SMC®

Operation Manual

PRODUCT NAME

AC Servo Motor Driver
(SSCNETⅢ/H Type)

MODEL/ Series

LECSS2-T□ Series

SMC Corporation

LECSS2-T□ Series / Driver 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 and safety requirements for systems and their components
ISO 4413: Hydraulic fluid power - General rules and safety requirements for systems and their components
IEC 60204-1: Safety of machinery - Electrical equipment of machines - Part 1: General requirements
ISO 10218-1: Robots and robotic devices - Safety requirements for industrial robots - Part 1:Robots
etc.

⚠	**Danger**	**Danger** indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
⚠	**Warning**	**Warning** indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
⚠	**Caution**	**Caution** indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate 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.
1. 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.
2. 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.
3. Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

4. SMC products cannot be used beyond their specifications. They are not developed, designed, and manufactured to be used under the following conditions or environments. Use under such conditions or environments is not allowed.
1. Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.
2. Use for nuclear power, railways, aviation, space equipment, ships, vehicles, military application, equipment affecting human life, body, and property, combustion equipment, entertainment equipment, emergency shut-off circuits, press clutches, brake circuits, safety equipment, etc., and use for applications that do not conform to standard specifications such as catalogs and operation manuals.
3. Use for interlock circuits, except for use with double interlock such as installing a mechanical protection function in case of failure. Please periodically inspect the product to confirm that the product is operating properly.

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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.

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⚠ LECSS2-T□ Series / Driver Safety Instructions

⚠ Caution

SMC develops, designs, and manufactures products to be used for automatic control equipment, and provides them for peaceful use in manufacturing industries.
Use in non-manufacturing industries is not allowed.
Products SMC manufactures and sells cannot be used for the purpose of transactions or certification specified in the Measurement Act of each country.
The new Measurement Act prohibits use of any unit other than SI units in Japan.

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

1. The warranty period of the product is 1 year in service or 1.5 years after the product is delivered, whichever is first.[*2]
   Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.
2. 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.
3. Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalog for the particular products.

   [*2] 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

1. The use of SMC products with production equipment for the manufacture of weapons of mass destruction (WMD) or any other weapon is strictly prohibited.
2. The exports of SMC products or technology from one country to another are governed by the relevant security laws and regulations of the countries involved in the transaction. Prior to the shipment of a SMC product to another country, assure that all local rules governing that export are known and followed.

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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.

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4. Additional instructions

The following instructions should also be fully noted. Incorrect handling may cause a fault, injury, electric shock, etc.
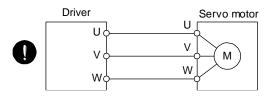
(1) Transportation and installation

+---+
| ⚠ 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.

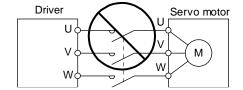● When you keep or use the equipment, please fulfill the following environment.

Environment			Conditions	
			Driver	Servo motor
Ambient temperature	In operation	[℃]	0 to +55 (non-freezing)	0 to +40 (non-freezing)
		[℉]	32 to 131 (non-freezing)	32 to 104 (non-freezing)
	In storage	[℃]	−20 to +65 (non-freezing)	−15 to +70 (non-freezing)
		[℉]	−4 to 149 (non-freezing)	5 to 158 (non-freezing)
Ambient humidity	In operation		90%RH or less (non-condensing)	80%RH or less (non-condensing)
	In storage		90%RH or less (non-condensing)	
Ambience			Indoors (no direct sunlight) Free from corrosive gas, flammable gas, oil mist, dust and dirt	
Altitude			Max. 1000m (3280 ft) above sea level	
(Note) Vibration	[m/s²]		5.9 or less	LECSS2-T5 LECSS2-T7 LECSS2-T8 LECSS2-T9 series X・Y: 49

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

● When handling the driver, be careful about the edged parts such as corners of the driver.

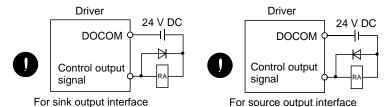● The driver must be installed in the metal cabinet.

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(2) Wiring

⚠ CAUTION

● Wire the equipment correctly and securely. Otherwise, the servo motor may operate unexpectedly.

● Do not install a power capacitor, surge killer, or radio noise filter (FR-BIF of Mitsubishi Electric Corparation) on the driver output side.

● To avoid a malfunction, connect the wires to the correct phase terminals (U, V, and W) of the driver and servo motor.

● 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.

(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.
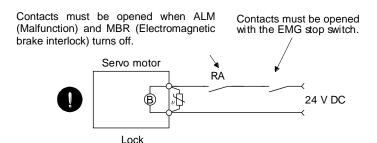
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⚠ CAUTION

● 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.
● **Do not use the 24 V DC interface power supply for the lock.**
   Configure a lock circuit so that it is activated also by an external EMG stop switch.

Contacts must be opened when ALM (Malfunction) and MBR (Electromagnetic brake interlock) turns off.   Contacts must be opened with the EMG stop switch.

Servo motor   RA

Ⓑ   24 V DC

Lock
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.

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● DISPOSAL OF WASTE ●

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

⚠ EEP-ROM life

The number of write times to the EEP-ROM, which stores parameter settings, etc., is limited to 100,000. If the total number of the following operations exceeds 100,000, the 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

STO function of the driver

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 LECSS2-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 [($\times 10^{-4}$ kg•m^2)]	5.4675 [oz•in^2]
Load (thrust load/axial load)	1 [N]	0.2248 [lbf]
Temperature	N [°C] $\times$ 9/5 + 32	N [°F]

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APPENDIX

1. FUNCTIONS AND CONFIGURATION

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1. FUNCTIONS AND CONFIGURATION

1.1 Summary

The LECSS2-T□ series general-purpose AC servo has further higher performance and higher functions compared to the previous LECSS□-S□ series.

LECSS2-T□ driver is connected to PC or PLC…etc controllers, including a servo system controller, on the high-speed synchronous network SSCNET III/H. The driver directly receives a command from a PC or PLC…etc to drive a servo motor.

LECSS2-T□ series compatible servo motor is equipped with 22-bit (4194304 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 LECSS□-S□ series.

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 LECSS2-T□ 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.

SSCNET III/H achieves high-speed communication of 150 Mbps full duplex with high noise immunity due to the SSCNET III optical cables. Large amounts of data are exchanged in real-time between the PC or PLC…etc and the driver. Servo monitor information is stored in the upper information system and is used for control.

On the SSCNET III/H network, the stations are connected with a maximum distance of 100 m between them. This allows you to create a large system.
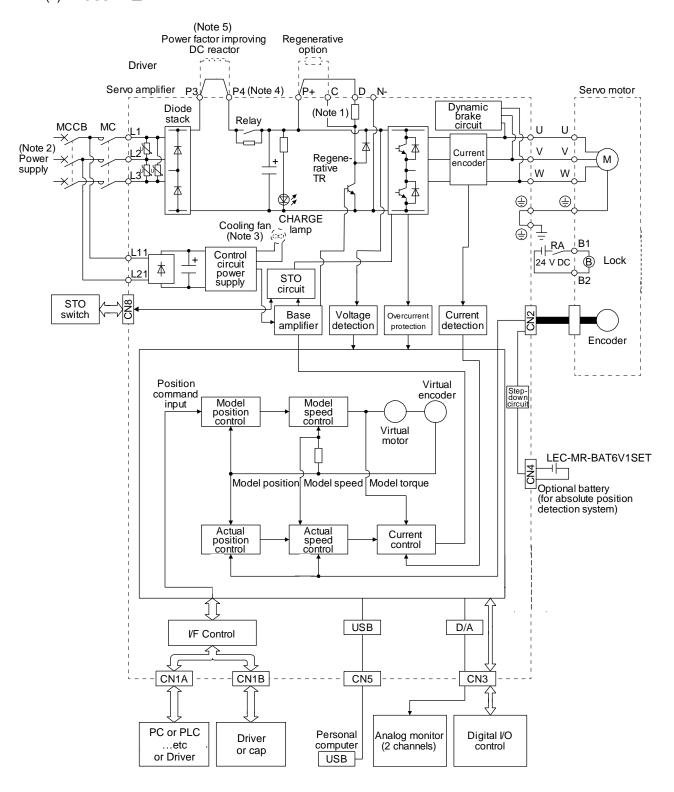
The LECSS2-T□ driver supports the Safe Torque Off (STO) function for safety. When the LECSS2-T□ driver is connected to a SSCNET III/H-compatible motion controller, in addition to the STO function, the driver also supports the Safe Stop 1 (SS1), Safe Stop 2 (SS2), Safe Operating Stop (SOS), Safely-Limited Speed (SLS), Safe Brake Control (SBC), and Safe Speed Monitor (SSM) functions.

The LECSS2-T□ driver has a USB communication interface. Therefore, you can connect the driver to the personal computer with setup software (MR Configurator2™) installed to perform the parameter setting, test operation, gain adjustment, and others.

1. FUNCTIONS AND CONFIGURATION

1.2 Function block diagram

The function block diagram of this servo is shown below.

(1) LECSS2-T□

Note 1. The built-in regenerative resistor is not provided for LECSS2-T5.
2. For 1-phase 200 V AC to 240 V AC, connect the power supply to L1 and L3. Leave L2 open.
   Refer to section 1.3 for the power supply specifications.
3. Driver LECSS2-T9 have a cooling fan.
4. LECSS2-T□ driver has P3 and P4 in the upstream of the inrush current suppression circuit. They are different from P1 and P2 of LECSS□-S□ drivers.
5. Short P3 and P4.

1.3 Driver standard specifications

Model: LECSS2-T□			5	7	8	9
Output	Rated voltage		3-phase 170 V AC			
	Rated current [A]		1.1	1.5	2.8	
Main circuit power supply	Voltage/Frequency (Note 6)		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 (Note 6)		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) 0.3 (including CN8 connector signals)			
Control method			Sine-wave PWM control, current control method			
Dynamic brake			Built-in			
SSCNET III/H communication cycle (Note 5)			0.222 ms, 0.444 ms, 0.888 ms			
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			
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, magnetic pole, and detection protection			
Safety function			STO (IEC/EN 61800-5-2)			
Safety performance	Standards certified by CB		EN ISO 13849-1 category 3 PL d, EN 61508 SIL 2, EN 62061 SIL CL 2, 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)		$PFH = 6.4 \times 10^{-9}$ [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	90 %RH or less (non-condensing)			
		Storage				
	Ambience		Indoors (no direct sunlight), free from corrosive gas, flammable gas, oil mist, dust, and dirt			
	Altitude		1000 m or less above sea level			
	Vibration resistance		5.9 m/s², at 10 Hz to 55 Hz (directions of X, Y and Z axes)			
Mass [kg]			0.8		1.0	1.4

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Note 1. 0.3 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 driver of 3.5 kW, operate them at the ambient temperatures 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 communication cycle depends on the PC or PLC…etc specifications and the number of axes connected.
6. The driver will be damaged if 3-phase 400V AC is applied.

1.4 Combinations of driver and servo motors

Driver	Servo motor
	LE-☐-☐
LECSS2-T5	T5, T6
LECSS2-T7	T7
LECSS2-T8	T8
LECSS2-T9	T9

1. FUNCTIONS AND CONFIGURATION
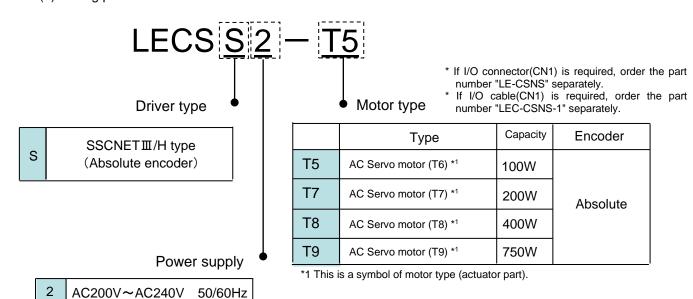
1.5 Function list

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

Function	Description	Detailed explanation
Position control mode	This servo is used as a position control servo.	
Speed control mode	This servo is used as a speed control servo.	
Torque control mode	This servo is used as a torque control servo.	
High-resolution encoder	High-resolution encoder of 4194304 pulses/rev is used as the encoder of the servo motor compatible with the LECSS2-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
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 a 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 produced at a servo motor stop.	[Pr. PB24]
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. PC21]
Output signal selection (device settings)	The output devices including ALM (Malfunction) and DB (Dynamic brake interlock) can be assigned to certain pins of the CN3 connector.	[Pr. PD07] to [Pr. PD09]
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 4.5.1 (1) (d)
Test operation mode	Jog operation, positioning operation, motor-less operation, DO forced output, and program operation Setup software (MR Configurator2) is necessary for this function.	Section 4.5
Analog monitor output	Servo status is output in terms of voltage in real time.	[Pr. PC09], [Pr. PC10]
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). Setup software (MR Configurator2) is necessary for this function.	Section 6.2

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1. FUNCTIONS AND CONFIGURATION
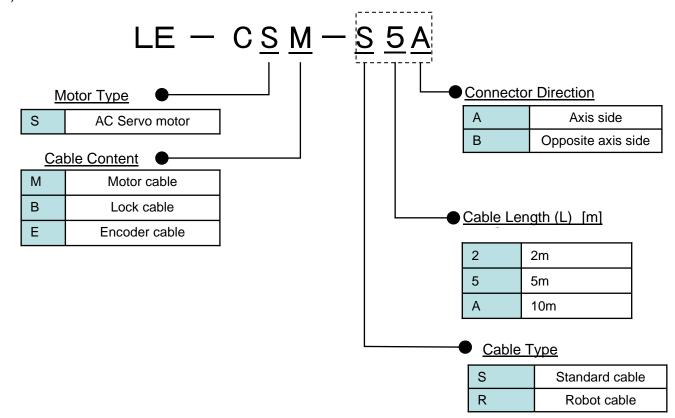
Function	Description	Detailed explanation
Tough drive function	This function makes the equipment continue operating even under the condition that an alarm occurs. The tough drive function includes two types: the vibration tough drive and the instantaneous power failure tough drive.	Section 7.3
Drive 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". 4. The PC or PLC…etc is not connected (except the test operation mode). 5. An alarm related to the PC or PLC…etc is occurring.	[Pr. PA23]
STO function	This function is a safety function that complies with IEC/EN 61800-5-2. You can create a safety system for the equipment easily.	
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. Setup software (MR Configurator2) is necessary for this function.	
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. For the SSCNET III/H system, Setup software (MR Configurator2) can display the data, including the power consumption. Since the driver can send the data to a motion controller, you can analyze the data and display the data on a display.	
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.	

SMC
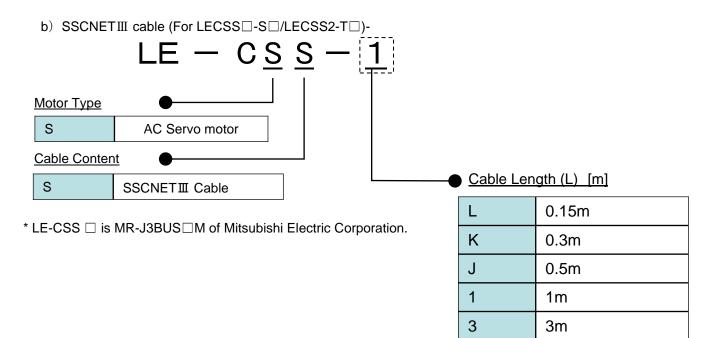
1.6 Model designation
  (1) Rating plate

$$\text{LECS}\boxed{S}\boxed{2}-\boxed{T5}$$

Driver type

S	SSCNETⅢ/H type （Absolute encoder）

Power supply

2	AC200V～AC240V　50/60Hz

Motor type

* If I/O connector(CN1) is required, order the part number "LE-CSNS" separately.
* If I/O cable(CN1) is required, order the part number "LEC-CSNS-1" separately.

	Type	Capacity	Encoder
T5	AC Servo motor (T6) [1]	100W	
T7	AC Servo motor (T7) [1]	200W	Absolute
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

SMC

b）SSCNETⅢ cable (For LECSS□-S□/LECSS2-T□)-

LE － CSS － 1

Motor Type

S	AC Servo motor

Cable Content

S	SSCNETⅢ Cable

* LE-CSS □ is MR-J3BUS□M of Mitsubishi Electric Corporation.

Cable Length (L) [m]

L	0.15m
K	0.3m
J	0.5m
1	1m
3	3m

c）I/O Connector (For LECSS□-S□/LECSS2-T□)-

LE-CSNS

Driver Type

S	LECSS

*LE-CSNS is 10126-3000PE （Connector)/ 10320-52F0-008 （Shell kit） of Sumitomo 3M Limited or equivalent goods.
Applicable wire size: AWG24~30

d）Regenerative options

LEC-MR-RB-032

Regenerative option Type
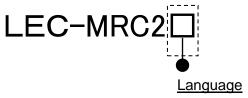
032	Permissible regenerative power 30W
12	Permissible regenerative power 100W
32	Permissible regenerative power 300W

*MR-RB□ of Mitsubishi Electric Corporation.

e） Setup software (MR Configurator2) (Japanese version)

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.
  *LECSS2-T□ cannot be used by LEC-MR-SETUP221□.

f） USB cable(3m)

LEC-MR-J3USB

* MR-J3USBCBL3M of Mitsubishi Electric Corporation.

g） 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.

h） STO cable(3m)
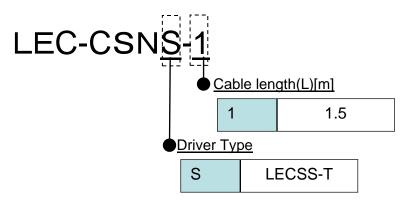
LEC-MR-D05UDL3M

* MR-D05UDL3M-B 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.

SMC

ⅰ） I/O Connector

LEC-CSNS-1

● Cable length(L)[m]

1	1.5

● Driver Type

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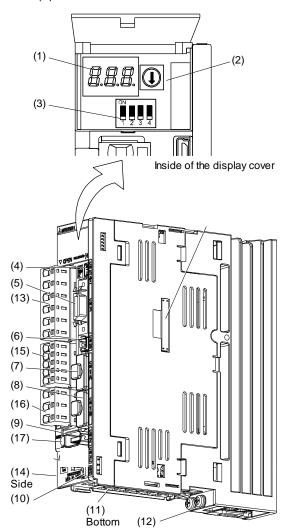
*LEC-CSNS-1 is 10120-3000PE（Connector)/ 10320-52F0-008（Shell kit）of Sumitomo 3M Limited or equivalent goods.
*Conductor size:AWG24

1.7 Structure
1.7.1 Parts identification
   (1) LECSS2-T□

Inside of the display cover

Side

(11) Bottom (12)

No.	Name/Application	Detailed explanation
(1)	Display The 3-digit, seven-segment LED shows the servo status and the alarm number.	Chapter 4
(2)	Axis selection rotary switch (SW1) Used to set the axis No. of driver.	Section 4.3
(3)	Control axis setting switch (SW2) The test operation switch, the control axis deactivation setting switch, and the auxiliary axis number setting switch are available.	Section 4.3
(4)	USB communication connector (CN5) Connect with the personal computer.	Section 11.3
(5)	I/O signal connector (CN3) Used to connect digital I/O signals.	Section 3.2 Section 3.4
(6)	STO input signal connector (CN8) Used to connect STO cable.	Chapter 13
(7)	SSCNET III cable connector (CN1A) Used to connect the servo system controller or the previous axis driver.	Section 3.2 Section 3.4
(8)	SSCNET III cable connector (CN1B) Used to connect the next axis driver. For the final axis, put a cap.	
(9)	Encoder connector (CN2) Used to connect the servo motor encoder.	Section 3.4
(10)	Battery connector (CN4) Used to connect the battery or the battery unit for absolute position data backup.	Chapter 12
(11)	Battery holder Install the battery for absolute position data backup.	Section 12.4
(12)	Protective earth (PE) terminal Grounding terminal	Section 3.1 Section 3.3
(13)	Main circuit power supply connector (CNP1) Connect the input power supply.	
(14)	Rating plate	Section 1.6
(15)	Control circuit power supply connector (CNP2) Connect the control circuit power supply and regenerative option.	Section 3.1 Section 3.3
(16)	Servo motor power output connector (CNP3) Connect the servo motor.	
(17)	Charge lamp When the main circuit is charged, this will light. While this lamp is lit, do not reconnect the cables.	

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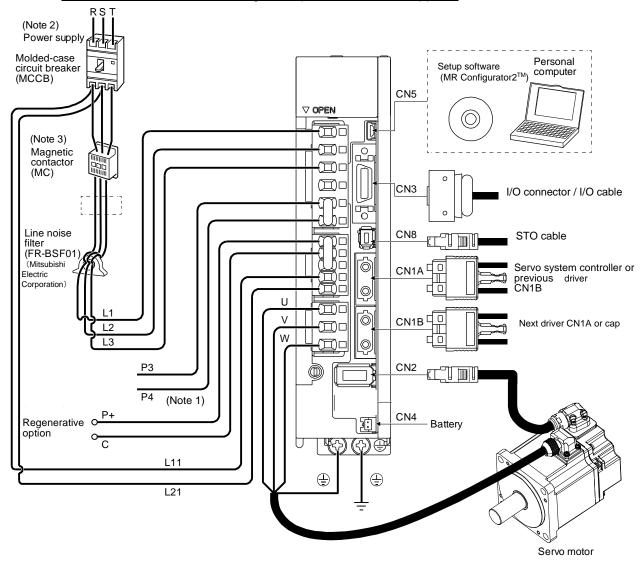
> POINT
>
> ● Equipment other than the driver and servo motor are optional or recommended products.

(1) LECSS2-T□

The diagram is for LECSS2-T7.

Caution: The driver will be damaged if 3-phase 400V AC is applied.

Servo motor

Note 1. Short P3 and P4.
2. For 1-phase 200 V AC to 240 V AC, connect the power supply to L1 and L3. Leave L2 open. Refer to section 1.3 for the power supply specifications.
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.

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. ●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 LECSS2-T8 or less drivers, pull out CN3 and CN8 connectors beforehand.
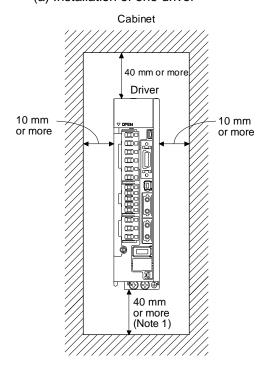
SMC

2. INSTALLATION
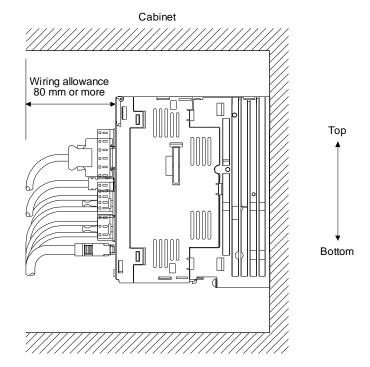
2.1 Installation direction and clearances

<table>
<tr>
<td>⚠ CAUTION</td>
<td>●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.</td>
</tr>
</table>

(1) Installation clearances of the driver
    (a) Installation of one driver

Cabinet

40 mm or more

Driver

10 mm or more

▽ OPEN

10 mm or more

40 mm or more (Note 1)

Cabinet

Wiring allowance 80 mm or more

Top

Bottom

⊘ SMC
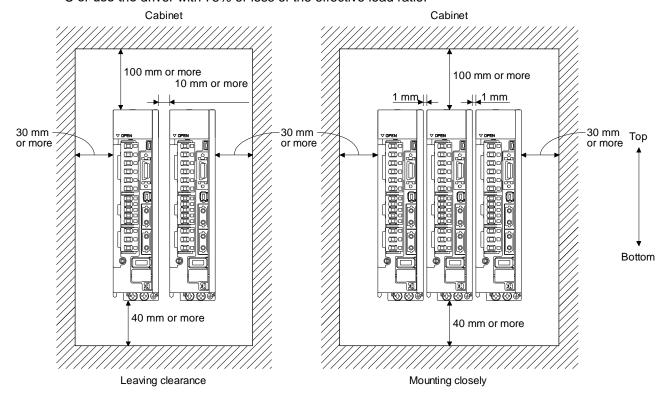
(b) Installation of two or more drivers

```
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.

Leaving clearance   Mounting closely

(2) Others

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

2.2 Keep out foreign materials
(1) When 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 SSCNET III cable laying

SSCNET III cable is made from optical fiber. If optical fiber is added a power such as a major shock, lateral pressure, haul, sudden bending or twist, its inside distorts or breaks, and optical transmission will not be available. Especially, as optical fiber for LE-CSS-□ is made of synthetic resin, it melts down if being left near the fire or high temperature. Therefore, do not make it touched the part, which can become hot, such as heat sink or regenerative option of driver.
Read described item of this section carefully and handle it with caution.
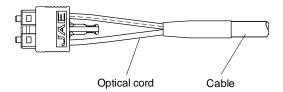
(1) Minimum bend radius

Make sure to lay the cable with greater radius than the minimum bend radius. Do not press the cable to edges of equipment or others. For SSCNET III cable, the appropriate length should be selected with due consideration for the dimensions and arrangement of driver. When closing the door of cabinet, pay careful attention for avoiding the case that SSCNET III cable is hold down by the door and the cable bend becomes smaller than the minimum bend radius. For the minimum bend radius, refer to section 11.1.3.

(2) Prohibition of vinyl tape use

Migrating plasticizer is used for vinyl tape. Keep the LE-CSS-□ cables away from vinyl tape because the optical characteristic may be affected.

SSCNET III cable	Cord
LE-CSS-□	△

△: Phthalate ester plasticizer such as DBP and DOP may affect optical characteristic of cable.

Optical cord   Cable

(3) Precautions for migrating plasticizer added materials

Generally, soft polyvinyl chloride (PVC), polyethylene resin (PE) and fluorine resin contain non-migrating plasticizer and they do not affect the optical characteristic of SSCNET III cable. However, some wire sheaths and cable ties, which contain migrating plasticizer (phthalate ester), may affect LE-CSS-□ cable.
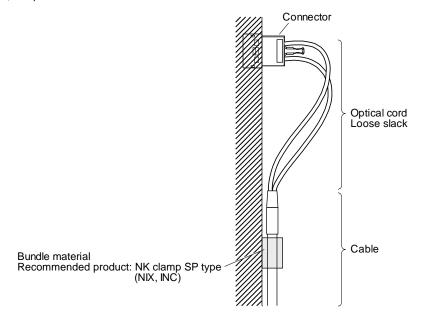
A chemical substance may affect its optical characteristic. Therefore, previously check that the cable is not affected by the environment.

(4) Bundle fixing

Fix the cable at the closest part to the connector with bundle material in order to prevent SSCNET III cable from putting its own weight on CN1A/CN1B connector of driver. Optical cord should be given loose slack to avoid from becoming smaller than the minimum bend radius, and it should not be twisted.

When bundling the cable, fix and hold it in position by using cushioning such as sponge or rubber which does not contain migratable plasticizers.

If adhesive tape for bundling the cable is used, fire resistant acetate cloth adhesive tape 570F (Teraoka Seisakusho Co., Ltd) is recommended.

(5) Tension

If tension is added on optical cable, the increase of transmission loss occurs because of external force which concentrates on the fixing part of optical fiber or the connecting part of optical connector. Doing so may cause the breakage of the optical fiber or damage of the optical connector. For cable laying, handle without putting forced tension. For the tension strength, refer to section 11.1.3.

(6) Lateral pressure

If lateral pressure is added on optical cable, the optical cable itself distorts, internal optical fiber gets stressed, and then transmission loss will increase. Doing so may cause the breakage of the optical cable. As the same condition also occurs at cable laying, do not tighten up optical cable with a thing such as nylon band (TY-RAP).

Do not trample it down or tuck it down with the door of cabinet or others.

(7) Twisting

If optical fiber is twisted, it will become the same stress added condition as when local lateral pressure or bend is added. Consequently, transmission loss increases, and the breakage of optical fiber may occur.

(8) Disposal

When incinerating optical cable (cord) used for SSCNET III, hydrogen fluoride gas or hydrogen chloride gas which is corrosive and harmful may be generated. For disposal of optical fiber, request for specialized industrial waste disposal services who has incineration facility for disposing hydrogen fluoride gas or hydrogen chloride gas.

2.5 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.

2.6 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.

3. SIGNALS AND WIRING

⚠ WARNING	●Any person who is involved in wiring should be fully competent to do the work. ●Before wiring, turn off the power and wait for 15 minutes or 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
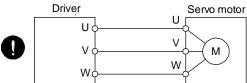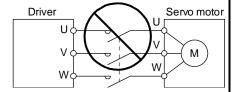
●Use a noise filter, etc. to minimize the influence of electromagnetic interference. Electromagnetic interference may be given to the electronic equipment used near the driver.
●Do not install a power capacitor, surge killer or radio noise filter (FR-BIF of Mitsubishi Electric Corparation) with the power 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.

⚠CAUTION ❗

●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.

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

SMC

3.1 Input power supply circuit
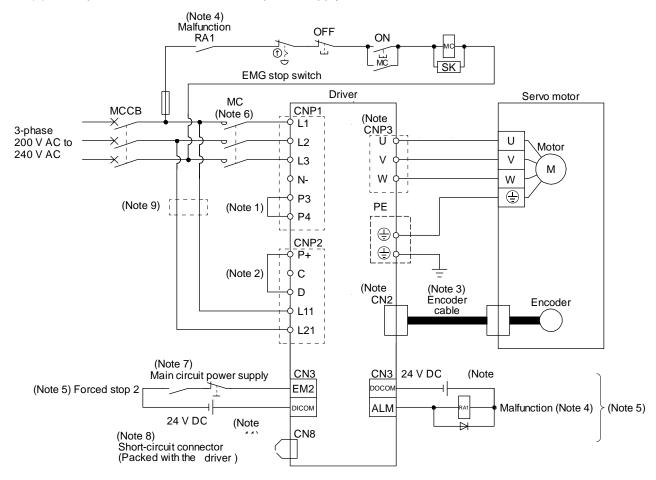
<table>
<tr><td rowspan="1">⚠ CAUTION</td><td>
●Always connect a magnetic contactor between the power supply and the main circuit power supply (L1, L2, and L3) of the driver, in order to configure a circuit that shuts down the power supply on the side of the driver's power supply. If a magnetic contactor is not connected, continuous flow of a large current may cause a fire when the driver malfunctions.
●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, the driver will break down.
●The driver has a built-in surge absorber (varistor) to reduce noise and to suppress lightning surge. The varistor can break down due to its aged deterioration. 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.
</td></tr>
</table>

POINT

●Even if alarm has occurred, do not switch off the control circuit power supply. When the control circuit power supply has been switched off, optical module does not operate, and optical transmission of SSCNET III/H communication is interrupted. Therefore, the next axis driver displays "AA" at the indicator and turns into base circuit shut-off. The servo motor stops with starting dynamic brake.

●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 LECSS□-S□ Series Driver's. When using LECSS2-T□ as a replacement for LECSS□-S□, be careful not to connect the power to L2.

Configure the wiring so that the main circuit power supply is shut off and the servo-on command turned off after deceleration to a stop due to an alarm occurring, an enabled servo forced stop, or an enabled PC or PLC…etc forced stop. A molded-case circuit breaker (MCCB) must be used with the input cables of the main circuit power supply.
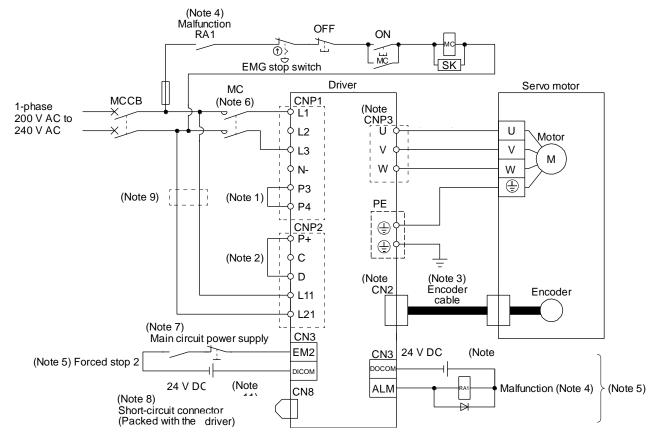
(1) For 3-phase 200 V AC to 240 V AC power supply of LECSS2-T□

Note 1. Always connect between P3 and P4 terminals. (factory-wired)

2. Always connect between P+ and D terminals. (factory-wired) When using the regenerative option, refer to section 11.2.

3. For the encoder cable, use of the option cable is recommended. For selecting cables, refer to section 11.1.

4. If disabling ALM (Malfunction) output with the parameter, configure up the power supply circuit which switches off the magnetic contactor after detection of alarm occurrence on the PC or PLC…etc side.

5. This diagram is for sink I/O interface. For source I/O interface, refer to section 3.8.3.

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 11.6.)

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) For 1-phase 200 V AC to 240 V AC power supply of LECSS2-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 LECSS□-S□ Series Driver's. When using LECSS2-T□ as a replacement for LECSS□-S□, be careful not to connect the power to L2.

Note 1. Always connect between P3 and P4 terminals. (factory-wired)

2. Always connect between P+ and D terminals. (factory-wired) When using the regenerative option, refer to section 11.2.

3. For the encoder cable, use of the option cable is recommended. For selecting cables, refer to section11.1.

4. If disabling ALM (Malfunction) output with the parameter, configure up the power supply circuit which switches off the magnetic contactor after detection of alarm occurrence on the PC or PLC…etc side.

5. This diagram is for sink I/O interface. For source I/O interface, refer to section 3.8.3.

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 11.6.)

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. SIGNALS AND WIRING

3.2 I/O signal connection example

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

3.2.1 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. If the PC or PLC…etc does not have forced stop function, always install the forced stop 2 switch (normally closed contact).

   4. When starting operation, always turn on EM2 (Forced stop 2). (Normally closed contact)

   5. Use LEC-MRC2E. (Refer to section 11.3.)

   6. Use SSCNET III cables listed in the following table.

Cable	Cable model	Cable length
Standard cord inside cabinet	LE-CSS-□	0.15 m to 3 m

   7. The wiring after the second driver is omitted.

   8. Up to 64 axes of drivers can be connected. The number of connectable axes depends on the PC or PLC…etc you use. Refer to section 4.3 for setting of axis selection.

   9. Make sure to cap the unused CN1B connector.

   10. Supply 24 V DC ± 10% for interfaces from outside. Set the total current capacity to 300 mA. 300 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 3.8.2 (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.

   11. ALM (Malfunction) turns on in normal alarm-free condition. (Normally closed contact)

   12. The pins with the same signal name are connected in the driver.

   13. You can change devices of these pins with [Pr. PD07], [Pr. PD08], and [Pr. PD09].

   14. Devices can be assigned for these signals with PC or PLC…etc setting. For devices that can be assigned, refer to the PC or PLC…etc instruction manual. The following devices can be assigned for Q172DSCPU, Q173DSCPU, and QD77MS_ of Mitsubishi Electric Corparation .
   FLS: Upper stroke limit
   RLS: Lower stroke limit
   DOG: Proximity dog
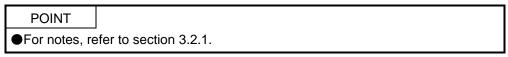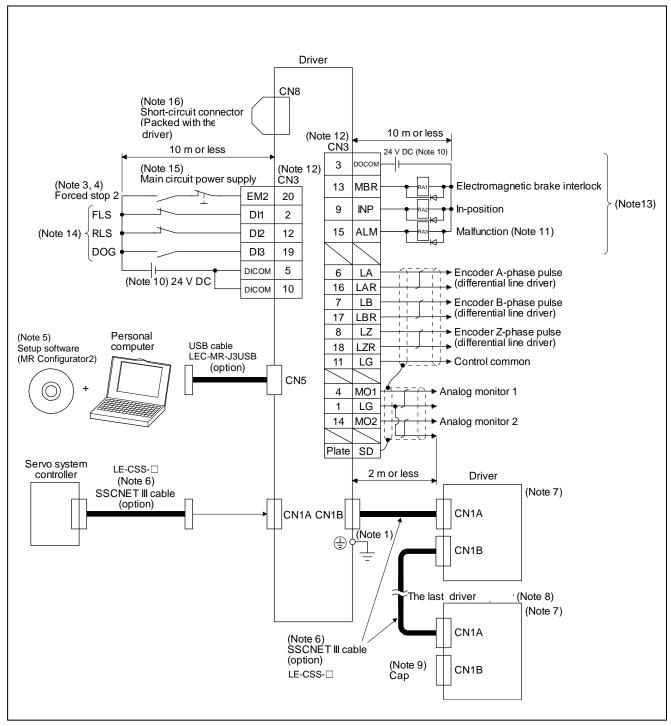
   15. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the driver.

   16. When not using the STO function, attach the short-circuit connector came with a driver.

3. SIGNALS AND WIRING

3.2.2 For source I/O interface

> **POINT**
>
> ● For notes, refer to section 3.2.1.

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. │
└─────────────────────────────────────────────────────────────────────────┘
```

Symbol	Connection target (application)	Description
L1/L2/L3	Main circuit power supply	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. ┌──┐ │ Power \ Driver │ LECSS2-T5 to LECSS2-T9 │ │ 3-phase 200 V AC to 240 V AC, 50 Hz/60 Hz │ L1/L2/L3 │ │ 1-phase 200 V AC to 240 V AC, 50 Hz/60 Hz │ L1/L3 │ └──┘
P3/P4	-	Connect P3 and P4. (factory-wired)
P+/C/D	Regenerative option	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.
L11/L21	Control circuit power supply	Supply the following power to L11 and L21. ┌──┐ │ Power \ Driver │ LECSS2-T5 to LECSS2-T9 │ │ 1-phase 200 V AC to 240 V AC │ L11/L21 │ └──┘
U/V/W	Servo motor power output	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.
N-	-	Do not connect to the driver.
⏚	Protective earth (PE)	Connect it to the grounding terminal of the servo motor and to the protective earth (PE) of the cabinet for grounding.

3.3.2 Power-on sequence
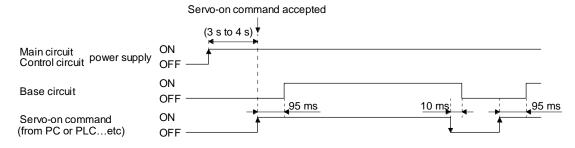
```
┌─────────────────────────────────────────────────────────────────┐
│ POINT                                                             │
├─────────────────────────────────────────────────────────────────┤
│ ●A voltage, output signal, etc. of analog monitor output may be   │
│  irregular at power-on.                                           │
└─────────────────────────────────────────────────────────────────┘
```

(1) Power-on procedure

1) Always wire the power supply as shown in above section 3.1 using the magnetic contactor with the main circuit power supply (3-phase: L1, L2, and L3, 1-phase: L1 and L3). 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 and L21) simultaneously with the main circuit power supply or before switching on the main circuit power supply. If the control circuit power supply is turned on with the main circuit power supply off, and then the servo-on command is transmitted, [AL. E9 Main circuit off warning] will occur. Turning on the main circuit power supply stops the warning and starts the normal operation.

3) The driver receives the servo-on command within 3 s to 4 s after the main circuit power supply is switched on.
(Refer to (2) of this section.)

(2) Timing chart

SMC

3.3.3 Wiring CNP1, CNP2, and CNP3

```
┌─────────────────────────────────────────────────────┐
│ POINT                                               │
├─────────────────────────────────────────────────────┤
│ ●For the wire sizes used for wiring, refer to       │
│   section 11.5.                                     │
└─────────────────────────────────────────────────────┘
```

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

(1) Connector
    (a) LECSS2-T□
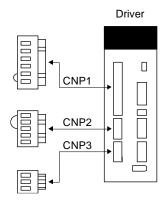
Table 3.1 Connector and applicable wire
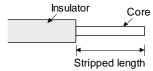
Connector	Receptacle assembly	Applicable wire		Stripped length [mm]	Manufacturer	Remarks
		Size	Insulator OD			
CNP1	K05A01490216	AWG 18 to 14	39 mm or shorter	9	MITSUBISHI ELECTRIC SYSTEM & SERVICE CO., LTD (Note)	Open tool comes with.
CNP2	K05A01490209					-
CNP3	K05A01490210					-

Note. Please purchase from distributor or distributor of Mitsubishi Electric Corporation.
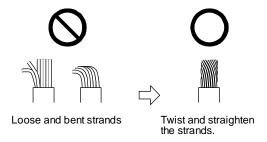
(2) Cable connection procedure

(a) Fabrication on cable insulator

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

Insulator   Core

Stripped length

Twist strands lightly and straighten them as follows.

Loose and bent strands   Twist and straighten the strands.
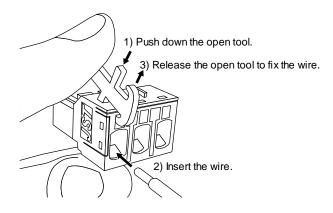
You can also use a ferrule to connect with the connectors. The following shows references to select ferrules according to wire sizes.

Driver	Wire size	Ferrule model (Phoenix Contact)		Crimping tool (Phoenix Contact)
		For one	For two	
LECSS2-T5 to LECSS2-T9	AWG 16	AI1.5-10BK	AI-TWIN2×1.5-10BK	CRIMPFOX-ZA3
	AWG 14	AI2.5-10BU		

(b) Inserting wire

Insert the open tool as follows and push down it to open the spring. While the open tool is pushed down, insert the stripped wire into the wire insertion hole. Check the insertion depth so that the cable insulator does not get caught by the spring.
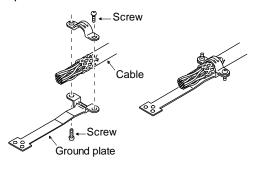
Release the open tool to fix the wire. Pull the wire lightly to confirm that the wire is surely connected.

1) Push down the open tool.

3) Release the open tool to fix the wire.

2) Insert the wire.

SMC
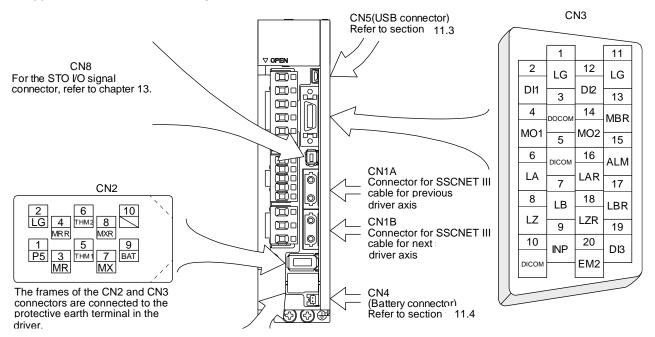
3.4 Connectors and pin assignment

POINT

● The pin assignment of the connectors are as viewed from the cable connector wiring section.
● For the STO I/O signal connector (CN8), refer to chapter 13.
● For the CN3 connector, securely connect the shielded external conductor of the cable to the ground plate and fix it to the connector shell.

Screw

Cable

Screw

Ground plate

3. SIGNALS AND WIRING

The driver front view shown is that of the LECSS2-T7 or less. Refer to chapter 9 DIMENSIONS for the appearances and connector layouts of the other drivers.

CN8
For the STO I/O signal connector, refer to chapter 13.

CN5(USB connector)
Refer to section 11.3

CN1A
Connector for SSCNET III cable for previous driver axis

CN1B
Connector for SSCNET III cable for next driver axis

CN4
(Battery connector)
Refer to section 11.4

CN2

2	LG	6	THM2	10		
		4	MRR		8	MXR
1	P5	5	THM1	9	BAT
		3	MR	7	MX

The frames of the CN2 and CN3 connectors are connected to the protective earth terminal in the driver.

CN3

	1		11
2	LG	12	LG
DI1	3	DI2	13
4	DOCOM	14	MBR
MO1	5	MO2	15
6	DICOM	16	ALM
LA	7	LAR	17
8	LB	18	LBR
LZ	9	LZR	19
10	INP	20	DI3
DICOM		EM2	

SMC

3.5 Signal (device) explanations

For the I/O interfaces (symbols in I/O division column in the table), refer to section 3.8.2.
The pin numbers in the connector pin No. column are those in the initial status.

3.5.1 Input device

Device	Symbol	Connector pin No.	Function and application			I/O division
Forced stop 2	EM2	CN3-20	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. Set [Pr. PA04] to "2 1 _ _" to disable EM2. The following shows the setting of [Pr. PA04].			DI-1
				[Pr. PA04] setting	EM2/EM1	Deceleration method
						EM2 or EM1 is off
				0 0 _ _	EM1	MBR (Electromagnetic brake interlock) turns off without the forced stop deceleration.
				2 0 _ _	EM2	MBR (Electromagnetic brake interlock) turns off after the forced stop deceleration.
				0 1 _ _	Not using EM2 or EM1	
				2 1 _ _	Not using EM2 or EM1	
			EM2 and EM1 are mutually exclusive. EM2 has the same function as EM1 in the torque control mode.			
Forced stop 1	EM1	(CN3-20)	When using EM1, set [Pr. PA04] to "0 0 _ _" to enable EM1. Turn EM1 off (open between commons) to bring the motor to an forced stop state. The base circuit is shut off, the dynamic brake is operated and decelerate the servo motor to a stop. Turn EM1 on (short between commons) in the forced stop state to reset that state. Set [Pr. PA04] to "0 1 _ _" to disable EM1.			DI-1
	DI1	CN3-2	Devices can be assigned for these signals with PC or PLC…etc setting. For devices that can be assigned, refer to the PC or PLC…etc instruction manual. The following devices can be assigned for LECSS2-T□ compatible PC or PLC…etc (Q172DSCPU, Q173DSCPU, and QD77MS_ of Mitsubishi Electric Corparation).			DI-1
	DI2	CN3-12				DI-1
	DI3	CN3-19				DI-1

The embedded deceleration-method table reads as follows:

[Pr. PA04] setting	EM2/EM1	Deceleration method	
		EM2 or EM1 is off	Alarm occurred
0 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 0 _ _	EM2	MBR (Electromagnetic brake interlock) turns off after the forced stop deceleration.	MBR (Electromagnetic brake interlock) turns off after the forced stop deceleration.
0 1 _ _	Not using EM2 or EM1		MBR (Electromagnetic brake interlock) turns off without the forced stop deceleration.
2 1 _ _	Not using EM2 or EM1		MBR (Electromagnetic brake interlock) turns off after the forced stop deceleration.

3.5.2 Output device
(1) Output device pin

The following shows the output device pins and parameters for assigning devices.

Connector pin No.	Parameter	Initial device	I/O division
CN3-13	[Pr. PD07]	MBR	
CN3-15	[Pr. PD09]	ALM	DO-1
CN3-9	[Pr. PD08]	INP	

(2) Output device explanations

Device	Symbol	Function and application
Electromagnetic brake interlock	MBR	When using the device, set operation delay time of the lock in [Pr. PC02]. When a servo-off status or alarm occurs, MBR will turn off.
Malfunction	ALM	When the protective circuit is activated to shut off the base circuit, 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.
In-position	INP	When the number of droop pulses is in the 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. The device cannot be used in the speed control mode, torque control mode, and for continuous operation to torque control mode.
Dynamic brake interlock	DB	It is not necessary to use this device.
Ready	RD	Enabling servo-on to make the driver ready to operate will turn on RD.
Speed reached	SA	SA will turn off during servo-off. 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. The device cannot be used in the position control mode and torque control mode.
Limiting speed	VLC	When the speed reaches the speed limit value in the torque control mode, VLC will turn on. When the servo is off, TLC will be turned off. The device cannot be used in the position control mode and speed control mode.
Zero speed detection	ZSP	ZSP turns on when the servo motor speed is zero speed (50r/min) or less. Zero speed can be changed with [Pr. PC07]. 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.

Device	Symbol	Function and application
Limiting torque	TLC	When the torque reaches the torque limit value during torque generation, TLC will turn on. When the servo is off, TLC will be turned off. This device cannot be used in the torque control mode.
Warning	WNG	When warning has occurred, WNG turns on. When a warning is not occurring, turning on the power will turn off WNG after 2.5 s to 3.5 s.
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 2.5 s to 3.5 s.
Variable gain selection	CDPS	CDPS will turn on during variable gain.
Absolute position undetermined	ABSV	ABSV turns on when the absolute position is undetermined. The device cannot be used in the speed control mode and torque control mode.
During tough drive	MTTR	When a tough drive is enabled in [Pr. PA20], activating the instantaneous power failure tough drive will turn on MTTR.

3.5.3 Output signal

Signal name	Symbol	Connector pin No.	Function and application
Encoder A-phase pulse (differential line driver)	LA LAR	CN3-6 CN3-16	These devices output pulses of encoder output set in [Pr. PA15] and [Pr. PA16] 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.
Encoder B-phase pulse (differential line driver)	LB LBR	CN3-7 CN3-17	The relation between rotation direction and phase difference of the A-phase and B-phase pulses can be changed with [Pr. PC03]. Output pulse specification, dividing ratio setting, and electronic gear setting can be selected.
Encoder Z-phase pulse (differential line driver)	LZ LZR	CN3-8 CN3-18	The encoder zero-point signal is output in the differential line driver type. One pulse is output 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.
Analog monitor 1	MO1	CN3-4	This is used to output the data set in [Pr. PC09] to between MO1 and LG in terms of voltage. Resolution: 10 bits or equivalent
Analog monitor 2	MO2	CN3-14	This signal output the data set in [Pr. PC10] to between MO2 and LG in terms of voltage. Resolution: 10 bits or equivalent

3.5.4 Power supply

Signal name	Symbol	Connector pin No.	Function and application
Digital I/F power supply input	DICOM	CN3-5 CN3-10	Input 24 V DC (24 V DC ± 10% 300 mA) for 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.
Digital I/F common	DOCOM	CN3-3	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.
Monitor common	LG	CN3-1 CN3-11	Common terminal of MO1 and MO2. Pins are connected internally.
Shield	SD	Plate	Connect the external conductor of the shielded wire.

3.6 Forced stop deceleration function
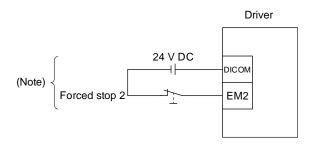
```
┌─────────────┐
│    POINT    │
├─────────────┴──────────────────────────────────────────────────────┐
│ ●When alarms not related to the forced stop function occur, control of motor │
│   deceleration can not be guaranteed. (Refer to section 8.1.)        │
│ ●When SSCNET III/H communication brake occurs, forced stop deceleration will │
│   operate. (Refer to section 3.7.1 (3).)                             │
│ ●In the torque control mode, the forced stop deceleration function is not available. │
└────────────────────────────────────────────────────────────────────┘
```

3.6.1 Forced stop deceleration function (SS1)

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.
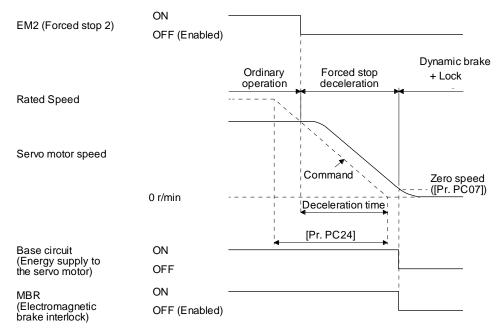
(1) Connection diagram

Note. This diagram is for sink I/O interface. For source I/O interface, refer to section 3.8.3.

(2) Timing chart

When EM2 (Forced stop 2) turns off, the motor will decelerate according to [Pr. PC24 Forced stop deceleration time constant]. Once the motor speed is below [Pr. PC07 Zero speed], base power is cut and the dynamic brake activates.

SMC
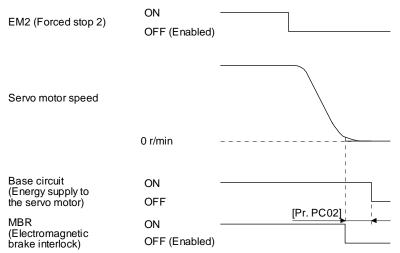
3.6.2 Base circuit shut-off delay time function

The base circuit shut-off delay time function is used to prevent vertical axis from dropping at a forced stop (EM2 goes off), alarm occurrence, or SSCNET III/H communication brake due to delay time of the lock. Set the time from MBR (Electromagnetic brake interlock) off to base circuit shut-off with [Pr. PC02].

(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. PC02], 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. PC02], and set the value to approximately 1.5 times of the smallest delay time in which the servo motor shaft does not freefall.

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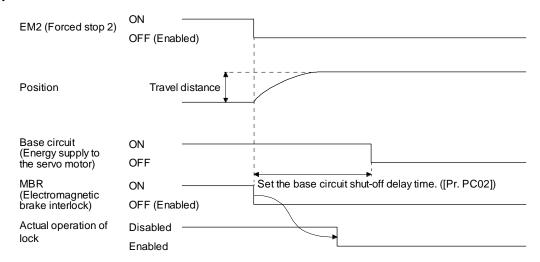
The vertical axis freefall prevention function avoids machine damage by pulling up the shaft slightly like the following case.

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

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

・Other than "0" is set to [Pr. PC31 Vertical axis freefall prevention compensation amount].

・EM2 (Forced stop 2) turned off, an alarm occurred, or SSCNET III/H communication brake occurred while the servo motor speed is zero speed or less.

・The base circuit shut-off delay time function is enabled.

(1) Timing chart

(2) Adjustment

・Set the freefall prevention compensation amount in [Pr. PC31].

・While the servo motor is stopped, turn off the EM2 (Forced stop 2). Adjust the base circuit shut-off delay time in [Pr. PC02] in accordance with the travel distance ([Pr. PC31). Adjust it considering the freefall prevention compensation amount by checking the servo motor speed, torque ripple, etc.

3.6.4 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.

3.7 Alarm occurrence timing chart

⚠CAUTION	●When an alarm has occurred, remove its cause, make sure that the operation signal is not being input, ensure safety, and reset the alarm before restarting operation.

> POINT
>
> ●In the torque control mode, the forced stop deceleration function is not available.
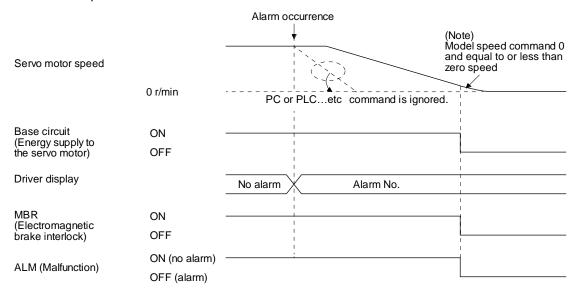
To deactivate the alarm, cycle the control circuit power or give the error reset or CPU reset command from the servo system controller. However, the alarm cannot be deactivated unless its cause is removed.

3.7.1 When you use the forced stop deceleration function
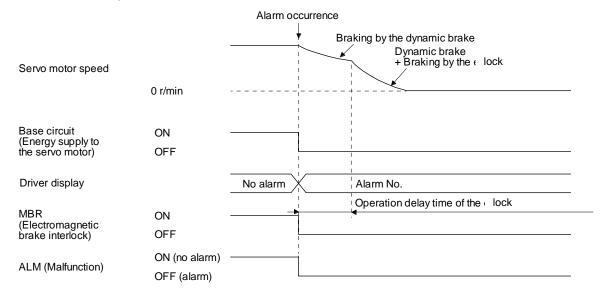
> POINT
>
> ●To enable the function, set "2 _ _ _ (initial value)" in [Pr. PA04].

(1) When the forced stop deceleration function is enabled
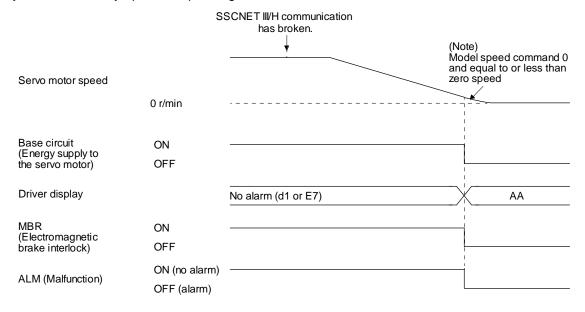
Note. The model speed command is a speed command generated in the driver for forced stop deceleration of the servo motor.

SMC

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

Alarm occurrence

Braking by the dynamic brake

Dynamic brake
+ Braking by the clock

Servo motor speed

0 r/min

| Base circuit (Energy supply to the servo motor) | ON |
| | OFF |

| Driver display | No alarm | Alarm No. |

Operation delay time of the clock

| MBR (Electromagnetic brake interlock) | ON |
| | OFF |

| ALM (Malfunction) | ON (no alarm) |
| | OFF (alarm) |
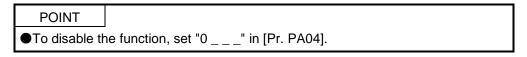
(3) When SSCNET III/H communication brake occurs

The dynamic brake may operate depending on the communication shut-off status.

SSCNET III/H communication
has broken.

(Note)
Model speed command 0
and equal to or less than
zero speed

Servo motor speed

0 r/min

| Base circuit (Energy supply to the servo motor) | ON |
| | OFF |

| Driver display | No alarm (d1 or E7) | AA |

| MBR (Electromagnetic brake interlock) | ON |
| | OFF |

| ALM (Malfunction) | ON (no alarm) |
| | OFF (alarm) |

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

3.7.2 When you do not use the forced stop deceleration function

POINT

●To disable the function, set "0 _ _ _" in [Pr. PA04].
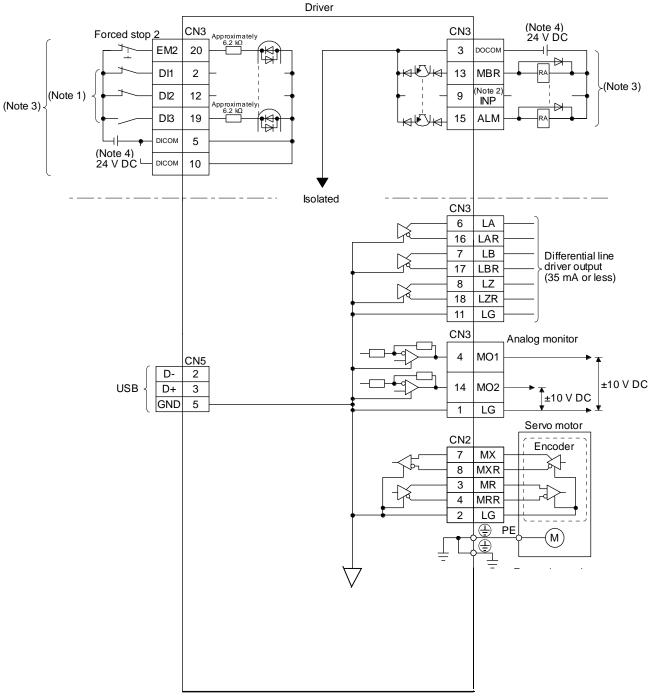
The timing chart that shows the servo motor condition when an alarm or SSCNET III/H communication brake occurs is the same as section 3.7.1 (2).

SMC

3.8 Interfaces
3.8.1 Internal connection diagram

```
┌─────────────────────────────────────────────┐
│ POINT                                        │
│ ●Refer to section 13.3.1 for the CN8 connector. │
└─────────────────────────────────────────────┘
```


Note 1. Signal can be assigned for these pins with the PC or PLC…etc setting.
        For contents of signals, refer to the instruction manual of the PC or PLC…etc.
     2. The signal cannot be used in the speed control mode and torque control mode.
     3. This diagram is for sink I/O interface. For source I/O interface, refer to section 3.8.3.
     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.
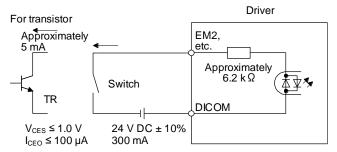
SMC

3.8.2 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 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 3.8.3 for source input.
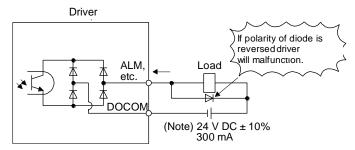
(2) Digital output interface DO-1

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 2.6 V voltage drop occurs in the driver.

The following shows a connection diagram for sink output. Refer to section 3.8.3 for source output.
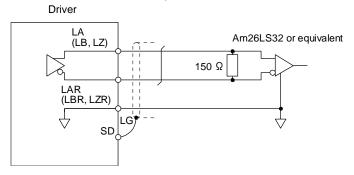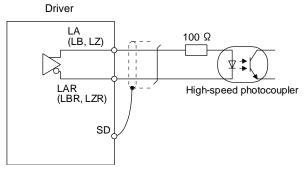
Note. If the voltage drop (maximum of 2.6 V) interferes with the relay operation, apply high voltage (maximum of 26.4 V) from external source.

(3) Encoder output pulses DO-2 (differential line driver type)
  (a) Interface
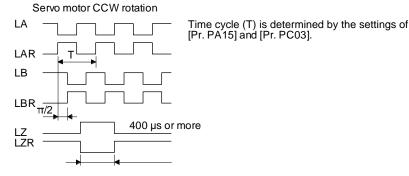
    Maximum output current: 35 mA

Driver

LA
(LB, LZ)

Am26LS32 or equivalent

150 Ω

LAR
(LBR, LZR)

LG

SD

Driver

LA
(LB, LZ)

100 Ω

High-speed photocoupler

LAR
(LBR, LZR)

SD

  (b) Output pulse

Servo motor CCW rotation

LA

LAR   T

LB

LBR π/2

LZ
LZR   400 μs or more

Time cycle (T) is determined by the settings of
[Pr. PA15] and [Pr. PC03].

(4) Analog output

Driver

MO1
(MO2)

LG
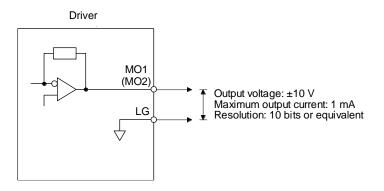
Output voltage: ±10 V
Maximum output current: 1 mA
Resolution: 10 bits or equivalent
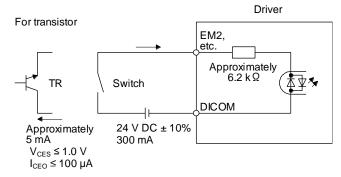
Note. Output voltage range varies depending on the output contents.

3.8.3 Source I/O interfaces

In this driver, source type I/O interfaces can be used.
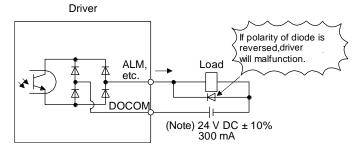
(1) Digital input interface DI-1

This is an input circuit whose photocoupler anode side is 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 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.

SMC

3.9 SSCNET III cable connection
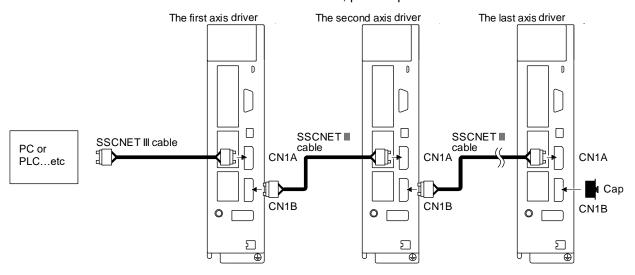
> POINT
>
> ●Do not look directly at the light (red) generated from CN1A/CN1B connector of the driver or the end of SSCNET III cable. The light can be a discomfort when it enters the eye.
> (For LECSS-S, emitted light (transparent and colorless).)

(1) SSCNET III cable connection

For the CN1A connector, connect the SSCNET III cable connected to a PC or PLC…etc in host side or a driver of the previous axis. For CN1B connector, connect SSCNET III cable connected to driver of the next axis. For CN1B connector of the final axis, put a cap came with driver.

(2) How to connect/disconnect cable
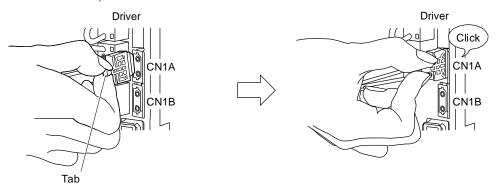
> POINT
>
> ●CN1A and CN1B connector are capped to protect light device inside connector from dust. For this reason, do not remove a cap until just before mounting SSCNET III cable. Then, when removing SSCNET III cable, make sure to put a cap.
> ●Keep the cap for CN1A/CN1B connector and the tube for protecting optical cord end of SSCNET III cable in a plastic bag with a zipper of SSCNET III cable to prevent them from becoming dirty.
> ●When asking repair of driver for some malfunctions, make sure to cap CN1A and CN1B connector. When the connector is not put a cap, the light device may be damaged at the transit. In this case, replacing and repairing the light device is required.

(a) Connection
   1) For SSCNET III cable in the shipping status, the tube for protect optical cord end is put on the end of connector. Remove this tube.

   2) Remove the CN1A and CN1B connector caps of the driver.

SMC

3) With holding a tab of SSCNET III cable connector, make sure to insert it into the CN1A and CN1B connector of the driver until you hear the click. If the end face of optical cord tip is dirty, optical transmission is interrupted and it may cause malfunctions. If it becomes dirty, wipe with a bonded textile, etc. Do not use solvent such as alcohol.

(b) Disconnection

With holding a tab of SSCNET III cable connector, pull out the connector.

When pulling out the SSCNET III cable from driver, be sure to put the cap on the connector parts of driver to prevent it from becoming dirty. For SSCNET III cable, attach the tube for protection optical cord's end face on the end of connector.

SMC
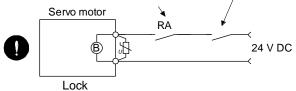
3.10 Servo motor with a lock
3.10.1 Safety precautions

⚠CAUTION

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

Contacts must be opened when ALM (Malfunction) and MBR (Electromagnetic brake interlock) turns off.

Contacts must be opened with the EMG stop switch.

Servo motor

RA

24 V DC

B

Lock

Refer to section 3.10.3 when wiring for the circuit configuration.

●The lock is provided for holding purpose and must not be used for ordinary braking.
●Before operating the servo motor, be sure to confirm that the lock operates properly.
●**Do not use the 24 V DC interface power supply for the lock.** Always use the power supply designed exclusively for the lock. Otherwise, it may cause a malfunction.
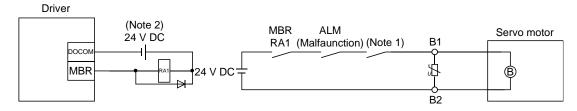
POINT

●Refer to chapter 14 for specifications such as the power supply capacity and operation delay time of the lock.
●Refer to chapter 14 for the selection of a surge absorber for the lock.

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

1) The lock will operate when the power (24 V DC) turns off.

2) Turn off the servo-on command after the servo motor stopped.

(1) Connection diagram

Driver

(Note 2)
24 V DC

DOCOM

MBR

RA1

24 V DC

MBR   ALM
RA1   (Malfaunction) (Note 1)   B1

Servo motor

B

B2

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 lock.**
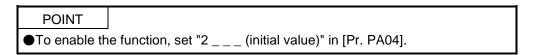
(2) Setting
In [Pr. PC02 Electromagnetic brake sequence output], set the time delay (Tb) from lock operation to base circuit shut-off at a servo-off as in the timing chart in section 3.10.2.

SMC
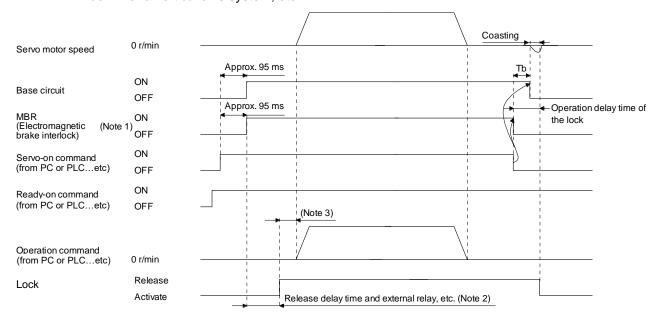
3.10.2 Timing chart
   (1) When you use the forced stop deceleration function

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

(a) Servo-on command (from PC or PLC…etc) on/off
   When servo-on command is turned off, the servo lock will be released after Tb [ms], and the servo motor will coast. If the lock 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.
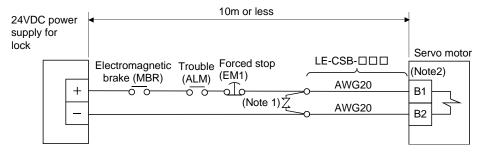
Note 1. ON: Lock is not activated.
          OFF: Lock is activated.
      2. Lock is released after delaying for the release delay time of lock and operation time of external circuit relay. For the release delay time of lock, refer to chapter 14.
      3. Give the operation command from the PC or PLC…etc after the lock is released.

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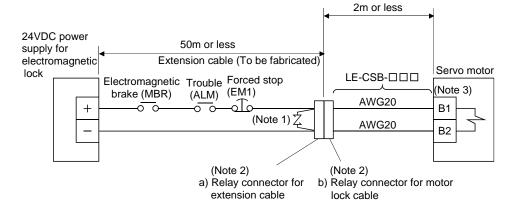
When fabricating the lock cable LE-CSB-R□□, refer to section 11.1.6.

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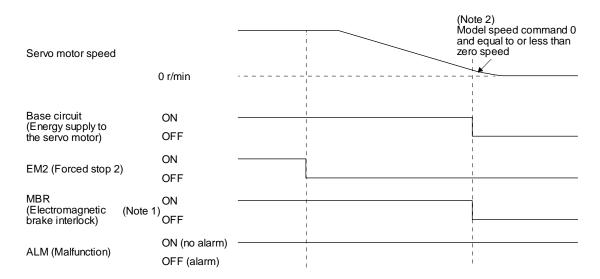
Relay connector	Description	Protective structure
a) Relay connector for extension cable	CM10-CR2P-∗ (DDK) └ Wire size: S, M, L	IP65
b) Relay connector for motor lock cable	CM10-SP2S-∗ (DDK) └ Wire size: S, M, L	IP65

   3. There is no polarity in electromagnetic lock terminals (B1 and B2).

(b) Forced stop 2 on/off

> POINT
>
> ●In the torque control mode, the forced stop deceleration function is not available.
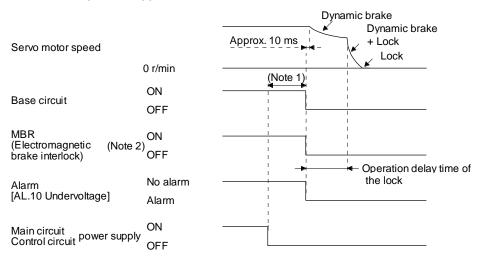
(Note 2)
Model speed command 0
and equal to or less than
zero speed

Servo motor speed

0 r/min

Base circuit
(Energy supply to
the servo motor)   ON / OFF

EM2 (Forced stop 2)   ON / OFF

MBR
(Electromagnetic   (Note 1)   ON / OFF
brake interlock)

ALM (Malfunction)   ON (no alarm) / OFF (alarm)

Note 1. ON: Lock is not activated.
        OFF: Lock is 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
    The operation status during an alarm is the same as section 3.7.

(d) Both main and control circuit power supplies off

Dynamic brake
Dynamic brake + Lock
Lock

Servo motor speed

Approx. 10 ms

0 r/min

(Note 1)

Base circuit   ON / OFF

MBR
(Electromagnetic   (Note 2)   ON / OFF
brake interlock)

Operation delay time of
the lock

Alarm
[AL.10 Undervoltage]   No alarm / Alarm

Main circuit
Control circuit power supply   ON / OFF

Note 1. Variable according to the operation status.
     2. ON: Lock is not activated.
        OFF: Lock is activated.

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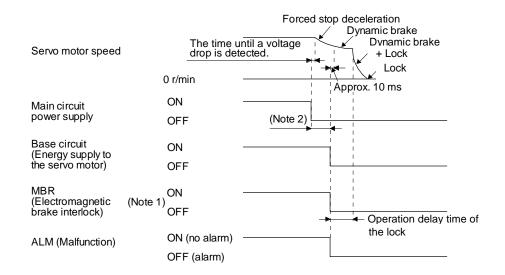
(e) Main circuit power supply off during control circuit power supply on

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

Servo motor speed

Forced stop deceleration
Dynamic brake
Dynamic brake + Lock
The time until a voltage drop is detected.
Lock
0 r/min
Approx. 10 ms

Main circuit power supply — ON / OFF (Note 2)

Base circuit (Energy supply to the servo motor) — ON / OFF

MBR (Electromagnetic brake interlock) (Note 1) — ON / OFF

ALM (Malfunction) — ON (no alarm) / OFF (alarm)

Operation delay time of the lock

Note 1. ON: Lock is not activated.
OFF: Lock is activated.
2. Variable according to the operation status.

(f) Ready-off command from PC or PLC…etc

Servo motor speed

Dynamic brake
Dynamic brake + Lock
Approx. 10 ms
Lock
0 r/min

Base circuit — ON / OFF

MBR (Electromagnetic brake interlock) (Note) — ON / OFF

Ready-on command (from PC or PLC…etc) — ON / OFF
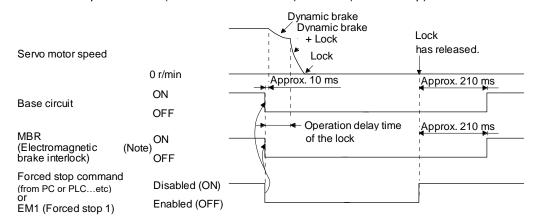
Operation delay time of the lock

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

SMC

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

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

(a) Servo-on command (from PC or PLC…etc) on/off
   It is the same as (1) (a) in this section.

(b) Off/on of the forced stop command (from PC or PLC…etc) or EM1 (Forced stop)
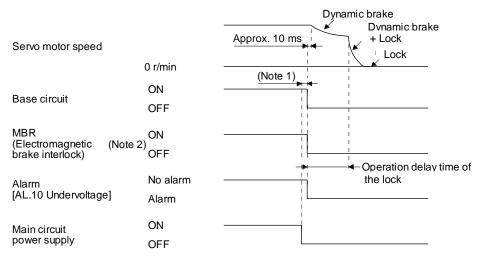
   Note. ON: Lock is not activated.
         OFF: Lock is activated.

(c) Alarm occurrence
   The operation status during an alarm is the same as section 3.7.

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

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

   Note 1. Variable according to the operation status.
         2. ON: Lock is not activated.
            OFF: Lock is activated.

SMC
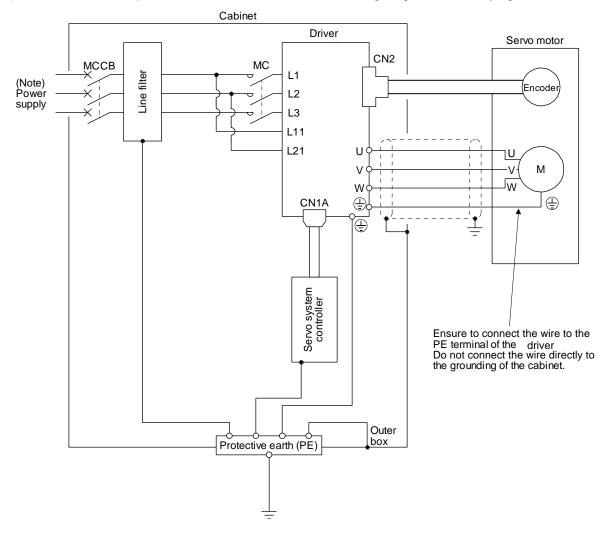
(f) Ready-off command from PC or PLC…etc
It is the same as (1) (f) in this section.

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.

Ensure to connect the wire to the PE terminal of the driver
Do not connect the wire directly to the grounding of the cabinet.

Note. 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.

4. STARTUP

SMC

4. STARTUP

⚠ WARNING	●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 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. ●During operation, never touch the rotor of the servo motor. Otherwise, it may cause injury.
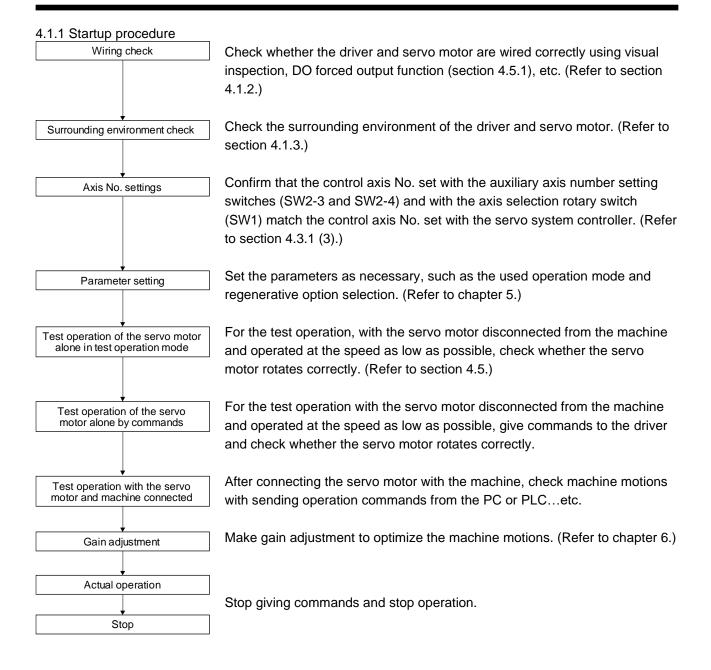
4.1 Switching power on for the first time

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

SMC

4. 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.

SMC

4.1.2 Wiring check
  (1) Power supply system wiring

   Before switching on the main circuit and control circuit power supplies, check the following items.
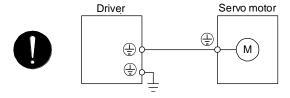
   (a) Power supply system wiring

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

   (b) Connection of driver and servo motor
     1) The driver power output (U, V, and W) should match in phase with the servo motor power input terminals (U, V, and W).
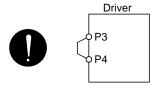
     2) The power supplied to the driver should not be connected to the servo motor power terminals (U, V, and W). To do so will fail the connected driver and servo motor.

     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.

     5) Between P3 and P4 should be connected.

SMC

   (c) When you use an option and auxiliary equipment

     1) When you use a regenerative option for drivers under 750W for 200 V class

      ・The lead wire between P+ terminal and D terminal should not be connected.

      ・The regenerative option wire should be connected between P+ and C terminal.

      ・A twisted cable should be used. (Refer to section 11.2.3.)

 (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 CN3 connector. This function can be used to perform a wiring check. 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 CN3 connector.

  (c) SD and DOCOM of the CN3 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
  Connect the servo motor with a machine after confirming that the servo motor operates properly alone.

  (1) Power on
     When the main and control circuit power supplies are turned on, "b01" (for the first axis) appears on the driver display.
     When the absolute position detection system is used in a servo motor, first power-on results in [AL. 25 Absolute position erased] and the servo-on cannot be ready. 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) Parameter setting

> POINT
> ●The following encoder cables are of two-wire type. When using any of the encoder cables, set [Pr. PC04] to "0 _ _ _" to select the two-wire type. Incorrect setting will result in [AL. 16 Encoder initial communication error 1].

  Set the parameters according to the structure and specifications of the machine. Refer to chapter 5 for details.
  After setting the above parameters, turn power off as necessary. Then switch power on again to enable the parameter values.

  (3) Servo-on
     Enable the servo-on with the following procedure.

     (a) Switch on main circuit power supply and control circuit power supply.

     (b) Transmit the servo-on command with the PC or PLC…etc.

     When the servo-on status is enabled, the driver is ready to operate and the servo motor is locked.

  (4) Home position return
     Always perform home position return before starting positioning operation.

(5) 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 a lock.

	Operation/command	Stopping condition
Servo system controller	Servo-off command	The base circuit is shut off and the servo motor coasts.
	Ready-off command	The base circuit is shut off and the dynamic brake operates to bring the servo motor to a stop.
	Forced stop command	The servo motor decelerates to a stop with the command. [AL. E7 Controller forced stop warning] occurs.
Driver	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 section 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 brake operates to bring the servo motor to a stop.

4.3 Switch setting and display of the driver

Switching to the test operation mode, deactivating control axes, and setting control axis No. are enabled with switches on the driver.

On the driver display (three-digit, seven-segment LED), check the status of communication with the servo system controller at power-on, and the axis number, and diagnose a malfunction at occurrence of an alarm.

4.3.1 Switches
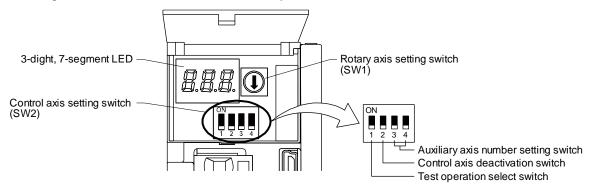
⚠ WARNING	●When switching the axis selection rotary switch (SW1) and auxiliary axis number setting switch (SW2), use insulated screw driver. Do not use a metal screw driver. Touching patterns on electronic boards, lead of electronic parts, etc. may cause an electric shock.

POINT
●Turning "ON (up)" all the control axis setting switches (SW2) enables an operation mode for manufacturer setting and displays "off". The mode is not available. Set the control axis setting switches (SW2) correctly according to this section.
●Cycling the main circuit power supply and control circuit power supply enables the setting of each switch.
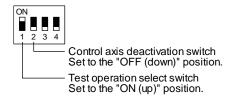
The following explains the test operation select switch, the disabling control axis switch, auxiliary axis number setting switches, and the axis selection rotary switch.

3-dight, 7-segment LED

Control axis setting switch (SW2)

Rotary axis setting switch (SW1)

Auxiliary axis number setting switch
Control axis deactivation switch
Test operation select switch

(1) Test operation select switch (SW2-1)

To use the test operation mode, turn "ON (up)" the switch. Turning "ON (up)" the switch enables the test operation mode. In the test operation mode, the functions such as JOG operation, positioning operation, and machine analyzer are available with setup software (MR Configurator2™). Before turning "ON (up)" the test operation select switch, turn "OFF (down)" the disabling control axis switch.

Control axis deactivation switch
Set to the "OFF (down)" position.

Test operation select switch
Set to the "ON (up)" position.

(2) Disabling control axis switch (SW2-2)

Turning "ON (up)" the disabling control axis switch disables the corresponding servo motor. The servo motor will be disabled-axis status and will not be recognized by the PC or PLC…etc.

Control axis deactivation switch

(3) Switches for setting control axis No.

> POINT
>
> ● The control axis No. set to the auxiliary axis number setting switches (SW2-3 and SW2-4) and the axis selection rotary switch (SW1) should be the same as the one set to the servo system controller. The number of the axes you can set depends on the PC or PLC…etc.
> ● For setting the axis selection rotary switch, use a flat-blade screwdriver with the blade edge width of 2.1 mm to 2.3 mm and the blade edge thickness of 0.6 mm to 0.7 mm.
> ● When the test operation mode is selected with the test operation select switch (SW2-1), the SSCNET III/H communication for the driver in the test operation mode and the following drivers is blocked.

You can set the control axis No. between 1 and 64 by using auxiliary axis number setting switches with the axis selection rotary switch. (Refer to (3) (c) of this section.)

If the same numbers are set to different control axes in a single communication system, the system will not operate properly. The control axes may be set independently of the SSCNET III cable connection sequence. The following shows the description of each switch.

(a) Auxiliary axis number setting switches (SW2-3 and SW2-4)

   Turning these switches "ON (up)" enables you to set the axis No. 17 or more.

(b) Axis selection rotary switch (SW1)

   You can set the control axis No. between 1 and 64 by using auxiliary axis number setting switches with the axis selection rotary switch. (Refer to (3) (c) of this section.)

Rotary axis setting switch (SW1)

(c) Switch combination list for the control axis No. setting

The following lists show the setting combinations of the auxiliary axis number setting switches and the axis selection rotary switch.

Auxiliary axis number setting switch	Axis selection rotary switch	Control axis No.
	0	1
	1	2
	2	3
	3	4
	4	5
	5	6
	6	7
ON [switch diagram 1 2 3 4]	7	8
	8	9
	9	10
	A	11
	B	12
	C	13
	D	14
	E	15
	F	16

Auxiliary axis number setting switch	Axis selection rotary switch	Control axis No.
	0	17
	1	18
	2	19
	3	20
	4	21
	5	22
	6	23
ON [switch diagram 1 2 3 4]	7	24
	8	25
	9	26
	A	27
	B	28
	C	29
	D	30
	E	31
	F	32
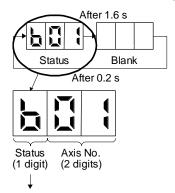
Auxiliary axis number setting switch	Axis selection rotary switch	Control axis No.
	0	33
	1	34
	2	35
	3	36
	4	37
	5	38
	6	39
ON [switch diagram 1 2 3 4]	7	40
	8	41
	9	42
	A	43
	B	44
	C	45
	D	46
	E	47
	F	48

Auxiliary axis number setting switch	Axis selection rotary switch	Control axis No.
	0	49
	1	50
	2	51
	3	52
	4	53
	5	54
	6	55
ON [switch diagram 1 2 3 4]	7	56
	8	57
	9	58
	A	59
	B	60
	C	61
	D	62
	E	63
	F	64

4.3.2 Scrolling display

(1) Normal display
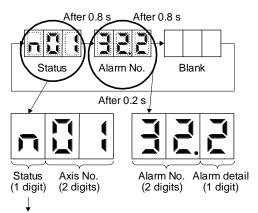
When there is no alarm, the axis No. and blank are displayed in rotation.

After 1.6 s

Status | Blank

After 0.2 s

Status (1 digit) | Axis No. (2 digits)

"b" : Indicates ready-off and servo-off status.
"C" : Indicates ready-on and servo-off status.
"d" : Indicates ready-on and servo-on status.

(2) Alarm display
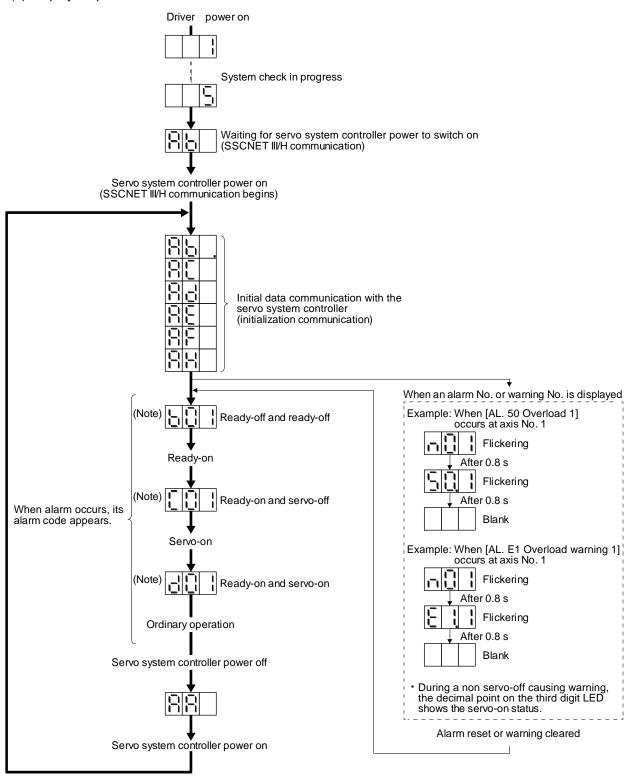
When an alarm occurs, the alarm number (two digits) and the alarm detail (one digit) are displayed following the status display. For example, the following shows when [AL. 32 Overcurrent] is occurring.

After 0.8 s   After 0.8 s

Status | Alarm No. | Blank

After 0.2 s

Status (1 digit) | Axis No. (2 digits) | Alarm No. (2 digits) | Alarm detail (1 digit)

"n": Indicates that an alarm is occurring.

4.3.3 Status display of an axis
(1) Display sequence

Driver power on

System check in progress

Waiting for servo system controller power to switch on
(SSCNET III/H communication)

Servo system controller power on
(SSCNET III/H communication begins)

Initial data communication with the servo system controller (initialization communication)

When alarm occurs, its alarm code appears.

(Note) Ready-off and ready-off

Ready-on

(Note) Ready-on and servo-off

Servo-on

(Note) Ready-on and servo-on

Ordinary operation

Servo system controller power off

Servo system controller power on

When an alarm No. or warning No. is displayed

Example: When [AL. 50 Overload 1] occurs at axis No. 1

Flickering
After 0.8 s
Flickering
After 0.8 s
Blank

Example: When [AL. E1 Overload warning 1] occurs at axis No. 1

Flickering
After 0.8 s
Flickering
After 0.8 s
Blank

· During a non servo-off causing warning, the decimal point on the third digit LED shows the servo-on status.

Alarm reset or warning cleared

Note. The segment of the last 2 digits shows the axis number.
Axis No. 1   Axis No. 2   Axis No. 64

SMC

(2) Indication list

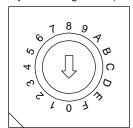| Indication	Status	Description
☐☐i ┊ ☐☐S	Initializing	System check in progress
A b ☐	Initializing	・Power of the driver was switched on at the condition that the power of the servo system controller is off. ・The control axis No. set to the auxiliary axis number setting switches (SW2-3 and SW2-4) and the axis selection rotary switch (SW1) do not match the one set to the servo system controller. ・A driver malfunctioned, or communication error occured with the servo system controller or the previous axis driver. In this case, the indication changes as follows: 　"Ab", "AC", "Ad", and "Ab" ・The servo system controller is malfunctioning.
A b .	Initializing	During initial setting for communication specifications
A C ☐	Initializing	Initial setting for communication specifications completed, and then it synchronized with servo system controller.
A d ☐	Initializing	During initial parameter setting communication with servo system controller
A E ☐	Initializing	During the servo motor/encoder information and telecommunication with servo system controller
A F ☐	Initializing	During initial signal data communication with servo system controller
A H ☐	Initializing completion	The process for initial data communication with the servo system controller is completed.
A A ☐	Initializing standby	The power supply of servo system controller is turned off during the power supply of driver is on.
(Note 1) b # #	Ready-off	The ready-off signal from the servo system controller was received.
(Note 1) d # #	Servo-on	The ready-off signal from the servo system controller was received.
(Note 1) C # #	Servo-off	The ready-off signal from the servo system controller was received.
(Note 2) * * *	Alarm and warning	The alarm No. and the warning No. that occurred is displayed. (Refer to section 8.)
8 8 8	CPU error	CPU watchdog error has occurred.
(Note 1) b # #. d # #. C # #.	(Note 3) Test operation mode	Motor-less operation

Note　1. The meanings of ## are listed below.

##	Description
01	Axis No. 1
≀	≀
64	Axis No. 64

　2. ** indicates the alarm No. and the warning No.
　3. Requires the setup software (MR Configurator2™).

SMC
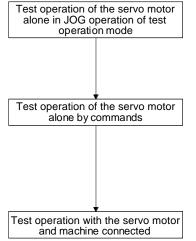
4.4 Test operation

Before starting actual operation, perform test operation to make sure that the machine operates normally.

Refer to section 4.2 for the power on and off methods of the driver.

```
┌─ POINT ─────────────────────────────────────────────────────────┐
│ ●If necessary, verify PC or PLC…etc program by using motor-less operation. │
│   Refer to section 4.5.2 for the motor-less operation.           │
└───────────────────────────────────────────────────────────────────┘
```

| 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 rotates correctly. Refer to section 4.5 for the test operation mode. |

| Test operation of the servo motor alone by commands | In this step, confirm that the servo motor rotates correctly under the commands from the PC or PLC…etc. 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. 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. Check any problems with the servo motor speed, load ratio, and other status display items with setup software (MR Configurator2™). Then, check automatic operation with the program of the PC or PLC…etc. |

4.5 Test operation mode

```
┌──────────────┬──────────────────────────────────────────────────┐
│ ⚠CAUTION     │ ●The test operation mode is designed for checking servo operation. It is not for │
│              │  checking machine operation. Do not use this mode with the machine. Always use │
│              │  the servo motor alone.                          │
│              │ ●If the servo motor operates abnormally, use EM2 (Forced stop 2) to stop it. │
└──────────────┴──────────────────────────────────────────────────┘
```

```
┌─ POINT ─────────────────────────────────────────────────────────┐
│ ●The content described in this section indicates that the driver and a personal │
│   computer are directly connected.                               │
└───────────────────────────────────────────────────────────────────┘
```

By using a personal computer and setup software (MR Configurator2™), you can execute jog operation, positioning operation, DO forced output program operation without connecting the servo system controller.

4.5.1 Test operation mode in setup software (MR Configurator2™)

```
┌─────────────┐
│ POINT       │
└─────────────┘
●When the test operation mode is selected with the test operation select switch
  (SW2-1), the SSCNET III/H communication for the driver in the test operation
  mode and the following drivers is blocked.
```

(1) Test operation mode

    (a) Jog operation

        Jog operation can be performed without using the servo system controller. Use this operation
        with the forced stop reset. This operation may be used independently of whether the servo is on
        or off and whether the servo system controller is connected or not.

        Exercise control on the jog operation screen of setup software (MR Configurator2™).

        1) Operation pattern

Item	initial value	Setting range
Speed [r/min]	200	0 to max. speed
Acceleration/deceleration time constant [ms]	1000	0 to 50000

        2) Operation method

        ・ When the check box of "Rotation only while the CCW or CW button is being pushed." is
          checked.

Operation	Screen control
Forward rotation start	Keep pressing the "Forward" button.
Reverse rotation start	Keep pressing the "Reverse" button.
Stop	Release the "Forward" or "Reverse" button.
Forced stop	Click the "Forced stop" button.

        ・ When the check box of "Rotation only while the CCW or CW button is being pushed." is not
          checked.

Operation	Screen control
Forward rotation start	Click the "Forward" button.
Reverse rotation start	Click the "Reverse" button.
Stop	Click the "Stop" button.
Forced stop	Click the "Forced stop" button.

SMC

(b) Positioning operation

Positioning operation can be performed without using the servo system controller. Use this operation with the forced stop reset. This operation may be used independently of whether the servo is on or off and whether the servo system controller is connected or not.

Exercise control on the positioning operation screen of setup software (MR Configurator2™).

1) Operation pattern

Item	initial value	Setting range
Travel distance [pulse]	4000	0 to 99999999
Speed [r/min]	200	0 to max. speed
Acceleration/deceleration time constant [ms]	1000	0 to 50000
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 repeats [time]	1	1 to 9999

2) Operation method

Operation	Screen control
Forward rotation start	Click the "Forward" button.
Reverse rotation start	Click the "Reverse" button.
Pause	Click the "Pause" button.
Stop	Click the "Stop" button.
Forced stop	Click the "Forced stop" button.

(c) Program operation

Positioning operation can be performed in two or more operation patterns combined, without using the servo system controller. Use this operation with the forced stop reset. This operation may be used independently of whether the servo is on or off and whether the servo system controller is connected or not.
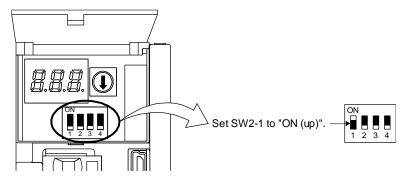
Exercise control on the program operation screen of setup software (MR Configurator2™).

Operation	Screen control
Start	Click the "Start" button.
Pause	Click the "Pause" button.
Stop	Click the "Stop" button.
Forced stop	Click the "Forced stop" button.

(d) Output signal (DO) forced output

Output signals can be switched on/off forcibly independently of the servo status. Use this function for output signal wiring check, etc. Exercise control on the DO forced output screen of setup software (MR Configurator2™).
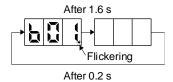
(2) Operation procedure
1) Turn off the power.

2) Turn "ON (up)" SW2-1.

Set SW2-1 to "ON (up)".
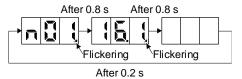
Turning "ON (up)" SW2-1 during power-on will not start the test operation mode.

3) Turn on the driver.
When initialization is completed, the decimal point on the first digit will flicker.

After 1.6 s

Flickering

After 0.2 s

When an alarm or warning also occurs during the test operation, the decimal point on the first digit will flicker as follows.

After 0.8 s   After 0.8 s

Flickering   Flickering

After 0.2 s

4) Start operation with the personal computer.

4.5.2 Motor-less operation in PC or PLC…etc

> POINT
>
> ●Use motor-less operation which is available by making the servo system
>   controller parameter setting.
> ●Motor-less operation is done while connected with the servo system controller.

(1) Motor-less operation

Without connecting the servo motor, output signals or status displays can be provided in response to the servo system controller commands as if the servo motor is actually running. This operation may be used to check the servo system controller sequence. Use this operation with the forced stop reset. Use this operation with the driver connected to the servo system controller.

To stop the motor-less operation, set the motor-less operation selection to "Disable" in the servo parameter setting of the servo system controller. When the power supply is turned on next time, motor-less operation will be disabled.

(a) Load conditions
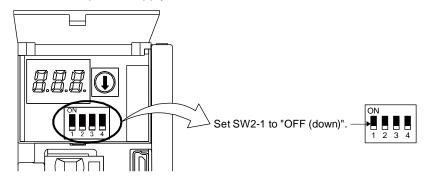
Load item	Condition
Load torque	0
Load to motor inertia ratio	Same as the moment of inertia of the servo motor

(b) Alarms
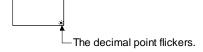
The following alarms and warning do not occur. However, the other alarms and warnings occur as when the servo motor is connected.

Alarm and warning	Servo motor
[AL. 16 Encoder initial communication error 1]	○
[AL. 1E Encoder initial communication error 2]	○
[AL. 1F Encoder initial communication error 3]	○
[AL. 20 Encoder normal communication error 1]	○
[AL. 21 Encoder normal communication error 2]	○
[AL. 25 Absolute position erased]	○
[AL. 28 Linear encoder error 2]	
[AL. 2A Linear encoder error 1]	
[AL. 2B Encoder counter error]	
[AL. 92 Battery cable disconnection warning]	○
[AL. 9F Battery warning]	○
[AL. E9 Main circuit off warning]	○
[AL. 70 Load-side encoder error 1]	
[AL. 71 Load-side encoder error 2]	

(2) Operation procedure

1) Set the driver to the servo-off status.

2) Set [Pr. PC05] to "_ _ _ 1", turn "OFF (down: normal condition side)" the test operation mode switch (SW2-1), and then turn on the power supply.

Set SW2-1 to "OFF (down)".

3) Start the motor-less operation with the servo system controller.

The display shows the following screen.

The decimal point flickers.

5. PARAMETERS

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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.

```
 POINT
```
●When you connect the driver to a servo system controller, servo parameter values of the servo system controller will be written to each parameter.
●Setting may not be made to some parameters and their ranges depending on the servo system controller model, driver software version, and setup software (MR Configurator2™) software version. For details, refer to the servo system controller user's manual.

5.1 Parameter list

```
 POINT
```
●The parameter whose symbol is preceded by * is enabled with the following conditions:
 * : After setting the parameter, cycle the power or reset the PC or PLC…etc.
 **: After setting the parameter, cycle the power.

5. PARAMETERS

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

No.	Symbol	Name	Initial value	Unit	Setting
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		For manufacturer setting	10000		
PA06			1		
PA07			1		
PA08	ATU	Auto tuning mode	0001h		○
PA09	RSP	Auto tuning response	16		○
PA10	INP	In-position range	1600	[pulse]	○
PA11		For manufacturer setting	1000.0		
PA12			1000.0		
PA13			0000h		
PA14	*POL	Rotation 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	00ABh		○
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		

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

No.	Symbol	Name	Initial value	Unit	Setting
PB01	FILT	Adaptive tuning mode (adaptive filter II)	0000h		○
PB02	VRFT	Vibration suppression control tuning mode (advanced vibration suppression control II)	0000h		○
PB03	TFBGN	Torque feedback loop gain	18000	[rad/s]	○
PB04	FFC	Feed forward gain	0	[%]	○
PB05		For manufacturer setting	500		
PB06	GD2	Load to motor inertia 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		For manufacturer setting	0000h		
PB26	*CDP	Gain switching function	0000h		○
PB27	CDL	Gain switching condition	10	[kpps]/ [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	VRF11B	Vibration suppression control 1 - Vibration frequency after gain switching	0.0	[Hz]	○
PB34	VRF12B	Vibration suppression control 1 - Resonance frequency after gain switching	0.0	[Hz]	○
PB35	VRF13B	Vibration suppression control 1 - Vibration frequency damping after gain switching	0.00		○
PB36	VRF14B	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			0		
PB42			0		
PB43			0000h		
PB44			0.00		
PB45	CNHF	Command notch filter	0000h		○

5. PARAMETERS

No.	Symbol	Name	Initial value	Unit	Setting
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	Setting
PC01	ERZ	Error excessive alarm level	0	[rev]	○
PC02	MBR	Electromagnetic brake sequence output	0	[ms]	○
PC03	*ENRS	Encoder output pulse selection	0000h		○
PC04	**COP1	Function selection C-1	0000h		○
PC05	**COP2	Function selection C-2	0000h		○
PC06	*COP3	Function selection C-3	0000h		○
PC07	ZSP	Zero speed	50	[r/min]	○
PC08	OSL	Overspeed alarm detection level	0	[r/min]	○
PC09	MOD1	Analog monitor 1 output	0000h		○
PC10	MOD2	Analog monitor 2 output	0001h		○
PC11	MO1	Analog monitor 1 offset	0	[mV]	○
PC12	MO2	Analog monitor 2 offset	0	[mV]	○
PC13	MOSDL	Analog monitor - Feedback position output standard data - Low	0	[pulse]	○
PC14	MOSDH	Analog monitor - Feedback position output standard data - High	0	[10000pulses]	○
PC15		For manufacturer setting	0		
PC16			0000h		
PC17	**COP4	Function selection C-4	0000h		○
PC18	*COP5	Function selection C-5	0000h		○
PC19		For manufacturer setting	0000h		
PC20	*COP7	Function selection C-7	0000h		○

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5. PARAMETERS

No.	Symbol	Name	Initial value	Unit	Setting
PC21	*BPS	Alarm history clear	0000h		○
PC22		For manufacturer setting	0		
PC23			0000h		
PC24	RSBR	Forced stop deceleration time constant	100	[ms]	○
PC25		For manufacturer setting	0		
PC26	**COP8	Function selection C-8	0000h		○
PC27	**COP9	Function selection C-9	0000h		
PC28		For manufacturer setting	0000h		
PC29	*COPB	Function selection C-B	0000h		○
PC30		For manufacturer setting	0		
PC31	RSUP1	Vertical axis freefall prevention compensation amount	0	[0.0001rev]	○
PC32		For manufacturer setting	0000h		
PC33			0		
PC34			100		
PC35			0000h		
PC36			0000h		
PC37			0000h		
PC38			0000h		
PC39			0000h		
PC40			0000h		
PC41			0000h		
PC42			0000h		
PC43			0000h		
PC44			0000h		
PC45			0000h		
PC46			0000h		
PC47			0000h		
PC48			0000h		
PC49			0000h		
PC50			0000h		
PC51			0000h		
PC52			0000h		
PC53			0000h		
PC54			0000h		
PC55			0000h		
PC56			0000h		
PC57			0000h		
PC58			0000h		
PC59			0000h		
PC60			0000h		
PC61			0000h		
PC62			0000h		
PC63			0000h		
PC64			0000h		

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

No.	Symbol	Name	Initial value	Unit	Setting
PD01		For manufacturer setting	0000h		
PD02	*DIA2	Input signal automatic on selection 2	0000h		○
PD03		For manufacturer setting	0020h		
PD04			0021h		
PD05			0022h		
PD06			0000h		
PD07	*DO1	Output device selection 1	0005h		○
PD08	*DO2	Output device selection 2	0004h		○
PD09	*DO3	Output device selection 3	0003h		○
PD10		For manufacturer setting	0000h		
PD11			0004h		
PD12	*DOP1	Function selection D-1	0000h		○
PD13		For manufacturer setting	0000h		
PD14	*DOP3	Function selection D-3	0000h		○
PD15		For manufacturer setting	0000h		
PD16			0000h		
PD17			0000h		
PD18			0000h		
PD19			0000h		
PD20			0		
PD21			0		
PD22			0		
PD23			0		
PD24			0000h		
PD25			0000h		
PD26			0000h		
PD27			0000h		
PD28			0000h		
PD29			0000h		
PD30			0		
PD31			0		
PD32			0		
PD33			0000h		
PD34			0000h		
PD35			0000h		
PD36			0000h		
PD37			0000h		
PD38			0000h		
PD39			0000h		
PD40			0000h		
PD41			0000h		
PD42			0000h		
PD43			0000h		
PD44			0000h		
PD45			0000h		
PD46			0000h		
PD47			0000h		
PD48			0000h		

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

No.	Symbol	Name	Initial value	Unit	Setting
PE01	**FCT1	Fully closed loop function selection 1 (Do not change this value.)	0000h		
PE02		For manufacturer setting	0000h		
PE03	*FCT2	Fully closed loop function selection 2 (Do not change this value.)	0003h		
PE04	**FBN	Fully closed loop control - Feedback pulse electronic gear 1 – Numerator (Do not change this value.)	1		
PE05	**FBD	Fully closed loop control - Feedback pulse electronic gear 1 – Denominator (Do not change this value.)	1		
PE06	BC1	Fully closed loop control - Speed deviation error detection level (Do not change this value.)	400	[r/min]	
PE07	BC2	Fully closed loop control - Position deviation error detection level (Do not change this value.)	100	[kpulse]	
PE08	DUF	Fully closed loop dual feedback filter (Do not change this value.)	10	[rad/s]	
PE09		For manufacturer setting	0000h		
PE10	FCT3	Fully closed loop function selection 3 (Do not change this value.)	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		○

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No.	Symbol	Name	Initial value	Unit	Setting
PE42		For manufacturer setting	0		
PE43			0.0		
PE44			0000h		
PE45			0000h		
PE46			0000h		
PE48		For manufacturer setting	0000h		
PE49			0000h		
PE50			0000h		
PE51			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		

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

No.	Symbol	Name	Initial value	Unit	Setting
PF01		For manufacturer setting	0000h		
PF02			0000h		
PF03			0000h		
PF04			0		
PF05			0000h		
PF06	*FOP5	Function selection F-5	0000h		○
PF07		For manufacturer setting	0000h		
PF08			0000h		
PF09			0		
PF10			0		
PF11			0		
PF12	DBT	Electronic dynamic brake operating time	2000	[ms]	○
PF13		For manufacturer setting	0000h		
PF14			10		
PF15			0000h		
PF16			0000h		
PF17			0000h		
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 (instantaneous power failure tough drive - detection time)	200	[ms]	○
PF26		For manufacturer setting	0		
PF27			0		
PF28			0		

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No.	Symbol	Name	Initial value	Unit	Setting
PF29		For manufacturer setting	0000h		
PF30			0		
PF31	FRIC	Machine diagnosis function - Friction judgement speed	0	[r/min]	○
PF32		For manufacturer setting	50		
PF33			0000h		
PF34			0000h		
PF35			0000h		
PF36			0000h		
PF37			0000h		
PF38			0000h		
PF39			0000h		
PF40			0000h		
PF41			0000h		
PF42			0000h		
PF43			0000h		
PF44			0000h		
PF45			0000h		
PF46			0000h		
PF47			0000h		
PF48			0000h		

5.1.7 Extension setting 4 parameters ([Pr. PL_ _])

No.	Symbol	Name	Initial value	Unit	Setting
PL01	**LIT1	Linear servo motor/DD motor function selection 1 (Do not change this value.)	0301h		
PL02	**LIM	Linear encoder resolution – Numerator (Do not change this value.)	1000	[μm]	
PL03	**LID	Linear encoder resolution - Denominator (Do not change this value.)	1000	[μm]	
PL04	*LIT2	Linear servo motor/DD motor function selection 2 (Do not change this value.)	0003h		
PL05	LB1	Position deviation error detection level (Do not change this value.)	0	[0.01rev]	
PL06	LB2	Speed deviation error detection level (Do not change this value.)	0	[r/min]	
PL07	LB3	Torque/thrust deviation error detection level (Do not change this value.)	100	[%]	
PL08	*LIT3	Linear servo motor/DD motor function selection 3 (Do not change this value.)	0010h		
PL09	LPWM	Magnetic pole detection voltage level (Do not change this value.)	30	[%]	
PL10		For manufacturer setting	5		
PL11			100		
PL12			500		
PL13			0000h		
PL14			0		
PL15			20		
PL16			0		
PL17	LTSTS	Magnetic pole detection - Minute position detection method - Function selection (Do not change this value.)	0000h		
PL18	IDLV	Magnetic pole detection - Minute position detection method - Identification signal amplitude (Do not change this value.)	0	[%]	

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No.	Symbol	Name	Initial value	Unit	Setting
PL19		For manufacturer setting	0		
PL20			0		
PL21			0		
PL22			0		
PL23			0000h		
PL24			0		
PL25			0000h		
PL26			0000h		
PL27			0000h		
PL28			0000h		
PL29			0000h		
PL30			0000h		
PL31			0000h		
PL32			0000h		
PL33			0000h		
PL34			0000h		
PL35			0000h		
PL36			0000h		
PL37			0000h		
PL38			0000h		
PL39			0000h		
PL40			0000h		
PL41			0000h		
PL42			0000h		
PL43			0000h		
PL44			0000h		
PL45			0000h		
PL46			0000h		
PL47			0000h		
PL48			0000h		

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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 and function	Initial value [unit]	Setting range
PA01	**STY	Operation mode Select a operation mode. _Setting digit table:_ | Setting digit | Explanation | Initial value | | _ _ _ x | For manufacturer setting | 0h | | _ _ x _ | Operation mode selection 0: Standard control mode (Set 0.) | 0h | | _ x _ _ | For manufacturer setting | 0h | | x _ _ _ | Operation mode selection To change this digit, use an application software "MR-J4(W)-B mode selection". When you change it without the application, [AL. 3E Operation mode error] will occur. Refer to App.7 for details. 0: J3 compatibility mode (LECSS□-□) 1: J4 mode (LECSS2-T□) | 1h |	Refer to Name and function column.	
PA02	**REG	Regenerative option Used to 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. | Setting digit | Explanation | Initial value | | _ _ x x | 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 750 W, built-in regenerative resistor is used. 02: LEC-MR-RB-032 03: LEC-MR-RB-12 | 00h | | _ x _ _ | For manufacturer setting | 0h | | x _ _ _ | | 0h |	Refer to Name and function column.	

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No.	Symbol	Name and function	Initial value [unit]	Setting range
PA03	*ABS	**Absolute position detection system** Set this parameter when using the absolute position detection system. The parameter is not available in the speed control mode and torque control mode. <table><tr><td>Setting digit</td><td>Explanation</td><td>Initial value</td></tr><tr><td>_ _ _ x</td><td>Absolute position detection system selection 0: Disabled (used in incremental system) 1: Enabled (used in absolute position detection system)</td><td>0h</td></tr><tr><td>_ _ x _</td><td>For manufacturer setting</td><td>0h</td></tr><tr><td>_ x _ _</td><td></td><td>0h</td></tr><tr><td>x _ _ _</td><td></td><td>0h</td></tr></table>	Refer to Name and function column.	
PA04	*AOP1	**Function selection A-1** This is used to select the forced stop input and forced stop deceleration function. <table><tr><td>Setting digit</td><td>Explanation</td><td>Initial value</td></tr><tr><td>_ _ _ x</td><td>For manufacturer setting</td><td>0h</td></tr><tr><td>_ _ x _</td><td></td><td>0h</td></tr><tr><td>_ x _ _</td><td>Servo forced stop selection 0: Enabled (The forced stop input EM2 or EM1 is used.) 1: Disabled (The forced stop input EM2 and EM1 are not used.) Refer to table 5.1 for details.</td><td>0h</td></tr><tr><td>x _ _ _</td><td>Forced stop deceleration function selection 0: Forced stop deceleration function disabled (EM1) 2: Forced stop deceleration function enabled (EM2) Refer to table 5.1 for details.</td><td>2h</td></tr></table> Table 5.1 Deceleration method <table><tr><td rowspan="2">Setting value</td><td rowspan="2">EM2/EM1</td><td colspan="2">Deceleration method</td></tr><tr><td>EM2 or EM1 is off</td><td>Alarm occurred</td></tr><tr><td>0 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 0 _ _</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><tr><td>0 1 _ _</td><td>Not using EM2 or EM1</td><td></td><td>MBR (Electromagnetic brake interlock) turns off without the forced stop deceleration.</td></tr><tr><td>2 1 _ _</td><td>Not using EM2 or EM1</td><td></td><td>MBR (Electromagnetic brake interlock) turns off after the forced stop deceleration.</td></tr></table>	Refer to Name and function column.	

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No.	Symbol	Name and function	Initial value [unit]	Setting range
PA08	ATU	Auto tuning mode Select the gain adjustment mode.	Refer to Name and function column.	

Setting digit	Explanation	Initial value
_ _ _ x	Gain adjustment mode selection 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]

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No.	Symbol	Name and function	Initial value [unit]	Setting range
PA09	RSP	Auto tuning response Set a response of the auto tuning.	16	1 to 40

Setting value	Machine characteristic		Setting value	Machine characteristic	
	Response	Guideline for machine resonance frequency [Hz]		Response	Guideline for machine resonance frequency [Hz]
1	Low response ↕ Middle response	2.7	21	Middle response ↕ High response	67.1
2		3.6	22		75.6
3		4.9	23		85.2
4		6.6	24		95.9
5		10.0	25		108.0
6		11.3	26		121.7
7		12.7	27		137.1
8		14.3	28		154.4
9		16.1	29		173.9
10		18.1	30		195.9
11		20.4	31		220.6
12		23.0	32		248.5
13		25.9	33		279.9
14		29.2	34		315.3
15		32.9	35		355.1
16		37.0	36		400.0
17		41.7	37		446.6
18		47.0	38		501.2
19		52.9	39		571.5
20		59.6	40		642.7

No.	Symbol	Name and function	Initial value [unit]	Setting range
PA10	INP	In-position range Set an in-position range per command pulse.	1600 [pulse]	0 to 65535
PA14	*POL	Rotation direction selection This is used to select a rotation direction.	0	0 to 1

Setting value	Servo motor rotation direction	
	Positioning address increase	Positioning address decrease
0	CCW or positive direction	CW or negative direction
1	CW or negative direction	CCW or positive direction

The following shows the servo motor rotation directions.

Forward rotation (CCW)

Reverse rotation (CW)

No.	Symbol	Name and function	Initial value [unit]	Setting range
PA15	*ENR	Encoder output pulses 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. PC03]. The maximum output frequency is 4.6 Mpps. Set the parameter within this range.	4000 [pulse/ rev]	1 to 65535
PA16	*ENR2	Encoder output pulses 2 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. PC03].	1	1 to 65535

Used to set the encoder pulses (A-phase, B-phase) output by the driver.

Set the value 4 times greater than the A-phase or B-phase pulses.

You can use parameter No.PC03 to choose the output pulse setting or output division ratio setting.

The number of A/B-phase pulses actually output is 1/4 times greater than the preset number of pulses.

The maximum output frequency is 4.6Mpps (after multiplication by 4). Use this parameter within this range.

(1) For output pulse designation

Set " □ □ 0 □ " (initial value) in parameter No.PC03.

Set the number of pulses per servo motor revolution.

Output pulse = set value [pulses/rev]

For instance, set "5600" to Parameter No.PA15, the actually output A/B-phase pulses are as indicated below.

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

(2) For output division ratio setting

Set " □ □ 1 □ " in parameter No.PC03.

The number of pulses per servo motor revolution is divided by the set value.

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

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

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

(3) When multiplying A-phase/B-phase output pulses by the value of the electronic gear
Set parameter No. PC03 to " □□ 3 □ ".
The value resulted from multiplying the number of pulses per servo motor revolution by the value of the electronic gear becomes the output pulse.

(a) Set the electric gear numerator in the A-phase/B-phase output pulses to parameter No. PA15.

(Example) When using the LE-T5-□, LE-T6-□, LE-T7-□, LE-T8-□ servo motor series
When parameter No. PA15 is set to "5600" and PA16 to "4096", the A/B-phase pulses actually outputted are as follows.

A-phase/B-phase output pulses =
Resolution per servo motor revolution $\cdot \dfrac{\text{parameter No.15}}{\text{parameter No.16}} \cdot \dfrac{1}{4}$

$= 4194304 \cdot \dfrac{5600}{4096} \cdot \dfrac{1}{4} = 1433600$ [pulse]

POINT

・Resolution per servo motor revolution depends on the servo motor as follows.
  LE-T5-□, LE-T6-□, LE-T7-□, LE-T8-□ servo motor: 4194304pulse/rev

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No.	Symbol	Name and function	Initial value [unit]	Setting range
PA17	**MSR	Do not change this value.	0000h	0000h
PA18	**MTY	Do not change this value.	0000h	0000h
PA19	*BLK	Parameter writing inhibit Select a reference range and writing range of the parameter. Refer to table 5.3 for settings.	00ABh	Refer to Name and function column.

Table 5.3 [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	○	○	○	○			
000Fh	Reading	○	○	○	○	○		○
	Writing	○	○	○	○	○		○
00AAh	Reading	○	○	○	○	○	○	
	Writing	○	○	○	○	○	○	
00ABh (initial value)	Reading	○	○	○	○	○	○	○
	Writing	○	○	○	○	○	○	○
100Bh	Reading	○						
	Writing	Only 19						
100Ch	Reading	○	○	○	○			
	Writing	Only 19						
100Fh	Reading	○	○	○	○	○		○
	Writing	Only 19						
10AAh	Reading	○	○	○	○	○	○	
	Writing	Only 19						
10ABh	Reading	○	○	○	○	○	○	○
	Writing	Only 19						

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No.	Symbol	Name and function	Initial value [unit]	Setting range
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 CN3-9 to CN3-13 and CN3-15 with [Pr. PD07] to [Pr. PD09].	Refer to Name and function column.	
PA21	*AOP3	Function selection A-3	Refer to Name and function column.	

PA20 table:

Setting digit	Explanation	Initial value
_ _ _ 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]. Refer to section 7.3 for details.	0h
_ x _ _	SEMI-F47 function selection (instantaneous power failure tough drive selection) 0: Disabled 1: Enabled Selecting "1" enables to avoid occurring [AL. 10.1 Voltage drop in the control circuit power] using the electrical energy charged in the capacitor in case that an instantaneous power failure occurs during operation. Set the time of until [AL. 10.1 Voltage drop in the control circuit power] occurs in [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time (instantaneous power failure tough drive - detection time)].	0h
x _ _ _	For manufacturer setting	0h

PA21 table:

Setting digit	Explanation	Initial value
_ _ _ x	One-touch tuning function selection 0: Disabled 1: Enabled When the digit is "0", the one-touch tuning with setup software (MR Configurator2) will be disabled.	1h
_ _ x _	For manufacturer setting	0h
_ x _ _		0h
x _ _ _		0h

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No.	Symbol	Name and function	Initial value [unit]	Setting range
PA22	**PCS	Position control composition selection	Refer to Name and function column.	

Position control composition selection

Setting digit	Explanation	Initial value
_ _ _ x	For manufacturer setting	0h
_ _ x _		0h
_ x _ _		0h
x _ _ _	Scale measurement mode selection 0: Disabled 1: Used in absolute position detection system 2: Used in incremental system The absolute position detection system cannot be used while an incremental type encoder is used. Enabling absolute position detection system will trigger [AL. 37 Parameter error].	0h

No.	Symbol	Name and function	Initial value [unit]	Setting range
PA23	DRAT	Drive recorder arbitrary alarm trigger setting	Refer to Name and function column.	

Setting digit	Explanation	Initial value
_ _ 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".

No.	Symbol	Name and function	Initial value [unit]	Setting range
PA24	AOP4	Function selection A-4	Refer to Name and function column.	

Setting digit	Explanation	Initial value
_ _ _ x	Vibration suppression mode selection 0: Standard mode 1: 3 inertia mode 2: Low response mode When two low resonance frequencies are generated, select "3 inertia mode (_ _ _ 1)". When the load to motor inertia ratio exceeds the recommended load to motor inertia ratio, select "Low response mode (_ _ _ 2)". 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 with the PC or PLC…etc during the 3 inertia mode or low response mode, stop the motor.	0h
_ _ x _	For manufacturer setting	0h
_ x _ _		0h
x _ _ _		0h

No.	Symbol	Name and function		Initial value [unit]	Setting range
PA25	OTHOV	One-touch tuning - Overshoot permissible level This is used to set a permissible value of overshoot amount with a percentage to in-position range. However, setting "0" will be 50%.		0 [%]	0 to 100
PA26	*AOP	Function selection A-5		Refer to Name and function column.	

For PA26, the following sub-table:

Setting digit	Explanation	Initial value
_ _ _ x	Torque limit function selection at instantaneous power failure 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 Instantaneous power failure tough drive - Detection time]. To enable the torque limit function at instantaneous power failure, select "Enabled (_ 1 _ _)" of "SEMI-F47 function selection (instantaneous power failure tough drive selection)" in [Pr. PA20]. This parameter setting is supported by driver with software version A6 or later.	0h
_ _ x _	For manufacturer setting	0h
_ x _ _		0h
x _ _ _		0h

5. PARAMETERS

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

No.	Symbol	Name and function	Initial value [unit]	Setting range
PB01	FILT	Adaptive tuning mode (adaptive filter II) Set the adaptive filter tuning. <table><tr><td>Setting digit</td><td>Explanation</td><td>Initial value</td></tr><tr><td>_ _ _ x</td><td>Filter tuning mode selection Select the adjustment mode of the machine resonance suppression filter 1. Refer to section 7.1.2 for details. 0: Disabled 1: Automatic setting 2: Manual setting</td><td>0h</td></tr><tr><td>_ _ x _</td><td>For manufacturer setting</td><td>0h</td></tr><tr><td>_ x _ _</td><td></td><td>0h</td></tr><tr><td>x _ _ _</td><td></td><td>0h</td></tr></table>	Refer to Name and function column.	
PB02	VRFT	Vibration suppression control tuning mode (advanced vibration suppression control II) This is used to set the vibration suppression control tuning. Refer to section 7.1.5 for details. <table><tr><td>Setting digit</td><td>Explanation</td><td>Initial value</td></tr><tr><td>_ _ _ x</td><td>Vibration suppression control 1 tuning mode selection Select the tuning mode of the vibration suppression control 1. 0: Disabled 1: Automatic setting 2: Manual setting</td><td>0h</td></tr><tr><td>_ _ x _</td><td>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 Function selection A-4]. 0: Disabled 1: Automatic setting 2: Manual setting</td><td>0h</td></tr><tr><td>_ x _ _</td><td>For manufacturer setting</td><td>0h</td></tr><tr><td>x _ _ _</td><td></td><td>0h</td></tr></table>	Refer to Name and function column.	
PB03	TFBGN	Torque feedback loop gain This is used to set a torque feedback loop gain in the continuous operation to torque control mode. Decreasing the setting value will also decrease a collision load during continuous operation to torque control mode. Setting a value less than 6 rad/s will be 6 rad/s.	18000 [rad/s]	0 to 18000
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.	0 [%]	0 to 100

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No.	Symbol	Name and function	Initial value [unit]	Setting range
PB06	GD2	Load to motor inertia ratio This is used to set the load to motor inertia ratio. 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. table: Pr. PA08 / This parameter _ _ _ 0 (2 gain adjustment mode 1 (interpolation mode)) — Automatic setting _ _ _ 1 (Auto tuning mode 1) — Automatic setting _ _ _ 2 (Auto tuning mode 2) — Manual setting _ _ _ 3 (Manual mode) — Manual setting _ _ _ 4 (2 gain adjustment mode 2) — Manual setting	7.00 Multiplier	0.00 to 300.00
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/or 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. table: 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) — Automatic setting _ _ _ 3 (Manual mode) — Manual setting _ _ _ 4 (2 gain adjustment mode 2) — Manual setting	15.0 [rad/s]	1.0 to 2000.0
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/or 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. table: Pr. PA08 / This parameter _ _ _ 0 (2 gain adjustment mode 1 (interpolation mode)) — Automatic setting _ _ _ 1 (Auto tuning mode 1) — Automatic setting _ _ _ 2 (Auto tuning mode 2) — Automatic setting _ _ _ 3 (Manual mode) — Manual setting _ _ _ 4 (2 gain adjustment mode 2) — Automatic setting	37.0 [rad/s]	1.0 to 2000.0
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/or 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.	823 [rad/s]	20 to 65535
PB10	VIC	Speed integral compensation This is used to 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/or 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.	33.7 [ms]	0.1 to 1000.0

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No.	Symbol	Name and function	Initial value [unit]	Setting range
PB11	VDC	Speed differential compensation This is used to set the differential compensation. To enable the parameter, select "Continuous PID control enabled (_ _ 3 _)" of "PI-PID switching control selection" in [Pr. PB24].	980	0 to 1000
PB12	OVA	Overshoot amount compensation This is used to set a viscous friction torque in percentage unit at servo motor rated speed. When the response level is low or when the torque is limited, the efficiency of the parameter may be lower.	0 [%]	0 to 100
PB13	NH1	Machine resonance suppression filter 1 Set the notch frequency of the machine resonance suppression filter 1. When you select "Automatic setting (_ _ _ 1)" of "Filter tuning mode selection" in [Pr. PB01], this parameter will be adjusted automatically. When you select "Manual setting (_ _ _ 2)" of "Filter tuning mode selection" in [Pr. PB01], the setting value will be enabled.	4500 [Hz]	10 to 4500
PB14	NHQ1	Notch shape selection 1 Set the shape of the machine resonance suppression filter 1. When you select "Automatic setting (_ _ _ 1)" of "Filter tuning mode selection" in [Pr. PB01], this parameter will be adjusted automatically. Set manually for the manual setting. <table><tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr><tr><td>_ _ _ x</td><td>For manufacturer setting</td><td>0h</td></tr><tr><td>_ _ x _</td><td>Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB</td><td>0h</td></tr><tr><td>_ x _ _</td><td>Notch width selection 0: α = 2 1: α = 3 2: α = 4 3: α = 5</td><td>0h</td></tr><tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td></tr></table>	Refer to Name and function column.	
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].	4500 [Hz]	10 to 4500
PB16	NHQ2	Notch shape selection 2 Set the shape of the machine resonance suppression filter 2. <table><tr><th>Setting digit</th><th>Explanation</th><th>Initial value</th></tr><tr><td>_ _ _ x</td><td>Machine resonance suppression filter 2 selection 0: Disabled 1: Enabled</td><td>0h</td></tr><tr><td>_ _ x _</td><td>Notch depth selection 0: -40 dB 1: -14 dB 2: -8 dB 3: -4 dB</td><td>0h</td></tr><tr><td>_ x _ _</td><td>Notch width selection 0: α = 2 1: α = 3 2: α = 4 3: α = 5</td><td>0h</td></tr><tr><td>x _ _ _</td><td>For manufacturer setting</td><td>0h</td></tr></table>	Refer to Name and function column.	

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No.	Symbol	Name and function	Initial value [unit]	Setting range
PB17	NHF	Shaft resonance suppression filter This is used for setting the shaft resonance suppression filter. This is used to suppress a low-frequency machine vibration. When you select "Automatic setting (_ _ _ 0)" of "Shaft resonance suppression filter selection" 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 "Disabled (_ _ _ 2)" in [Pr. PB23], the setting value of this parameter will be disabled. When you select "Enabled (_ _ _ 1)" of "Machine resonance suppression filter 4 selection" in [Pr. PB49], the shaft resonance suppression filter is not available.	Refer to Name and function column.	
PB18	LPF	Low-pass filter setting Set the low-pass filter. The following shows a relation of a required parameter to this parameter.	3141 [rad/s]	100 to 18000

For PB17:

Setting digit	Explanation	Initial value
_ _ x x	Shaft resonance suppression filter setting frequency selection This is used for setting the shaft resonance suppression filter. Refer to table 5.4 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 5.4 Shaft resonance suppression filter setting frequency selection

Setting value	Frequency [Hz]	Setting value	Frequency [Hz]
00	Disabled	10	562
01	Disabled	11	529
02	4500	12	500
03	3000	13	473
04	2250	14	450
05	1800	15	428
06	1500	16	409
07	1285	17	391
08	1125	18	375
09	1000	19	360
0A	900	1A	346
0B	818	1B	333
0C	750	1C	321
0D	692	1D	310
0E	642	1E	300
0F	600	1F	290

For PB18:

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

No.	Symbol	Name and function	Initial value [unit]	Setting range
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 "Automatic setting (_ _ _ 1)" in [Pr. PB02], this parameter will be set automatically. Set manually for "Manual setting (_ _ _ 2)". Refer to section 7.1.5 for details.	100.0 [Hz]	0.1 to 300.0
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 "Automatic setting (_ _ _ 1)" in [Pr. PB02], this parameter will be set automatically. Set manually for "Manual setting (_ _ _ 2)". Refer to section 7.1.5 for details.	100.0 [Hz]	0.1 to 300.0
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 "Automatic setting (_ _ _ 1)" in [Pr. PB02], this parameter will be set automatically. Set manually for "Manual setting (_ _ _ 2)". Refer to section 7.1.5 for details.	0.00	0.00 to 0.30
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 "Automatic setting (_ _ _ 1)" in [Pr. PB02], this parameter will be set automatically. Set manually for "Manual setting (_ _ _ 2)". Refer to section 7.1.5 for details.	0.00	0.00 to 0.30
PB23	VFBF	Low-pass filter selection Select the shaft resonance suppression filter and low-pass filter.		Refer to Name and function column.
PB24	*MVS	Slight vibration suppression control Select the slight vibration suppression control and PI-PID switching control.		Refer to Name and function column.

PB23 VFBF detail:

Setting digit	Explanation	Initial value
_ _ _ x	Shaft resonance suppression filter selection 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 0: Automatic setting 1: Manual setting 2: Disabled	0h
_ x _ _	For manufacturer setting	0h
x _ _ _		0h

PB24 *MVS detail:

Setting digit	Explanation	Initial value
_ _ _ x	Slight vibration suppression control selection 0: Disabled 1: Enabled To enable the slight vibration suppression control, select "Manual mode (_ _ _ 3)" of "Gain adjustment mode selection" in [Pr. PA08]. Slight vibration suppression control cannot be used in the speed control mode.	0h
_ _ x _	PI-PID switching control selection 0: PI control enabled (Switching to PID control is possible with commands of PC or PLC…etc.) 3: Continuous PID control enabled	0h
_ x _ _	For manufacturer setting	0h
x _ _ _		0h

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No.	Symbol	Name and function	Initial value [unit]	Setting range
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].	Refer to Name and function column.	
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.)	10 [kpps]/ [pulse]/ [r/min]	0 to 65535
PB28	CDT	Gain switching time constant This is used to set the time constant at which the gains will change in response to the conditions set in [Pr. PB26] and [Pr. PB27].	1 [ms]	0 to 100
PB29	GD2B	Load to motor inertia ratio after gain switching This is used to set the load to motor inertia ratio to motor mass ratio when gain switching is enabled. This parameter is enabled only when you select "Manual mode (_ _ _ 3)" of "Gain adjustment mode selection" in [Pr. PA08].	7.00 [Multiplier]	0.00 to 300.00
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 you select "Manual mode (_ _ _ 3)" of "Gain adjustment mode selection" in [Pr. PA08].	0.0 [rad/s]	0.0 to 2000.0
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 you select "Manual mode (_ _ _ 3)" of "Gain adjustment mode selection" in [Pr. PA08].	0 [rad/s]	0 to 65535
PB32	VICB	Speed integral compensation 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 you select "Manual mode (_ _ _ 3)" of "Gain adjustment mode selection" in [Pr. PA08].	0.0 [ms]	0.0 to 5000.0
PB33	VRF11B	Vibration suppression control 1 - Vibration frequency after gain switching Set the vibration 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. 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 "Control command from PC or PLC…etc is enabled (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops.	0.0 [Hz]	0.0 to 300.0

Inner table for PB26:

Setting digit	Explanation	Initial value
_ _ _ x	Gain switching selection 0: Disabled 1: Control command from PC or PLC…etc is enabled 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 _ _	For manufacturer setting	0h
x _ _ _		0h

SMC

No.	Symbol	Name and function	Initial value [unit]	Setting range
PB34	VRF12B	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 "Control command from PC or PLC…etc is enabled (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops.	0.0 [Hz]	0.0 to 300.0
PB35	VRF13B	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 "Control command from PC or PLC…etc is enabled (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops.	0.00	0.00 to 0.30
PB36	VRF14B	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 "Control command from PC or PLC…etc is enabled (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops.	0.00	0.00 to 0.30

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No.	Symbol	Name and function	Initial value [unit]	Setting range
PB45	CNHF	Command notch filter Set the command notch filter.	Refer to Name and function column.	

Setting digit	Explanation	Initial value
_ _ x x	Command notch filter setting frequency selection Refer to table 5.5 for the relation of setting values to frequency.	00h
_ x _ _	Notch depth selection Refer to table 5.6 for details.	0h
x _ _ _	For manufacturer setting	0h

Table 5.5 Command notch filter setting frequency selection

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
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

No.	Symbol	Name and function					Initial value [unit]	Setting range
PB45	CNHF	Table 5.6 Notch depth selection					Refer to Name and function column.	
		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		
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].					4500 [Hz]	10 to 4500
PB47	NHQ3	Notch shape selection 3 Set the shape of the machine resonance suppression filter 3.					Refer to Name and function column.	

PB47 (continued):

Setting digit	Explanation	Initial value
_ _ _ 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

No.	Symbol	Name and function	Initial value [unit]	Setting range
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].	4500 [Hz]	10 to 4500

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No.	Symbol	Name and function			Initial value [unit]	Setting range
PB49	NHQ4	Notch shape selection 4 Set the shape of the machine resonance suppression filter 4. 	Setting digit	Explanation	Initial value
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_ _ _ 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: α = 2 1: α = 3 2: α = 4 3: α = 5	0h
x _ _ _	For manufacturer setting	0h				Refer to Name and function column.	
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].			4500 [Hz]	10 to 4500
PB51	NHQ5	Notch shape selection 5 Set the shape 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. 	Setting digit	Explanation	Initial value
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_ _ _ 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				Refer to Name and function column.	
PB52	VRF21	Vibration suppression control 2 - Vibration frequency Set the vibration frequency for vibration suppression control 2 to suppress low-frequency machine vibration. To enable this, select "3 inertia mode (_ _ _ 1)" of "Vibration suppression mode selection" in [Pr. PA24]. When "Vibration suppression control 2 tuning mode selection" is "Automatic setting (_ _ 1 _)" in [Pr. PB02], this parameter will be set automatically. Set manually for "Manual setting (_ _ 2 _)".			100.0 [Hz]	0.1 to 300.0

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No.	Symbol	Name and function	Initial value [unit]	Setting range
PB53	VRF22	Vibration suppression control 2 - Resonance frequency Set the resonance frequency for vibration suppression control 2 to suppress low-frequency machine vibration. To enable this, select "3 inertia mode (_ _ _ 1)" of "Vibration suppression mode selection" in [Pr. PA24]. When "Vibration suppression control 2 tuning mode selection" is "Automatic setting (_ _ 1 _)" in [Pr. PB02], this parameter will be set automatically. Set manually for "Manual setting (_ _ 2 _)".	100.0 [Hz]	0.1 to 300.0
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. To enable this, select "3 inertia mode (_ _ _ 1)" of "Vibration suppression mode selection" in [Pr. PA24]. When "Vibration suppression control 2 tuning mode selection" is "Automatic setting (_ _ 1 _)" in [Pr. PB02], this parameter will be set automatically. Set manually for "Manual setting (_ _ 2 _)".	0.00	0.00 to 0.30
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. To enable this, select "3 inertia mode (_ _ _ 1)" of "Vibration suppression mode selection" in [Pr. PA24]. When "Vibration suppression control 2 tuning mode selection" is "Automatic setting (_ _ 1 _)" in [Pr. PB02], this parameter will be set automatically. Set manually for "Manual setting (_ _ 2 _)".	0.00	0.00 to 0.30
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. To enable this, select "3 inertia mode (_ _ _ 1)" of "Vibration suppression mode selection" in [Pr. PA24]. 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 2 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ 2 _)". · "Gain switching selection" in [Pr. PB26] is "Control command from PC or PLC…etc is enabled (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops.	0.0 [Hz]	0.0 to 300.0
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. To enable this, select "3 inertia mode (_ _ _ 1)" of "Vibration suppression mode selection" in [Pr. PA24]. 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 2 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ 2 _)". · "Gain switching selection" in [Pr. PB26] is "Control command from PC or PLC…etc is enabled (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops.	0.0 [Hz]	0.0 to 300.0

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No.	Symbol	Name and function	Initial value [unit]	Setting range
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. To enable this, select "3 inertia mode (_ _ _ 1)" of "Vibration suppression mode selection" in [Pr. PA24]. 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 2 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ 2 _)". ・"Gain switching selection" in [Pr. PB26] is "Control command from PC or PLC…etc is enabled (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops.	0.00	0.00 to 0.30
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. To enable this, select "3 inertia mode (_ _ _ 1)" of "Vibration suppression mode selection" in [Pr. PA24]. 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 2 tuning mode selection" in [Pr. PB02] is "Manual setting (_ _ 2 _)". ・"Gain switching selection" in [Pr. PB26] is "Control command from PC or PLC…etc is enabled (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops.	0.00	0.00 to 0.30
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 "Control command from PC or PLC…etc is enabled (_ _ _ 1)". Switching during driving may cause a shock. Be sure to switch them after the servo motor stops.	0.0 [rad/s]	0.0 to 2000.0

5. PARAMETERS

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

No.	Symbol	Name and function	Initial value [unit]	Setting range
PC01	ERZ	Error excessive alarm level Set an error excessive alarm level. Set this per rev. for servo motors. Setting "0" will be 3 rev. Setting over 200 rev will be clamped with 200 rev. Note. Setting can be changed in [Pr. PC06].	0 [rev] (Note)	0 to 1000
PC02	MBR	Electromagnetic brake sequence output This is used to set the delay time between MBR (Electromagnetic brake interlock) and the base drive circuit is shut-off.	0 [ms]	0 to 1000
PC03	*ENRS	Encoder output pulse selection This is used to select the encoder pulse direction and encoder output pulse setting.	Refer to Name and function column.	

PC03 *ENRS — Encoder output pulse selection

Setting digit	Explanation	Initial value
_ _ _ x	Encoder output pulse phase selection 0: Increasing A-phase 90° in CCW or positive direction 1: Increasing A-phase 90° in CW or negative direction	0h

Setting value	Servo motor rotation direction	
	CCW or positive direction	CW or negative direction
0	A-phase ⌐_⌐_⌐_⌐ B-phase _⌐_⌐_⌐	A-phase ⌐_⌐_⌐_ B-phase ⌐_⌐_⌐_
1	A-phase ⌐_⌐_⌐_ B-phase ⌐_⌐_⌐_	A-phase ⌐_⌐_⌐_ B-phase _⌐_⌐_⌐

Setting digit	Explanation	Initial value
_ _ x _	Encoder output pulse setting selection 0: Output pulse setting (When "_ 1 0 _" is set to this parameter, [AL. 37 Parameter error] will occur.) 1: Division ratio setting 3: A-phase/B-phase pulse electronic gear setting	0h
_ x _ _	Selection of the encoders for encoder output pulse This is used for selecting an encoder for driver output. 0: Servo motor encoder (Do not change this value.)	0h
x _ _ _	For manufacturer setting	0h

5. PARAMETERS

No.	Symbol	Name and function			Initial value [unit]	Setting range
PC04	**COP1	Function selection C-1 Select the encoder cable communication method selection.			Refer to Name and function column.	
		Setting digit	Explanation	Initial value		
		_ _ _ x	For manufacturer setting	0h		
		_ _ x _		0h		
		_ x _ _		0h		
		x _ _ _	Encoder cable communication method selection 0: Two-wire type (Do not change this value.)	0h		
PC05	**COP2	Function selection C-2 This is used to select the motor-less operation.			Refer to Name and function column.	
		Setting digit	Explanation	Initial value		
		_ _ _ x	Motor-less operation selection 0: Disabled 1: Enabled	0h		
		_ _ x _	For manufacturer setting	0h		
		_ x _ _		0h		
		x _ _ _		0h		
PC06	*COP3	Function selection C-3 Select the error excessive alarm level setting for [Pr. PC01]. The parameter is not available in the speed control mode and torque control mode.			Refer to Name and function column.	
		Setting digit	Explanation	Initial value		
		_ _ _ x	For manufacturer setting	0h		
		_ _ x _		0h		
		_ x _ _		0h		
		x _ _ _	Error excessive alarm level unit selection 0: Per 1 rev 1: Per 0.1 rev 2: Per 0.01 rev 3: Per 0.001 rev	0h		
PC07	ZSP	Zero speed Used to set the output range of ZSP (Zero speed detection). ZSP (Zero speed detection) has hysteresis of 20 r/min or 20 mm/s.			50 [r/min]	0 to 10000
PC08	OSL	Overspeed alarm detection level This is used to set an overspeed alarm detection level. When you set a value more than "servo motor maximum speed × 120%" , the set value will be clamped. When you set "0", the value of "servo motor maximum speed × 120%" will be set.			0 [r/min]	0 to 20000

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5. PARAMETERS

No.	Symbol	Name and function	Initial value [unit]	Setting range
PC09	MOD1	Analog monitor 1 output Select a signal to output to MO1 (Analog monitor 1).	Refer to Name and function column.	

Within the Name and function cell:

Setting digit	Explanation	Initial value
_ _ x x	Analog monitor 1 output selection Refer to table 5.7 for settings.	00h
_ x _ _	For manufacturer setting	0h
x _ _ _		0h

Table 5.7 Analog monitor setting value

Setting value	Item	Setting
00	Servo motor speed (±8 V/max. speed)	○
01	Torque (±8 V/max. torque)	○
02	Servo motor speed (+8V/max. speed)	○
03	Torque (+8 V/max. torque)	○
04	Current command (±8 V/max. current command)	○
05	Speed command (±8 V/max. speed)	○
06	Servo motor-side droop pulses (±10 V/100 pulses) (Note 1)	○
07	Servo motor-side droop pulses (±10 V/1000 pulses) (Note 1)	○
08	Servo motor-side droop pulses (±10 V/10000 pulses) (Note 1)	○
09	Servo motor-side droop pulses (±10 V/100000 pulses) (Note 1)	○
0A	Feedback position (±10 V/1 Mpulses) (Note 1)	○
0B	Feedback position (±10 V/10 Mpulses) (Note 1)	○
0C	Feedback position (±10 V/100 Mpulses) (Note 1)	○
0D	Bus voltage (+8 V/400 V, 200 V drivers)	○
0E	Speed command 2 (±8 V/max. speed)	○
15	Servo motor-side position deviation (±10 V/100000 pulses)	
16	Servo motor-side speed deviation (±8 V/max. speed)	
17	Encoder inside temperature (±10 V/±128 ˚C)	○

Note 1. Encoder pulse unit

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No.	Symbol	Name and function				Initial value [unit]	Setting range
PC10	MOD2	Analog monitor 2 output Select a signal to output to MO2 (Analog monitor 2).				Refer to Name and function column.	
			Setting digit	Explanation	Initial value		
			_ _ x x	Analog monitor 2 output selection Refer to [Pr. PC09] for settings.	01h		
			_ x _ _	For manufacturer setting	0h		
			x _ _ _		0h		
PC11	MO1	Analog monitor 1 offset This is used to set the offset voltage of MO1 (Analog monitor 1).				0 [mV]	-999 to 999
PC12	MO2	Analog monitor 2 offset This is used to set the offset voltage of MO2 (Analog monitor 2).				0 [mV]	-999 to 999
PC13	MOSDL	Analog monitor - Feedback position output standard data - Low Set a monitor output standard position (lower 4 digits) for the feedback position for when selecting "Feedback position" for MO1 (Analog monitor 1) and MO2 (Analog monitor 2). Monitor output standard position = [Pr. PC14] setting × 10000 + [Pr. PC13] setting				0 [pulse]	-9999 to 9999
PC14	MOSDH	Analog monitor - Feedback position output standard data - High Set a monitor output standard position (higher 4 digits) for the feedback position for when selecting "Feedback position" for MO1 (Analog monitor 1) and MO2 (Analog monitor 2). Monitor output standard position = [Pr. PC14] setting × 10000 + [Pr. PC13] setting				0 [10000 pulses]	-9999 to 9999
PC17	**COP4	Function selection C-4 This is used to select a home position setting condition.				Refer to Name and function column.	
			Setting digit	Explanation	Initial value		
			_ _ _ x	Selection of home position setting condition 0: Need to pass servo motor Z-phase after power on 1: Not need to pass servo motor Z-phase after power on	0h		
			_ _ x _	For manufacturer setting	0h		
			_ x _ _		0h		
			x _ _ _		0h		
PC18	*COP5	Function selection C-5 This is used to select an occurring condition of [AL. E9 Main circuit off warning].				Refer to Name and function column.	
			Setting digit	Explanation	Initial value		
			_ _ _ x	For manufacturer setting	0h		
			_ _ x _		0h		
			_ x _ _		0h		
			x _ _ _	[AL. E9 Main circuit off warning] selection 0: Detection with ready-on and servo-on command 1: Detection with servo-on command	0h		

No.	Symbol	Name and function	Initial value [unit]	Setting range
PC20	*COP7	Function selection C-7 This is used to select an undervoltage alarm detection method. | Setting digit	Explanation	Initial value
---	---	---
_ _ _ x	[AL. 10 Undervoltage] detection method selection This is set when FR-RC (Mitsubishi Electric Corporation) is used and if [AL. 10 undervoltage] occurs due to distorted power supply voltage waveform. 0: [AL. 10] not occurrence 1: [AL. 10] occurrence	0h
_ _ x _	For manufacturer setting	0h
_ x _ _		0h
x _ _ _		0h		Refer to Name and function column.	
PC21	*BPS	Alarm history clear Used to clear the alarm history. | Setting digit	Explanation	Initial value
---	---	---
_ _ _ x	Alarm history clear selection 0: Disabled 1: Enabled When you select "Enabled", the alarm history will be cleared at next power-on. After the alarm history is cleared, the setting is automatically disabled.	0h
_ _ x _	For manufacturer setting	0h
_ x _ _		0h
x _ _ _		0h		Refer to Name and function column.	
PC24	RSBR	Forced stop deceleration time constant This is used to 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. [Precautions] ・If the servo motor torque is saturated at the maximum torque 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. ・Set a longer time than deceleration time at quick stop of the PC or PLC…etc. If a shorter time is set, [AL. 52 Error excessive] may occur.	100 [ms]	0 to 20000

No.	Symbol	Name and function				Initial value [unit]	Setting range
PC26	**COP8	Function selection C-8				Refer to Name and function column.	
			Setting digit	Explanation	Initial value		
			_ _ _ x	For manufacturer setting	0h		
			_ _ x _		0h		
			_ x _ _		0h		
			x _ _ _	Load-side encoder communication method 0: Two-wire type (Do not change this value.)	0h		
PC27	**COP9	Function selection C-9 (Do not change this value.)				Refer to Name and function column.	
PC29	*COPB	Function selection C-B This is used to select the POL reflection at torque control.				Refer to Name and function column.	
			Setting digit	Explanation	Initial value		
			_ _ _ x	For manufacturer setting	0h		
			_ _ x _		0h		
			_ x _ _		0h		
			x _ _ _	POL reflection selection at torque control 0: Enabled 1: Disabled	0h		

No.	Symbol	Name and function	Initial value [unit]	Setting range
PC31	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 a positive value is set, compensation is performed to the address increasing direction. When a negative value is set, compensation is performed to the address decreasing 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) was enabled in [Pr. PD07] to [Pr. PD09], and the base circuit shut-off delay time was set in [Pr. PC16].	0 [0.0001 rev]	-25000 to 25000

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

No.	Symbol	Name and function	Initial value [unit]	Setting range
PD02	*DIA2	Input signal automatic on selection 2	Refer to Name and function column.	

Setting digit		Explanation	Initial value
HEX.	BIN.		
_ _ _ x	_ _ _ x	FLS (Upper stroke limit) selection 0: Disabled 1: Enabled	0h
	_ _ x _	RLS (Lower stroke limit) selection 0: Disabled 1: Enabled	
	_ x _ _	For manufacturer setting	
	x _ _ _		
_ _ x _		For manufacturer setting	0h
_ x _ _			0h
x _ _ _			0h

Convert the setting value into hexadecimal as follows.

Signal name	Initial value	
	BIN	HEX
FLS (Upper stroke limit) selection	0	
RLS (Lower stroke limit) selection	0	0
	0	
	0	

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

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No.	Symbol	Name and function		Initial value [unit]	Setting range
PD07	*DO1	Output device selection 1 You can assign any output device to the CN3-13 pin.		Refer to Name and function column.	
			Setting digit	Explanation	Initial value
			_ _ x x	Device selection Refer to table 5.8 for settings.	05h
			_ x _ _	For manufacturer setting	0h
			x _ _ _		0h
		Table 5.8 Selectable output devices			
			Setting value	Output device	
			00	Always off	
			02	RD (Ready)	
			03	ALM (Malfunction)	
			04	INP (In-position)	
			05	MBR (Electromagnetic brake interlock)	
			06	DB (Dynamic brake interlock)	
			07	TLC (Limiting torque)	
			08	WNG (Warning)	
			09	BWNG (Battery warning)	
			0A	SA (Speed reached)	
			0C	ZSP (Zero speed detection)	
			0F	CDPS (Variable gain selection)	
			11	ABSV (Absolute position undetermined)	
			17	MTTR (During tough drive)	
PD08	*DO2	Output device selection 2 You can assign any output device to the CN3-9 pin. INP (In-position) is assigned as the initial value. The devices that can be assigned and the setting method are the same as in [Pr. PD07].		Refer to Name and function column.	
			Setting digit	Explanation	Initial value
			_ _ x x	Device selection Refer to table 5.8 in [Pr. PD07] for settings.	04h
			_ x _ _	For manufacturer setting	0h
			x _ _ _		0h
PD09	*DO3	Output device selection 3 You can assign any output device to the CN3-15 pin. ALM (Malfunction) is assigned as the initial value. The devices that can be assigned and the setting method are the same as in [Pr. PD07].		Refer to Name and function column.	
			Setting digit	Explanation	Initial value
			_ _ x x	Device selection Refer to table 5.8 in [Pr. PD07] for settings.	03h
			_ x _ _	For manufacturer setting	0h
			x _ _ _		0h

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No.	Symbol	Name and function			Initial value [unit]	Setting range
PD12	*DOP1	Function selection D-1			Refer to Name and function column.	
		Setting digit	Explanation	Initial value		
		_ _ _ x	For manufacturer setting	0h		
		_ _ x _		0h		
		_ x _ _		0h		
		x _ _ _	Servo motor thermistor enabled/disabled selection (Supported by drivers with software version A5 or above.) 0: Enabled 1: Disabled For servo motors without thermistor, the setting will be disabled.	0h		
PD14	*DOP3	Function selection D-3			Refer to Name and function column.	
		Setting digit	Explanation	Initial value		
		_ _ _ x	For manufacturer setting	0h		
		_ _ x _	Selection of output device at warning occurrence Select WNG (Warning) and ALM (Malfunction) output status at warning occurrence. Driver output 	Setting value	(Note 1) Device status
0	WNG 1/0, ALM 1/0 — Warning occurrence
1	WNG 1/0, ALM 1/0 — Warning occurrence (Note 2)	 Note 1. 0: Off 1: On 2. Although ALM is turned off upon occurrence of the warning, the forced stop deceleration is performed.	0h		
		_ x _ _	For manufacturer setting	0h		
		x _ _ _		0h		

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5. PARAMETERS

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

No.	Symbol	Name and function	Initial value [unit]	Setting range
PE01	**FCT1	Fully closed loop function selection 1 (Do not change this value.)	0000h	0000h
PE03	*FCT2	Fully closed loop function selection 2 (Do not change this value.)	0003h	0003h
PE04	**FBN	Fully closed loop control - Feedback pulse electronic gear 1 - Numerator (Do not change this value.)	1	1
PE05	**FBD	Fully closed loop control - Feedback pulse electronic gear 1 - Denominator (Do not change this value.)	1	1
PE06	BC1	Fully closed loop control - Speed deviation error detection level (Do not change this value.)	400 [r/min]	400 [r/min]
PE07	BC2	Fully closed loop control - Position deviation error detection level (Do not change this value.)	100 [kpulse]	100 [kpulse]
PE08	DUF	Fully closed loop dual feedback filter (Do not change this value.)	10 [rad/s]	10 [rad/s]
PE10	FCT3	Fully closed loop function selection 3 (Do not change this value.)	0000h	0000h
PE34	**FBN2	Fully closed loop control - Feedback pulse electronic gear 2 - Numerator (Do not change this value.)	1	1
PE35	**FBD2	Fully closed loop control - Feedback pulse electronic gear 2 - Denominator (Do not change this value.)	1	1
PE41	EOP3	Function selection E-3 (see sub-table below)	Refer to Name and function column.	

Sub-table for PE41 (EOP3) Function selection E-3:

Setting digit	Explanation	Initial value
_ _ _ 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

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

No.	Symbol	Name and function	Initial value [unit]	Setting range
PF06	*FOP5	Function selection F-5 <table><tr><td>Setting digit</td><td>Explanation</td><td>Initial value</td></tr><tr><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><td>Series</td><td>Servo motor</td></tr><tr><td>LE-□-□</td><td>LE-T5-□/ LE-T6-□/ LE-T7-□/ LE-T8-□</td></tr></table></td><td>0h</td></tr><tr><td>_ _ x _</td><td>For manufacturer setting</td><td>0h</td></tr><tr><td>_ x _ _</td><td></td><td>0h</td></tr><tr><td>x _ _ _</td><td></td><td>0h</td></tr></table>	Refer to Name and function column.	
PF12	DBT	Electronic dynamic brake operating time Set a operating time for the electronic dynamic brake.	2000 [ms]	0 to 10000
PF21	DRT	Drive recorder switching time setting This is used to set a drive recorder switching time. When a USB communication is cut during using a graph function, 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. However, when "0" is set, it will switch after 600 s. When "-1" is set, the drive recorder function is disabled.	0 [s]	-1 to 32767
PF23	OSCL1	Vibration tough drive - Oscillation detection level This is used to 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. Example: When you set "50" to the parameter, the filter will be readjusted at the time of 50% or more oscillation level.	50 [%]	0 to 100
PF24	*OSCL2	Vibration tough drive function selection <table><tr><td>Setting digit</td><td>Explanation</td><td>Initial value</td></tr><tr><td>_ _ _ x</td><td>Oscillation detection alarm selection 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 Select alarm or warning when a 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].</td><td>0h</td></tr><tr><td>_ _ x _</td><td>For manufacturer setting</td><td>0h</td></tr><tr><td>_ x _ _</td><td></td><td>0h</td></tr><tr><td>x _ _ _</td><td></td><td>0h</td></tr></table>	Refer to Name and function column.	
PF25	CVAT	SEMI-F47 function - Instantaneous power failure detection time (instantaneous power failure tough drive - detection time) Set the time of the [AL. 10.1 Voltage drop in the control circuit power] occurrence. To disable the parameter, select "Disabled (_ 0 _ _)" of "SEMI-F47 function selection (instantaneous power failure tough drive selection)" in [Pr. PA20].	200 [ms]	30 to 200

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No.	Symbol	Name and function	Initial value [unit]	Setting range
PF31	FRIC	Machine diagnosis function - Friction judgement speed Set a servo motor speed to divide a friction estimation area into high and low for the friction estimation process of the machine diagnosis. However, setting "0" will be the value half of the rated speed. When your operation pattern is under rated speed, we recommend that you set half value to the maximum speed with this. Maximum speed in operation Forward rotation direction ↑ [Pr. PF31] setting Servo motor speed 0 r/min Operation pattern Reverse rotation direction ↓	0 [r/min]	0 to permiss-ible speed

5.2.7 Extension setting 4 parameters ([Pr. PL_ _])

No.	Symbol	Name and function	Initial value [unit]	Setting range
PL01	**LIT1	Linear servo motor/DD motor function selection 1 (Do not change this value.)	0301h	0301h
PL02	**LIM	Linear encoder resolution - Numerator (Do not change this value.)	1000 [μm]	1000 [μm]
PL03	**LID	Linear encoder resolution - Denominator (Do not change this value.)	1000 [μm]	1000 [μm]
PL04	*LIT2	Linear servo motor/DD motor function selection 2 (Do not change this value.)	0003h	0003h
PL05	LB1	Position deviation error detection level (Do not change this value.)	0 [0.01rev]	0 [0.01rev]
PL06	LB2	Speed deviation error detection level (Do not change this value.)	0 [r/min]	0 [r/min]
PL07	LB3	Torque/thrust deviation error detection level (Do not change this value.)	100 [%]	100 [%]
PL08	*LIT3	Linear servo motor/DD motor function selection 3 (Do not change this value.)	0010h	0010h
PL09	LPWM	Magnetic pole detection voltage level (Do not change this value.)	30 [%]	30 [%]
PL17	LTSTS	Magnetic pole detection - Minute position detection method - Function selection (Do not change this value.)	0000h	0000h
PL18	IDLV	Magnetic pole detection - Minute position detection method - Identification signal amplitude (Do not change this value.)	0 [%]	0 [%]

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6. NORMAL GAIN ADJUSTMENT

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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.

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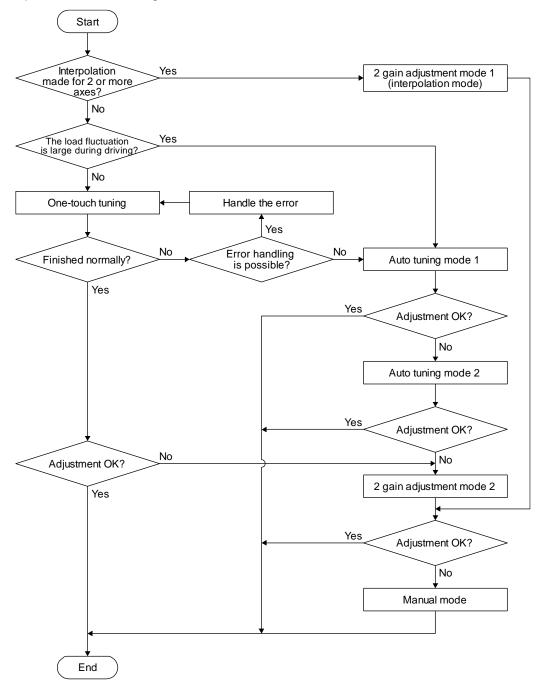
The following table shows the gain adjustment modes that can be set on a single driver. For gain adjustment, first execute "Auto tuning mode 1". If you are not satisfied with the result of the adjustment, execute "Auto tuning mode 2" and "Manual mode" in this order.

(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])

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(2) Adjustment sequence and mode usage

```
                              ┌─────────┐
                              │  Start  │
                              └─────────┘
                                   │
                    ┌──────────────────────────┐
                    │ Interpolation             │ Yes        ┌────────────────────────┐
                    │ made for 2 or more ───────────────────▶│ 2 gain adjustment mode 1│
                    │ axes?                     │            │ (interpolation mode)    │
                    └──────────────────────────┘            └────────────────────────┘
                              │ No
                    ┌──────────────────────────┐
                    │ The load fluctuation      │ Yes
                    │ is large during driving? ─────────────┐
                    └──────────────────────────┘            │
                              │ No                          │
              ┌────────────────────┐    ┌──────────────────┐│
              │ One-touch tuning   │◀───│ Handle the error ││
              └────────────────────┘    └──────────────────┘│
                        │                        ▲ Yes       │
            ┌───────────────────┐  No  ┌──────────────────┐ No ┌────────────────────┐
            │ Finished normally?├─────▶│ Error handling   ├───▶│ Auto tuning mode 1 │
            └───────────────────┘      │ is possible?     │    └────────────────────┘
                      │ Yes            └──────────────────┘           │
                      │                                     ┌───────────────────┐
                      │                          Yes        │ Adjustment OK?    │
                      │                      ┌──────────────┤                   │
                      │                      │              └───────────────────┘
                      │                      │                      │ No
                      │                      │              ┌────────────────────┐
                      │                      │              │ Auto tuning mode 2 │
                      │                      │              └────────────────────┘
                      │                      │                      │
                      │                      │          Yes ┌───────────────────┐
                      │                      │         ┌────┤ Adjustment OK?    │
            ┌───────────────────┐  No        │         │    └───────────────────┘
            │ Adjustment OK?    ├────────────┤         │           │ No
            └───────────────────┘            │         │   ┌────────────────────┐
                      │ Yes                  │         │   │ 2 gain adjustment   │
                      │                      │         │   │ mode 2             │
                      │                      │         │   └────────────────────┘
                      │                      │         │           │
                      │                      │    Yes  │   ┌───────────────────┐
                      │                      │    ◀────────┤ Adjustment OK?    │
                      │                      │         │   └───────────────────┘
                      │                      │         │           │ No
                      │                      │         │   ┌────────────────────┐
                      │                      │         │   │ Manual mode        │
                      │                      │         │   └────────────────────┘
                      │                      └─────────┴───────────┘
                 ┌─────────┐
                 │   End   │
                 └─────────┘
```

6.1.2 Adjustment using setup software (MR Configurator2™)

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

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.

SMC

6.2 One-touch tuning

Connect setup software (MR Configurator2™) and open the one-touch tuning window, and you can use the function. The following parameters are set automatically with one-touch tuning.
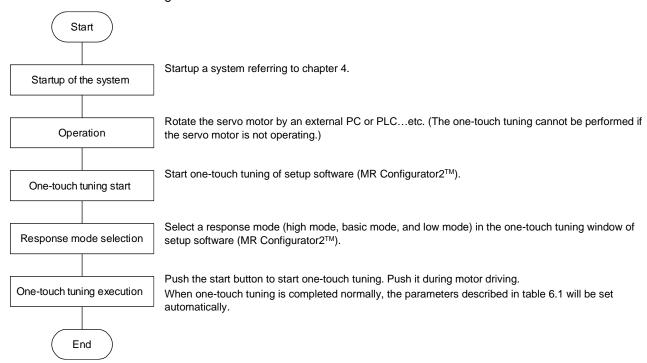
Table 6.1 List of parameters automatically set with one-touch tuning

Parameter	Symbol	Name	Parameter	Symbol	Name
PA08	ATU	Auto tuning mode	PB16	NHQ2	Notch shape selection 2
PA09	RSP	Auto tuning response	PB18	LPF	Low-pass filter setting
PB01	FILT	Adaptive tuning mode (adaptive filter II)	PB19	VRF11	Vibration suppression control 1 - Vibration frequency
PB02	VRFT	Vibration suppression control tuning mode (advanced vibration suppression control II)	PB20	VRF12	Vibration suppression control 1 - Resonance frequency
PB06	GD2	Load to motor inertia ratio	PB21	VRF13	Vibration suppression control 1 - Vibration frequency damping
PB07	PG1	Model loop gain	PB22	VRF14	Vibration suppression control 1 - Resonance frequency damping
PB08	PG2	Position loop gain			
PB09	VG2	Speed loop gain	PB23	VFBF	Low-pass filter selection
PB10	VIC	Speed integral compensation	PB47	NHQ3	Notch shape selection 3
PB12	OVA	Overshoot amount compensation	PB48	NH4	Machine resonance suppression filter 4
PB13	NH1	Machine resonance suppression filter 1	PB49	NHQ4	Notch shape selection 4
PB14	NHQ1	Notch shape selection 1	PB51	NHQ5	Notch shape selection 5
PB15	NH2	Machine resonance suppression filter 2	PE41	EOP3	Function selection E-3

6.2.1 One-touch tuning flowchart
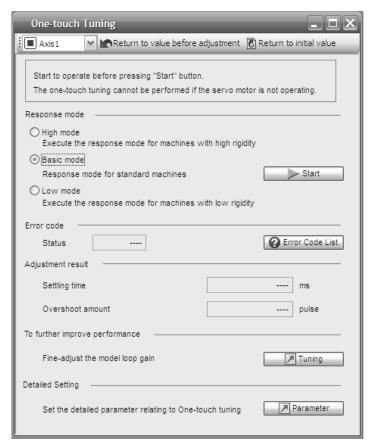
Make one-touch tuning as follows.

```
      ( Start )
          |
          |
[ Startup of the system ]      Startup a system referring to chapter 4.
          |
          |
[ Operation ]                  Rotate the servo motor by an external PC or PLC…etc. (The one-touch tuning cannot be performed if
                               the servo motor is not operating.)
          |
          |
[ One-touch tuning start ]     Start one-touch tuning of setup software (MR Configurator2™).
          |
          |
[ 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 ] Push the start button to start one-touch tuning. Push it during motor driving.
                               When one-touch tuning is completed normally, the parameters described in table 6.1 will be set
                               automatically.
          |
          |
       ( End )
```

6.2.2 Display transition and operation procedure of one-touch tuning
  (1) Response mode selection

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

One-touch Tuning
Axis1   Return to value before adjustment   Return to initial value
Start to operate before pressing "Start" button.
The one-touch tuning cannot be performed if the servo motor is not operating.
Response mode
○ High mode
Execute the response mode for machines with high rigidity
⊙ Basic mode
Response mode for standard machines   ▶ Start
○ Low mode
Execute the response mode for machines with low rigidity
Error code
Status   ----   Error Code List
Adjustment result
Settling time   ----   ms
Overshoot amount   ----   pulse
To further improve performance
Fine-adjust the model loop gain   ↗ Tuning
Detailed Setting
Set the detailed parameter relating to One-touch tuning   ↗ Parameter

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.
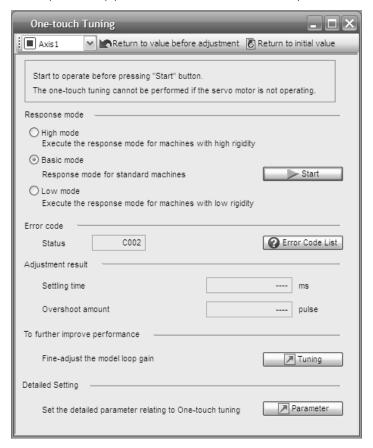
Response mode			Response	Machine characteristic
Low mode	Basic mode	High mode		Guideline of corresponding machine
			Low response	
				Arm robot, General machine tool conveyor, Precision working machine, Inserter Mounter Bonder
			High response	
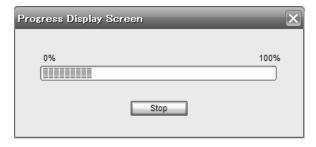
POINT
● For equipment in which overshoot during one-touch tuning is in the permissible
level of the in-position range, changing the value of [Pr. PA25 One-touch tuning -
Overshoot permissible level] will shorten the settling time and improve the
response.

(2) One-touch tuning execution
After the response mode is selected in (1), pushing the start button during driving will start one-
touch tuning. If the start button is pushed while the motor stops, "C 0 0 2" or "C 0 0 4" will be
displayed at status in error code. (Refer to (4) in this section for error codes.)

During processing of one-touch tuning, the status will be displayed in the progress window as
follows. One-touch tuning will be finished at 100%.

Completing the one-touch tuning starts writing tuning parameters to the driver. "0 0 0 0" is displayed
at status in error code. In addition, settling time and overshoot amount will be displayed in
"Adjustment result" after adjustment.

(3) One-touch tuning execution

During one-touch tuning, pushing the stop button stops one-touch tuning.

If the one-touch tuning is stopped, "C 0 0 0" will be displayed at status in error code.

(4) If an error occur

If a tuning error occurs during tuning, one-touch tuning will be forcibly terminated. With that, the following error code will be displayed in status. Check the cause of tuning error.

Error code	Name	Description	Action
C000	Tuning canceled	The stop button was pushed during one-touch tuning.	
C001	Overshoot exceeded	The overshoot amount is lager than the value set in [Pr. PA10 In-position range].	Increase the in-position range.
C002	Servo-off during tuning	The one-touch tuning was attempted during servo-off.	Perform the one-touch tuning after servo-on.
C003	Control mode error	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 from the PC or PLC…etc, and then make one-touch tuning.
C004	Time-out	1. 1 cycle time during the operation has been over 30 s.	Set the 1 cycle time during the operation to 30 s or less.
		2. The command speed is low.	Set the servo motor speed to100 r/min or higher.
		3. The operation interval of the continuous operation is short.	Maintain the operation interval during motor driving about 200 ms.
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/deceleration time constant to reach 2000 r/min is 5 s or less. ・Speed is 150 r/min or higher. ・The load to servo 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 such as an oscillation.	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] properly with manual setting.
C00F	One-touch tuning disabled	"One-touch tuning function selection" in [Pr. PA21] is "Disabled (_ _ _ 0)"	Select "Enabled (_ _ _ 1)".

(5) If an alarm occur

If an alarm occurs during tuning, one-touch tuning will be forcibly terminated.

Remove the cause of the alarm and execute one-touch tuning again.

(6) If a warning occur

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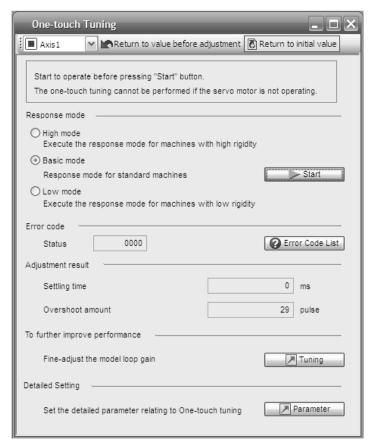
If a warning which does not continue the motor driving occurs during the tuning, one-touch tuning will be stopped.

(7) Clearing one-touch tuning

You can clear the parameter values set with one-touch tuning.

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

Pushing "Return to value before adjustment" in the one-touch tuning window of setup software (MR Configurator2™) enables to rewrite the parameter to the value before pushing the start button.

In addition, pushing "Return to initial value" in the one-touch tuning window enables to rewrite the parameter to the initial value.

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

6.2.3 Caution for one-touch tuning

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

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

(3) The tuning is not available during the following test operation mode.

   (a) Output signal (DO) forced output

   (b) Motor-less operation

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 is 5 s or less.
- ・Speed is 150 r/min or higher.
- ・The load to servo 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
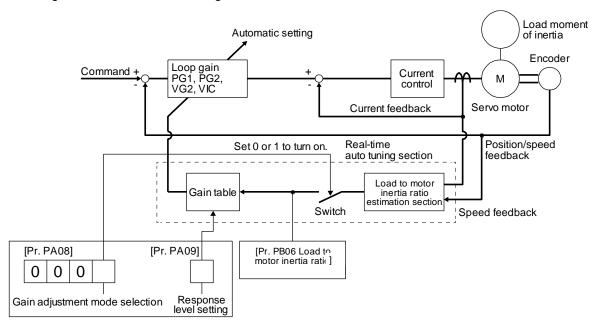
Use the auto tuning mode 2 when proper gain adjustment cannot be made by auto tuning mode 1.

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 Configurator2™).

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 or load to motor mass 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.
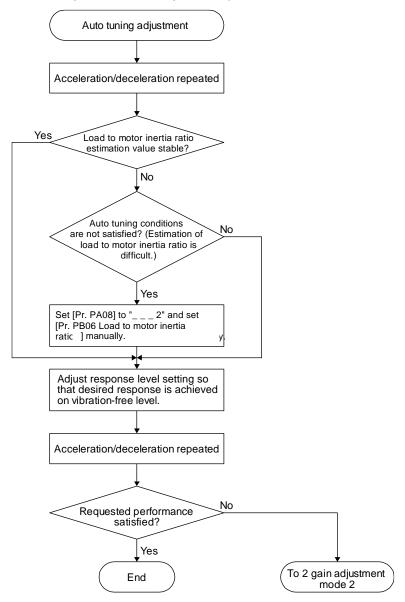
The auto tuning results are saved in the EEP-ROM of the driver every 60 minutes since power-on. At power-on, auto tuning is performed with the value of each loop gain saved in the EEP-ROM being used as an initial value.

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.

```
          ┌─────────────────────────────┐
          │   Auto tuning adjustment    │
          └─────────────┬───────────────┘
                        │
          ┌─────────────▼───────────────┐
          │ Acceleration/deceleration   │
          │         repeated            │
          └─────────────┬───────────────┘
                        │
  Yes          ◇ Load to motor inertia ratio
  ◄──────────── estimation value stable? ◇
                        │ No
                        │
               ◇ Auto tuning conditions        No
               are not satisfied? (Estimation of ──►
               load to motor inertia ratio is
               difficult.) ◇
                        │ Yes
          ┌─────────────▼───────────────┐
          │ Set [Pr. PA08] to "_ _ _ 2" │
          │ and set [Pr. PB06 Load to   │
          │ motor inertia ratio]        │
          │ manually.                   │
          └─────────────┬───────────────┘
                        │
          ┌─────────────▼───────────────┐
          │ Adjust response level       │
          │ setting so that desired     │
          │ response is achieved on     │
          │ vibration-free level.       │
          └─────────────┬───────────────┘
                        │
          ┌─────────────▼───────────────┐
          │ Acceleration/deceleration   │
          │         repeated            │
          └─────────────┬───────────────┘
                        │
               ◇ Requested performance        No
               satisfied? ◇ ──────────────────►
                        │ Yes
          ┌─────────────▼──────┐    ┌──────────────────┐
          │        End         │    │ To 2 gain        │
          └────────────────────┘    │ adjustment mode 2│
                                     └──────────────────┘
```

SMC

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, the track ability and settling time for a command decreases, but a too high response level will generate vibration. Hence, make setting until desired response is obtained within the vibration-free range.

If the response level setting cannot be increased up to the desired response because of machine resonance beyond 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 LECSS□-S□)	Setting value	Machine characteristic		Reference (setting value of LECSS□-S□)
	Response	Guideline for machine resonance frequency [Hz]			Response	Guideline for machine resonance frequency [Hz]	
1	Low response	2.7		21	Middle response	67.1	17
2		3.6		22		75.6	18
3		4.9		23		85.2	19
4		6.6		24		95.9	20
5		10.0	1	25		108.0	21
6		11.3	2	26		121.7	22
7		12.7	3	27		137.1	23
8		14.3	4	28		154.4	24
9		16.1	5	29		173.9	25
10		18.1	6	30		195.9	26
11		20.4	7	31		220.6	27
12		23.0	8	32		248.5	28
13		25.9	9	33		279.9	29
14		29.2	10	34		315.3	30
15		32.9	11	35		355.1	31
16		37.0	12	36		400.0	32
17		41.7	13	37		446.6	
18		47.0	14	38		501.2	
19	Middle response	52.9	15	39	High response	571.5	
20		59.6	16	40		642.7	

6.4 Manual mode

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

```
┌─────────────────────────────────────────────────────────────────────────┐
│ ┌──────────┐                                                              │
│ │  POINT   │                                                              │
│ └──────────┘                                                              │
│ ●If machine resonance occurs, 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 slightly smaller value to the model loop gain. Set a slightly larger value to the speed integral compensation.	
5	Increase the speed loop gain within the vibration- and unusual noise-free range, and return slightly if vibration takes place.	Increase the speed loop gain.
6	Decrease the speed integral compensation within the vibration-free range, and return slightly if vibration takes place.	Decrease the time constant of the speed integral compensation.
7	Increase the model loop gain, and return slightly if 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.

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.

Speed integral compensation setting [ms]

$$\geq \frac{2000 \text{ to } 3000}{\text{Speed loop gain}/(1 + \text{Load to motor inertia ratio})}$$

3) [Pr. PB07 Model loop gain]

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

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

SMC

(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 slightly smaller value to the model loop gain and the position loop gain. Set a slightly larger value to the speed integral compensation.	
5	Increase the speed loop gain within the vibration- and unusual noise-free range, and return slightly if vibration takes place.	Increase the speed loop gain.
6	Decrease the speed integral compensation within the vibration-free range, and return slightly if vibration takes place.	Decrease the time constant of the speed integral compensation.
7	Increase the position loop gain, and return slightly if vibration takes place.	Increase the position loop gain.
8	Increase the model loop gain, and return slightly if 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.

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

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.

   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 track ability to a position command, but a too high value will make overshoot liable to occur at settling.

   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 track ability. 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 track ability.
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 position loop gain.
7	Considering the interpolation characteristic and motor status, fine-adjust the model loop gain and response level setting.	Fine adjustment

SMC

(4) Parameter adjustment

[Pr. PB07 Model loop gain]

This parameter determines the response level of the position control loop. Increasing the value improves track ability to a position command, but a too high value will make overshoot liable to occur at settling. The droop pulse value is determined by the following expression.

Number of droop pulses [pulse]

$$= \frac{\text{Position command frequency [pulse/s]}}{\text{Model loop gain setting}}$$

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

SMC

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 LECSS2-T□ drivers.

7. SPECIAL ADJUSTMENT FUNCTIONS

7.1.1 Machine resonance suppression filter
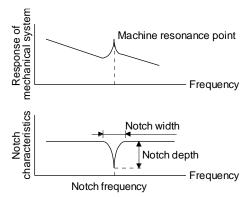
POINT
●The machine resonance suppression filter is a delay factor for the servo system. Therefore, vibration may increase if you set an incorrect resonance frequency or set notch characteristics too deep or too wide.
●If the frequency of machine resonance is unknown, decrease the notch frequency from 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.

SMC

(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			PB47
Machine resonance suppression filter 4	PB48/PB49	Enabling the filter disables the shaft resonance suppression filter. The shaft resonance suppression filter is enabled for the initial setting.		PB48/PB49
Machine resonance suppression filter 5	PB50/PB51	The setting of this filter is disabled while you use the robust filter. 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]).
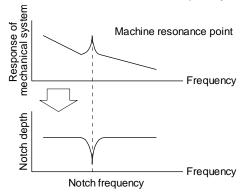
7.1.2 Adaptive filter II

> 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.
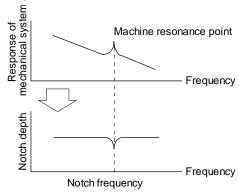
(1) Function

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.
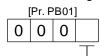
When machine resonance is large and frequency is low

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 0 ☐

Filter tuning mode selection

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

SMC

(3) Adaptive tuning mode procedure

```
                    ┌──────────────────────────┐
                    │     Adaptive tuning      │
                    └──────────────────────────┘
                                 │
                    ┌──────────────────────────┐
                    │        Operation         │◄─────────────┐
                    └──────────────────────────┘              │
                                 │                            │
                    ╱────────────────────────╲   Yes          │
                   ╱   Is the target response  ╲───────────┐   │
                   ╲        reached?           ╱           │   │
                    ╲────────────────────────╱            │   │
                                 │ No                      │   │
                    ┌──────────────────────────┐          │   │
                    │ Increase the response     │          │   │
                    │ setting.                  │          │   │
                    └──────────────────────────┘          │   │
                                 │                         │   │
                    ╱────────────────────────╲   No        │   │
                   ╱  Has vibration or unusual ╲───────────┼───┤
                   ╲    noise occurred?        ╱           │   │
                    ╲────────────────────────╱            │   │
                                 │ Yes                     │   │
                    ┌──────────────────────────┐          │   │
                    │ Execute or re-execute     │          │   │
                    │ adaptive tuning.          │          │   │
                    │ (Set [Pr. PB01] to        │          │   │
                    │ "_ _ _ 1".)               │          │   │
                    └──────────────────────────┘          │   │
                                 │                         │   │
                    ┌──────────────────────────┐          │   │
                    │ Tuning ends automatically │          │   │
                    │ after the predetermined   │          │   │
                    │ period of time.           │          │   │
                    │ ([Pr. PB01] will be       │          │   │
                    │ "_ _ _ 2" or "_ _ _ 0".)  │          │   │
                    └──────────────────────────┘          │   │
                                 │                         │   │
                    ╱────────────────────────╲   Yes       │   │
                   ╱  Has vibration or unusual ╲────────────┼───┘
                   ╲  noise been resolved?     ╱           │
                    ╲────────────────────────╱            │
                                 │ No                      │
         ┌─────────────────────┐ ┌─────────────────────┐  │
         │ Decrease the        │ │ Using the machine   │  │
         │ response until      │ │ analyzer, set the   │  │
         │ vibration or unusual│ │ filter manually.    │  │
         │ noise is resolved.  │ │                     │  │
         └─────────────────────┘ └─────────────────────┘  │
                                 │                         │
                    ┌──────────────────────────┐          │
                    │           End            │◄─────────┘
                    └──────────────────────────┘
```

If assumption fails after tuning is executed at a large vibration or oscillation, decrease the response setting temporarily down to the vibration level and execute again.

Factor
· The response has increased to the machine limit.
· The machine is too complicated to provide the optimum filter.
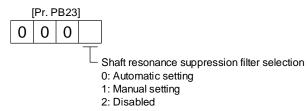
7.1.3 Shaft resonance suppression filter

(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

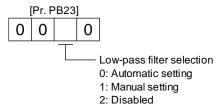| Setting value	Frequency [Hz]	Setting value	Frequency [Hz]
_ _ 0 0	Disabled	_ _ 1 0	562
_ _ 0 1	Disabled	_ _ 1 1	529
_ _ 0 2	4500	_ _ 1 2	500
_ _ 0 3	3000	_ _ 1 3	473
_ _ 0 4	2250	_ _ 1 4	450
_ _ 0 5	1800	_ _ 1 5	428
_ _ 0 6	1500	_ _ 1 6	409
_ _ 0 7	1285	_ _ 1 7	391
_ _ 0 8	1125	_ _ 1 8	375
_ _ 0 9	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

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.

Filter frequency ([rad/s])

$$= \frac{VG2}{1 + GD2} \times 10$$

To set [Pr. PB18] manually, select "Manual setting (_ _ 1 _)" of "Low-pass filter selection" in [Pr. PB23].

(2) Parameter
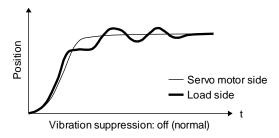
Set "Low-pass filter selection" in [Pr. PB23].

[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**
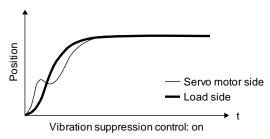> ● The function is enabled when "Gain adjustment mode selection" in [Pr. PA08] is "Auto tuning mode 2 (_ _ _ 2)", "Manual mode (_ _ _ 3)", or "2 gain adjustment mode 2 (_ _ _ 4)".
> ● The machine resonance frequency supported in the vibration suppression control tuning mode is 1.0 Hz to 100.0 Hz. As 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].

SMC

(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.

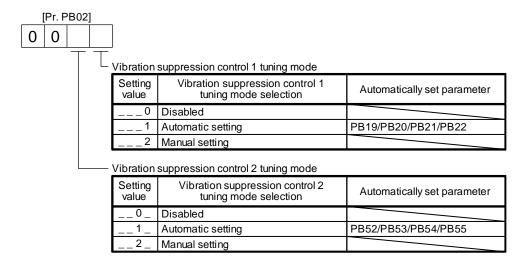Vibration suppression: off (normal)

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].
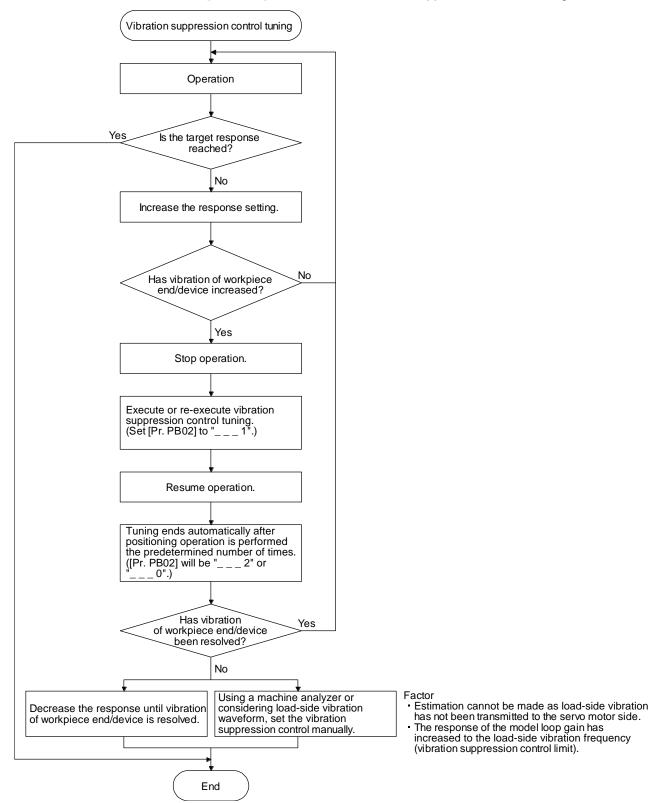
(2) Parameter

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]

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	

SMC

(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.

```
        ( Vibration suppression control tuning )
                        │
                        ▼
        ┌──────────────────────────────┐◄──────┐
        │         Operation            │       │
        └──────────────────────────────┘       │
                        │                       │
              Yes       ▼                        │
     ◄───────◄ Is the target response           │
                     reached? ◄                  │
                        │ No                     │
                        ▼                        │
        ┌──────────────────────────────┐        │
        │  Increase the response        │       │
        │  setting.                     │       │
        └──────────────────────────────┘        │
                        │                        │
                        ▼              No        │
       ◄ Has vibration of workpiece ◄─────────   │
              end/device increased? ◄            │
                        │ Yes                     │
                        ▼                         │
        ┌──────────────────────────────┐         │
        │       Stop operation.         │        │
        └──────────────────────────────┘         │
                        │                         │
                        ▼                         │
        ┌──────────────────────────────┐         │
        │ Execute or re-execute vibration│       │
        │ suppression control tuning.    │       │
        │ (Set [Pr. PB02] to "_ _ _ 1".) │       │
        └──────────────────────────────┘         │
                        │                         │
                        ▼                         │
        ┌──────────────────────────────┐         │
        │      Resume operation.        │        │
        └──────────────────────────────┘         │
                        │                         │
                        ▼                         │
        ┌──────────────────────────────┐         │
        │ Tuning ends automatically after│       │
        │ positioning operation is       │       │
        │ performed the predetermined    │       │
        │ number of times.               │       │
        │ ([Pr. PB02] will be "_ _ _ 2" or│      │
        │ "_ _ _ 0".)                    │       │
        └──────────────────────────────┘         │
                        │                         │
                        ▼            Yes          │
       ◄ Has vibration of workpiece ◄─────────────┘
            end/device been resolved? ◄
                        │ No
                        ▼
```

| Decrease the response until vibration of workpiece end/device is resolved. | Using a machine analyzer or considering load-side vibration waveform, set the vibration suppression control manually. |

Factor
· Estimation cannot be made as load-side vibration has not been transmitted to the servo motor side.
· The response of the model loop gain has increased to the load-side vibration frequency (vibration suppression control limit).

```
                    ( End )
```

(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.
> ● A vibration suppression control effect is not produced if the relation between the [Pr. PB07 Model loop gain] value and vibration frequency is as follows.
> Vibration suppression control 1:
>
> $$[Pr.\ PB19] < \frac{1}{2\pi}(0.9 \times [Pr.\ PB07])$$
>
> $$[Pr.\ PB20] < \frac{1}{2\pi}(0.9 \times [Pr.\ PB07])$$
>
> Vibration suppression control 2:
> $$[Pr.\ PB52] < 5.0 + 0.1 \times [Pr.\ PB07]$$
> $$[Pr.\ PB53] < 5.0 + 0.1 \times [Pr.\ PB07]$$
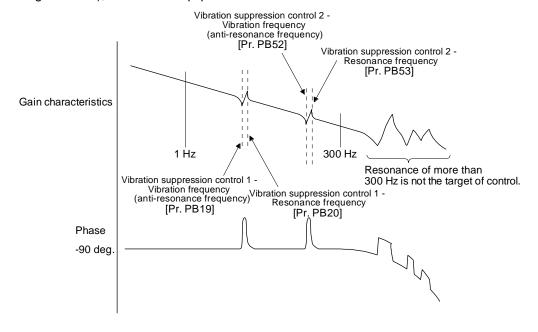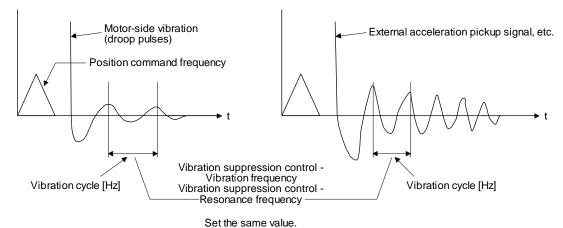
Measure work-side vibration and device shake with the machine analyzer or external measuring instrument, and set the following parameters to adjust vibration suppression control manually.

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.

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

Vibration suppression control 2 -
Vibration frequency
(anti-resonance frequency)
[Pr. PB52]

Vibration suppression control 2 -
Resonance frequency
[Pr. PB53]

Gain characteristics

1 Hz

300 Hz

Resonance of more than
300 Hz is not the target of control.

Vibration suppression control 1 -
Vibration frequency
(anti-resonance frequency)
[Pr. PB19]

Vibration suppression control 1 -
Resonance frequency
[Pr. PB20]

Phase
-90 deg.

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

Motor-side vibration
(droop pulses)

Position command frequency

External acceleration pickup signal, etc.

t

Vibration cycle [Hz]

Vibration suppression control -
Vibration frequency
Vibration suppression control -
Resonance frequency

t

Vibration cycle [Hz]

Set the same value.

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

SMC

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).
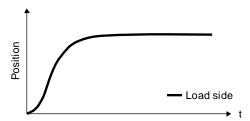
(1) Function

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.
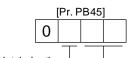
Command notch filter: disabled

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]

Notch depth ┘ └ Command notch filter setting frequency

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

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

SMC

7. SPECIAL ADJUSTMENT FUNCTIONS

7.2 Gain switching function

You can switch gains with the function. You can switch gains during rotation and during stop, and can use a control command from a PC or PLC…etc to switch gains during operation.
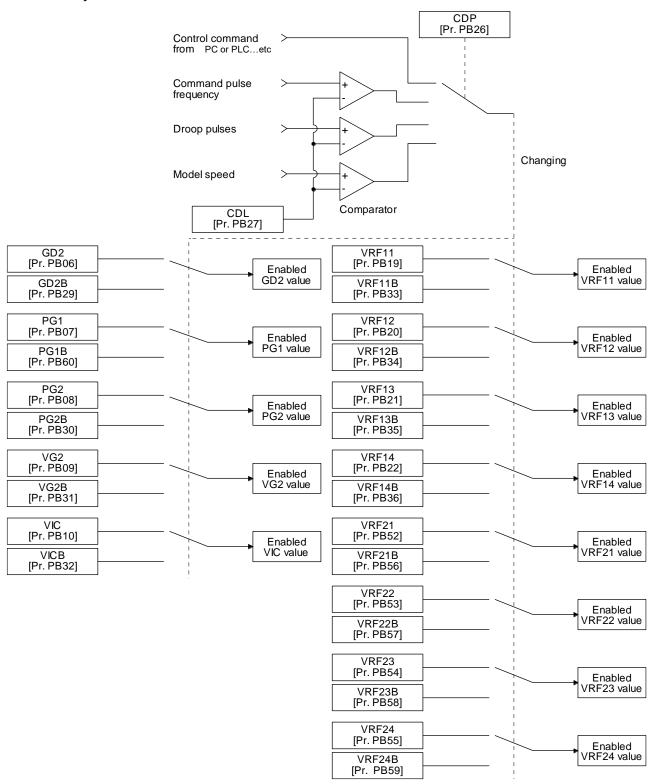
7.2.1 Applications

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 a control command from a PC or PLC…etc 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).

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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. SPECIAL ADJUSTMENT FUNCTIONS

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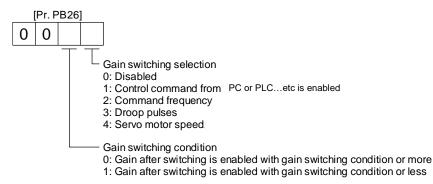
When using the gain switching function, always select "Manual mode (_ _ _ 3)" of "Gain adjustment mode selection" in [Pr. PA08 Auto tuning mode]. The gain switching function cannot be used in the auto tuning mode.

(1) Variable gain operation setting parameter

Parameter	Symbol	Name	Unit	Description
PB26	CDP	Gain switching selection		Used to select the changing condition.
PB27	CDL	Gain switching condition	[kpps] /[pulse] /[r/min]	Used to set the changing condition values.
PB28	CDT	Gain switching time constant	[ms]	You can set the filter time constant for a gain change at changing.

(a) [Pr. PB26 Gain switching function]
Used to set the gain switching condition. Select the switching condition in the first digit and second digit.

[Pr. PB26]

Gain switching selection
0: Disabled
1: Control command from PC or PLC…etc is enabled
2: Command frequency
3: Droop pulses
4: Servo motor speed

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

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

Gain switching condition	Unit
Command frequency	[kpps]
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. SPECIAL ADJUSTMENT FUNCTIONS
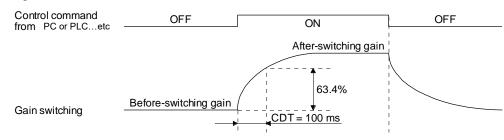
7.2.4 Gain switching procedure

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	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 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 control command from the PC or PLC…etc.)	
PB28	CDT	Gain switching time constant	100	[ms]
PB33	VRF11B	Vibration suppression control 1 - Vibration frequency after gain switching	60	[Hz]
PB34	VRF12B	Vibration suppression control 1 - Resonance frequency after gain switching	60	[Hz]
PB35	VRF13B	Vibration suppression control 1 - Vibration frequency damping after gain switching	0.15	
PB36	VRF14B	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	

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(b) Switching timing chart

Model loop gain	100	→	50	→	100
Load to motor inertia 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
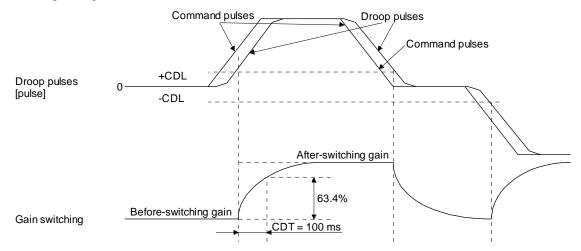
In this case, the vibration suppression control after gain switching and model loop gain after gain switching cannot be used.

(a) Setting

Parameter	Symbol	Name	Setting value	Unit
PB06	GD2	Load to motor inertia ratio	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 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

7. SPECIAL ADJUSTMENT FUNCTIONS

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.

7.3.1 Vibration tough drive function

This function prevent from vibrating by resetting a filter instantaneously when machine resonance occurs due to varied vibration frequency caused 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].
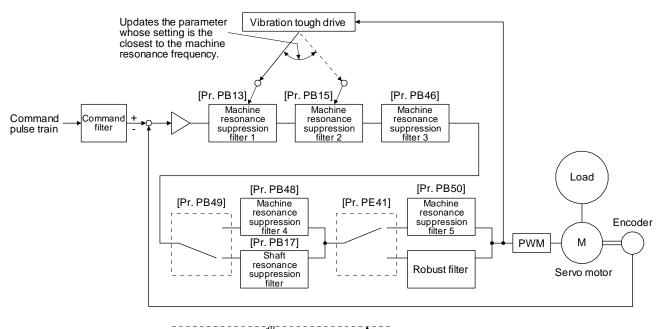
> **POINT**
> ● Resetting [Pr. PB13] and [Pr. PB15] by the vibration tough drive function is performed constantly. However, the number of write times to the EEPROM is limited to once per hour.
> ● The vibration tough drive function does not reset [Pr. PB46 Machine resonance suppression filter 3], [Pr. 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.
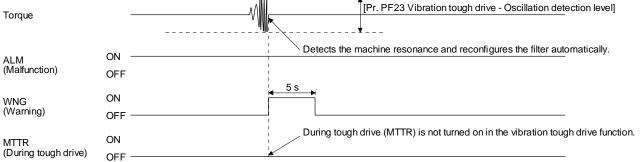
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The following shows the function block diagram of the vibration tough drive function.

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 filter disables the shaft resonance suppression filter. The shaft resonance suppression filter is enabled for the initial setting.	
Machine resonance suppression filter 5	PB50/PB51	The setting of this filter is disabled while you use the robust filter. The robust filter is disabled for the initial setting.	

7.3.2 Instantaneous power failure tough drive function
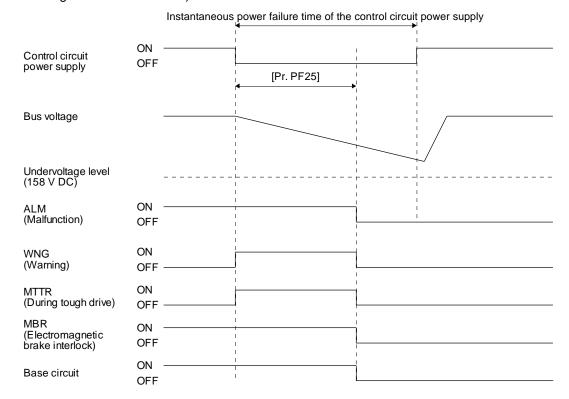
The instantaneous power failure tough drive function avoids [AL. 10 Undervoltage] even when an instantaneous power failure occurs during operation. When the instantaneous power failure tough drive activates, the function will increase the immunity to instantaneous power failures using the electrical 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 (instantaneous power failure tough drive - 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 the load of instantaneous power failure is large, the undervoltage alarm ([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 (instantaneous power failure tough drive - detection time)]. |

(1) Instantaneous power failure time of the control circuit power supply > [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time (instantaneous power failure tough drive - detection time)]
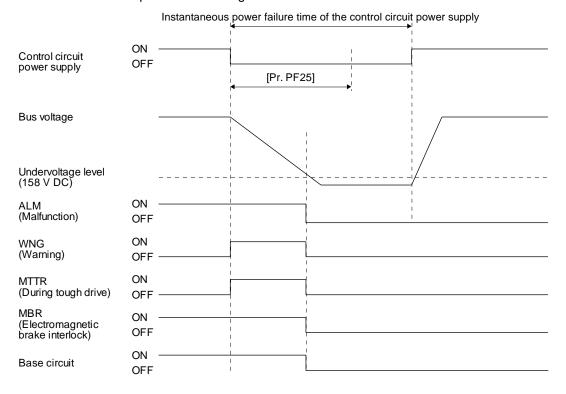
The alarm occurs when the instantaneous power failure time of the control circuit power supply exceeds [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time (instantaneous power failure tough drive - detection time)].

MTTR (During tough drive) turns on after detecting the instantaneous power failure.

MBR (Electromagnetic brake interlock) turns off when the alarm occurs.
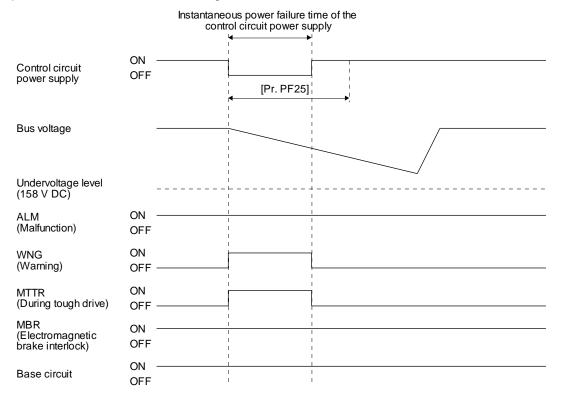
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(2) Instantaneous power failure time of the control circuit power supply < [Pr. PF25 SEMI-F47 function - Instantaneous power failure detection time (instantaneous power failure tough drive - detection time)]

Operation status differs depending on how bus voltage decrease.

(a) When the bus voltage decrease lower than 158 V DC within the instantaneous power failure time of the control circuit power supply

[AL. 10 Undervoltage] occurs when the bus voltage decrease lower than 158 V DC regardless of the enabled instantaneous power failure tough drive.

(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.

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7.4 Compliance with SEMI-F47 standard

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┌─ POINT ──────────────────────────────────────────────────────────────┐
│ ●The control circuit power supply of the driver can be possible to comply with │
│  SEMI-F47. 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. Be sure to check them by testing the entire │
│  equipment using actual machines. │
│ ●Use a 3-phase for the input power supply of the driver. │
└──────────────────────────────────────────────────────────────────────┘
```

The following explains the compliance with "SEMI-F47 semiconductor process equipment voltage sag immunity test" of LECSS2-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 with "Rated voltage × 50% or less". 200 ms later, [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.

Driver	Bus voltage which triggers alarm
LECSS2-T5 to LECSS2-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 7.1 Requirements and recommended conditions of SEMI-F47 standard

Instantaneous power failure voltage	Permissible time of instantaneous power failure [s]	
	Requirement	Recommended condition
Rated voltage × 90%		10 to 100
Rated voltage × 80%	0.5 to 1	0.5 to 10
Rated voltage × 70%	0.2 to 0.5	0.2 to 0.5
Rated voltage × 50%	0.05 to 0.2	0.02 to 0.2
Rated voltage × 0%		to 0.02

8. TROUBLESHOOTING

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8. TROUBLESHOOTING

POINT
●As soon as an alarm occurs, make the Servo-off status and interrupt the main circuit power.

8.1 Alarms and warning list

When an error occurs during operation, the corresponding alarm or warning is displayed. When the alarm or the warning occurs, refer to this section to remove the failure. When an alarm occurs, ALM will turn off.

After its cause has been removed, the alarm can be deactivated in any of the methods marked ○ in the alarm deactivation column in the following table. Warnings are automatically canceled after the cause of occurrence is removed.

For the alarms and warnings in which "SD" is written in the stop method column, the axis stops with the dynamic brake after forced stop deceleration. For the alarms and warnings in which "DB" or "EDB" is written in the stop method column, the axis stops with the dynamic brake without forced stop deceleration.

	No.	Name	Detail display	Detail name	Stop method (Note 3, 4)	Alarm reset		
						Error reset	CPU reset	Power off → on
Alarm	10	Undervoltage	10.1	Voltage drop in the control circuit power	EDB	○	○	○
			10.2	Voltage drop in the main circuit power	SD	○	○	○
	12	Memory error 1 (RAM)	12.1	RAM error 1	DB			○
			12.2	RAM error 2	DB			○
			12.3	RAM error 3	DB			○
			12.4	RAM error 4	DB			○
			12.5	RAM error 5	DB			○
	13	Clock error	13.1	Clock error 1	DB			○
			13.2	Clock error 2	DB			○
	14	Control process error	14.1	Control process error 1	DB			○
			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			○
	15	Memory error 2 (EEP-ROM)	15.1	EEP-ROM error at power on	DB			○
			15.2	EEP-ROM error during operation	DB			○

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	No.	Name	Detail display	Detail name	Stop method (Note 3, 4)	Alarm reset		
						Error reset	CPU reset	Power off → on
Alarm	16	Encoder initial communication error 1	16.1	Encoder initial communication - Receive data error 1	DB			○
			16.2	Encoder initial communication - Receive data error 2	DB			○
			16.3	Encoder initial communication - Receive data error 3	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.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			○
	17	Board error	17.1	Board error 1	DB			○
			17.3	Board error 2	DB			○
			17.4	Board error 3	DB			○
			17.5	Board error 4	DB			○
			17.6	Board error 5	DB			○
			17.8	Board error 6 (Note 5)	EDB			○
	19	Memory error 3 (FLASH-ROM)	19.1	Flash-ROM error 1	DB			○
			19.2	Flash-ROM error 2	DB			○
	1A	Servo motor combination error	1A.1	Servo motor combination error	DB			○
			1A.2	Servo motor control mode combination error	DB			○
	1E	Encoder initial communication error 2	1E.1	Encoder malfunction	DB			○
			1E.2	Load-side encoder malfunction	DB			○
	1F	Encoder initial communication error 3	1F.1	Incompatible encoder	DB			○
			1F.2	Incompatible load-side encoder	DB			○
	20	Encoder normal communication error 1	20.1	Encoder normal communication - Receive data error 1	EDB			○
			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			○

	No.	Name	Detail display	Detail name	Stop method (Note 3, 4)	Alarm reset		
						Error reset	CPU reset	Power off → on
Alarm	21	Encoder normal communication error 2	21.1	Encoder data error 1	EDB			O
			21.2	Encoder data update error	EDB			O
			21.3	Encoder data waveform error	EDB			O
			21.4	Encoder non-signal error	EDB			O
			21.5	Encoder hardware error 1	EDB			O
			21.6	Encoder hardware error 2	EDB			O
			21.9	Encoder data error 2	EDB			O
	24	Main circuit error	24.1	Ground fault detected by hardware detection circuit	DB			O
			24.2	Ground fault detected by software detection function	DB	O	O	O
	25	Absolute position erased	25.1	Servo motor encoder - Absolute position erased	DB			O
	27	Initial magnetic pole detection error	27.1	Magnetic pole detection - Abnormal termination	DB			O
			27.2	Magnetic pole detection - Time out error	DB			O
			27.3	Magnetic pole detection - Limit switch error	DB			O
			27.4	Magnetic pole detection - Estimated error	DB			O
			27.5	Magnetic pole detection - Position deviation error	DB			O
			27.6	Magnetic pole detection - Speed deviation error	DB			O
			27.7	Magnetic pole detection - Current error	DB			O
	28	Linear encoder error 2	28.1	Linear encoder - Environment error	EDB			O
	2A	Linear encoder error 1	2A.1	Linear encoder error 1-1	EDB			O
			2A.2	Linear encoder error 1-2	EDB			O
			2A.3	Linear encoder error 1-3	EDB			O
			2A.4	Linear encoder error 1-4	EDB			O
			2A.5	Linear encoder error 1-5	EDB			O
			2A.6	Linear encoder error 1-6	EDB			O
			2A.7	Linear encoder error 1-7	EDB			O
			2A.8	Linear encoder error 1-8	EDB			O
	2B	Encoder counter error	2B.1	Encoder counter error 1	EDB			O
			2B.2	Encoder counter error 2	EDB			O
	30	Regenerative error (Note 1)	30.1	Regeneration heat error	DB	O (Note 1)	O (Note 1)	O (Note 1)
			30.2	Regeneration signal error	DB	O (Note 1)	O (Note 1)	O (Note 1)
			30.3	Regeneration feedback signal error	DB	O (Note 1)	O (Note 1)	O (Note 1)
	31	Overspeed	31.1	Abnormal motor speed	SD	O	O	O
	32	Overcurrent	32.1	Overcurrent detected at hardware detection circuit (during operation)	DB			O
			32.2	Overcurrent detected at software detection function (during operation)	DB	O	O	O
			32.3	Overcurrent detected at hardware detection circuit (during a stop)	DB			O
			32.4	Overcurrent detected at software detection function (during a stop)	DB	O	O	O
	33	Overvoltage	33.1	Main circuit voltage error	EDB	O	O	O
	34	SSCNET receive error 1	34.1	SSCNET receive data error	SD	O	O (Note 2)	O
			34.2	SSCNET connector connection error	SD	O	O	O
			34.3	SSCNET communication data error	SD	O	O	O
			34.4	Hardware error signal detection	SD	O	O	O
	35	Command frequency error	35.1	Command frequency error	SD	O	O	O
	36	SSCNET receive error 2	36.1	Continuous communication data error	SD	O	O	O

	No.	Name	Detail display	Detail name	Stop method (Note 3, 4)	Alarm reset		
						Error reset	CPU reset	Power off → on
Alarm	37	Parameter error	37.1	Parameter setting range error	DB		○	○
			37.2	Parameter combination error	DB		○	○
	3A	Inrush current suppression circuit error	3A.1	Inrush current suppression circuit error	EDB			○
	3E	Operation mode error	3E.1	Operation mode error	DB			○
	42	Servo control error (for linear servo motor and direct drive motor)	42.1	Servo control error by position deviation	EDB	○ (Note 3)	○ (Note 3)	○
			42.2	Servo control error by speed deviation	EDB	○ (Note 3)	○ (Note 3)	○
			42.3	Servo control error by torque/thrust deviation	EDB	○ (Note 3)	○ (Note 3)	○
		Fully closed loop control error (during fully closed loop control)	42.8	Fully closed loop control error by position deviation	EDB	○ (Note 3)	○ (Note 3)	○
			42.9	Fully closed loop control error by speed deviation	EDB	○ (Note 3)	○ (Note 3)	○
			42.A	Fully closed loop control error by position deviation during command stop	EDB	○ (Note 3)	○ (Note 3)	○
	45	Main circuit device overheat (Note 1)	45.1	Main circuit device overheat error	SD	○ (Note 1)	○ (Note 1)	○ (Note 1)
	46	Servo motor overheat (Note 1)	46.1	Abnormal temperature of servo motor 1	SD	○ (Note 1)	○ (Note 1)	○ (Note 1)
			46.2	Abnormal temperature of servo motor 2	SD	○ (Note 1)	○ (Note 1)	○ (Note 1)
			46.3	Thermistor disconnected	SD	○ (Note 1)	○ (Note 1)	○ (Note 1)
			46.5	Abnormal temperature of servo motor 3	DB	○ (Note 1)	○ (Note 1)	○ (Note 1)
			46.6	Abnormal temperature of servo motor 4	DB	○ (Note 1)	○ (Note 1)	○ (Note 1)
	47	Cooling fan error	47.1	Cooling fan stop error	SD			○
			47.2	Cooling fan speed reduction error	SD			○
	50	Overload 1 (Note 1)	50.1	Thermal overload error 1 during operation	SD	○ (Note 1)	○ (Note 1)	○ (Note 1)
			50.2	Thermal overload error 2 during operation	SD	○ (Note 1)	○ (Note 1)	○ (Note 1)
			50.3	Thermal overload error 4 during operation	SD	○ (Note 1)	○ (Note 1)	○ (Note 1)
			50.4	Thermal overload error 1 during a stop	SD	○ (Note 1)	○ (Note 1)	○ (Note 1)
			50.5	Thermal overload error 2 during a stop	SD	○ (Note 1)	○ (Note 1)	○ (Note 1)
			50.6	Thermal overload error 4 during a stop	SD	○ (Note 1)	○ (Note 1)	○ (Note 1)
	51	Overload 2 (Note 1)	51.1	Thermal overload error 3 during operation	DB	○ (Note 1)	○ (Note 1)	○ (Note 1)
			51.2	Thermal overload error 3 during a stop	DB	○ (Note 1)	○ (Note 1)	○ (Note 1)
	52	Error excessive	52.1	Excess droop pulse 1	SD	○	○	○
			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	○	○	○
	56	Forced stop error	56.2	Over speed during forced stop	EDB	○	○	○
			56.3	Estimated distance over during forced stop	EDB	○	○	○
	63	STO timing error	63.1	STO1 off	DB	○	○	○
			63.2	STO2 off	DB	○	○	○

	No.	Name	Detail display	Detail name	Stop method (Note 3, 4)	Alarm reset		
						Error reset	CPU reset	Power off → on
Alarm	70	Load-side encoder initial communication error 1	70.1	Load-side encoder initial communication - Receive data error 1	DB			○
			70.2	Load-side encoder initial communication - Receive data error 2	DB			○
			70.3	Load-side encoder initial communication - Receive data error 3	DB			○
			70.5	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.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			○
	71	Load-side encoder normal communication error 1	71.1	Load-side encoder communication - Receive data error 1	EDB			○
			71.2	Load-side encoder communication - Receive data error 2	EDB			○
			71.3	Load-side encoder communication - Receive data error 3	EDB			○
			71.5	Load-side encoder communication - Transmission data error 1	EDB			○
			71.6	Load-side encoder communication - Transmission data error 2	EDB			○
			71.7	Load-side encoder communication - Transmission data error 3	EDB			○
			71.9	Load-side encoder communication - Transmission data error 4	EDB			○
			71.A	Load-side encoder communication - Transmission data error 5	EDB			○
	72	Load-side encoder normal communication error 2	72.1	Load-side encoder data error 1	EDB			○
			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			○
	8A	USB communication time-out error	8A.1	USB communication time-out error	SD	○	○	○
	8E	USB communication error	8E.1	USB communication receive error	SD	○	○	○
			8E.2	USB communication checksum error	SD	○	○	○
			8E.3	USB communication character error	SD	○	○	○
			8E.4	USB communication command error	SD	○	○	○
			8E.5	USB communication data number error	SD	○	○	○
	888	Watchdog	88._	Watchdog	DB			○

Note 1. Leave for about 30 minutes of cooling time after removing the cause of occurrence.
    2. In some controller communication status, the alarm factor may not be removed.
    3. Stop method indicates as follows:
       ・DB: Stops with dynamic brake. (Coasts for the driver without dynamic brake.)
       ・EDB: Stops with electronic dynamic brake for 400 W or less drivers
            Stops with dynamic brake for 750 W drivers
       ・SD: Forced stop deceleration
    4. 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. This alarm will occur only in the J3 compatibility mode.

	No.	Name	Detail display	Detail name	Stop method (Note 2, 3)
Warning	91	Servo amplifier 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	
	95	STO warning	95.1	STO1 off detection	DB
			95.2	STO2 off detection	DB
	96	Home position setting warning	96.1	In-position warning at home positioning	
			96.2	Command input warning at home positioning	
	9F	Battery warning	9F.1	Low battery	
			9F.2	Battery degradation warning	
	E0	Excessive regeneration warning (Note 1)	E0.1	Excessive regeneration warning	
	E1	Overload warning 1 (Note 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 error 1 during a stop	
			E1.6	Thermal overload error 2 during a stop	
			E1.7	Thermal overload error 3 during a stop	
			E1.8	Thermal overload error 4 during a stop	
	E2	Servo motor overheat warning	E2.1	Servo motor temperature warning	
	E3	Absolute position counter warning	E3.2	Absolute position counter warning	
			E3.5	Encoder absolute positioning counter warning	
	E4	Parameter warning	E4.1	Parameter setting range error warning	
	E6	Servo forced stop warning	E6.1	Forced stop warning	SD
	E7	Controller forced stop warning	E7.1	Controller forced stop 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
	EC	Overload warning 2 (Note 1)	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	
	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	

Note 1. Leave for about 30 minutes of cooling time after removing the cause of occurrence.

2. Stop method indicates as follows:
   ・ DB: Stops with dynamic brake. (Coasts for the driver without dynamic brake.)
   ・ SD: Decelerates to a stop

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].

8.2 Troubleshooting at power on

When the servo system does not boot and system error occurs at power on of the servo system controller, improper boot of the driver might be the cause. Check the display of the driver, and take actions according to this section.

Display	Description	Cause	Checkpoint	Action
AA	Communication with the servo system controller has disconnected.	The power of the servo system controller was turned off.	Check the power of the servo system controller.	Switch on the power of the servo system controller.
		A SSCNET III cable was disconnected.	"AA" is displayed in the corresponding axis and following axes.	Replace the SSCNET III cable of the corresponding axis.
			Check if the connectors (CNIA, CNIB) are unplugged.	Connect it correctly.
		The power of the driver was turned off.	"AA" is displayed in the corresponding axis and following axes.	Check the power of the driver.
				Replace the driver of the corresponding axis.
Ab	Initialization communication with the servo system controller has not completed.	The control axis is disabled.	Check if the disabling control axis switch (SW2-2) is on.	Turn off the disabling control axis switch (SW2-2).
		The setting of the axis No. is incorrect.	Check that the other driver is not assigned to the same axis No.	Set it correctly.
		Axis No. does not match with the axis No. set to the servo system controller.	Check the setting and axis No. of the servo system controller.	Set it correctly.
		Information about the servo series has not set in the simple motion module.	Check the value set in Servo series (Pr.100) in the simple motion module.	Set it correctly.
		Communication cycle does not match.	Check the communication cycle at the servo system controller side. When using 8 axes or less: 0.222 ms When using 16 axes or less: 0.444 ms When using 32 axes or less: 0.888 ms	Set it correctly.
		A SSCNET III cable was disconnected.	"Ab" is displayed in the corresponding axis and following axes.	Replace the SSCNET III cable of the corresponding axis.
			Check if the connectors (CNIA, CNIB) are unplugged.	Connect it correctly.
		The power of the driver was turned off.	"Ab" is displayed in an axis and the following axes.	Check the power of the driver.
		The driver is malfunctioning.	"Ab" is displayed in an axis and the following axes.	Replace the driver of the corresponding axis.
b##. (Note)	The system has been in the test operation mode.	Test operation mode has been enabled.	Test operation setting switch (SW2-1) is turned on.	Turn off the test operation setting switch (SW2-1).
off	Operation mode for manufacturer setting is set.	Operation mode for manufacturer setting is enabled.	Check if all of the control axis setting switches (SW2) are on.	Set the control axis setting switches (SW2) correctly.

Note. ## indicates axis No.

8.3 Remedies for alarms

⚠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.

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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.				
Display	Detail name	Cause	Check method	Check result	Action	Target
10.1	Voltage drop in the control circuit power	(1) The connection of the control circuit power supply connector (CNP2) has a failure.	Check the control circuit power supply connector.	It has a failure.	Connect it correctly.	LECSS 2-T□
				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. LECSS2-T□ driver: 160 V AC or less	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 the power-on method if it has a problem.	It has a problem.	Cycle the power after the seven-segment LED of the driver is turned off.	
				It does not have a 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 _ _".	Check if the power has a problem.	It has a problem.	Review the power.	
10.2	Voltage drop in the main circuit power	(1) The main circuit power supply connector (CNP1) was disconnected.	Check the main circuit power supply connector.	It is disconnected.	Connect it correctly.	
				It is connected.	Check (2).	
		(2) 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. LECSS2-T□ driver: 160 V AC or less	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 (3).	
		(3) The alarm has occurred during acceleration.	Check that the bus voltage during acceleration is the prescribed value or more. LECSS2-T□ driver: 200 V DC or less	The voltage is lower than the prescribed value.	Increase the acceleration time constant. Or increase the power supply capacity.	
				The voltage is the prescribed value or higher.	Check (4).	
		(4) The driver is malfunctioning.	Check the bus voltage value.	The voltage of the main circuit power supply is 160 V AC or more, and the bus voltage is less than 200 V DC. LECSS2-T□ driver: 200 V DC or less	Replace the driver.	

Alarm No.: 12		Name: Memory error 1 (RAM)				
Alarm content		・A part (RAM) in the driver is failure.				
Display	Detail name	Cause	Check method	Check result	Action	Target
12.1	RAM error 1	(1) A part in the driver is failure.	Disconnect the cables except the control circuit power supply, and then check the repeatability.	It is repeatable.	Replace the driver.	LECSS 2-T□
				It is not repeatable.	Check (2).	
		(2) Something near the device caused it.	Check the power supply for noise.	It has a failure.	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					

Alarm No.: 13			Name: Clock error				
Alarm content			・A part in the driver is failure. ・A clock error transmitted from the PC or PLC…etc occurred.				
Display	Detail name		Cause	Check method	Check result	Action	Target
13.1	Clock error 1	(1)	A part in the driver is failure.	Disconnect the cables except the control circuit power supply, and then check the repeatability.	It is repeatable.	Replace the driver.	LECSS 2-T□
					It is not repeatable.	Check (2).	
		(2)	A clock error transmitted from the PC or PLC…etc occurred.	Check if the error occurs when you connect the driver to the PC or PLC…etc.	It occurs.	Replace the PC or PLC…etc.	LECSS 2-T□
					It does not occur.	Check (3).	
		(3)	The driver of the next axis is malfunctioning.	Check if the driver of the next axis is malfunctioning.	It is malfunctioning.	Replace the driver of the next axis.	
					It is not malfunctioning.	Check (4).	
		(4)	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.	LECSS 2-T□
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.				
Display	Detail name		Cause	Check method	Check result	Action	Target
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.	LECSS 2-T□
					It is correct.	Check (2).	
		(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 (3).	
		(3)	The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.	

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Alarm No.: 14		Name: Control process error				
Alarm content		・The process did not complete within the specified time.				
Display	Detail name	Cause	Check method	Check result	Action	Target
14.2	Control process error 2	(1) A synchronous signal error transmitted from the PC or PLC…etc occurred.	Replace the PC or PLC…etc, and then check the repeatability.	It is repeatable.	Replace the driver.	LECSS 2-T□
				It is not repeatable.	Check (2).	
		(2) The parameter setting is incorrect.	Check if the parameter setting is incorrect.	It is incorrect.	Set it correctly.	LECSS 2-T□
				It is correct.	Check (3).	
		(3) 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).	
		(4) 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					

Alarm No.: 15			Name: Memory error 2 (EEP-ROM)				
Alarm content			・A part (EEP-ROM) in the driver is failure.				
Display	Detail name		Cause	Check method	Check result	Action	Target
15.1	EEP-ROM error at power on	(1)	EEP-ROM is malfunctioning at power on.	Disconnect the cables except the control circuit power supply, and then check the repeatability.	It is repeatable.	Replace the driver.	LECSS 2-T□
					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.	It has a failure.	Take countermeasures against its cause.	
					It has no failure.	Check (3).	
		(3)	The number of write times exceeded 100,000.	Check if parameters has been used very frequently.	It has a failure.	Replace the driver. Change the process to use parameters 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.	LECSS 2-T□
					It does not occur.	Check (2).	
		(2)	A write error occurred while tuning results was 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 (3).	
		(3)	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.	

Alarm No.: 16				Name: Encoder initial communication error 1				
Alarm content				· Communication error occurred between encoder and driver				
Display	Detail name		Cause	Check method	Check result	Action	Target	
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.	LECSS 2-T☐	
					It has no failure.	Check (2).		
		(2)	When you use a linear servo motor with an A/B/Z-phase differential output linear encoder, the driver is not compatible with the linear encoder.	Check if the driver is compatible with the A/B/Z-phase differential output linear encoder.	The driver is not compatible with it.	Use a driver which is compatible with it.	LECSS 2-T☐	
					The driver is compatible with it.	Check (3).		
		(3)	When you use a linear servo motor with an A/B/Z-phase differential output linear encoder, the connection with the linear encoder is incorrect.	Check if the wiring of the linear encoder is correct. (Check if it is wired to PSEL.)	The wiring is incorrect.	Wire it correctly.		
					The wiring is correct.	Check (4).		
		(4)	The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.	LECSS 2-T☐	
					It is repeatable.	Check (5).		
		(5)	An encoder is malfunctioning.	Replace the servo motor or linear encoder, 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.	It has a failure.	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				· Communication error occurred between encoder and driver.				
Display	Detail name		Cause	Check method	Check result	Action	Target	
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.	[A] [B] [WB] [RJ010]	
					It is connected.	Check (2).		
		(2)	The parameter setting of two-wire type/four-wire type is incorrect. [Pr. PC04]	Check the parameter setting.	The setting is incorrect.	Set it correctly.		
					The setting is correct.	Check (3).		
		(3)	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 (4).		
		(4)	When you use a linear servo motor with an A/B/Z-phase differential output linear encoder, the connection with the linear encoder is incorrect.	Check if the wiring of the linear encoder is correct. (Check if it is wired to PSEL.)	The wiring is incorrect.	Wire it correctly.	[A] [B]	
					The wiring 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.	The control circuit power supply has been an instantaneous power failure.	Review the power and related parts.	[A] [B] [WB] [RJ010]	
					It has no failure.	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 is malfunctioning.	Replace the servo motor, and then check the repeatability.	It is not repeatable.	Replace the servo motor.		
					It is repeatable.	Check (8).		
		(8)	Something near the device caused it.	Check the noise, ambient temperature, vibration, etc.	It has a failure.	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							

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Alarm No.: 16			Name: Encoder initial communication error 1				
Alarm content			・Communication error occurred between encoder and driver.				
Display	Detail name		Cause	Check method	Check result	Action	Target
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.	LECSS 2-T□
					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 servo motor.	
					It is repeatable.	Check (3).	
		(3)	Something near the device caused it.	Check the noise, ambient temperature, vibration, etc.	It has a failure.	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.				
Display	Detail name		Cause	Check method	Check result	Action	Target
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.	LECSS 2-T□
					It does not occur.	Check (2).	
		(2)	Something near the device caused it.	Check the noise, ambient temperature, etc.	It has a failure.	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 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.	It has a failure.	Take countermeasures against its cause.	
17.5	Board error 4	(1)	The setting value of the rotary switch (SW1) was not read properly.	Disconnect the cables except the control circuit power supply, and then check the repeatability.	It is repeatable.	Replace the driver.	LECSS 2-T□
					It is not repeatable.	Check (2).	
		(2)	Something near the device caused it.	Check the noise, ambient temperature, etc.	It has a failure.	Take countermeasures against its cause.	

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Alarm No.: 17		Name: Board error				
Alarm content		· A part in the driver is malfunctioning.				
Display	Detail name	Cause	Check method	Check result	Action	Target
17.6	Board error 5	(1) The setting value of the DIP switches (SW2) was not read properly.	Disconnect the cables except the control circuit power supply, and then check the repeatability.	It is repeatable.	Replace the driver.	LECSS 2-T□
				It is not repeatable.	Check (2).	
		(2) Something near the device caused it.	Check the noise, ambient temperature, etc.	It has a failure.	Take countermeasures against its cause.	
17.8	Board error 6	(1) Inrush current suppressor circuit is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.	

Alarm No.: 19		Name: Memory error 3 (Flash-ROM)				
Alarm content		· A part (Flash-ROM) in the driver is failure.				
Display	Detail name	Cause	Check method	Check result	Action	Target
19.1	Flash-ROM error 1	(1) The Flash-ROM is malfunctioning.	Disconnect the cables except the control circuit power supply, and then check the repeatability.	It is repeatable.	Replace the driver.	LECSS 2-T□
				It is not repeatable.	Check (2).	
		(2) Something near the device caused it.	Check the noise, ambient temperature, etc.	It has a failure.	Take countermeasures against its cause.	
19.2	Flash-ROM error 2	Check it with the check method for [AL. 19.1].				

Alarm No.: 1A		Name: Servo motor combination error				
Alarm content		· The combination of driver and servo motor is incorrect.				
Display	Detail name	Cause	Check method	Check result	Action	Target
1A.1	Servo motor combination error	(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.	LECSS 2-T□
				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. Servo motor: "_ _ 0 _"	The combination is incorrect.	Set [Pr. PA01] correctly.	LECSS 2-T□
				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.	LECSS 2-T□
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. Servo motor: "_ _ 0 _"	The combination is incorrect.	Set [Pr. PA01] correctly.	LECSS 2-T□

Alarm No.: 1E		Name: Encoder initial communication error 2				
Alarm content		・An encoder is malfunctioning.				
Display	Detail name	Cause	Check method	Check result	Action	Target
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.	LECSS 2-T☐
				It is repeatable.	Check (2).	
		(2) Something near the device caused it.	Check the noise, ambient temperature, vibration, etc.	It has a failure.	Take countermeasures against its cause.	
1E.2	Load-side encoder malfunction	(1) A load-side encoder is malfunctioning.	Replace the load-side encoder, and then check the repeatability.	It is not repeatable.	Replace the load-side encoder.	LECSS 2-T☐
				It is repeatable.	Check (2).	
		(2) Something near the device caused it.	Check the noise, ambient temperature, vibration, etc.	It has a failure.	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.				
Display	Detail name	Cause	Check method	Check result	Action	Target
1F.1	Incompatible encoder	(1) A servo motor or linear encoder, which is not compatible with the driver, was connected.	Check the model the servo motor/linear encoder.	It is not compatible with the driver.	Replace it with a compatible one.	LECSS 2-T☐
				It is compatible with the driver.	Check (2).	
		(2) The software version of the driver does not support the servo motor or linear encoder.	Check if the software version supports the servo motor/linear encoder.	It is not supported.	Replace the driver to one which software version supports the servo motor/linear encoder.	
				It is supported.	Check (3).	
		(3) An encoder is malfunctioning.	Replace the servo motor or linear encoder, and then check the repeatability.	It is not repeatable.	Replace the servo motor or linear encoder.	
				It is repeatable.	Replace the driver.	
1F.2	Incompatible load-side encoder	(1) A load-side encoder, which is not compatible with the driver, was connected.	Check the model of the load-side encoder.	It is not compatible with the driver.	Use a load-side encoder which is compatible with the driver.	LECSS 2-T☐
				It is compatible with the driver.	Check (2).	
		(2) The software version of the driver does not support the load-side encoder.	Check if the software version of the driver supports the load-side encoder.	It is not supported.	Replace the driver to one which software version supports the load-side encoder.	
				It is supported.	Check (3).	
		(3) A load-side encoder is malfunctioning.	Replace the load-side encoder, and then check the repeatability.	It is not repeatable.	Replace the load-side encoder.	
				It is repeatable.	Replace the driver.	

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Alarm No.: 20			Name: Encoder normal communication error 1				
Alarm content			・Communication error occurred between encoder and driver.				
Display	Detail name		Cause	Check method	Check result	Action	Target
20.1	Encoder normal communication - Receive data 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.	LECSS 2-T□
					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.	It has a failure.	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	(1)	When you use an A/B/Z-phase differential output linear encoder, the wiring of the linear encoder is incorrect.	Check if the A/B-phase pulse signals (PA, PAR, PB, and PBR) of the encoder cable are disconnected or shorted.	It is disconnected or shorted.	Repair the encoder cable.	LECSS 2-T□
					It is not disconnected or shorted.	Check (2).	
		(2)	An encoder cable is malfunctioning.	Check it with the check method for [AL. 20.1]			LECSS 2-T□
		(3)	The driver is malfunctioning.				
		(4)	An encoder is malfunctioning.				
		(5)	Something near the device caused it.				
20.6	Encoder normal communication - Transmission data error 2	(1)	When you use an A/B/Z-phase differential output linear encoder, the wiring of the linear encoder is incorrect.	Check if the Z-phase pulse signals (PZ and PZR) of the encoder cable are disconnected or shorted.	It is disconnected or shorted.	Repair the encoder cable.	LECSS 2-T□
					It is not disconnected or shorted.	Check (2).	
		(2)	An encoder cable is malfunctioning.	Check it with the check method for [AL. 20.1].			LECSS 2-T□
		(3)	The driver is malfunctioning.				
		(4)	An encoder is malfunctioning.				
		(5)	Something near the device caused it.				

Alarm No.: 20		Name: Encoder normal communication error 1				
Alarm content		· Communication error occurred between encoder and driver.				
Display	Detail name	Cause	Check method	Check result	Action	Target
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.				
Display	Detail name		Cause	Check method	Check result	Action	Target
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.	LECSS 2-T□
					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 servo motor.	
					It is repeatable.	Check (3).	
		(3)	Something near the device caused it.	Check the noise, ambient temperature, vibration, etc.	It has a failure.	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)	Something near the device caused it.	Check the noise, ambient temperature, etc.	It has a failure.	Take countermeasures against its cause.	
21.3	Encoder data waveform error	Check it with the check method for [AL. 21.2].					
21.4	Encoder non-signal 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.	LECSS 2-T□
					It has no failure.	Check (2).	
		(2)	Something near the device caused it.	Check the noise, ambient temperature, etc.	It has a failure.	Take countermeasures against its cause.	
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.				
Display	Detail name		Cause	Check method	Check result	Action	Target
24.1	Ground fault detected by hardware detection circuit	(1)	The driver is malfunctioning.	Disconnect the servo motor power cables (U, V, and W) and check if the alarm occurs.	It occurs.	Replace the driver.	LECSS 2-T□
					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, and ⏚).	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.	It has a failure.	Take countermeasures against its cause.	
24.2	Ground fault detected by software detection function	Check it with the check method for [AL. 24.1].					

Alarm No.: 25		Name: Absolute position erased				
Alarm content		・Absolute position data in error ・Power was switched on for the first time in the absolute position detection system.				
Display	Detail name	Cause	Check method	Check result	Action	Target
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 in the absolute position detection system.	This is the first time.	Check that the battery is mounted, and make home position return.	LECSS 2-T□
				This is not the first time.	Check (2).	
		(2) The battery was removed (replaced) when the control circuit power supply was off.	Check if the battery was removed (changed) when the control circuit power supply was off.	It was removed.	Check that the battery is mounted, and make home position return.	
				It was not removed.	Check (3).	
		(3) 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 (4).	
		(4) The voltage drop of the battery cable is large.	Check if a recommended wire is used.	It is not used.	Use a recommended wire.	
				It is used.	Check (5).	
		(5) 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 (6).	
		(6) 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.	
		(7) The absolute position storage unit was not connected for using a direct drive motor.	Check if the absolute position storage unit is connected correctly.	It is not connected.	Connect the absolute position storage unit correctly.	LECSS 2-T□
				It is connected.	Check (8).	
		(8) The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.	LECSS 2-T□
				It is repeatable.	Check (9).	
		(9) An encoder is malfunctioning.	Replace the servo motor, and then check the repeatability.	It is not repeatable.	Replace the servo motor.	

Alarm No.: 27			Name: Initial magnetic pole detection error				
Alarm content			· The initial magnetic pole detection was not completed properly.				
Display	Detail name		Cause	Check method	Check result	Action	Target
27.1	Magnetic pole detection - Abnormal termination	(1)	A moving part collided against the machine.	Check if it collided.	It collided.	Move the start position of the magnetic pole detection.	LECSS 2-T□
					It did not collided.	Check (2).	
		(2)	The wiring of the servo motor power cable is incorrect.	Check if the wiring of the servo motor power cable is correct.	It has a failure.	Correct the wiring.	
					It has no failure.	Check (3).	
		(3)	The linear encoder resolution setting differs from the setting value.	Check the setting of [Pr. PL02] and [Pr. PL03].	The setting is incorrect.	Set it correctly.	
					The setting is correct.	Check (4).	
		(4)	The direction of mounting linear encoder is incorrect.	Check polarities of the linear encoder and the linear servo motor.	The mounting direction is incorrect.	Mount it correctly.	
					The mounting direction is correct.	Check (5).	
		(5)	The magnetic pole detection voltage level is small.	Check if the travel distance during the magnetic pole detection is too short (for a position detection method).	It is too short.	Increase it with the [Pr. PL09] setting.	
				Check if the travel distance during the magnetic pole detection is too long or if a vibration is occurring (for a minute position detection method).	The travel distance is too long or a vibration is occurring.	Review the [Pr. PL17] setting.	
27.2	Magnetic pole detection - Time out error	(1)	Only one of the limit switches is on during magnetic pole detection.	Check the limit switches.	It has a failure.	Remove the cause. Move the start position of the magnetic pole detection.	
					It has no failure.	Check (2).	
		(2)	The magnetic pole detection voltage level is small.	Check if the travel distance during the magnetic pole detection is too short (for a position detection method).	It is too short.	Increase it with the [Pr. PL09] setting.	
27.3	Magnetic pole detection - Limit switch error	(1)	Both of the limit switches are off during the magnetic pole detection.	Check the limit switches.	Both of them are off.	Turn on the limit switches.	
27.4	Magnetic pole detection - Estimated error	Check it with the check method for [AL. 27.1].					
27.5	Magnetic pole detection - Position deviation error						
27.6	Magnetic pole detection - Speed deviation error						
27.7	Magnetic pole detection - Current error						

Alarm No.: 28			Name: Linear encoder error 2				
Alarm content			・Working environment of linear encoder is not normal.				
Display	Detail name		Cause	Check method	Check result	Action	Target
28.1	Linear encoder - Environment error	(1)	The ambient temperature of the linear encoder is out of specifications.	Check the ambient temperature of the linear encoder.	It is out of specifications.	Lower the temperature. Contact the linear encoder manufacturer.	LECSS 2-T□
					It is within specifications.	Check (2).	
		(2)	The signal level of the linear encoder has dropped.	Check the mounting condition of the linear encoder.	It has a failure.	Correct the mounting method of the linear encoder.	

Alarm No.: 2A			Name: Linear encoder error 1				
Alarm content			・An error of the linear encoder was detected. (The details differ depending on the linear encoder manufacturer.)				
Display	Detail name		Cause	Check method	Check result	Action	Target
2A.1	Linear encoder error 1-1	(1)	Mounting condition of the linear encoder and head is failure.	Adjust the positions of the scale and head, and then check the repeatability.	It is not repeatable.	Use the equipment at the adjusted position.	LECSS 2-T□
					It is repeatable.	Check (2).	
		(2)	Something near the device caused it.	Check the noise, ambient temperature, vibration, etc.	It has a failure.	Take countermeasures against its cause.	
					It has no failure.	Check (3).	
		(3)	An alarm of the linear encoder was detected.	Check the content of the alarm detail list of the Linear Encoder Instruction Manual. (Note)	Remove its cause described in the instruction manual. (Note)	Contact each encoder manufacturer for how to deal with it.	
2A.2	Linear encoder error 1-2	Check it with the check method for [AL. 2A.1].					
2A.3	Linear encoder error 1-3						
2A.4	Linear encoder error 1-4						
2A.5	Linear encoder error 1-5						
2A.6	Linear encoder error 1-6						
2A.7	Linear encoder error 1-7						
2A.8	Linear encoder error 1-8						

Note. Please download the Linear Encoder Instruction Manual from the Mitsubishi Electric Corporation website.

Alarm No.: 2B			Name: Encoder counter error				
Alarm content			・Data which encoder created is failure.				
Display	Detail name		Cause	Check method	Check result	Action	Target
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.	LECSS 2-T□
					It has no failure.	Check (2).	
		(2)	Something near the device caused it.	Check the noise, ambient temperature, vibration, etc.	It has a failure.	Take countermeasures against its cause.	
					It has no failure.	Check (3).	
		(3)	An encoder is malfunctioning.	Replace the direct drive motor, and then check the repeatability.	It is not repeatable.	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.				
Display	Detail name		Cause	Check method	Check result	Action	Target
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.	LECSS 2-T□
					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)	Power supply voltage high.	Check the input power supply voltage.	It is higher than the prescribed value. LECSS2-T□ driver: 264 V AC or less	Reduce the power supply voltage.	
					It is the prescribed value or lower.	Check (4).	
		(4)	The regenerative load ratio has been over 100%.	Check the regenerative load ratio when alarm occurs.	It is 100% or more.	Reduce the frequency of positioning. Reduce the load. Use a regenerative option if not being using. 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 occur at power on.	The alarm occurs.	Replace the driver.	
					The alarm does not occur.	Check (2).	
		(2)	Something near the device caused it.	Check the noise, ground fault, ambient temperature, etc.	It has a failure.	Take countermeasures against its cause.	

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Alarm No.: 31			Name: Overspeed				
Alarm content			· The servo motor seed has exceeded the permissible instantaneous speed.				
Display	Detail name		Cause	Check method	Check result	Action	Target
31.1	Abnormal motor speed	(1)	The command from the PC or PLC…etc is excessive.	Check if the command from the PC or PLC…etc is over the permissible speed.	It is over the permissible speed.	Check operation pattern.	LECSS 2-T□
					It is less than the permissible speed.	Check (2).	
		(2)	A larger speed command than the overspeed alarm level was inputted.	Check that the actual motor speed is higher than the setting value of [Pr. PC08 Overspeed alarm detection level].	The motor speed is higher than the overspeed alarm detection level.	Review the [Pr. PC08] setting.	
					The motor speed is lower than the overspeed alarm level.	Check (3).	
		(3)	The servo motor was at the maximum torque at the time of acceleration.	Check if the torque at the time of acceleration is the maximum torque.	It is the maximum torque.	Increase the acceleration/deceleration time constant. Or reduce the load.	LECSS 2-T□
					It is less than the maximum torque.	Check (4).	
		(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.	
		(6)	The encoder or liner encoder is malfunctioning.	Check if the alarm is occurring during less than permissible instantaneous speed.	It is occurring during less than permissible instantaneous speed.	Replace the servo motor or linear encoder.	LECSS 2-T□

Alarm No.: 32			Name: Overcurrent				
Alarm content			・Current that flew is higher than the permissible current of the driver.				
Display	Detail name		Cause	Check method	Check result	Action	Target
32.1	Overcurrent detected at hardware detection circuit (during operation)	(1)	The driver is malfunctioning.	Disconnect the servo motor power cables (U, V, and W) and check if the alarm occurs.	It occurs.	Replace the driver.	LECSS 2-T□
					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, and ⏚).	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 error occurs when you turn on the servo-on command.	It occurs.	Replace the driver.	
		(5)	Something near the device caused it.	Check the noise, ambient temperature, etc.	It has a failure.	Take countermeasures against its cause.	LECSS 2-T□
					It has no failure.	Check it with the check method for [AL. 45.1].	
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]).	LECSS 2-T□
					An oscillation is not occurring.	Check (2).	
		(2)	The driver is malfunctioning.	Disconnect the servo motor power cables (U, V, and 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, and ⏚).	A ground fault is occurring.	Replace the servo motor.	
		(5)	Something near the device caused it.	Check the noise, ambient temperature, etc.	It has a failure.	Take countermeasures against its cause.	LECSS 2-T□

Alarm No.: 32		Name: Overcurrent				
Alarm content		・Current that flew is higher than the permissible current of the driver.				
Display	Detail name	Cause	Check method	Check result	Action	Target
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. ・LECSS2-T□ driver: 400 V DC or less					
Display	Detail name		Cause	Check method	Check result	Action	Target
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.	LECSS2-T□
					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 built-in 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 larger 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 the input voltage.	It is higher than the prescribed value. LECSS2-T□ driver: 264 V AC or less	Reduce the input voltage.	
					It is the prescribed value or lower.	Check (6).	
		(6)	Something near the device caused it.	Check the noise, ambient temperature, etc.	It has a failure.	Take countermeasures against its cause.	

Alarm No.: 34		Name: SSCNET receive error 1				
Alarm content		· An error occurred in SSCNET III/H communication. (continuous communication error with 3.5 ms interval)				
Display	Detail name	Cause	Check method	Check result	Action	Target
34.1	SSCNET receive data error	(1) The SSCNET III cable is disconnected.	Check the SSCNET III cable connection.	It is disconnected.	Turn off the control circuit power supply of the driver, and then connect the SSCNET III cable.	LECSS2-T□
				It is connected.	Check (2).	
		(2) The surface at the end of SSCNET III cable got dirty.	Wipe off the dirt from the cable tip, and then check the repeatability.	It is not repeatable.	Take measure to keep the cable tip clean.	
				It is repeatable.	Check (3).	
		(3) The SSCNET III cable is broken or severed.	Check if the SSCNET III cable is malfunctioning.	It has a failure.	Replace the SSCNET III cable.	
				It has no failure.	Check (4).	
		(4) A vinyl tape is stacked to the SSCNET III cable. Or a wire insulator containing migrating plasticizer is adhered to the cable.	Check if a vinyl tape is used. Check if the cable is contacting with other cables.	It is used. They are in contact.	Take countermeasures against its cause.	
				It is not used. They are not in contact.	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) The previous or next axis driver of the alarm occurred is malfunctioning.	Replace the previous and next driver of the alarm occurred axis, and then check the repeatability.	It is not repeatable.	Replace the driver.	
				It is repeatable.	Check (7).	
		(7) The PC or PLC…etc is malfunctioning.	Replace the PC or PLC…etc, and then check the repeatability.	It is not repeatable.	Replace the PC or PLC…etc.	
				It is repeatable.	Check (8).	
		(8) Something near the device caused it.	Check the noise, ambient temperature, etc.	It has a failure.	Take countermeasures against its cause.	
34.2	SSCNET connector connection error	Check it with the check method for [AL. 34.1].				
34.3	SSCNET communication data error					
34.4	Hardware error signal detection					

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Alarm No.: 35			Name: Command frequency error				
Alarm content			・Input pulse frequency of command pulse is too high.				
Display	Detail name		Cause	Check method	Check result	Action	Target
35.1	Command frequency error	(1)	The command from the PC or PLC…etc is excessive.	Check if the command from the PC or PLC…etc is over the permissible speed.	It is over the permissible speed.	Check operation pattern.	LECSS 2-T□
					It is less than the permissible speed.	Check (2).	
		(2)	The PC or PLC…etc is malfunctioning.	Replace the PC or PLC…etc, and then check the repeatability.	It is not repeatable.	Replace the PC or PLC…etc.	
					It is repeatable.	Check (3).	
		(3)	Something near the device caused it.	Check the noise, ambient temperature, etc.	It has a failure.	Take countermeasures against its cause.	LECSS 2-T□

Alarm No.: 36			Name: SSCNET receive error 2				
Alarm content			・An error occurred in SSCNET III/H communication. (intermittent communication error with about 70 ms interval)				
Display	Detail name		Cause	Check method	Check result	Action	Target
36.1	Continuous communication data error	(1)	The SSCNET III cable is disconnected.	Check the SSCNET III cable connection.	It is disconnected.	Turn off the control circuit power supply of the driver, and then connect the SSCNET III cable.	LECSS 2-T□
					It is connected.	Check (2).	
		(2)	The surface at the end of SSCNET III cable got dirty.	Wipe off the dirt from the cable tip, and then check the repeatability.	It is not repeatable.	Take measure to keep the cable tip clean.	
					It is repeatable.	Check (3).	
		(3)	The SSCNET III cable is broken or severed.	Check if the SSCNET III cable is malfunctioning.	It has a failure.	Replace the SSCNET III cable.	
					It has no failure.	Check (4).	
		(4)	A vinyl tape is stacked to the SSCNET III cable. Or a wire insulator containing migrating plasticizer is adhered to the cable.	Check if a vinyl tape is used. Check if the cable is contacting with other cables.	It is used. They are in contact.	Take countermeasures against its cause.	
					It is not used. They are not in contact.	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)	The previous or next axis driver of the alarm occurred is malfunctioning.	Replace the previous and next driver of the alarm occurred axis, and then check the repeatability.	It is not repeatable.	Replace the driver.	
					It is repeatable.	Check (7).	
		(7)	The PC or PLC…etc is malfunctioning.	Replace the PC or PLC…etc, and then check the repeatability.	It is not repeatable.	Replace the PC or PLC…etc.	
					It is repeatable.	Check (8).	
		(8)	Something near the device caused it.	Check the noise, ambient temperature, etc.	It has a failure.	Take countermeasures against its cause.	

Alarm No.: 37			Name: Parameter error				
Alarm content			・Parameter setting is incorrect.				
Display	Detail name		Cause	Check method	Check result	Action	Target
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.	Set it within the range.	LECSS 2-T□
					It is within the setting range.	Check (2).	
		(2)	The parameter setting has changed due to a driver malfunction.	Replace the driver, 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.	

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Alarm No.: 3A			Name: Inrush current suppression circuit error				
Alarm content			・The inrush current suppression circuit error was detected.				
Display	Detail name		Cause	Check method	Check result	Action	Target
3A.1	Inrush current suppression circuit error	(1)	Inrush current suppressor circuit faulty.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.	LECSS 2-T□

Alarm No.: 3E			Name: Operation mode error				
Alarm content			・The operation mode setting was changed.				
Display	Detail name		Cause	Check method	Check result	Action	Target
3E.1	Operation mode error	(1)	The LECSS2-T□ driver used in J3 compatibility mode was connected to the other SSCNET III/H PC or PLC…etc. Or a LECSS2-T□ driver which was connected another SSCNET III/H PC or PLC…etc was connected to the SSCNET III controller.	Check if the connection was changed to like these.	It is changed.	Initialize the driver with the built-in application software "MR-J4(W)-B mode selection" of setup software (MR Configurator2TM), and then connect the driver to the PC or PLC…etc.	LECSS 2-T□
		(2)	The [Pr. PA01] setting value was changed.	Check if [Pr. PA01] was changed.	It is changed.	Set [Pr. PA01] correctly.	

Alarm No.: 42			Name: Servo control error				
Alarm content			・A servo control error occurred.				
Display	Detail name		Cause	Check method	Check result	Action	Target
42.1	Servo control error by position deviation	(1)	The linear encoder resolution setting differs from the setting value.	Check the setting of [Pr. PL02] and [Pr. PL03].	The setting is incorrect.	Set it correctly.	LECSS 2-T□
					The setting is correct.	Check (2).	
		(2)	The direction of mounting linear encoder is incorrect.	Check polarities of the linear encoder and the linear servo motor.	The mounting direction is incorrect.	Mount it correctly.	
					The mounting direction is correct.	Check (3).	
		(3)	The connection of the servo motor is incorrect.	Check the wiring.	The wiring is incorrect.	Connect it correctly.	
					The wiring is correct.	Check (4).	
		(4)	The initial magnetic pole detection was not executed.	Execute the magnetic pole detection, and then check the repeatability.	It is not repeatable.	Execute the magnetic pole detection.	
					It is repeatable.	Check (5).	
		(5)	The position deviation exceeded the detection level.	Check the value of droop pulses.	The deviation is large.	Review the operation status. Review the [Pr. PL05] setting depending on circumstances.	

Alarm No.: 42		Name: Servo control error				
Alarm content		・A servo control error occurred.				
Display	Detail name	Cause	Check method	Check result	Action	Target
42.2	Servo control error by speed deviation	(1) The linear encoder resolution setting differs from the setting value.	Check the setting of [Pr. PL02] and [Pr. PL03].	The setting is incorrect.	Set it correctly.	LECSS 2-T□
				The setting is correct.	Check (2).	
		(2) The direction of mounting linear encoder is incorrect.	Check polarities of the linear encoder and the linear servo motor.	The mounting direction is incorrect.	Mount it correctly.	
				The mounting direction is correct.	Check (3).	
		(3) The connection of the servo motor is incorrect.	Check the wiring.	The wiring is incorrect.	Connect it correctly.	
				The wiring is correct.	Check (4).	
		(4) The initial magnetic pole detection was not executed.	Execute the magnetic pole detection, and then check the repeatability.	It is not repeatable.	Execute the magnetic pole detection.	
				It is repeatable.	Check (5).	
		(5) The speed deviation exceeded the detection level.	Calculate the deviation between the speed command and actual speed.	The deviation is large.	Review the operation status. Review the [Pr. PL06] setting depending on circumstances.	
42.3	Servo control error by torque/ thrust deviation	(1) The linear encoder resolution setting differs from the setting value.	Check the setting of [Pr. PL02] and [Pr. PL03].	The setting is incorrect.	Set it correctly.	
				The setting is correct.	Check (2).	
		(2) The direction of mounting linear encoder is incorrect.	Check polarities of the linear encoder and the linear servo motor.	The mounting direction is incorrect.	Mount it correctly.	
				The mounting direction is correct.	Check (3).	
		(3) The connection of the servo motor is incorrect.	Check the wiring.	The wiring is incorrect.	Connect it correctly.	
				The wiring is correct.	Check (4).	
		(4) The initial magnetic pole detection was not executed.	Execute the magnetic pole detection, and then check the repeatability.	It is not repeatable.	Execute the magnetic pole detection.	
				It is repeatable.	Check (5).	
		(5) The torque deviation exceeded the detection level.	Calculate the deviation between the current command and torque.	The deviation is large.	Review the operation status. Review the [Pr. PL07] setting depending on circumstances.	

Alarm No.: 42		Name: Fully closed loop control error detection (during fully closed loop control)				
Alarm content		・A fully closed loop control error has occurred.				
Display	Detail name	Cause	Check method	Check result	Action	Target
42.8	Fully closed loop control error by position deviation	(1) The resolution of the load-side encoder setting differs from the setting value.	Check the setting of [Pr. PE04] and [Pr. PE05].	The setting is incorrect.	Set it correctly.	LECSS 2-T□
				The setting is correct.	Check (2).	
		(2) The direction of mounting load-side encoder is incorrect.	Check the mounting direction of the load-side encoder.	The mounting direction is incorrect.	Mount it correctly.	
				The mounting direction is correct.	Check (3).	
		(3) The position deviation exceeded the detection level.	Check the value of droop pulses.	The deviation is large.	Review the operation status. Review the [Pr. PE07] setting depending on circumstances.	

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Alarm No.: 42		Name: Fully closed loop control error detection (during fully closed loop control)				
Alarm content		· A fully closed loop control error has occurred.				
Display	Detail name	Cause	Check method	Check result	Action	Target
42.9	Fully closed loop control error by speed deviation	(1) The resolution of the load-side encoder setting differs from the setting value.	Check the setting of [Pr. PE04] and [Pr. PE05].	The setting is incorrect.	Set it correctly.	LECSS 2-T□
				The setting is correct.	Check (2).	
		(2) The direction of mounting load-side encoder is incorrect.	Check the mounting direction of the load-side encoder.	The mounting direction is incorrect.	Mount it correctly.	
				The mounting direction is correct.	Check (3).	
		(3) The speed deviation exceeded the detection level.	Calculate the deviation between the speed command and actual speed.	The deviation is large.	Review the operation status. Review the [Pr. PE06] setting depending on circumstances.	
42.A	Fully closed loop control error by position deviation during command stop	Check it with the check method for [AL. 42.8].				

Alarm No.: 45			Name: Main circuit device overheat				
Alarm content			· Inside of the driver overheated.				
Display	Detail name		Cause	Check method	Check result	Action	Target
45.1	Main circuit device overheat error	(1)	Ambient temperature has exceeded 55 °C.	Check the ambient temperature.	It is over 55 °C.	Lower the ambient temperature.	LECSS 2-T□
					It is less than 55 °C.	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.	

Alarm No.: 46			Name: Servo motor overheat				
Alarm content			· The servo motor overheated.				
Display	Detail name		Cause	Check method	Check result	Action	Target
46.1	Abnormal temperature of servo motor 1	(1)	Ambient temperature of the servo motor has exceeded 40 °C.	Check the ambient temperature of the servo motor.	It is over 40 °C.	Lower the ambient temperature.	LECSS 2-T□
					It is less than 40 °C.	Check (2).	
		(2)	Servo motor is overloaded.	Check the effective load ratio.	The effective load ratio is large.	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.	
46.2	Abnormal temperature of servo motor 2	(1)	Ambient temperature of the linear servo motor or direct drive motor has exceeded 40 °C.	Check the ambient temperature of the linear servo motor or direct drive motor.	It is over 40 °C.	Lower the ambient temperature.	LECSS 2-T□
					It is less than 40 °C.	Check (2).	
		(2)	The linear servo motor or direct drive motor has been under overload status.	Check the effective load ratio.	The effective load ratio is large.	Reduce the load or review the operation pattern.	
					The effective load ratio is small.	Replace the servo motor.	
46.3	Thermistor disconnected	(1)	A thermistor wire is not connected.	Check the thermistor wire.	It is not connected.	Connect it correctly.	
					It is connected.	Check (2).	
		(2)	The thermistor wire is disconnected.	Check the thermistor wire.	It is disconnected.	Repair the lead wire.	
					It is not disconnected.	Replace the servo motor.	
46.5	Abnormal temperature of servo motor 3	Check it with the check method for [AL. 46.1].					LECSS 2-T□
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.	

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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.				
Display	Detail name		Cause	Check method	Check result	Action	Target
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.	LECSS 2-T□
					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.				
Display	Detail name		Cause	Check method	Check result	Action	Target
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.	LECSS 2-T□
					It is not disconnected.	Check (2).	
		(2)	The connection of the servo motor is incorrect.	Check the wiring of U, V, and W.	It is incorrect.	Connect it correctly.	
					It is correct.	Check (3).	
		(3)	The lock has not released. (The lock has been activated.)	Check if the lock is released during operation.	It is not released.	Release the lock .	
					It is released.	Check (4).	
		(4)	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.	
		(5)	The servo system is unstable and resonating.	Check if it is resonating.	It is resonating.	Adjust gains.	LECSS 2-T□
					It is not resonating.	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)	The encoder or liner encoder is malfunctioning.	Replace the servo motor or linear encoder, and then check the repeatability.	It is not repeatable.	Replace the servo motor or linear 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.				
Display	Detail name		Cause	Check method	Check result	Action	Target
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.	LECSS 2-T□
					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 lock has not released. (The lock has been activated.)	Check if the lock is released.	It is not released.	Release the lock.	
					It is released.	Check (5).	
		(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.	
		(6)	The servo system is unstable and resonating.	Check if it is resonating.	It is resonating.	Adjust gains.	LECSS 2-T□
					It is not resonating.	Check (7).	
		(7)	The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.	
					It is repeatable.	Check (8).	
		(8)	The encoder or liner encoder is malfunctioning.	Replace the servo motor or linear encoder, and then check the repeatability.	It is not repeatable.	Replace the servo motor or linear encoder.	
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.				
Display	Detail name		Cause	Check method	Check result	Action	Target
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.	LECSS 2-T□
					It is not disconnected.	Check (2).	
		(2)	The connection of the servo motor is incorrect.	Check the wiring of U, V, and 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 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 (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.	
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.				
		(5)	The torque is saturated.				
		(6)	The driver is malfunctioning.				
		(7)	An encoder is malfunctioning.				

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Alarm No.: 52			Name: Error excessive				
Alarm content			・Droop pulses have exceeded the alarm occurrence level.				
Display	Detail name		Cause	Check method	Check result	Action	Target
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.	LECSS 2-T□
					It is not disconnected.	Check (2).	
		(2)	The connection of the servo motor is incorrect.	Check the wiring of U, V, and 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 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 (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 servo-lock status.	It was rotated by external force.	Review the machine.	
					It was 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.	
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.	LECSS 2-T□
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.				
Display	Detail name		Cause	Check method	Check result	Action	Target
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.	LECSS 2-T□
					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 or liner encoder is malfunctioning.	Replace the servo motor or linear encoder, and then check the repeatability.	It is not repeatable.	Replace the servo motor or linear encoder.	

Alarm No.: 56			Name: Forced stop error				
Alarm content			・The servo motor does not decelerate normally during forced stop deceleration.				
Display	Detail name		Cause	Check method	Check result	Action	Target
56.2	Over speed during forced stop	(1)	The forced stop deceleration time constant value is short. [Pr. PC24]	Increase the parameter setting value, and then check the repeatability.	It is not repeatable.	Adjust the deceleration time constant.	LECSS 2-T□
					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 or liner encoder is malfunctioning.	Replace the servo motor or linear encoder, and then check the repeatability.	It is not repeatable.	Replace the servo motor or linear encoder.	

Alarm No.: 56			Name: Forced stop error				
Alarm content			・The servo motor does not decelerate normally during forced stop deceleration.				
Display	Detail name		Cause	Check method	Check result	Action	Target
56.3	Estimated distance over during forced stop	(1)	The forced stop deceleration time constant value is short. [Pr. PC24]	Increase the parameter setting value, and then check the repeatability.	It is not repeatable.	Adjust the deceleration time constant.	LECSS 2-T□
					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 liner encoder is malfunctioning.	Replace the servo motor or linear encoder, and then check the repeatability.	It is not repeatable.	Replace the servo motor or linear encoder.	

Alarm No.: 63			Name: STO timing error				
Alarm content			・STO was activated during motor driving.				
Display	Detail name		Cause	Check method	Check result	Action	Target
63.1	STO1 off	(1)	STO1 was turned off under the following speed conditions. 1) Servo motor speed: 50 r/min or more 2) Linear servo motor speed: 50 mm/s or more 3) Direct drive motor speed: 5 r/min or more	Check if STO1 is off.	It is off.	Turn on STO1.	LECSS 2-T□
63.2	STO2 off	(1)	STO2 was turned off under the following speed conditions. 1) Servo motor speed: 50 r/min or more 2) Linear servo motor speed: 50 mm/s or more 3) Direct drive motor speed: 5 r/min or more	Check if STO2 is off.	It is off.	Turn on STO2.	

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Alarm No.: 70			Name: Load-side encoder initial communication error 1				
Alarm content			・An error occurs in the communication between the load-side encoder and the driver.				
Display	Detail name		Cause	Check method	Check result	Action	Target
70.1	Load-side encoder initial communication - Receive data error 1	(1)	A load-side encoder cable is malfunctioning.	Check if the load-side encoder cable is disconnected or shorted.	It has a failure.	Replace or repair the cable.	LECSS 2-T□
					It has no failure.	Check (2).	
		(2)	When you use an A/B/Z-phase differential output linear encoder, thedriver is not compatible with the linear encoder.	Check if the driver is compatible with the A/B/Z-phase differential output linear encoder.	The driver is not compatible with it.	Use a driver which is compatible with it.	LECSS 2-T□
					The driver is compatible with it.	Check (3).	
		(3)	When you use an A/B/Z-phase differential output linear encoder, the connection with the linear encoder is incorrect.	Check if the wiring of the linear encoder is correct. (Check if it is wired to PSEL.)	The wiring is incorrect.	Wire it correctly.	
					The wiring is correct.	Check (4).	
		(4)	The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.	LECSS 2-T□
					It is repeatable.	Check (5).	
		(5)	A load-side encoder is malfunctioning.	Replace the load-side encoder, and then check the repeatability.	It is not repeatable.	Replace the load-side encoder.	
					It is repeatable.	Check (6).	
		(6)	Something near the device caused it.	Check the noise, ambient temperature, vibration, etc.	It has a failure.	Take countermeasures against its cause.	
70.2	Load-side encoder initial communication - Receive data error 2		Check it with the check method for [AL. 70.1].				

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Alarm No.: 70				Name: Load-side encoder initial communication error 1				
Alarm content				· An error occurs in the communication between the load-side encoder and the driver.				
Display	Detail name		Cause	Check method	Check result	Action	Target	
70.3	Load-side encoder initial communication - Receive data error 3	(1)	The load-side encoder cable is malfunctioning.	Check if the load-side encoder cable is connected correctly.	It is not connected correctly.	Connect it correctly.	LECSS 2-T□	
					It is connected.	Check (2).		
		(2)	A load-side encoder cable is malfunctioning.	Check if the load-side encoder cable is disconnected or shorted.	It has a failure.	Replace or repair the cable.		
					It has no failure.	Check (3).		
		(3)	The power voltage has been unstable. (For the load-side encoder with the external power supply input)	Check the power capacity and voltage.	It has a failure.	Review the power and related parts.		
					It has no failure.	Check (4).		
		(4)	When you use an A/B/Z-phase differential output linear encoder, the connection with the linear encoder is incorrect.	Check if the wiring of the linear encoder is correct. (Check if it is wired to PSEL.)	The wiring is incorrect.	Wire it correctly.	LECSS 2-T□	
					The wiring is correct.	Check (5).		
		(5)	When you use a four-wire type linear encoder, the driver is not compatible with the four-wire type linear encoder.	Check if the driver is compatible with the four-wire type linear encoder.	It is not supported.	Use a driver which is compatible with it.		
					It is supported.	Check (6).		
		(6)	The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.	LECSS 2-T□	
					It is repeatable.	Check (7).		
		(7)	A load-side encoder is malfunctioning.	Replace the load-side encoder, and then check the repeatability.	It is not repeatable.	Replace the load-side encoder.		
					It is repeatable.	Check (8).		
		(8)	Something near the device caused it.	Check the noise, ambient temperature, vibration, etc.	It has a failure.	Take countermeasures against its cause.		
70.5	Load-side encoder initial communication - Transmission data error 1	(1)	When you use an A/B/Z-phase differential output linear encoder, the wiring of the linear encoder is incorrect.	Check if the A/B-phase pulse signals (PA, PAR, PB, and PBR) of the encoder cable are disconnected or shorted.	It is disconnected or shorted.	Repair the encoder cable.	LECSS 2-T□	
					It is not disconnected or shorted.	Check (2).		
		(2)	An load-side encoder cable is malfunctioning.	Check it with the check method for [AL. 70.1].			LECSS 2-T□	
		(3)	The driver is malfunctioning.					
		(4)	A load-side encoder is malfunctioning.					
		(5)	Something near the device caused it.					

Alarm No.: 70		Name: Load-side encoder initial communication error 1				
Alarm content		・An error occurred in the initial communication between the load-side encoder and driver.				
Display	Detail name	Cause	Check method	Check result	Action	Target
70.6	Load-side encoder initial communication - Transmission data error 2	(1) When you use an A/B/Z-phase differential output linear encoder, the wiring of the linear encoder is incorrect.	Check if the Z-phase pulse signals (PZ and PZR) of the encoder cable are disconnected or shorted.	It is disconnected or shorted.	Repair the encoder cable.	LECSS 2-T□
				It is not disconnected or shorted.	Check (2).	
		(2) An load-side encoder cable is malfunctioning.	Check it with the check method for [AL. 70.1].			LECSS 2-T□
		(3) The driver is malfunctioning.				
		(4) A load-side encoder is malfunctioning.				
		(5) Something near the device caused it.				
70.7	Load-side encoder initial communication - Transmission data error 3	Check it with the check method for [AL. 70.1].				
70.A	Load-side 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.	LECSS 2-T□
				It is repeatable.	Check (2).	
		(2) A load-side encoder is malfunctioning.	Replace the load-side encoder, and then check the repeatability.	It is not repeatable.	Replace the load-side encoder.	
				It is repeatable.	Check (3).	
		(3) Something near the device caused it.	Check the noise, ambient temperature, vibration, etc.	It has a failure.	Take countermeasures against its cause.	
70.B	Load-side encoder initial communication - Process error 2	Check it with the check method for [AL. 70.A].				
70.C	Load-side encoder initial communication - Process error 3					
70.D	Load-side encoder initial communication - Process error 4					
70.E	Load-side encoder initial communication - Process error 5					
70.F	Load-side encoder initial communication - Process error 6					

Alarm No.: 71		Name: Load-side encoder normal communication error 1				
Alarm content		・An error occurred in the communication between the load-side encoder and driver.				
Display	Detail name	Cause	Check method	Check result	Action	Target
71.1	Load-side encoder communication - Receive data error 1	(1) A load-side encoder cable is malfunctioning.	Check if the load-side encoder cable is disconnected or shorted.	It has a failure.	Repair or replace the cable.	LECSS 2-T□
				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) A load-side encoder is malfunctioning.	Replace the load-side encoder, and then check the repeatability.	It is not repeatable.	Replace the load-side encoder.	
				It is repeatable.	Check (4).	
		(4) Something near the device caused it.	Check the noise, ambient temperature, vibration, etc.	It has a failure.	Take countermeasures against its cause.	
71.2	Load-side encoder communication - Receive data error 2	Check it with the check method for [AL. 71.1].				
71.3	Load-side encoder communication - Receive data error 3					
71.5	Load-side encoder communication - Transmission data error 1					
71.6	Load-side encoder communication - Transmission data error 2					
71.7	Load-side encoder communication - Transmission data error 3					
71.9	Load-side encoder communication - Transmission data error 4					
71.A	Load-side encoder communication - Transmission data error 5					

Alarm No.: 72			Name: Load-side encoder normal communication error 2				
Alarm content			・The load-side encoder detected an error signal.				
Display	Detail name		Cause	Check method	Check result	Action	Target
72.1	Load-side 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.	LECSS 2-T□
					It is repeatable.	Check (2).	
		(2)	A load-side encoder is malfunctioning.	Replace the load-side encoder, and then check the repeatability.	It is not repeatable.	Replace the load-side encoder.	
					It is repeatable.	Check (3).	
		(3)	Something near the device caused it.	Check the noise, ambient temperature, vibration, etc.	It has a failure.	Take countermeasures against its cause.	
72.2	Load-side encoder data update error	(1)	A load-side encoder is malfunctioning.	Replace the load-side encoder, and then check the repeatability.	It is not repeatable.	Replace the load-side encoder.	
					It is repeatable.	Check (2).	
		(2)	Something near the device caused it.	Check the noise, ambient temperature, etc.	It has a failure.	Take countermeasures against its cause.	
72.3	Load-side encoder data waveform error		Check it with the check method for [AL. 72.2].				
72.4	Load-side encoder non-signal error	(1)	A signal of the load-side encoder has not been inputted.	Check if the load-side encoder cable is wired correctly.	It has a failure.	Review the wiring.	LECSS 2-T□
					It has no failure.	Check (2).	
		(2)	Something near the device caused it.	Check the noise, ambient temperature, etc.	It has a failure.	Take countermeasures against its cause.	
72.5	Load-side encoder hardware error 1		Check it with the check method for [AL. 72.2].				
72.6	Load-side encoder hardware error 2						
72.9	Load-side encoder data error 2		Check it with the check method for [AL. 72.1].				

Alarm No.: 8A			Name: USB communication time-out error				
Alarm content			・Communication between the driver and a personal computer stopped for the specified time or longer.				
Display	Detail name		Cause	Check method	Check result	Action	Target
8A.1	USB communication time-out error	(1)	A communication cable is disconnected.	Replace the communication cable, and then check the repeatability.	It is not repeatable.	Replace the communication cable.	LECSS 2-T□
					It is repeatable.	Check (2).	
		(2)	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				
Alarm content			· The communication error occurred between driver and a personal computer.				
Display	Detail name		Cause	Check method	Check result	Action	Target
8E.1	USB communication receive error/Serial communication receive error	(1)	A communication cable is malfunctioning.	Check the communication cable, and then check the repeatability.	It is not repeatable.	Replace the communication cable.	LECSS 2-T□
					It is repeatable.	Check (2).	
		(2)	The setting of the personal computer is incorrect.	Check the setting of the personal computer.	It is incorrect.	Review the settings.	
					It is correct.	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 is incorrect.	Check the setting of the personal computer.	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 character is within specifications.	Check (2).	
		(2)	The communication protocol is failure.	Check if transmission data conforms 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 is incorrect.	Check the setting of the personal computer.	It is incorrect.	Review the settings.	

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Alarm No.: 8E			Name: USB communication error				
Alarm content			· The communication error occurred between driver and a personal computer.				
Display	Detail name		Cause	Check method	Check result	Action	Target
8E.4	USB 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.	LECSS 2-T□
					The transmitted command is within specifications.	Check (2).	
		(2)	The communication protocol is failure.	Check if transmission data conforms 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 is incorrect.	Check the setting of the personal computer.	It is incorrect.	Review the settings.	
8E.5	USB 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 conforms 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 is incorrect.	Check the setting of the personal computer.	It is incorrect.	Review the settings.	

Alarm No.: 88888			Name: Watchdog				
Alarm content			· A part such as CPU is malfunctioning.				
Display	Detail name		Cause	Check method	Check result	Action	Target
88._/ 8888._	Watchdog	(1)	A part in the driver is failure.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.	LECSS 2-T□

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8.4 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.: 91			Name: Driver overheat warning				
Alarm content			・The temperature inside of the driver reached a warning level.				
Display	Detail name		Cause	Check method	Check result	Action	Target
91.1	Main circuit device overheat warning	(1)	Ambient temperature of the driver has exceeded 55 °C.	Check the ambient temperature.	It is over 55 °C.	Lower the ambient temperature.	LECSS 2-T☐
					It is less than 55 °C.	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			・Absolute position detection system battery voltage is low.				
Display	Detail name		Cause	Check method	Check result	Action	Target
92.1	Encoder battery cable disconnection warning	(1)	Battery cable is disconnected.	Check if the battery cable is malfunctioning.	It has a failure.	Replace or repair the cable.	LECSS 2-T☐
					It has no failure.	Check (2).	
		(2)	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 the battery.	
					It is 3.1 V DC or more.	Check (3).	
		(3)	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 repeatability.	It is not repeatable.	Replace the battery.	

Alarm No.: 95			Name: STO warning				
Alarm content			・The STC signal turned off while the servo motor is stopped.				
Display	Detail name		Cause	Check method	Check result	Action	Target
95.1	STO1 off detection	(1)	STO1 was turned off under the following speed conditions. 1) Servo motor speed: 50 r/min or less 2) Linear servo motor speed: 50 mm/s or less 3) Direct drive motor speed: 5 r/min or less	Check if STO1 is off.	It is off.	Turn on STO1.	LECSS2-T□
95.2	STO2 off detection	(1)	STO2 was turned off under the following speed conditions. 1) Servo motor speed: 50 r/min or less 2) Linear servo motor speed: 50 mm/s or less 3) Direct drive motor speed: 5 r/min or less	Check if STO2 is off.	It is off.	Turn on STO2.	

Alarm No.: 96			Name: Home position setting warning				
Alarm content			・Home position setting could not be made.				
Display	Detail name		Cause	Check method	Check result	Action	Target
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 In-position range. Remove the cause of droop pulse occurrence.	LECSS2-T□
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.	Reduce the creep speed.	

Alarm No.: 9F			Name: Battery warning				
Alarm content			・Absolute position detection system battery voltage is low.				
Display	Detail name		Cause	Check method	Check result	Action	Target
9F.1	Low battery	(1)	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.	LECSS2-T□
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.	LECSS2-T□

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.				
Display	Detail name	Cause	Check method	Check result	Action	Target
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 not being using.	LECSS 2-T□

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Alarm No.: E1		Name: Overload 1				
Alarm content		・[AL.50 Overload 1] or [AL.51 Overload 2] may occur.				
Display	Detail name	Cause	Check method	Check result	Action	Target
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].			LECSS 2-T□
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 warning 1 during a stop	(1) The 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 warning 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 warning 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 warning 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] may occur.				
Display	Detail name	Cause	Check method	Check result	Action	Target
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].			LECSS 2-T□

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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.				
Display	Detail name	Cause	Check method	Check result	Action	Target
E3.2	Absolute position counter warning	(1) Something near the device caused it.	Check the noise, ambient temperature, etc.	It has a failure.	Take countermeasures against its cause.	LECSS 2-T□
				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.	
E3.5	Encoder absolute positioning counter warning	Check it with the check method for [AL. E3.2].				

Alarm No.: E4		Name: Parameter warning				
Alarm content		· Out of the setting range was attempted to write during parameter writing.				
Display	Detail name	Cause	Check method	Check result	Action	Target
E4.1	Parameter setting range error warning	(1) Parameter value set from servo system controller is outside setting range.	Check the parameter setting value set with the servo system controller.	It is out of setting range.	Set it within the range.	LECSS 2-T□

Alarm No.: E6		Name: Servo forced stop warning				
Alarm content		· EM2/EM1 (Forced stop) turned off.				
Display	Detail name	Cause	Check method	Check result	Action	Target
E6.1	Forced stop warning	(1) EM2/EM1 (Forced stop) turned off.	Check the status of EM2/EM1.	It is off.	Ensure safety and turn on EM2/EM1 (Forced stop).	LECSS 2-T□
				It is on.	Check (2).	
		(2) An external 24 V DC power supply have not inputted.	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.	

Alarm No.: E7		Name: Controller forced stop warning				
Alarm content		· The forced stop signal of the servo system controller was enabled.				
Display	Detail name	Cause	Check method	Check result	Action	Target
E7.1	Controller forced stop warning	(1) The forced stop signal of the servo system controller was inputted.	Check if the servo system controller is a forced stop status.	It is the forced stop status.	Ensure safety and cancel the forced stop signal of the PC or PLC…etc.	LECSS 2-T□

Alarm No.: E8		Name: Cooling fan speed reduction warning				
Alarm content		· The cooling fan speed decreased to the warning occurrence level or less.				
Display	Detail name	Cause	Check method	Check result	Action	Target
E8.1	Decreased cooling fan speed warning	(1) Foreign matter caught in the cooling fan and the speed was decreased.	Check if a foreign matter is caught in the cooling fan.	Something has been caught.	Remove the foreign matter.	LECSS 2-T□
				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].				

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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.				
Display	Detail name	Cause	Check method	Check result	Action	Target
E9.1	Servo-on signal on during main circuit off	(1) The main circuit power supply is off.	Check if the main circuit power supply is inputted.	It is not inputted.	Turn on the main circuit power.	LECSS 2-T□
				It is inputted.	Check (2).	
		(2) The main circuit power supply connector was disconnected.	Check the main circuit power supply connector.	It is disconnected.	Connect it correctly.	
				It has no failure.	Check (3).	
		(3) The bus voltage is less than the prescribed value. LECSS2-T□ driver: 215 V DC	Check the bus voltage.	The voltage is lower than the prescribed value.	Review the wiring. Check the power supply capacity.	
				The voltage is the prescribed value or higher.	Check (4).	
		(4) The driver is malfunctioning.	Replace the driver, and then check the repeatability.	It is not repeatable.	Replace the driver.	
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 driver: 200 V DC	Review the power supply capacity. Increase the acceleration time constant.	LECSS 2-T□
E9.3	Ready-on signal on during main circuit off	Check it with the check method for [AL. E9.1].				LECSS 2-T□

Alarm No.: EC				Name: Overload 2				
Alarm content				· Operations over rated output were repeated while the servo motor shaft was not rotated.				
Display	Detail name		Cause	Check method	Check result	Action		Target
EC.1	Overload warning 2	(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.		LECSS 2-T□

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.				
Display	Detail name		Cause	Check method	Check result	Action		Target
ED.1	Output watt excess warning	(1)	The status, in which the output wattage (speed × torque or thrust) of the servo motor exceeded 150% of the rated output (continuous thrust), continued steadily.	Check the servo motor speed and torque.	The output wattage is 150% of rating.	Reduce the servo motor speed. Reduce the load.		LECSS 2-T□

Alarm No.: F0				Name: Tough drive warning				
Alarm content				· Tough drive function was activated.				
Display	Detail name		Cause	Check method	Check result	Action		Target
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 alarm No. "10.1".				LECSS 2-T□
F0.3	Vibration tough 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.				
Display	Detail name		Cause	Check method	Check result	Action		Target
F2.1	Drive recorder - Area writing time-out warning	(1)	The Flash-ROM is malfunctioning.	Disconnect the cables except the control circuit power supply, and then check the repeatability.	It is repeatable.	Replace the driver.		LECSS 2-T□
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 disabled.	Replace the driver.		

Alarm No.: F3				Name: Oscillation detection warning				
Alarm content				· [AL. 54 Oscillation detection] may occur.				
Display	Detail name		Cause	Check method	Check result	Action		Target
F3.1	Oscillation detection warning	Check it with the check method for [AL. 54.1].						LECSS 2-T□

8. TROUBLESHOOTING

8.5 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	Possible cause	Check result	Action	Target
The display shows "AA".	The power of the servo system controller was turned off.	Check the power of the servo system controller.	Switch on the power of the servo system controller.	LECSS2 -T□
	A SSCNET III cable was disconnected.	Check if "AA" is displayed in the corresponding axis and following axes.	Replace the SSCNET III cable of the corresponding axis.	
		Check if the connectors (CNIA, CNIB) are unplugged.	Connect it correctly.	
	The power of the driver was turned off.	Check if "AA" is displayed in the corresponding axis and following axes.	Check the power of the driver.	
	The driver-less operation function of servo system controller is enabled.	Check if the driver -less operation function of servo system controller is enabled.	Disable the driver -less operation function.	

SMC

Description	Possible cause	Check result	Action	Target
The display shows "Ab".	The axis is disabled.	Check if the disabling control axis switch is on. SW2-2	Turn off the disabling control axis switch.	LECSS2 -T☐
	The setting of the axis No. is incorrect.	Check that the other driver is not assigned to the same axis No.	Set it correctly.	
	Axis No. does not match with the axis No. set to the servo system controller.	Check the setting and axis No. of the servo system controller.	Set it correctly.	
	Information about the servo series has not set in the simple motion module.	Check the value set in Servo series (Pr.100) in the simple motion module.	Set it correctly.	
	Communication cycle does not match.	Check the communication cycle at the servo system controller side. When using 8 axes or less: 0.222 ms When using 16 axes or less: 0.444 ms When using 32 axes or less: 0.888 ms	Set it correctly.	
	A SSCNET III cable was disconnected.	Check if "Ab" is displayed in the corresponding axis and following axes.	Replace the SSCNET III cable of the corresponding axis.	LECSS2 -T☐
		Check if the connectors (CNIA, CNIB) are unplugged.	Connect it correctly.	
	The power of the driver was turned off.	Check if "Ab" is displayed in the corresponding axis and following axes.	Check the power of the driver.	
	The driver-less operation function of servo system controller is enabled.	Check if the driver-less operation function of servo system controller is enabled.	Disable the driver-less operation function.	
	The driver is malfunctioning.	Check if "Ab" is displayed in the corresponding axis and following axes.	Replace the driver of the corresponding axis.	

SMC

Description	Possible cause	Check result	Action	Target
The display shows "b##". (Note)	Test operation mode has been enabled.	Test operation setting switch (SW2-1) is turned on.	Turn off the test operation setting switch (SW2-1).	LECSS2 -T□
	The system has been in the ready-off state.	Check if the servo ready state is off with the servo system controller.	Turn on the servo-on signals for all axes.	
The display shows "off".	Operation mode for manufacturer setting is enabled.	Check if all of the control axis setting switches (SW2) are on.	Set the control axis setting switches (SW2) correctly.	LECSS2 -T□
The display turned 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. CN2, CN3	Review the wiring of I/O signals.	LECSS2 -T□
	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, and W.	Connect it correctly.	LECSS2 -T□
	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.	
	The servo-on command was inputted with main circuit power supply off.	Check if [AL. E9] is occurring.	Turn on the main circuit power.	
	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 test operation setting switch (SW2-1) is on (up).	Cancel the test operation mode.	
	The motor-less operation has been enabled.	Check the [Pr. PC05] setting.	Disable the motor-less operation.	
	The torque is insufficient due to large load.	Check instantaneous torque using status display (only [A]) 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 the torque limit is enabled.	Cancel the torque limit.	

Note. ## indicates axis No.

Description	Possible cause	Check result	Action	Target
The servo motor does not operate.	The setting of the torque limit is incorrect.	Check if the torque limit is "0". Setting on PC or PLC…etc side	Set it correctly.	LECSS2 -T□
	Machine is interfering with the motor.	Check if machine is interfering.	Remove the interference.	
	For a servo motor with a lock, the lock has not released.	Check the power supply of the lock.	Turn on the lock power.	

8. TROUBLESHOOTING

Description	Possible cause	Check result	Action	Target
The servo motor does not operate.	The axis is disabled.	Check if the disabling control axis switch is on. SW2-2	Turn off the disabling control axis switch.	LECSS2 -T□
	An error is occurring on the servo system controller side.	Check if an error is occurring on the servo system controller side.	Cancel the error of the servo system controller.	
	The setting of a servo parameter is incorrect on the servo system controller side.	Check the settings of servo parameters on the servo system controller side.	Review the setting of the servo parameter on the servo system controller side.	
	The position command is not inputted correctly.	Check cumulative command pulses using setup software (MR Configurator2™) and check if numerical values are changed by inputting the command.	Review the setting of the servo system controller and the servo program.	
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.	LECSS2 -T□
	The connection of the servo motor is incorrect.	Check the wiring of U, V, and 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 a lock, the lock has not released.	Check the power supply of the lock.	Turn on the lock power.	
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 one-touch tuning to reset the load to motor inertia ratio. Set the load to motor inertia ratio correctly for manual setting.	LECSS2 -T□
	The command from the PC or PLC…etc is unstable.	Check the command from the PC or PLC…etc.	Review the command from the PC or PLC…etc. Check the cable for command if there is failure such as disconnection.	
	Torque during acceleration/deceleration is overshooting exceeding the limit of the servo motor when the motor stops.	Check the effective load ratio during acceleration/deceleration if torque exceeds the maximum torque/thrust.	Reduce the effective load ratio by 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.	

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Description	Possible cause	Check result	Action	Target
An unusual noise is occurring at the 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.	LECSS2-T□
	Bearing life expired.	If the servo motor may be driven with safety, remove the load and check the noise with the 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 a lock, the lock has not released.	Check the power supply of the lock.	Turn on the lock power.	
	For a servo motor with a lock, the lock release timing is not correct.	Check the lock release timing.	Review the lock release timing. Please consider that the lock 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.	LECSS2-T□
	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 II.	Execute the advanced vibration suppression control II.	
	Feedback pulses are being miscounted due to entered noise into an encoder cable.	Check the cumulative feedback pulses using status display (only [A]) or setup software (MR Configurator2™) 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 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, and 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.	
	An external vibration propagated to the servo motor.	Check the vibration from outside.	Prevent the vibration from the external vibration source.	

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Description	Possible cause	Check result	Action	Target
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.	LECSS2-T□
	The torque is insufficient due to large load.	Check instantaneous torque using status display (only [A]) 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 TLC (Limiting torque) is on using status display or setup software (MR Configurator2™).	Cancel the torque limit.	
	The setting of the torque limit is incorrect.	Check if the limiting torque is too low. Setting on PC or PLC…etc side	Set it correctly.	
	For a servo motor with a lock, the lock has not released.	Check the power supply of the lock.	Turn on the lock power.	
	The command from the PC or PLC…etc is unstable.	Check the ripple of the command frequency with MR Configurator2™.	Review the command from the PC or PLC…etc. 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.	LECSS2-T□
The motor starts to drive immediately after power on of the driver. The motor starts to drive immediately after servo-on.	For a servo motor with a lock, the lock release timing is not correct.	Check the lock release timing.	Review the lock release timing.	LECSS2-T□
	The connection of the servo motor is incorrect.	Check the wiring of U, V, and W.	Connect it correctly.	

SMC

Description	Possible cause	Check result	Action	Target
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 Z-phase pulse is detected (CR input position) are too close.	Check if a fixed amount (in one revolution) deviates.	Adjust the dog position.	LECSS2-T□
	The in-position range is too large.	Check the setting of the in-position 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 PC or PLC…etc side is incorrect.	Check the program on the PC or PLC…etc side such as home position address settings or sequence programs.	Review the programs on the PC or PLC…etc side.	
The position deviates during operation after home position return.	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.	LECSS2-T□
	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 pulses per revolution, travel distance (setting on the PC or PLC…etc side)	Review the calculation of the reduction ratio.	
	The in-position range is too large.	Check the setting of the in-position range in [Pr. PA10].	Set a narrower in-position range.	
	A mechanical slip occurred. Or backlash of the machine part is large.	Check if "cumulative feedback pulses × travel distance per pulse" matches actual machine position.	Adjust the machine part.	

Description	Possible cause	Check result	Action	Target
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.	LECSS2 -T□
	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.	
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.	LECSS2 -T□
	Capacity shortage or shortage of the maximum torque due to too large load	Check the instantaneous torque using status display if the maximum torque exceeds the torque 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 exceeds the torque 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.	

Description	Possible cause	Check result	Action	Target
A communication with driver fails using setup software (MR Configurator2™). (For details, refer to Help of setup software (MR Configurator2™).)	They are off-line status.	Check if they are off-line.	Set them to on-line.	LECSS2 -T□
	A communication cable is malfunctioning.	Check if the communication cable is malfunctioning.	Replace the communication cable.	
	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.	
For a servo motor with a lock, the lock went out.	The lock is failure due to its life.	Remove the servo motor and all wirings from the machine and check if the motor shaft can be rotated by hands. (If it is rotated by hands, the lock is failure.)	Replace the servo motor.	LECSS2 -T□
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.	LECSS2 -T□
	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 lock is failure due to its life.	Remove the servo motor and all wirings from the machine and check if the motor shaft can be rotated by hands. (If it is rotated by hands, the lock is failure.)	Replace the servo motor.	

SMC

8.6 How to use drive recorder

```
┌─────────────────────────────────────────────────────────────────────┐
│  ┌─────────┐                                                          │
│  │  POINT  │                                                          │
│  └─────────┘                                                          │
│ ●The drive recorder will not operate on the following conditions.     │
│    ・You are using the graph function of setup software (MR           │
│      Configurator2™).                                                 │
│    ・You are using the machine analyzer function.                     │
│    ・[Pr. PF21] is set to "1".                                        │
│    ・The PC or PLC…etc is not connected (except the test operation    │
│      mode).                                                           │
│    ・You are operating in the J3 compatibility mode.                  │
│ ●When the following alarms occur, the drive recorder will not         │
│   operate.                                                            │
│    ・[AL. 10.1 Voltage drop in the control circuit power]             │
│    ・[AL. 12 Memory error 1 (RAM)]                                    │
│    ・[AL. 15 Memory error 2 (EEP-ROM)]                                │
│    ・[AL. 16 Encoder initial communication error 1]                   │
│    ・[AL. 17 Board error]                                             │
│    ・[AL. 19 Memory error 3 (FLASH-ROM)]                              │
│    ・[AL. 1A Servo motor combination error]                           │
│    ・[AL. 1E Encoder initial communication error 2]                   │
│    ・[AL. 1F Encoder initial communication error 3]                   │
│    ・[AL. 25 Absolute position erased]                                │
│    ・[AL. 37 Parameter error]                                         │
│    ・[AL. 70 Load-side encoder initial communication error 1]         │
│    ・[AL. 888 Watchdog]                                               │
│ ●When the graph is displayed with setup software (MR Configurator2™), │
│   the drive recorder function will be enabled. After the graph        │
│   function is completed, passing time set with [Pr. PF21] or cycling  │
│   the power of the driver will enable the drive recorder function     │
│   again.                                                              │
└─────────────────────────────────────────────────────────────────────┘
```

When an alarm occurs at the driver, the conditions (such as motor speed and droop pulses) of the driver before/after alarm occurrences will be recorded. You can refer to the recorded data with setup software (MR Configurator2™).
The drive recorder records sixteen data at alarm occurrences in the past. Occurring an alarm deletes the oldest data.

(1) Trigger setting of drive recorder
   When you operate the drive recorder only for any alarms, set [Pr. PA23 Drive recorder arbitrary alarm trigger setting].
   When the setting value is "0 0 0 0" (initial value) in [Pr. PA23 Drive recorder arbitrary alarm trigger setting], the drive recorder will operate at alarm occurrences other than alarms described in above POINT.

(2) Recordable data by drive recorder

When the setting value is "0 0 0 0" (initial value) in [Pr. PA23 Drive recorder arbitrary alarm trigger setting], the drive recorder will record data of standard column in table 2.1 or 2.2 for all alarms. When you set an alarm in table 2.1 or 2.2 to [Pr. PA23], each data described in alarm column will be recorded. When you set an alarm other than in table 2.1 and 2.2, data described in standard column will be recorded. Refer to table 2.3 for description of each signal.

(3) When the power of the driver is turned off during data storage (immediately after alarm occurrence), the data at alarm occurrence can not be recorded normally. When the following alarms occur, the data at alarm occurrence can not be recorded depending on its circumstances.

・[AL. 13 Clock error]
・[AL. 14 Control process error]
・[AL. 34 SSCNET receive error 1]
・[AL. 36 SSCNET receive error 2]

Table 2.1 LECSS2-T□

		Data 1	Data 2	Data 3	Data 4	Data 5	Data 6	Data 7	Data 8
Standard	Analog	Motor speed	Torque	Current command	Droop pulses (1 pulse)	Speed command	Bus voltage	Effective load ratio	
	Digital	CSON	EMG	ALM2	INP	MBR	RD	STO	IPF
AL.10	Analog	Motor speed	Torque	Current command	Droop pulses (1 pulse)	Speed command	Bus voltage	Effective load ratio	
	Digital	CSON	EMG	ALM2	INP	MBR	RD	STO	IPF
AL.20	Analog	Motor speed	Torque	ABS counter	Within one-revolution position	Current command	Encoder error counter 1	Encoder error counter 2	
	Digital	CSON	EMG	ALM2	INP	MBR	RD	STO	IPF
AL.21	Analog	Motor speed	Torque	ABS counter	Within one-revolution position	Current command	Encoder error counter 1	Encoder error counter 2	
	Digital	CSON	EMG	ALM2	INP	MBR	RD	STO	IPF
AL.24	Analog	Motor speed	Torque	Current command	Within one-revolution position	Bus voltage	U-phase current feedback	V-phase current feedback	
	Digital	CSON	EMG	ALM2	INP	MBR	RD	STO	IPF
AL.30	Analog	Motor speed	Torque	Current command	Droop pulses (1 pulse)	Bus voltage	Regenerative load ratio	Effective load ratio	
	Digital	CSON	EMG	ALM2	INP	MBR	RD	STO	IPF
AL.31	Analog	Motor speed	Torque	Current command	Command pulse frequency	Within one-revolution position	Speed command	Bus voltage	
	Digital	CSON	EMG	ALM2	INP	MBR	RD	STO	IPF
AL.32	Analog	Motor speed	Torque	Current command	Bus voltage	Effective load ratio	U-phase current feedback	V-phase current feedback	
	Digital	CSON	EMG	ALM2	INP	MBR	RD	STO	IPF
AL.33	Analog	Motor speed	Torque	Current command	Speed command	Bus voltage	Regenerative load ratio	Effective load ratio	
	Digital	CSON	EMG	ALM2	INP	MBR	RD	STO	IPF
AL.35	Analog	Motor speed	Torque	Current command	Command pulse frequency	Droop pulses (1 pulse)	Speed command	Bus voltage	
	Digital	CSON	EMG	ALM2	INP	MBR	RD	STO	IPF
AL. 42	Analog	Motor speed	Torque	Motor-side/load-side position deviation (100 pulses)	Motor-side/load-side speed deviation	Command pulse frequency (speed unit)	Droop pulses (100 pulses)	Load-side droop pulses (100 pulses)	
	Digital	CSON	EMG	ALM2	INP	MBR	RD	STO	IPF
AL.46	Analog	Motor speed	Torque	Current command	Internal temperature of encoder	Temperature of motor thermistor	Bus voltage	Effective load ratio	
	Digital	CSON	EMG	ALM2	INP	MBR	RD	STO	IPF
AL.50	Analog	Motor speed	Torque	Current command	Droop pulses (100 pulses)	Overload alarm margin	Bus voltage	Effective load ratio	
	Digital	CSON	EMG	ALM2	INP	MBR	RD	STO	IPF
AL.51	Analog	Motor speed	Torque	Current command	Droop pulses (100 pulses)	Overload alarm margin	Bus voltage	Effective load ratio	
	Digital	CSON	EMG	ALM2	INP	MBR	RD	STO	IPF
AL.52	Analog	Motor speed	Torque	Current command	Droop pulses (100 pulses)	Speed command	Bus voltage	Error excessive alarm margin	
	Digital	CSON	EMG	ALM2	INP	MBR	RD	STO	TLC
AL. 71 (Note)	Analog	Motor speed	Torque	Load-side encoder information 2	Load-side encoder information 1	Current command	Load-side encoder error counter 1	Load-side encoder error counter 2	
	Digital	CSON	EMG	ALM2	INP	MBR	RD	STO	IPF
AL. 72 (Note)	Analog	Motor speed	Torque	Load-side encoder information 2	Load-side encoder information 1	Current command	Load-side encoder error counter 1	Load-side encoder error counter 2	
	Digital	CSON	EMG	ALM2	INP	MBR	RD	STO	IPF
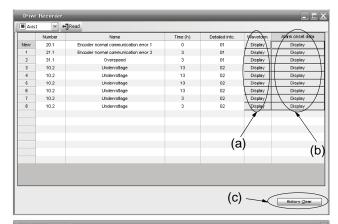
Table 2.3 Signal explanations

	Signal name	Description	Unit
Analog	Motor speed	The servo motor speed is displayed.	[r/min]
	Torque	The servo motor torque is displayed with current value. The value of torque being occurred is displayed in real time considering a rated torque as 100%.	[0.1%]
	Current command	This indicates current command applying to the servo motor.	[0.1%]
	Droop pulses (1 pulse)	This indicates the number of droop pulses in the deviation counter per pulse.	[pulse]
	Droop pulses (100 pulses)	This indicates the number of droop pulses in the deviation counter per 100 pulses.	[100 pulses]
	Speed command	This indicates speed command applying to the servo motor.	[r/min]
	Bus voltage	This indicates bus voltage at the converter of the driver.	[V]
	Effective load ratio	The continuous effective load torque is displayed. This indicates effective value for past 15 seconds.	[0.1%]
	ABS counter	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.	[rev]
	Within one-revolution position	Position within one revolution is displayed in encoder pulses.	[16 pulses]
	Encoder error counter 1	This indicates the number of cumulative errors during a communication with the encoder.	[times]
	Encoder error counter 2	The same as encoder error counter 1.	[times]
	U-phase current feedback	This indicates U-phase current value applying to the servo motor per internal unit.	
	V-phase current feedback	This indicates V-phase current value applying to the servo motor per internal unit.	
	Regenerative load ratio	The ratio of regenerative power to permissible regenerative power is displayed in %.	[0.1%]
	Command pulse frequency	This indicates the command pulse frequency.	[1.125 kpps]
	Command pulse frequency (speed unit)	This converts and indicates command pulse frequency per servo motor speed.	[r/min]
	Motor-side/load-side position deviation (100 pulses)	This indicates a deviation between motor-side position and load-side position during fully closed loop control. The number of pulses displayed is in the load-side encoder pulse unit.	[100 pulses]
	Motor-side/load-side speed deviation	This indicates a deviation between motor speed and load-side speed during fully closed loop control.	[r/min]
	Load-side droop pulses (100 pulses)	Droop pulses of the deviation counter between a load-side position and a command are displayed.	[100 pulses]
	Internal temperature of encoder	Inside temperature of encoder detected by the encoder is displayed.	[˚C]
	Temperature of motor thermistor	The thermistor temperature is displayed for the rotary servo motor with thermistor, linear servo motor with thermistor, and direct drive motor.	[˚C]
	Overload alarm margin	This indicates margins to the levels which trigger [AL. 50 Overload 1] and [AL. 51 Overload 2] in percent. When the value becomes 0%, the overload alarm will occur.	[0.1%]
	Error excessive alarm margin	This indicates a margin to the level which trigger the error excessive alarm in encoder pulse unit. When the value becomes 0 pulse, the error excessive alarm will occur.	[pulse]
	Load-side encoder information 1	The position in load-side encoder 1-revolution is displayed. This indicates a Z-phase counter for the INC linear encoder. The value is counted up from 0 based on the home position (reference mark). This indicates an absolute position for the ABS linear encoder. It is displayed in load-side encoder pulse unit.	[pulse]
	Load-side encoder information 2	Multi-revolution counter of the load-side encoder is displayed.	[pulse]
	Load-side encoder error counter 1	This indicates the number of cumulative errors during a communication with the load-side encoder.	[times]
	Load-side encoder error counter 2	The same as load-side encoder error counter 1.	[times]

SMC
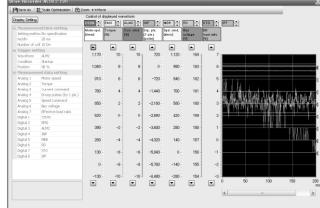
	Signal name	Description	Unit
Digital	CSON	This indicates status of the servo-on signal from the PC or PLC…etc.	
	SON	This Indicates the SON status of the external input signal.	
	EMG	This indicates status of the emergency stop input.	
	EM2/EM1	This Indicates the EM2/EM1 status of the external input signal.	
	ALM2	This will turn on when an alarm is detected in the driver. This changes faster than ALM of the external output signal.	
	INP	This indicates INP status of the external output signal.	
	MBR	This indicates MBR status of the external output signal.	
	RD	This indicates RD status of the external output signal.	
	STO	This Indicates the STO status of the external input signal.	
	IPF	This will turn on when the control circuit power becomes instantaneous power failure status.	

SMC

8.7 How to display drive recorder information
Select "Diagnosis" and "Drive Recorder" from the menu bar of setup software (MR Configurator2™). The window shown in the right hand image will be displayed.
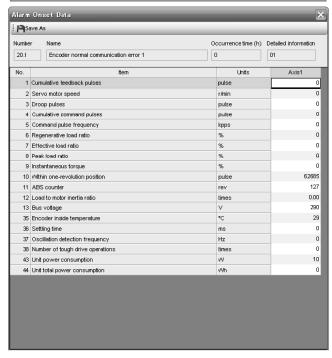
(a) Click the Waveform-Display button to display the graph preview window which shows data before and after alarm occurrence.
For operating the graph preview window, refer to Help of setup software (MR Configurator2™).

(b) Click the Display button of Alarm onset data to display each data at alarm occurrence.

(c) Click the History Clear button to delete all data at alarm occurrence recorded in the driver. After clicking the History Clear button, cycle the power of the driver. Note that the time to restart will be longer than usual due to the deletion of the data.
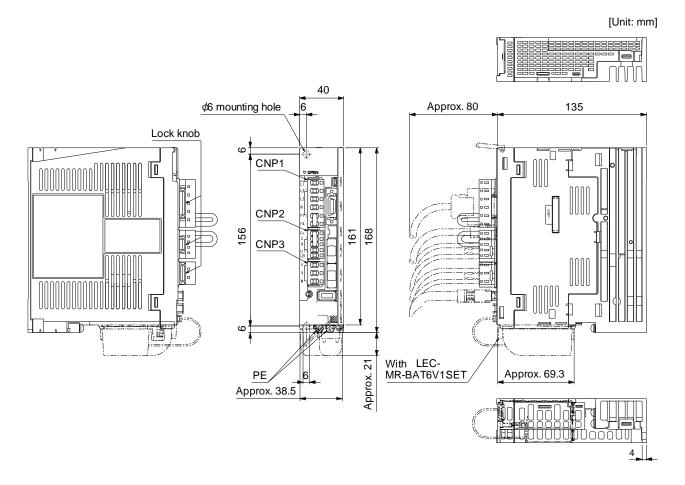
9. OUTLINE DRAWINGS
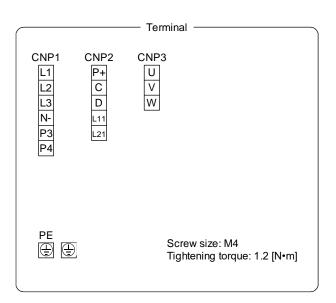
9. OUTLINE DRAWINGS
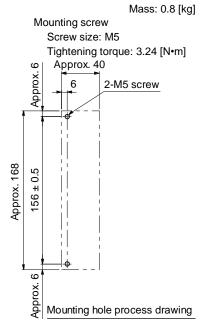
9.1 Driver

(1) LECSS2-T5/LECSS2-T7

[Unit: mm]

Lock knob

40

6

φ6 mounting hole

CNP1
CNP2
CNP3

156

161

168

Approx. 21

PE

Approx. 38.5

6

Approx. 80

135

With LEC-MR-BAT6V1SET

Approx. 69.3

4

Mass: 0.8 [kg]

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 screw
Screw size: M5
Tightening torque: 3.24 [N•m]

Approx. 6

Approx. 40

6

2-M5 screw

Approx. 168

156 ± 0.5

Approx. 6

Mounting hole process drawing

SMC

9. OUTLINE DRAWINGS

(2) LECSS2-T8

[Unit: mm]

With LEC-MR-BAT6V1SET

Mass: 1.0 [kg]

Mounting screw
Screw size: M5
Tightening torque: 3.24 [N•m]

Mounting hole process drawing

Terminal

CNP1	CNP2	CNP3
L1	P+	U
L2	C	V
L3	D	W
N-	L11	
P3	L21	
P4		

PE

Screw size: M4
Tightening torque: 1.2 [N•m]

SMC

9. OUTLINE DRAWINGS

(3) LECSS2-T9

[Unit: mm]

Terminal

CNP1	CNP2	CNP3
L1	P+	U
L2	C	V
L3	D	W
N-	L11	
P3	L21	
P4		

PE

Screw size: M4
Tightening torque: 1.2 [N•m]

Mass: 1.4 [kg]

Mounting screw
Screw size: M5
Tightening torque: 3.24 [N•m]

Mounting hole process drawing

SMC

9. OUTLINE DRAWINGS

9.2 Connector
(1)CN1A/CN1B connector

[Unit: mm]

F0-PF2D103

4.8
13.4
15
6.7
9.3
1.7
2.3
17.6 ± 0.2
20.9 ± 0.2
8

(2) LE-CSNS

[Unit: mm]

E
D
A
C
39.0
23.8
B
12.7
Logo etc, are indicated here.
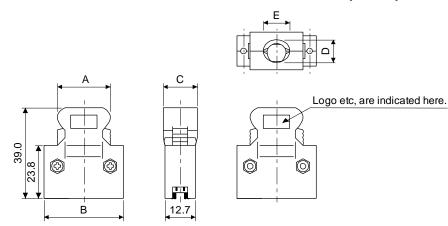
Connector	Shell kit	Each type of dimension				
		A	B	C	D	E
10120-3000PE	10320-52F0-008	22.0	33.3	14.0	10.0	12.0

Accept wire : AWG 24, 26, 28, 30

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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.
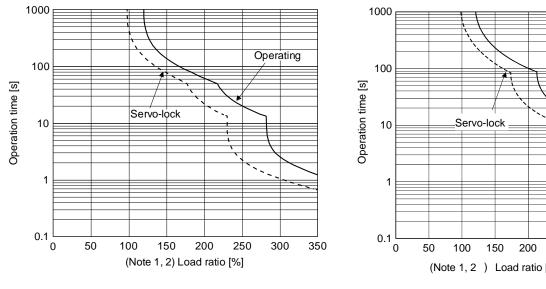
When unbalanced torque is generated, such as in a vertical lift machine, it is recommended that the unbalanced torque of the machine be kept at 70% or less of the motor's rated torque.
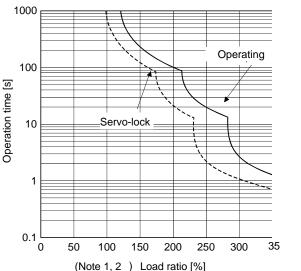
This driver has solid-state servo motor overload protection. (The servo motor overload current (full load current) is set on the basis of 120% rated current of the driver.)

The following table shows combinations of each servo motor and graph of overload protection characteristics.

Servo motor LE-□-□	Graph of overload protection characteristics
T5 T6	Characteristics a
T7 T8 T9	Characteristics b

The following graphs show overload protection characteristics.

Characteristics a

Characteristics b

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 30 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-□-□ servo motor.

Fig. 10.1 Electronic thermal protection characteristics

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10. 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	
LECSS2-T5	LE-T5-□	0.3	25	15	0.5
	LE-T6-□	0.3	25	15	0.5
LECSS2-T7	LE-T7-□	0.5	25	15	0.5
LECSS2-T8	LE-T8-□	0.9	35	15	0.7
LECSS2-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.

$$A = \frac{P}{K \cdot \Delta T} \qquad (10.1)$$

A: Heat dissipation area [m²]
P: Loss generated in the cabinet [W]
ΔT: Difference between internal and ambient temperatures [°C]
K: Heat dissipation coefficient [5 to 6]

SMC

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.

(Outside the cabinet)   (Inside the cabinet)

Air flow
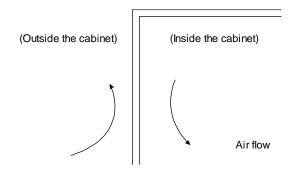
Fig. 10.2 Temperature distribution in an enclosed type cabinet

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. CHARACTERISTICS

10.3 Dynamic brake characteristics

> **POINT**
> ● Do not use dynamic brake 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 brake 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 LECSS2-T□ may have the different coasting distance from that of the previous model.
> ● The electronic dynamic brake operates in the initial state for the servo motors of 400 W or smaller capacity. The time constant "τ" for the electronic dynamic brake will be shorter than that of normal dynamic brake. Therefore, coasting distance will be longer than that of normal dynamic brake. For how to set the electronic dynamic brake, refer to [Pr. PF06] and [Pr. PF12].

10.3.1 Dynamic brake operation

  (1) Calculation of coasting distance

     Fig. 10.3 shows the pattern in which the servo motor comes to a stop when the dynamic brake is operated. Use equation 10.2 to calculate an approximate coasting distance to a stop. The dynamic brake time constant τ varies with the servo motor and machine operation speeds. (Refer to (2) 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.
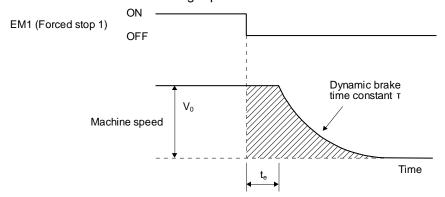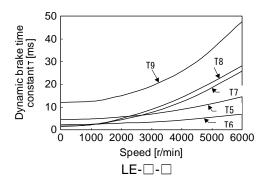
Fig. 10.3 Dynamic brake operation diagram

$$L_{max} = \frac{V_0}{60} \cdot \left\{ t_e + \tau \left(1 + \frac{J_L}{J_M} \right) \right\} \quad \cdots \quad (10.2)$$

L_{max}: Maximum coasting distance ·· [mm]
V_0: Machine's fast feed speed ·· [mm/min]
J_M: Moment of inertia of the servo motor ··· [× 10^{-4} kg·m^2]
J_L: Load moment of inertia converted into equivalent value on servo motor shaft ·············· [× 10^{-4} kg·m^2]
τ: Dynamic brake time constant ·· [s]
t_e: Delay time of control section ·· [s]
    For LECSS2-T□, there is internal relay delay time of about 10 ms.

10. CHARACTERISTICS

(2) Dynamic brake time constant
The following shows necessary dynamic brake time constant τ for equation 10.2.

LE-□-□

10.3.2 Permissible load to motor inertia when the dynamic brake is used
Use the dynamic brake under the load to motor inertia ratio indicated in the following table. If the load inertia moment is higher than this value, the dynamic brake 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.
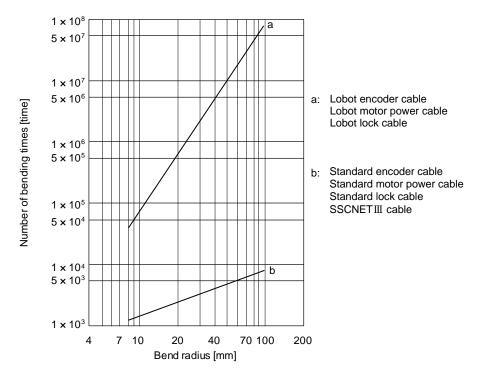
Servo motor	Permissible load to motor inertia ratio [multiplier]
LE-T5-□	30
LE-T6-□	
LE-T7-□	
LE-T8-□	
LE-T9-□	

10. CHARACTERISTICS

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.

a: Lobot encoder cable
    Lobot motor power cable
    Lobot lock cable

b: Standard encoder cable
    Standard motor power cable
    Standard lock cable
    SSCNETIII cable

10.5 Inrush currents at power-on of main circuit and control circuit

The following table indicates the inrush currents (reference data) that will flow when 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 LECSS2-T5 to LECSS2-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)
LECSS2-T5/ LECSS2-T7/ LECSS2-T8	30 A (attenuated to approx. 3 A in 20 ms)	20 A to 30 A (attenuated to approx. 1 A in 20 ms)
LECSS2-T9	34 A (attenuated to approx. 7 A in 20 ms)	

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.

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11. OPTIONS AND PERIPHERAL EQUIPMENT

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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.
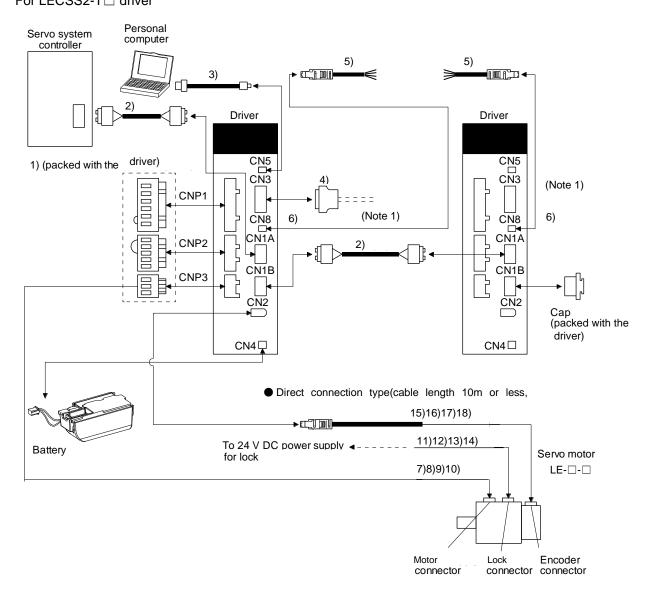
11.1 Cable/connector sets

> 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.

SMC

11.1.1 Combinations of cable/connector sets
For LECSS2-T□ driver

Note 1. When not using the STO function, attach the short-circuit connector (6)) came with a driver.

SMC

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) Open tool (CNP1 Connector comes with)	Supplied with drivers of 750 W or less
			Applicable wire size: 0.8 mm^2 to 2.1 mm^2 (AWG 18 to 14) Insulator OD: to 3.9 mm			
2)	SSCNET III cable	LE-CSS-□ Cable length: 0.15 m to 3 m (Refer to section 11.1.3.)	Connector: PF-2D103 (JAE)	Connector: PF-2D103 (JAE)		Standard cord inside cabinet
3)	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
4)	Connector set	LE-CSNS		Connector: 10120-3000PE Shell kit: 10320-52F0-008 (Sumitomo 3M Limited or equivalent)		
5)	STO cable	LEC-MR-D05UDL3M		Connector set: 2069250-1 (TE Connectivity)		Connection cable for the CN8 connector
6)	Short-circuit connector					Supplied with driver

SMC
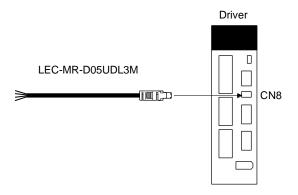
No.	Product name	Model	Description	Application
7)	Motor power supply cable	LE-CSM-S□A Cable length: 2・5・10m	Motor cable LE-□-□ series	IP65 Load side lead
8)	Motor power supply cable	LE-CSM-R□A Cable length: 2・5・10m		IP65 Load side lead Robot cable
9)	Motor power supply cable	LE-CSM-S□B Cable length: 2・5・10m	Motor cable LE-□-□ series	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	Lock cable LE-□-□ series	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	Lock cable LE-□-□ series	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	Encoder connector LE-□-□ series	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	Encoder connector LE-□-□ series	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

SMC

11.1.2 STO cable
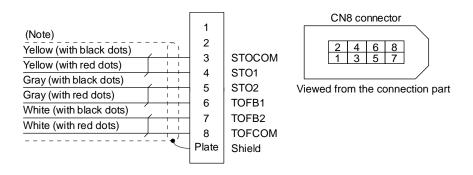
This cable is for connecting an external device to the CN8 connector.

Cable model	Cable length	Application
LEC-MR-D05UDL3M	3 m	Connection cable for the CN8 connector

(1) Configuration diagram

Driver

LEC-MR-D05UDL3M

CN8

(2) Internal wiring diagram

1	
2	
(Note)	
Yellow (with black dots)	3 STOCOM
Yellow (with red dots)	4 STO1
Gray (with black dots)	5 STO2
Gray (with red dots)	6 TOFB1
White (with black dots)	7 TOFB2
White (with red dots)	8 TOFCOM
	Plate Shield

CN8 connector

2	4	6	8
1	3	5	7

Viewed from the connection part

Note. Do not use the two core wires with orange insulator (with red or black dots).

SMC

11.1.3 SSCNET III cable

```
┌─────────────┐
│   POINT     │
└─────────────┘
●Do not look directly at the light (red) generated from CN1A/CN1B connector of
  the driver or the end of SSCNET III cable. The light can be a discomfort when it
  enters the eye.
  ( For LECSS-S, emitted light (transparent and colorless).)
```

(1) Model explanations

The numbers in the cable length field of the table indicate the symbol filling the underline "_" in the cable model. The cables of the lengths with the symbols are available.

Cable model	Cable length					Bending life	Application/remark
	0.15 m	0.3 m	0.5 m	1 m	3 m		
LE-CSS-□	L	K	J	1	3	Standard	Using standard cord inside cabinet
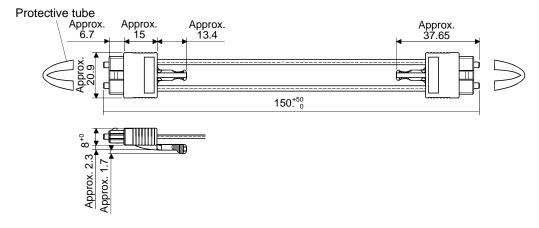
(2) Specifications

		Description	
SSCNET III cable model		LE-CSS-□	
SSCNET III cable length		0.15 m	0.3 m to 3 m
Optical cable (cord)	Minimum bend radius	25 mm	
	Tension strength	70 N	140 N
	Temperature range for use (Note)	-40 °C to 85 °C	
	Ambience	Indoors (no direct sunlight), no solvent or oil	
	Appearance [mm]	2.2 ± 0.07	2.2 ± 0.07 4.4 ± 0.1

Note. This temperature range for use is the value for optical cable (cord) only. Temperature condition for the connector is the same as that for driver.

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(3) Dimensions
  (a) LE-CSS-L

[Unit: mm]

Protective tube

Approx. 6.7
Approx. 15
Approx. 13.4
Approx. 37.65

Approx. 20.9

150^{+50}_{-0}

8^{+0}

Approx. 2.3
Approx. 1.7
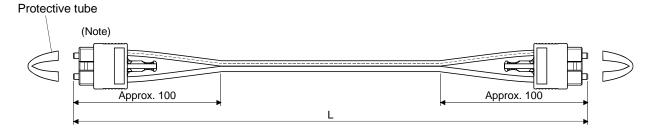
(b) LE-CSS-K, LE-CSS-J, LE-CSS-1, LE-CSS-3

Refer to the table shown in (1) of this section for cable length (L).

[Unit: mm]

Protective tube

(Note)

Approx. 100
Approx. 100

L

Note. Dimension of connector part is the same as that of LE-CSS-L.

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11. OPTIONS AND PERIPHERAL EQUIPMENT
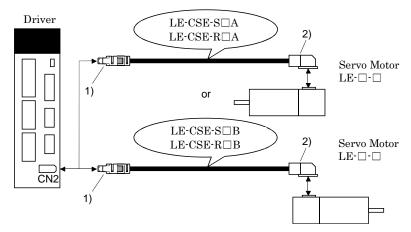
11.1.4 Encoder cable/connector sets

(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.

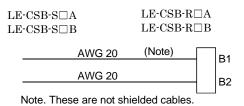| Cable model	Cable length			Protective structure	Flex life	Application
	2m	5m	10m			
LE-CSE-S□A	2	5	A	IP65	Standard	For LE-□-□ servo motor Axis side lead
LE-CSE-R□A	2	5	A	IP65	Robot cable	
LE-CSE-S□B	2	5	A	IP65	Standard	For LE-□-□ servo motor Counter axis side lead
LE-CSE-R□B	2	5	A	IP65	Robot cable	
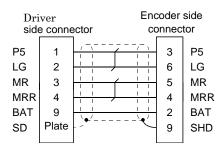
(a) Connection of driver and servo motor

Cable model	1) For CN2 connector	2) For encoder connector
LE-CSE−S□A	Receptacle: 36210-0100PL Connector set: 54599-1019(Molex) Shell kit: 36310-3200-008 (Sumitomo 3M Limited)	Connector: 1674320-1 Crimping tool for ground clip: 1596970-1 Crimping tool for receptacle contact: 1596847-1 (Tyco Electronics)
LE-CSE−R□A	(Note) Signal layout　　　　(Note) Signal layout	(Note) Signal layout
LE-CSE−S□B	View seen from wiring side.　View seen from wiring side.	View seen from wiring side.
LE-CSE−R□B	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.	Note. Keep open the pin shown with an ◺.

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(b) Cable internal wiring diagram

LE-CSE-S☐A   LE-CSE-R☐A
LE-CSE-S☐B   LE-CSE-R☐B

Driver
side connector

Encoder side
connector

P5	1		3	P5
LG	2		6	LG
MR	3		5	MR
MRR	4		4	MRR
BAT	9		2	BAT
SD	Plate		9	SHD

SMC

11. OPTIONS AND PERIPHERAL EQUIPMENT
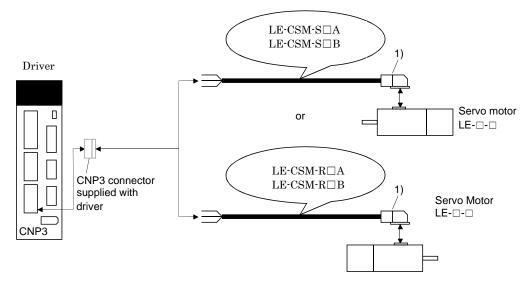
11.1.5 Motor cables

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
LE-CSM–S□B		
LE-CSM-R□A		1 ⏚ 2 U 3 V 4 W
LE-CSM–R□B		View seen from wiring side.

(2) Internal wiring diagram

LE-CSM-S□A   LE-CSM-R□A
LE-CSM-S□B   LE-CSM-R□B

AWG 19 (Red)   (Note)
AWG 19 (White)
AWG 19 (Black)
AWG 19 (Green/yellow)

U
V
W
⏚

Note. These are not shielded cables.

SMC
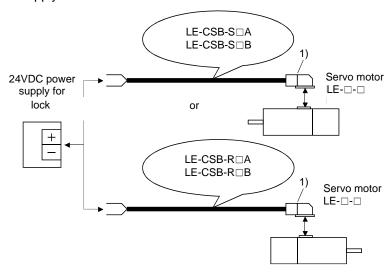
11.1.6 Lock cables

These cables are motor brake 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 motor brake connector	
LE-CSB-S□A	Connector: JN4FT02SJ1-R Hood, socket insulator Bushing, ground nut Contact: ST-TMH-S-C1B-100-(A534G) Crimping tool: CT160-3-TMH5B (Japan Aviation Electronics Industry)	Signal layout 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

LE-CSB-S□A   LE-CSB-R□A
LE-CSB-S□B   LE-CSB-R□B

AWG 20   (Note)   B1

AWG 20   B2

Note. These are not shielded cables.

11. OPTIONS AND PERIPHERAL EQUIPMENT

11.2 Regenerative options

⚠CAUTION	●Do not use drivers with regenerative options other than the combinations specified below. Otherwise, it may cause a fire.
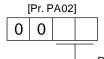
11.2.1 Combination and regenerative power

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]	LEC-MR-RB-32 [40Ω]
LECSS2-T5		30		
LECSS2-T7	10	30	100	
LECSS2-T8	10	30	100	
LECSS2-T9	20	30	100	300

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
04: LEC-MR-RB-32

SMC

11.2.3 Selection of regenerative option
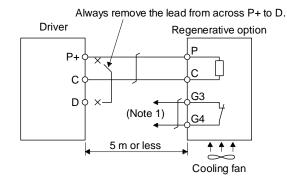
POINT
●For the wire sizes used for wiring, refer to section 11.5.

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) LECSS2-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
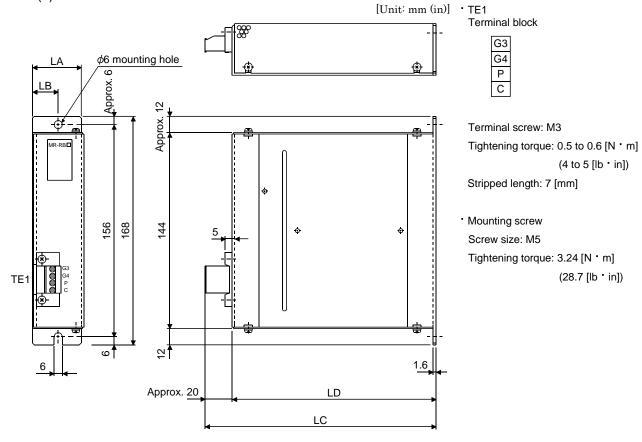
11. OPTIONS AND PERIPHERAL EQUIPMENT

11.2.4 Dimensions
    (1) LEC-MR-RB-032/LEC-MR-RB-12

[Unit: mm (in)]

· TE1
Terminal block

| G3 |
| G4 |
| P |
| C |

Terminal screw: M3
Tightening torque: 0.5 to 0.6 [N・m]
                   (4 to 5 [lb・in])
Stripped length: 7 [mm]

· Mounting screw
Screw size: M5
Tightening torque: 3.24 [N・m]
                   (28.7 [lb・in])

Regenerative option	Variable dimensions				Mass	
	LA	LB	LC	LD	[kg]	[lb]
LEC-MR-RB-032	30	15	119	99	0.5	1.1
LEC-MR-RB-12	40	15	169	149	1.1	2.4

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11. OPTIONS AND PERIPHERAL EQUIPMENT

(2) LEC-MR-RB-32

[Unit: mm]

Cooling fan mounting screen (2-M4 screw)

8.5
125
8.5
10
7
90
100

150
142
82.5
30
101.5
82.5
A
318
B

Approx. 30
79
Intake

Terminal block

| P |
| C |
| G3 |
| G4 |

Terminal screw size: M4
Tightening torque: 1.2 [N•m]

・ Mounting screw
Screw size: M5
Tightening torque: 5.4 [N•m]

Mass: 2.9 [kg]

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11. OPTIONS AND PERIPHERAL EQUIPMENT

11.3 Setup software (MR Configurator2TM)

Setup software (MR Configurator2TM) (LEC-MRC2E) uses the communication function of the driver to perform parameter setting changes, graph display, test operation, etc. on a personal computer.
When setup software (MR Configurator2TM) is used, the selection of the model of LECSS□-T□ is needed. Please select 'MR-J4-B' by "Model" - "New" - "Project".

11.3.1 Specifications

Item	Description
Compatibility with a driver	The set up software(MR Configurator2 TM) software version compatible with the driver is Ver1.52E or later.
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

Note 1. This is available only in the standard control mode. This will be available in the fully closed loop control mode, linear servo motor control mode, and DD motor control mode in the future.

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 ™) 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.
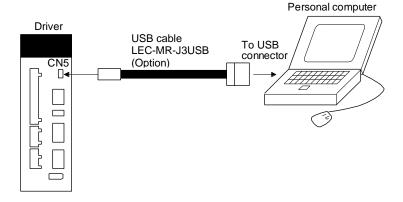
2. Windows ® and Windows Vista ® is the registered trademarks of Microsoft Corporation in the United States and other countries.

3. On some personal computers, set up software (MR Configurator2™) 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. OPTIONS AND PERIPHERAL EQUIPMENT
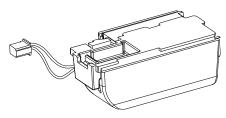
11.4 Battery (LEC-MR-BAT6V1SET)

> POINT
>
> ●Refer to appendix 2 and 3 for battery transportation and the new EU Battery Directive.
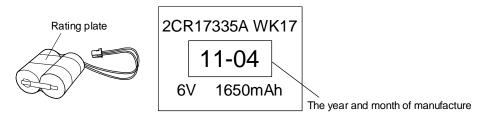
(1) Purpose of use for LEC-MR-BAT6V1SET

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.

Rating plate

2CR17335A WK17

11-04

6V   1650mAh

The year and month of manufacture

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11. OPTIONS AND PERIPHERAL EQUIPMENT

11.5 Selection example of wires
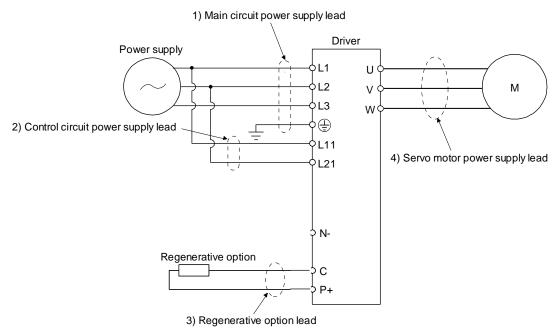
```
┌─────────────────────────────────────────────────────────────────┐
│  ┌──────────┐                                                     │
│  │  POINT   │                                                     │
│  └──────────┘                                                     │
│  ●Refer to section 11.1.3 for SSCNET III cable.                   │
│  ●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 [mm²] (Note 1)			
	1) L1/L2/L3/⏚	2) L11/L21	3) P+/C	4) U/V/W/⏚
LECSS2-T5	2 (AWG 14)	1.25 to 2 (AWG 16 to 14)	2 (AWG 14)	AWG 18 to 14
LECSS2-T7				
LECSS2-T8				
LECSS2-T9				

Note 1. Wires are selected based on the highest rated current among combining servo motors.

11. OPTIONS AND PERIPHERAL EQUIPMENT

(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 3) Finishing OD [mm]	Wire model
					Structure [Wires/mm]	Conductor resistance [Ω/mm]	Insulation coating OD d [mm] (Note 1)		
Encoder Cable	LE-CSE-S□A	2 to 10	AWG22	6 (3 pairs)	7/0.26	53 or less	1.2	7.1±0.3	(Note 3) VSVP 7/0.26 (AWG#22 or equivalent)-3P Ban-gi-shi-16823
	LE-CSE-S□B								
	LE-CSE-R□A	2 to 10	AWG22	6 (3 pairs)	70/0.08	56 or less	1.2	7.1±0.3	(Note 3) ETFE・SVP 70/0.08 (AWG#22 or equivalent)-3P Ban-gi-shi-16824
	LE-CSE-R□B								
Motor cable	LE-CSM-S□A	2 to 10	(Note 5) AWG19	4	50/0.08	25.40 or less	1.8	5.7±0.3	(Note 4) UL Style 2103 AWG19 4 cores
	LE-CSM-S□B	2 to 10							
	LE-CSM-R□A	2 to 10							
	LE-CSM-R□B	2 to 10							
Lock cable	LE-CSB-S□A	2 to 10	(Note 5) AWG20	2	100/0.08	38.14 or less	1.3	4.0±0.3	(Note 4) UL Style 2103 AWG20 2 cores
	LE-CSB-S□B	2 to 10							
	LE-CSB-R□A	2 to 10							
	LE-CSB-R□B	2 to 10							

Note 1. d is as shown below.

Conductor Insulation sheath

2. Purchased from Toa Electric Industry

3. Standard OD. Max. OD is about 10% greater.

4. Kurabe

5. These wire sizes assume that the UL-compliant wires are used at the wiring length of 10m.

11. OPTIONS AND PERIPHERAL EQUIPMENT

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)		Voltage AC [V]	Fuse			Magnetic contactor (Note 2)
	Frame, rated current			Class	Current [A]	Voltage AC [V]	
	Power factor Improving reactor is not used	Power factor Improving reactor is used					
LECSS2-T5	30 A frame 5 A		240	T	10	300	S-N10 （Mitsubishi Electric Corporation）
LECSS2-T7							
LECSS2-T8	30 A frame 10 A	30 A frame 5 A			15		
LECSS2-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]
LECSS2-T5	30 A frame 5 A	240	1	300	1	250
LECSS2-T7						
LECSS2-T8						
LECSS2-T9						

11.7 Relay (recommended)
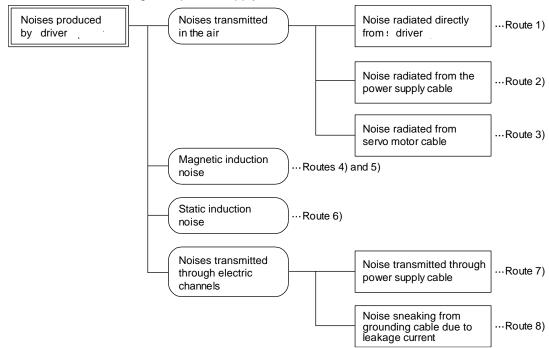
The following relays should be used with the interfaces
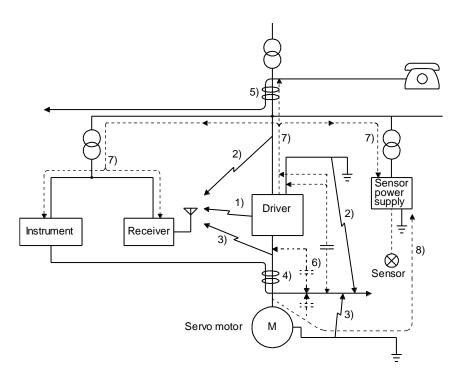
Interface	Selection example
Digital input (interface DI-1) Relay used for digital input command signals	To prevent defective contacts, use a relay for small signal (twin contacts). (Ex.) Omron : type G2A, MY
Digital output (interface DO-1) Relay used for digital output signals	Small relay with 12 V DC or 24 V DC of rated current 40 mA or less (Ex.) Omron : type MY

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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.

Noises produced by driver	Noises transmitted in the air	Noise radiated directly from driver	···Route 1)
		Noise radiated from the power supply cable	···Route 2)
		Noise radiated from servo motor cable	···Route 3)
	Magnetic induction noise		···Routes 4) and 5)
	Static induction noise		···Route 6)
	Noises transmitted through electric channels	Noise transmitted through power supply cable	···Route 7)
		Noise sneaking from grounding cable due to leakage current	···Route 8)

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.
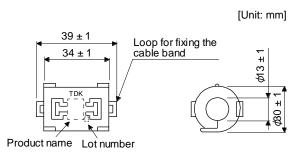
(2) Noise reduction techniques

  (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.
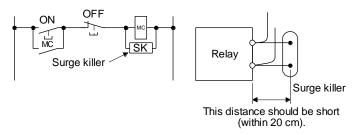
Impedance [Ω]	
10 MHz to 100 MHz	100 MHz to 500 MHz
80	150

[Unit: mm]

Outline drawing (ZCAT3035-1330)
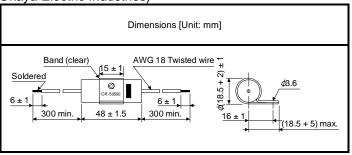
  (b) Surge killer (recommended)

    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.

This distance should be short (within 20 cm).

(Ex.) CR-50500 Okaya Electric Industries)
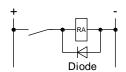
Rated voltage AC [V]	C [μF ± 20%]	R [Ω ± 30%]	Test voltage	Dimensions [Unit: mm]
250	0.5	50 (1/2W)	Between terminals: 625 V AC, 50 Hz/60 Hz 60 s; Between terminal and case: 2000 V AC 50/60 Hz 60 s	

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.

SMC
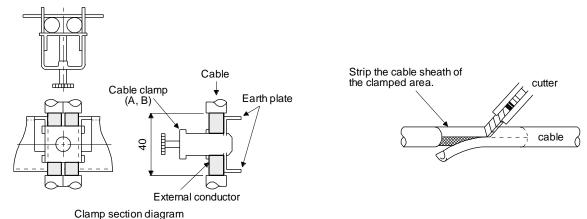
(c) Cable clamp fitting (AERSBAN -□SET (Mitsubishi Electric Corporation))

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.
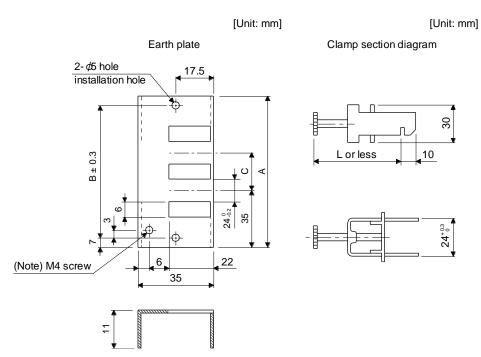
Install the grounding plate near the driver for the encoder cable. Peel part of the cable sheath to expose the external conductor, and press that part against the grounding plate with the cable clamp. If the cable is thin, clamp several cables in a bunch.

The cable clamp comes as a set with the grounding plate.

[Unit: mm]

Clamp section diagram

・ Dimensions

[Unit: mm]   [Unit: mm]

Earth plate   Clamp section diagram
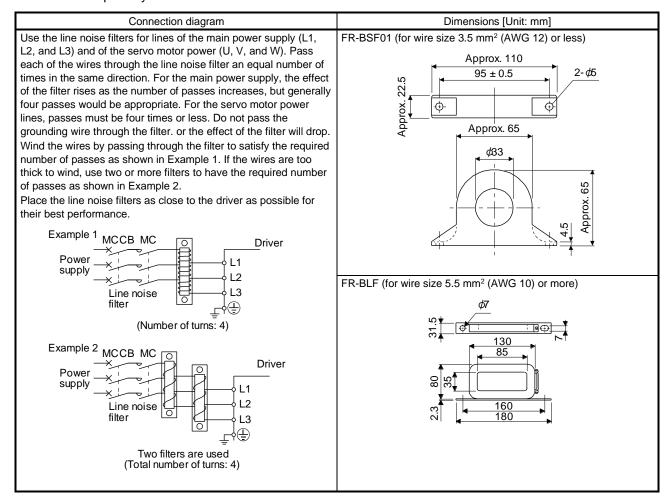
Note. Screw hole for grounding. Connect it to the grounding plate of the cabinet.

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

SMC
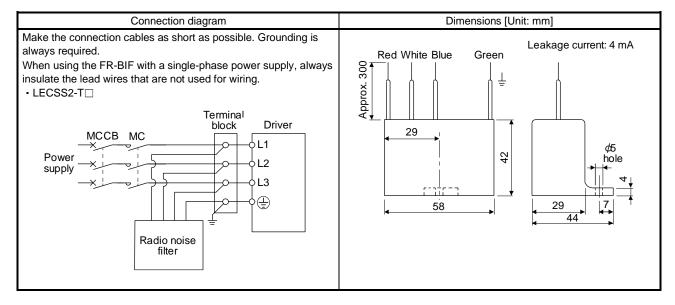
(d) Line noise filter (FR-BSF01/FR-BLF of Mitsubishi Electric Corparation)

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.

Connection diagram	Dimensions [Unit: mm]
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. Example 1 (Number of turns: 4) Example 2 Two filters are used (Total number of turns: 4)	FR-BSF01 (for wire size 3.5 mm^2 (AWG 12) or less) FR-BLF (for wire size 5.5 mm^2 (AWG 10) or more)

(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. ・LECSS2-T□ 	
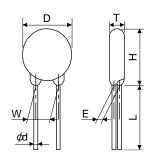
(f) Varistor for input power supply (recommended)

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
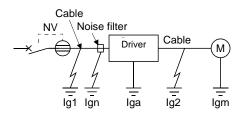
(1) Selection method

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 $\geq 10 \cdot \{Ig1 + Ign + Iga + K \cdot (Ig2 + Igm)\}$ [mA] ·················· (11.1)

Earth-leakage current breaker		
Type	Mitsubishi Electric Corparation products	K
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.)
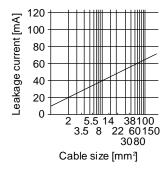
Fig. 11.7 Example of leakage current per km (Ig1, Ig2) for CV cable run in metal conduit

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)
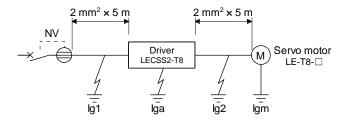
Driver capacity [W]	Leakage current [mA]
100 to 400	0.1
750	0.15

Table 11.4 Earth-leakage current breaker selection example

Driver	Rated sensitivity current of earth-leakage current breaker [mA]
LECSS2-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 ≥ 10 • {0.1 + 0 + 0.1 + 1 • (0.1 + 0.1)}
 ≥ 4 [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. OPTIONS AND PERIPHERAL EQUIPMENT

11.10 EMC filter (recommended)
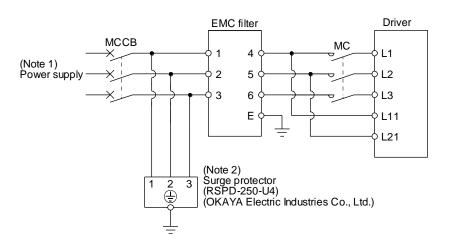
It is recommended that one of the following filters be used to comply with EN EMC directive. Some EMC filters have large in leakage current.

(1) Combination with the driver

Driver	Recommended filter (Soshin Electric)				Mass [kg]
	Model	Rated current [A]	Rated voltage [VAC]	Leakage current [mA]	
LECSS2-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]

3-M4   4-5.5 × 7   3-M4   M4

32 ± 2
85 ± 2
110 ± 4

258 ± 4
273 ± 2
288 ± 4
300 ± 5

Approx. 41
65 ± 4
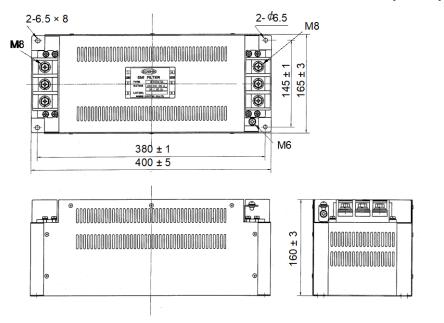
HF3030A-UN/HF-3040A-UN

[Unit: mm]

6-K
3-L   3-L

G ± 1
F ± 2
E ± 1
D ± 2

M

C ± 1   C ± 1
B ± 2
A ± 5

J ± 2
H ± 2

Model	Dimensions [mm]											
	A	B	C	D	E	F	G	H	J	K	L	M
HF3030A-UN	260	210	85	155	140	125	44	140	70	R3.25 length: 8	M5	M4
HF3040A-UN												

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HF3100A-UN

[Unit: mm]

2-6.5 × 8   2- ϕ6.5   M8

M8

145 ± 1
165 ± 3

M6

380 ± 1
400 ± 5

160 ± 3
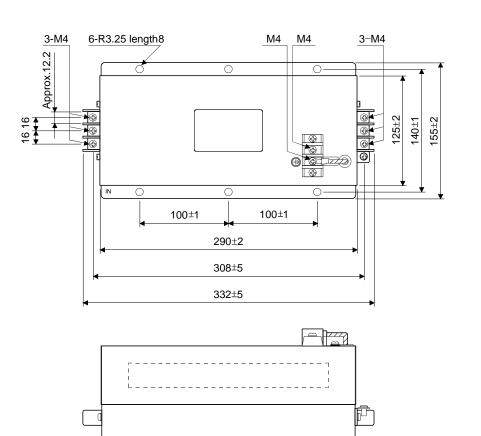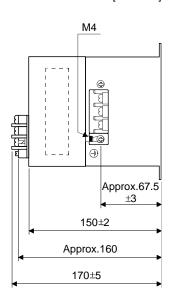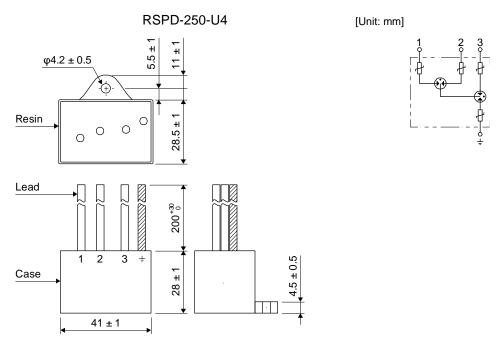
TF3005C-TX/TX3020C-TX/TF3030C-TX

[Unit: mm]

3-M4   6-R3.25 length8   M4 M4   3−M4

M4

Approx.12.2

16 16

125±2
140±1
155±2

IN

100±1   100±1

290±2

308±5

332±5

Approx.67.5 ±3

150±2

Approx.160

170±5

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(b) Surge protector

RSPD-250-U4
[Unit: mm]

φ4.2 ± 0.5

5.5 ± 1

11 ± 1

28.5 ± 1

Resin

Lead

200 +30 0

1   2   3   ⏚

Case

28 ± 1

4.5 ± 0.5

41 ± 1

1   2   3

SMC

12. ABSOLUTE POSITION DETECTION SYSTEM

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. ●Refer to appendix 2 and 3 for battery transportation and the new EU Battery Directive. ●If [AL. 25], [AL. 92], or [AL. 9F] occur due to such as short circuit of the battery, the battery can become hot. Use the battery with case to prevent getting burnt.
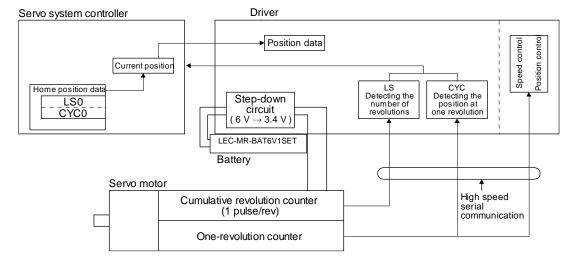
> **POINT**
> ●Disconnecting the encoder cable will erase the absolute position data. After disconnecting the encoder cable, always execute home position setting and then positioning operation.
> ●Before replacing batteries, check that the new batteries are within battery life.

12.1 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 controller 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.

12.2 Specifications
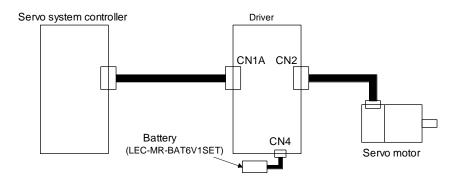
(1) Specification list

Item		Description
System		Electronic battery backup type
Battery	Model	LEC-MR-BAT6V1SET
	Battery pack	2CR17335A (CR17335A × 2 pcs. Assembled battery) (Primary lithium battery)
	Nominal voltage [V]	6
	Nominal capacity [mAh]	1650
	Storage temperature [°C]	0 to 55
	Operating temperature [°C]	0 to 55
	Amount of lithium metal [g]	1.2
	Mercury content	Less than 1 ppm
	Dangerous goods class	Inapplicable to Class 9 (Battery pack containing 2 g or less lithium)
	Operating humidity and storage humidity	90% RH or less (non-condensing)
	Mass [g]	57
Maximum revolution range		Home position ±32767 rev.
(Note 1) Maximum speed at power failure [r/min]		6000 (only when the acceleration time up to 6000 r/min is 0.2 s or more)
(Note 2) Battery backup time		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 4)
(Note 3) Battery life		5 years from date of manufacture

Note 1. Maximum speed available when the shaft is rotated by external force at the time of power failure or the like.
2. The data-holding time by the using LEC-MR-BAT6V1SET. Replace the batteries batteries within three years since the operation start whether the power supply of the driver is on/off. If the battery is used out of specification, [AL. 25 Absolute position erased] may occur.
3. Quality of battery degrades by the storage condition. The life of battery is 5 years from the production date regardless of the connection.
4. The power-on time ratio 25% is equivalent to 8 hours power on for a weekday and off for a weekend.
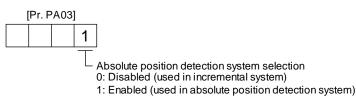
(2) Structure

(3) Parameter setting

Set "_ _ _ 1" in [Pr. PA03] to make the absolute position detection system valid.

[Pr. PA03]

			1

Absolute position detection system selection
0: Disabled (used in incremental system)
1: Enabled (used in absolute position detection system)

12.3 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.
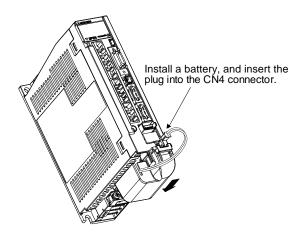
Refer to section 12.4 for installation procedure of battery to the driver.

12. ABSOLUTE POSITION DETECTION SYSTEM

12.4 Battery installation and removal procedure
    (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.
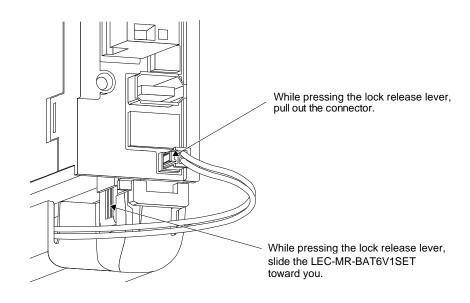
Install a battery, and insert the plug into the CN4 connector.

    (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.

While pressing the lock release lever, pull out the connector.

While pressing the lock release lever, slide the LEC-MR-BAT6V1SET toward you.

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12.5 Confirmation of absolute position detection data

You can check the absolute position data with setup software (MR Configurator2).

Choose "Monitor" and "ABS Data Display" to open the absolute position data display screen.

13. USING STO FUNCTION

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 d
・IEC/EN 61508 SIL 2
・IEC/EN 61800-5-2 SIL 2
・IEC/EN 62061 SIL CL2

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.

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13. USING STO FUNCTION

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.

SMC
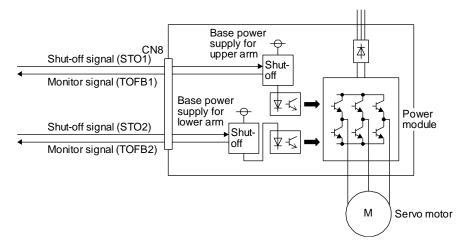
13.1.5 Specifications

(1) Specifications
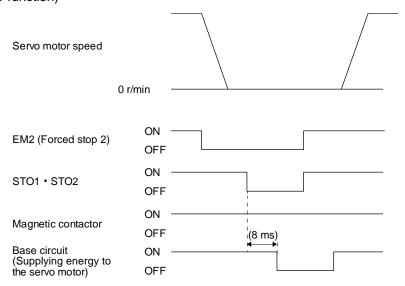
Item	Specifications
Safety function	STO (IEC/EN 61800-5-2)
Safety performance	ISO/EN ISO 13849-1 category 3 PL d, IEC/EN 61508 SIL 2, EN 62061 SIL CL2, EN 61800-5-2
Mean time to dangerous failure (MTTFd)	MTTFd ≥ 100 [years] (Note)
Diagnostic converge (DC)	DC = Medium, 97.6 (Note)
Average probability 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. This is the value required by safety standards.

(2) Function block diagram (STO function)

(3) Operation sequence (STO function)

13.1.6 Maintenance
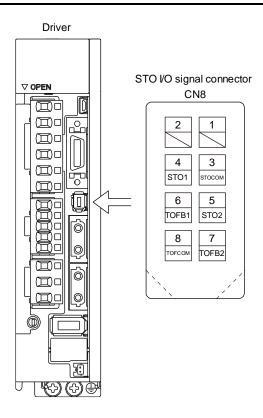
This driver has alarms and warnings for maintenance that supports the drive safety function. (Refer to chapter 8.)

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.

Driver

▽ OPEN

STO I/O signal connector
CN8

2	1
4 STO1	3 STOCOM
6 TOFB1	5 STO2
8 TOFCOM	7 TOFB2

SMC

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).
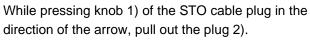
Input signal		State		
STO1	STO2	Between TOFB1 and TOFCOM (Monitoring STO1 state)	Between TOFB2 and TOFCOM (Monitoring STO2 state)	Between TOFB1 and TOFB2 (Monitoring STO state of driver)
Off	Off	On: STO state (base circuit shut-off)	On: STO state (base circuit shut-off)	On: STO state (base circuit shut-off)
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
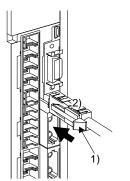
(3) Test pulse of STO input signal
Set the test pulse off time inputted from outside to 1 ms or less.

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).
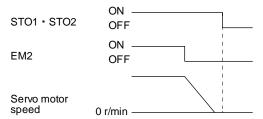
13.3 Connection example

```
┌─────────────────────────────────────────────────────────────────┐
│ ┌──────────┐                                                      │
│ │  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.  │
│                                                                    │
│              STO1・STO2    ON ─────────────┐                       │
│                           OFF              └───────                │
│                                                                    │
│              EM2           ON ──────┐                              │
│                           OFF       └──────────────               │
│                                                                    │
│              Servo motor         ───────┐                         │
│              speed        0 r/min       └╲_____                  │
│ ●If STO is turned off during operation, the servo motor is in     │
│  dynamic brake stop (stop category 0), and [AL.63 STO timing      │
│  error] will occur.                                               │
└─────────────────────────────────────────────────────────────────┘
```
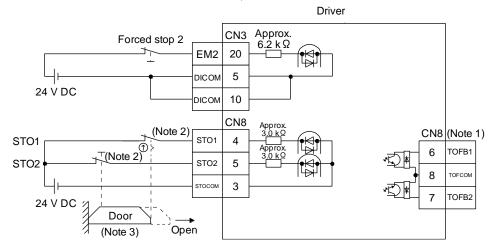
13.3.1 Connection example for CN8 connector

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.
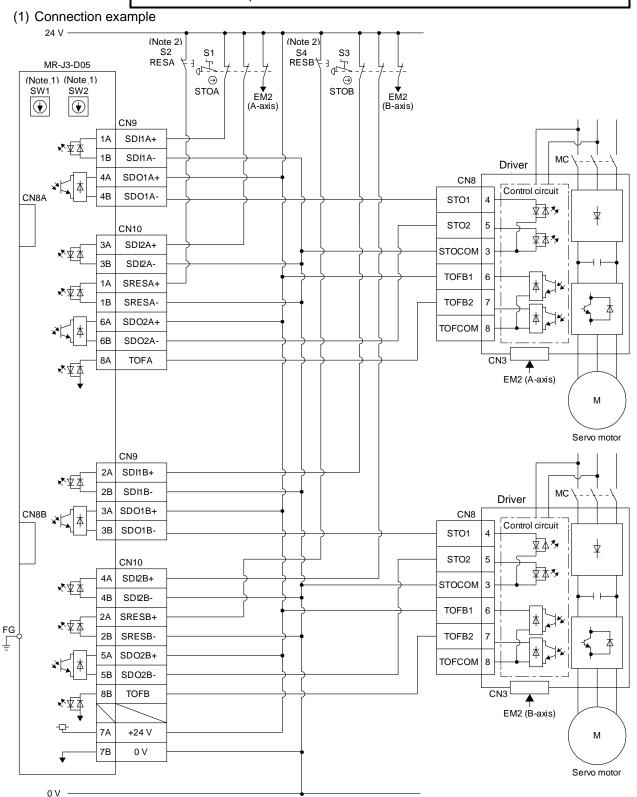
Note 1. By using TOFB, whether the servo is in the STO state can be confirmed. For connection examples, refer to section 13.3.2 to 13.3.4.

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.

SMC

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 3.2.2.

(1) Connection example

Note 1. Set the delay time of STO output with SW1 and SW2. These switches for MR-J3-D05 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.

SMC
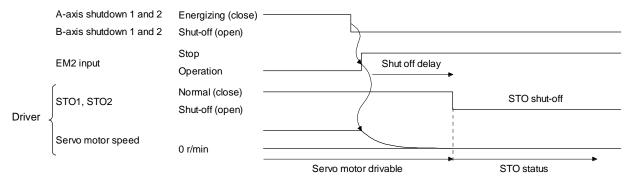
(2) Basic operation example

The switch status of STOA is input to SDI2A+ of MR-J3-D05 of Mitsubishi Electric Corporation, and then it will be input to STO1 and STO2 of the driver via SDO1A and SDO2A of MR-J3-D05 of Mitsubishi Electric Corporation.

The switch status of STOB is input to SDI2B+ of MR-J3-D05 of Mitsubishi Electric Corporation, and then it will be input to STO1 and STO2 of the driver via SDO1B and SDO2B of MR-J3-D05 of Mitsubishi Electric Corporation.
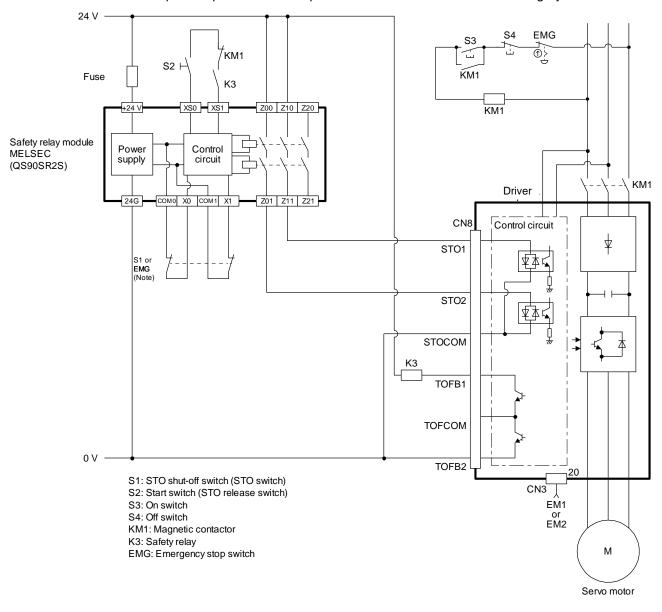
13.3.3 External I/O signal connection example using an external safety relay unit

POINT

● This connection is for the source interface. For the other I/O signals, refer to the connection examples in section 3.2.2.

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
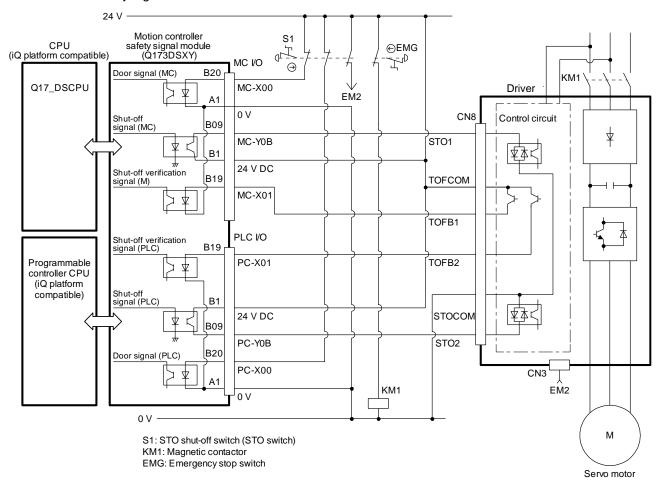
Note. To enable the STO function of the driver by using "Emergency switching off", change S1 to EMG. The stop category at this time is "0". If STO is turned off while the servo motor is rotating, [AL. 63 STO timing error] will occur.

13.3.4 External I/O signal connection example using a motion controller

```
┌─────────────────────────────────────────────────────────────────────┐
│  POINT                                                                │
│                                                                       │
│ ●This connection is for the source interface. For the other I/O      │
│   signals, refer to the connection examples in section 3.2.2.         │
│ ●For MC-Y0B and PC-Y0B, design a ladder program to output MC-Y0B      │
│   and PC-Y0B after the servo motor stops.                             │
└─────────────────────────────────────────────────────────────────────┘
```

This connection diagram is an example of STO circuit configured with a driver and motion controller. Use the switch that complies with the requirement of ISO/EN ISO 13849-1 category 3 PL d as an emergency stop switch. This connection example complies with the requirement of ISO/EN ISO 13849-1 category 3 PL d. The following shows an example of I/O (X and Y) signal assignment of the motion controller safety signal module.

S1: STO shut-off switch (STO switch)
KM1: Magnetic contactor
EMG: Emergency stop switch

13. USING STO FUNCTION
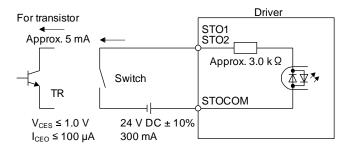
13.4 Detailed description of interfaces

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.

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(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.
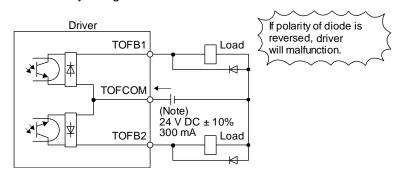
(2) Digital output interface DO-1
This is a circuit of emitter output terminal of the output transistor. When the output transistor is turned on, current will be applied from the output to a load.
A maximum of 5.2 V voltage drop occurs in the driver.

(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.

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14. SERVO MOTOR

14. SERVO MOTOR
14.1 Servo motor with a lock
14.1.1 Features
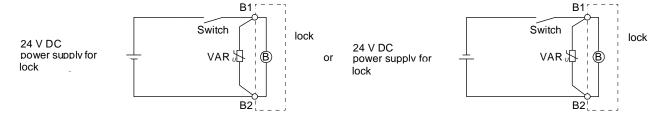
⚠CAUTION	●The lock is provided to prevent a drop at a power failure or servo alarm occurrence during vertical drive or to hold a shaft at a stop. Do not use it for normal braking (including braking at servo-lock). ●The lock has a time lag. Use the lock so that servo motor control starts after the lock has completely opened. Be sure to check the time lag of the locking with a real machine. ●Configure a lock circuit so that it is activated also by an external EMG stop switch. ●While the lock is opened, the motor may be raised to high temperature regardless of driving. ●The life will be shorten under sudden acceleration/deceleration conditions.

The servo motor with a lock can be used to prevent a drop in vertical lift applications or to ensure double safety at an emergency stop, for example. When operating the servo motor, supply power to the lock to release the lock. Switching power off enables the lock.

(1) Lock power supply
Prepare the following power supply for use with the lock only. The lock terminals (B1 and B2) have no polarity.

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.
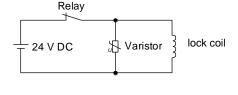
(3) Selection of surge absorbers for lock circuit
The following shows an example how to select a varistor with a surge absorber.
(a) Selection conditions

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 14.1.2

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(b) Tentative selection and verification of surge absorber

    1) Maximum allowable circuit voltage of varistor

      Tentatively select a varistor whose maximum allowable voltage is larger than Vb [V].

    2) Lock current (Ib)

$$Ib = \frac{Vb}{R} \text{ [A]}$$

    3) Energy (E) generated by lock coil

$$E = \frac{L \times Ib^2}{2} \text{ [J]}$$

    4) Varistor limit voltage (Vi)

      From the energy (E) generated in the lock coil and the varister characteristic diagram, calculate the varistor limit voltage (Vi) when the lock current (Ib) flows into the tentatively selected varistor during opening of the circuit. Please refer to the varistor characteristic diagram to the varistor manufacturer.

      The desired suppressed voltage (Vs) is the sum of the 24 VDC ± 10% used and the other devices (relays etc.) used by the user.

      Please confirm the specification of the equipment to be used.

      Vi is favorable when the varistor limit voltage (Vi) [V] is smaller than the desired suppressed voltage (Vs) [V].

      If Vi is not smaller than Vs, reselect a varistor or improve the withstand voltage of devices.

      Regarding the characteristics characteristic diagram, specification, selection of the varistor, it is necessary to check with the varistor manufacturer.

    5) Surge current width (τ)

      Given that the varistor absorbs all energies, the surge current width (τ) will be as follows.

$$τ = \frac{E}{Vi \times Ib} \text{ [S]}$$

    6) Examining surge life of varister

      From the varistor characteristic diagram, the guaranteed current value (Ip) in which the number of the surge application life is N at the surge current width (τ). Calculate the guaranteed current value (Ip) ratio to lock current (Ib).

      If an enough margin is ensured for Ip/Ib, the number of the surge application life N [time] can be considered as favorable.

(4) Others

  A leakage magnetic flux will occur at the shaft end of the servo motor equipped with a lock. Note that chips, screws, etc. are attracted.

14.1.2 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.
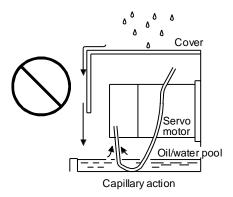
| Item | Servo motor | | LE-□-B | | | | |
		T5 (50W)	T6 (100W)	T7 (200W)	T8 (400W)	T9 (750W)
Type (Note 1)		Spring actuated type safety lock				
Rated voltage (Note 4)		24 V DC $_{-10\%}^{0}$				
Power consumption [W] at 20 °C		6.3	7.9			10
Coil resistance (Note 6) [Ω]		91.0	73.0			57.0
Inductance (Note 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 125 V	TND20V-680KB				
	For the suppressed voltage 350 V	TND10V-221KB				

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.

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14.2 Protection from oil and water

(1) Do not use the servo motor with its cable soaked in oil or water.

14.3 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.
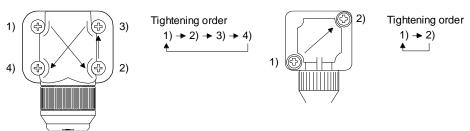
14.4 Rated speed of servo motor

The rated speed of servo motor (LE-T5-□, LE-T6-□, LE-T7-□, LE-T8-□, LE-T9-□) is 3000[r/min].

14.5 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.
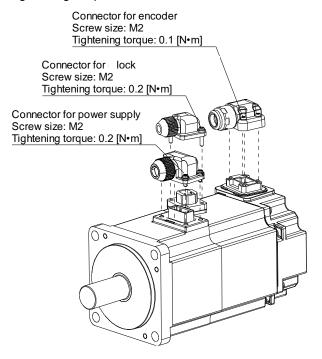
(1) When screwing the connector, hold the connector still and gradually tighten the screws in a crisscross pattern.

Tightening order
1) → 2) → 3) → 4)

Tightening order
1) → 2)

Connector for power supply, connector for encoder

Connector for lock

(2) Tighten the screws evenly. Tightening torques are as indicated below.

Connector for encoder
Screw size: M2
Tightening torque: 0.1 [N•m]

Connector for lock
Screw size: M2
Tightening torque: 0.2 [N•m]

Connector for power supply
Screw size: M2
Tightening torque: 0.2 [N•m]

(3) The servo motor fitting part of each connector is provided with a splash-proof seal (O ring). When mounting a connector, use care to prevent the seal (O ring) from dropping and being pinched. If the seal (O ring) has dropped or is pinched, a splash-proof effect is not produced.

APPENDIX

APPENDIX

App. 1 Peripheral equipment manufacturer (for reference)

Names given in the table are as of February 2013.

Manufacturer	Reference
JST	J.S.T. Mfg. Co., Ltd.
Junkosha	Purchase from Toa Electric Industry Co. Ltd., Nagoya Branch
3M	Sumitomo 3M Ltd.
Soshin Electric	Soshin Electric Co., Ltd.
TE Connectivity	TE Connectivity
Molex	Molex

App. 2 Handling of AC driver batteries for the United Nations Recommendations on the Transport of Dangerous Goods

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 battery (LEC-MR-BAT6V1SET) is an assembled battery from two batteries (lithium metal battery CR17335A).

The IATA Dangerous Goods Regulations are revised, and the requirements are changed annually.

When transporting lithium batteries, the responsibility for the cargo lies with the customer.

Thus, be sure to check the latest version of the IATA Dangerous Goods Regulations.

When contracting transportation to a carrier, follow the carrier's instructions.

Battery (Assembled Battery)　　: LEC-MR-BAT6V1SET
Lithium content : 1.20(g)

APPENDIX

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.

Theproduct is designed and manufactured with high quality materials and components which can be recycled and/or reused.

This symbol means that batteries and accumulators, at their end-of-life, should be disposed of separately from your household waste.

If a chemical symbol is printed beneath the symbol shown above, this chemical symbol means that the battery or accumulator contains a heavy metal at a certain concentration.

This will be indicated as follows.

Hg: mercury (0.0005%), Cd: cadmium (0.002%), Pb: lead (0.004%)

In the European Union there are separate collection systems for used batteries and accumulators.

Please, dispose of batteries and accumulators correctly at your local community waste collection/recycling centre.

Please, help us to conserve the environment we live in!

App. 4 Compliance with global standards

App. 4.1 Terms related to safety (IEC 61800-5-2 Stop function)

STO function (Refer to IEC/EN 61800-5-2: 2007 4.2.2.2 STO.)

LECSS2-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 section explains safety of users and machine operators. Please read the section carefully before mounting the equipment.

APPENDIX

App. 4.2.1 Professional engineer

Only professional engineers should mount LECSS2-T☐ drivers.

Here, professional engineers should meet the all conditions below.

(1) Persons who took aproper training of related work of electrical equipment or persons who can avoid risk based on past experience.
(2) Person 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

LECSS2-T☐ drivers comply with the following safety standards.

ISO/EN ISO 13849-1 Category 3 PL d, IEC/EN 62061 SIL CL 2, IEC/EN 61800-5-2 (STO), IEC/EN 61800-5-1, IEC/EN 61800-3, IEC/EN 60204-1

In addition, LECSS2-T☐ drivers can be used with the MR-J3-D05 safety logic unit of Mitsubishi Electric Corporation or safety PLCs.

App. 4.2.3 Correct use

Use the LECSS2-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 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. 14.

(a) Local 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)
LECSS2-T5/ LECSS2-T7/ LECSS2-T8/ LECSS2-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.

APPENDIX

(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. For selecting ones other than Class T fuses and molded-case circuit breakers below, refer to section 11.6.

Driver (Note 1)	Molded-case circuit breaker (240 V AC) (Note 2)	Fuse (300 V)
LECSS2-T5/ LECSS2-T7/ LECSS2-T8/ LECSS2-T9 (T)	NF50-SVFU-5A (50 A frame 5 A)	10 A
LECSS2-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
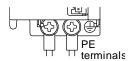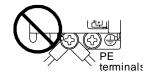
(c) Power supply

This driver can be supplied from star-connected supply with grounded neutral point of overvoltage category III set forth in IEC/EN 60664-1. However, when you use the neutral point for single phase supply, a reinforced insulating transformer is required in the power input section. 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.
If using an earth-leakage current breaker, always ground the protective earth (PE) terminal of the driver to prevent an electric shock. This product can cause a d.c. current in the protective earthing conductor. Where a residual current-operated protective (RCD: earth-leakage current breaker) device is used for protection in case of direct or indirect contact, only an RCD of Type B is allowed on supply side of the product.

- 5 -

(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

The drivers comply with category C3 in accordance with IEC/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 10 m), use shielded wires and ground the shielded. Install an EMC filter and surge protector on the primary side.

The following shows recommended products.

EMC filter: Soshin Electric HF3000A-UN series
Surge protector: Okaya Electric Industries RSPD series
Line noise filter. Mitsubishi Electric FR-BLF

The drivers on this guide 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 driver 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.14.

(a) Installation

The minimum cabinet size is 150% of each LECSS2-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 a 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 section app.4.8.1. The driver needs to be installed at or below of pollution degree 2. For connection, use only 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 LECSS2-T□ drivers have servo motor overload protective function. (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 LECSS2-T□ drivers.

(1) For safety components and installing systems, only qualified personnel and professional engineers should perform.

(2) When mounting, installing, and using the LECSS2-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 modules 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 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.).

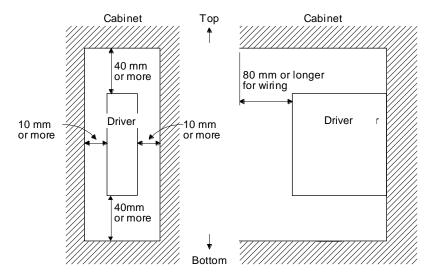(7) Keep the required clearance/creepage distance depending on voltage you use.

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. 4.3 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
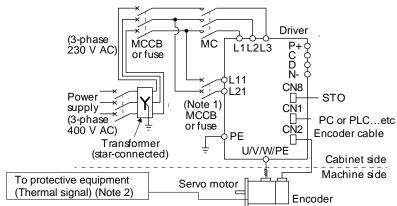
⚠ WARNING	● Turn off the molded-case circuit breaker (MCCB) to avoid electrical shocks or damages to the product before starting the installation or wiring.

⚠ CAUTION	● The installation complies with IEC/EN 60204-1. The voltage supply to machines must be 20 ms of immunity to instantaneous power failures as specified in IEC/EN 60204-1.

The following shows representative configuration diagram examples to conform to the IEC/EN/UL/CSA standards.
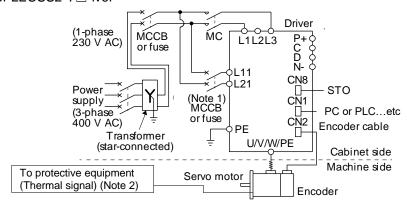
(1) 3-phase input for LECSS2-T□ driver

Note 1. When the wire size of L1 and L11 are the same, MCCB or fuse is not requied.
Note 2. Please use a thermal sensor, etc. for thermal protection of the sarvo motor.

(2) 1-phase input for LECSS2-T□ iver

Note 1. When the wire size of L1 and L11 are the same, MCCB or fuse is not requied.
Note 2. Please use a thermal sensor, etc. for thermal protection of the sarvo motor.
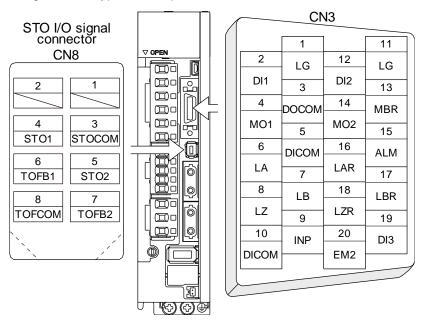
The control circuit connectors described by rectangles are safely separated from the main circuidescribed by circles.
The connected motors will be limited as follows.

(1) LE-□-□ series servo motors
(2) Using a servo motor complied with IEC60034-1 and encoder (OBA, OSA) of Mitsubishi Electric corporation

APPENDIX

App. 4.5 Signal
App. 4.5.1 Signal

The following shows LECSS2-T5 signals as a typical example.

STO I/O signal
connector
CN8

CN3

2		1	
STO1	4	3	STOCOM
TOFB1	6	5	STO2
TOFCOM	8	7	TOFB2

App. 4.5.2 Input device

Input device

Symbol	Device	Connector	Pin No.
EM2	Forced stop 2	CN3	20
STOCOM	Common terminal for input signals STO1/STO2		3
STO1	STO1 state input	CN8	4
STO2	STO2 state input		5

Output device

Symbol	Device	Connector	Pin No.
TOFCOM	Common terminal for monitor output signal in STO state		8
TOFB1	Monitor output signal in STO1 state	CN8	6
TOFB2	Monitor output signal in STO2 state		7

Power supply

Symbol	Device	Connector	Pin No.
DICOM	Digital I/F power supply input		5, 10
DOCOM	Digital I/F common	CN3	3
SD	Shield		Plate

APPENDIX

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
LECSS2-T5 / LECSS2-T7 / LECSS2-T8 / LECSS2-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.

APPENDIX

App. 4.6.2 Parts having service lives

Service lives of the following parts are listed below. However, the service life vary depending or operating methods and environment. If any fault is found in the parts, they must be replaced immediately regardless of their service lives. 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 controller 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)
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 using a LEC-MR-BAT6V1SET. For details and other battery backup time, refer to section 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 reach the end of its life in 10 years of continuous operation in normal air-conditioned environment (40 ˚C surrounding air temperature or less for use at the maximum 1000 m above sea level).

APPENDIX

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 hold the front cover to transport the driver. Otherwise, it may drop. ●Install the driver and servo motor in a load-bearing place in accordance with the Instruction Manual. ●Do not get on or put heavy load on the equipment.

When you keep or use it, please fulfill the following environment.
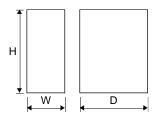
Item			Environment
Ambient temperature	Operation	[°C]	0 to 55 Class 3K3 (IEC/EN 60721-3-3)
	Transportation (Note)	[°C]	-20 to 65 Class 2K4 (IEC/EN 60721-3-2)
	Storage (Note)	[°C]	-20 to 65 Class 1K4 (IEC/EN 60721-3-1)
Ambient humidity	Operation, transportation, storage		5% to 90 %RH
Vibration load	Test values		10 Hz to 57 Hz with constant deviation of 0.075 mm 57 Hz to 150 Hz with constant acceleration of 9.8 m/s2 (1 g) to IEC/EN 61800-5-1 (Test Fc of IEC 60068-2-6)
	Operation		5.9 m/s^2 (0.6 g)
	Transportation (Note)		Class 2M3 (IEC/EN 60721-3-2)
	Storage		Class 1M2 (IEC/EN 60721-3-2)
Pollution degree			2
IP rating			Except terminal block IP20 (IEC/EN 60529) and fan finger guard
			Open type (UL 50)
Altitude	Operation, storage		1000 m or less above sea level
	Transportation		10000 m or less above sea level

Note. In regular transport packaging

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App. 4.8 Technical data
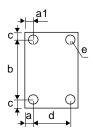App. 4.8.1 LECSS2-T□ driver

Item		LECSS2-T5 / LECSS2-T7 / LECSS2-T8 / LECSS2-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 Hz/60 Hz
	Interface (SELV)	24 V DC, (required current capacity: LECSS2, 300 mA)
Control method		Sine-wave PWM control, current control method
Safety function (STO) IEC/EN 61800-5-2		EN ISO 13849-1 category 3 PL d, IEC 61508 SIL 2, EN 62061 SIL CL 2, and EN 61800-5-2
Mean time to dangerous failure		MTTFd ≥ 100 [years]
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		TM = 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 200 V AC: II (IEC/EN 60664-1), 3-phase 200 V AC: III (IEC/EN 60664-1),
Protection 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	
LECSS2-T5 / LECSS2-T7	40	168	135	0.8
LECSS2-T8	40	168	170	1.0
LECSS2-T9	60	168	185	1.4

App. 4.8.3 Mounting hole

Driver	Variable dimensions [mm]					Screw size
	a	a1	b	c	d	e
LECSS2-T5 / LECSS2-T7 / LECSS2-T8	6	6	156 ± 0.5	6		M5
LECSS2-T9	12	12	156 ± 0.5	6	42 ± 0.3	M5

APPENDIX

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 (protection 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.

APPENDIX

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 LECSS2-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 LECSS2-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 LECSS2-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/EN 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	●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

· 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 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 safety 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. For a linear servo motor, the primary side will move a distance of pole pitch.

APPENDIX

App. 6 Analog monitor
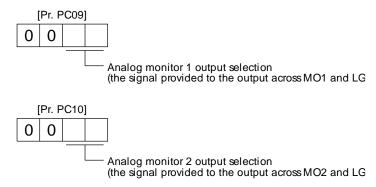
```
┌─────────┐
│  POINT  │
├─────────┴──────────────────────────────────────────────────┐
│ ●A voltage of analog monitor output may be irregular at     │
│   power-on.                                                 │
└────────────────────────────────────────────────────────────┘
```

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. PC09] and [Pr. PC10] value.

Setting value	Output item	Description	Setting value	Output item	Description
00	Servo motor speed		01	Torque	
02	Servo motor speed		03	Torque	
04	Current command		05	Speed command	
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)	

Setting value	Output item	Description	Setting value	Output item	Description
0A	Feedback position (Note 1, 2, 3) (±10 V/1 Mpulse)	CCW direction, 10 [V], 1 [Mpulse], 0, 1 [Mpulse], -10 [V], CW direction	0B	Feedback position (Note 1, 2, 3) (±10 V/10 Mpulse)	CCW direction, 10 [V], 10 [Mpulse], 0, 10 [Mpulse], -10 [V], CW direction
0C	Feedback position (Note 1, 2, 3) (±10 V/100 Mpulse)	CCW direction, 10 [V], 100 [Mpulse], 0, 100 [Mpulse], -10 [V], CW direction	0D	Bus voltage	8 [V], 0, 400 [V]
0E	Speed command 2 (Note 3)	CCW direction, 8 [V], Maximum speed, 0, Maximum speed, -8 [V], CW direction	15	Motor-side/load-side position deviation (Note 3, 4, 5, 6) (±10 V/100000 pulses)	CCW direction, 10 [V], 100000 [pulse], 0, 100000 [pulse], -10 [V], CW direction
16	Servo motor-side/load-side speed deviation (Note 4)	CCW direction, 8 [V], Maximum speed, 0, Maximum speed, -8 [V], CW direction	17	Encoder inside temperature (±10 V/±128 °C)	10 [V], -128 [°C], 0, 128 [°C], -10 [V]

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.

APPENDIX

App. 7 J3 compatibility mode

POINT
●Specifications of the J3 compatibility mode of the driver with software version A4 or earlier differ from those with software version A5. Refer to table 8.8.

App. 7.1 Outline of J3 compatibility mode

LECSS2-T□ drivers have two operation modes. "J4 mode" is for using all functions with full performance and "J3 compatibility mode" is compatible with LECSS□-S□ series for using the drivers as the conventional series.

When you connect a driver with SSCNET III/H communication for the first PC or PLC…etc communication by factory setting, the operation mode will be fixed to "J4 mode". For SSCNET communication, it will be fixed to "J3 compatibility mode". When you set the mode back to the factory setting, use the application "MR-J4(W)-B mode selection".

The application "MR-J4(W)-B mode selection" is packed with setup software (MR Configurator2) of software version 1.12N or later.

For the operating conditions of the application "MR-J4(W)-B mode selection", use setup software (MR Configurator2).

App. 7.2 Operation modes supported by J3 compatibility mode

The J3 compatibility mode supports the following operation modes.

Operation mode in J3 compatibility mode	Model of LECSS□-S□
LECSS□-S□ standard control mode (servo motor)	MR-J3-_B

Each operation mode has the same ordering as conventional LECSS□-S□ series drivers and is compatible with their settings. Therefore, new functions added for LECSS2-T□ drivers cannot be used.

In addition, the control response characteristic in the J3 compatibility mode will be the same as that of LECSS□-S□ series. When you need a higher response, using the J4 mode is recommended.

App. 7.3 J3 compatibility mode supported function list

Function	Name	Corresponding (□: J4 new, ○: Equivalent to J3, ×: Not available)		
		LECSS2-T□ series		LECSS□-S□ series (Note 3)
		J4 mode	J3 compatibility mode	
Basic specification	Speed frequency response	2.5 kHz	2.1 kHz	2.1 kHz
	Encoder resolution	22 bit (Note 1)	18 bit (Note 1)	18 bit
SSCNET III/H communication or SSCNET III communication	Communication baud rate	150 Mbps	50 Mbps	50 Mbps
	Maximum distance between stations	100 m	50 m	50 m
Basic function	Absolute position detection system	○	○	○
	Motor-less operation	○	○	○
	Rotation direction selection	○	○	○
Encoder output pulses	A/B-phase pulse output	○	○	○
	Z-phase pulse output	○	○	○
Input/output	Analog monitor output	○	○	○
	Motor thermistor	○	○	×
Control mode	Position control mode	○	○	○
	Speed control mode	○	○	○
	Torque control mode	○	○	○
	Continuous operation to torque control mode	○	○	○
Auto tuning	Auto tuning mode 1	○	○	○
	Auto tuning mode 2	○	○	○
	2 gain adjustment mode 1 (interpolation mode)	○	○	○
	2 gain adjustment mode 2	□	×	×
	Manual mode	○	○	○

APPENDIX

Function	Name	Corresponding (□: J4 new, ○: Equivalent to J3, ×: Not available)		MR-J3 series (Note 8)
		MR-J4/J4W series		
		J4 mode	J3 compatibility mode	
Filter function	Machine resonance suppression filter 1	○	○	○
	Machine resonance suppression filter 2	○	○	○
	Machine resonance suppression filter 3	□	×	×
	Machine resonance suppression filter 4	□	×	×
	Machine resonance suppression filter 5	□	×	×
	Shaft resonance suppression filter	○	×	×
	Low-pass filter	○	○	○
	Robust disturbance compensation (Note 10)	×	○	○
	Robust filter	□	×	×
Vibration suppression control	Standard mode/3 inertia mode	□	×	×
	Vibration suppression control 1	○	○	○
	Vibration suppression control 2	□	×	×
	Command notch filter	○	○	○
Applied control	Gain switching	○	○	○
	Slight vibration suppression control	○	○	○
	Overshoot amount compensation	○	○	○
	PI-PID switching control	○	○	○
	Feed forward	○	○	○
	Torque limit	○	○	○
	Master-slave operation function	× (Available in the future)	× (Available in the future)	○
Adjustment function	One-touch tuning	□	×	×
	Adaptive tuning	○	○	○
	Vibration suppression control 1 tuning	○	○	○
	Vibration suppression control 2 tuning	□	×	×

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Function	Name	Corresponding (□: J4 new, ○: Equivalent to J3, ×: Not available)		
		MR-J4/J4W series		MR-J3 series (Note 8)
		J4 mode	J3 compatibility mode	
Safety function	STO function	○	○	×
	Forced stop deceleration function at alarm occurrence	○	○	×
	Vertical axis freefall prevention function	○	○	×
Tough drive function	Vibration tough drive	□	×	×
	Instantaneous power failure tough drive	□	×	×
Diagnosis function	3-digit alarm display	□	□	×
	16 alarm histories supported	□	× (Note 2)	× (Note 2)
	Drive recorder function	□	×	×
	Machine diagnosis function	□	×	×
Controller	SSCNET III	×	○	○
	SSCNET III/H	□	×	×
	Home position return function	○	○	○
Others	J4/J3 compatibility mode automatic identification (Note 11)	○	○	×
	Power monitoring function	□	×	×

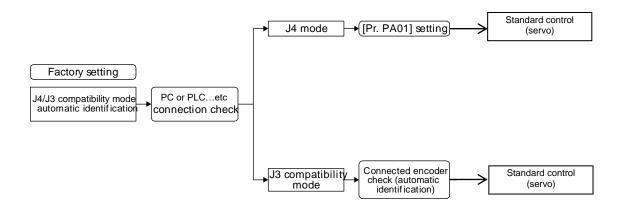Note 1. The value is at the LE-□-□ series servo motor driving.
2. Alarm history will be saved up to five times.
3. The functions of the product with modified parts (GA) in the LECSS□-S□ drivers are all covered by the J3 compatibility mode of the LECSS2-T□ drivers.
4. For LECSS2-T□ series, the robust filter and vibration tough drive are available instead.
5. The operation mode will be adjusted automatically at the first PC or PLC…etc communication. You can change the operation mode with the application "MR-J4(W)-B mode selection".
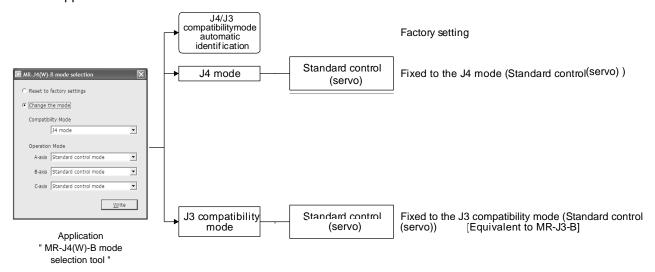
APPENDIX

App. 7.4 How to switch J4/J3 compatibility mode

There are two ways to switch the J4/J3 compatibility mode with the LECSS2-T☐ driver.

(1) Mode selection by the automatic identification of the driver

J4/J3 compatibility mode is identified automatically depending on the connected PC or PLC…etc.
When the PC or PLC…etc make a connection request with SSCNET III/H communication, the
mode will be "J4 mode". For SSCNET communication, it will be "J3 compatibility mode".
For the J3 compatibility mode, standard control will be identified automatically with a motor
(encoder) connected to the driver. For the J4 mode, the operation mode will be the setting of [Pr.
PA01].

```
                                                              ┌──────────┐   ┌──────────────┐   ┌──────────────┐
                                                          ──→ │ J4 mode  │──→│[Pr. PA01] setting│─→│Standard control│
                                                          │   └──────────┘   └──────────────┘   │   (servo)    │
                                                          │                                       └──────────────┘
 ┌─────────────────┐                                      │
 │ Factory setting │                                      │
 └─────────────────┘     ┌──────────────┐                 │
 ┌─────────────────┐     │ PC or PLC…etc │                 │
 │J4/J3 compatibility mode│─→│connection check│───────────┤
 │automatic identification│   └──────────────┘            │
 └─────────────────┘                                      │   ┌──────────────┐   ┌──────────────┐   ┌──────────────┐
                                                          ──→ │J3 compatibility│→│Connected encoder│→│Standard control│
                                                              │    mode      │   │check (automatic │   │   (servo)    │
                                                              └──────────────┘   │ identification) │   └──────────────┘
                                                                                 └──────────────┘
```

APPENDIX

(2) Mode selection by the automatic identification of the driver

You set the factory setting, J4/J3 compatibility mode, and operation mode with the dedicated application.

Application
" MR-J4(W)-B mode selection tool "

App. 7.5 How to use the J3 compatibility mode

(1) Setting of the PC or PLC…etc

To use in the J3 compatibility mode, select MR-J3 series in the system setting window.

Operation mode in J3 compatibility mode	System setting
LECSS□-S□ standard control mode (servo motor)	Select MR-J3-_B.

(2) Setting of setup software (MR Configurator)

To use in the J3 compatibility mode, make the system setting as follows.

Operation mode in J3 compatibility mode	System setting
LECSS□-S□ standard control mode (servo motor)	Select MR-J3-_B.

Cautions for using setup software (MR Configurator)

・The gain search cannot be used. You can use the advanced gain search.

(3) Setting of setup software (MR Configurator2)

To use in the J3 compatibility mode, make the system setting as follows.

Operation mode in J3 compatibility mode	System setting
LECSS□-S□ standard control mode (servo motor)	Select MR-J3-_B.

Cautions for using setup software (MR Configurator2)

· Use setup software (MR Configurator2) with software version 1.12N or later. Older version than 1.12N cannot be used.

· Information about existing models (MR-J3) cannot be updated with the parameter setting range update function. Register a new model to use.

· The alarm will be displayed by 3 digits.

· The robust disturbance compensation cannot be used.

App. 7.6 Cautions for switching J4/J3 compatibility mode

The J3 compatibility mode of the operation mode is automatically identified by factory setting depending on a connected encoder. If a proper encoder is not connected at the first connection, the system will not start normally due to a mismatch with a set mode with the PC or PLC…etc. (For the J4 mode, you can set the operation mode with [Pr. PA01].) When the operation mode mismatches, the driver will display [AL. 3E.1 Operation mode error]. Set the mode correctly (J4/J3 compatibility mode and operation mode).

App. 7.7 Cautions for the J3 compatibility mode

The J3 compatibility mode are partly changed and has restrictions compared with MR-J3 series.

(1) The alarm display was changed from 2 digits (_ _) to 3 digits (_ _. _). The alarm detail number (._) is displayed in addition to the alarm No (_ _). The alarm No. (_ _) is not changed.

(2) When the power of the driver is cut or fiber-optic cable is disconnected, the same type communication can be cut regardless of connection order. When you power on/off the driver during operation, use the connect/disconnect function of the PC or PLC…etc. Refer to the following manuals for detail of Mitsubishi Electric Corporation.

· Motion controller Q series Programming Manual (COMMON) (Q173D(S)CPU/Q172D(S)CPU) (IB-0300134) "4.11.1 Connect/disconnect function of SSCNET communication"

· MELSEC-Q QD77MS Simple Motion Module User's Manual (IB-0300185) "14.12 Connect/disconnect function of SSCNET communication"

· MELSEC-L LD77MH Simple Motion Module User's Manual (IB-0300172) "14.13 Connect/disconnect function of SSCNET communication"

(3) The J3 compatibility mode has a functional compatibility. However, the operation timing may differ. Check the operation timing on customer side to use.

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App. 7.8 Change of specifications of "J3 compatibility mode" switching process
Confirm details of Motion controller,simple motion module and positioning module to PLC manufacturer.

App. 7.8.1 Detailed explanation of "J3 compatibility mode" switching
(1) Operation when using a driver before change of specifications
For the PC or PLC…etc in which "Not required" is described to PC or PLC…etc reset in table app. 1, the mode will be switched to "J3 compatibility mode" for all axes at the first connection. However, it takes about 10 s per axis for completing the connection.
For the PC or PLC…etc in which "Reset required" is described in table app. 1, the operation at the first connection is shown in table app. 2. The LED displays will be "Ab." for all axes at the first connection to the PC or PLC…etc as shown in table app. 2. After that, resetting PC or PLC…etc will change the 1-axis to "b01". The 2-axis and later will not change from "Ab.". After that, one axis will be connected per two times of PC or PLC…etc reset.
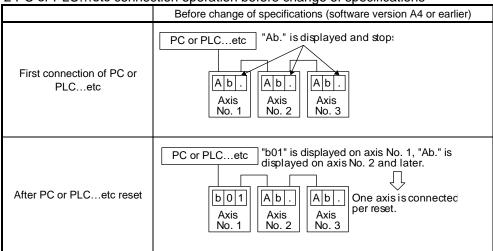
Table app. 1 PC or PLC…etc reset required/not required list (before change of specifications)

PC or PLC…etc	Model	PC or PLC…etcreset required/not required	
		Single-axis connection	Multi-axis connection
Motion controller	Q17_DSCPU	Not required	Not required
	Q17_DCPU	Not required	Not required
	Q17_HCPU	Not required	Not required
	Q170MCPU	Not required	Not required
Simple motion module Positioning module	QD77MS_	Not required	Not required
	QD75MH_	Not required	Not required
	QD74MH_	Reset required	Reset required
	LD77MH_	Not required	Not required
	FX3U-20SSC-H	Not required	Reset required

Table app. 2 PC or PLC…etc connection operation before change of specifications

	Before change of specifications (software version A4 or earlier)
First connection of PC or PLC…etc	PC or PLC…etc "Ab." is displayed and stops A b . / A b . / A b . Axis No. 1 / Axis No. 2 / Axis No. 3
After PC or PLC…etc reset	PC or PLC…etc "b01" is displayed on axis No. 1, "Ab." is displayed on axis No. 2 and later. b 0 1 / A b . / A b . Axis No. 1 / Axis No. 2 / Axis No. 3 One axis is connected per reset.

APPENDIX

(2) Operation when using a driver after change of specifications

For the PC or PLC…etc in which "Not required" is described to PC or PLC…etc reset in table app. 3, the mode will be switched to "J3 compatibility mode" for all axes at the first connection. It takes about 10 s for completing the connection not depending on the number of axes.
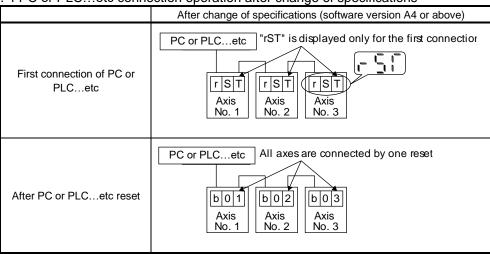
For the PC or PLC…etc in which "Reset required" is described in table app. 3, the operation at the first connection is shown in table app. 4. The driver's mode will be "J3 compatibility mode" and the LED displays will be "rST" for all axes at the first connection to the PC or PLC…etc as shown in table app. 4. At the status, resetting PC or PLC…etc once will change the display to "b##" (## means axis No.) for all axes and all axes will be ready to connect.

(One PC or PLC…etc reset enables to all-axis connection.)

Table app. 3 PC or PLC…etc reset required/not required list (after change of specifications)

PC or PLC…etc	Model	PC or PLC…etc reset required/not required	
		Single-axis connection	Multi-axis connection
Motion controller	Q17_DSCPU	Not required	Not required
	Q17_DCPU	Not required	Not required
	Q17_HCPU	Not required	Not required
	Q170MCPU	Not required	Not required
Simple motion module Positioning module	QD77MS_	Not required	Not required
	QD75MH_	Not required	Not required
	QD74MH_	Reset required	Reset required
	LD77MH_	Not required	Not required
	FX3U-20SSC-H	Reset required	Reset required

Table app. 4 PC or PLC…etc connection operation after change of specifications

(3) Using drivers before and after change of specifications simultaneously

When using drivers before change of specifications and after change of specifications simultaneously, PC or PLC…etc reset is necessary for number of connecting axes of drivers.

App. 8 Recommended parameter values for each actuator

The recommended parameters for each actuator.Please change the parameter values by use of the customer.Refer to "LECSS2-T Operation Manual", section 5 for details.

Recommended parameter values [LEF/LEKFS]

Series			LEFS25T6 /LEKFS25T6			LEFS32T7 /LEKFS32T7			LEFS40T8 /LEKFS40T8		
	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								
Regenerative option	PA02	0000	**0000(Non) / 0002(LEC-MR-RB-032)**								
Rotation direction selection	PA14	0	**1(+ : Counter motors side)**								
Load to motor inertia moment ratio	PB06	7	7								
Function selection E-3	PE41	0000	0000								

Series			LEFS25(L,R)T6 /LEKFS25(L,R)T6			LEFS32(L,R)T7 /LEKFS32(L,R)T7			LEFS40(L,R)T8 /LEKFS40(L,R)T8		
	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								
Regenerative option	PA02	0000	**0000(Non) / 0002(LEC-MR-RB-032)**								
Rotation direction selection	PA14	0	0(+ : Counter motors side)								
Load to motor inertia moment ratio	PB06	7	7								
Function selection E-3	PE41	0000	0000								

Series			LEFB25 T6	LEFB25U T6	LEFB32 T7	LEFB32U T7	LEFB40 T8	LEFB40U T8
	Lead symbol		S					
	Lead		54					
Parameter *1,*2	Para. No.	Initial value	Recommended value					
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 should be changed.
Different from the initial value.

*1 Parameter is the recommended value. Please change the parameter to make appropriate value for your operating method.

*2 A mechanical resonance may occur depending on the configuration or the mounting orientation of the transferred object. Please change the parameter in the initial setting.

*For LECSS2-T□, please set the electronic gear with PC, PLC etc. in your application.

Recommended parameter values [LEJ]

Series	Lead symbol		LEJS40T6			LEJS63T7			LEJB40T6	LEJB63T7
			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							
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)	

Series	Lead symbol		LEJS100T9		
			H	A	B
	Lead		50	25	10
Parameter *1,*2	Para. No.	Initial value	Recommended value		
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)		

★ : Parameter should be changed.

     : Different from the initial value.

*1 This Parameter is the recommended value. Please change this parameter to an appropriate value for your operating method.

*2 A mechanical resonance may occur depending on the configuration or the mounting orientation of the transferred object. Please change the parameter in the initial setting.

* For LECSS2-T□, please set the electronic gear with PC, PLC etc. in your application.

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Recommended parameter values [LEY]

Series			LEY25T6 / LEYG25T6			LEY25DT6 / LEYG25DT6			LEY32T7 / LEYG32T7			LEY32DT7 / LEYG32DT7		
	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											
Regenerative option	PA02	0000	**0000 (Non)/ 0002 (LEC-MR-RB-032)**											
Rotation direction selection *3	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											

Series			LEY63T8				LEY63DT8		
	Lead symbol		A	B	C	L	A	B	C
	Lead		20	10	5	2.86	20	10	5
Parameter *1,*2	Para. No	Initial value	Recommended value						
Regenerative option	PA02	0000	**0000 (Non)/ 0002 (LEC-MR-RB-032)/ 0003 (LEC-MR-RB-12)**						
Rotation direction selection *3	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						

Series			LEY100T9			LEY100DT9		
	Lead symbol		B	D	L	B	D	L
	Lead (Including pulley ratio)		10	10 (3.33) [Pulley ratio 1/3]	10 (2) [Pulley ratio 1/5]	10	10 (3.33) [Pulley ratio 1/3]	10 (2) [Pulley ratio 1/5]
Parameter *1,*2	Para. No	Initial value	Recommended value					
Regenerative option	PA02	0000	**0000 (Non)/ 0002 (LEC-MR-RB-032)/ 0003 (LEC-MR-RB-12)**					
Rotation direction selection	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	**0001 (Robust filter enabled)**					

[____] : Different from the initial value.

*1 Parameter is the recommended value. Please change the parameter to make appropriate value for your operating method.

*2 A mechanical resonance may occur depending on the configuration or the mounting orientation of the transferred object. Please change the parameter in the initial setting.

*3 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).

* For LECSS2-T□, please set the electronic gear with PC, PLC etc. in your application.

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	Recommended value							
Regenerative option	PA02	0000	**0000 (Non)/ 0002 (LEC-MR-RB-032)**							
Rotation direction selection *3	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							

　　　　　　　　　　　　　　　　　　　　　　　 ▭ : Different from the initial value.

*1 Parameter is the recommended value. Please change the parameter to make appropriate value for your operating method.
*2 A mechanical resonance may occur depending on the configuration or the mounting orientation of the transferred object. Please change the parameter in the initial setting.
*3 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).

* For LECSS2-T□, please set the electronic gear with PC, PLC etc. in your application.

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Recommended parameter values [LET]

Series	Lead symbol		LET80			LET100			
			D	L	M	D	L	M	N
	Lead(Including pulley ratio)		130(43.3)	130(26)	130(14.4)	240(80)	240(48)	240(26.7)	240(16)
	Pulley ratio		1/3	1/5	1/9	1/3	1/5	1/9	1/15
Pa *1,*2	Para. No	Initial value	Recommended parameter values						
Regenerative option	PA02	0000	0000(Non) / 0002(LEC-MR-RB-032) / 0003(LEC-MR-RB-12) /0004(LEC-MR-RB-32)						
Rotation direction	PA14	0	1：Motor arrangement RL,FR 0：Motor arrangement RR,FL						
★Load to motor inertia moment ratio	PB06	7	50						
★Function selection E-3	PE41	0000	0001(Robust filter enable)						

★ : Parameter change required

☐ : Different from the initial value.

*1. Parameter is the recommended value. Please change the parameter to make appropriate value for your operating method.

*2. A mechanical resonance may occur depending on the configuration or the mounting orientation of the transferred object. Please change the parameter in the initial setting.

※In the case of LECSS2-T☐, the electronic gear ratio should be set at the upper-end used by your company.

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