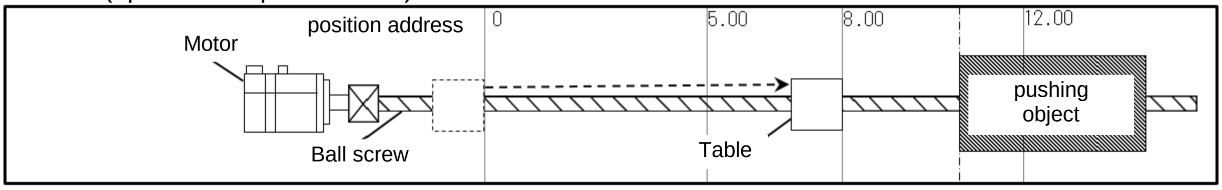
Note2 : The feed length magnification setting ([Pr. PT03]) is not reflected in the unit magnification. If you want to change the unit magnification, adjust the electronic gear setting ([Pr. PA06] and [Pr. PA07]).

17.7.3 Point table

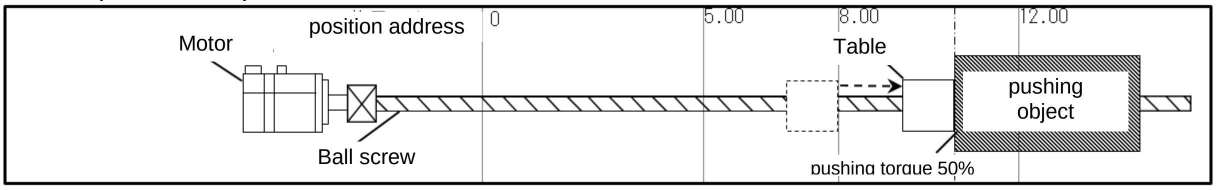
Point table method when using the pushing operation, set each value of the point table using the setup software (MR Configurator2™) or the operation unit.

The following describes an example of pushing operation divided into the following three steps.

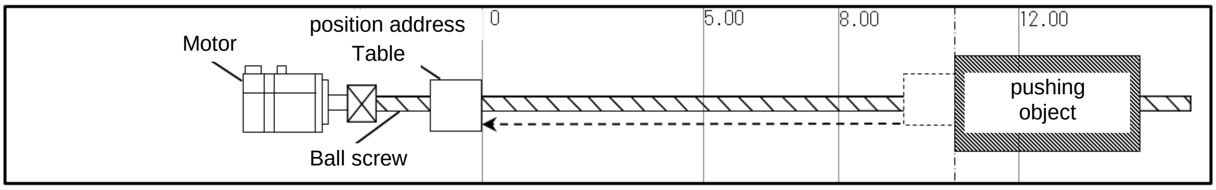
<STEP1> In positioning operation, move from Positioning start position to Pushing start position (operation of point table 1)



<STEP2> In the pushing operation, perform the pushing operation to the pushing object (operation of point table 2).



<STEP3> Return to Positioning start position in positioning operation (operation of point table 3)



Assign a point table for each of the above STEPs.

	Point table No.	Position data / Pushing limit position [10 stm m]	Servo motor rotation speed / speed limit value [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	Auxiliary function	M code	Pushing torque [0.1%]
STEP1 ⇒	1	8.00	3000	100	150	0(Note2)	1	0(Note4)	0(Note5)
STEP2 ⇒	2	12.00	500	0(Note1)	0(Note1)	0(Note3)	16	0(Note4)	500
STEP3 ⇒	3	0	2000	100	300	0	0	15	0(Note5)

Note1 : Set the auxiliary function to "1", "3", "8" or "9" and perform continuous operation when dwell = 0. At this time, the acceleration time constant and deceleration time constant data selected when starting position data are valid The acceleration time constant and deceleration time constant of the following point tables are disabled.

Note2 : When performing the pushing operation, always set the dwell of the point table data immediately before the pushing operation to 0 .
If you set a value other than 0 , [AL7F.4 Pushing start error] will occur.

Note3 : When "0", "2", "16" or "18" is set for the auxiliary function, the dwell of this point table No is disabled.

Note4 : When the point table number including the pushing operation is started, no M code is output.

Note5 : If a value other than "16" or "18" is set for the auxiliary function, the pushing torque of this point table No will be disabled.

The positioning operation using the point table number selected when ST1 (start signal) is turned on, and the pushing operation using consecutive point table numbers are performed. After reaching the pushing torque, confirm that INP is turned on, and select and start the next point table. At this time, the pushing operation is continued (the pushing torque is continued) until ST1 is entered.

POINT

- During pushing operation (STEP2), it stops at the position where the pushing torque is reached. Therefore, the current position at the end of the pushing operation does not reach the Push limit position.
  Since the incremental value command for positioning operation specifies the amount of movement from the stop position, if the operation pattern is set only with the incremental value command, the deviation of the stop position will be carried over to the next positioning operation and pushing operation start position. .
  Positioning start position (STEP3) or Pushing start position (STEP1), or setting both position data by absolute value command is recommended.

- If the width of the Pushing start position and the Push limit position is not sufficient, the position reaches the Push limit position before switching to the pushing operation, and the positioning operation is completed. Set the Pushing start position so that it is wide enough to switch to the pushing operation.

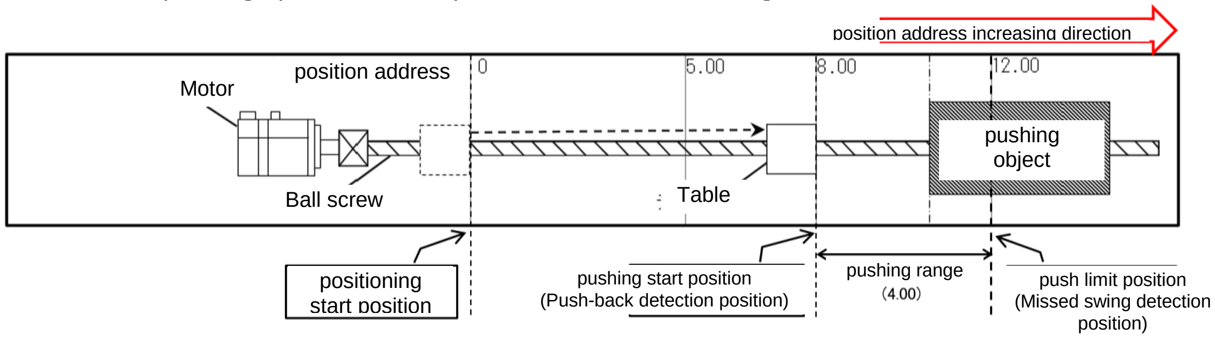
17.7.4 Point table data list

Item	Setting range	Unit	contents
Position data/ Push limit position	-999999 to 999999 (Note1)	$\times 10^{STM}$ μm $\times 10^{(STM-4)}$ inch 10-3 degree pulse	Set the target address (absolute value). This value can also be set using the teaching function. When pushing operation is selected by auxiliary function "16" or "18", the limit position to be operated in pushing operation is set.
Servo motor speed / Speed limit value	0 to Allowable rotation speed	r/min mm/s (Note2)	Set the command rotation speed of the servo motor during positioning execution. When pushing operation is selected with auxiliary function "16" or "18", the speed limit value during pushing operation is set. Set the value below the instantaneous allowable rotation speed of the servo motor to be used. During pushing operation, if the setting exceeds [Pr.PS05 Pushing operation speed upper limit], the speed is limited by the speed of [Pr.PS05].
Acceleration time constant	0 to 20000	ms	Set the time until the servo motor reaches the rated rotation speed.
Deceleration time constant	0 to 20000	ms	Set the time from the rated rotation speed of the servo motor to the stop.
Dwell	0 to 20000	ms	Set the dwell. When "0", "2", "16" or "18" is set for the auxiliary function, the dwell of this point table No is disabled. Set "1", "3", "8" or "9" for the auxiliary function, and continuous operation is performed when dwell = 0. When the dwell is set, the position command of the selected point table is completed, and the position command of the next point table starts after the set dwell has elapsed. When performing the pushing operation, always set 0 to the dwell of the point table immediately before the pushing operation. (Note4)
Auxiliary function	0 to 3, 8 to 11, 16, 18		Set the auxiliary function. (1) When using this point table for positioning operation (absolute value command method) 0: Executes the selected point table automatic operation. 1: Automatic continuous operation is performed without stopping the next point table. 8: Executes automatic continuous operation without stopping the selected point table at startup. 9: Executes automatic continuous operation without stopping point table number 1. (2) When using this point table for positioning operation (incremental value command method) 2: Executes one selected point table automatic operation. 3: Executes automatic continuous operation without stopping the next point table. 10: Execute automatic continuous operation to the selected point table at startup

			11: Executes automatic continuous operation without stopping point table number 1. (3) When using this point table in pushing operation (absolute value command method) 16: Pushing until the next point table is executed when ST1 (start signal) is turned on To keep driving. Set the Push limit position as an absolute value. Set following the positioning operation using the auxiliary function "1" or "3". (Note3) (Note4) (4) When using this point table in pushing operation (incremental value command method) 18: Pushing until the next point table is executed by turning on ST1 (start signal) To keep driving. Set the Push limit position by the increment value. Set following the positioning operation using the auxiliary function "1" or "3". (Note3) (Note4) If a different rotation direction is set, the motor rotates in the reverse direction after checking for smoothing zero (command output). If "1" or "3" is set for point table number 255, [AL. 61] will be generated when the point table is executed.
M code	0 to 99		The first and second digits of the M code are output in 4-bit binary. When the point table number including the pushing operation is started, no M code is output.
Pushing torque	0 to 1000	0.1%	Set the pushing torque (in units of [0.1%]). This setting is valid when pushing operation is selected with auxiliary function "" 16 "or" 18 ". Set as the maximum torque = 1000 ([0.1%] unit). If 0 (push torque 0.0%) is set, the push torque is disabled. If the pushing torque exceeds the upper limit, the pushing torque is limited. (For details, refer to section 5.7.2 (1) of this specification.)

Note1.	When setting μm or inch, the decimal point position is changed by STM setting.
3.	It does not support single pushing operation. [AL7F.4 Pushing start error] occurs when ST1 (start signal) is turned on by specifying a point table No. with "16" or "18" set in the auxiliary function of point table data.
4.	[AL7F.4 Pushing start error] will occur if a value other than 0 is set to the dwell of the point table immediately before the pushing operation.

17.7.5 About pushing operation in the position address increasing direction



(1) Point table setting example

a) For positioning operation (absolute value command method) and pushing operation (absolute value command method)

Point table No.	**Position data / Pushing limit position [10^stm μm]**	Servo motor rotation speed / speed limit value [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	**Auxiliary function**	M code	Pushing torque [0.1%]
1	**8.00**	3000	100	150	0	**1**	0(Note1)	0(Note1)
2	**12.00**	500	0(Note1)	0(Note1)	0(Note1)	**16**	0(Note1)	500
3	**0**	2000	100	300	0	**0**	15	0(Note1)

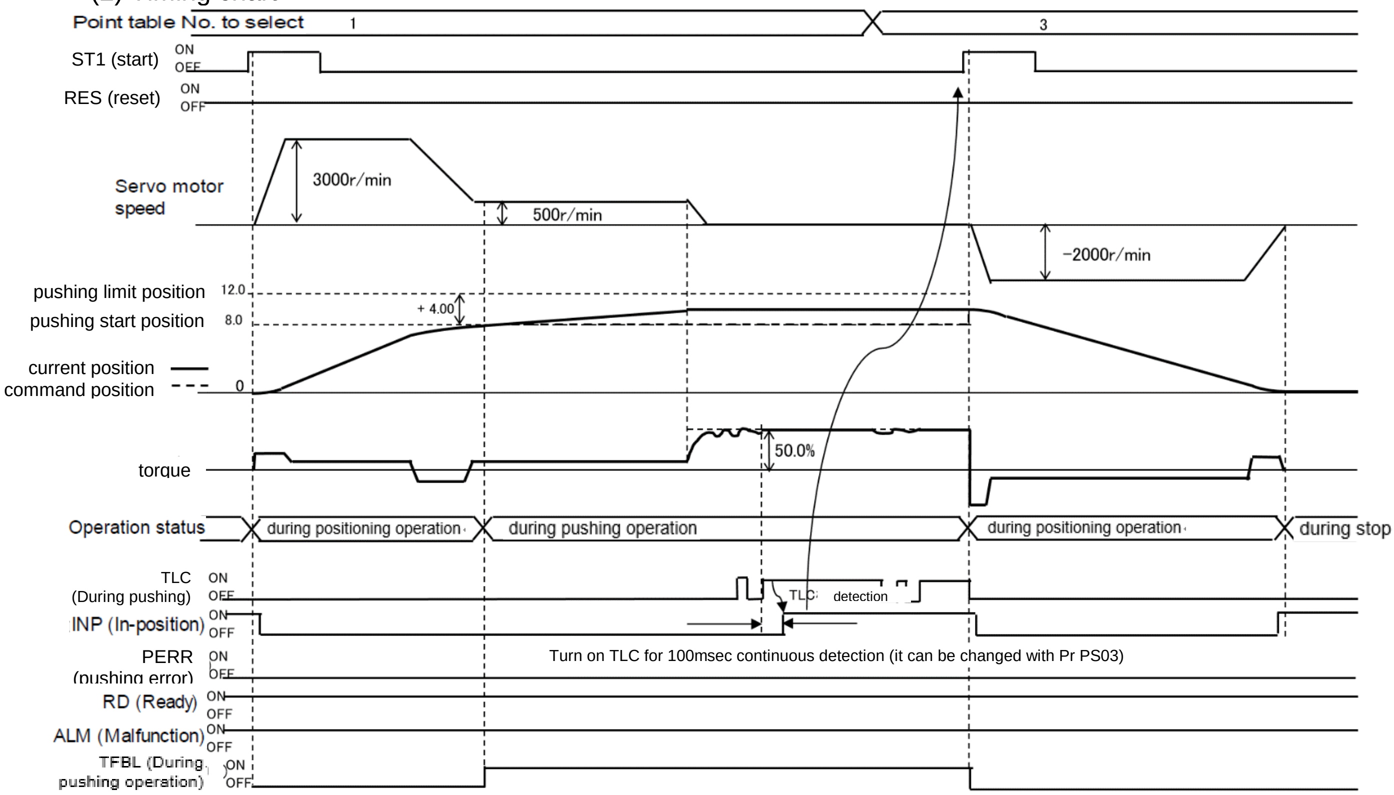
Note1 : The set value of the point table becomes invalid. Refer to section 6.1.3 of this specification for details.

b) For positioning operation (absolute value command method) and pushing operation (incremental value command method)

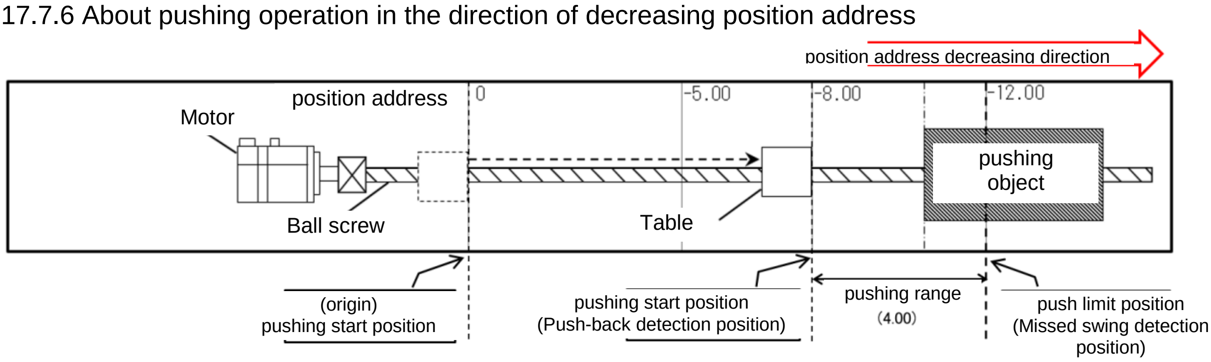
Point table No.	**Position data / Pushing limit position [10^stm μm]**	Servo motor rotation speed / speed limit value [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	**Auxiliary function**	M code	Pushing torque [0.1%]
1	**8.00**	3000	100	150	0	**1**	0(Note1)	0(Note1)
2	**4.00**	500	0(Note1)	0(Note1)	0(Note1)	**18**	0(Note1)	500
3	**0**	2000	100	300	0	**0**	15	0(Note1)

Note1 : The set value of the point table becomes invalid. Refer to section 6.1.3 of this specification for details.

(2) Timing chart



17.7.6 About pushing operation in the direction of decreasing position address



(1) Point table setting example

a) For positioning operation (absolute value command method) and pushing operation (absolute value command method)

Point table No.	**Position data / Pushing limit position [10^stm μm]**	Servo motor rotation speed / speed limit value [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	**Auxiliary function**	M code	Pushing torque [0.1%]
1	**-8.00 (Note1)**	3000	100	150	0	**1**	0(Note2)	0(Note2)
2	**-12.00**	500	0(Note2)	0(Note2)	0(Note2)	**16**	0(Note2)	500
3	**0**	2000	100	300	0	**0**	15	0(Note2)

Note1 : In the case of the position address decreasing direction, set the position data of the point table data / Push limit position with a negative value.

Note2 : The set value of the point table becomes invalid. Refer to section 6.1.3 of this specification for details.

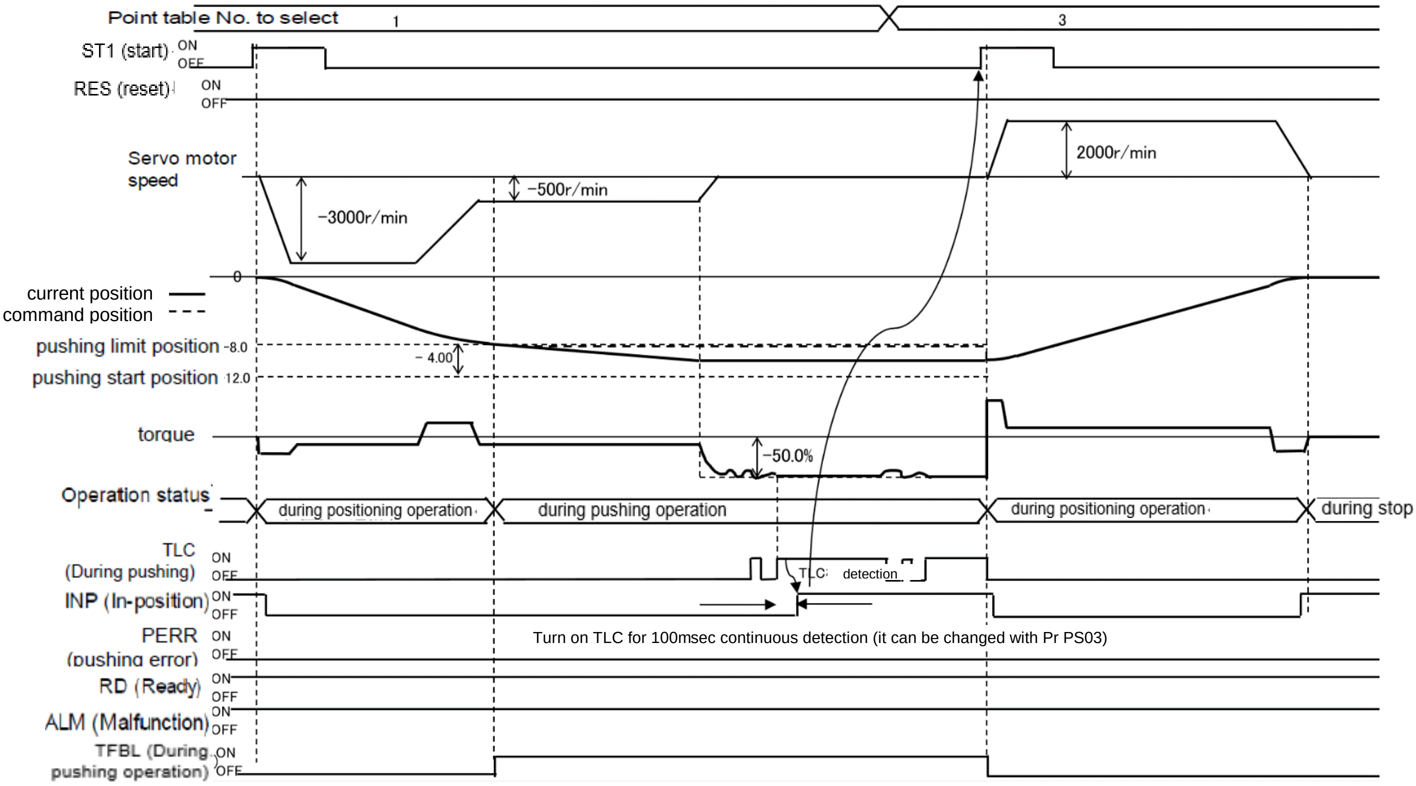
b) For positioning operation (absolute value command method) and pushing operation (incremental value command method)

Point table No.	**Position data / Pushing limit position [10^stm μm]**	Servo motor rotation speed / speed limit value [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	**Auxiliary function**	M code	Pushing torque [0.1%]
1	**-8.00 (Note1)**	3000	100	150	0	**1**	0(Note2)	0(Note2)
2	**-4.00 (Note1)**	500	0(Note2)	0(Note2)	0(Note2)	**18**	0(Note2)	500
3	**0**	2000	100	300	0	**0**	15	0(Note2)

Note1 : In the case of the position address decreasing direction, set the position data of the point table data / Push limit position with a negative value.

Note2 : The set value of the point table becomes invalid. Refer to section 6.1.3 of this specification for details.

(2) Timing chart



17.8 Pushing error detection

If the pushing operation cannot be continued or the pushing operation cannot be started during the point table type pushing operation, a pushing error is detected, the dynamic brake is activated, and the motor stops.
At this time, PERR (Pushing error) turns on. PERR turns off when RES (reset) or ST1 (start signal) turns on. During alarm [7F. □], turning off PERR (Pushing error) by ST1 (start signal) is disabled.

Pushing error is detected due to the following factors.

Detailed name	Detection factor	Alarm No.	Remarks
Missed swing error	The current position has exceeded the Push limit position during the pushing operation.	7F.1	[Pr.PS01] Select the detection method with x .
Push back error	During the pushing operation, the current position is pushed back from the starting position.	7F.2	[Pr.PS01] x can be used to select the detection method.
Pushing direction error	Abnormal relationship between Positioning start position, Pushing start position, Push limit position	7F.3	
Pushing start error	The starting method of the pushing operation is abnormal.	7F.4	

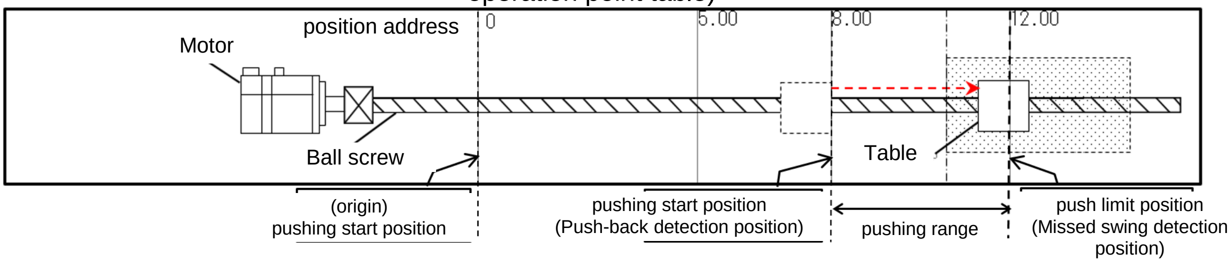
※For details of the alarm [7F. □], refer to Section 6.3 Troubleshooting in this specification.

> POINT
>
> ● In the case of an incremental system, the origin is lost when the servo is turned off due to an alarm.
> After resetting the alarm with RES (reset), perform home return again.
> Or, select [Pr.PT02] 1 (follow up at servo-off)
> Origin disappearance can be avoided.

17.8.1 Missed swing motion detection

If the current position reaches the Push limit position during the pushing operation, a Pushing error occurs and the motor stops due to dynamic brake (DB) stop (alarm [AL7F.1 Missed swing error] occurs) or servo lock stop (position lock). To do.
Select the stop method in parameter setting ([Pr.PS01]   x   ).
The pushing range is determined by the position data of the point table data / Push limit position.

Missed swing detection position：Push limit position (Determined by Push limit position in pushing operation point table)



(1) Point table setting example

a) For positioning operation (absolute value command method) and pushing operation (absolute value command method)

Point table No.	Position data / Pushing limit position [10 stm m]	Servo motor rotation speed / speed limit value [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	Auxiliary function	M code	Pushing torque [0.1%]
1	8.00	3000	100	150	0	1	0(Note1)	0(Note1)
2	**12.00 → (Missed swing detection position 12.00)**	500	0(Note1)	0(Note1)	0(Note1)	**16**	0(Note1)	500
3	0	2000	100	300	0	0	15	disabled

Note1： The set value of the point table becomes invalid. Refer to section 6.1.3 of this specification for details.

b) For positioning operation (absolute value command method) and pushing operation (incremental value command method)

Point table No.	Position data / Pushing limit position [10 stm m]	Servo motor rotation speed / speed limit value [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	Auxiliary function	M code	Pushing torque [0.1%]
1	8.00	3000	100	150	0	1	0(Note1)	0(Note1)
2	**4.00 → (Missed swing detection position 8.00＋4.00=12.00)**	500	0(Note1)	0(Note1)	0(Note1)	**18**	0(Note1)	500
3	0	2000	100	300	0	0	15	0(Note1)

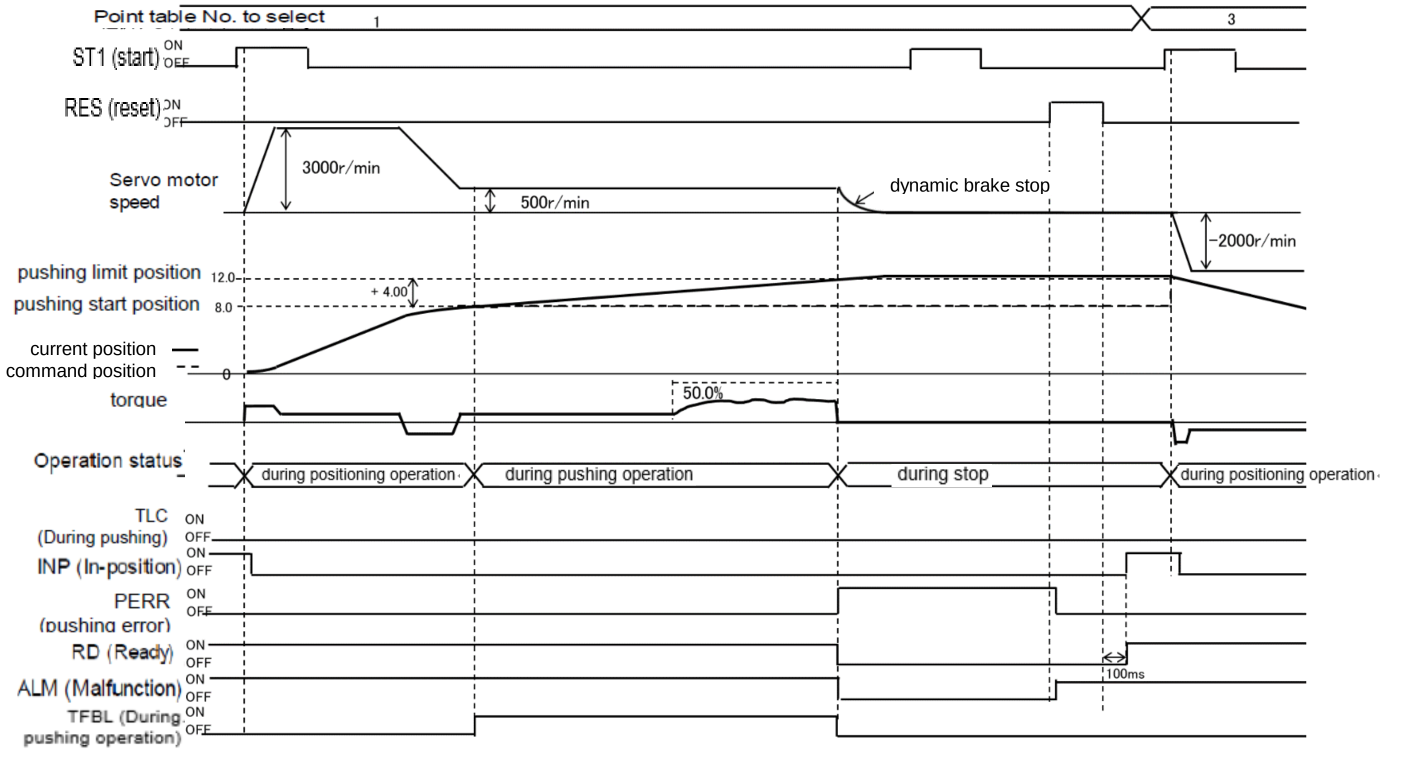
Note1： The set value of the point table becomes invalid. Refer to section 6.1.3 of this specification for details.

(2)Timing chart

a) Response during miss swing operation ([Pr.PS01] 1 dynamic brake (DB) stop method)

When the current position reaches the Push limit position during the pushing operation, PERR (Pushing error) turns on, an alarm [AL7F.1 Pushing operation missed detection error] occurs, the pushing operation is interrupted, and the dynamic brake is activated. Operates and stops the servo motor.

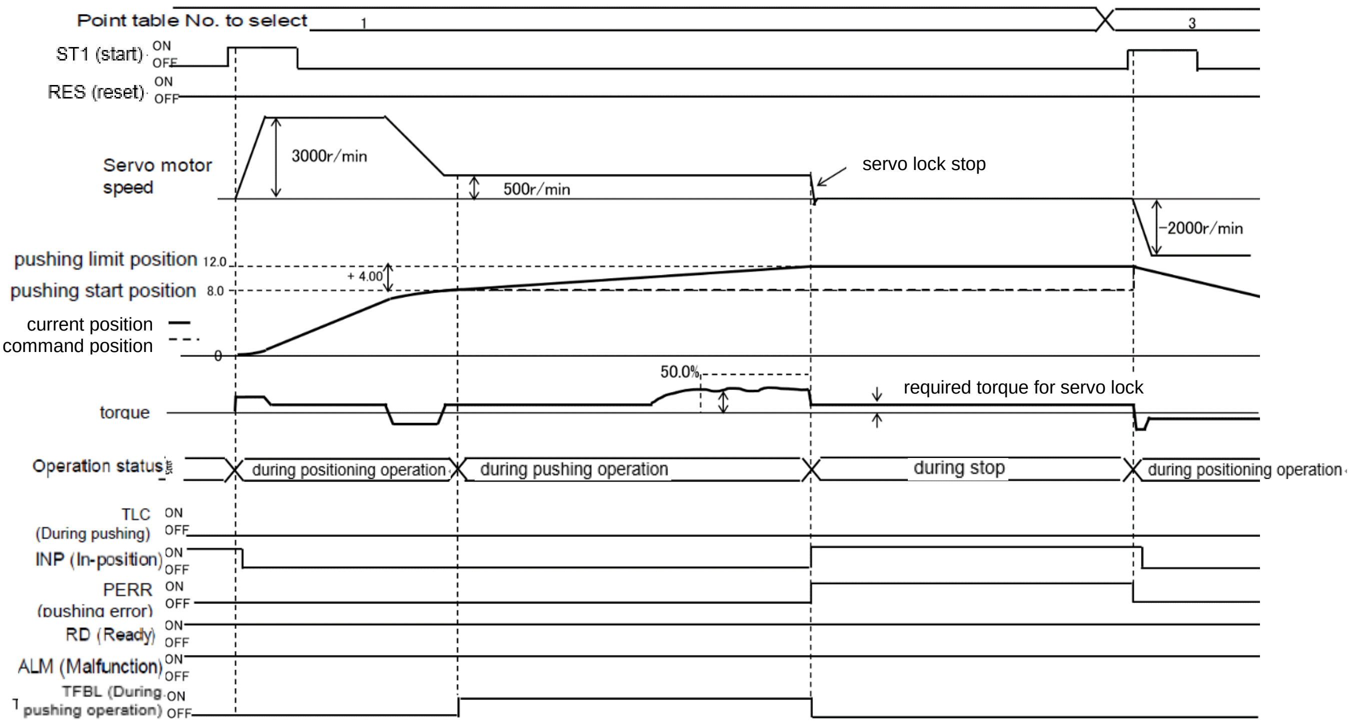
RES (reset) resets the alarm and turns off PERR (Pushing error). PERR does not turn off with ST1 (start signal).



b) Response during miss swing operation ([Pr.PS01] 0 servo lock stop method)

If the current position reaches the Push limit position during pushing operation, PERR (Pushing error) turns on, pushing operation is interrupted, and the servo motor stops.

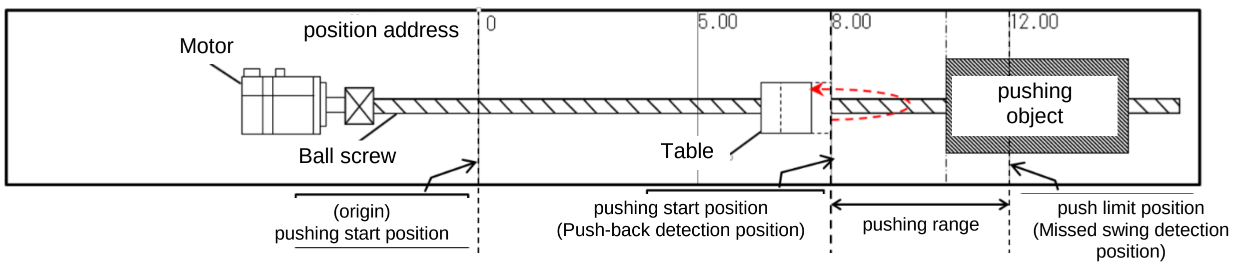
PER (Pushing error) is turned off by RES (reset) or ST1 (start signal).



17.8.2 Push-back operation detection

If the current position reaches the Pushing start position during the pushing operation, a Pushing error occurs, and the servomotor stops due to the dynamic brake (DB) stop (alarm [AL7F.2 Push back error] occurs) or the servo lock stops (position lock). Stop. Select the stop method in parameter setting ([Pr.PS01] x).
The pushing range is determined by the position data of the point table data / Push limit position.

Push-back detection position : Pushing start position
(Determined by the position data of the point table immediately before the pushing operation point table)



(1) Point table setting example

a)For positioning operation (absolute value command method) and pushing operation (absolute value command method)

Point table No.	Position data / Pushing limit position [10 stm m]	Servo motor rotation speed / speed limit value [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	Auxiliary function	M code	Pushing torque [0.1%]
1	**8.00 → (Push-back detection position 8.00)**	3000	100	150	0	1	0(Note1)	0(Note1)
2	12.00	500	0(Note1)	0(Note1)	0(Note1)	**16**	0(Note1)	500
3	0	2000	100	300	0	0	15	0(Note1)

Note1 : The set value of the point table becomes invalid. Refer to section 6.1.3 of this specification for details.。

b) For positioning operation (absolute value command method) and pushing operation (incremental value command method)

Point table No.	Position data / Pushing limit position [10 stm m]	Servo motor rotation speed / speed limit value [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	Auxiliary function	M code	Pushing torque [0.1%]
1	**8.00 → (Push-back detection position 8.00)**	3000	100	150	0	1	0(Note1)	0(Note1)
2	4.00	500	0(Note1)	0(Note1)	0(Note1)	**18**	0(Note1)	500
3	0	2000	100	300	0	0	15	0(Note1)

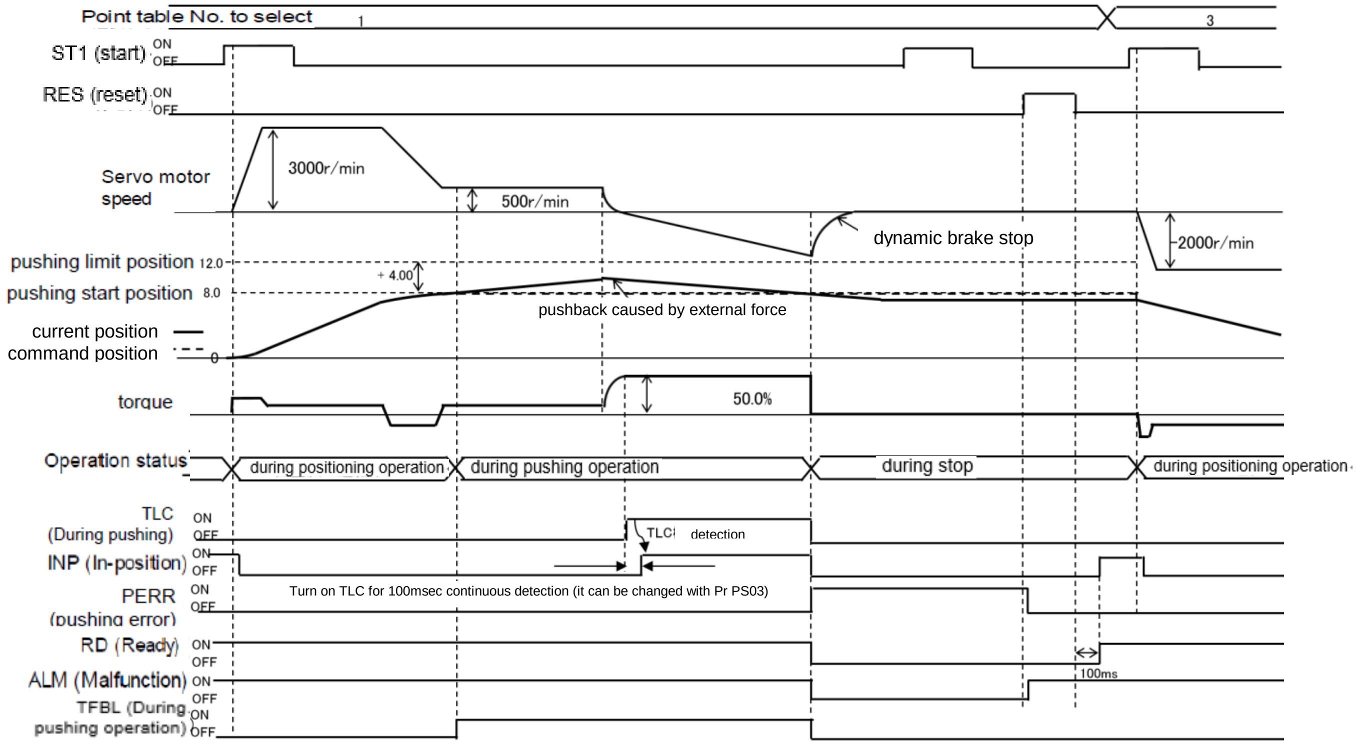
Note1 : The set value of the point table becomes invalid. Refer to section 6.1.3 of this specification for details.。

(2)Timing chart

a) Response during push-back operation ([Pr.PS01] 1 dynamic brake (DB) stop method)

When the current position reaches the Pushing start position during the pushing operation, PERR (Pushing error) turns on, an alarm [AL7F.2 Pushing operation pushback detection error] occurs, the pushing operation is interrupted, and the dynamic braking is stopped. Operates and the servo motor stops.

RES (reset) resets the alarm and turns off PERR (Pushing error). PERR does not turn off with ST1 (start signal).

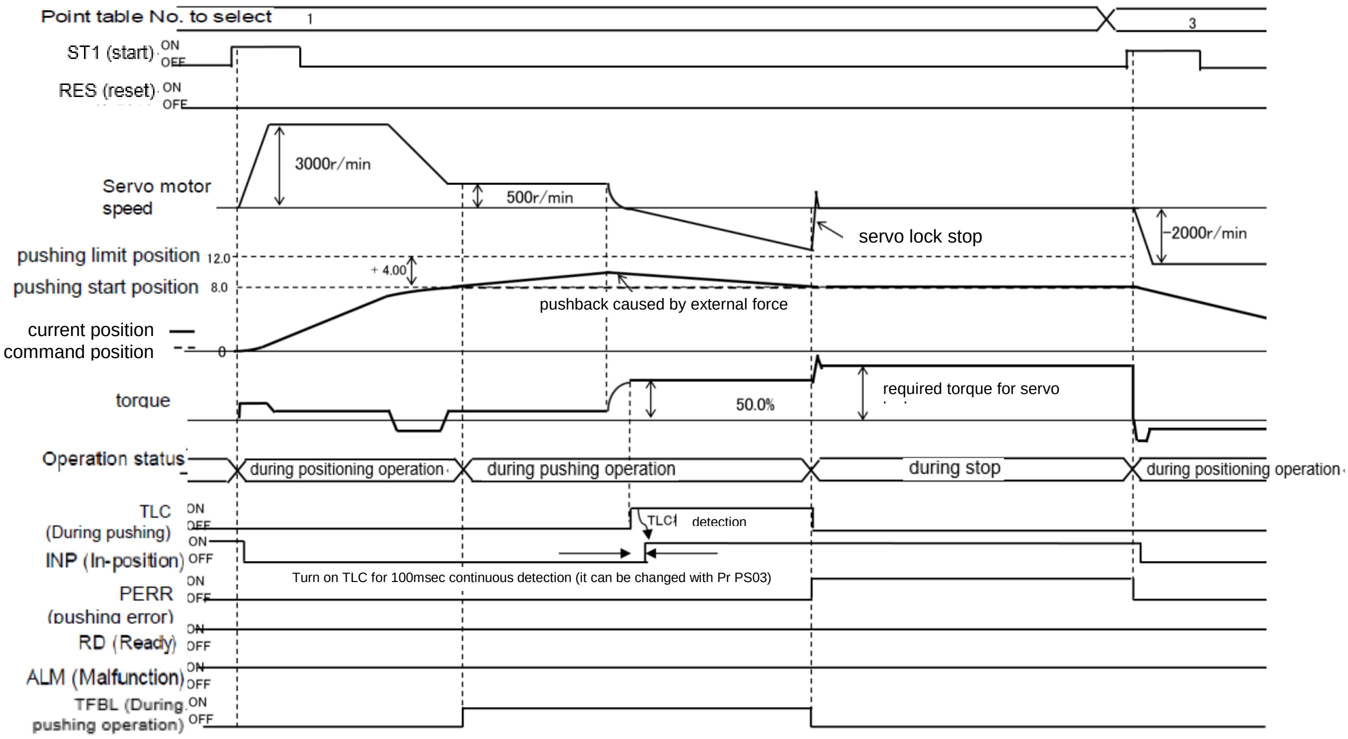


b) Response during push-back operation ([Pr.PS01] 0 servo lock stop method)

When the current position reaches the Pushing start position during pushing operation, PERR (Pushing error) turns on, pushing operation is interrupted, and the servo motor stops.

PER (Pushing error) is turned off by RES (reset) or ST1 (start signal).

17. Positioning mode (pushing operation)

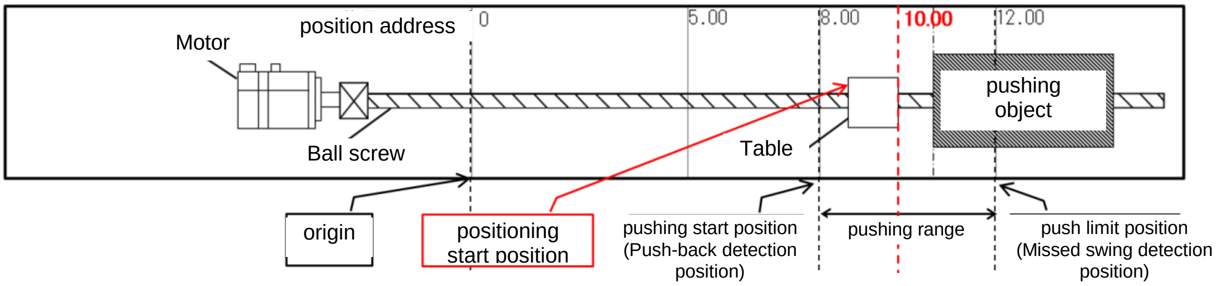


17.8.3 Pushing direction error

If the relationship between Positioning start position, Pushing start position, and Push limit position does not satisfy
Positioning start position＜Pushing start position≦Push limit position, or
Positioning start position＞Pushing start position≧Push limit position,
[AL7F.3 Pushing direction error] occurs after the command position reaches the Pushing start position, and PERR (Pushing error) turns on. The dynamic brake operates and the servo motor stops.
RES (reset) resets the alarm and turns off PERR (Pushing error). PERR does not turn off with ST1 (start signal).

17.8.4 When the positioning start position including the pushing operation is incorrect

When the start signal (ST1) is turned on within the pushing range as shown below, [AL7F.3] is generated after the current reaches the pushing start position.
In this case, move out of the pushing range and then start the point table including the pushing operation again.
Alarm detection under these conditions can be detected when the pushing start position is set by an absolute value command.



(1) Point table setting example

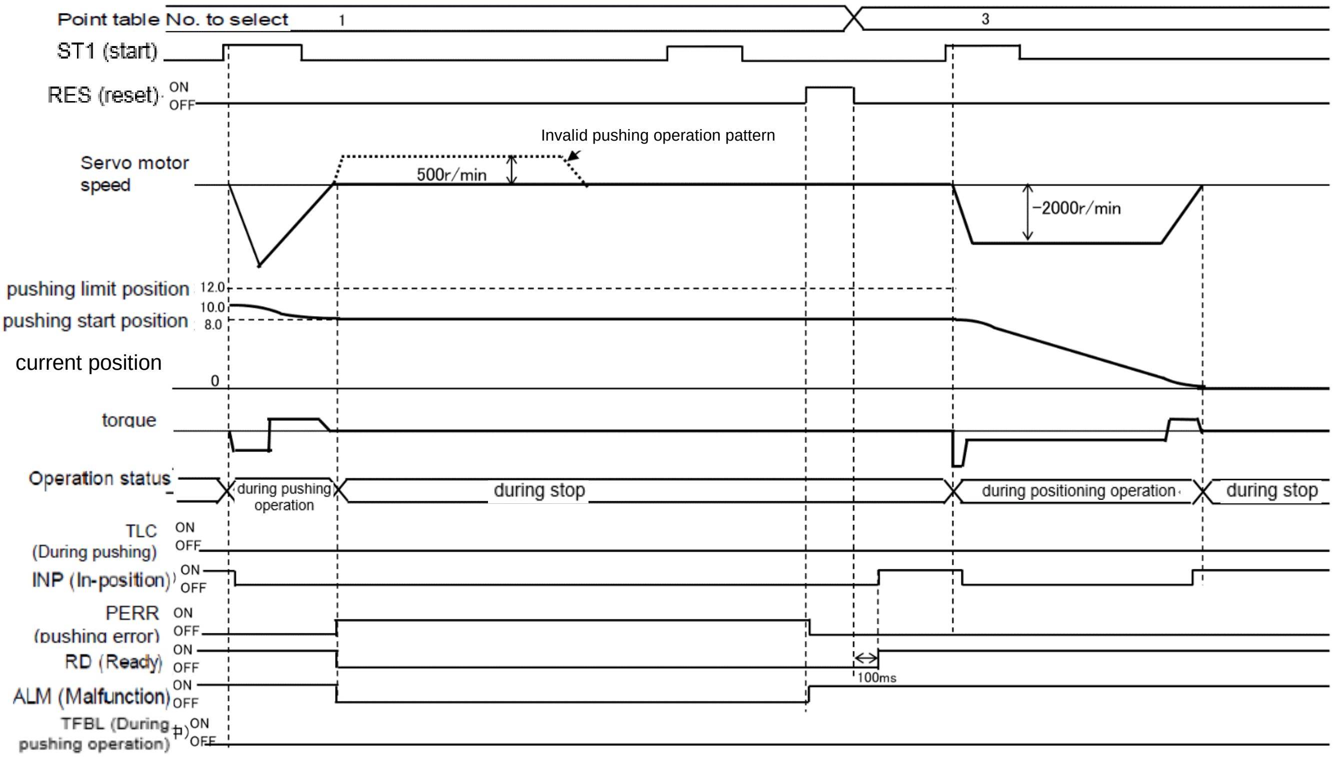
a) For positioning operation (absolute value command method) and pushing operation (absolute value command method)

Point table No.	Position data / Pushing limit position [10 stm m]	Servo motor rotation speed / speed limit value [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	Auxiliary function	M code	Pushing torque [0.1%]
1	8.00	3000	100	150	0	1	0(Note1)	0(Note1)
2	**12.00**	500	0(Note1)	0(Note1)	0(Note1)	**18**	0(Note1)	500
3	0	2000	100	300	0	0	15	0(Note1)

Note1: The set value of the point table becomes invalid. Refer to section 6.1.3 of this specification for details.

(2)Timing chart

Wrong positioning start position (Starts point table positioning operation from current position of 10.00)

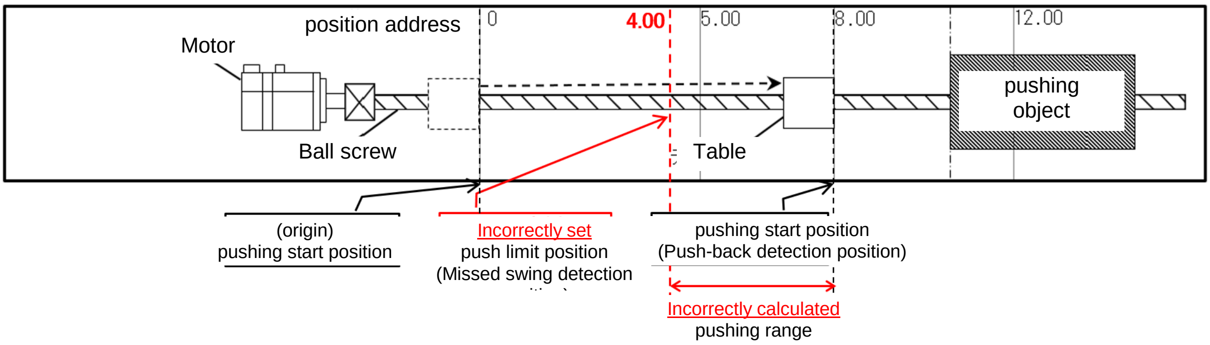


17.8.5 When the point table setting value is incorrect

[AL7F.3] occurs if the push limit position setting of the point table is incorrect.

If the position data of the point table data / Push limit position is set incorrectly, [AL7F.3] will be generated after the start signal (ST1) is turned on, the positioning starts and the command position reaches the pushing start position.

In this case, correct the position data in the point table data of the pushing operation.



(1)Point table setting example

a) For positioning operation (absolute value command method) and pushing operation (absolute value command method)

Point table No.	Position data / Pushing limit position [10 stm m]	Servo motor rotation speed / speed limit value [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	Auxiliary function	M code	Pushing torque [0.1%]	Point table No.
1	8.00	3000		100	150	0	1	0(Note1)	0(Note1)
2	**4.00**	500		0(Note1)	0(Note1)	0(Note1)	**16**	0(Note1)	500
3	0	2000		100	300	0	0	15	disabled

Note1: The set value of the point table becomes invalid. Refer to section 6.1.3 of this specification for details.

b) For positioning operation (absolute value command method) and pushing operation (incremental value command method)

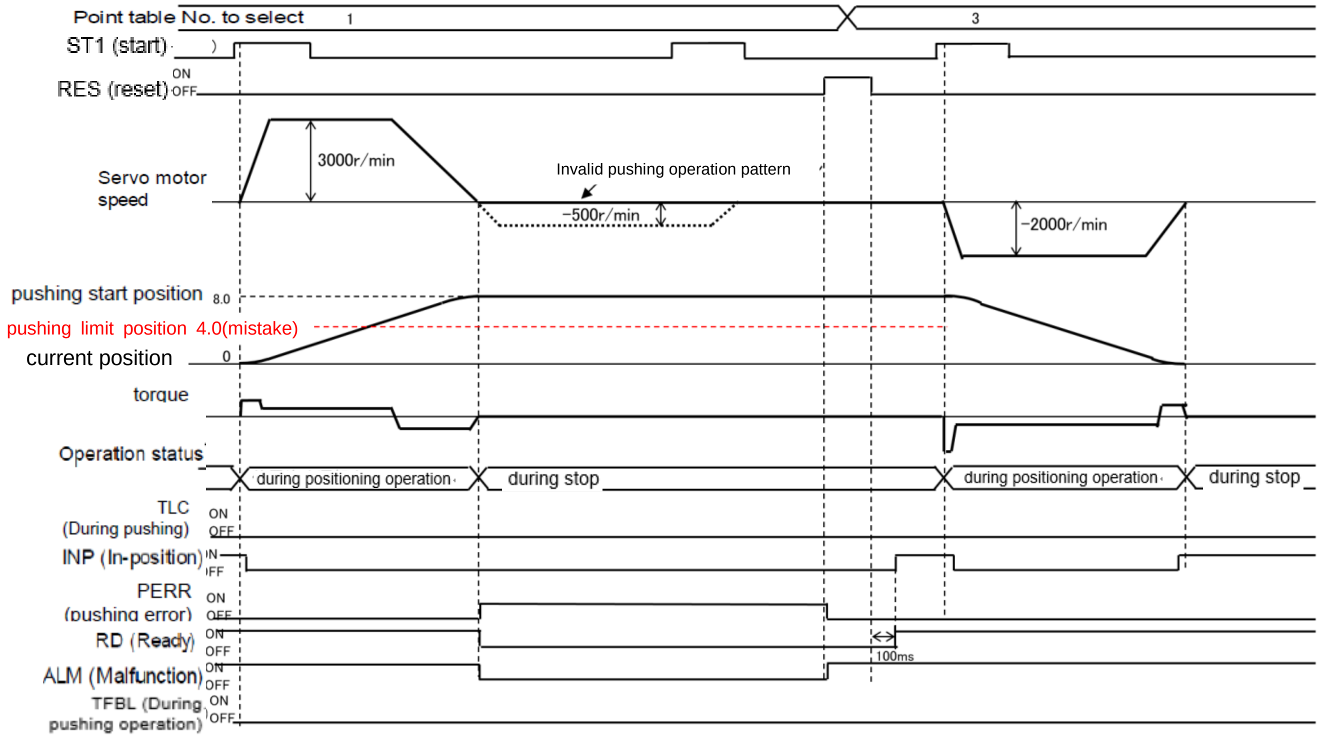
Point table No.	Position data / Pushing limit position [10 stm m]	Servo motor rotation speed / speed limit value [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	Auxiliary function	M code	Pushing torque [0.1%]
1	8.00	3000	100	150	0	1	0(Note1)	0(Note1)
2	**-4.00 → (Push limit position 8.00－4.00=4.00)**	500	0(Note1)	0(Note1)	0(Note1)	**18**	0(Note1)	500
3	0	2000	100	300	0	0	15	0(Note1)

Note1: The set value of the point table becomes invalid. Refer to section 6.1.3 of this specification for details.

(2)Timing chart

The set value in the point table is incorrect

(Pushing start position < Not pushing limit position)



17.8.6 Pushing start error

[AL7F.4 Pushing start error] occurs when there is an error in the pushing operation start method, PERR (Pushing error) turns on, and the dynamic brake stops.

17.8.7 When pushing operation is started independently

When ST1 (start signal) is turned on by specifying a point table No. with "16" or "18" set in the auxiliary function of point table data, PERR (Pushing error) turns on and [AL7F.4 Pushing start error] occurs. In this case, the servo motor does not operate.
RES (reset) resets the alarm and turns off PERR (Pushing error). PERR does not turn off with ST1 (start signal).

17.8.8 When the dwell is set immediately before the pushing operation

When the dwell is set immediately before the pushing operation, [AL7F.4 Pushing start error] occurs after reaching the pushing start position and the dwell time has elapsed, PERR (Pushing error) is turned on, and the dynamic brake is activated. The servo motor stops.
In this case, set the dwell of the point table data immediately before the pushing operation to 0 .
RES (reset) resets the alarm and turns off PERR (Pushing error). PERR does not turn off with ST1 (start signal).

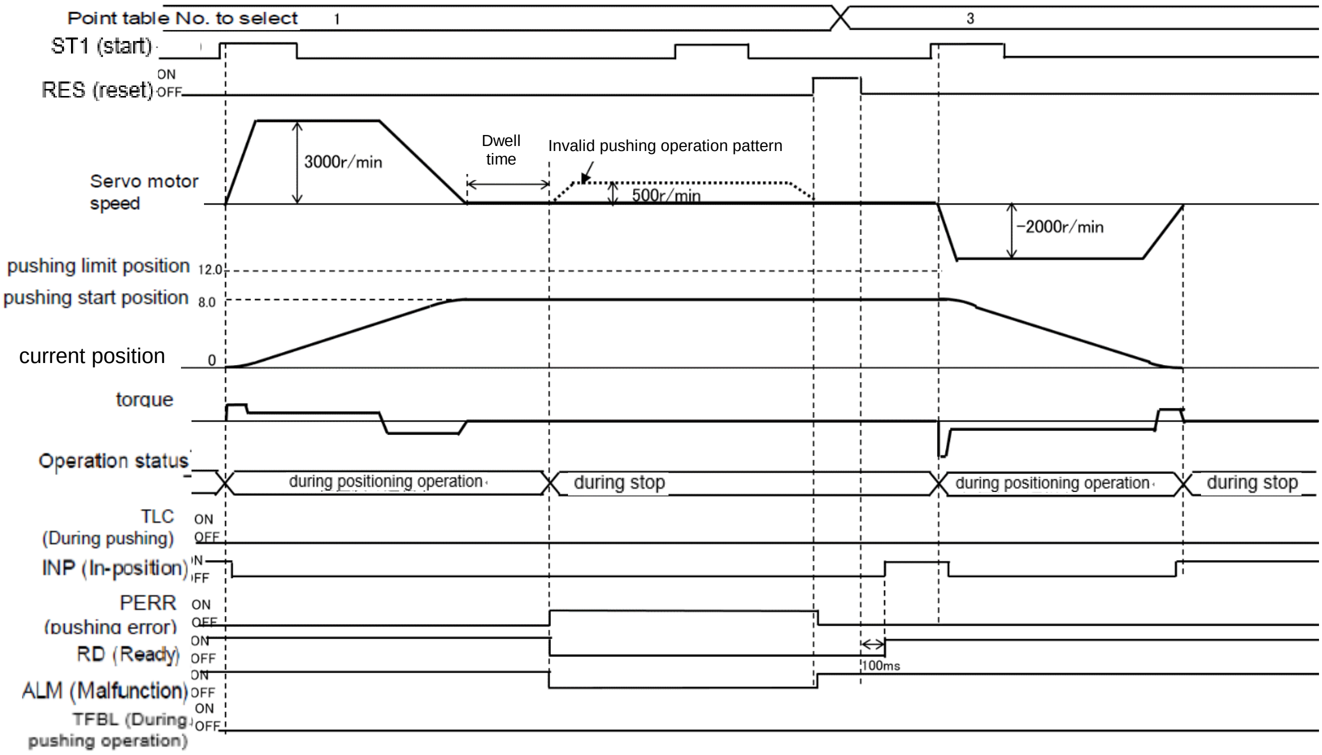
(1) Point table setting example

a) For positioning operation (absolute value command method) and pushing operation (absolute value command method)

Point table No.	Position data / Pushing limit position [10 stm m]	Servo motor rotation speed / speed limit value [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	Auxiliary function	M code	Pushing torque [0.1%]
1	8.00	3000	100	150	**100**	1	0(Note1)	0(Note1)
2	12.00	500	0(Note1)	0(Note1)	0(Note1)	16	0(Note1)	500
3	0	2000	100	300	0	0	15	0(Note1)

Note1: The set value of the point table becomes invalid. Refer to section 6.1.3 of this specification for details.

(2) Timing chart



17.9 PARAMETERS

Refer to Chapter 16 for items not described in this chapter.

> **POINT**
>
> ●To enable a parameter whose symbol is preceded by *, cycle the power after setting it.
>
> ●The symbols in the control mode column mean as follows.
>
> CP: Positioning mode (point table method)
>
> CL: Positioning mode (program method)
>
> PS: Positioning mode (indexer method)
>
> ●Setting a value out of the setting range in each parameter will trigger [AL. 37 Parameter error].

17.9.1 Positioning control parameters ([Pr. PT_ _])

No.	Symbol	Name	Initial value	Unit	Operation mode	Control mode		
					Standard	CP	CL	PS
PT01	*CTY	Command mode selection	0000h		○	○	○	○
PT02	*TOP1	Function selection T-1	0000h		○	○	○	○
PT03	*FTY	Feeding function selection	0000h		○	○	○	
PT04	*ZTY	Home position return type	0010h		○	○	○	○
PT05	ZRF	Home position return speed	100	[r/min]	○	○	○	○
PT06	CRF	Creep speed	10	[r/min]	○	○	○	○
PT07	ZST	Home position shift distance	0	[m]	○	○	○	○
PT08	*ZPS	Home position return position data	0	10^{STM} [m]	○	○	○	
PT09	DCT	Travel distance after proximity dog	1000	10^{STM} [m]	○	○	○	
PT10	ZTM	Stopper type home position return stopper time	100	[ms]	○	○	○	
PT11	ZTT	Stopper type home position return torque limit value	15.0	[%]	○	○	○	
PT12	CRP	Rough match output range	0	10^{STM} [m]	○	○	○	○
PT13	JOG	JOG operation	100	[r/min]	○	○	○	○
PT14	*BKC	Backlash compensation	0	[pulse]	○	○	○	○
PT15	LMPL	Software limit +	0	10^{STM} [m]	○	○	○	
PT16	LMPH							
PT17	LMNL	Software limit -	0	10^{STM} [m]	○	○	○	
PT18	LMNH							
PT19	*LPPL	Position range output address +	0	10^{STM} [m]	○	○	○	
PT20	*LPPH							
PT21	*LNPL	Position range output address -	0	10^{STM} [m]	○	○	○	
PT22	*LNPH							
PT23	OUT1	OUT1 output setting time	0	[ms]	○		○	
PT24	OUT2	OUT2 output setting time	0	[ms]	○		○	
PT25	OUT3	OUT3 output setting time	0	[ms]	○		○	
PT26	*TOP2	Function selection T-2	0000h		○	○	○	
PT27	*ODM	Operation mode selection	0000h		○			○
PT28	*STN	Number of stations per rotation	8	[stations]	○			○
PT29	*TOP3	Function selection T-3	0000h		○	○	○	○

No.	Symbol	Name	Initial value	Unit	Operation mode: Standard	Control mode: CP	Control mode: CL	Control mode: PS
PT30	MSTL	Mark sensor stop travel distance	0	10^{STM} [μm]	○	○	○	
PT31	MSTH		0		○	○	○	
PT32		For manufacturer setting	0001h					
PT33			0000h					
PT34	*PDEF	Point table/program default	0000h		○	○	○	
PT35	*TOP5	Function selection T-5	0000h		○	○	○	
PT36		For manufacturer setting	0000h					
PT37			10					
PT38	*TOP7	Function selection T-7	0000h		○			○
PT39	INT	Torque limit delay time	100	[ms]	○			○
PT40	*SZS	Station home position shift distance	0	[pulse]	○			○
PT41	ORP	Home position return inhibit function selection	0000h		○	○	○	○
PT42	*OVM	Digital override minimum multiplication	0	[%]	○			○
PT43	*OVS	Digital override pitch width	0	[%]	○			○
PT44		For manufacturer setting	0000h					
PT45	*CZTY	Home position return type 2	0000h					
PT46		For manufacturer setting	0000h					
PT47			0000h					
PT48			0000h					

17.9.2 Special setting parameter ([Pr.PS_ _])

No.	Symbol	Name	Initial value	Unit	Operation mode	Control mode		
					Standard	CP	CL	PS
PS01	*SOP1	Pushing error detection method	0010h		○	○		
PS02		For manufacturer setting	0		○	○		
PS03	*PENDT	Pushing completion detection time	100	[ms]	○	○		
PS04	TLMT	Pushing torque upper limit	0.0	[%]	○	○		
PS05	VLMT	Pushing operation Speed limit upper limit	0	[r/min]	○	○		
PS06		For manufacturer setting	0000h					
PS07			0000h					
PS08			0000h					
PS09			0000h					
PS10			0000h					
PS11			0000h					
PS12			0000h					
PS13			0000h					
PS14			0000h					
PS15			0000h					
PS16			0000h					
PS17			0000h					
PS18			0000h					
PS19			0000h					
PS20			0000h					
PS21			0000h					
PS22			0000h					
PS23			0000h					
PS24			0000h					
PS25			0000h					
PS26			0000h					
PS27			0000h					
PS28			0000h					
PS29			0000h					
PS30			0000h					
PS31			0000h					
PT32			0000h					

17.10 Detailed list of parameters

17.10.1 Basic setting parameters ([Pr. PA_ _])

Refer to Chapter 7.2.1 for items not described in this chapter.

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode		
				CP	CL	PS
PA01 *STY Operation mode	_ _ _ x	Control mode selection Select a control mode. 0 to 5: Not used in positioning mode. 6: Positioning mode (point table method) 7: Positioning mode (program method) 8: Positioning mode (Equal division indexing method) Point table method When using the pushing operation, set "6" positioning mode (point table method).	0h	○	○	○
	_ _ x _	Do not change this value.	0h	○	○	○
	_ x _ _	Do not change this value.	0h	○	○	○
	x _ _ _	For manufacturer setting	1h			

17.10.2 I/O setting parameters ([Pr. PD_ _])

Refer to Chapter 7.2.4 for items not described in this chapter.

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PD23 *DO1 Output device selection 1	_ _ x x	Device selection Any output device can be assigned to the CN1-22 pin. Refer to below table for settings.	04h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			

Selectable output devices

Setting value	Output device (Note1) CP	CL	PS
00	Always off	Always off	Always off
02	RD	RD	RD
03	ALM	ALM	ALM
04	INP	INP	INP
05	MBR	MBR	MBR
06	DB	DB	DB
07	TLC	TLC	TLC
08	WNG	WNG	WNG
09	BWNG	BWNG	BWNG
0A	SA	SA	Always off
0B	VLC	Always off	Always off
0C	ZSP	ZSP	ZSP
0D	MTTR	MTTR	MTTR
0F	CDPS	CDPS	CDPS
10	CLDS	CLDS	CLDS
11	ABSV	ABSV	ABSV
19	PERR	Always off	Always off
1A	TFBL	Always off	Always off
1F	CPCC	CPCC	
23	CPO	CPO	CPO
24	ZP	ZP	ZP
25	POT	POT	Always off
26	PUS	PUS	Always off
27	MEND	MEND	MEND
29	CLTS	CLTS	
2B	CLTSM	CLTSM	
2C	PED	PED	
2D		SOUT	
2E		OUT1	
2F		OUT2	
30		OUT3	
31	ALMWNG	ALMWNG	ALMWNG
32	BW9F	BW9F	BW9F
33	MSDH	MSDH	
34	MSDL	MSDL	
37	CAMS	CAMS	
38	PT0		PS0
39	PT1		PS1
3A	PT2		PS2
3B	PT3		PS3
3C	PT4		PS4
3D	PT5		PS5
3E	PT6		PS6
3F	PT7		PS7

Note 1. CP: Positioning mode (point table method)
CL: Positioning mode (program method)
PS: Positioning mode (equal indexing method)

No./symbol/ name	Setting digit	Function	Initial value [unit]	Control mode CP	CL	PS
PD24 *DO2 Output device selection 2	_ _ x x	Device selection Any output device can be assigned to the CN1-23 pin. Refer to [Pr. PD23] for settings.	0Ch	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PD25 *DO3 Output device selection 3	_ _ x x	Device selection Any output device can be assigned to the CN1-24 pin. Refer to [Pr. PD23] for settings.	04h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PD26 *DO4 Output device selection 4	_ _ x x	Device selection Any output device can be assigned to the CN1-25 pin. Refer to [Pr. PD23] for settings.	07h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			
PD28 *DO6 Output device selection 6	_ _ x x	Device selection Any output device can be assigned to the CN1-49 pin. Refer to [Pr. PD23] for settings.	02h	○	○	○
	_ x _ _	For manufacturer setting	0h			
	x _ _ _		0h			

17.10.3 Positioning control parameters ([Pr.PT_ _])

Refer to Chapter 7.2.9 for items not described in this chapter.

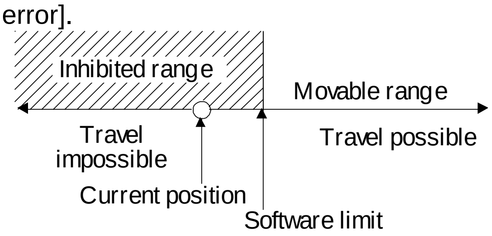
No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PT01 *CTY Command mode selection	_ _ _ x	Positioning command method selection 0: Absolute value command method 1: Incremental value command method Point table method When using the pushing operation, set the "0" absolute value command method.	0h	○	○	
	_ _ x _	For manufacturer setting	0h			
	_ x _ _	Position data unit 0: mm 1: inch 2: degree 3: pulse Point table method When using the pushing operation, set a value other than "2" degree.	0h	○	○	
	x _ _ _	RS-422 communication - Previous model equivalent selection Refer to the description of [Pr.PT01] in section 7.2.9 for details.	0h	○	○	○

17.10.4 Special setting parameter ([Pr.PS_ _])

No./symbol/name	Setting digit	Function	Initial value [unit]	Control mode CP	Control mode CL	Control mode PS
PS01 *SOP1 Pushing error detection method	_ _ _ x	Pushing error Set the missed swing detection method. 0: Servo lock stop method 1: Dynamic brake (DB) stop method (alarm [AL7F.1] is generated)	0h	○		
	_ _ x _	Pushing error Set the push-back detection method. 0: Servo lock stop method 1: Dynamic brake (DB) stop method (alarm [AL7F.2] is generated)	1h	○		
	_ x _ _	For manufacturer setting	0h			
	x _ _ _	For manufacturer setting	0h			
PS03 *PENDT Pushing completion detection time		Set the detection time of the pushing completion. During the pushing operation, set the continuous detection time from when the pushing torque is reached until INP turns on. Setting range: 50 to 500	100 [ms]	○		
PS04 TLMT Pushing torque upper limit		You can set the upper limit of the torque generated during the pushing operation. Use this parameter after referring to section 5.7. If the pushing torque of the point table data exceeds the upper limit, the pushing torque of the pushing operation is limited. (For details, refer to section 5.7.2 (1) of this specification.) Set as the maximum torque = 100.0 [%]. However, when "0.0" is set, this parameter operates as 100.0 [%]. Setting range: 0.0 to 100.0	0.0 [%]	○		
PS05 VLMT Pushing operation Speed limit upper limit		Set the upper limit of the speed limit during the pushing operation. If the speed limit value of the point table data exceeds the set value of this parameter, the speed limit value of the pushing operation will be limited to this parameter set value. However, if "0" is set, this parameter operates at the instantaneous allowable rotation speed. Setting range: 0 to instantaneous allowable rotation speed	0 [r/min]	○		

17.10.5 How to set the electronic gear
Refer to Chapter 7.3.

17.10.6 Software limit
The limit stop with the software limit ([Pr. PT15] to [Pr. PT18]) is the same as the motion of the stroke end. Exceeding a setting range will stop and servo-lock the shaft. This will be enabled at power-on and will be disabled at home position return. Setting a same value to "Software limit +" and "Software limit -" will disable this function. Setting a larger value to "Software limit -" than "Software limit +" will trigger [AL. 37.2 Parameter combination error].



The software limit during the equal division indexing method or during the point table method pushing operation is invalid.

17.10.7 Stop method for LSP（Forward rotation stroke end）off or LSN（Reverse rotation stroke end）Off
Refer to Chapter 7.5 for items not described in this chapter.

Select a servo motor stop method for when LSP (Forward rotation stroke end) or LSN (Reverse rotation stroke end) is off with the first digit of [Pr. PD30].
LSP (forward stroke end) or LSN (reverse stroke end) during point table type pushing operation is invalid.

17.10.8 Stop method at software limit detection
Refer to Chapter 7.6 for items not described in this chapter.

Select a stop method of the servo motor for when a software limit ([Pr. PT15] to [Pr. PT18]) is detected with the setting of the third digit in [Pr. PD30]. The software limit limits a command position controlled in the driver. Therefore, actual stop position will not reach the set position of the software limit.
The software limit during the equal division indexing method or during the point table method pushing operation is invalid.

17.11 Troubleshooting

17.11.1 Alarm list

Refer to Chapter 8 for items not described in this chapter.

Alarm No.	Alarm Name	Detail No.	Detail name	Stop Type (Note 1)	Alarm deactivation: Alarm reset	Alarm deactivation: Cycling the power	Alarm code: ACD3 (Bit 3)	Alarm code: ACD2 (Bit 2)	Alarm code: ACD1 (Bit 1)	Alarm code: ACD0 (Bit 0)
7F	Pushing error	7F.1	Missed swing	DB			1	1	0	1
		7F.2	Push back error	DB			1	1	0	1
		7F.3	Pushing direction error	DB			1	1	0	1
		7F.4	Pushing start error	DB			1	1	0	1

Note 1. DB: Dynamic brake stop (free run for products without dynamic brake)

17.11.2 Remedies for alarms

Refer to Chapter 8 for items not described in this chapter.

Alarm No.:7F		Name:Pushing error				
Alarm content		The current position has exceeded the pushing limit position during pushing operation. During the pushing operation, the current position is pushed back from the pushing start position. There is an error in the relationship between the positioning start position, pushing start position, and pushing limit position The starting method of the pushing operation is abnormal.				
Display	Detail name	Cause		Check method	Check result	Action
7F.1	Missed swing	(1)	There is no pressing target in the pressing range.	Check the installation position of the object to be pressed.	There is a problem with the installation position of the pressing target.	Set the object to be pressed in the correct position.
					There is no problem with the installation position of the pressing object.	Check (2).
		(2)	The object to be pressed was pushed out of the pressing range during the pressing. (Pushing torque is too strong)	Check the value of the pushing torque in the point table data for the pushing operation.	There is a problem with the set value of the pushing torque.	Set the pushing torque correctly.
					There is no problem with the set value of pushing torque.	Check (3).
		(3)	The setting of the pushing limit position is incorrect.	Check the value of the pushing limit position in the point table data for the pushing operation.	There is a problem with the set value of the pushing limit position.	Set the pushing limit position correctly.
					There is no problem with the set value of the pushing limit position.	Check (4).
		(4)	The setting of the pushing start position is incorrect.	Check the value of the position data of the point table data immediately before the point table for performing the pushing operation.	There is a problem with the set value of the pushing start position.	Set the pushing start position correctly.。

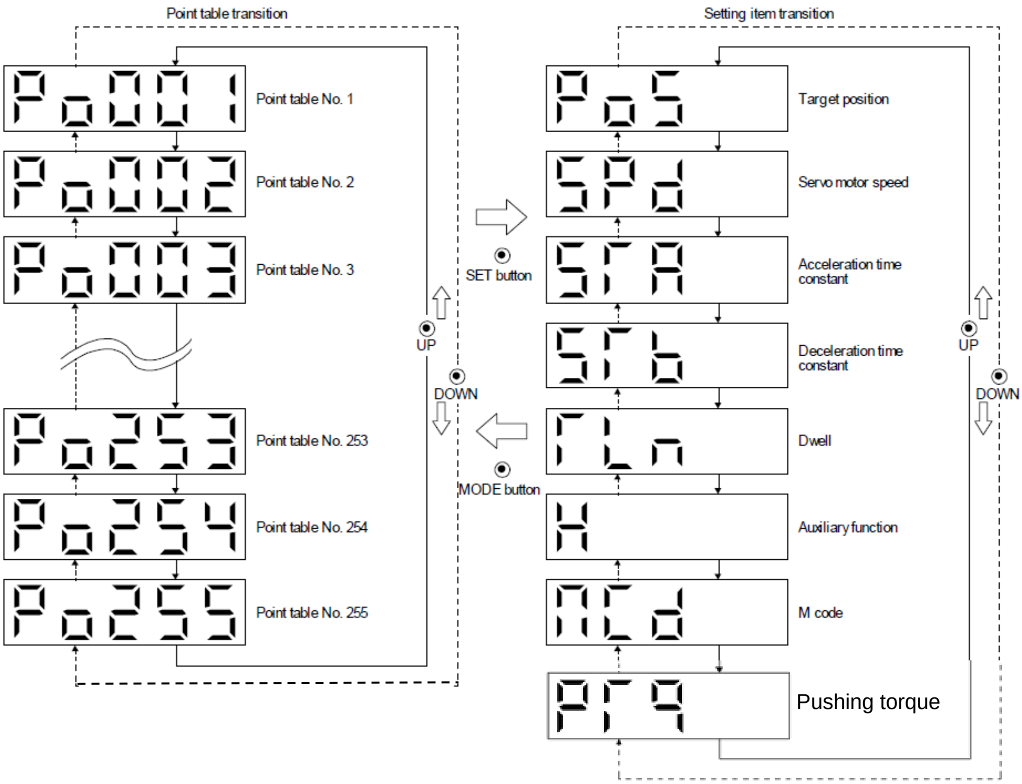
Alarm No.:7F		Name:Pushing error				
Alarm content		The current position has exceeded the pushing limit position during pushing operation. During the pushing operation, the current position is pushed back from the pushing start position. There is an error in the relationship between the positioning start position, pushing start position, and pushing limit position The starting method of the pushing operation is abnormal.				
Display	Detail name	Cause		Check method	Check result	Action
7F.2	Push back error	(1)	It was pushed back by the reaction force from the object to be pressed. (Pushing torque is too weak)	Check the value of the pushing torque in the point table data for the pushing operation.	There is a problem with the set value of the pushing torque.	Set the pushing torque correctly.
					There is no problem with the set value of pushing torque.	Check (2).
		(2)	The setting of the pushig start position is incorrect.	Check the value of the position data of the point table data immediately before the point table for performing the pushing operation.	There is a problem with the set value of the pushing start position.	Set the pushing start position correctly.
7F.3	Pushing direction error	(1)	The positioning start position was within the pushing range.	Check the current position where the start signal was input.	The positioning start position was within the pushing range.	Start the point table that does not include the pushing operation, and move out of the pushing range.
					There is no problem with the positioning start position.	Check (2).
		(2)	The setting of the pushing limit position of the point table data was incorrect.	Check the value of the pushing limit position in the point table data for the pushing operation.	There is a problem with the set value of the pushing limit position.	Set the pushing limit position correctly.
					There is no problem with the set value of the pushing limit position.	Check (3).
		(3)	The setting of the pushing start position is incorrect.	Check the value of the position data of the point table data immediately before the point table for performing the pushing operation.	There is a problem with the set value of the pushing start position.	Set the pushing start position correctly.
7F.4	Pushing start error	(1)	The activated point table was a pushing operation.	Check the auxiliary function of the specified point table data when turning on ST1 (start signal).	The auxiliary function of the point table data specified at the timing of turning on ST1 (start signal) is "16" or "18".	Set the pushing operation following the positioning operation using the auxiliary function "1" or "3" of the point table data.
					The auxiliary function of the point table data specified at the timing of turning on ST1 (start signal) is "16",Not "18".	Check (2).
		(2)	A dwell is set immediately before the pushing operation.	Check the dwell time of the point table data immediately before the point table for performing the pushing operation.	Dwell setting value is other than "0".	Set "0" to the dwell.

17.12 DISPLAY AND OPERATION SECTIONS

17.12.1 Point table setting

The target position, servo motor speed, acceleration time constant, deceleration time constant, dwell, auxiliary function, M code and pushing torque can be set.

(1) Display transition



(2) Setting list

The following table indicates the point table settings that may be displayed.

Status display	Symbol	Unit	Description	Indication range
Point table No.	Po001		Specify the target position, servo motor speed, acceleration time constant, deceleration time constant, dwell, auxiliary function, M code, and point table for setting the pushing torque.	1 to 255
Target position/ Pushing limit position	Pos	$\times10^{STM}$ µm $10^{(STM-4)}$ inch 10^{-3} degree pulse (Note 1)	Set the travel distance. When the pushing operation is selected with the auxiliary function "16" or "18", the limit position that operates in the pushing operation is set.	-999999 to 999999
Servomotor Rotational speed/ Speed limit value	SPd	r/min	Set the command rotation speed of the servo motor during positioning execution. When pushing operation is selected by auxiliary function "16" or "18", the speed limit value during pushing operation is set. Set the value below the permissible rotation speed of the servo motor to be used. If a value higher than the permissible speed is set, it will be clamped to the permissible speed. Positioning mode During the pushing operation of the point table method, if the setting exceeds the [Pr. PS05 pushing operation speed upper limit value], the speed is limited by the speed of [Pr. PS05].	0 to Permissible speed
Acceleration time constant	STA	ms	Set a time until the servo motor rotates at the rated speed.	0 to 20000
Deceleration time constant	STb	ms	Set a time from when the servo motor rotates at the rated speed until when the motor stops.	0 to 20000
Dwell	TLn	ms	This function is effective when the point table is selected by the input signal. If the auxiliary function is set to "0", "2", "16" or "18", the dwell of this point table becomes invalid. Set "1", "3", "8" or "9" for the auxiliary function, and change the speed when dwell = 0. When the dwell is set, the position command for the selected point table is completed, and the position command for the next point table starts after the set dwell has elapsed. When performing the pushing operation, always set 0 to the dwell the point table immediately before the pushing operation. (Note 4)	0 to 20000
Auxiliary function	H		This function is effective when the point table is selected by the input signal. (1) When using this point table in the absolute value command method 0: Executes one selected point table automatic operation 1: Automatic continuous operation without stopping the next point table 8: Execute automatic continuous operation to the selected point table at startup 9: Execute automatic continuous operation to point table number 1 (2) When using this point table in the incremental value command method 2: Execute one selected point table automatic operation 3: Automatic continuous operation without stopping the next point table 10: Execute automatic continuous operation to the selected point table at startup 11: Execute automatic continuous operation to point table number 1 (3) When using this point table in pushing operation (absolute value command method) 16: Pushing operation is continued until the next point table is executed when ST1 (start signal) is turned on. Set the pushing limit position as an absolute value. Set following the positioning operation using the auxiliary function "1" or "3". (Note 3) (Note 4) (4) When using this point table in pushing operation (incremental value command method) 18: Pushing operation is continued until the next point table is executed when ST1 (start signal) is turned on. Set the pushing limit position with the increment value. Set following the positioning operation using the auxiliary function "1" or "3". (Note 3) (Note 4) If a different rotation direction is set, the motor rotates in the reverse direction after checking for smoothing zero (command output). If "1" or "3" is set for point table number 255, [AL. 61] will be	0 to 3, 8 to 11, 16, 18

			generated when the point table is executed.	
M code	MCd		This is the code output at the completion of positioning. Outputs the first digit and the second digit of the M code in 4-bit binary respectively.	0 to 99
Pushing torque	PTq	0.1%	Set the pushing torque (in units of [0.1%]). This setting is valid when pushing operation is selected with auxiliary function "" 16 "or" 18 ". Set as the maximum torque = 1000 ([0.1%] unit). If 0 (push torque 0.0%) is set, the push torque becomes invalid. If the pushing torque exceeds the upper limit, the pushing torque is limited. (Refer to Section 5.7.2 (1) for details.)	0 to 1000

Note 1. The unit can be selected from m / inch /degree / pulse with [Pr. PT01].

3. It does not support single pushing operation. [AL7F.4 Pushing start error] occurs when ST1 (start signal) is turned on by specifying the point table No. for which "16" or "18" is set in the auxiliary function of the point table data.

4. If a value other than 0 is set to the dwell of the point table immediately before the pushing operation, [AL7F.4 Pushing start error] will occur.

17.13 1 Single-Step feed

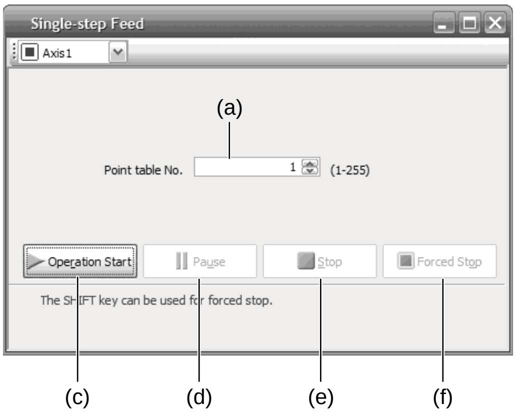
⚠CAUTION

- The test operation mode is designed for checking servo operation. Do not use it for actual operation.
- If the servo motor operates unexpectedly, use EM2 (Forced stop 2) to stop it.

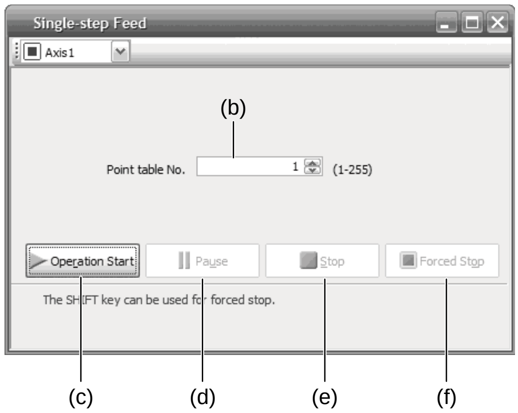
POINT

- Setup software (MR Configurator2TM) is required to perform single-step feed.
- Test operation cannot be performed if SON (Servo-on) is not turned off.

The positioning operation can be performed in accordance with the point table No. or program No. set by Setup software (MR Configurator2TM).
Select the test operation/single-step feed by the menu of Setup software (MR Configurator2TM). When the single-step feed window is displayed, input the following items and operate.



Point table operation



Program operation

(1) Point table No. or program No. setting
Input a point table No. into the input box (a) "Point table No.", or a program No. into the input box (b) "Program No.".

(2) Forward/reverse the servo motor
Click "Operation Start" (c) to rotate the servo motor.
Point table method During the pushing operation, the pushing operation is continued until the next point table is executed. Enter the next point table number in the "Point table No." input field (a) and click "Start operation" (c) to end the pushing operation and start the next positioning operation.

(3) Pause the servo motor

Click "Pause" (d) to temporarily stop the servo motor.

While the servo motor is temporarily stopped, click "Operation Start" (c) to restart the rotation by the amount of the remaining travel distance.

While the servo motor is temporarily stopped, click "Stop" (e) to clear the remaining travel distance.
During pushing operation, clicking "Pause" (d) is invalid and the servo motor does not stop.
To stop the motor during the pushing operation, click "Forced stop" (f).

(4) Stop the servo motor

Click "Stop" (e) to stop the servo motor. At this time, the remaining travel distance is cleared. Click "Operation Start" (c) to restart the rotation.
During pushing operation, clicking "Stop" (e) is invalid and the servo motor does not stop.
To stop the motor during the pushing operation, click "Forced stop" (f).

(5) Forced stop of the servo motor software

Click "Forced Stop" (f) to make an instantaneous stop. When "Forced Stop" is enabled, the servo motor does not drive even if "Operation Start" is clicked. Click "Forced Stop" again to enable "Operation Start" to be clicked.

(6) Switch to the normal operation mode

Before switching from the test operation mode to the normal operation mode, turn off the driver.

17.14 COMMUNICATION FUNCTION(Mitsubishi general-purpose AC servo protocol)

See Chapter 16 for items not described in this chapter.

17.14.1 Reading command

See Chapter 16 for items not described in this chapter.

(1) Status display (Command[0][1])
Same as standard product.

(2) parameter (Command[0][4] ・ [1][5] ・ [1][6] ・ [1][7] ・ [0][8] ・ [0][9])
Items not described below are the same as standard products.

Command	Data number	Description	Control mode CP	Control mode CL	Control mode PS	Frame length
[0][4]	[0][1]	Read parameter group 0000: Basic setting parameter ([Pr. PA_ _]) 0001: Gain filter parameter ([Pr. PB_ _]) 0002: Extension setting parameter ([Pr. PC_ _]) 0003: I / O setting parameter ([Pr. PD_ _]) 0004: Extension setting 2parameter ([Pr. PE_ _]) 0005: Extension setting 3parameter ([Pr. PF_ _]) 0009: Option setting parameter ([Pr. Po_ _]) 000A: Special control parameter ([Pr. PS_ _]) 000B: Linear servo motor / DD motor setting parameter ([Pr. PL_ _]) (Note) 000C: Positioning control parameter ([Pr. PT_ _]) Reads the parameter group specified by Command [8] [5] + Data number [0] [0]. Therefore, before reading the current value, be sure to specify the parameter group with Command [8] [5] + Data number [0] [0].				4

(3) External input / output signals (Command [1] [2])
(4) Current position latch display (Command [1] [A])
(5) Alarm history (Command [3] [3])
(6) Current alarm (Command [0] [2])
(7) Status display at alarm occurrence (Command [3] [5])
(8) Point table setting data (Command [4] [0] / [4] [5] / [5] [0] / [5] [4] / [5] [8] / [6] [0] ・ [6] [4] ・ [4] [C])
Items not described below are the same as standard products.

Command	Data number	Description	Control mode CP	Control mode CL	Control mode PS	Frame length
[4][0]	[0][0]to[F][F]	Reading the position data / push limit position of each point table The value obtained by converting the numeric value (hexadecimal number) of Data number to decimal number corresponds to the point table number.				8
[5][0]	[0][0]to[F][F]	Reading speed data (servo motor speed / speed limit value) of each point table The value obtained by converting the numeric value (hexadecimal number) of Data number to decimal number corresponds to the point table number.				
[4][C]	[0][0]to[F][F]	Reading of pushing torque of each point table The value obtained by converting the numeric value (hexadecimal number) of Data number to decimal number corresponds to the point table number.				

(9) Position data unit / current position latch data (Command [6] [C])
(10) General-purpose register (Rx) value (Command [6] [D])
(11) General-purpose register (Dx) value (Command [6] [E])
(12) Number of general-purpose registers (Command [6] [F])
(13) Other (Command [0] [0] ・ [0] [2])
Same as standard product.

17.14.2 Writing commands
Refer to Chapter 16 for items not described in this chapter.

(1) Status display (Command[8][1])
Same as standard product.

(2) parameter (Command[9][4]・[8][5])
Items not described below are the same as standard products.

command	Data number	Description	Control mode			Frame length
			CP	CL	PS	
[8][5]	[0][0]	Write parameter group 0000: Basic setting parameter ([Pr. PA_ _]) 0001: Gain filter parameter ([Pr. PB_ _]) 0002: Extended setting parameter ([Pr. PC_ _]) 0003: I / O setting parameter ([Pr. PD_ _]) 0004: Extended setting 2 parameter ([Pr. PE_ _]) 0005: Extension setting 3 parameter ([Pr. PF_ _]) 0009: Option setting parameter ([Pr. Po_ _]) 000A: Special control parameter ([Pr. PS_ _]) 000B: Linear servo motor / DD motor setting parameter ([Pr. PL_ _]) (Note) 000C: Positioning control parameter ([Pr. PT_ _])				4

(3) External input / output signal (command [9] [2])
(4) Alarm history (command [8] [2])
(5) Current alarm (command [8] [2])
(6) I / O device disabled (command [9] [0])
(7) Operation mode selection (command [8] [B])
(8) Test operation mode data (command [9] [2] ・ [A] [0])
(9) Point table setting data (commands [C] [0], [C] [2], [C] [6], [C] [7], [C] [8], [C] [A] ・ [C] [B] ・ [C] [4])
Items not described below are the same as standard products.

Command	Data number	Description	Control mode			Frame length
			CP	CL	PS	
[C][0]	[0][0]to[F][F]	Write the position data / push limit position of each point table The value obtained by converting the data number (hexadecimal number) to decimal number corresponds to the point table number.				8
[C][6]	[0][0]to[F][F]	Writing speed data (servo motor speed / speed limit value) for each point table The value obtained by converting the data number (hexadecimal number) to decimal number corresponds to the point table number.				
[C][4]	[0][0]to[F][F]	Writing of pushing torque of each point table The value obtained by converting the data number (hexadecimal number) to decimal number corresponds to the point table number.				

(10) General-purpose register (Rx) value (command [B] [9])
(11) General-purpose register (Dx) value (command [B] [A])
Same as standard product.

17.14.3 Detailed explanations of commands

Refer to Chapter 16 for items not described in this chapter.

17.14.4 External I/O signal status (DIO diagnosis)

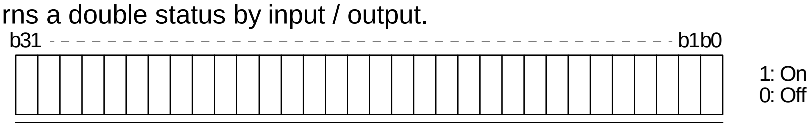
Refer to Chapter 16 for items not described in this chapter.

(1) Reading the status of input devices
(2) Reading external input pin status
(3) Reading the status of the input device turned on by communication
(4) Reading external output pin status
Same as standard product.

(5) Reading output device status
You can read the on / off status of the output device.
(a) Sending
Send command [1] [2] + data number [8] [0] to [8] [3].

Command	Data number
[1][2]	[8][0]to[8][3]

(b) Replying
The slave returns a double status by input / output.



Command of each bit is transmitted to the master station as hexadecimal data.

bit	abbreviation			
	Data number [8][0]	Data number [8][1]	Data number [8][2]	Data number [8][3]
0	RD			MCD00
1	SA			MCD01
2	ZSP			MCD02
3	TLC		CPO	MCD03
4	VLC		ZP	MCD10
5	INP		POT	MCD11
6			PUS	MCD12
7	WNG		MEND	MCD13
8	ALM			ACD0
9	OP			ACD1
10	MBR			ACD2
11	DB			ACD3
12	ALCD0		PED	PRQ0
13	ALCD1			PRQ1
14	ALCD2			
15	BWNG			
16				
17			ALMWNG	
18			BW9F	
19	TFBL	MSDH		
20	PERR	MSDL		
21		SOUT		
22		OUT1		
23		OUT2		
24		OUT3	PT0/PS0	
25	CDPS	CAMS	PT1/PS1	
26	CLDS	CLTS	PT2/PS2	
27	ABSV	CLTSM	PT3/PS3	
28		CLTS	PT4/PS4	
29			PT5/PS5	
30			PT6/PS6	
31	MTTR		PT7/PS7	

17.14.5 Input device on/off
Refer to Chapter 16.

17.14.6 Input device on/off (For test operation)
Refer to Chapter 16.

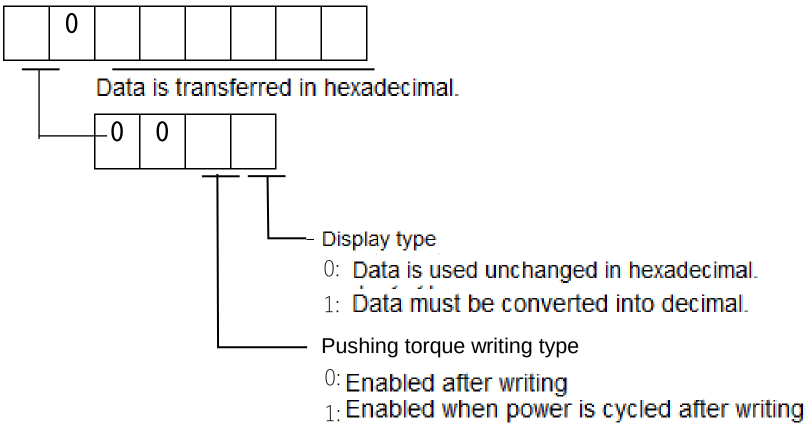
17.14.7 Test operation mode
Refer to Chapter 16.

17.14.8 Output signal pin on/off (output signal (DO) forced output)
Refer to Chapter 16.

17.14.9 Point table
Refer to Chapter 16 for items not described in this chapter.

(1) Reading data
(a) Position data
(b) Speed data
(c) Acceleration time constant
(d) Deceleration time constant
(e) Dwell
(f) Auxiliary function
(g) M code
(h) Pushing torque
Reads the pushing torque of the point table.

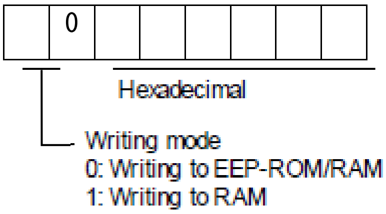
1) Sending
Command [4] [C] + data number [0] [1] to [F] [F] corresponding to the point table to be read please send. Refer to Section 10.1.1.
2) Replying
The slave station reads the requested pushing torque of the point table.



(2) Writing data
- (a) Position data
- (b) Speed data
- (c) Acceleration time constant
- (d) Deceleration time constant
- (e) Dwell
- (f) Auxiliary function
- (g) M code
- (h) Pushing torque

Write the pushing torque of the point table.
Command [C] [4] + Data number [0] [1] to [F] [F] data corresponding to the point table to be written please send. Refer to Section 10.1.1.

Command	Data number	Data
[C][4]	[0][1] to [F][F]	See the following figure.



If you frequently change the pushing torque using communication, set this setting to 1 and change the RAM in the driver.
Only change the above data.
When changing data more than once an hour, do not write to EEP-ROM.

App. 1 Peripheral equipment manufacturer (for reference)

Names given in the table are as of December 2017.

Manufacturer	Reference
NEC TOKIN	NEC TOKIN Corporation
Kitagawa Industries	Kitagawa Industries Co., Ltd.
JST	J.S.T. Mfg. Co., Ltd.
Junkosha	Purchase from Toa Electric Industry Co. Ltd., Nagoya Branch
3M	Sumitomo 3M Ltd.
SEIWA ELECTRIC	Seiwa Electric Mfg. Co. Ltd.
Soshin Electric	Soshin Electric Co., Ltd.
TE Connectivity	TE Connectivity Ltd. Company
TDK	TDK Corporation
Molex	Molex
Toho Technology	Toho Technology Corp. Kyoto factory

App. 2 Handling of AC driver batteries for the United Nations Recommendations on the Transport of Dangerous Goods

United Nations Recommendations on the Transport of Dangerous Goods Rev. 15 (hereinafter Recommendations of the United Nations) has been issued. To reflect this, transport regulations for lithium metal batteries are partially revised in the Technical Instruction (ICAO-TI) by the International Civil Aviation Organization (ICAO) and the International Maritime Dangerous Goods Code (IMDG Code) by the International Maritime Organization (IMO).
To comply the instruction and code, we have modified the indication on the package for general-purpose AC servo batteries.
The above change will not affect the function and performance of the product.

(1) Target model

Option model	Type	Lithium content	Mass of battery	Remark
LEC-MR-BAT6V1SET	Assembled battery (Two)	1.20 g	34 g	Assembled batteries with more than 0.3 grams of lithium content must be handled as dangerous goods (Class 9) depending on packaging requirements.

(2) Purpose
Safer transportation of lithium metal batteries.

(3) Change in regulations
The following points are changed for lithium metal batteries in transportation by sea or air based on the revision of Recommendations of the United Nations Rev. 15 and ICAO-TI 2009-2010 edition, and IATA Dangerous Goods Regulations 54th Edition (effective January 1, 2013). For lithium metal batteries, cells are classified as UN3090, and batteries contained in or packed with equipment are classified as UN3091.

(a) Transportation of lithium metal batteries alone

Packaging requirement	Classification	Main requirement
Less than eight cells per package with less than one gram of lithium content	UN3090 PI968 Section II	The package must pass a 1.2 m drop test, and the handling label with battery illustration (size: 120 × 110 mm) must be attached on the package.
Less than two assembled batteries per package with less than two grams of lithium content		
More than eight cells per package with less than one gram of lithium content	UN3090 PI968 Section IB	The package must pass a 1.2 m drop test, and the handling label with battery illustration (size: 120 × 110 mm) must be attached on the package. The Class 9 hazard label must be attached or others to comply with dangerous goods (Class 9).
More than two assembled batteries per package with less than two grams of lithium content		
Cells with more than one gram of lithium content	UN3090 PI968 Section IA	The package must be compliant with Class 9 Packages, and the Class 9 hazard label must be attached or others to comply with dangerous goods (Class 9).
Assembled batteries with more than two grams of lithium content		

(b) Transportation of lithium metal batteries packed with or contained in equipment

1) For batteries packed with equipment, follow the necessary requirements of UN3091 PI969. Batteries are classified into either Section II/Section I depending on the lithium content/packaging requirements.

2) For batteries contained in equipment, follow the necessary requirements of UN3091 PI970. Batteries are classified into either Section II/Section I depending on the lithium content/packaging requirements.
The special handling may be unnecessary depending on the number of batteries and gross mass per package.

Fig. app. 1 Example of label with battery illustration

(Available until December 31, 2018)

* Place for UN number (s)
** Place for telephone number for additional information

Fig. app. 2 Example of label with battery illustration

(Available from January 1, 2017)

The handling label shown in Fig. app. 1 has been changed to the one shown in Fig. app. 2 in accordance with the IATA Dangerous Goods Regulations 58th Edition (effective January 1, 2017). However, the label shown in Fig. app. 1 may be used until December 31, 2018 (for two years as an interim measure).

(4) Details of the package change
The following caution is added to the packages of the target batteries.
"Containing lithium metal battery. Regulations apply for transportation."

(5) Transportation precaution for customers
For sea or air transportation, attaching the handling label (Fig. app. 1) must be attached to the package of battery. In addition, attaching it to the outer package containing several packages of batteries is also required. When the content of a package must be handled as dangerous goods (Class 9), the Shipper's Declaration for Dangerous Goods is required, and the package must be compliant with Class 9 Packages. Documentations like the handling label in the specified design and the Shipper's Declaration for Dangerous Goods are required for transportation. Please attach the documentations to the packages and the outer package.

The IATA Dangerous Goods Regulations 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.

App. 3 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.
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 center.
Please, help us to conserve the environment we live in!

App. 4 Compliance with global standards

App. 4.1 Terms related to safety (IEC 61800-5-2 Stop function)

STO function (Refer to IEC 61800-5-2:2007 4.2.2.2 STO.)

The LECSB2-T□ drivers have the STO function. The STO function shuts down energy to servo motors, thus removing torque. This function electronically cuts off power supply in the driver.

App. 4.2 About safety

This chapter explains safety of users and machine operators. Please read the section carefully before mounting the equipment.

App. 4.2.1 Professional engineer

Only professional engineers should mount LECSB2-T□ drivers.

Here, professional engineers should meet the all conditions below.

(1) Persons who took a proper training of related work of electrical equipment or persons who can avoid risk based on past experience.
(2) Persons who have read and familiarized himself/herself with this installation guide and operating manuals for the protective devices (e.g. light curtain) connected to the safety control system.

App. 4.2.2 Applications of the devices

・IEC/EN 61800-5-1, IEC/EN 61800-3, IEC/EN 60204-1
・ISO/EN ISO 13849-1 Category 3 PL e, IEC/EN 62061 SIL CL 3, IEC/EN 61800-5-2 (STO)

LECSB2-T□ drivers can be used with the MR-D30 functional safety unit of Mitsubishi Electric Corporation, MR-J3-D05 safety logic unit of Mitsubishi Electric Corporation, or safety PLCs.

App. 4.2.3 Correct use

Use the LECSB2-T□ drivers within specifications. Refer to section 1.3 for specifications such as voltage, temperature, etc. SMC Co. accepts no claims for liability if the equipment is used in any other way or if modifications are made to the device, even in the context of mounting and installation.

⚠WARNING	●If you need to get close to the moving parts of the machine for inspection or others, ensure safety by confirming the power off, etc. Otherwise, it may cause an accident. ●It takes 15 minutes maximum for capacitor discharging. Do not touch the unit and terminals immediately after power off.

(1) Peripheral device and power wiring

The followings are selected based on IEC/EN 61800-5-1, UL 508C, and CSA C22.2 No. 274.

(a) Power Wiring (local wiring and crimping tool)

Use only copper wires or copper bus bars for wiring. The following table shows the stranded wire sizes [AWG] and the crimp terminal symbols rated at 75 °C/60 °C.

Driver	75 °C / 60 °C stranded wire [AWG]			
	L1/L2/L3 ⏚	L11/L21	P+/C	U/V/W/⏚ (Note 1)
LECSB2-T5/ LECSB2-T7/ LECSB2-T8/ LECSB2-T9	14/14	14/14	14/14	14/14

Note 1. Select wire sizes depending on the rated output of the servo motors. The values in the table are sizes based on rated output of the drivers.

(b) Selection example of MCCB and fuse

Use T class fuses or molded-case circuit breaker (UL489 Listed MCCB) as the following table. The T class fuses and molded-case circuit breakers in the table are selected examples based on rated I/O of the drivers. When you select a smaller capacity servo motor to connect it to the driver, you can also use smaller capacity T class fuses or molded-case circuit breaker than ones in the table.

Driver (Note 1)	Molded-case circuit breaker (240 V AC) (Note 2)	Fuse (300 V)
LECSB2-T5/ LECSB2-T7/ LECSB2-T8/ LECSB2-T9 (T)	NF50-SVFU-5A (50 A frame 5 A)	10 A
LECSB2-T9 (S)	NF50-SVFU-10A (50 A frame 10 A)	15 A

Note 1. "(S)" means 1-phase 200 V AC power input and "(T)" means 3-phase 200 V AC power input in the table.

Note 2. MFG.:Mitsubishi Electric Corporation

(c) Power supply

This driver can be supplied from star-connected supply with grounded neutral point of overvoltage category III (overvoltage category II for 1-phase drivers) set forth in IEC/EN 60664-1. For the interface power supply, use an external 24 V DC power supply with reinforced insulation on I/O terminals.

(d) Grounding

To prevent an electric shock, always connect the protective earth (PE) terminal (marked ⏚) of the driver to the protective earth (PE) of the cabinet. Do not connect two grounding cables to the same protective earth (PE) terminal. Always connect cables to the terminals one-to-one.

This product can cause a DC current in the protective earthing conductor. To protect direct/indirect contact using an earth-leakage current breaker (RCD), only an RCD of type B can be used for the power supply side of the product.

(2) EU compliance

The drivers are designed to comply with the following directions to meet requirements for mounting, using, and periodic technical inspections: Machinery directive (2006/42/EC), EMC directive (2014/108/EC), and Low-voltage directive (2014/35/EC), and RoHS directive (2011/65/EC).

(a) EMC requirement

LECSB2-T□ drivers comply with category C3 in accordance with EN 61800-3. As for I/O wires (max. length 10 m. However, 3 m for STO cable for CN8.) and encoder cables (max. length 50 m), use shielded wires and ground the shields. Install an EMC filter and surge protector on the primary side for input and output of LECSB2-T□ drivers. The following shows recommended products.

EMC filter: Soshin Electric HF3000A-UN series, TF3000C-TX series, COSEL FTB series
Surge protector: Okaya Electric Industries RSPD series
Line noise filter: Mitsubishi Electric FR-BLF

LECSB2-T□ drivers are not intended to be used on a low-voltage public network which supplies domestic premises; radio frequency interference is expected if used on such a network. The installer shall provide a guide for Installation and use, including recommended mitigation devices. To avoid the risk of crosstalk to signal cables, the installation instructions shall either recommend that the power interface cable be segregated from signal cables.

Use the DC power supply installed with the drivers in the same cabinet. Do not connect the other electric devices to the DC power supply.

(3) USA/Canada compliance

This driver is designed in compliance with UL 508C and CSA C22.2 No. 274.

(a)Installation

The minimum cabinet size is 150% of each LECSB2-T□ driver's volume. Also, design the cabinet so that the ambient temperature in the cabinet is 55 °C or less. The driver must be installed in the metal cabinet. Additionally, mount the driver on a cabinet that the protective earth based on the standard of IEC/EN 60204-1 is correctly connected. For environment, the units should be used in open type (UL 50) and overvoltage category shown in table in app. 4.8.1. The driver needs to be installed at or below pollution degree 2. For connection, use copper wires.

(b) Short-circuit current rating (SCCR)

Suitable For Use On A Circuit Capable Of Delivering Not More Than 100 kA rms Symmetrical Amperes, 500 Volts Maximum.

(c) Overload protection characteristics
The LECSB2-T□ drivers have solid-state servo motor overload protection. (It is set on the basis (full load current) of 120% rated current of the driver.)

(d) Over-temperature protection for motor
Motor Over temperature sensing is not provided by the drive.
Integral thermal protection(s) is necessary for motor and refer to app. 4.4 for the proper connection.

(e) Branch circuit 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.

App. 4.2.4 General cautions for safety protection and protective measures
Observe the following items to ensure proper use of the LECSB2-T□ drivers.

(1) For safety components and installing systems, only qualified personnel and professional engineers should perform.

(2) When mounting, installing, and using the MELSERVO LECSB2-T□ driver, always observe standards and directives applicable in the country.

(3) The item about noises of the test notices in the manuals should be observed.

App. 4.2.5 Residual risk
(1) Be sure that all safety related switches, relays, sensors, etc., meet the required safety standards.

(2) Perform all risk assessments and safety level certification to the machine or the system as a whole.

(3) If the upper and lower power module in the driver are shorted and damaged simultaneously, the servo motor may make a half revolution at a maximum.

(4) Only qualified personnel are authorized to install, start-up, repair or service the machines in which these components are installed. Only trained engineers should install and operate the equipment. (ISO 13849-1 Table F.1 No. 5)

(5) Separate the wiring for safety observation function from other signal wirings. (ISO 13849-1 Table F.1 No. 1)

(6) Protect the cables with appropriate ways (routing them in a cabinet, using a cable guard, etc.).

(7) Keep the required clearance/creepage distance depending on voltage you use.

App. 4.2.6 Disposal
Disposal of unusable or irreparable devices should always occur in accordance with the applicable country-specific waste disposal regulations. (Example: European Waste 16 02 14)

App. 4.2.7 Lithium battery transportation

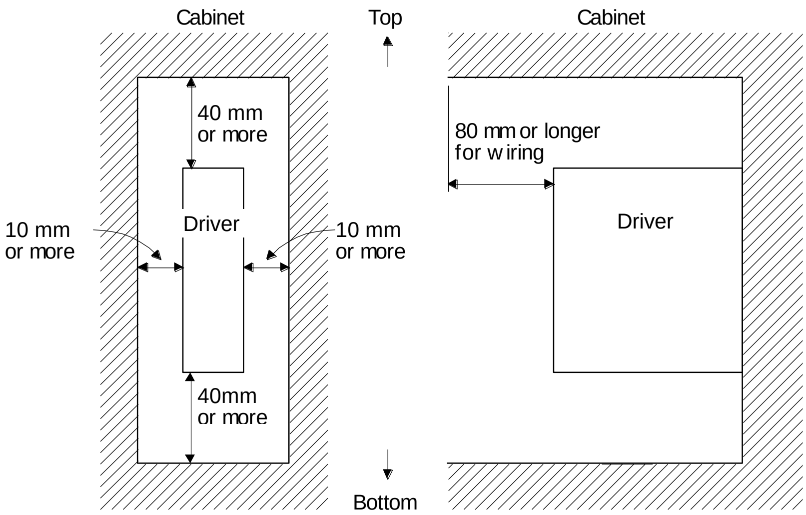
To transport lithium batteries, take actions to comply with the instructions and regulations such as the United Nations (UN), the International Civil Aviation Organization (ICAO), and the International Maritime Organization (IMO).

The batteries are assembled batteries from two batteries (lithium metal battery CR17335A) which are not subject to the dangerous goods (Class 9) of the UN Recommendations.

App. 4.3 Mounting/dismounting

Installation direction and clearances

⚠CAUTION	●The devices must be installed in the specified direction. Not doing so may cause a malfunction. ●Mount the driver on a cabinet which meets IP54 in the correct vertical direction to maintain pollution degree 2.



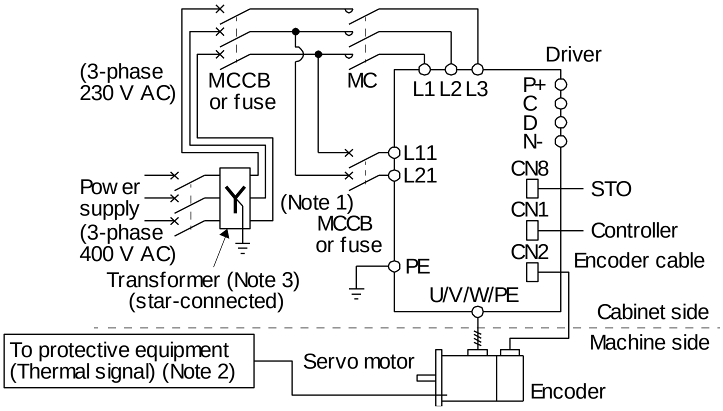
App. 4.4 Electrical Installation and configuration diagram

⚠WARNING	●Turn off the molded-case circuit breaker (MCCB) to avoid electrical shocks or damages to the product before starting the installation or wiring.

⚠CAUTION	●The installation complies with IEC/EN 60204-1. The voltage supply to machines must be 20 ms or more of tolerance against instantaneous power failure as specified in IEC/EN 60204-1. ●Connecting a servo motor for different axis to U, V, W, or CN2_ of the driver may cause a malfunction. ●Securely connect the cables in the specified method and tighten them with the specified torque. Otherwise, the servo motor may operate unexpectedly.

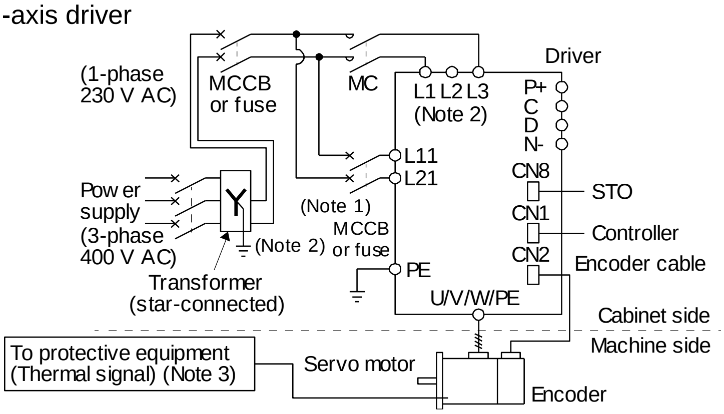
The following shows representative configuration examples to conform to the IEC/EN/UL/CSA standards.

(1) 3-phase input for LECSB2-T□ 1-axis driver



Note 1. When the wire sizes of L1 and L11 are the same, MCCB or fuse is not required.
2. Please use a thermal sensor, etc. for thermal protection of the servo motor.

(2) 1-phase input for LECSB2-T□ 1-axis driver



Note 1. When the wire sizes of L1 and L11 are the same, MCCB or fuse is not required.
2. When using a 100 V class driver, step down the power supply voltage to 100 V and connect the main circuit power supply lines to L1 and L2. For 1-phase 200 V AC drivers, connect the lines to L1 and L3.

The connectors described by rectangles are safely separated from the main circuits described by circles.
The connected motors will be limited as follows.

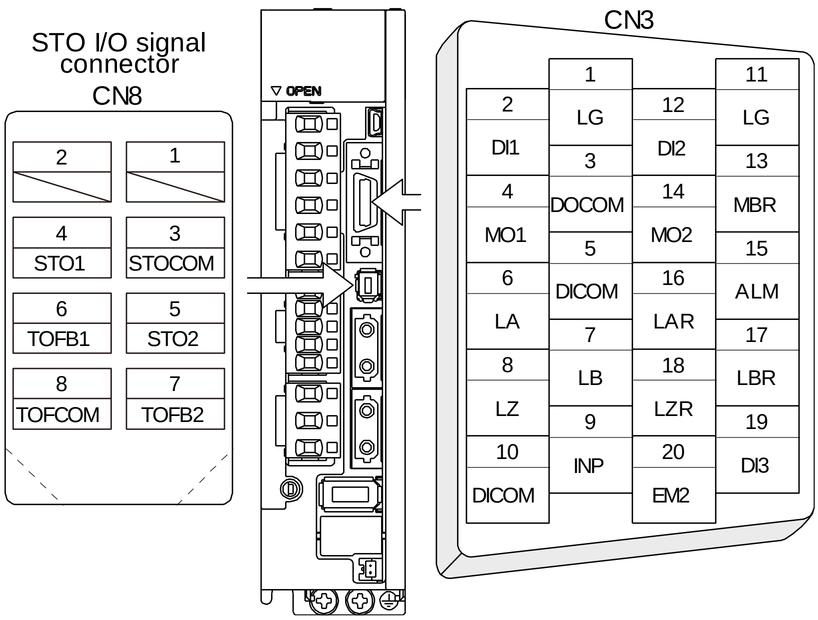
(1) HG/HF/HC/HA series servo motors (Mfg.: Mitsubishi Electric)

(2) Using a servo motor complied with IEC 60034-1 and Mitsubishi Electric encoder (OBA, OSA)

App. 4.5 Signal

App. 4.5.1 Signal

The following shows LECSB2-T5 signals as a typical example. For other drivers, refer to each driver instruction manual.



App. 4.5.2 I/O device

Input device

Symbol	Device	Connector	Pin No.
EM2	Forced stop 2	CN3	20
STOCOM	Common terminal for input signals STO1/STO2	CN8	3
STO1	STO1 state input		4
STO2	STO2 state input		5

Output device

Symbol	Device	Connector	Pin No.
TOFCOM	Common terminal for monitor output signal in STO state	CN8	8
TOFB1	Monitor output signal in STO1 state		6
TOFB2	Monitor output signal in STO2 state		7

Power supply

Symbol	Device	Connector	Pin No.
DICOM	Digital I/F power supply input	CN3	5, 10
DOCOM	Digital I/F common		3
SD	Shield		Plate

App. 4.6 Maintenance and service

⚠WARNING	●To avoid an electric shock, only qualified personnel should attempt inspections. For repair and parts replacement, contact your local sales office.

⚠CAUTION	●Do not perform insulation resistance test on the driver. Otherwise, it may cause a malfunction. ●Do not disassemble and/or repair the equipment on customer side.

App. 4.6.1 Inspection items

It is recommended that the following points periodically be checked.

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

Driver	Tightening torque [N•m]
	PE
LECSB2-T5 / LECSB2-T7 / LECSB2-T8 / LECSB2-T9	1.2

(2) Check servo motor bearings, lock section, etc. for unusual noise.

(3) Check the cables and the like for scratches or cracks. Perform periodic inspection according to operating conditions.

(4) Check that the connectors are securely connected to the servo motor.

(5) Check that the wires are not coming out from the connector.

(6) Check for dust accumulation on the driver.

(7) Check for unusual noise generated from the driver.

(8) Check the servo motor shaft and coupling for connection.

(9) Make sure that the emergency stop circuit operates properly suchi that an operation can be stopped immediately and a power is shut off by the emergency stop switch.

App. 4.6.2 Parts having service lives

Service life of the following parts is listed below. However, the service life varies depending on operation and environment. If any fault is found in the parts, they must be replaced immediately regardless of their service life. For parts replacement, please contact your local sales office.

Part name	Life guideline
Smoothing capacitor	10 years (Note 3)
Relay	Number of power-on, forced stop and PC or PLC...etc forced stop times: 100 000 times Number of on and off for STO: 1,000,000 times
Cooling fan	10,000 hours to 30,000 hours (2 years to 3 years) (Note 4)
Battery backup time (Note 1)	Approximately 20,000 hours (equipment power supply: off, ambient temperature: 20 °C)
Battery life (Note 2)	5 years from date of manufacture

Note 1. The time is for using LEC-MR-BAT6V1SET. For details and other battery backup time, refer to chapter 12.2.

2. Quality of the batteries degrades by the storage condition. The battery life is 5 years from the production date regardless of the connection status.

3. The characteristic of smoothing capacitor is deteriorated due to ripple currents, etc. The life of the capacitor greatly depends on ambient temperature and operating conditions. The capacitor will be the end of its life in 10 years of continuous operation in air-conditioned environment (ambient temperature of 40 °C or less.

App. 4.7 Transportation and storage

⚠CAUTION	●Transport the products correctly according to their mass. ●Stacking in excess of the limited number of product packages is not allowed. ●Do not carry the driver by the front cover during transportation. The product may fall. ●For detailed information on transportation and handling of the battery, refer to app. 2 and app. 3. ●Install the product in a load-bearing place of driver and servo motor in accordance with the instruction manual. ●Do not get on or put heavy load on the equipment. ●Do not hold the cables, or connectors when carrying the driver. Otherwise, it may drop.

When you keep or use it, please fulfill the following environment.

Item		Environment
Ambient temperature	Operation [°C]	0 to 55 Class 3K3 (IEC/EN 60721-3-3)
	Transportation (Note) [°C]	-20 to 65 Class 2K4 (IEC/EN 60721-3-2)
	Storage (Note) [°C]	-20 to 65 Class 1K4 (IEC/EN 60721-3-1)
Ambient humidity	Operation, transportation, storage	5% to 90 %RH
Vibration load	Test condition	10 Hz to 57 Hz with constant amplitude of 0.075 mm 57 Hz to 150 Hz with constant acceleration of 9.8 m/s^2 to IEC/EN 61800-5-1 (Test Fc of IEC 60068-2-6)
	Operation	5.9 m/s^2
	Transportation (Note)	Class 2M3 (IEC/EN 60721-3-2)
	Storage	Class 1M2 (IEC/EN 60721-3-2)
Pollution degree		2
IP rating		IP20 (IEC/EN 60529), Terminal block IP00
		Open type (UL 50)
Altitude	Operation, storage	Max. 2000 m above sea level
	Transportation	Max. 10000 m above sea level

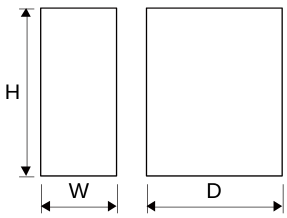
Note. In regular transport packaging

App. 4.8 Technical data

App. 4.8.1 LECSB2-T□ driver

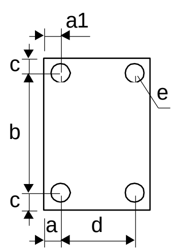
Item		LECSB2-T5 / LECSB2-T7 / LECSB2-T8 / LECSB2-T9
Power supply	Main circuit (line voltage)	3-phase or 1-phase 200 V AC to 240 V AC, 50 Hz/60 Hz
	Control circuit (line voltage)	1-phase 200 V AC to 240 V AC, 50/60 Hz (Note 2)
	Interface (SELV)	24 V DC (required current capacity: LECSB2-T□, 300 mA)
Control method		Sine-wave PWM control, current control method
Safety observation function (STO) IEC/EN 61800-5-2 (Note 3)		EN ISO 13849-1 Category 3 PL e, IEC 61508 SIL 3, EN 62061 SIL CL 3, and EN 61800-5-2
Mean time to dangerous failure		MTTFd ≥ 100 [years] (314a)
Effectiveness of fault monitoring of a system or subsystem		DC = Medium, 97.6 [%]
Average probability of dangerous failures per hour		PFH = 6.4×10^{-9} [1/h]
Mission time		T_M = 20 [years]
Response performance		8 ms or less (STO input off → energy shut off)
Pollution degree		2 (IEC/EN 60664-1)
Overvoltage category		1-phase 100 V AC/200 V AC: II (IEC/EN 60664-1), 3-phase 200 V AC/400 V AC: III (IEC/EN 60664-1)
Protective class		I (IEC/EN 61800-5-1)
Short-circuit current rating (SCCR)		100 kA

App. 4.8.2 Driver dimensions



Driver	Variable dimension [mm]			Mass [kg]
	W	H	D	
LECSB2-T5 / LECSB2-T7	40	168	135	0.8
LECSB2-T8	40	168	170	1.0
LECSB2-T9	60	168	185	1.4

App. 4.8.3 Mounting hole



Driver	Variable dimensions [mm]					Screw size
	a	a1	b	c	d	e
LECSB2-T5 / LECSB2-T7 / LECSB2-T8	6	6	156 ± 0.5	6		M5
LECSB2-T9	12	12	156 ± 0.5	6	42 ± 0.3	M5

App. 4.9 Check list for user documentation

LECS installation checklist for manufacturer/installer

The following items must be satisfied by the initial test operation at least. The manufacturer/installer must be responsible for checking the standards in the items.
Maintain and keep this checklist with related documents of machines to use this for periodic inspection.

1. Is it based on directive/standard applied to the machine? Yes [ ], No [ ]
2. Is directive/standard contained in Declaration of Conformity (DoC)? Yes [ ], No [ ]
3. Does the protection instrument conform to the category required? Yes [ ], No [ ]
4. Are electric shock protective measures (protective class) effective? Yes [ ], No [ ]
5. Is the STO function checked (test of all the shut-off wiring)? Yes [ ], No [ ]

Checking the items will not be instead of the first test operation or periodic inspection by professional engineers.

App. 5 MR-J3-D05 Safety logic unit of Mitsubishi Electric Corporation

App. 5.1 Terms related to safety

App. 5.1.1 Stop function for IEC/EN 61800-5-2

(1) STO function (Refer to IEC/EN 61800-5-2: 2007 4.2.2.2 STO.)

This function is integrated into the LECSB2-T□ series drivers.

The STO function shuts down energy to servo motors, thus removing torque. This function electronically cuts off power supply in drivers for LECSB2-T□ series drivers.

The purpose of this safety function is as follows.

1)Uncontrolled stop according to stop category 0 of IEC/EN 60204-1

2) Preventing unexpected start-up

(2) SS1 function (Refer to IEC/EN 61800-5-2: 2007 4.2.2.3C Safe stop 1 temporal delay.)

SS1 is a function which initiates the STO function when the previously set delay time has passed after the servo motor starts decelerating. The delay time can be set with MR-J3-D05 of Mitsubishi Electric Corporation.

The purpose of this safety function is as follows. This function is available by using an LECSB2-T□ series driver with MR-J3-D05 of Mitsubishi Electric Corporation.

・Controlled stop according to stop category 1 of IEC/EN 60204-1

App. 5.1.2 Emergency operation for IEC/EN 60204-1

(1) Emergency stop (Refer to IEC/EN 60204-1: 2005 9.2.5.4.2 Emergency Stop.)

Emergency stop must override all other functions and actuation in all operation modes. Power to the machine driving part which may cause a hazardous state must be either removed immediately (stop category 0) or must be controlled to stop such hazardous state as soon as possible (stop category 1). Restart must not be allowed even after the cause of the emergency state has been removed.

(2) Emergency switching off (Refer to IEC/EN 60204-1: 2005 9.2.5.4.3 Emergency Switching OFF.)

Removal of input power to driving device to remove electrical risk and to meet above mentioned safety standards.

App. 5.2 Cautions

The following basic safety notes must be read carefully and fully in order to prevent injury to persons or damage to property.

Only qualified personnel are authorized to install, start-up, repair or service the machines in which these components are installed.

They must be familiar with all applicable local safety regulations and laws in which machines with these components are installed, particularly the standards and guidelines mentioned in this Instruction Manual and the requirements mentioned in ISO/EN ISO 13849-1, IEC 61508, IEC/EN 61800-5-2, and IEC/EN 60204-1.

The staff responsible for this work must be given express permission from the company to perform start-up, programming, configuration, and maintenance of the machine in accordance with the safety standards.

⚠WARNING	● mproper installation of the safety related components or systems may cause improper operation in which safety is not assured, and may result in severe injuries or even death.

Protective Measures

・ As described in IEC/EN 61800-5-2, the Safe Torque Off (STO) function only prevents the driver from supplying energy to the servo motor. Therefore, if an external force acts upon the drive axis, additional safety measures, such as locks or counter-weights must be used.

App. 5.3 Residual risk

Machine manufacturers are responsible for all risk evaluations and all associated residual risks. Below are residual risks associated with the STO/EMG function. SMC Co. is not liable for any damages or injuries caused by the residual risks.

(1) The SS1 function only guarantees the delay time before STO/EMG is engaged. Proper setting of this delay time is the full responsibility of the company and/or individuals responsible for installation and commissioning of the safety related system. The system, as a whole, must pass safety standards certification.

(2) When the SS1 delay time is shorter than the required servo motor deceleration time, if the forced stop function is malfunctioning, or if STO/EMG is engaged while the servo motor is still rotating; the servo motor will stop with the dynamic brake or freewheeling.

(3) For proper installation, wiring, and adjustment, thoroughly read the manual of each individual safety related component.

(4) Be sure that all safety related switches, relays, sensors, etc., meet the required safety standards.

(5) Safety is not assured until safety-related components of the system are completely installed or adjusted.

(6) When replacing a driver etc. or MR-J3-D05 of Mitsubishi Electric Corporation, confirm that the new equipment is exactly the same as those being replaced. Once installed, be sure to verify the performance of the functions before commissioning the system.

(7) Perform all risk assessments and safety level certification to the machine or the system as a whole. It is recommended that a Certification Body final safety certification of the system be used.

(8) To prevent accumulation of multiple malfunctions, perform a malfunction check at regular intervals as deemed necessary by the applicable safety standard. Regardless of the system safety level, malfunction checks should be performed at least once per year.

(9) If the upper and lower power module in the driver are shorted and damaged simultaneously, the servo motor may make a half revolution at a maximum.

App. 7 Analog monitor

POINT
● A voltage of analog monitor output may be irregular at power-on.

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

(1) Setting

Change the following digits of [Pr. PC09] and [Pr. PC10].

[Pr. PC09]

0	0		

Analog monitor 1 output selection
(the signal provided to the output across MO1 and LG)

[Pr. PC10]

0	0		

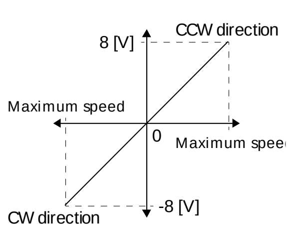
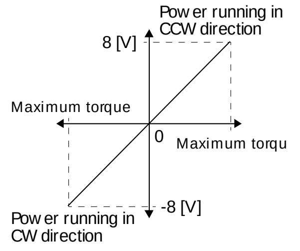
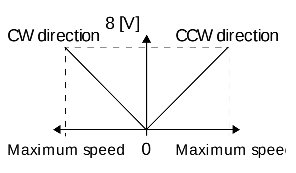
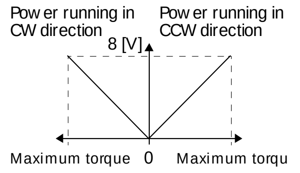
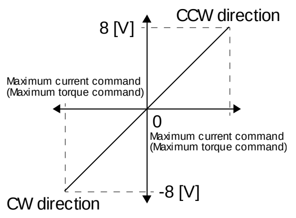
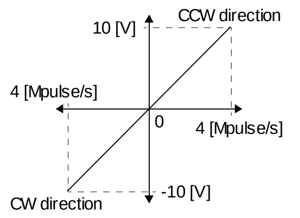
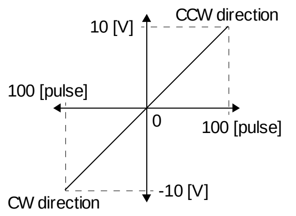
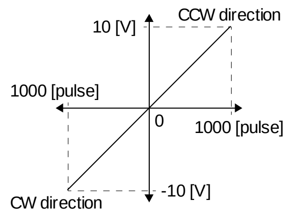
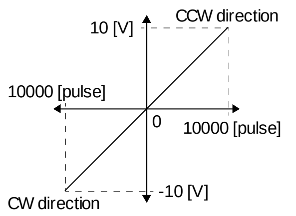
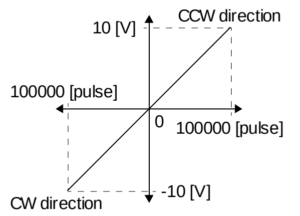
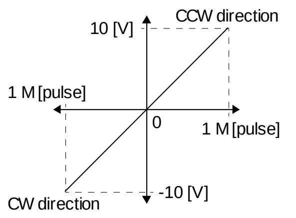
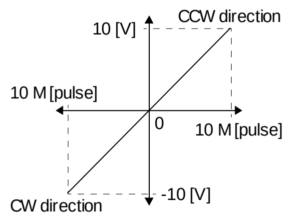
Analog monitor 2 output selection
(the signal provided to the output across MO2 and LG)

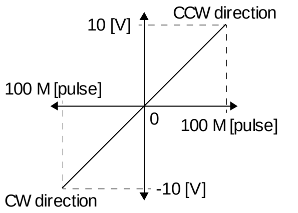
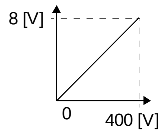
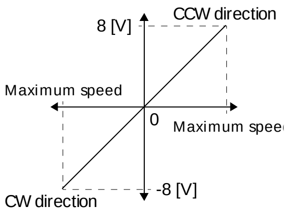
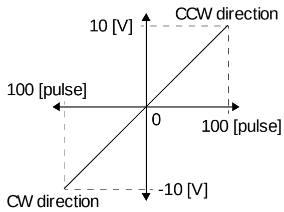
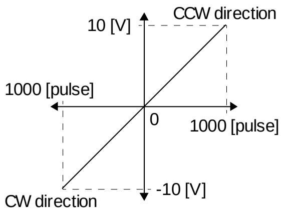
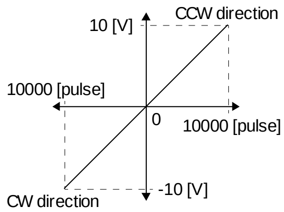
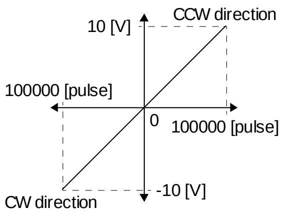
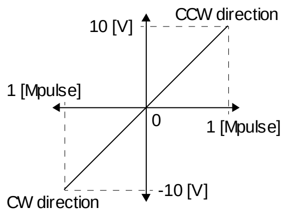
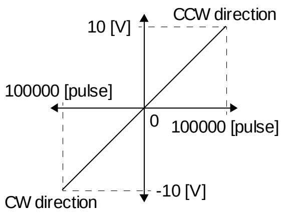
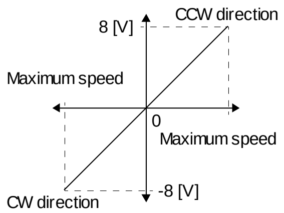
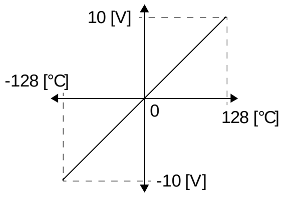
[Pr. PC11] and [Pr. PC12] can be used to set the offset voltages to the analog output voltages. Setting value is -999 mV to 999 mV.

Parameter	Description	Setting range [mV]
PC11	This is used to set the offset voltage of MO1 (Analog monitor 1).	-999 to 999
PC12	This is used to set the offset voltage of MO2 (Analog monitor 2).	

(2) Setting

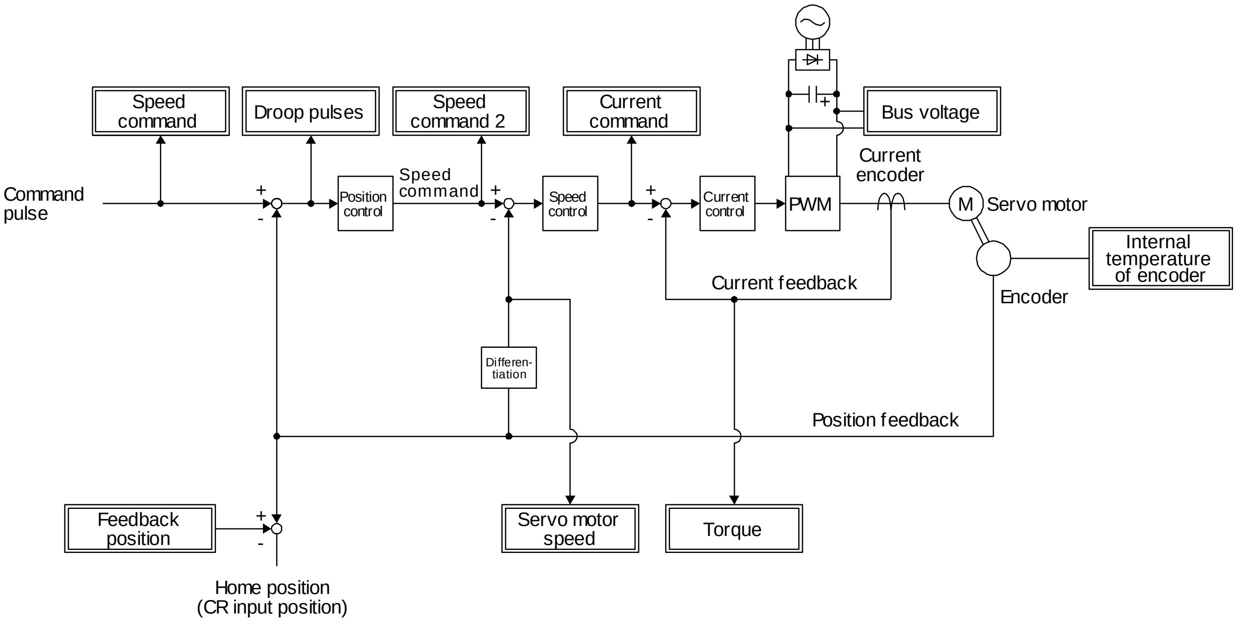
The driver is factory-set to output the servo motor speed to MO1 (Analog monitor 1) and the torque to MO2 (Analog monitor 2). The setting can be changed as listed below by setting the [Pr. PC14] and [Pr. PC15] value.

Setting value	Output item	Description	Setting value	Output item	Description
00	Servo motor speed		01	Torque (Note 8)	
02	Servo motor speed		03	Torque (Note 8)	
04	Current command (Note 8)		05	Command pulse frequency (±10 V/±4 Mpulses/s)	
06	Servo motor-side droop pulses (Note 1, 3, 5, 6) (±10 V/100 pulses)		07	Servo motor-side droop pulses (Note 1, 3, 5, 6) (±10 V/1000 pulses)	
08	Servo motor-side droop pulses (Note 1, 3, 5, 6) (±10 V/10000 pulses)		09	Servo motor-side droop pulses (Note 1, 3, 5, 6) (±10 V/100000 pulses)	
0A	Feedback position (Note 1, 2, 3) (±10 V/1 Mpulse)		0B	Feedback position (Note 1, 2, 3) (±10 V/10 Mpulse)	

Setting value	Output item	Description	Setting value	Output item	Description
0C	Feedback position (Note 1, 2, 3) (±10 V/100 Mpulse)		0D	Bus voltage	
0E	Speed command 2 (Note 3)		10	Load-side droop pulses (Note 3, 4, 5) (±10 V/100 pulses)	
11	Load-side droop pulses (Note 3, 4, 5) (±10 V/1000 pulses)		12	Load-side droop pulses (Note 3, 4, 5) (±10 V/10000 pulses)	
13	Load-side droop pulses (Note 3, 4, 5) (±10 V/100000 pulses)		14	Load-side droop pulses (Note 3, 4, 5) (±10 V/1 Mpulse)	
15	Motor-side/load-side position deviation (Note 3, 4, 5) (±10 V/100000 pulses)		16	Servo motor-side/load-side speed deviation (Note 4)	
17	Internal temperature of encoder (±10 V/±128 ˚C)				

Note 1. Encoder pulse unit.
2. Available in position control mode
3. This cannot be used in the torque control mode.
4. This can be used with setup software (MR Configurator2™) with software version 1.19V or later.
5. This cannot be used in the speed control mode.
8. For details on the maximum current command (maximum torque) for ±8 V, refer to app. 7.(4) for details.

(3) Analog monitor block diagram



(4) Values of the maximum current command when the analog monitor is at the maximum/minimum voltage

Values of the maximum current command when the analog monitor is at the maximum/minimum voltage are listed.
The current command (torque) outputs the maximum current command (maximum torque) at ±8 V. The maximum current command may not match the rated current/maximum current ratio since it is created from the torque current in the driver.

Servo motor LE-□-□	Driver/drive unit	Maximum current command (maximum torque) [%]
T6	LECSB2-T5	373
T7	LECSB2-T7	387
T8	LECSB2-T8	383
T9	LECSB2-T9	367

App. 8 STO function with SIL 3 certification

The LECSB2-T□ series now comply with safety integrity level 3 (SIL 3) of the IEC 61508:2010 functional safety standard.

(1) Change of the compliance
The target LECSB2-T□ drivers now comply with SIL 3 (Table app. 3).

Table app. 3 Compliance with SIL 3

Safety performance (Standards certified by CB)	EN ISO 13849-1 Category 3 PL e, IEC 61508 SIL 3, EN 62061 SIL CL 3, EN 61800-5-2 STO function

(2) Use with SIL 3
Set the safety level with [Pr. PF18 STO diagnosis error detection time].
To use the driver with SIL 3, set [Pr. PF18 STO diagnosis error detection time] within the range of 1 to 60, connect the TOFB output (CN8) of the driver to the input of a SIL 3-certified PC or PLC...etc and execute the diagnosis. SIL 3 functional safety of the drivers is certified by TÜV SÜD.

(3) Use with SIL 2 (as conventional)
The drivers are still capable of SIL 2 as before regardless of whether the STO diagnosis function is enabled or not.
Either of the conventionally-used TÜV Rheinland certification or the new TÜV SÜD certification may be used.

App. 9 Status of compliance with the China RoHS directive

(1) Summary

The China RoHS directive: 电子信息产品污染控制管理办法 (Management Methods for Controlling Pollution by Electronic Information Products) came into effect on March 1, 2007. The China RoHS directive was replaced by the following China RoHS directive: 电器电子产品有害物质限制使用管理办法 (Management Methods for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products). The succeeding China RoHS directive has been in effect since July 1, 2016.
The China RoHS directive restricts the use of six hazardous substances (lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB), and polybrominated diphenyl ethers (PBDE)) and other hazardous substances specified by the State (currently no applicable substances). The EU RoHS directive (2011/65/EU) also restricts the use of the above six hazardous substances.

(2) Status of our products for compliance with the China RoHS directive

The following tables show the content of six hazardous substances in our products and Environment-Friendly Use Period marks. Table app. 4 is created based on the standard SJ/T11364.

Table app. 4 Names and the content of hazardous substances in the products

Part name	Substance name / Threshold standard	Hazardous substance (Note 1) Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent chromium (Cr(VI))	PBB	PBDE	Environment-Friendly Use Period mark (Note 2)	Remark
		Threshold of cadmium: 0.01 wt% (100 ppm), Threshold of substances other than cadmium: 0.1 wt% (1000 ppm)							
Driver Servo system PC or PLC...etc	Mounting board	×	○	○	○	○	○		
	Heat sink	×	○	○	○	○	○		
	Resin cabinet	○	○	○	○	○	○		
	Plate and screw	○	○	○	○	○	○		
Servo motor	Bracket	×	○	○	○	○	○		
	Mounting board	×	○	○	○	○	○		
	Resin cabinet	○	○	○	○	○	○		
	Core and cable	○	○	○	○	○	○		
Cable product	Cable	○	○	○	○	○	○		Including connector set
	Connector	○	○	○	○	○	○		
Optional unit	Mounting board	×	○	○	○	○	○		
	Resin cabinet	○	○	○	○	○	○		
	Plate and screw	○	○	○	○	○	○		

Note 1. ○: Indicates that said hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T26572.
×: Indicates that said hazardous substance contained in at least one of the homogeneous materials for this part is above the limit requirement of GB/T26572.

2. Indications based on "Marking for the restriction of the use of hazardous substances in electrical and electronic product" [SJ/T11364-2014]


Indicates that a certain hazardous substance is contained in the product manufactured or sold in China. Observe safety and usage precautions for the product, and use it within a limited number of years from the production date. Thereby, any of the hazardous substances in the product does not cause environmental pollution, or seriously affect human health or property.

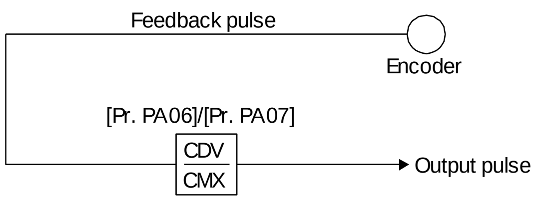

Indicates that no certain hazardous substance is contained in the product.

(3) Difference between the China RoHS directive and the EU RoHS directive
The China RoHS directive allows no restriction exemption unlike the EU RoHS directive. Although a product complies with the EU RoHS directive, a hazardous substance in the product may be considered to be above the limit requirement (marked "×") in the China RoHS directive.
The following shows some restriction exemptions and their examples according to the EU RoHS directive.

- Lead as an alloying element in steel for machining purposes and in galvanized steel containing up to 0.35% lead by weight, lead as an alloying element in aluminum containing up to 0.4% lead by weight, and copper alloy containing up to 4% lead by weight, e.g. brass-made insert nuts
- Lead in high melting temperature type solders (i.e. lead-based alloys containing 85% by weight or more lead)
- Electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors, e.g. piezoelectronic devices
- Electrical and electronic components containing lead in a glass or ceramic matrix compound, e.g. chip resistors

App. 10 Encoder output pulse setting method

For details of "Encoder output pulse setting selection" in [Pr. PC19], refer to the following table.

Setting value	Servo motor/direct drive motor
_ _ 0 _ (Output pulse setting)	Set the output pulses per revolution with [Pr. PA15 Encoder output pulses]. Output pulse = a value set in [Pr. PA15] [pulse/rev] Selecting "Load side encoder (_ 1 _ _)" of "Encoder selection for encoder output pulse" in [Pr. PC19] triggers [AL. 37 Parameter error].
_ _1 _ (Dividing ratio setting)	Set the dividing ratio to the resolution per servo motor revolution with [Pr. PA15 Encoder output pulses]. $\text{Output pulse} = \dfrac{\text{Resolution per revolution}}{\text{[Pr. PA15] setting}}$ [pulse/rev]
_ _ 2 _ (The same output pulse setting as the command pulse)	Feedback pulses from the encoder are processed as follows to be outputted. Feedback pulses are outputted in the same pulse unit as the command pulse. 
_ _ 3 _ (A-phase/B-phase pulse electronic gear setting)	Set the A-phase/B-phase pulse electronic gear with [Pr. PA15 Encoder output pulses] and [Pr. PA16 Encoder output pulses 2]. $\text{Output pulse} = \text{the servo motor resolution per revolution} \times \dfrac{\text{[Pr. PA15] setting}}{\text{[Pr. PA16] setting}}$ [pulse/rev]
_ _ 4 _ (A/B-phase pulse through output setting)	[AL. 37 Parameter error] occurs.

App .11 Recommended parameter values for each actuator

Please change the parameter values according to the customer application. See section 5, section 16 of the “LECSB2-T□ Operation Manual” for details.

Recommended Parameter Values [LEF]

Series			LEFS25			LEFS32			LEFS40		
	Lead symbol		H	A	B	H	A	B	H	A	B
	Lead		20	12	6	24	16	8	30	20	10
Parameter *1,*2	Para No	Initial value	Recommended Value								
Number of command input pulses per revolution *3.	PA05	10000	10000								
Electronic gear numerator *3.	PA06	1	**262144**								
Electronic gear denominator *3.	PA07	1	**(Position control mode)**								
			2000	**1200**	**600**	**2400**	**1600**	**800**	**3000**	**2000**	**1000**
			(Positioning mode)								
			20000	**12000**	**6000**	**24000**	**16000**	**8000**	**30000**	**20000**	**10000**
Function selection A-3	PA21	0001	**2001 (J3 electronic gear setting value compatibility mode)**								
Feel length multiplication (STM) (Multiplier)	PT03	0000	**0000 ((<1000 stroke)/0001 (>1000 stroke)**								
Home position return type	PT04	0010	**□□□3 (Stopper type)**								
Home position return direction	PT04	0010	□□1□ (Motor side)								
Home position return Speed (rpm)	PT05	500	**90**	**150**	**300**	**75**	**113**	**225**	**60**	**90**	**180**
Home position return position data (μm)	PT08	0	**-2000 (<1000 stroke)/-200 (>1000 stroke)**								
Stopper type home position return stopper time (msec)	PT10	100	**200**								
Stopper type home position return torque limit value (%)	PT11	15	**24**								
Regenerative option	PA02	0000	**0000 (Non)/0002 (LEC-MR-RB-032)**								
Rotation direction selection *4	PA14	0	**1 (+ : Counter motors side)**								
Load to motor inertia moment ratio	PB06	7	7								
Function selection E-3	PE41	0000	0000								

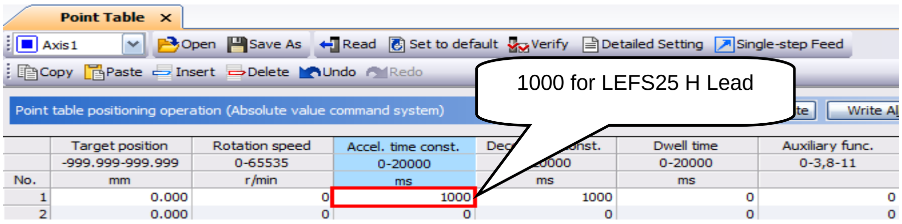
Differs to initial value

*1. Parameter is set to the recommended value. Please set parameter according to customer application.
*2. Mechanical resonance may occur depending on the shape or mounting orientation of the work piece. Please change this parameter during initial configuration.
(Parameter initial configuration ⇒ Set the recommended parameter value ⇒ Operation start)
*3. Other than positioning mode: Actuator travel distance at 10 [μm/pulse] per pulse.
Positioning Mode: Minimum actuator travel distance of 1[μm].
*4. When the motor mounting position is right side parallel (LEFS*R) or left side parallel (LEFS*L), the rotation direction selection is 0(+: Counter motors side).

Recommended Value of acceleration time constant of Point table No.1 [LEF]

Series	Lead symbol	LEFS25 H	LEFS25 A	LEFS25 B	LEFS32 H	LEFS32 A	LEFS32 B	LEFS40 H	LEFS40 A	LEFS40 B
	Lead	20	12	6	24	16	8	30	20	10
Point table No.1	Initial value	Recommended Value								
Home position return acceleration time constant (msec) *5	0	**1000**	**600**	**300**	**1200**	**800**	**400**	**1500**	**1000**	**500**

Differs to initial value



*5. Use the acceleration time constant of Point table No.1 as the acceleration time constant (msec) of Home position return. Set the recommended value in the above figure.

Series		Lead symbol	LEFB25	LEFB25U	LEFB32	LEFB32U	LEFB40	LEFB40U
		Lead symbol	S					
		Lead	54					
Parameter *1,*2	Para No	Initial value	Recommended value					
Number of command input pulses per revolution *3.	PA05	10000	10000					
Electronic gear numerator *3.	PA06	1	**262144**					
Electronic gear denominator *3.	PA07	1	**(Position control mode)** **5400** **(Positioning mode)** **54000**					
Function selection A-3	PA21	0001	**2001 (J3 electronic gear setting value compatibility mode)**					
Feel length multiplication (STM) (Multiplier)	PT03	0000	**0000 (<1000 stroke)/0001 (>1000 stroke)**					
Home position return type	PT04	0010	**□□□3 (Stopper type)**					
Home position return direction	PT04	0010	□□1□ (Motor side)					
Home position return Speed (rpm)	PT05	500	**33**					
Home position return position data (μm)	PT08	0	**-3000 (<1000 stroke)/-300 (>1000 stroke)**					
Stopper type home position return stopper time (msec)	PT10	100	**200**					
Stopper type home position return torque limit value (%)	PT11	15	**24**					
Regenerative option	PA02	0000	**0000 (Non)/0002 (LEC-MR-RB-032)**					
Rotation direction selection	PA14	0	**1 (+ : Counter motors side)**	0 (+ : Counter motors side)	**1 (+ : Counter motors side)**	0 (+ : Counter motors side)	**1 (+ : Counter motors side)**	0 (+ : Counter motors side)
★ Load to motor inertia moment ratio	PB06	7	**50**					
★Function selection E-3	PE41	0000	**0001(Robust filter enabled)**					

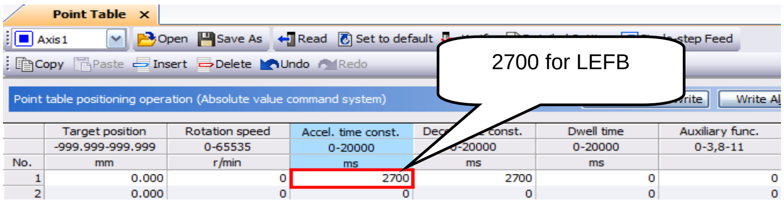
★ Parameter setting required.
Differs to initial value

*1. Parameter is set to the recommended value. Please set parameter according to customer application.
*2. Mechanical resonance may occur depending on the shape or mounting orientation of the work piece.
Please change this parameter during initial configuration.
(Parameter initial configuration ⇒ Set the recommended parameter value ⇒ Operation start)
*3. Other than positioning mode: Actuator travel distance at 10 [μm/pulse] per pulse.
Positioning Mode: Minimum actuator travel distance of 1[μm].

Recommended Value of acceleration time constant of Point table No.1 [LEF]

Series		LEFB25	LEFB25U	LEFB32	LEFB32U	LEFB40	LEFB40U
	Lead symbol	S					
	Lead	54					
Point table No.1	Initial value	Recommended value					
Home position return acceleration time constant (msec) *4	0	**2700**					

Differs to initial value



*4. Use the acceleration time constant of Point table No.1 as the acceleration time constant (msec) of Home position return. Set the recommended value in the above figure.

Recommended Parameter Values [LEJ]

Series			LEJS40			LEJS63			LEJB40	LEJB63
	Lead symbol		H	A	B	H	A	B	T	
	Lead		24	16	8	30	20	10	27	42
Parameter *1,*2	Para. No	Initial value	Recommended value							
Number of command input pulses per revolution *3.	PA05	10000	10000							
Electronic gear numerator *3.	PA06	1	**262144**							
Electronic gear denominator *3.	PA07	1	**(Position control mode)**							
			2400	**1600**	**800**	**3000**	**2000**	**1000**	**2700**	**4200**
			(Positioning mode)							
			24000	**16000**	**8000**	**30000**	**20000**	**10000**	**27000**	**42000**
Function selection A-3	PA21	0001	**2001 (J3 electronic gear setting value compatibility mode)**							
Feel length multiplication (STM) (Multiplier)	PT03	0000	**0000 (<1000 stroke)/0001 (>1000 stroke)**							
Home position return type	PT04	0010	**□□□3 (Stopper type)**							
Home position return direction	PT04	0010	□□1□ (Motor side)							
Home position return Speed (rpm)	PT05	500	**75**	**113**	**225**	**60**	**90**	**180**	**133**	**86**
Home position return position data (μm)	PT08	0	**-2000 (<1000 stroke)/-200 (>1000 stroke)**							
Stopper type home position return stopper time (msec)	PT10	100	**200**							
Stopper type home position return torque limit value (%)	PT11	15	**24**							
Regenerative option	PA02	0000	**0000 (Non)/0002 (LEC-MR-RB-032)/0003 (LEC-MR-RB-12)**							
Rotation direction selection	PA14	0	**1 (+ : Counter motors side)**						0 (+ : Counter motors side)	
★Load to motor inertia moment ratio	PB06	7	7						**50**	
★Function selection E-3	PE41	0000	0000						**0001(Robust filter enabled)**	

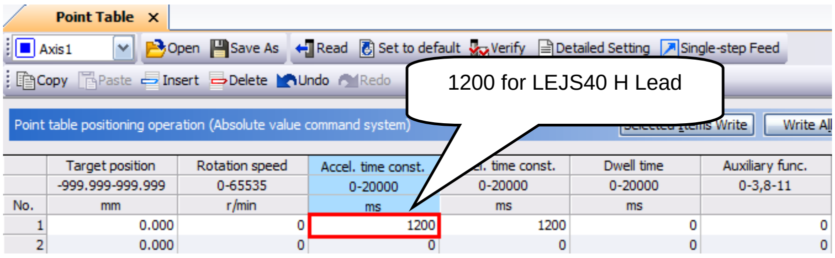
★ Parameter setting required.
(grey box) Differs to initial value

*1. Parameter is set to the recommended value. Please set parameter according to customer application.
*2. Mechanical resonance may occur depending on the shape or mounting orientation of the work piece.
Please change this parameter during initial configuration.
(Parameter initial configuration ⇒ Set the recommended parameter value ⇒ Operation start)
*3. Other than positioning mode: Actuator travel distance at 10 [μm/pulse] per pulse.
Positioning Mode: Minimum actuator travel distance of 1[μm].

Recommended Value of acceleration time constant of Point table No.1 [LEJ]

Series		LEJS40			LEJS63			LEJB40	LEJB63
	Lead symbol	H	A	B	H	A	B	T	
	Lead	24	16	8	30	20	10	27	42
Point table No.1	Initial value	Recommended value							
Home position return acceleration time constant (msec) *4	0	**1200**	**800**	**400**	**1500**	**1000**	**500**	**1350**	**2100**

Differs to initial value



*4. Use the acceleration time constant of Point table No.1 as the acceleration time constant (msec) of Home position return. Set the recommended value in the above figure..

Series			LEJS100		
	Lead symbol		H	A	B
	Lead		50	25	10
Parameter *1,*2	Para. No	Initial value	Recommended value		
Number of command input pulses per revolution *3.	PA05	10000	10000		
Electronic gear numerator *3.	PA06	1	**262144**		
Electronic gear denominator *3.	PA07	1	**(Position control mode)**		
			5000	**2500**	**1000**
			(Position control mode)		
			50000	**25000**	**10000**
Function selection A-3	PA21	0001	**2001 (J3 electronic gear setting value compatibility mode)**		
Feel length multiplication (STM) (Multiplier)	PT03	0000	**0000 (<1000 stroke)/0001 (>1000 stroke)**		
Home position return type	PT04	0010	**□□□3 (Stopper type)**		
Home position return direction	PT04	0010	□□1□ (Motor side)		
Home position return Speed (rpm)	PT05	100	**36**	**72**	**180**
Home position return position data (μm)	PT08	0	**-7000 (<1000 stroke)/-700 (>1000 stroke)**		
Stopper type home position return stopper time (msec)	PT10	100	**200**		
Stopper type home position return torque limit value (%)	PT11	15	**24**		
Regenerative option	PA02	0000	**0000 (Non)/0002 (LEC-MR-RB-032)/0003 (LEC-MR-RB-12)**		
Rotation direction selection	PA14	0	**1 (+ : Counter motors side)**		
Load to motor inertia moment ratio	PB06	7	7		
Function selection E-3	PE41	0000	**0001(Robust filter enabled)**		

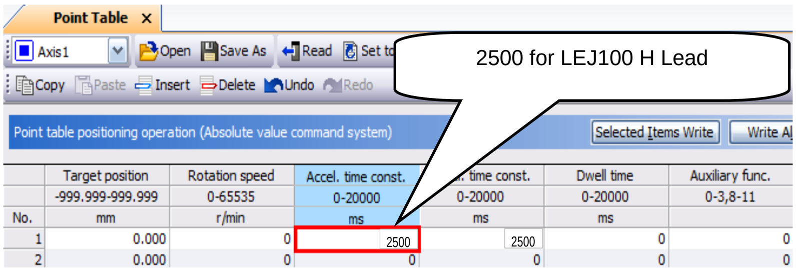
:Differs to initial value

*1. Parameter is set to the recommended value. Please set parameter according to customer application.
*2. Mechanical resonance may occur depending on the shape or mounting orientation of the work piece. Please change this parameter during initial configuration.
(Parameter initial configuration ⇒ Set the recommended parameter value ⇒ Operation start)
*3. Other than positioning mode: Actuator travel distance at 10 [μm/pulse] per pulse.
Positioning Mode: Minimum actuator travel distance of 1[μm].

Recommended Value of acceleration time constant of Point table No.1 [LEJ]

Series		LEJS100		
	Lead symbol	H	A	B
	Lead	50	25	10
Point table No.1	Initial value	Recommended value		
Home position return acceleration time constant (msec) *4	0	**2500**	**1250**	**500**

(Gray shading) : Differs to initial value



*4. Use the acceleration time constant of Point table No.1 as the acceleration time constant (msec) of Home position return. Set the recommended value in the above figure.

Recommended Parameter Values [LEY]

Series			LEY25/LEYG25			LEY25D/LEYG25D			LEY32/LEYG32			LEY32D/LEYG32D		
	Lead symbol		A	B	C	A	B	C	A	B	C	A	B	C
	Lead		12	6	3	12	6	3	20	10	5	16	8	4
Parameter *1,*2	Para. No	Initial value	Recommended value											
Number of command input pulses per revolution *3.	PA05	10000	10000											
Electronic gear numerator *3.	PA06	1	**262144**											
Electronic gear denominator *3.	PA07	1	**(Position control mode)**											
			1200	**600**	**300**	**1200**	**600**	**300**	**2000**	**1000**	**500**	**1600**	**800**	**400**
			(Positioning mode)											
			12000	**6000**	**3000**	**12000**	**6000**	**3000**	**20000**	**10000**	**5000**	**16000**	**8000**	**4000**
Function selection A-3	PA21	0001	**2001 (J3 electronic gear setting value compatibility mode)**											
Feel length multiplication (STM) (Multiplier)	PT03	0000	**0000 (<1000 stroke)/0001 (>1000 stroke)**											
Home position return type	PT04	0010	**□□□3 (Stopper type)**											
Home position return direction	PT04	0010	□□1□ (Motor side)											
Home position return Speed (rpm)	PT05	500	**150**	**300**	**600**	**150**	**300**	**600**	**90**	**180**	**360**	**112**	**225**	**450**
Home position return position data (μm)	PT08	0	**-2000 (<1000 stroke)/-200 (>1000 stroke)**											
Stopper type home position return stopper time (msec)	PT10	100	**200**											
Stopper type home position return torque limit value (%)	PT11	15	**24**											
Regenerative option	PA02	0000	**0000 (Non)/0002 (LEC-MR-RB-032)**											
Rotation direction selection *4	PA14	0	0 (+：Counter motors side)			**1 (+：Counter motors side)**			0 (+：Counter motors side)			**1 (+：Counter motors side)**		
Load to motor inertia moment ratio	PB06	7	7											
Function selection E-3	PE41	0000	0000											

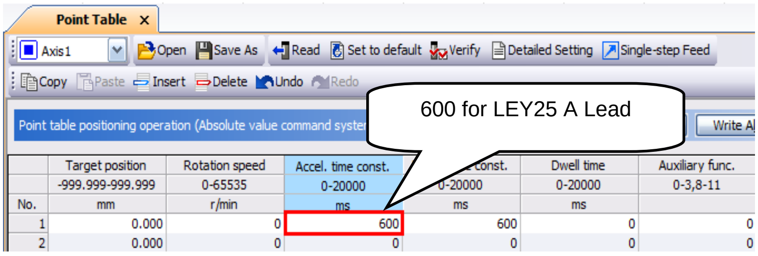
▭ Differs to initial value

*1. Parameter is set to the recommended value. Please set parameter according to customer application.
*2. Mechanical resonance may occur depending on the shape or mounting orientation of the work piece. Please change this parameter during initial configuration.
(Parameter initial configuration ⇒ Set the recommended parameter value ⇒ Operation start)
*3. Other than positioning mode: Actuator travel distance at 10 [μm/pulse] per pulse.
Positioning Mode: Minimum actuator travel distance of 1[μm].
*4. When the motor mounting position is right side parallel (LEY*R) or left side parallel (LEY*L), the rotation direction selection is 0(+: Counter motors side).

Recommended Value of acceleration time constant of Point table No.1 [LEY]

Series	Lead symbol	A	B	C	A	B	C	A	B	C	A	B	C
		LEY25/LEYG25			LEY25D/LEYG25D			LEY32/LEYG32			LEY32D/LEYG32D		
	Lead	12	6	3	12	6	3	20	10	5	16	8	4
Point table No.1	Initial value	Recommended value											
Home position return acceleration time constant (msec) *5	0	**600**	**300**	**150**	**600**	**300**	**150**	**1000**	**500**	**250**	**800**	**400**	**200**

Differs to initial value



*5. Use the acceleration time constant of Point table No.1 as the acceleration time constant (msec) of Home position return. Set the recommended value in the above figure.

Series			LEY63				LEY63D		
	Lead symbol		A	B	C	L	A	B	C
	Lead (Including pulley ratio)		20	10	5	5(2.86) (Pulley ratio 4/7)	20	10	5
Parameter *1,*2	Para. No	Initial value	Recommended value						
Number of command input pulses per revolution *3.	PA05	10000	10000						
Electronic gear numerator *3.	PA06	1	**262144**			**1835008**	**262144**		
Electronic gear denominator *3.	PA07	1	**(Position control mode)**						
			2000	**1000**	**500**	**2000**	**2000**	**1000**	**500**
			(Positioning mode)						
			20000	**10000**	**5000**	**20000**	**20000**	**10000**	**5000**
Function selection A-3	PA21	0001	**2001 (J3 electronic gear setting value compatibility mode)**						
Feel length multiplication (STM) (Multiplier)	PT03	0000	**0000 (<1000 stroke)/0001 (>1000 stroke)**						
Home position return type	PT04	0010	**□□□3 (Stopper type)**						
Home position return direction	PT04	0010	□□1□ (Motor side)						
Home position return Speed (rpm)	PT05	500	**90**	**180**	**360**	**629**	**90**	**180**	**360**
Home position return position data (μm)	PT08	0	**-4000 (<1000 stroke)/-400 (>1000 stroke)**						
Stopper type home position return stopper time (msec)	PT10	100	**200**						
Stopper type home position return torque limit value (%)	PT11	15	**24**						
Regenerative option	PA02	0000	**0000 (Non)/0002 (LEC-MR-RB-032)/0003 (LEC-MR-RB-12)**						
Rotation direction selection *4	PA14	0	0 (+ : Counter motors side)				**1 (+ : Counter motors side)**		
Load to motor inertia moment ratio	PB06	7	7						
Function selection E-3	PE41	0000	0000						

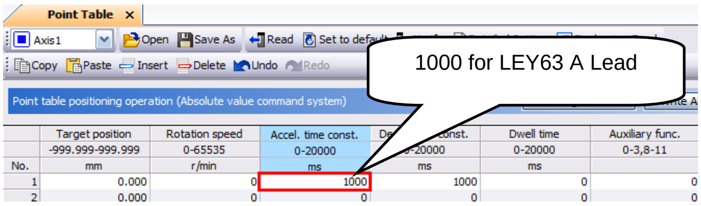
Differs to initial value

*1. Parameter is set to the recommended value. Please set parameter according to customer application.
*2. Mechanical resonance may occur depending on the shape or mounting orientation of the work piece.
Please change this parameter during initial configuration.
(Parameter initial configuration ⇒ Set the recommended parameter value ⇒ Operation start)
*3. Other than positioning mode: Actuator travel distance at 10 [μm/pulse] per pulse.
Positioning Mode: Minimum actuator travel distance of 1[μm].
*4. When the motor mounting position is right side parallel (LEY*R) or left side parallel (LEY*L), the rotation direction selection is 0(+: Counter motors side).

Recommended Value of acceleration time constant of Point table No.1 [LEY]

Series		LEY63				LEY63D		
	Lead symbol	A	B	C	L	A	B	C
	Lead (Including pulley ratio)	20	10	5	5(2.86) (Pulley ratio 4/7)	20	10	5
Point table No.1	Initial value	Recommended value						
Home position return acceleration time constant (msec) *5	0	**1000**	**500**	**250**	**143**	**1000**	**500**	**250**

Differs to initial value



*5. Use the acceleration time constant of Point table No.1 as the acceleration time constant (msec) of Home position return. Set the recommended value in the above figure.

Series			LEY100D		
	Lead symbol		B	D	L
	Lead (Including pulley ratio)		10	10(3.3) [Pulley ratio 1/3]	10(2) [Pulley ratio 1/5]
Parameter *1,*2	Para. No	Initial value	Recommended value		
Number of command input pulses per revolution *3.	PA05	10000	10000		
Electronic gear numerator *3.	PA06	1	**98304**		
Electronic gear denominator *3.	PA07	1	**(Position control mode)**		
			375	**125**	**75**
			(Position control mode)		
			3750	**1250**	**750**
Function selection A-3	PA21	0001	**2001 (J3 electronic gear setting value compatibility mode)**		
Feel length multiplication (STM) (Multiplier)	PT03	0000	**0000 (<1000 stroke)/0001 (>1000 stroke)**		
Home position return type	PT04	0010	**□□□3 (Stopper type)**		
Home position return direction	PT04	0010	□□1□ (Motor side)		
Home position return Speed (rpm)	PT05	100	**180**	**545**	**900**
Home position return position data (μm)	PT08	0	**-5000 (<1000 stroke)/-500 (>1000 stroke)**		
Stopper type home position return stopper time (msec)	PT10	100	**200**		
Stopper type home position return torque limit value (%)	PT11	15	**24**		
Regenerative option	PA02	0000	**0000 (Non)/0002 (LEC-MR-RB-032)/0003 (LEC-MR-RB-12)**		
Rotation direction selection	PA14	0	**1 (+ : Counter motors side)**		
Load to motor inertia moment ratio	PB06	7	7		
Function selection E-3	PE41	0000	**0001(Robust filter enabled)**		

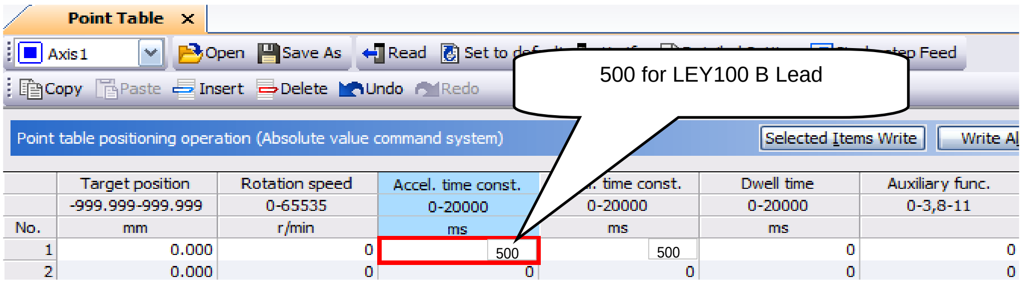
[shaded box] : Differs to initial value

*1. Parameter is set to the recommended value. Please set parameter according to customer application.
*2. Mechanical resonance may occur depending on the shape or mounting orientation of the work piece.
Please change this parameter during initial configuration.
(Parameter initial configuration ⇒ Set the recommended parameter value ⇒ Operation start)
*3. Other than positioning mode: Actuator travel distance at 10 [μm/pulse] per pulse.
Positioning Mode: Minimum actuator travel distance of 1[μm].

Recommended Value of acceleration time constant of Point table No.1 [LEY]

Series		LEY100D		
	Lead symbol	B	D	L
	Lead (Including pulley ratio)	10	10(3.3)	10(2)
Point table No.1	Initial value	Recommended value		
Home position return acceleration time constant (msec) *4	0	**500**	**166**	**100**

: Differs to initial value



*4. Use the acceleration time constant of Point table No.1 as the acceleration time constant (msec) of Home position return. Set the recommended value in the above figure.

Recommended Parameter Values [LESYH]

Series			LESYH16		LESYH16D		LESYH25		LESYH25D	
	Lead symbol		A	B	A	B	A	B	A	B
	Lead (Including pulley ratio)		10	6	10	6	16(20) (Pulley ratio 5/4)	8(10) (Pulley ratio 5/4)	16	8
Parameter *1,*2	Para. No	Initial value								
Number of command input pulses per revolution *3.	PA05	10000	10000							
Electronic gear numerator *3.	PA06	1	**262144**							
Electronic gear denominator *3.	PA07	1	**(Position control mode)**							
			1000	**600**	**1000**	**600**	**2000**	**1000**	**1600**	**800**
			(Position control mode)							
			10000	**6000**	**10000**	**6000**	**20000**	**10000**	**16000**	**8000**
Function selection A-3	PA21	0001	**2001 (J3 electronic gear setting value compatibility mode)**							
Feel length multiplication (STM) (Multiplier)	PT03	0000	**0000 (<1000 stroke)/0001 (>1000 stroke)**							
Home position return type	PT04	0010	**□□□3 (Stopper type)**							
Home position return direction	PT04	0010	□□1□ (Motor side)							
Home position return Speed (rpm)	PT05	100	**180**	**300**	**180**	**300**	**90**	**180**	**112**	**225**
Home position return position data (μm)	PT08	0	**-2000 (<1000 stroke)/-200 (>1000 stroke)**							
Stopper type home position return stopper time (msec)	PT10	100	**200**							
Stopper type home position return torque limit value (%)	PT11	15	**24**							
Regenerative option	PA02	0000	**0000 (Non)/0002 (LEC-MR-RB-032)/0003 (LEC-MR-RB-12)**							
Rotation direction selection *4	PA14	0	0 (+ : Counter motors side)		**1 (+ : Counter motors side)**		0 (+ : Counter motors side)		**1 (+ : Counter motors side)**	
Load to motor inertia moment ratio	PB06	7	7							
Function selection E-3	PE41	0000	0000							

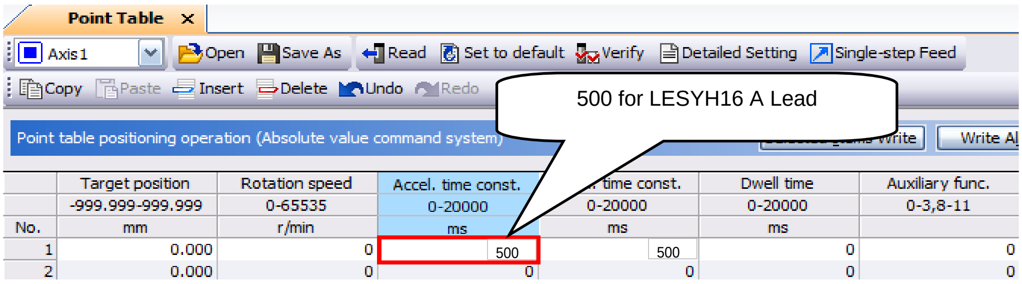
(Shaded): Differs to initial value

*1. Parameter is set to the recommended value. Please set parameter according to customer application.
*2. Mechanical resonance may occur depending on the shape or mounting orientation of the work piece.
Please change this parameter during initial configuration.
(Parameter initial configuration ⇒ Set the recommended parameter value ⇒ Operation start)
*3. Other than positioning mode: Actuator travel distance at 10 [μm/pulse] per pulse.
Positioning Mode: Minimum actuator travel distance of 1[μm].
*4. When the motor mounting position is right side parallel (LESYH*R) or left side parallel (LESYH*L), the rotation direction selection is 0(+: Counter motors side).

Recommended Value of acceleration time constant of Point table No.1 [LESYH]

Series		LESYH16		LESYH16D		LESYH25		LESYH25D	
	Lead symbol	A	B	A	B	A	B	A	B
	Lead (Including pulley ratio)	10	6	10	6	16(20)	8(10)	16	8
Point table No.1	Initial value	Recommended value							
Home position return acceleration time constant (msec) *5	0	**500**	**300**	**500**	**300**	**1000**	**500**	**800**	**400**

(shaded): Differs to initial value



*5. Use the acceleration time constant of Point table No.1 as the acceleration time constant (msec) of Home position return. Set the recommended value in the above figure.

Revision history
No.LEC*-OMY0114 Sep/2021 [App.11 Recommended parameter values for each actuator] add

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