



Operation Manual (Simplified edition)

PRODUCT NAME

AC Servo Motor Driver (Network card type)

MODEL / SERIES / PRODUCT NUMBER

LECSN-T□ Series



When connecting LECSN-T with MR Configurator2™, please select the model: "MR-J4-TM".
For SMC products, please contact the SMC sales office.

SMC Corporation

CONTENTS

Introduction	5
1.Functions and Configuration	5
2. Wiring	6
2.1 Power supply wiring	6
2.2 I/O signal connection	8
2.3 Forced stop deceleration function	9
3. Startup	10
3.1 Startup procedure	10
3.2 Procedures for actuator operation	11
3.3 Setup software (MR Configurator2™)	12
3.3.1 Installation method	12
3.3.2 Startup setup software (MR Configurator2™)	12
3.3.3 System settings	13
3.3.4 Model selection	13
3.3.5 Driver ON LINE check	14
3.3.6 Help function	14
4. Parameter setting	15
4.1 Operation mode【Pr. PA01】	16
4.2 Regenerative option【Pr. PA02】	17
4.3 Absolute position detection system【Pr. PA03】	17
4.4 Function selection A-1【Pr. PA04】	17
4.5 Electric gear【Pr. PA06, Pr. PA07】	17
4.6 Auto tuning mode【Pr.PA08】	18
4.7 Input signal automatic on selection【PD01】	18
4.8 Parameter setting by MR Configurator2™	19
4.8.1 Parameter reading	20
4.8.2 Parameter setting (Ex. Control mode change)	20
5. Test operation	21
5.1 Operation procedure	21
5.2 JOG Mode	22
5.3 Positioning Mode	23
5.3.1 Positioning Mode	24
5.3.2 Motor speed configuration	25
5.3.3 Acceleration/deceleration time configuration	26
5.3.4 Move distance Configuration and Operation	27
6. Monitor by MR Configurator 2™	28
6.1 Acquisition of motion waveform with graph monitor	28
6.1.1 Under the setting Tab: Setting of the items to display the graph	29
6.1.2 Trigger wait	31
6.1.3 Operation Instruction	32

6.1.4 Saving of waveform.....	32
6.2 Display All Monitor List.....	33
7. Network setting	34
7.1 EtherCAT Communication.....	34
7.1.1 EtherCAT Network card (LEC-S-NE).....	34
7.1.2 EtherCAT Communication setting.....	35
7.2 EtherNet/IP	36
7.2.1 EtherNet/IP Network card (LEC-S-N9)	36
7.2.2 EtherNet/IP Communication setting.....	37
7.3 PROFINET	38
7.3.1 PROFINET Network card (LEC-S-NP)	38
7.3.2 PROFINET Communication setting	39
8. Actuator operation from host.....	40
8.1 CiA 402 drive profile	40
8.1.1 FSA state.....	40
8.1.2 Controlword / Statusword.....	41
8.1.3 Control mode	42
8.2 Parameter setting.....	43
8.3 Servo-on and Homing.....	44
8.4 Positioning operation (Profile position mode)	45
9. Trouble shooting.....	46
9.1 Alarm and Warning	46
9.3 Alarm Display	46



LECS 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), and other safety regulations.

*1) ISO 4414: Pneumatic fluid power -- General rules relating to systems

ISO 4413: Hydraulic fluid power -- General rules relating to systems

IEC 60204-1: Safety of machinery -- Electrical equipment of machines (Part 1: General requirements)

ISO 10218: Manipulating industrial robots -- Safety etc.



Caution

Caution indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.



Warning

Warning indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.



Danger

Danger indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.



IMPORTANT

Indicates **important** information that should be memorized, as well as precautions, such as alarm displays, that do not involve potential damage to equipment.

Warning

1. The compatibility of the product is the responsibility of the person who designs the equipment or decides its specifications.

Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results.

The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product.

This person should also continuously review all specifications of the product referring to its latest catalog information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

2. Only personnel with appropriate training should operate machinery and equipment.

The product specified here may become unsafe if handled incorrectly.

The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

3. Do not service or attempt to remove product and machinery/equipment until safety is confirmed.

The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed.

When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.

Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.


4. Contact SMC beforehand and take special consideration of safety measures if the product is to be used in any of the following conditions.

1) Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.

2) Installation on equipment in conjunction with atomic energy, railways, air navigation, space, shipping, vehicles, military, medical treatment, combustion and recreation, or equipment in contact with food and beverages, emergency stop circuits, clutch and brake circuits in press applications, safety equipment or other applications unsuitable for the standard specifications described in the product catalog.

3) An application which could have negative effects on people, property, or animals requiring special safety analysis.

4) Use in an interlock circuit, which requires the provision of double interlock for possible failure by using a mechanical protective function, and periodical checks to confirm proper operation.

Note that the  CAUTION level may lead to a serious consequence according to conditions. Please follow the instructions of both levels because they are important to personnel safety.



LECS Series / Driver Safety Instructions

Caution

The product is provided for use in manufacturing industries.

The product herein described is basically provided for peaceful use in manufacturing industries.

If considering using the product in other industries, consult SMC beforehand and exchange specifications or a contract if necessary.

If anything is unclear, contact your nearest sales branch.

Limited warranty and Disclaimer/Compliance Requirements

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

Read and accept them before using the product.

Limited warranty and Disclaimer

The warranty period of the product is 1 year in service or 1.5 years after the product is delivered whichever is first. *3)

Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.

For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided.

This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.

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

***3) Vacuum pads are excluded from this 1 year warranty.**

A vacuum pad is a consumable part, so it is warranted for a year after it is delivered.

Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty.

Compliance Requirements

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

Introduction

This manual is intended for first-time users of LECSN-T servo motors and contains important excerpts from the "LECSN-T Operation Manual".

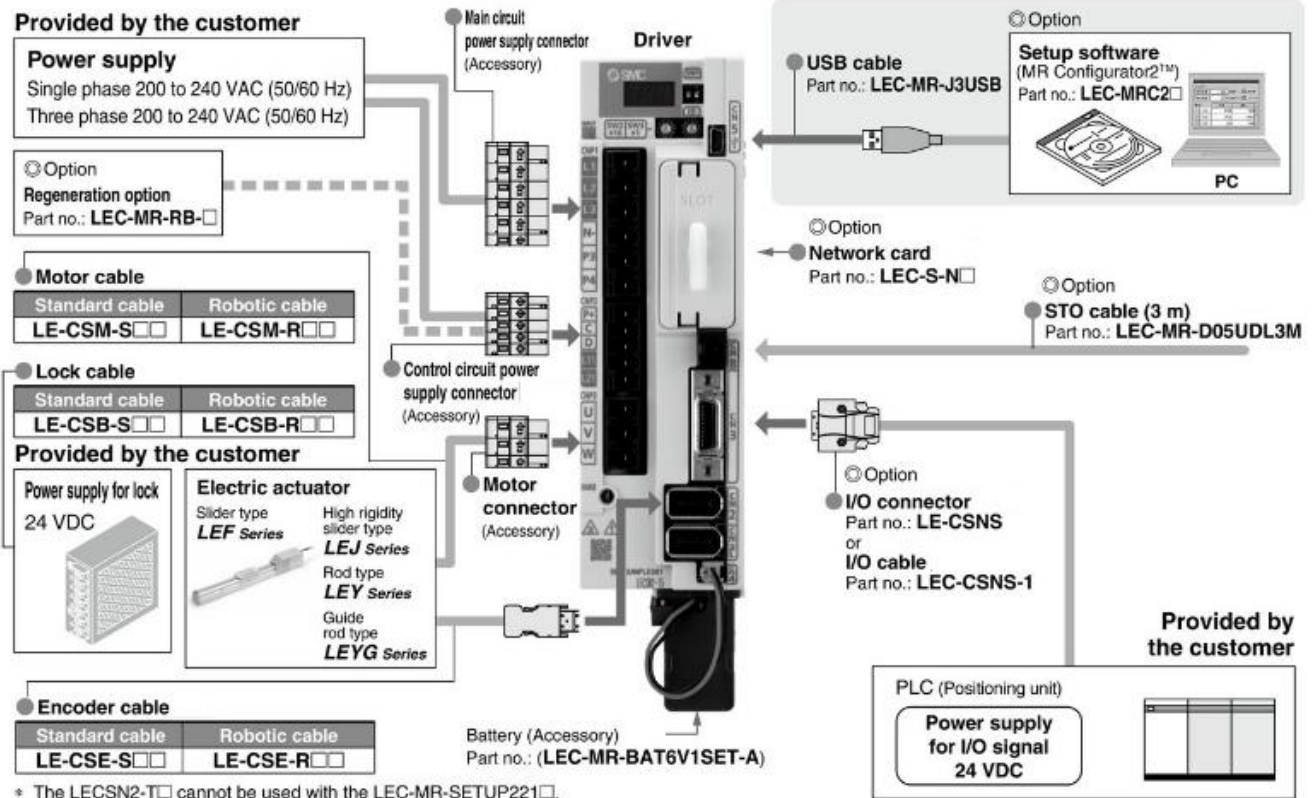
For details, please prepare the "LECSN-T Operation Manual" and check it as well.

For details on the handling of devices other than this driver, refer to the operation manuals of the devices. Refer to Chapter 2 for wiring, Chapter 4 for parameter settings, Chapter 5 for test operation, Chapter 7 for network settings, and Chapter 8 for operation method on the host side.

1.Functions and Configuration

The devices and wiring that make up the driver are shown below.

Absolute encoder compatible **LECSN-T Series** (Network card type)

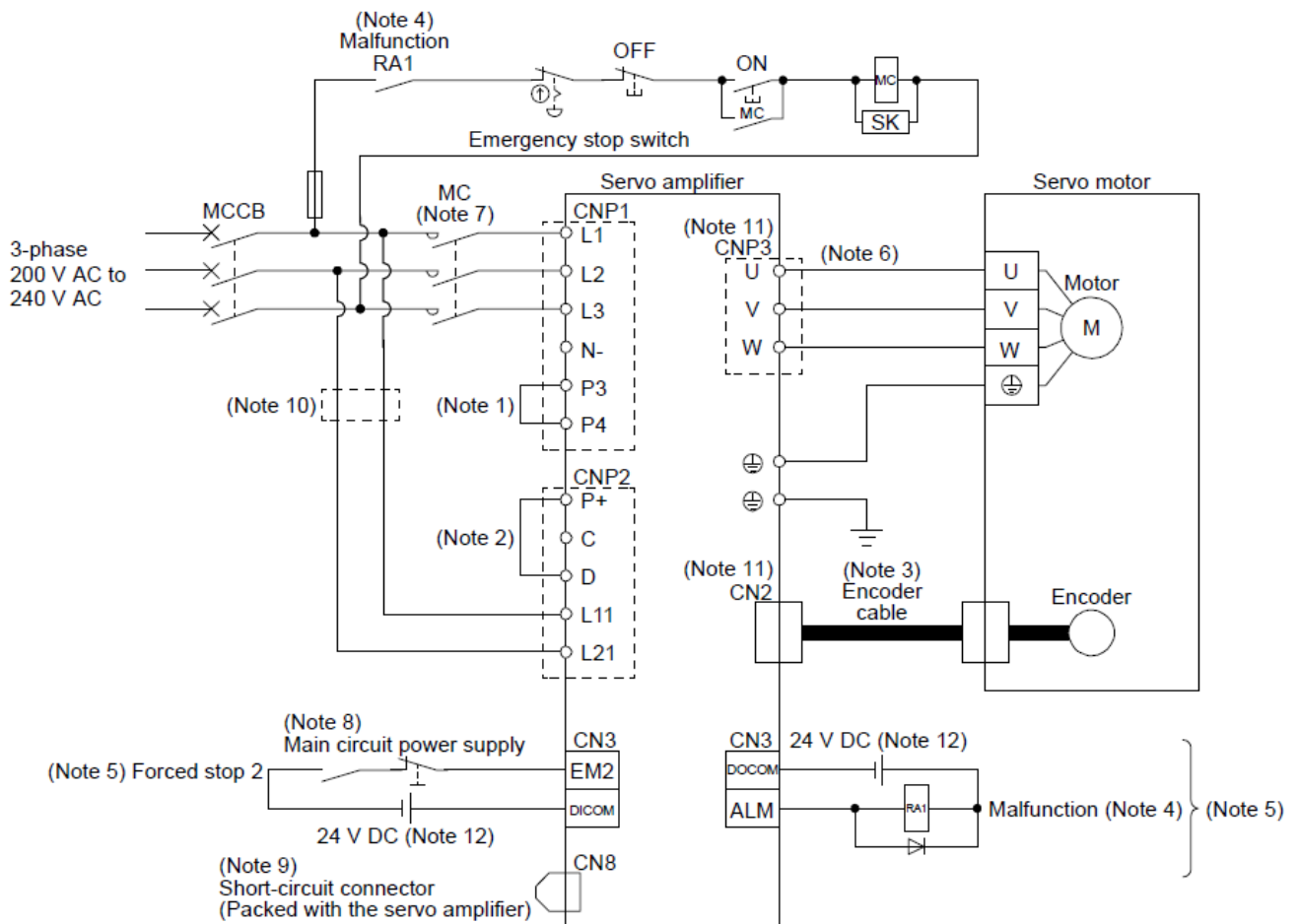


2. Wiring

2.1 Power supply wiring

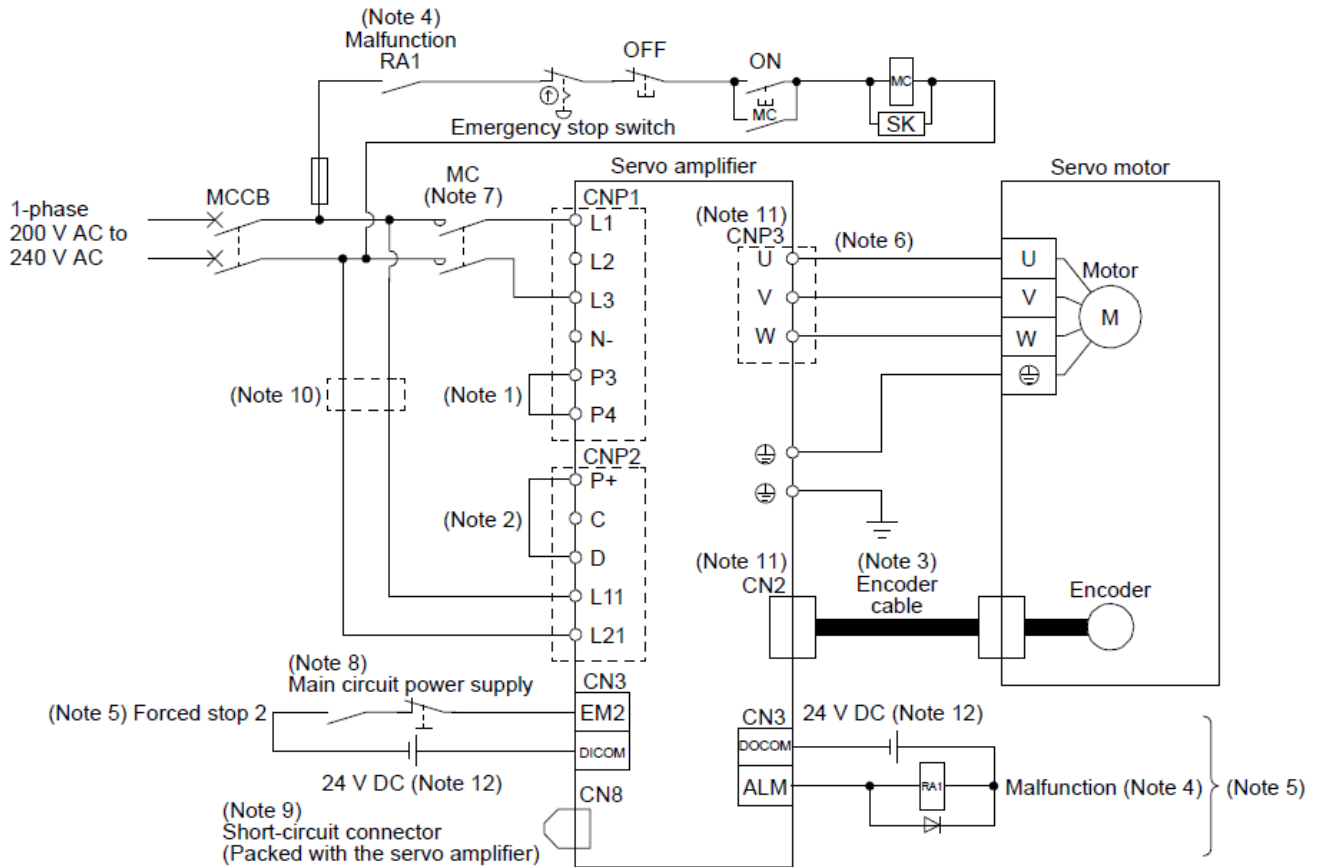
Wires the power supplies for the actuator and driver. This wiring is common in each mode.

(1) Using 3-phase 200 V AC to 240 V AC power supply for LECSN2-T



- Note 1. Between P3 and P4 is connected by default.
- Note 2. Always connect between P+ and D terminals. (Factory-wired)
- Note 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 upper side.
- Note 5. This diagram shows sink I/O interface.
- Note 7. 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.
- Note 8. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the driver
- Note 9. When not using the STO function, attach the short-circuit connector came with a driver.
- Note 10. When wires used for L11 and L21 are thinner than wires used for L1, L2, and L3, use a molded-case circuit breaker.
- Note 11. Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the driver may cause a malfunction.
- Note 12. The illustration of the 24 V DC power supply is divided between input signal and output signal for convenience. However, they can be configured by one.

(2) Using 1-phase 200 V AC to 240 V AC power supply for LECSN2-T

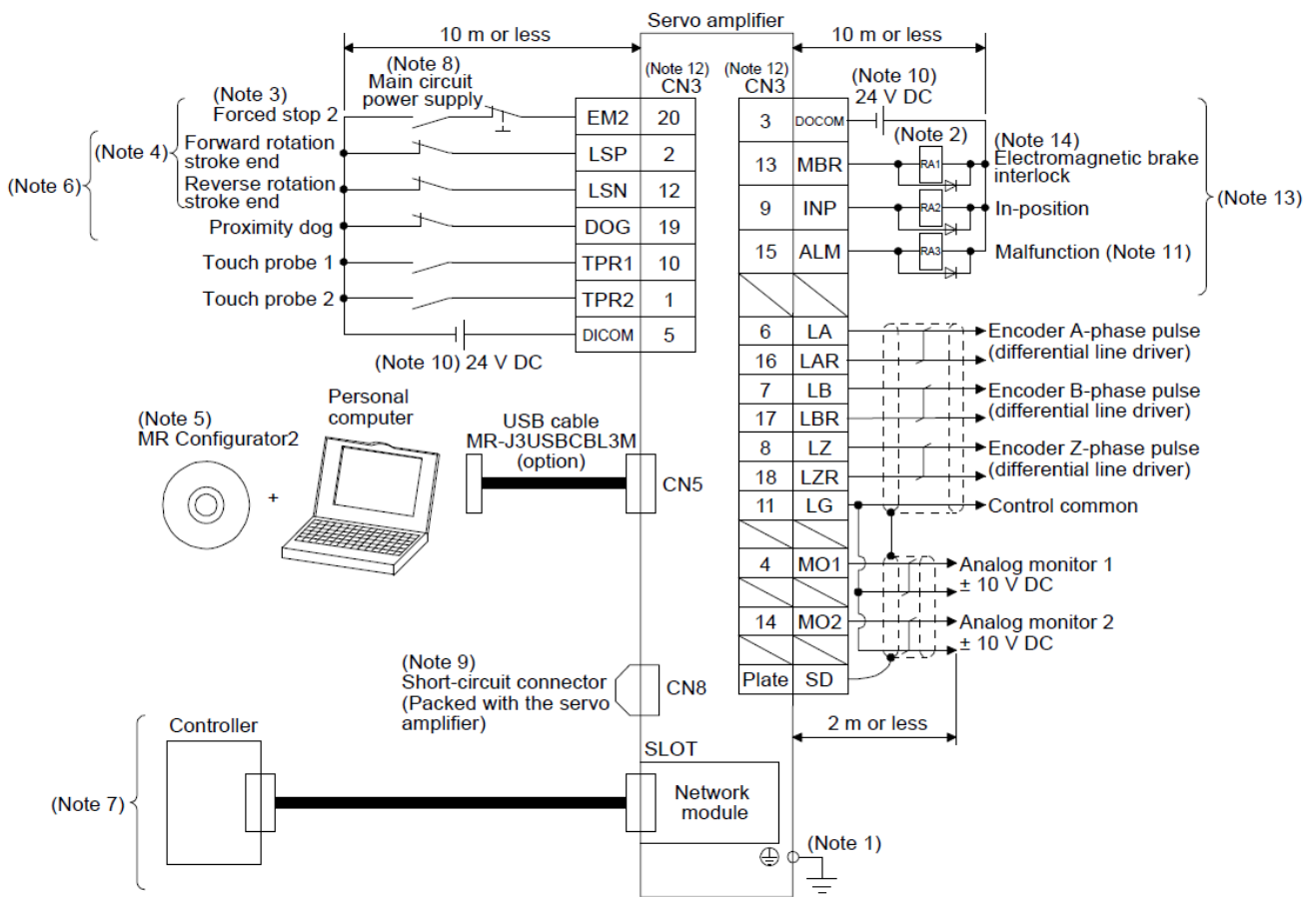


- Note 1. Between P3 and P4 is connected by default.
- Note 2. Always connect between P+ and D terminals. (Factory-wired)
- Note 4. If disabling ALM (Malfunction) output with the parameter, configure up the power supply circuit which switches off the magnetic contactor after detection of alarm occurrence on the upper side.
- Note 5. This diagram shows sink I/O interface.
- Note 7. 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.
- Note 8. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the driver
- Note 9. When not using the STO function, attach the short-circuit connector came with a driver.
- Note 10. When wires used for L11 and L21 are thinner than wires used for L1, and L3, use a molded-case circuit breaker.
- Note 11. Connecting a servo motor of the wrong axis to U, V, W, or CN2 of the driver may cause a malfunction.
- Note 12. 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.

2.2 I/O signal connection

An example of driver input/output signal connection is shown below.

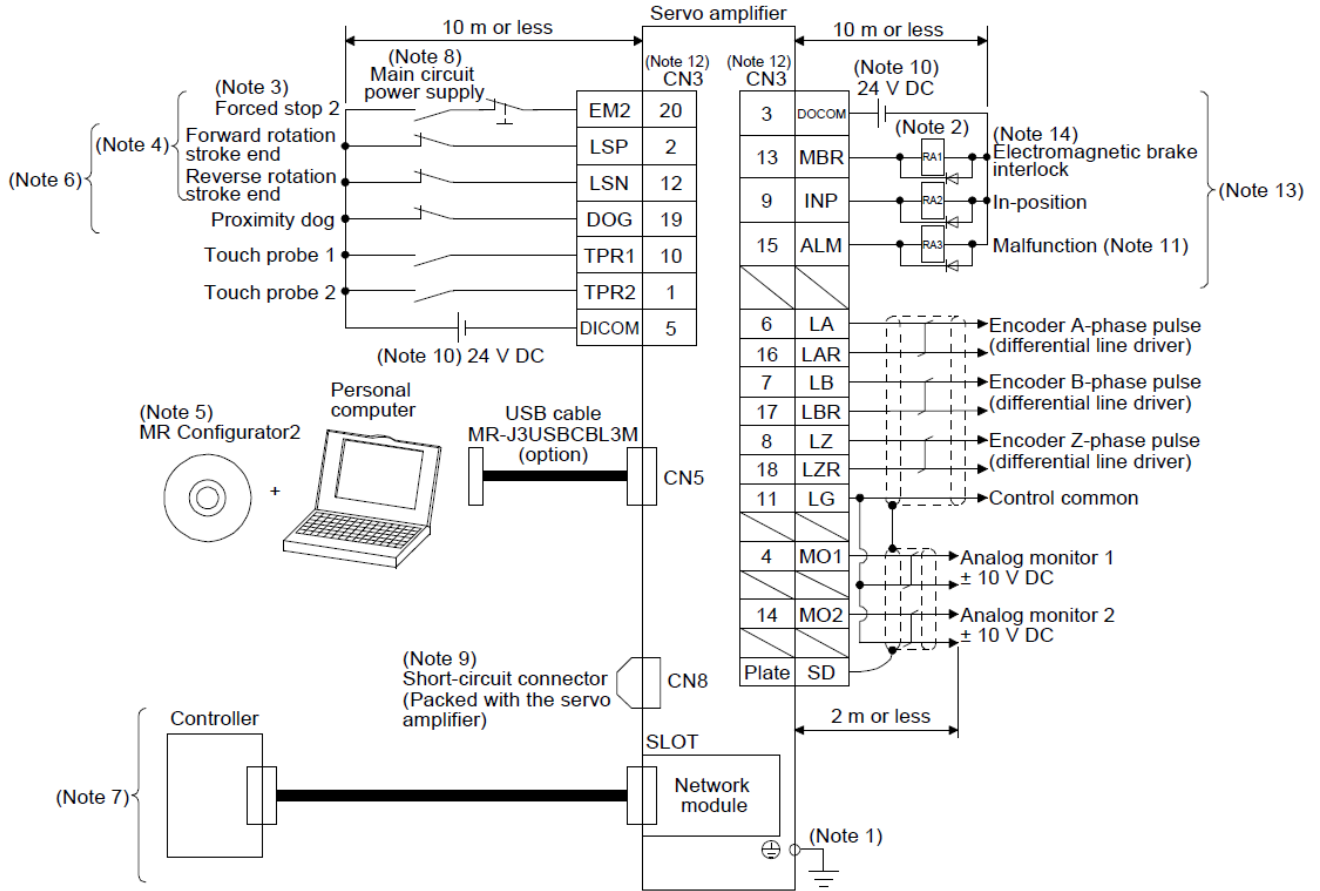
(1) For sink I/O interface



- Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal (marked \oplus) of the driver to the protective earth (PE) of the cabinet.
- Note 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.
- Note 3. If the upper side does not have forced stop function, always install the forced stop 2 switch (normally closed contact).
- Note 4. When starting operation, always turn on EM2 (Forced stop 2), LSP (Forward rotation stroke end) and LSN (Reverse rotation stroke end). (Normally closed contact)
- Note 6. You can change devices of these pins with [Pr. PD03], [Pr. PD05], and [Pr. PD06].
- Note 7. For the network connections, refer to "LECSN-T Operation Manual Chapter 18,19,20".
- Note 8. Configure a circuit to turn off EM2 when the main circuit power is turned off to prevent an unexpected restart of the driver.
- Note 9. When not using the STO function, attach the short-circuit connector came with a driver.
- Note 10. Supply 24 V DC \pm 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. 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.
- Note 11. ALM (Malfunction) turns on in normal alarm-free condition. (Normally closed contact)
- Note 12. The pins with the same signal name are connected in the driver.
- Note 13. You can change devices of these pins with [Pr. PD07], [Pr. PD08], and [Pr. PD09].

(2) For source I/O interface

POINT
●For notes, refer to section (1)



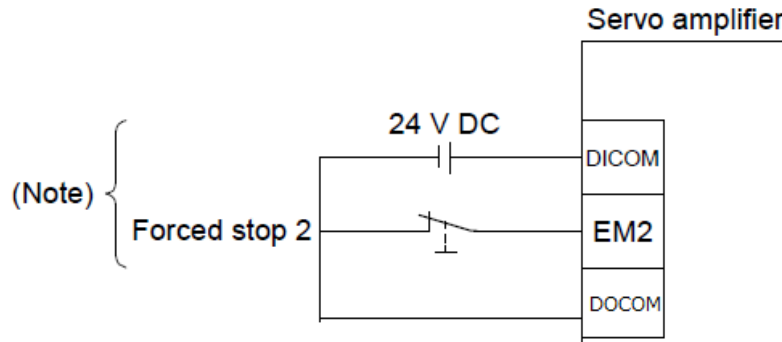
2.3 Forced stop deceleration function

The following is an explanation of the driver's forced stop deceleration signal EM2.

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].

If the servo motor is started up without EM2 connected, [AL. E6 Servo forced stop Warning] will occur and the servo motor will not be able to run.

Connection diagram



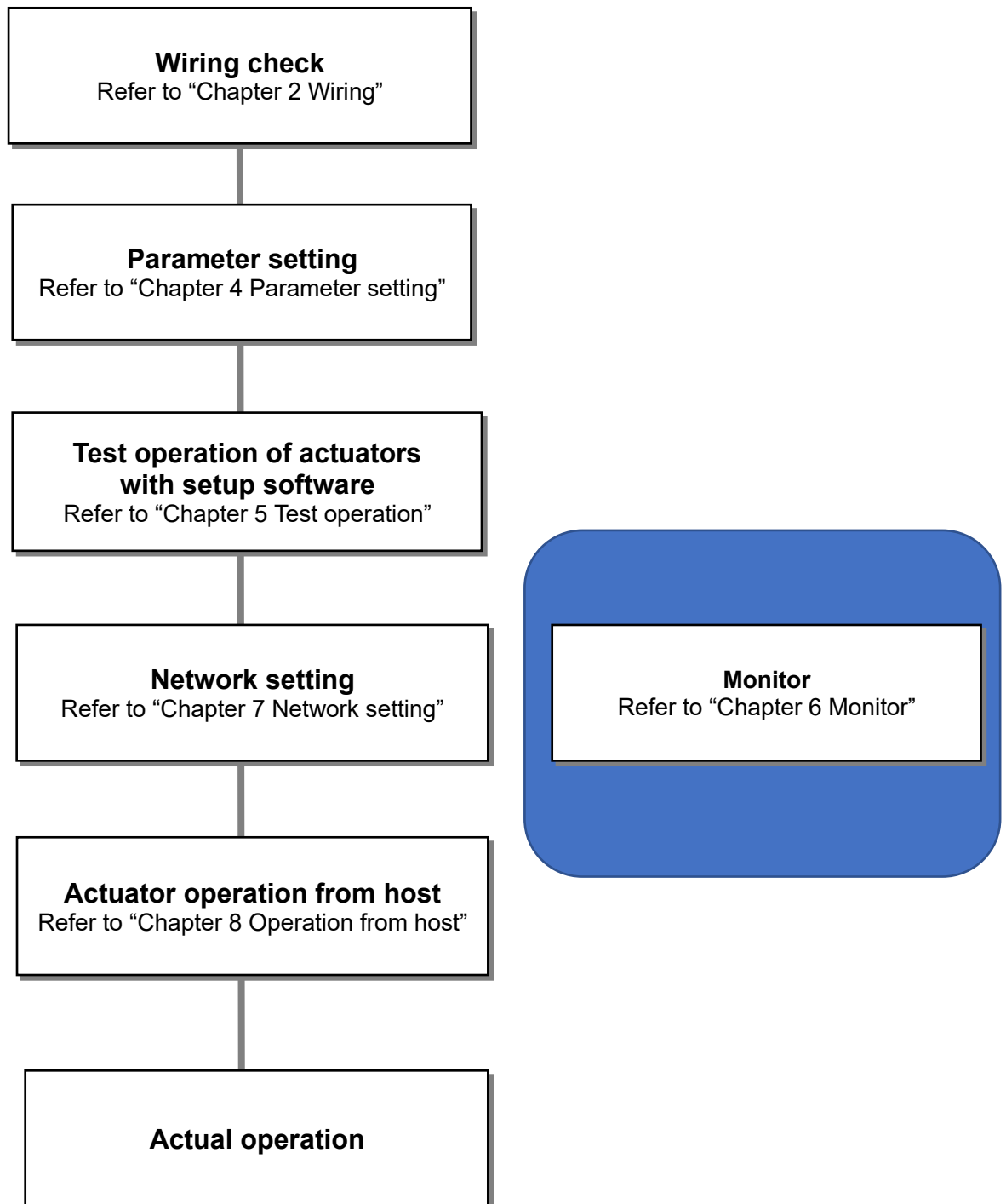
Note. This diagram shows sink I/O interface.

3. Startup

The following are the procedures for startup, actuator operation, and startup of the setup software.

3.1 Startup procedure

This section shows the startup procedure when installing the actuator for the first time. For details, refer to "LECSN-T Operation Manual, Section 4.1".



3.2 Procedures for actuator operation

The following is the procedure for actuator operation.

(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 rotary 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) 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 controller.

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

(3) Home position return

Always perform home position return before starting positioning operation.

When homing, a homing command is sent from the host in the homing mode.

When using the absolute positioning system, once the origin is set, there is no need to perform homing at subsequent power-on.

Note that homing is not performed in the test operation mode.

(4) Drive

In each control mode, an operation command is sent from the host.

This manual describes the procedure for "profile position mode."

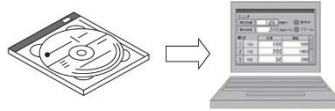
(5) Stop

Turn off the servo-on command after the servo motor has stopped, and then switch the power off. If any of the following situations occurs, the driver suspends the running of the servo motor and brings it to a stop.

Refer to "LECSN-T Operation Manual, Section 3.9" for the servo motor with an electromagnetic brake.

	Operation/command	Stopping condition
Upper side	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.
	Quick stop command	The servo motor decelerates to a stop with the command.
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.
	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 mode.
	STO (STO1, STO2) off	The base circuit is shut off and the dynamic brake operates to bring the servo motor to a stop.

3.3 Setup software (MR Configurator2™)



***1 Setup software version 1.52E or above is required.**

***2 MR Configurator2™ (LEC-MRC2E) must be purchased as an additional item.**

***3 The USB cable (LEC-MR-J3USB) must be purchased as an additional item.**

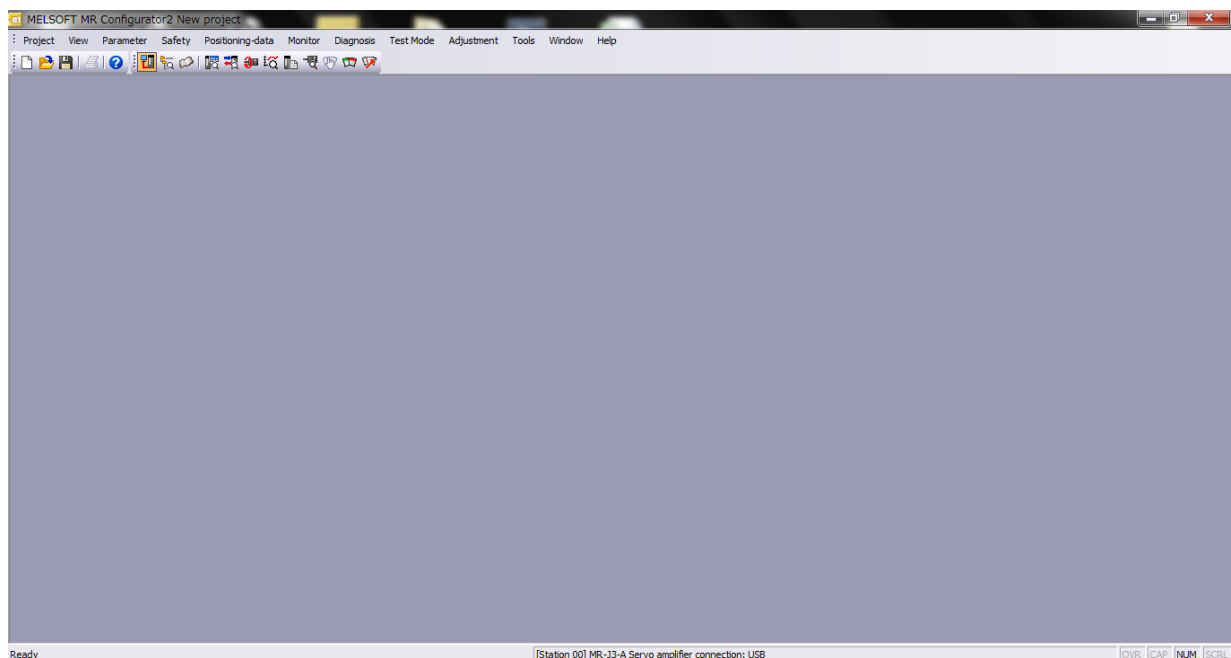
3.3.1 Installation method

Perform installation according to the “MR Configurator2™ instruction manual” (Manual/ib0300160*.pdf) contained on the setup software (MR Configurator2™) CD-ROM. The “MR Configurator2™” software will be added to the PC.

3.3.2 Startup setup software (MR Configurator2™)

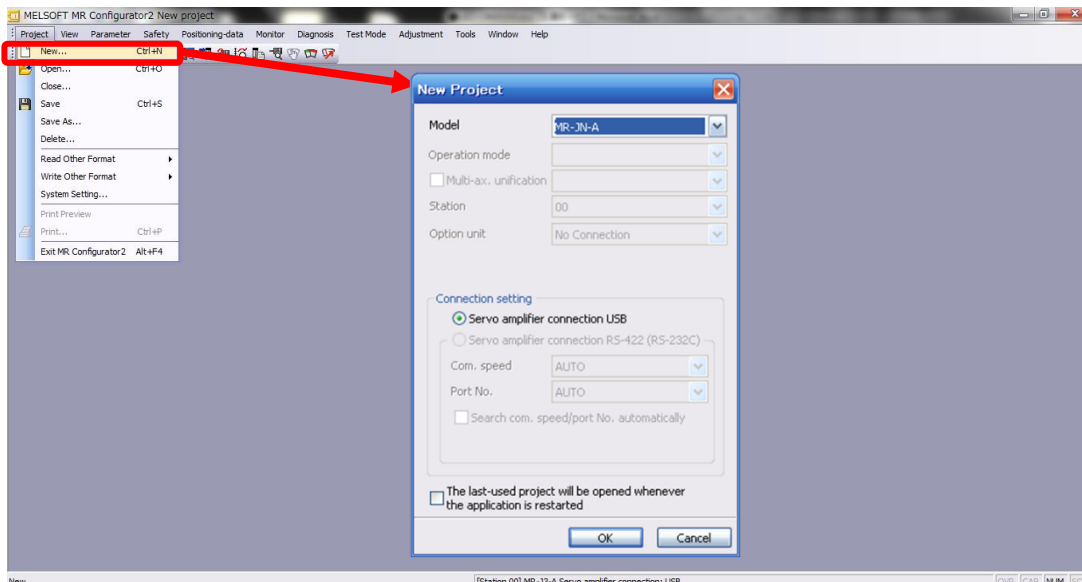
- ① Connect the PC and LECSN-T using the USB cable.
- ② Turn on the power of the LECSN-T.
- ③ Start application “MR Configurator2™”.

Once the application starts, the screen below will be displayed.



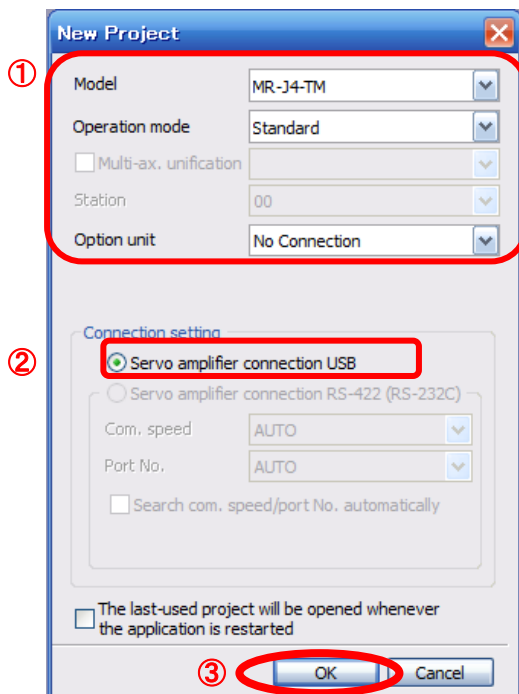
3.3.3 System settings

- ① From "Project" menu select "New", the "New project" window will be displayed.



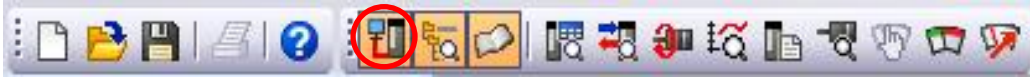
3.3.4 Model selection

- ① The Mitsubishi Electric Corporation series will be displayed in the model selection list.
Please select the model "MR-J4-TM", if using the LECSN-T.
Please select the station for the USB connection.
Please select the option unit "No Connection".
- ② Please select "servo amplifier connection USB" as the communication device.
- ③ Click OK.




3.3.5 Driver ON LINE check

Check that the driver is enabled (ONLINE).



Check that the “ONLINE / OFFLINE” icon is displayed “  ”.

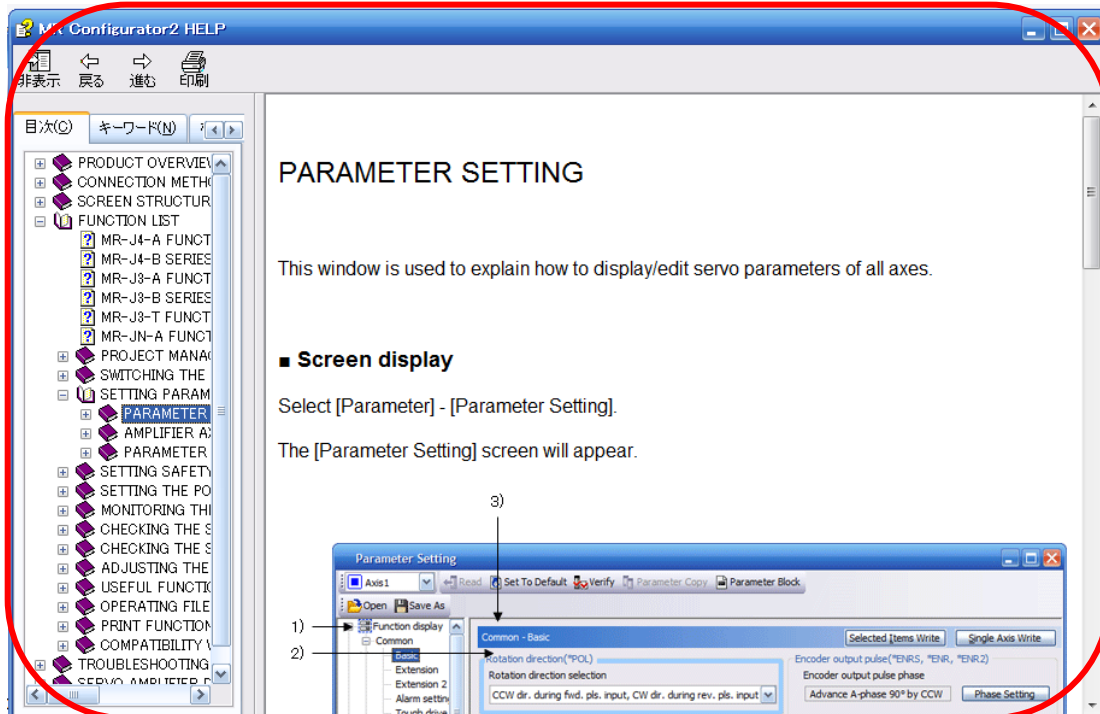
It is OFFLINE when displayed as “  ”.

* For OFFLINE, PC and driver aren't communicating. Confirm the following points.

- Is driver's power supply turning on?
- Are PC and driver connected with the USB cable?
- Is the USB driver installed?
- Is the USB driver which is compliant to Windows version installed?
- Is the setting of “Port” for USB connection corresponding?
Please select the option unit “No Connection”.

3.3.6 Help function

By selecting “MR Configurator2 Help” in “Help” from any window of the setup software, a “HELP” screen will be shown.



4. Parameter setting

Parameters that need to be set at startup.

For some items, please refer to the recommended parameter values for each actuator in "LECSN-T□ Operating Manual, Appendix 9".

For details and parameters other than those in this section, refer to "LECSN-T□ Operation Manual, Chapter 5".

Parameters can be set by commands from the host and setup software (MR Configurator2™: LEC-MRC2*). Refer to section 4.7 of this manual for how to use MR Configurator2™.

Parameters that need to be set

No.	Symbol	Name	Initial value	Reference
[Pr.PA01]	**STY	Operation mode	1000h	Section 4.1
[Pr.PA02]	**REG	Regenerative option	0000h	Section 4.2
[Pr.PA03]	*ABS	Absolute position detection system	0000h	Section 4.3
[Pr.PA04]	*AOP1	Function selection A-1	2000h	Section 4.4
[Pr.PA06]	*CMX	Electric gear numerator/Number of gear teeth on machine side	1	Refer to the "recommended parameter values for each actuator" and Section 4.5
[Pr.PA07]	*CDV	Electric gear numerator/Number of gear teeth on servo motor side	1	
[Pr.PA08]	RSP	Auto tuning mode	0001h	Section 4.6
[Pr.PA14]	*POL	Rotation direction selection / travel direction selection	0	Refer to the "recommended parameter values for each actuator"
[Pr.PB06]	GD2	Load to motor inertia ratio/load to motor mass ratio	7	
[Pr.PD01]	*DIA1	Input signal automatic on selection 1	0000h	Section 4.7
[Pr.PE41]	EOP	Function selection E-3	0000h	Refer to the "recommended parameter values for each actuator"
[Pr.PT01]	**CTY	Command mode selection	0300h	
[Pr.PT03]	*FTY	Feeding function selection	0000h	
[Pr.PT05]	ZRF	Home position return speed	100	
[Pr.PT06]	CRF	Creep speed	10	
[Pr.PT07]	ZRF	Home position shift distance	0	
[Pr.PT10]	ZTM	Stopper type home position return stopper time	100	
[Pr.PT11]	ZTT	Stopper type home position return torque limit value	15	
[Pr.PT45]	HMM	Home position return method	37	
[Pr.PT56]	HMA	Home position return acceleration time constant	0	

4.1 Operation mode 【Pr. PA01】

Select the control mode to be used.

For more information, please refer to section 8.1.3 of this manual.

POINT
<p>● Symbols in the network column indicate the following networks.</p> <p>ECT: EtherCAT EIP: EtherNet/IP PNT: PROFINET</p>

[Pr. PA01] setting	Control mode		
	EtherCAT	EtherNet/IP	PROFINET
___ 0	Cyclic synchronous mode Homing mode	Profile mode /homing mode	
___ 1	Cyclic synchronous mode Homing mode	/	
___ 2	Profile mode / homing mode		
___ 6	Point table mode / Jog mode / homing mode	/	
___ 8	Indexer mode / Jog mode / homing mode	/	

See below for a description of each control mode.

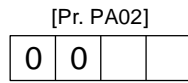
Function	Description	Network		
		ECT	EIP	PNT
Cyclic synchronous position mode (csp)	The position control operation performed by a synchronous sequential position command through network is supported.	○	/	/
Cyclic synchronous velocity mode (csv)	The speed control operation performed by a synchronous sequential speed command through network is supported.	○	/	/
Cyclic synchronous torque mode (cst)	The torque control operation performed by a synchronous sequential torque command through network is supported.	○	/	/
Profile position mode (pp)	The positioning operation performed by an asynchronous end position command through network is supported.	○	○	○
Profile velocity mode (pv)	The speed control operation performed by an asynchronous speed command through network is supported.	○	○	○
Profile torque mode (tq)	The torque control operation performed by an asynchronous torque command through network is supported.	○	○	○
Homing mode (hm)	The home position return operation specified in each network is supported.	○	○	○
Point table mode (pt)	Set 1-to-255-point tables in advance, and select any point table to perform operation in accordance with the set values.	○	/	○
Indexer mode (idx)	Set the station positions divided into 2 to 255 in advance to perform operation to the station positions.	○	/	○
Jog mode (jg)	This is a control mode where the servo motor speed is set to drive the servo motor manually.	○	/	○

4.2 Regenerative option 【Pr. PA02】

Set this parameter when the regenerative power generated is large and the driver's built-in regenerative resistor does not have sufficient regenerative capability.

For the regenerative option to be used, refer to the "Speed – Workload Graph / Required Conditions for Regeneration Option" in the catalog for each actuator.

For details on how to connect the regenerative options, refer to "LECSN-T Operation Manual, Section 11.2".



Select a regenerative option.

00: Regenerative option is not used.

For drivers of LECSN-T5, do not use a regenerative resistor.

For drivers of LECSN-T5/T7/T8 and LECSN2-T9,
use a built-in regenerative resistor.

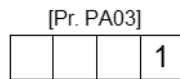
02: LEC-MR-RB-032

03: LEC-MR-RB-12

4.3 Absolute position detection system 【Pr. PA03】

Set this parameter to enable the absolute position detection system.

For details, refer to "LECSN-T Operation Manual, Chapter 12".



Set this digit when using the absolute position detection system.

0: Disabled (incremental system)

1: Enabled (absolute position detection system)

POINT

- This parameter becomes effective when the power is turned off and then turned on again after setting.

4.4 Function selection A-1 【Pr. PA04】

When the forced stop inputs EM2 and EM1 are not wired, they can be enabled forcibly.

To turn on the forced stop input automatically, change Pr. PA04 from the initial value "2000h" to "2100h".

For details, please refer to "LECSN-T Operation Manual, Section 5.2.1".

However, when enabling the forced stop input, be sure to provide an emergency stop function on the host side.

4.5 Electric gear 【Pr. PA06, Pr. PA07】

The electronic gear must be set to convert pulses from the positioning unit (PLC) into the actuator's travel. Basically, enter the "Recommended Parameter Values for Each Actuator" in "LECSN-T User's Manual, Appendix 9".

The electronic gear can be changed to suit your company's usage.

For details, refer to "LECSN-T Operation Manual, Section 5.4."

4.6 Auto tuning mode 【Pr.PA08】

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

The parameters that are automatically adjusted differ depending on the gain adjustment mode.

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]

The driver is set to "auto tuning mode 1" as shipped.

If you cannot obtain satisfactory adjustment, set the driver to "auto tuning mode 2" and then to "manual mode".

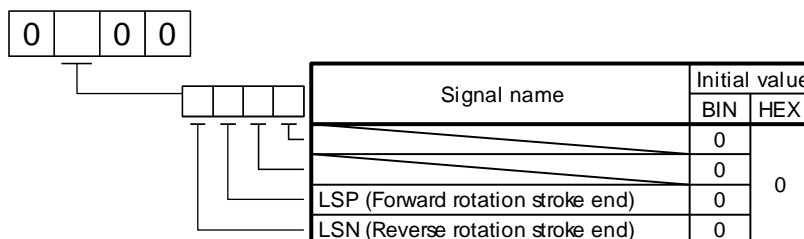
For details, refer to "LECSN-T Operation Manual, Chapter 6".

4.7 Input signal automatic on selection 【PD01】

If LSP (forward stroke end) and LSN (reverse stroke end) detection is not performed by an external input signal, set the input signal to "1: Automation on".

If LSP and LSN are not detected, an alarm occurs.

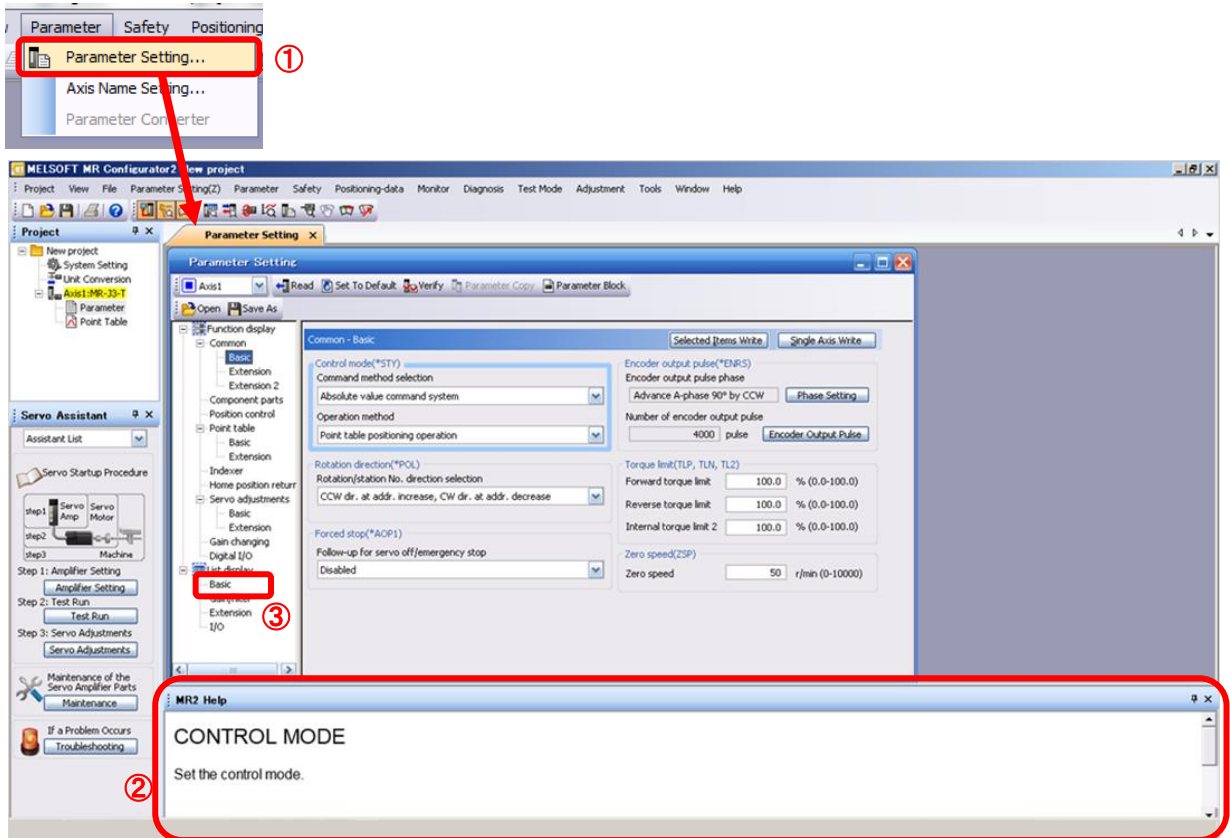
Convert the setting value into hexadecimal as follows.



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

4.8 Parameter setting by MR Configurator2™

- ① From the “Parameter” menu select “Parameter Setting”, the “parameter setting” window will open.
- ② The explanation of the parameter item is displayed in “MR2 Help”.
(When it is not displayed, from the “View” menu select “Docking window” – “Docking Help”.)



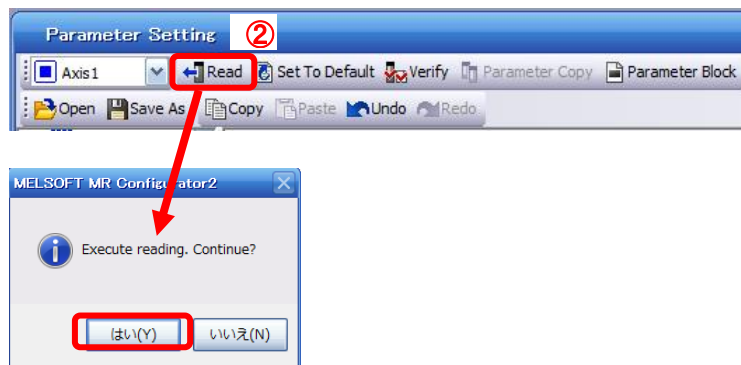
- ③ When each item of “List display” is clicked, “Parameter list” screen along each item is displayed. When “Basic” is selected, it is displayed as follows.

Basic				Selected Items Write	Single Axis Write
No.	Abbr.	Name	Units	Setting range	Axis1
PA01	*STY	Control mode		0000-0F55	0000
PA02	*REG	Regenerative option		0000-71FF	0000
PA03	*ABS	Absolute position detection system		0000-0004	0000
PA04	*AOP1	Function selection A-1		0000-F031	0000
PA05	*FBP	Number of command input pulses per revolution		0-0 / 1000-50000	0
PA06	CMX	Elec. gear numerator (Cmd. pls. mult. factor num.)		1-1048576	1
PA07	CDV	Elec. gear denominator (Cmd. pls. mult. factor den.)		1-1048576	1
PA08	ATU	Auto tuning mode		0000-0003	0001
PA09	RSP	Auto tuning response		1-32	12
PA10	INP	In-position range	pulse	0-65535	100
PA11	TLP	Forward rotation torque limit	%	0.0-100.0	100.0
PA12	TLN	Reverse rotation torque limit	%	0.0-100.0	100.0
PA13	*PLSS	Command pulse input status		0000-0812	0000
PA14	*POL	Rotation direction selection		0-1	0
PA15	*ENR	Encoder output pulse	pulse/rev	1-1048576	4000
PA16	*ENR2	For manufacturer setting		0000-FFFF	0000
PA17	*MSR	For manufacturer setting		0000-FFFF	0000
PA18	*MTY	For manufacturer setting		0000-FFFF	0000
PA19	*BLK	Parameter block		0000-FFFF	000C

4.8.1 Parameter reading

If you read the parameters of the driver to the software, please do the “read” operation.

- ① From the View menu bar "parameter (A)" - please click on the "parameter setting (P)". "Parameter Settings" screen will display.
- ② Please click on the “Read”.

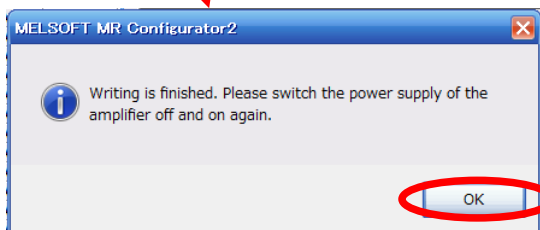


4.8.2 Parameter setting (Ex. Control mode change)

The following is an example of changing the Control mode (Pr.PA01).

- ① Set the parameters of Pr.PA01 to “0001” in “Basic” tab.
- ② Click on the “Single Axis Write” button.
- ③ Turn the power OFF and ON again. The Parameter is then enabled.

No.	Abbr.	Name	Units	Setting Range	Axis1
PA01	*STY	Control mode		0000-2F01	0000
PA02	*REG	Regenerative option		0000-71FF	0000
PA03	*ABS	Absolute position detection system		0000-0001	0000



When changing of each parameter, note the following points.

- Note1) Some of the various parameters, there is "Enable once on again turning the power OFF after setting". (If you do not the power to OFF, it does not reflect the data in the driver.)
- Note2) “Selected Items Write”: It writes the parameter values of the corresponding frame to the driver.
“Single Axis Write”: It writes all of the parameters to the driver.
- Note3) Do not change “For manufacturer setting” parameters. If you change by these by mistake, it may cause the driver to not work properly.

5. Test operation

Using a PC and setup software (MR Configurator2™), JOG operation, positioning operation, program operation, output signal (DO) forced output, and single-step feed can be executed.

This chapter describes JOG operation and positioning operation.

For other functions and details, please refer to "Section 4.5.1 of the LECSN-T Operation Manual".

(a) Jog operation

Jog operation can be performed without using the upper side. 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 upper side is connected or not. See section 5.2 for the procedure.

(b) Positioning operation

Positioning operation can be performed without using the upper side. 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 upper side is connected or not. See section 5.3 for the procedure.

(c) Program operation

Positioning operation can be performed in two or more operation patterns combined, without using the side. 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 host side is connected or not.

(d) Output signal (DO) forced output

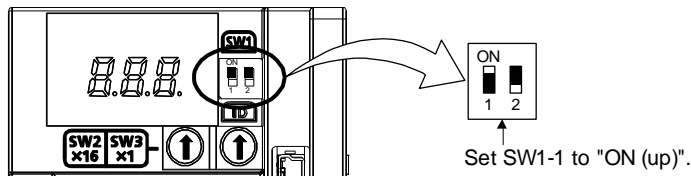
Output signals can be switched on/off forcibly independently of the servo status. Use this function for output signal wiring check, etc.

(e) Single-step feed

The positioning operation can be performed in accordance with the point table No. set with setup software (MR Configurator2™).

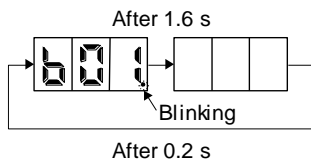
5.1 Operation procedure

- (1) Turn off the power.
- (2) Turn "ON (up)" SW1-1. (During power-on, test operation mode will not start.)

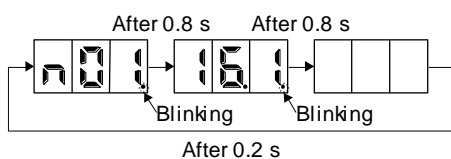


- (3) Turn on the driver.

When initialization is completed, the decimal point on the first digit will blink.



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

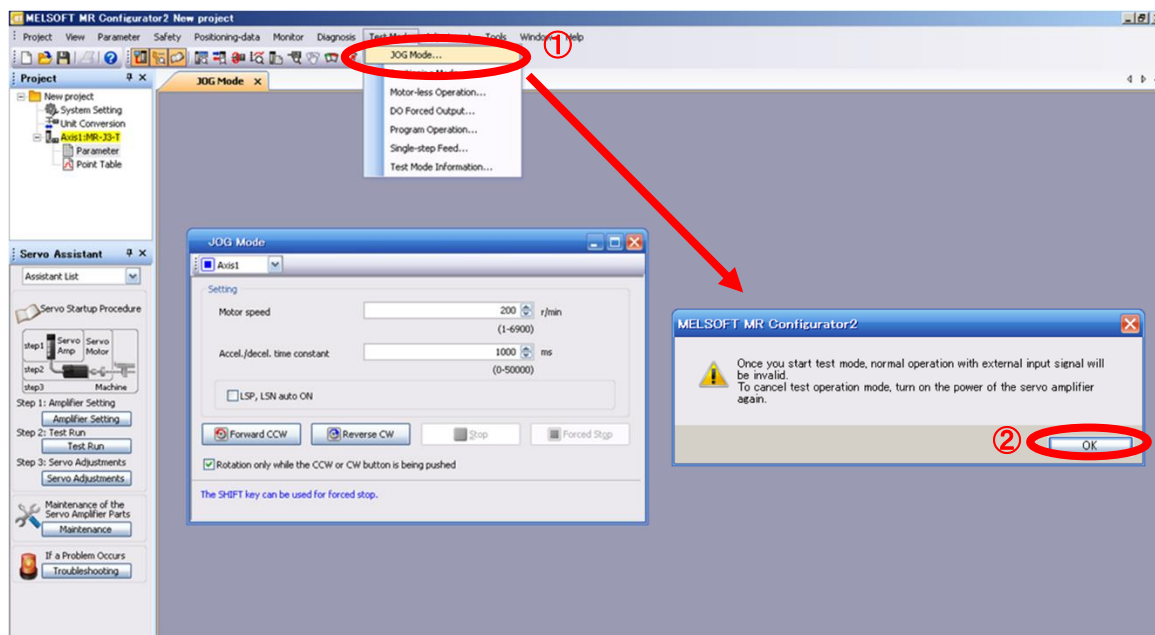


- (4) Start operation with the PC.

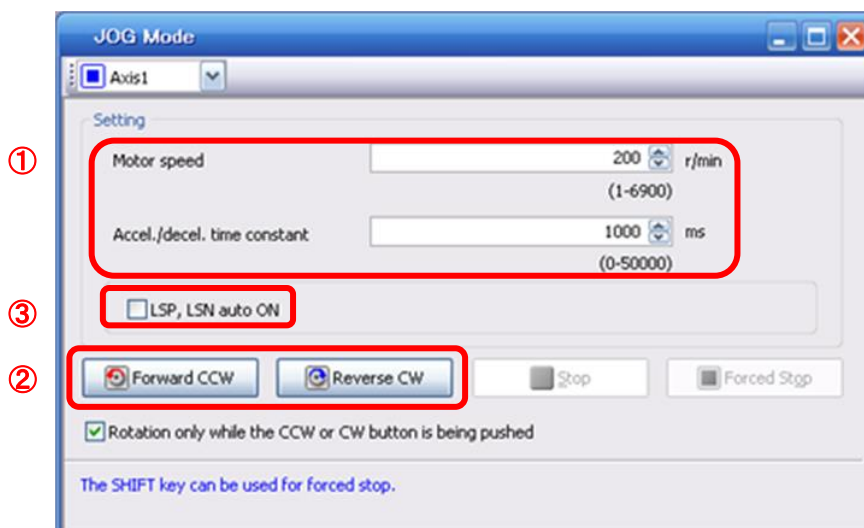
5.2 JOG Mode

JOG operation can be executed without host command. Use this function with the forced stop disabled.

- (1) The “JOG Mode” window can be displayed by selecting “Jog Mode” from the “Test Mode” menu in the **setup software**.
- (2) Click “OK”.
(When using this function, all external input signal operation will be disabled. If controlling using a PLC or other upper device, please turn off the power and reset the device before use.)



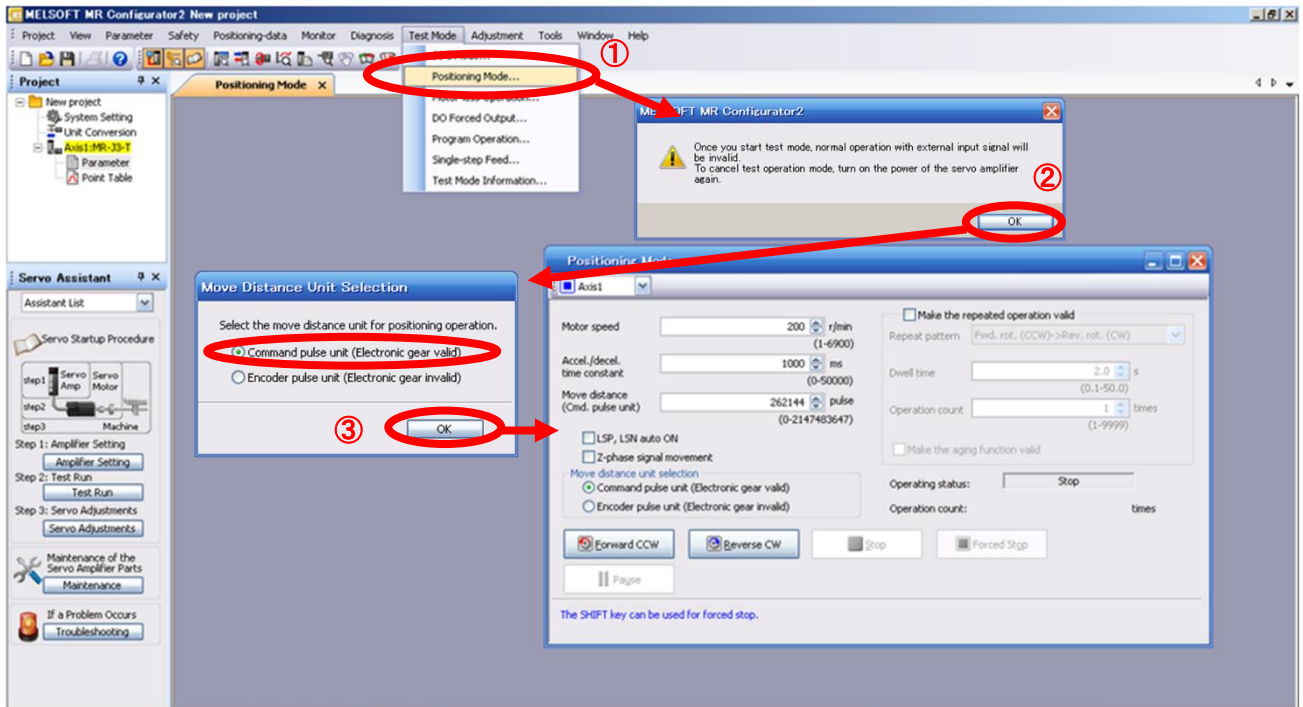
- (3) Check actuator JOG operation using [Forward (CCW)] and [Reverse (CW)] in JOG mode.
(if operation is not correct, please check wiring and parameters).
When performing JOG operation in the setup software, the rotation direction of the actuator does not change if you change the setting of parameter PA14 (Rotation direction selection).
The actuator moves in the direction of [Forward (CCW)] button and [Reverse (CW)] button.
- (4) If the selection “LSP and LSN are automatically turned ON” is not checked, an alarm will occur (if checked, the stroke end signals “LSP” & “LSN” will be automatically turned ON when this window is open).



Item	Setting range	Unit	Description
Motorspeed	0 to allowable actuator speed	r/min	Set the command speed of the servo motor for execution of positioning (motor rotations/minute).
Acceleration /deceleration time	0 to 50000	ms	Set the time until the servo motor reaches/stops to the rated speed (3000 r/min).

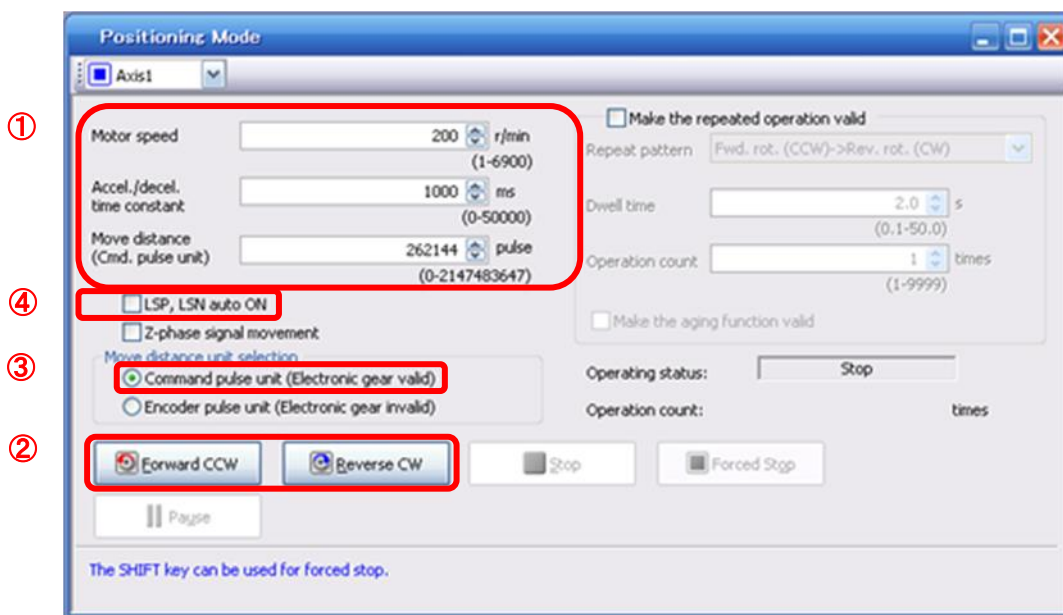
5.3 Positioning Mode

- ① From the Test Mode menu of the Setup Software select Positioning Mode. The Move Distance Unit Selection window opens.
- ② Click OK.
(When using this function, external input signal operation will be disabled. When controlling from a PLC or upper-level device, the power must be turned off and then on.)
- ③ Check Command pulse unit (Electronic gear valid) and click OK.
Electronic gear ratio that is set in the PA06 / PA07 is enabled.
- ④ The Positioning Mode window opens.



5.3.1 Positioning Mode

- ① To prevent accidental impact at the end of the stroke, operate the actuator at a low speed initially. When changing speed or movement, increase the values whilst checking operation (Change motor speed, acceleration/deceleration time, movement distance values if required).
- ② Actuator positioning operates using [Forward (CCW)] and [Reverse (CW)].
(Check wiring and parameters if operation cannot be performed correctly).
When performing positioning operation in the setup software, the rotation direction of the actuator does not change if you change the setting of parameter PA14 (Rotation direction selection). The actuator moves in the direction of [Forward (CCW)] button and [Reverse (CW)] button.
- ③ Check the command impulse unit (electronic gear enabled).
The electronic gear duty set to PA06/PA07 will be enabled.
- ④ If the “stroke-end (LSP, LSN)” signal is not configured as ON, an alarm may occur.
(When checked, the “stroke-end (LSP, LSN)” will be automatically turned ON only when this window is open.)



Item	Setting range	Unit	Description
Motor speed	0 to Allowed Speed for each actuator	r/min	Set the command speed of the servo motor for execution of positioning (Motor rotations/min).
Acceleration/deceleration time	0 to 50000	ms	Set the time until the servo motor reaches/stops to the rated speed <u>(3000 r/min)</u> .
Move distance	0 to 99999999	pulse	Sets movement distance.

5.3.2 Motor speed configuration

<Rotation Speed Configuration>

① Motor speed (r/min) configuration.

* r/min (rpm): Indicated motor rotation speed (motor rotations/min)

Rotation speed must be between 0 and the allowable speed limit for each actuator. Please be aware that the actuator will not operate if this is set to 0.

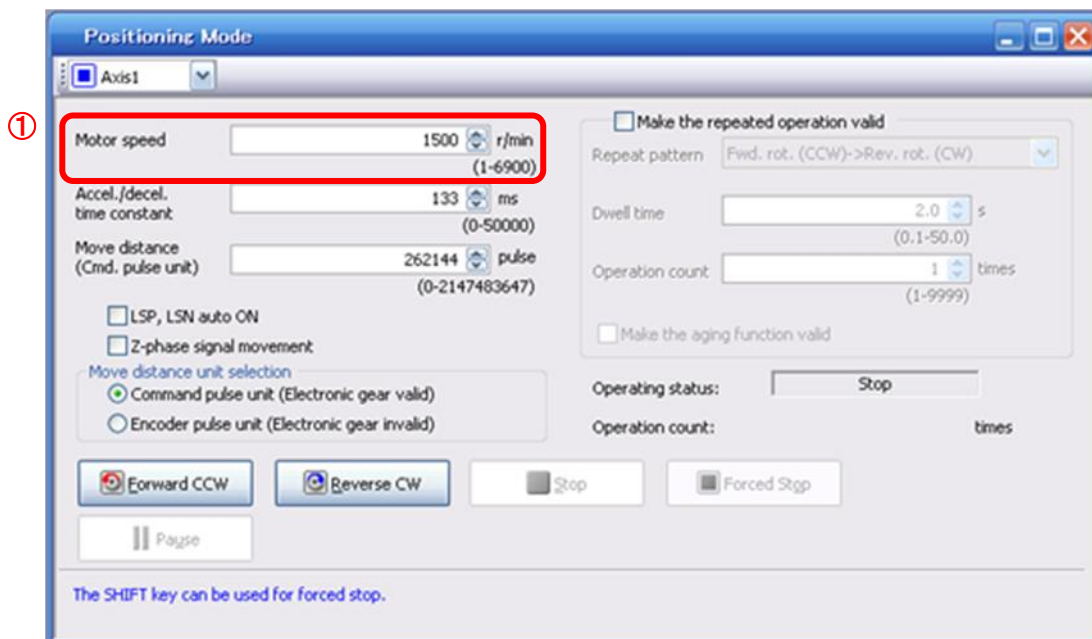
If the rotation speed is too low, this may cause vibration; check the actuator while changing settings.

Movement speed (mm/s) must be converted into rotation speed (r/min).

See below for the conversion formula.

Calculating motor speed conversion example using an actuator with a 20mm lead and 500[mm/sec] speed.

$$\begin{aligned} & \text{Rotations per Second} \\ & \frac{\text{Distance of movement per second}}{\text{Distance of movement per rotation}} \\ \text{Rotation Speed (rpm)} &= \frac{\text{Speed (mm/s)}}{\text{Lead (mm)}} \times 60 \text{ (S)} \\ &= \{500 \text{ (mm/s)} \div 20 \text{ (mm)}\} \times 60 \text{ (s)} = 1500 \text{ (rpm)} \end{aligned}$$



5.3.3 Acceleration/deceleration time configuration

< Acceleration/deceleration time Configuration >

- ① Acceleration/deceleration time (ms) configuration:
The acceleration/deceleration time sets the amount of time (ms) in which a prescribed rotation speed(3000[r/min]) is reached.
The acceleration/deceleration time must be set to a value between 0 and the allowable acceleration/deceleration speed for each actuator.

The acceleration/deceleration time must be converted from the acceleration/deceleration speed. See below for the conversion formula.

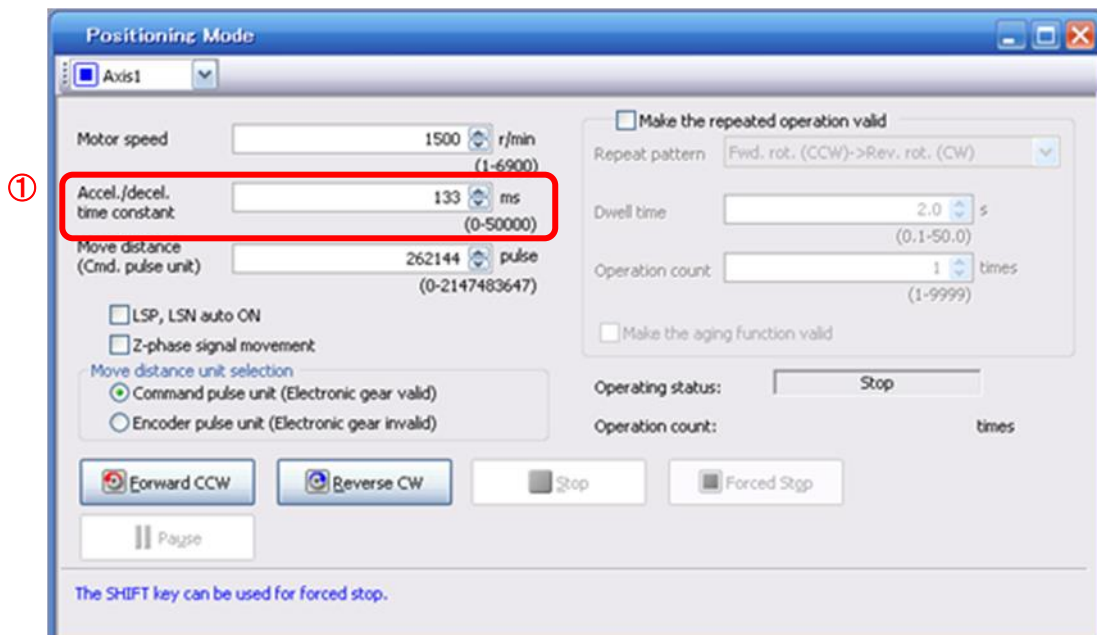
Calculating Acceleration/deceleration conversion example using an actuator with 8 [mm] lead with an acceleration of 3000[mm/sec²].

Speed at a rated motor rotation of 3000rpm

$$\text{Accel./decel. time (ms)} = \frac{\{\text{Rated Rotation Speed (r/min)} \div 60 (\text{S})\} \times \text{Screw Lead (mm)}}{\text{Acceleration/deceleration speed (mm/s}^2\text{)}} \times 1000$$

***Acceleration speed is measured in ms, so this must be calculated as (s) ×1000**

$$\begin{aligned} \text{Acceleration/deceleration time (ms)} &= \frac{\{3000 (\text{r/min}) \div 60 (\text{S})\} \times 8 (\text{mm}) \times 1000}{3000 (\text{mm/s}^2)} \\ &= 133 (\text{ms}) \end{aligned}$$



5.3.4 Move distance Configuration and Operation

< Move distance Configuration >

- ① Set the move distance [pulse]. Select a value within the stroke range.
- ② Actuator position will operate using [Forward (CCW)], [Reverse (CW)].
The position at which power is turned ON will be set as the home position, and the actuator will travel the amount set as move distance (check wiring and parameters. If operation is not performed correctly). When performing positioning operation in the setup software, the rotation direction of the actuator does not change if you change the setting of parameter PA14 (Rotation direction selection). The actuator moves in the direction of [Forward (CCW)] button and [Reverse (CW)] button.
- ③ Check command input pulse units (electronic gear enabled).
The electronic gear duty configured in PA06/PA07 will be enabled. If parameters PA06/PA07 are set according to "LECSN-T Operation Manual Appendix 9", the travel distance of the actuator per 1 pulse will be as follows.

travel distance of the actuator per 1 pulse = 1[μ m] (0.001[mm])

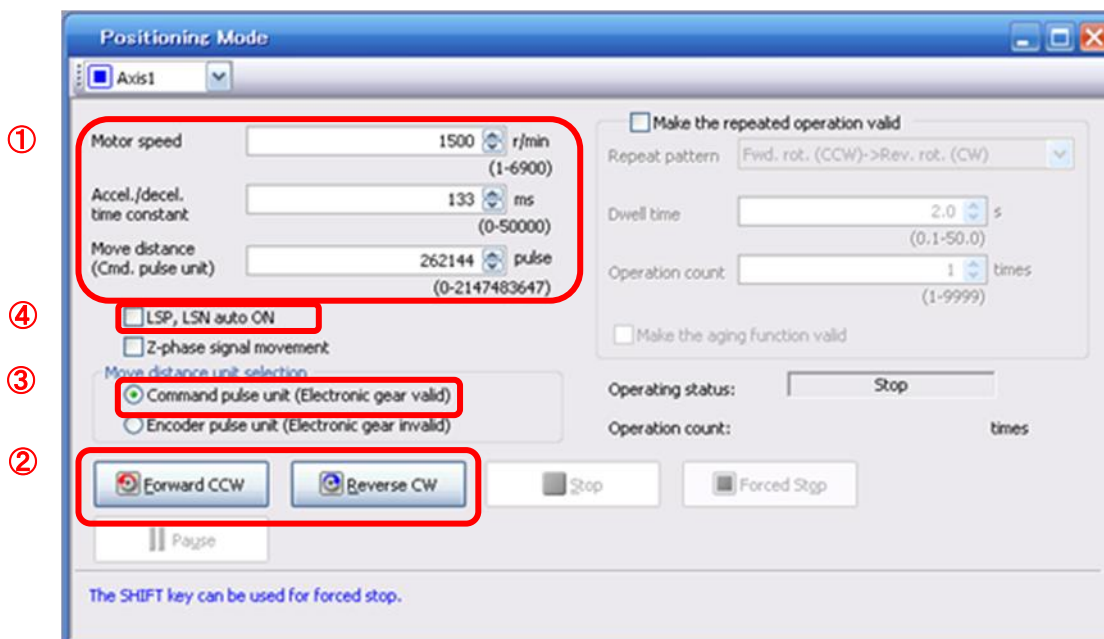
Travel distance (mm) must be converted to travel distance (pulse).
See below for the conversion formula.

As an example, for a travel of 100 (mm)

Travel distance of the actuator per 1 pulse = 0.001 (mm) *1
100 (mm)/0.001 (mm) = 100000 (pulse)

- ④ If the stroke end signals (LSP, LSN) are not turned ON, an alarm may occur. (If checked, the stroke end (LSP, LSN) signals will be turned ON automatically only when this window is open).

* Ensure that the [Forward (CCW)] and [Reverse (CW)] driving directions are checked. If the driving direction is unclear, operate the actuator slowly with a small move distance while checking the driving direction.



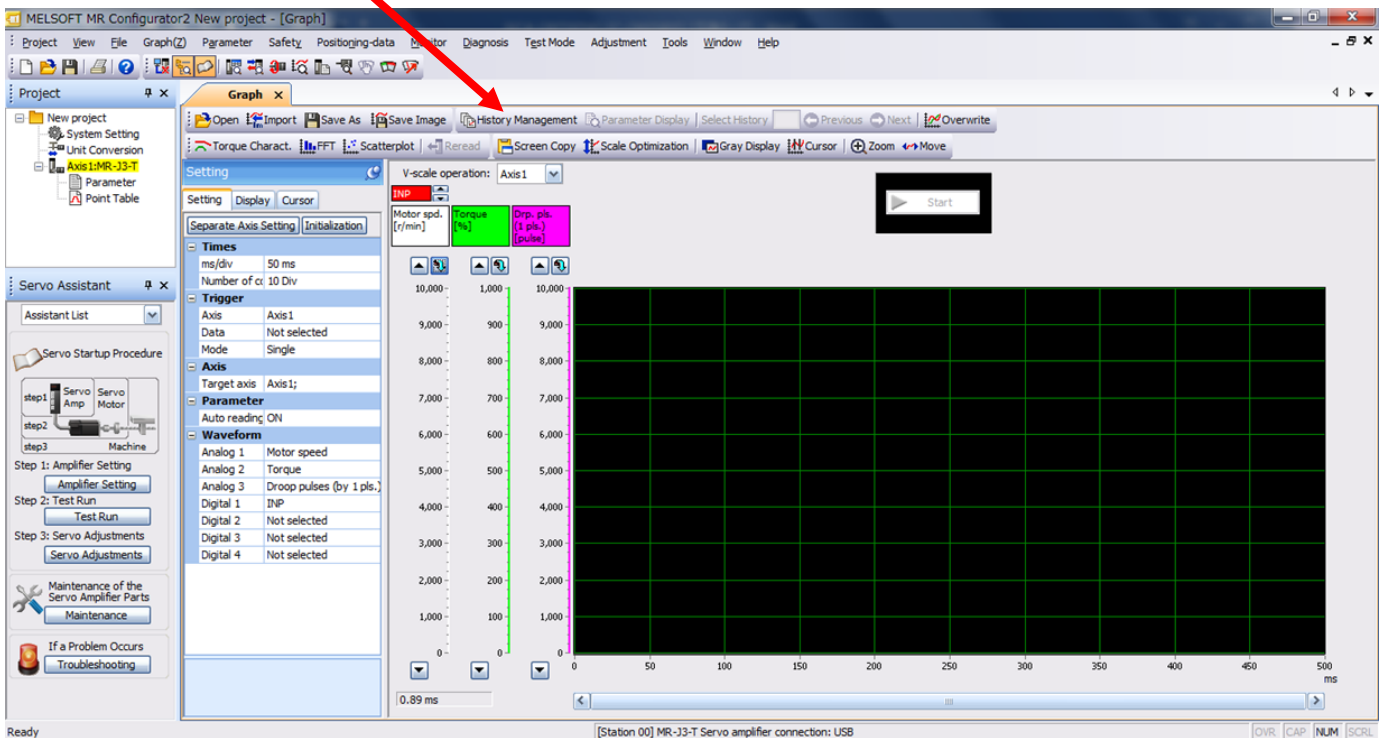
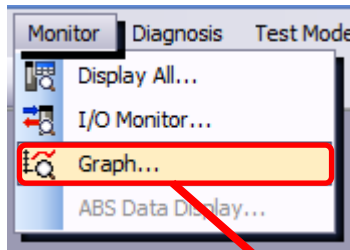
6. Monitor by MR Configurator 2™

The setup software (MR Configurator2™) allows the user to acquire the operating waveforms and status of the electric actuator.

6.1 Acquisition of motion waveform with graph monitor

With the setup software (MR Configurator2™: LEC-MRC2E) monitor graph function, the motion waveform during electric actuator operation can be obtained as described below.

- ① Click “Monitor” - “Graph” of Setup software to display “Graph” window.

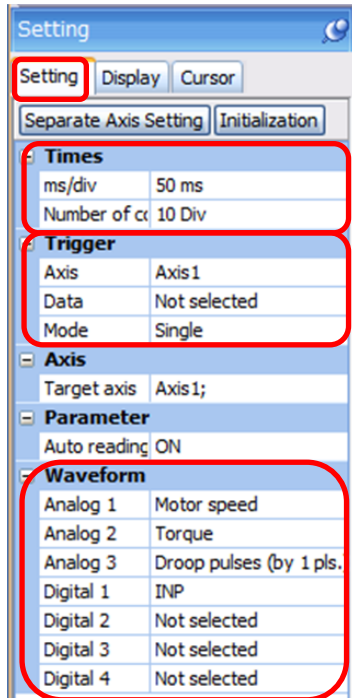


6.1.1 Under the setting Tab: Setting of the items to display the graph

Set the items to display analogue and digital waveform, trigger conditions and time for the horizontal axis of the graph.

Click the [Setting] tab of the [Setting] window to set the items to display the waveform, trigger conditions and horizontal axis of the graph.

3 types of analogue waveform (analogue 1 to 3) and 4 types of digital waveform (digital 1 to 4) can be set.

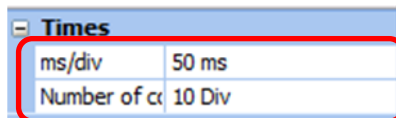




(1) Time

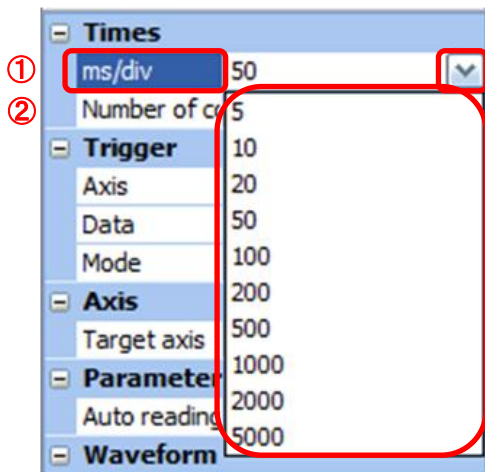
Set the horizontal axis (time axis) of the graph.

For LECSN-T, set [ms/div] and [Number of collection Div] to the horizontal axis (time axis).

[ms/div] × [Number of collection Div] will be [Measurement time].



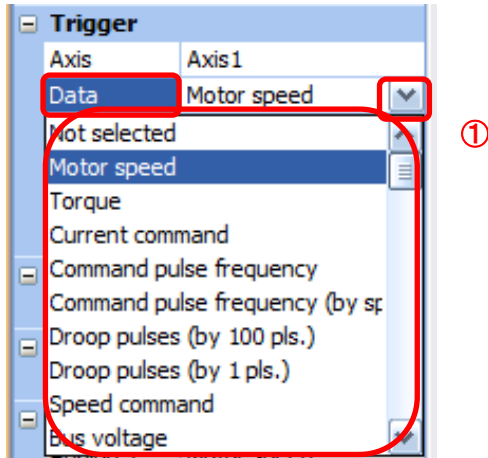
- ① Click “” of [ms/div] and set the Div number.
The unit ms of [Number of collection Div] is 1000ms=1s.
- ② Click “” of [Number of collection Div] and set the time.



(2) Trigger

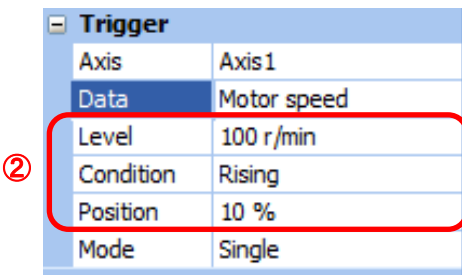
“Trigger” is a condition which decides the display timing of the graph.
If trigger conditions are not satisfied, waveform will not be displayed.

- ① Click “” of [Data] to set the condition.
(In general, set the Motor speed.)



- ② “Level” / “Condition” / “Position” are displayed.

Click “” of “Level” / “Condition” to set the condition.



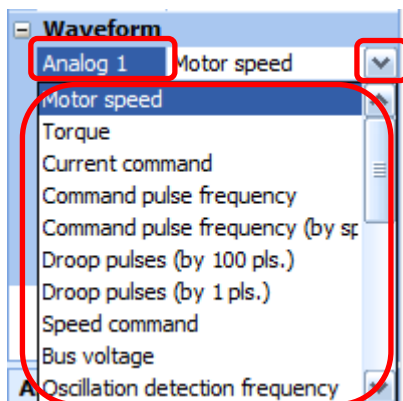
For Motor speed, when the operation direction is positive, “Level” should be 100 and when the operation direction is negative, “Level” should be “-100”.
Align the setting of “Condition” to the operation direction too.

“Level” / “Condition” setting (For Motor speed)

Operating direction	“Level” [r/min]	“Condition”
Positive direction operation	100	Startup
Negative direction operation	-100	Fall

(3) Waveform

Set the waveform data which will be displayed in the graph.



6.1.2 Trigger wait

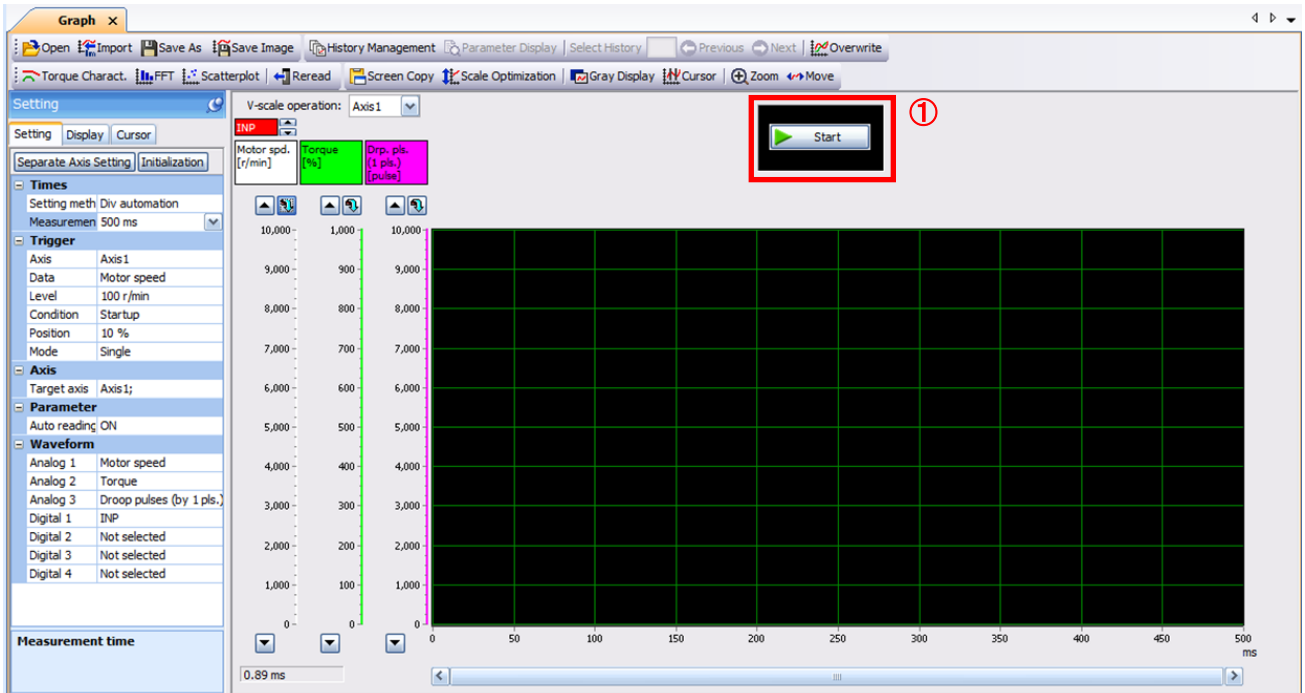
When the “Start” button is clicked, the screen will be on stand-by.

When trigger conditions are satisfied during the trigger wait, waveforms can be captured and displayed.

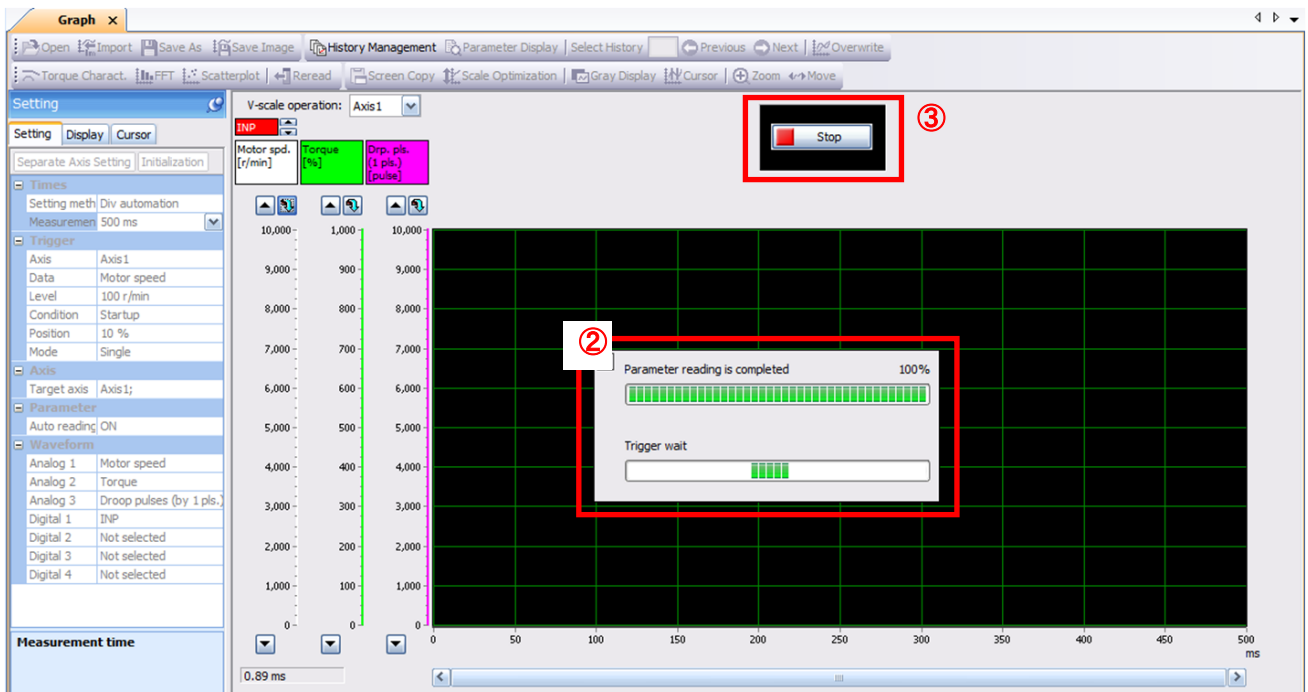
Click the “Start” button every time measurement fresh capture is required.

(The advantage of this method of capturing the waveform is a waveform will not be updated in the case of an incorrect operation.)

- ① Click the “Start” button.



- ② Trigger wait is displayed.
- ③ The acquisition of waveform will be canceled with “Stop” button.

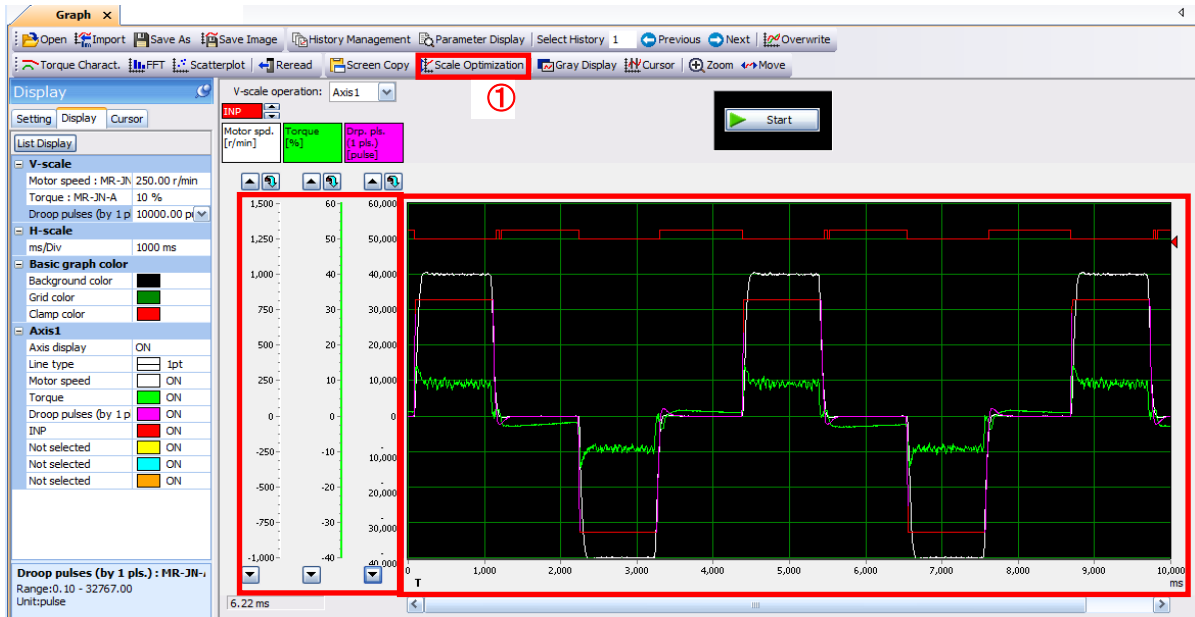


6.1.3 Operation Instruction

When the PLC on the master side sends the operation command, the actuator will operate.
When the trigger conditions in 6.1.1 (2) are satisfied, the operation waveforms can be captured.

When the time set in 6.1.1 (1) has passed after the acquisition start, the acquisition of the waveforms will complete, and waveforms are displayed on the screen.

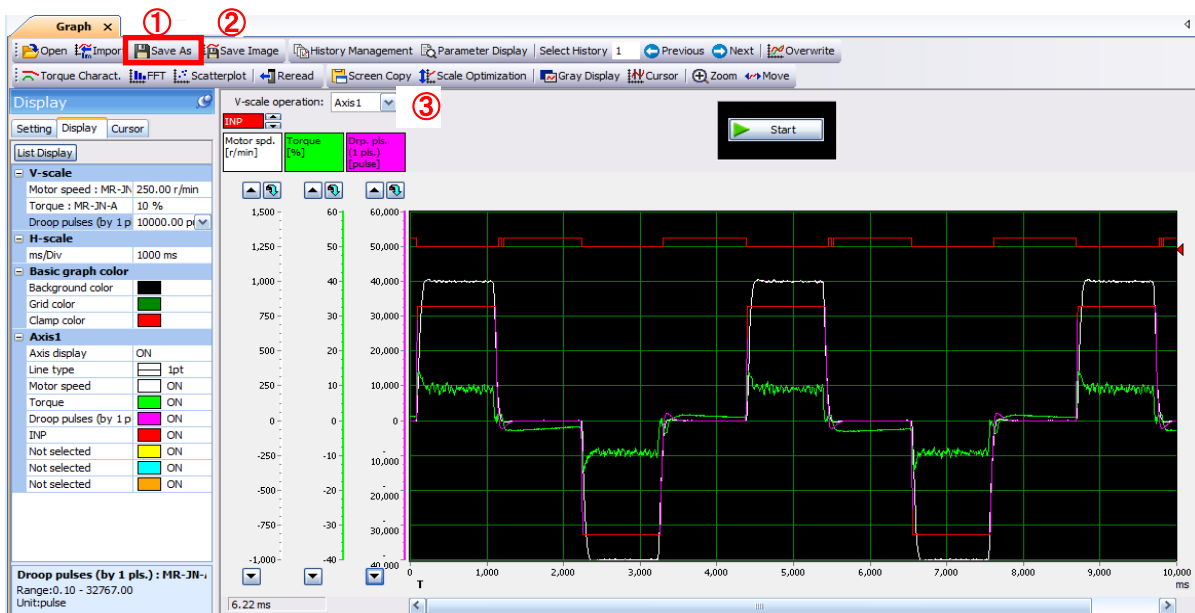
When the “Scale Optimization” button is clicked, the vertical axis range is adjusted automatically.



6.1.4 Saving of waveform

After the waveform is displayed, it is possible to save the data in 3 ways.

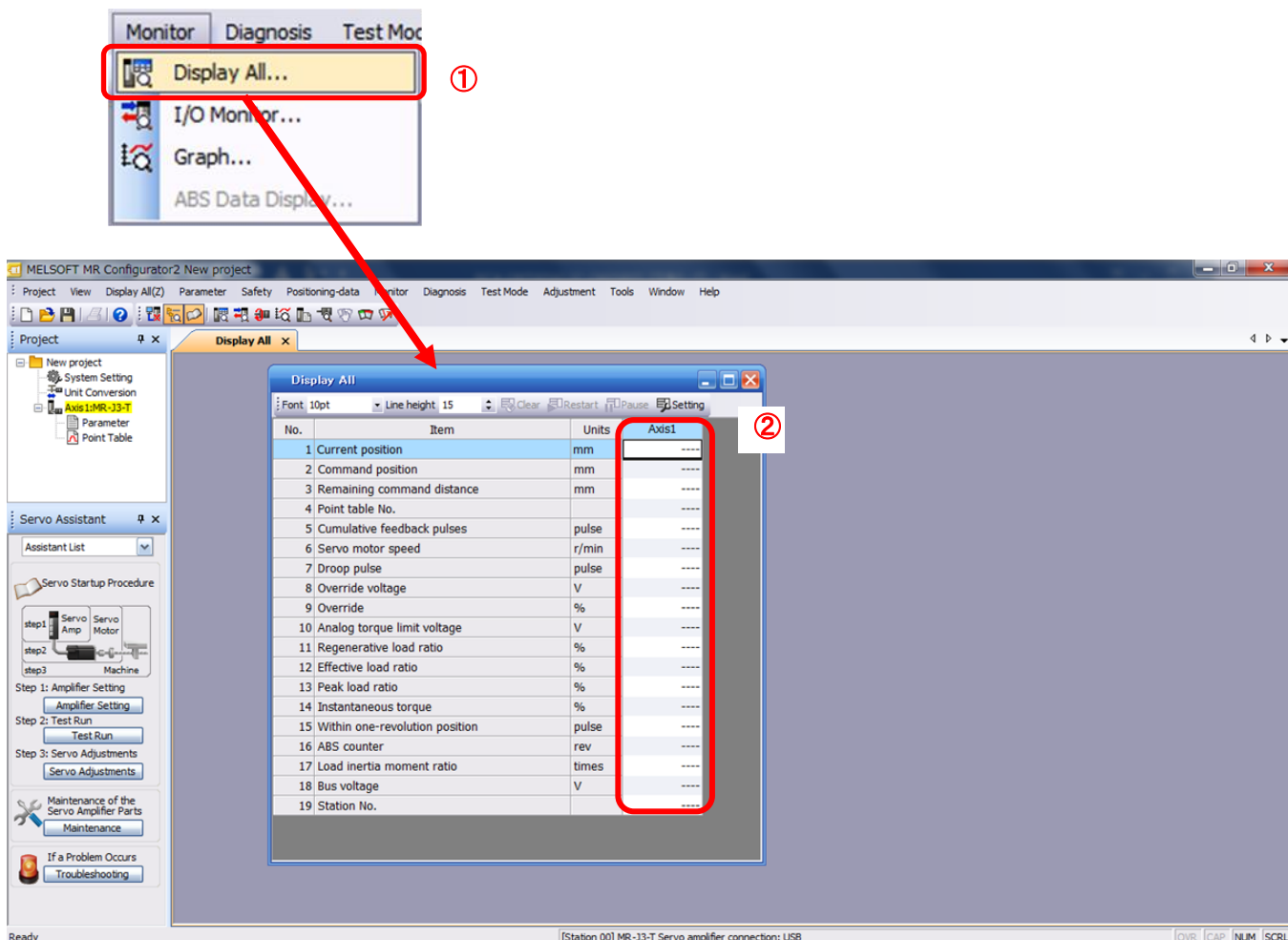
- ① Click the “Save As” button.
Select the folder in which the step data is to be saved and save the data. Waveform data file (extension: gpf2) will be prepared. If the waveform condition needs to be checked, it can be displayed on the graph window.
- ② Click the “Save Image” button.
Select the folder in which the step data is to be saved and save the data. An Image file (extension: jpg) will be prepared.
- ③ Click the “Screen Copy” button.
Save the displayed waveform screen (print screen).



6.2 Display All Monitor List

The method how to obtain the electric actuator condition is described with the display all function of the setup software.

- ① Click “Monitor” - “Display All” of the setup software to display “Display All” window.
 - ② The condition of each item is displayed.
- For off line of the setup software, [----] will be displayed.



Typical display items are shown below.

No.	Name	Function	Display range	Unit
1	Current position	The actual current position where the machine home position is assumed as zero is displayed.	-9999999 to 9999999 × 10STM	mm
2	Command position	The position data in the point table or the present command position is displayed.	-9999999 to 9999999 × 10STM	mm
3	Command remaining distance	The residual distance up to position command of the currently selected point table is displayed.	-9999999 to 9999999 × 10STM	mm
4	Cumulative feedback pulses	Feedback pulses from the motor encoder are counted and displayed. When exceeding 999999999, it returns to zero. Press the [Clear] button to reset the display value to 0 (zero). Reverse rotation is indicated by a minus (-) sign.	-999999999 to 999999999	pulse
5	Motor speed	The motor speed is displayed. The value rounded off is displayed in 0.1r/min.	-7200 to 7200	r/min

7. Network setting

Configure network settings to connect to the host side.

7.1 EtherCAT Communication

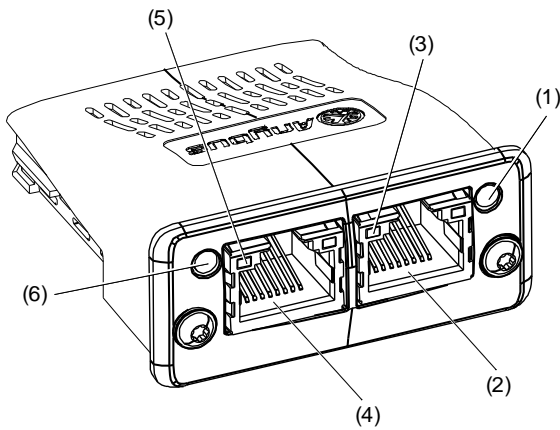
EtherCAT is an open network communication between master and slave using real-time Ethernet developed by Beckhoff and managed by ETG (EtherCAT Technology Group).

EtherCAT communication can be used by connecting an EtherCAT network card (LEC-S-NE) to the LECSN-T driver.

The LECSN-T driver with an EtherCAT network card connected acts as a slave station compliant with the CAN application protocol over EtherCAT (CoE) standard. The device type corresponds to a power drive system and supports the CiA 402 drive profile.

7.1.1 EtherCAT Network card (LEC-S-NE)

This section describes the names of the parts of the EtherCAT network card (LEC-S-NE). For details, refer to "LECSN-T Operation Manual, Section 18.2".



No.	Name/Application
(1)	ERROR LED Indicates an error of the EtherCAT communication.
(2)	RJ45 EtherCAT communication port (OUT port) Used to connect the next axis driver.
(3)	Link/Activity (OUT port) LED Indicates the link status of each EtherCAT communication port.
(4)	RJ45 EtherCAT communication port (IN port) Used to connect the EtherCAT master upper side or the previous axis driver.
(5)	Link/Activity (IN port) LED Indicates the link status of each EtherCAT communication port.
(6)	RUN LED Indicates the EtherCAT communication status (ESM).

RUN LED

The RUN LED indicates the EtherCAT communication status (ESM status). The extinguished RUN LED may be affected by the LED status of the Link/Activity LEDs.

LED		Description
Status	Color	
Extinguished	Green	Indicates that the power supply is shut off or the Init state.
Blinking		Indicates the Pre-Operational state.
Single flash		Indicates the Safe-Operational state.
Lit		Indicates the Operational state.
Lit	Red	Indicates that a fatal error has occurred. This indication is specific to the EtherCAT Network card (LEC-S-NE).

ERROR LED

The ERROR LED indicates an error of the EtherCAT communication. If the driver indicates an alarm, follow the remedy of the alarm number.

LED		Description
Status	Color	
Extinguished	Red	No error
Blinking		Indicates that the EtherCAT state cannot be changed according to the master command.
Single flash		Indicates that the EtherCAT state has been changed autonomously due to an internal error.
Double flash		Indicates a watchdog error in the Sync manager.
Lit		Indicates the EXCEPTION state, which is an error state of the EtherCAT Network card (ABCC-M40-ECT).
Flickering		Indicates an error at start-up of the EtherCAT Network card (ABCC-M40-ECT).

7.1.2 EtherCAT Communication setting

The setting and startup of EtherCAT communication are described below.
For details, refer to "LECSN-T Instruction Manual, Section 18.1".

(1) Connection with the upper side

Set up the upper side following the manual of the upper side used. For the setup, the EtherCAT Slave Information (ESI) file listing the information about the communication setting of devices is available. Store the ESI file in the upper side to use it. The upper side configures the setting for the slave connected to the master according to the contents of the ESI file corresponding to the slave connected.

Please install the ESI file from the following link (SMC website).

https://www.smcworld.com/assets/manual/other/files/LECSNx-Tx-E_ESI.zip

POINT
●Use the latest ESI file when setting up the upper side. If the ESI file is old, newly added objects may not be usable.

(2) Node address setting

Set the node address of EtherCAT with the axis selection rotary switch (SW2/SW3) on the display, [Pr. PN01 Node address setting] or SII Configured Station Alias as necessary. You can set a node address as follows. After the node address setting is changed, cycle the power.

Axis selection rotary switch (SW2/SW3)	Pr. PN01	SII Configured Station Alias	Node address setting value
00h	0000h	0001h to FFFFh	The value set in SII Configured Station Alias via network is the node address.
00h	0001h to FFFFh	0000h (Note)	The value of [Pr. PN01] is set as the node address.
01h to FFh	0000h to FFFFh	0000h (Note)	The set value of the rotary switch (SW2/SW3) is set as the node address.

Note. If the value in SII Configured Station Alias is set to other than 0000h, the ERROR LED of the network card blinks.

Cycling the power resets the set value in SII Configured Station Alias to 0000h and this enables the driver to start normally.

POINT
●The node address of drivers complies with the specifications of Explicit Device Identification. Configure the setting of Set Explicit Device Identification for the upper side.
●Do not connect multiple devices with the same node address setting.
●Node address setting via network and Configured Station Alias (0012h) are available with the combination of drivers and network cards .
●If the value in SII Configured Station Alias is set to other than 0000h when the node address is set with the axis selection rotary switch (SW2/SW3) or [Pr. PN01 Node address setting], the ERROR LED of the network card blinks. Cycling the power resets the set value in SII Configured Station Alias to 0000h and this enables the driver to start normally.

7.2 EtherNet/IP

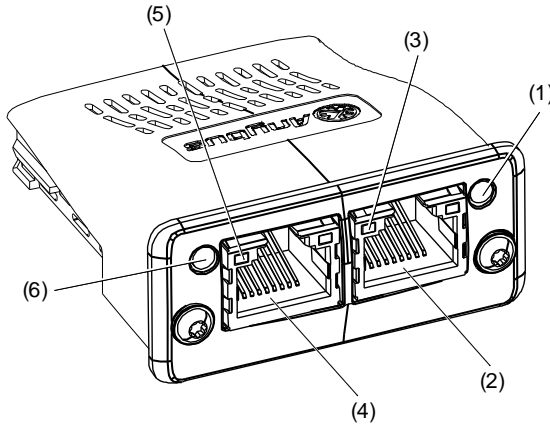
EtherNet/IP is an abbreviation for Ethernet Industrial Protocol. It is an industrial open network in which the TCP/IP protocol has been adopted and the CIP (Common Industrial Protocol) has been used in the application layer as the communication protocol. EtherNet/IP is controlled by ODVA (Open DeviceNet Vendor Association, Inc.).

The EtherNet/IP communication is available when the EtherNet/IP network card (LEC-S-N9) is connected to the driver. The driver to which the EtherNet/IP network card is connected is a Generic device type.

7.2.1 EtherNet/IP Network card (LEC-S-N9)

EtherNet/IP network card (LEC-S-N9) is required for EtherNet/IP communication with the LECSN-T driver. The names of each part are shown below.

For details, refer to “LECSN-T Operation Manual Section 19.2”.



No.	Name/Application
(1)	Card Status LED Indicates the card status.
(2)	RJ45 EtherNet/IP communication port (port 2) Connect an EtherNet/IP master upper side or a driver.
(3)	Link/Activity LED (port 2) Indicates the link status of each EtherNet/IP communication port.
(4)	RJ45 EtherNet/IP communication port (port 1) Connect an EtherNet/IP master upper side or a driver.
(5)	Link/Activity LED (port 1) Indicates the link status of each EtherNet/IP communication port.
(6)	Network Status LED Indicates the communication status.

Network Status LED

The Network Status LED indicates the EtherNet/IP communication status. The extinguished Network Status LED may be affected by the LED status of the Link/Activity LEDs.

LED status	Description
Extinguished	Indicates that the power is shut off or no IP address has been assigned.
Flickering 1 in green	Indicates that an IP address has been assigned and the EtherNet/IP Network card has not been connected to the network.
Lit in green	Indicates that a network connection has been established.
Flickering 1 in red	Indicates that a network connection timeout has occurred.
Lit in red	Indicates that duplication of an IP address has been detected. Indicates that a fatal error has occurred. This indication is specific to the EtherNet/IP Network card (ABCC-M40-EIP).
Flickering 1 alternately in green and red	Indicates that the driver and the network card are diagnosing themselves.

Card Status LED

The Card Status LED indicates each status of the driver and the network card and an error in the EtherNet/IP communication.

LED status	Description
Extinguished	Indicates that the power is shut off.
Lit in green	Indicates that the driver and the network card operate normally.
Flickering 1 in green	Indicates that the settings of the driver and the network card are not completed.
Flickering 1 in red	Indicates that the self-diagnoses of the driver and the network card have detected minor malfunctions that can be solved.
Lit in red	Indicates that the self-diagnoses of the driver and the network card have detected major malfunctions that cannot be solved.
Flickering 1 alternately in green and red	Indicates that the driver and the network card are diagnosing themselves.

7.2.2 EtherNet/IP Communication setting

The following describes the setup and startup of EtherNet/IP communication.

For details, refer to "LECSN-T Operation Manual, Section 19.1".

(1) Connection with upper side

The device type of LECSN-T connected to the EtherNet/IP network card (LEC-S-N9) corresponds to the generic device type, and there is no EDS file.

Please configure the generic device type for the upper side. For details, please refer to the manual of the host device to be used.

Note. When setting up the device as a generic device

Set the I/O communication format (input) Output data to Instance 150 and map size to 64 bytes.

Set the I/O communication format (output) Input data to Instance 100 and the map size to 64 bytes.

For details, refer to "LECSN-T Operation Manual, Section 19.3.2".

(2) IP address setting

Set an IP address using the "AnybusIPconfig tool" offered by HMS Industrial Networks and the axis selection rotary switch (SW2/SW3) on the display of the driver. Change the IP address with the axis selection rotary switch (SW2/SW3) before powering on the driver. The IP address you set can be checked with the "AnybusIPconfig tool" or system configuration window of MR Configurator 2™.

"AnybusIPconfig tool" can be downloaded from the following link (SMC website).

<https://www.smcworld.com/assets/manual/other/files/IPConfigTool.zip>

You can set an IP address as follows.

Axis selection rotary switch (SW2/SW3)	IP address setting value
00h	An IP address set by the AnybusIPconfig tool is used.
01h to FEh	Although an IP address set by the AnybusIPconfig tool is used, the fourth octet value is replaced with a value set with the axis selection rotary switch (SW2/SW3). The DHCP function is disabled. Set a hexadecimal value with the axis selection rotary switch (SW2/SW3). The hexadecimal value is converted into a decimal value and set as the fourth octet of the IP address.
FFh	The DHCP function is enabled.

7.3 PROFINET

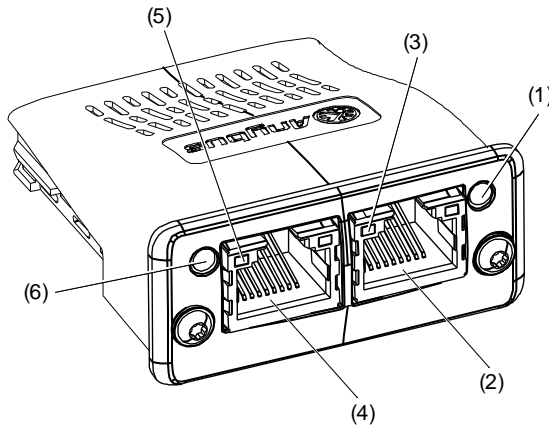
PROFINET represents the communication standard for the automation which was made by PI (PROFIBUS & PROFINET International).

The PROFINET IO communication is available when the PROFINET network card (LEC-S-NP) is connected to the driver. The driver to which the PROFINET network card is connected is an IO device. It supports two cyclic communication formats conforming to PROFI drive profile and CiA 402 drive profile. It is compatible with the following control modes.

7.3.1 PROFINET Network card (LEC-S-NP)

This section describes each name of the PROFINET network card (LEC-S-NP).

For details, please refer to "LECSN-T Operation Manual, Section 20.2".



No.	Name/Application
(1)	Card Status LED Indicates the card status.
(2)	RJ45 PROFINET communication port (port 2) Connect the upper side or driver.
(3)	Link/Activity LED (port 2) Indicates the link status of each PROFINET communication port.
(4)	RJ45 PROFINET communication port (port 1) Connect the upper side or driver.
(5)	Link/Activity LED (port 1) Indicates the link status of each PROFINET communication port.
(6)	Network Status LED Indicates the communication status.

Network Status LED

The Network Status LED indicates the PROFINET communication status.

LED status	Description
Extinguished	Indicates that the power is shut off or connection with the upper side has not been established.
Lit in green	Indicates that connection with the upper side has been established and the upper side is in RUN status.
Single flash in green	Indicates that connection with the upper side has been established and the upper side is in STOP status, or the communication data is incorrect.
Blinking in green	Indicates that the engineering tool is checking a node on network.
Lit in red	Indicates that a serious malfunction that cannot be restored has been detected. This will light simultaneously with Card Status LED in red.
Single flash in red	Indicates that a station name has not been set.
Double flash in red	Indicates that an IP address has not been set.
Triple flash in red	Indicates that identification information differs between upper side and device. It means a configuration error.

Card Status LED

The Card Status LED indicates the status of device and an error in the PROFINET communication.

LED status	Description
Extinguished	Indicates that the power is shut off or initialization has not been completed.
Lit in green	Indicates that initialization of the network card has been completed and the card operates normally.
Single flash in green	Indicates that the network card is diagnosing itself.
Lit in red	Indicates that an exception error has detected in the network card. Indicates that a serious malfunction that cannot be restored has been detected. This will light simultaneously with Network Status LED in red.

7.3.2 PROFINET Communication setting

The PROFINET communication settings and startup are shown below.
For details, refer to "LECSN-T Instruction Manual, Section 20.1".

(1) Connection with the upper side

Set up the upper side following the manual of the upper side used. For the setup, the General Station Description (GSD) file listing the information about the communication setting of devices is available. Install the EDS file to a configuration tool to be used. Refer to the manual of each configuration tool for how to use the GSD file.

Please install the GSD file from the following link (SMC website).

https://www.smcworld.com/assets/manual/other/files/LECSNx-Tx-P_GSD.zip

(2) Station name

This is used for identifying of driver from the upper side. Set up the upper side following the manual of the upper side used.

(3) IP address setting

Set an IP address using the "AnybusIPconfig tool" offered, axis selection rotary switch (SW2/SW3) on the display of the driver, and upper side. Change the IP address with the axis selection rotary switch (SW2/SW3) before powering on the driver. When you set it with automatic setting of the upper side, the upper side setting will be prioritized. The IP address you set can be checked with the "AnybusIPconfig tool" or system configuration window of setup software (MR Configurator2™).

"AnybusIPconfig tool" can be downloaded from the following link (SMC website).

<https://www.smcworld.com/assets/manual/other/files/IPConfigTool.zip>

You can set an IP address as follows.

Axis selection rotary switch (SW2/SW3)	IP address setting value
00h	An IP address set by the "AnybusIPconfig" tool is used.
01h to FEh	Although an IP address set by the "AnybusIPconfig" tool is used, the fourth octet value is replaced with a value set with the axis selection rotary switch (SW2/SW3). The DHCP function is disabled. Set a hexadecimal value with the axis selection rotary switch (SW2/SW3). The hexadecimal value is converted into a decimal value and set as the fourth octet of the IP address.
FFh	The DHCP function is enabled.

8. Actuator operation from host

8.1 CiA 402 drive profile

In LECSN-T, each network conforms to the CiA402 drive profile.

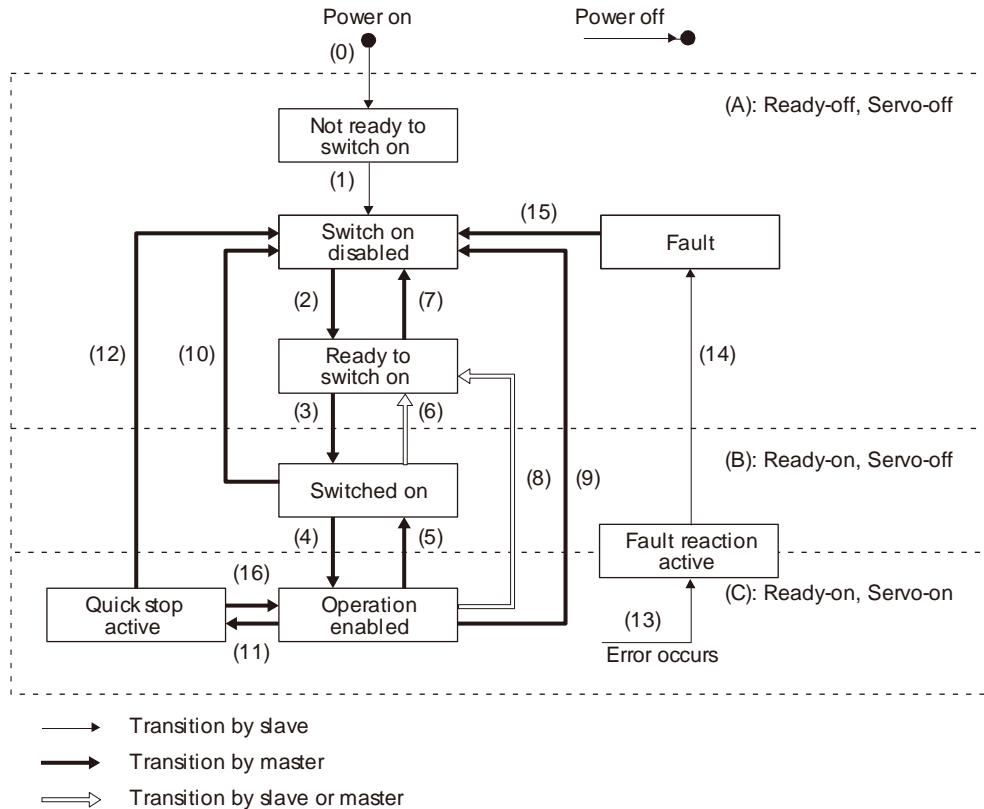
The CiA402 drive profile is a device profile for drive and motion control and mainly defines the functional operation of drivers for servo motors.

This section shows how to operate in accordance with the CiA402 drive profile.

8.1.1 FSA state

The inside state of the driver is controlled based on the FSA state, defined in the CiA 402 drive profile standard. The transition conditions between the FSA states are shown in the figure below.

The states are switched when the master sends a command. When the state has transitioned from “Not ready to switch on”, which is right after the power on, to “Operation enabled” with the predetermined procedure, the servo motor becomes ready to operate. For details, refer to “LESCN-T Operation Manual Section 18.5”.



FSA state transition command is sent by setting Bit0-3 and Bit7 of Controlword (6040h). The FSA state is notified in Bit0-3, Bit5, and Bit6 of the Statusword (6041h).

The following table lists the commands issued to the driver. Turn on the bits according to the command.

Command	Command bit setting of Controlword					Transition No.
	Bit 7 Fault Reset	Bit 3 Enable Operation	Bit 2 Quick Stop	Bit 1 Enable Voltage	Bit 0 Switch On	
Shutdown	0	/	1	1	0	(2)/(6)/(8)
Switch On	0	0	1	1	1	(3)
Disable Voltage	0	/	/	0	/	(7)/(9)/(10)/(12)
Quick Stop	0	/	0	1	/	(7)/(10)/(11)
Disable Operation	0	0	1	1	1	(5)
Enable Operation	0	1	1	1	1	(4)/(16)
Fault Reset	0 → 1 (Note)	/	/	/	/	(15)

Note. In faulty communication, hold the state of Bit 7 = 1 for at least 10 ms for the Fault Reset command to prevent the command from failing to be recognized.

8.1.2 Controlword / Statusword

(1) Controlword

The FSA state can be switched and control commands for the functions of the drive can be issued by rewriting the objects of Controlword (6040h) from the master (upper side).

The following table shows the bit definition of Controlword (6040h).

Bit	Symbol	Description
0	SO	Switch-on
1	EV	Enable voltage
2	QS	Quick stop
3	EO	Enable operation
4	OMS	Differs depending on Modes of operation (6060h).
5		
6		
7	FR	Fault reset
8	HALT	0: Operation ready 1: Temporary stop
9	OMS	Differs depending on Modes of operation (6060h).
10		The value at reading is undefined. Set "0" at writing.
11		
12		
13		
14		
15		

(2) Statusword

The objects of Statusword (6041h) notify the master (upper side) of the FSA state of the driver and other drive status.

The following table shows the bit definition of Statusword.

Bit	Symbol	Description
0	RTSO	Ready-to-switch-on
1	SO	Switch-on
2	OE	Operation-enabled
3	F	Fault
4	VE	Voltage-enabled 0: The bus voltage is lower than the certain (RA) level. 1: The bus voltage is equal to or higher than the certain level.
5	QS	Quick stop 0: During a quick stop 1: No during a quick stop (including during the test mode)
6	SOD	Switch on disabled
7	W	Warning 0: No warning has been occurred. 1: A warning has occurred.
8		The value at reading is undefined.
9	RM	Remote 0: Not following the Controlword command 1: In operation following the Controlword command
10	TR	Target reached Differs depending on Modes of operation (6060h).
11	ILA	Internal limit active 0: The forward rotation stroke end, reverse rotation stroke end, and software position limit have not been reached. 1: The forward rotation stroke end, reverse rotation stroke end, or software position limit has been reached. (Enabled in the csp, csv, pp, pv, hm, pt, jg, or idx mode)
12	OMS	Differs depending on Modes of operation (6060h).
13		
14		
15		The value at reading is undefined.

8.1.3 Control mode

In LECSN-T, homing and positioning control are defined by control modes.

The following is a list of control modes that can be selected for LECSN-T.

However, the point table mode, JOG operation mode, and equally divided indexing mode are unique control modes not included in the CiA402 standard. For details, please refer to “Chapters 16 and 17 of the LECSN-T Operation Manual”.

Control mode list

Control mode	Description
Homing mode (hm)	Execute homing.
Profile position mode (pp)	Receives an end position command from the host and executes positioning.
Profile velocity mode (pv)	Receives an endpoint speed command from the host and executes speed control.
Profile torque mode (tq)	Receives a target torque command from the host and executes torque control.
Point table mode (pt)	Position data, rotation speed, acceleration/deceleration time constants, etc. are set in the driver's point table to execute positioning operation. (A maximum of 255 points can be used in the point table.)
Jog mode (jg)	Execute the operation manually at the set rotation speed.
Indexer mode (idx)	Execute positioning operation by pre-setting the number of equal divisions of 360°, one revolution of the machine end. (Maximum number of divisions: 255)
Cyclic synchronous position mode (csp)	Receives synchronous sequential position commands from the host and executes positioning.
Cyclic synchronous velocity mode (csv)	Receives synchronous sequential speed commands from the host and executes speed control.
Cyclic synchronous torque mode (cst)	Receives synchronous sequential torque commands from the host and executes torque control.

Supported control modes vary by network. See the table below for a list of supported modes.

Table of supported control modes per network

● : supported - : not supported

Control mode	EtherCAT	EtherNet/IP	PROFINET
Homing mode (hm)	●	●	●
Profile position mode (pp)	●	●	●
Profile velocity mode (pv)	●	●	●
Profile torque mode (tq)	●	●	●
Point table mode (pt)	●	-	●
Jog mode (jg)	●	-	●
Indexer mode (idx)	●	-	●
Cyclic synchronous position mode (csp)	●	-	-
Cyclic synchronous velocity mode (csv)	●	-	-
Cyclic synchronous torque mode (cst)	●	-	-

The control mode should be specified in Modes of operation (6060h). However, there is a limit to the value that can be set in [Pr. PA01]. For details, see Section 4.1 of this manual.

Setting value of Modes of operation (6060h)

Control mode	Setting value (6060h)
Homing mode (hm)	6
Profile position mode (pp)	1
Profile velocity mode (pv)	3
Profile torque mode (tq)	4
Point table mode (pt)	-101
Jog mode (jg)	-100
Indexer mode (idx)	-103
Cyclic synchronous position mode (csp)	8
Cyclic synchronous velocity mode (csv)	9
Cyclic synchronous torque mode (cst)	10

8.2 Parameter setting

The parameter of the driver can be changed on the master (upper side) by writing values to the following objects. However, once the power supply is shut off, the changed setting is not held at the next startup. To hold the changed setting even after the power supply is shut-off, save the parameter setting value to EEPROM using Store Parameters (1010h).

To change the setting of the parameters where the changes are reflected by cycling the power (parameters whose symbols are preceded by **), change the value of the corresponding object and execute Store Parameters (1010h) before cycling the power. Refer to "LECSN-T Operation Manual chapter 5" for "*" of the parameter symbol.

The following table lists the related objects.

Index	Name	Description
2001h	PA01	[Pr. PA_ _] group
:	:	
2020h	PA32	
2081h	PB01	[Pr. PB_ _] group
:	:	
20C0h	PB64	
2101h	PC01	[Pr. PC_ _] group
:	:	
2150h	PC80	
2181h	PD01	[Pr. PD_ _] group
:	:	
21B0h	PD48	
2201h	PE01	[Pr. PE_ _] group
:	:	
2240h	PE64	
2281h	PF01	[Pr. PF_ _] group
:	:	
22C0h	PF48	
2401h	PL01	[Pr. PL_ _] group
:	:	
2430h	PL48	
2481h	PT01	[Pr. PT_ _] group
:	:	
24D0h	PT80	
2581h	PN01	[Pr. PN_ _] group
:	:	
25A0h	PN32	

8.3 Servo-on and Homing

The procedure for performing servo-on to homing positioning is shown below.

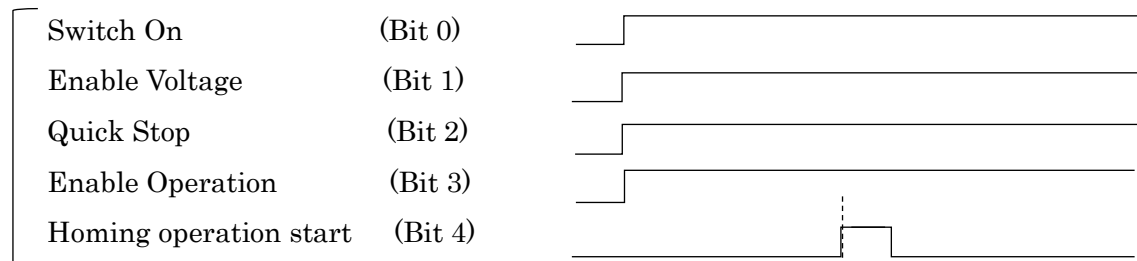
Note that the servo-on to home positioning conforms to the CiA402 drive profile, so the procedure shown here is the same for each network.

This section shows the case of push-on homing. For push-on homing, please refer to "LECSN-T Operation Manual Appendix 9" for the recommended parameter values for each actuator.

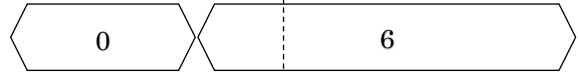
- (1) Set Bit 0 to 3 of Controlword (6040h) to "1" to set the FSA state to Enable operation (servo-on).
- (2) When the FSA state changes to Enable operation (servo-on), Operation-enabled (Bit 2) of Statusword (6041h) rises to "1".
- (3) Set the value of Modes of operation (6060h) to "6" (homing mode).
- (4) Starts homing by setting Homing operation start (Bit 4) of Controlword (6040h) to "1".
- (5) When homing is completed, both Target reached (Bit 10) and Homing attained (Bit 12) of Statusword (6041h) transition to "1".

Timing chart

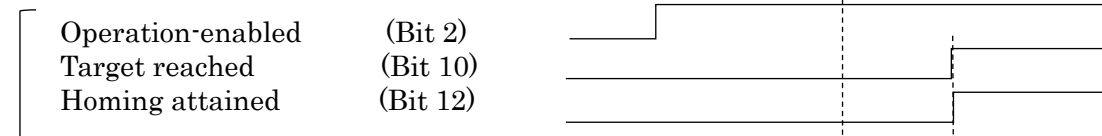
Control Word (6040h)



Modes of Operation (6060h)

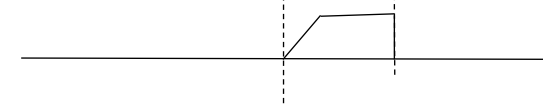


Status Word (6041h)



Servo motor rotation speed

0 r/min



8.4 Positioning operation (Profile position mode)

The procedure for positioning operation in profile position mode is shown below. Note that the profile position mode conforms to the CiA402 drive profile, so the procedure is the same for all networks.

- (1) Set the Modes of operation (6060h) to "1" (Profile position mode).
- (2) Sets the related objects in profile position mode.
Typical related objects (target position, target speed, target acceleration/deceleration) are shown below.

Index	Name	Default	Description
607Ah	Target position		Command position (Pos units)
6081h	Profile velocity	10000	Speed after acceleration completed Unit: Vel unit (0.01 r/min or 0.01 mm/s)
6083h	Profile Acceleration	0	Acceleration at start of movement to target position Unit: ms
6084h	Profile deceleration	0	Deceleration at arrival at target position Unit: ms

[Setting example]

If you set the recommended parameter values for each actuator (LECSN-T Operation Manual Appendix 9), the minimum unit for actuator movement is 1 [μm]. For the descriptions of target position, target speed, acceleration time constant, and deceleration time constant, refer to Section 5.3 of this manual.

When operating actuator with the following set values.

Target position: 100.000[mm] (=100000 [μm] = 186A0h)

Target speed: 100[r/min] (=10000 [0.01r/min] = 2710h)

Acceleration time constant: 100 [ms] (= 64h)

Deceleration time constant: 100 [ms] (= 64h)

The setup value is as follows.

Target position 607Ah = 186A0h

Target velocity 6081h = 2710h

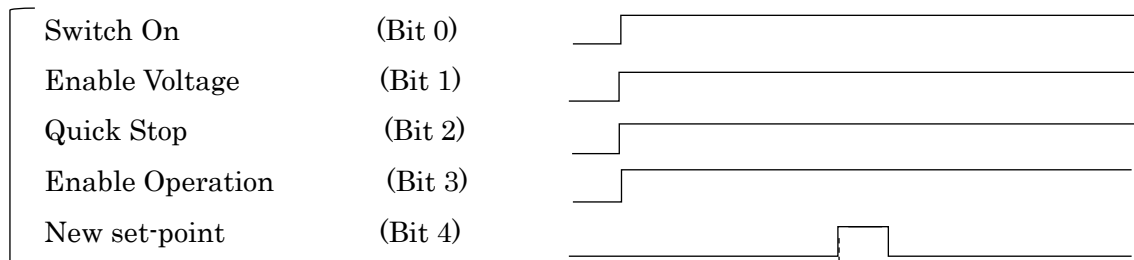
Profile acceleration time constant 6083h=64h

Profile deceleration time constant 6084h=64h

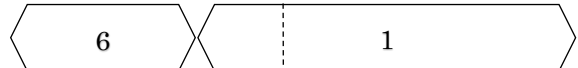
- (3) Start positioning operation by setting New set-point (Bit 4) of Controlword (6040h) to "1".
- (4) When positioning operation is completed, Target reached (Bit 10) of Statusword (6041h) changes to "1".

Timing chart

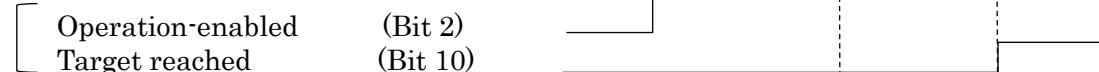
Control Word (6040h)



Modes of Operation (6060h)

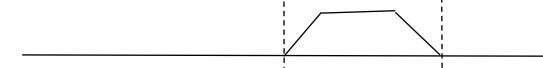


Status Word (6041h)



Servo motor rotation speed

0 r/min



9. Troubleshooting

9.1 Alarm and Warning

POINT

- Turn the servo-ON (SON) OFF and shut off the main circuit power supply as soon as the alarm occurs.

An alarm or warning is displayed when an abnormality occurs during operation. When an alarm or warning occurs, take appropriate measures according to "LECSN-T Operation Manual, Chapter 8". When an alarm occurs, the ALM is turned off.

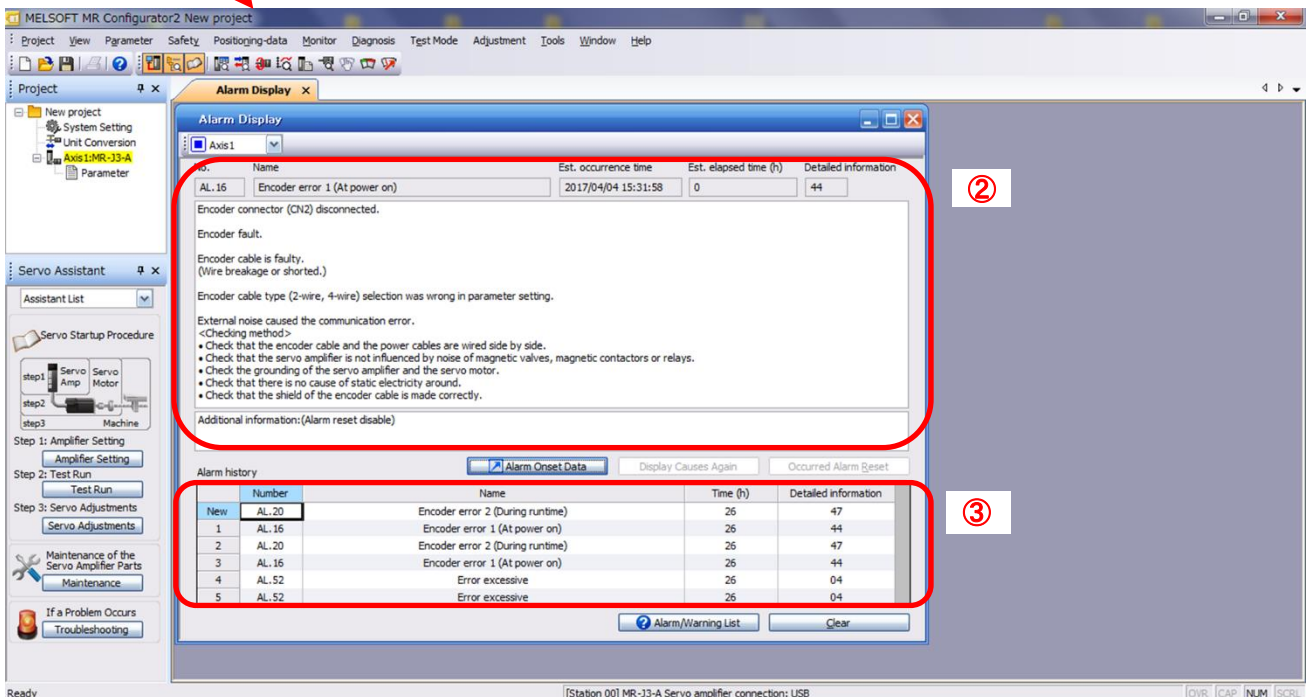
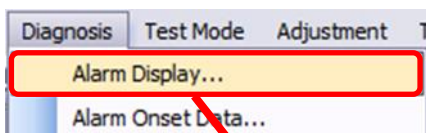
The alarm can be cleared by any of the methods marked with a circle (O) in the Alarm Clear column after removing the cause of the alarm. The warning is automatically cleared when the cause is removed.

9.3 Alarm Display

The contents of the alarm / warning that is currently occurring in the driver are displayed in the alarm display function of the setup software.

In addition, history is listed for alarms that occurred in the past.

- ① Click "Diagnosis" - "Alarm Display" of the setup software to display "Alarm Display" window.
- ② Alarms / warnings currently occurring in the driver display the contents. If no alarm / warning has occurred, it will not be displayed.
- ③ Lists the history (Maximum 6 cases) of alarms that occurred in the past. (Warnings are not displayed.)



Alarm Display

Axis 1

No.	Name	Est. occurrence time	Est. elapsed time (h)	Detailed information
0.	AL.16 Encoder error 1 (At power on)	2017/04/04 15:31:58	0	44

Encoder connector (CN2) disconnected.
Encoder fault.
Encoder cable is faulty.
(Wire breakage or shorted.)
Encoder cable type (2-wire, 4-wire) selection was wrong in parameter setting.
External noise caused the communication error.
<Checking method>
• Check that the encoder cable and the power cables are wired side by side.
• Check that the servo amplifier is not influenced by noise of magnetic valves, magnetic contactors or relays.
• Check the grounding of the servo amplifier and the servo motor.
• Check that there is no cause of static electricity around.
• Check that the shield of the encoder cable is made correctly.
Additional information: (Alarm reset disable)

Alarm history

New	Number	Name	Time (h)	Detailed information
	AL.20	Encoder error 2 (During runtime)	26	47
1	AL.16	Encoder error 1 (At power on)	26	44
2	AL.20	Encoder error 2 (During runtime)	26	47
3	AL.16	Encoder error 1 (At power on)	26	44
4	AL.52	Error excessive	26	04
5	AL.52	Error excessive	26	04

Revision history

SMC Corporation

4-14-1, Sotokanda, Chiyoda-ku, Tokyo 101-0021 JAPAN
Tel: + 81 3 5207 8249 Fax: +81 3 5298 5362
URL <https://www.smcworld.com>

Note: Specifications are subject to change without prior notice and any obligation on the part of the manufacturer.
© 2022 SMC Corporation All Rights Reserved