THK
The Mark of Linear Motion

THK Electric Actuator Controller series
Digital operator

TDO

INSTRUCTION MANUAL

No.6110-2(0)E

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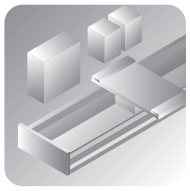
1. Introduction

About this chapter

This chapter describes the overview of the product.
This chapter includes information that we want you to check and understand before working with the product.

This section includes introduction about the product and this manual.

This section includes general precautions to follow when using the product.
Be sure to read this section before use and observe the precautions.



This section includes introduction about peripheral devices to be used with this product.

1. Introduction

1-1 Acknowledgment

Thank you for purchasing the digital operator TDO.
This manual describes the correct methods for handling and operating the digital operator TDO, and precautions for this product. Carefully read and understand this manual before using the product to safely and correctly handle the product. Be sure to keep this manual after reading it so that you can refer to it when needed.
Please visit THK technical support website (user registration is required) to check the latest manual.
<URL:https://tech.thk.com/>

1-2 About this manual

1-2-1 Intended Audience

The person in charge of designing embedded systems of the product and installing, wiring, and maintaining the product, and the person who actually uses the product.

1-2-2 Purpose

This manual describes correct handling methods and precautions for the product.
For the maximum performance and long life of the product, carefully read and understand this manual to safely and correctly use the product.
If you use the printed version of this manual, be sure to keep it in the place that the intended audience can refer to it when needed.

1-2-3 Notice and attention

- Do not use or handle the product in the ways that are not described in this manual.
- Do not reproduce, reprint, or lend the whole contents or a part of this manual without permission.
- Please note that description in this manual is subject to change without prior notice in the future, due to improvements of the product or other reasons.
- We have made all possible efforts to make the content of this manual accurate. However, if you find any mistake or uncertainty in this manual, please contact our Customer Support (refer to back cover).
- Drawings show representative examples, and may differ from your product.
- If descriptions in this manual differ from the actual operation of the product, the actual operation should be treated as correct, and THK shall not be responsible for matching the actual operation with the description.
- Note that THK shall not be liable for any result incurred by applying this manual, regardless of the reason.
- Usage or operation of the product that is not described in this manual is prohibited.
- This manual is also applied to special types. However, the descriptions defined in the delivery specification drawings or the delivery specification documents of those special types should take precedence over this manual. * Special types represent the products that have different materials and specifications from those of the standard products on catalogs.

Important ● **Notes that can lead to unsatisfactory function, error, or damage of the product if not observed while using the product.**

Note ● **Supplementary information for the description.**

Reference ● **Reference information for the description.**

1. Introduction

1-3 How to use this product

- This product cannot be used for the devices or systems that are used under the situations that can affect human life.
- If you consider using this product for special applications such as passenger movement vehicle, medical, aerospace, nuclear power, and electric power devices or systems, be sure to consult with THK in advance.
- This product is manufactured under the strict quality control, however, that does not mean that the product is free from failure. For applications to the equipment that may suffer serious accidents or loss from the failure of this product, install safety devices or backup devices that prevent such serious accidents or loss.

1-4 Saving programs and parameters (Important)

- Please save programs and parameters in preparation for possible loss by failures or operation errors and for fast recovery on the product replacement.
- Use the setup tool D-STEP to save the data. Execute "Save" for "File" on the "PROGRAM" and "Parameter List" screens. For more information, see the separate D-STEP instruction manual.

1-5 About related instruction manuals

- When you use the digital operator TDO, read the following instruction manuals as necessary.
  - · Controller series Driver controller TSC
  - · Controller series Driver controller TLC
  - · Controller series Driver controller THC
  - · Controller series Network unit TNU
  - · Controller series Setup tool D-STEP

1-6 About product support

For the following information, please contact our Customer Support (refer to back cover).

- Technical support for this product

1-7 Product and company information

To find the latest product and company information, we recommend you to periodically access our website.

- Website URL: http://www.thk.com/
- Technical support website URL: https://tech.thk.com/

2. Safety precautions

2-1 About ranks of precautions

This manual uses the classifications of "Danger," "Warning," and "Caution" for warning indications for safety matters.

⚠ DANGER	Erroneous handling may urgently cause death or serious injury to a person
⚠ WARNING	Erroneous handling may cause death or serious injury to a person
⚠ CAUTION	Erroneous handling may cause injury to a person or property damage only

2-2 About description of precautions

Precautions are classified as "Prohibition," "Instruction," and "Precaution" according to the action.

This mark indicates "prohibition" of the action.	Prohibited; Do not disassemble
This mark indicates "instruction" for the action.	Obligatory; Provide grounding connection
This mark indicates "caution" about the action.	Caution; Caution - Electrical shock; Caution – Flammable; Caution – High temperature; Caution – Getting caught

2. Safety precautions

2-3 Safety precautions

⚠ WARNING


Prohibited

- **While the actuator is operating or operable, do not enter the working area of any moving part including the load.**
  Doing so may cause you to touch the moving part and get injured.


Obligatory

- **If the product fails or any abnormality is observed, shut down the power of the driver controller.**
  Such abnormality may cause a malfunction of actuator, resulting in damage or injury.


Caution - Electrical shock

- **Do not touch the internal part of the digital operator TDO and the driver controller.**
  Doing so may cause electric shocks.
- **Do not damage, tuck, or apply excessive stresses on the cable.**
  Doing so may cause electric shocks.


Do not disassemble

- **Do not modify, disassemble, or alter the product.**
  Doing so may cause injury or fault.


Caution – High temperature

- **During the operation, or for a while after turning the power off, do not touch the driver controller or motor cover because they should be hot.**
  Doing so may cause burns.

⚠ CAUTION


Prohibited

- **Do not impact the product and do avoid rough handling such as throwing it.**
  Doing so may cause the fault or damage that leads to injury.
- **Do not frequently switch the power between on and off.**
  Doing so may generate heat from the internal parts of the driver controller, which results in fault or burns.
- **Do not set the speed or acceleration setting or place the load on the table that exceed the actuator specification.**
  Doing so may cause motor failure, which leads to unexpected accidents or damages.


Obligatory

- **If an alarm is generated, remove the cause, check the safety, deactivate the alarm, and restart the operation. (→ P.2-64)**
  Failure to do so may result in failure, which leads to injury.

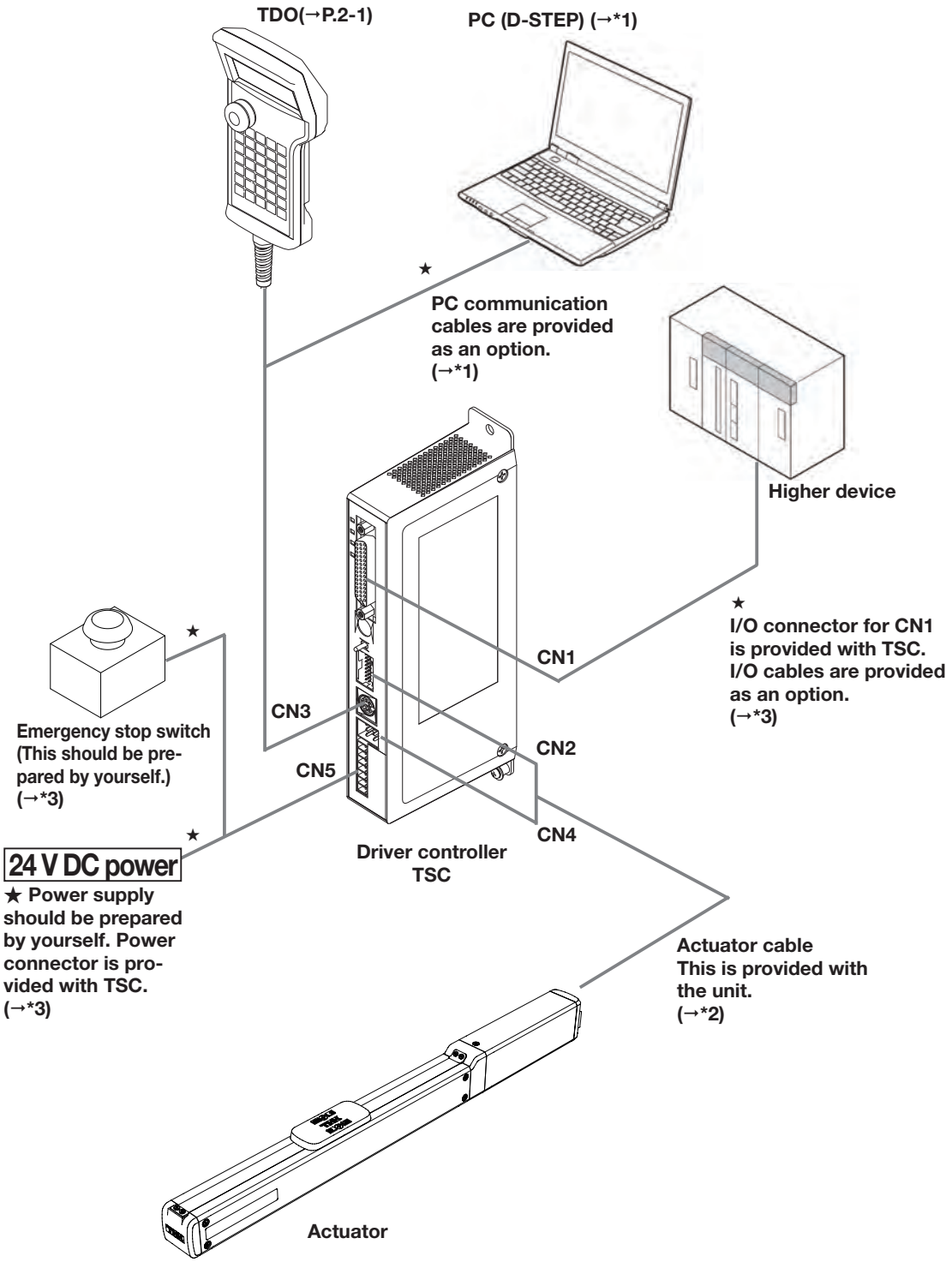

Caution – Flammable

- **Use the combination of a driver controller and an actuator that is specified beforehand.**
  Failure to do so may cause fire or fault.
- **Observe the specified input voltage.**
  Failure to do so may cause fire or fault.

3. System configuration

3-1 System configuration diagram (Example)

- The diagram below shows a representative example for using the economy series ES (with motor) with the driver controller TSC.
- Cables used for connecting the devices shown with ★ should be prepared by yourself.



* 1: See the separate D-STEP instruction manual.
* 2: See the separate ES/EC instruction manual.
* 3: See the separate TSC instruction manual.

2. Digital Operator TDO

About this chapter

This chapter describes the digital operator TDO.

This section describes the product overview.

This section describes the main unit of the operating portion.

This section describes the connection.

2. Digital Operator TDO

About this chapter

This chapter describes the digital operator TDO.

This section describes the basic operations.

This section describes the mode.

This section describes the Position Mode.

This section describes the Monitor Mode.

2. Digital Operator TDO

About this chapter

This chapter describes the digital operator TDO.

This section describes the Test Mode.

This section describes the Settings Mode.

This section describes the Alarm Mode.

This section describes the input of program data.

2. Digital Operator TDO

About this chapter

This chapter describes the digital operator TDO.

This section describes how the program operates.

This section describes the appendix.

2. Digital Operator TDO

About this chapter

This chapter describes the digital operator TDO.

1. Product overview

1-1 Characteristics of the product

- The digital operator for driver controllers TSC, TLC and THC.
- You can operate and configure the driver controllers easily and quickly without PC.
- Contains the easily viewable key seat and the LC with backlight (20 characters × 4 lines).
- Has the design that is lightweight (except 400 g cable) and easy to operate.
- Conforming to overseas standards (EN standard (Europe), UL standard (USA), CSA standard (North America)).

1-2 Model number coding

■ Product model number: TDO - N
① ②

Digital operator (TDO model)		
①	Model number	TDO
②	Type	N: Standard (Cable length 5 m)

1-3 Package contents

- Upon receipt of the ordered product, immediately check the product model and type, and that the accessories have been included.

⚠ CAUTION

Obligatory

- **Check whether the delivered product is the product you ordered.**
  Using a wrong product may cause malfunction that could lead to injury or fault.
- **Check whether the product has any fractured part.**
  Using a fractured product may cause injury or fault.

Packaged product	Type/Symbol	Quantity
Digital operator	TDO-N	1

* The cable used for connecting with the driver controller is provided with the main unit. It cannot be removed.

1. Product overview

1-4 Specifications

Item		Content	
Electrical specification	Rated input voltage	DC24V ±10%	
	Electric power consumption	2.8 W or less	
	Permissible time for momentary stop	10 ms or less	
	Rush current	10 A or less	
	Withstand voltage	500 V AC 10 mA for 1 minute (all supply terminals and between FG terminals)	
	Insulation resistance	10 MΩ min. at 500 V DC mega	
		(all supply terminals and between interface connector hoods)	
	Noise resistance	First transient/burst test Common mode: Level 3 Power supply unit: ±2 kV Communication line: ±1 kV	IEC61000-4-4
	Electrostatic discharge resistance	ESD-3(RH-1) Level 3 (±6 kV contact, ±8 kV air)	IEC61000-4-2
Environmental specification	Service ambient temperature	0°C to 40°C (no freezing)	
	Service ambient humidity	10% to 90% RH (no condensation)	
	Storage ambient temperature	-20°C to +60°C (no freezing)	
	Storage ambient humidity	10% to 90% RH (no condensation)	
	Vibration resistance (durability)	10 Hz to 55 Hz, 9.8 m/s^2 (2 hours for each direction of X, Y, Z)	
	Impact resistance (durability)	98 m/s^2 (5 times for each direction of X, Y, Z)	
Display specification	Display device	STN type semi-transmissive monochrome LCD (with LED backlight)	
	Display method	Character display	
	Display resolution	20 characters × 4 lines	
Structural specification	Protection structure	IP54 (except the cable connector portion)	
	Cable	Length 5 m (mini DIN connector)	
	External dimensions	110(W)×218.3(H)×66.6(D)mm	
	Weight	Approx. 400 g (except the cables)	

1-5 Service and storage environment

Classification	Item	Specifications
Service environment	Service ambient temperature	0°C to 40°C
	Operating humidity	10% to 90% RH or less (no condensation)
	Altitude	1,000 m or less
	Other	• Indoor place where there is no non-corrosive or explosive gas
		• Well-ventilated, dust-free, iron powder-free, non-freezing, and moisture-free place
		• Place where there is no vibration
		• Place where inspection and cleaning can be easily performed
Storage environment	Storage ambient temperature	-20°C to +60°C
	Storage humidity	10% to 90% RH or less (no condensation)
	Other	When storing the product, do not energize

1. Product overview

1-6 Configuration of required devices

1-6-1 Applicable driver controllers

- The following driver controllers are operational for this product. (as of November 1, 2012)
  - Controller series Driver controller TSC
  - Controller series Driver controller TLC
  - Controller series Driver controller THC
  - Controller series Network unit TNU

Important

- **To operate TLC, THC and TNU, TDO Ver.1.10 or higher is required.**

Note

- **The method for connecting to network unit TNU and how to operate are described in the separate manual, TNU/TJU Instruction Manual.**

1-6-2 Higher device and external power supply

- When operating the driver controller with the external input and output signals, higher control device for connecting with CN1 (PLC etc.) and 24 V DC external power supply are required.

1-6-3 D-SETP

- The PC setup tool D-STEP is PC software that can input, check, edit, save, print the programs and parameters, and operate and execute each function by connecting the PC with the driver controllers.
- It is not essential in the operation, but is required when saving the programs and parameters of the driver controllers.
- D-STEP PC software is freely available to download from THK technical support website (user registration is required).
  URL: https://tech.thk.com/
  Since programs are updated from time to time, use the latest version.
- Cable (purchased separately) is required to connect the PC with the driver controllers.
- For more information, see the separate D-STEP instruction manual.

2. Main unit of the operating portion

2-1 Overview

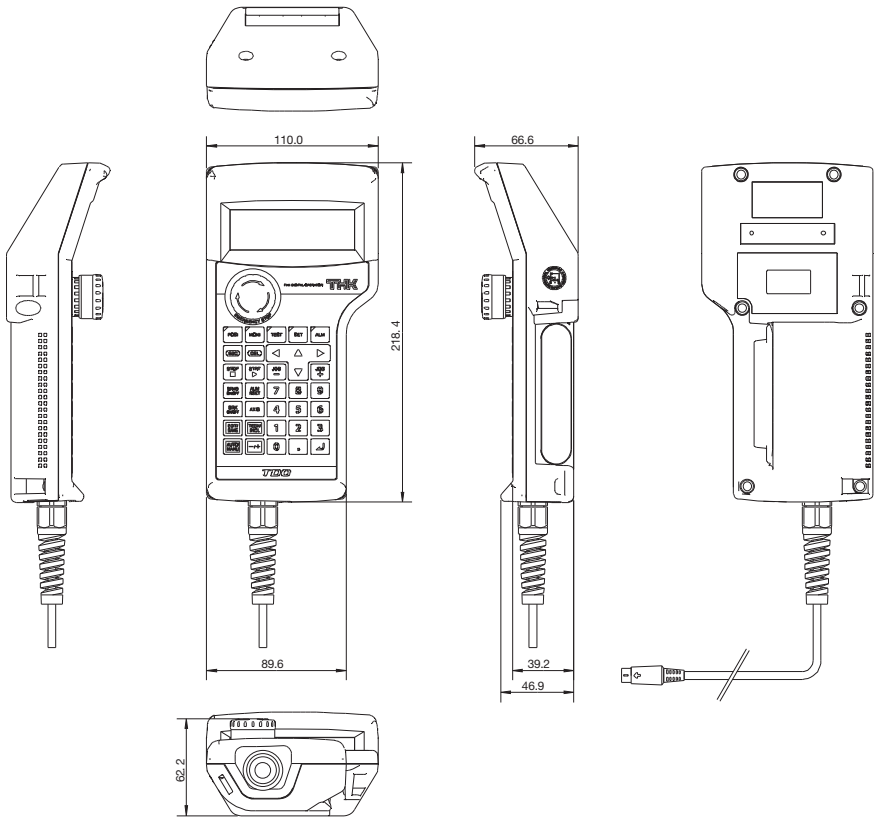
- It is a handheld digital operator to hold with one hand and to operate with the other hand.
- Emergency stop switch is mounted in preparation for unforeseen circumstances.
- Enable switch is mounted to enhance security. This switch can be invalid with parameter No.48 (Enable function) **{TSC: (→ P.2-68), TLC: (→ P.2-72), THC: (→ P.2-78)}.**

2-2 Functions list

- The following functions can be executed on this product.

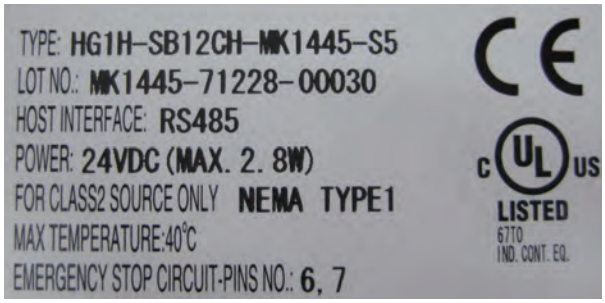
Program data	Check, change (numerical input, teaching)
Parameters	Check, change
Operation of actuator	Servo (ON/OFF), zero return, JOG operation (jog/inching) Program execution, electromagnetic brake (ON/OFF)
Monitor functions	I/O, current position, position command, load factor, version display
Alarm	History display, clear history, interrupting display in occurrence Alarm reset
TDO settings	Backlight luminance, LCD contrast, beep tone Communication speed, backlight automatic turn off, language (Japanese/ English)

2-3 Appearance



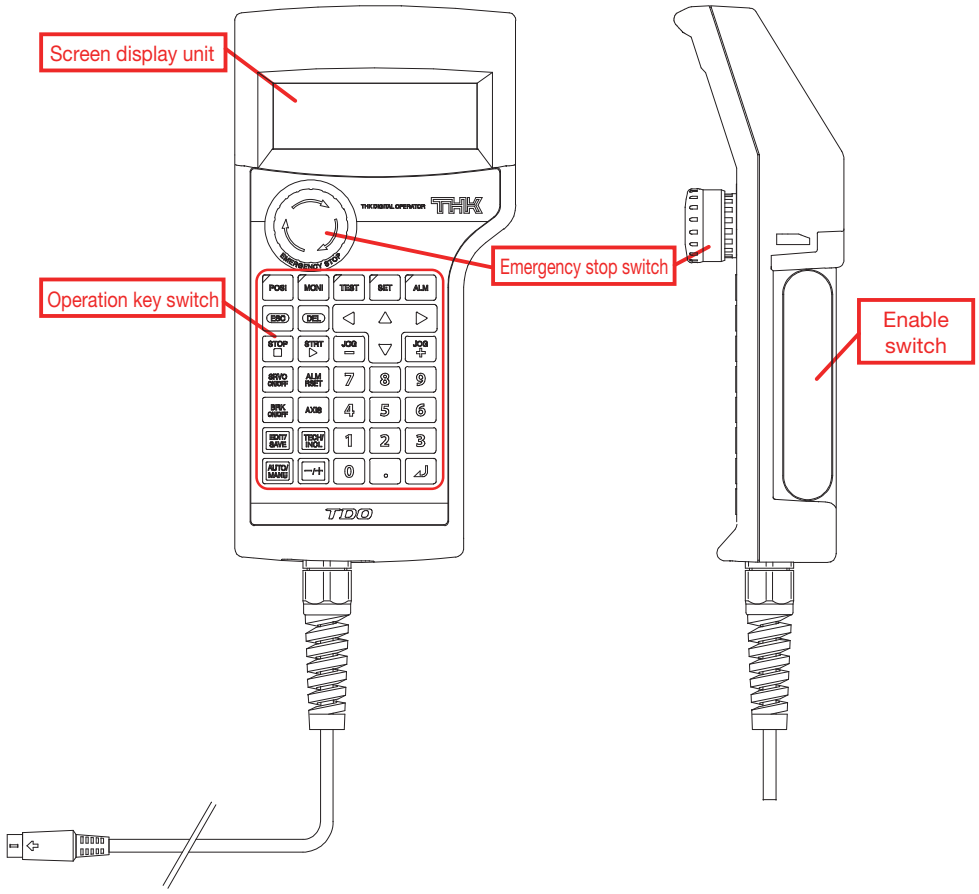
2. Main unit of the operating portion

2-4 Product label



2-5 Individual parts of the operating portion

2-5-1 Names of individual parts



2. Main unit of the operating portion

2-5-2 Functions of individual parts

Names	Functions
Screen display unit	Display various types of information by half-width alphanumeric and kana characters
Operation key switch	Switch display, and perform various operations such as actuator operation
Emergency stop switch	Shut down the motor drive power of the driver controller to be connected
Enable switch	Allow operation of the actuator to be connected from the digital operator (TDO) to the driver controller only when switched on. * Only when **{TSC: (→ P.2-68), TLC: (→ P.2-72), THC: (→ P.2-78)}** is valid

2-6 Operation key switch

2-6-1 Operation key switch placement

2. Main unit of the operating portion

2-6-2 Details of operation key switch

Number	Key name	Key image	Functions
①	Mode		Mode change (with LED)
②	Direction		Page navigation, cursor movement
③	JOG		JOG operation to each direction
④	Number		Numerical input, selection of menu item
⑤	Decimal point		Input the decimal point
⑥	Sign		Sign switching
⑦	Servo		Servo ON/OFF
⑧	Brake		Electromagnetic brake ON/OFF
⑨	Operation mode		AUTO/MANU switching
⑩	Instruction/reading		Migrate to Teach mode/ Reading the position information
⑪	Alarm reset		Resetting alarm
⑫	Shaft switching		Operational object shaft switching (Used when connecting TNU)
⑬	Edit/Save		Migrate to Edit mode/ Confirm input and save
⑭	Escape		Return to the previous screen (upper hierarchy)
⑮	Delete		Delete one character at the cursor position
⑯	Enter		Confirming input data
⑰ , ⑱	Start, Stop		Program execution, stop

3. Connection

⚠ WARNING

Prohibited

- **While the actuator is operating, do not install or remove this product.**
  Malfunction may cause damage to the devices and leading to injury.

⚠ CAUTION

Obligatory

- **Be sure to use the cable of TDO main unit to connect with TSC, TLC and THC, and do not fabricate or modify the cable (change the length etc.) by yourself.**
  Otherwise, unexpected behavior may occur.
- **Be sure to hold the connector when disconnecting the cable.**
  Unplugging the cable by forcibly pulling it may cause cable disconnection.

Prohibited

- **Do not bend or tension the cable.**
- **When inserting the round connector to CN3 of TSC, TLC and THC, do not insert while turning around to check the mate location of concavity and convexity.**
  Doing so may cause damage to the pin.

3-1 Connection to TSC/TLC/THC

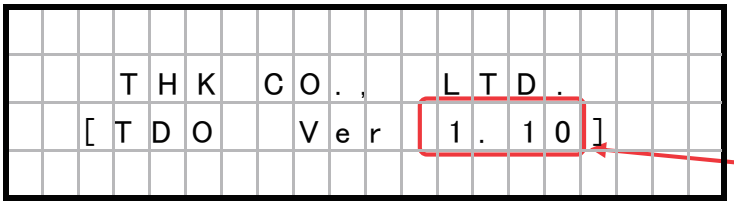
- Align the arrow of the connector with the arrow of the panel at CN3 of TSC, TLC and THC before inserting.
  If you insert the plug while rotating it, the connection pins may be damaged.
- Do not detach and attach the actuator while executing program though there is no problem detaching and attaching while energizing. Wait for the termination of the program or stop the program with the STOP key or enable key before detaching and attaching it.
  * "Execute" display flashes at the bottom row while program execution.
- It cannot be simultaneously used with D-STEP by connecting PC because it is altogether connected to the CN3 of TSC, TLC and THC.
- For connecting and wiring the power supply and actuator and so on, see each instruction manual of driver controllers and network units.

Important

- **You cannot use it by extending the cable. In addition, even when the cable is not extended, a high level of noise may prevent normal operation.**

3-2 Initial screen

- The screen immediately after connection. It starts the connection operation after this screen is displayed for three seconds.

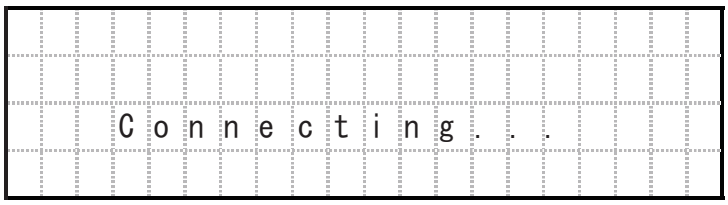


- TDO version can be also checked from "3 => Ver Display" of Monitor Mode "MONI".

3. Connection

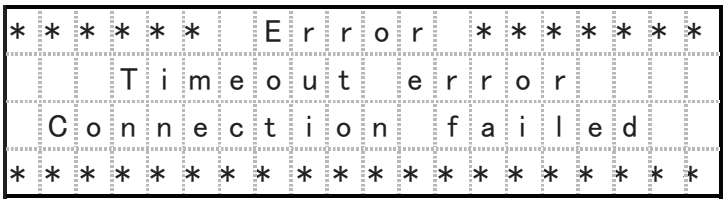
3-3 Connect start screen

- The following screen is displayed until the connection is established.



3-4 Connection failure screen

- The following screen is displayed when a connection is failed.

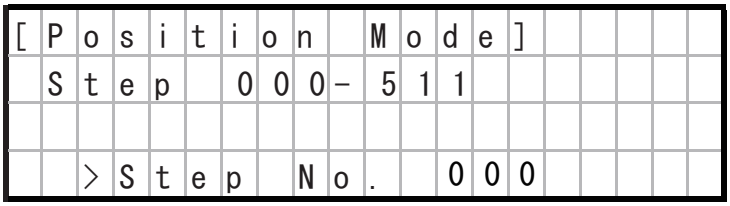


- Turn on the power again, and retry the connection. If the communication is still not established, there is a possibility of equipment failure or cable disconnection.

3-5 Start screen

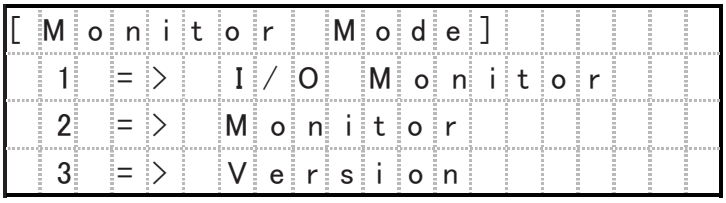
3-5-1 When TSC / TLC / THC is in MANU mode

- If a connection is successfully made, it will be the main screen "Step No. 000" of the Position Mode.



3-5-2 When TSC / TLC / THC is in AUTO mode

- If a connection is successfully made, it will be the menu screen of the Monitor Mode.



4. Basic operations

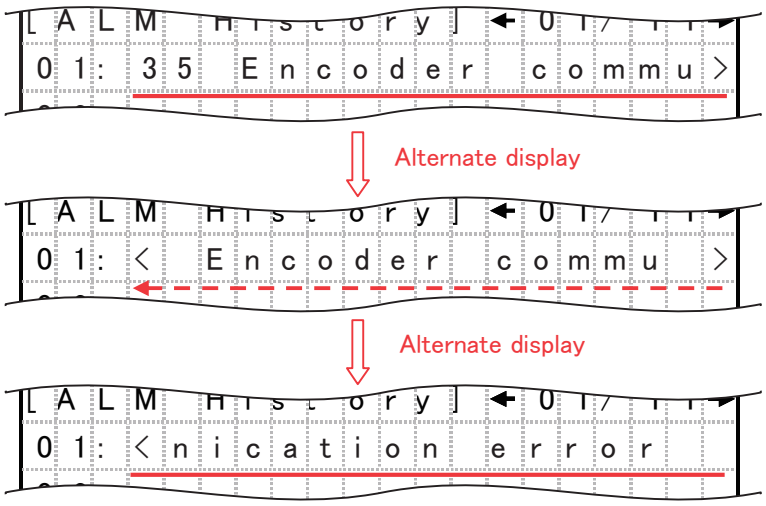
4-1 Display

4-1-1 Screen

- The configuration of the screen is 20 characters × 4 lines.
- The type of display character is half-width alphanumeric and kana.
- It can be operated in the dark since with an automatic turn off backlight.
- The following four items can be changed with "2 => Option" of Setting Mode "SET".
  For more information, see **9-4 Option settings(→P.2-38)**.
  ① Brightness of backlight
  ② Automatic turn off time
  ③ Contrast
  ④ Beep
  ⑤ Notation language

4-1-2 String that cannot be displayed in one line

- The portion excluding fixed display (No., unit, etc.) will be displayed with scrolling in the left automatically.
  When scrolled to the last digit, it repeats scroll display returning to the beginning.
- When display is skipped while scrolling, symbols (skipped on the right: >, skipped on the left: <) corresponding to the skipped portion are displayed with flashing.



4-1-3 Cursor

- In Edit mode or on the screen with multiple selection, the cursor ■ is displayed with flashing at the input position or on the selected item.
- The cursor ■ cannot be moved from side to side (◀ ▶ because the key is for page navigation).
  ▲ ▼ key can be used to move up and down only.

4. Basic operations

4-1-4 Page navigation

- If display is over multiple pages like "1 => Parameter" of Setting Mode, the page number is displayed in the upper right of the screen in the form of <<current page number>> / <<total number of pages>>.
- ◀ ▶ keys allow you to navigate between previous/next page by one page at a time.
- ◀ ▶ keys with pressing and holding them allows you to navigate by ten page at a time.
- An arrow is displayed in the upper right of the screen for the direction to which you can navigate the page.
  If an arrow is not displayed, you cannot navigate any further since it is the last page.

4-1-5 ESC

- Goes back to the upper hierarchy when navigating between screens with hierarchy structure.
  There is a case where the return destination is not described point by point in each transition diagram.
- Canceling an entry and undoing changes in Edit mode cause an exit from the mode at the same time.
- Canceling an entry and undoing changes in Teach mode cause a returning to Edit mode at the same time.

4-1-6 LED display

- On the top POSI MONI TEST SET ALM key, LED lights on the upper left of the key of selected mode.
  Even when the lower hierarchy is displayed, the current mode can not become unknown.

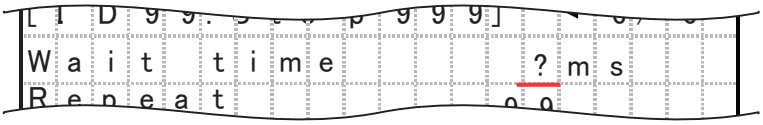
4-2 Settings

4-2-1 Edit mode

- You need to go into Edit mode to configure the settings via this equipment.
- On the screen with setting items, EDIT/SAVE key should be pressed and held.
  "Edit" is displayed on the upper right of the screen, and the cursor ■ showing the input position is displayed with flashing.
- Press EDIT/SAVE key again to exit Edit mode.
  You may be prompt to confirm if you want to save the data.
- ESC key should be pressed to cancel an entry and undo changes and exit Edit mode at the same time.

4-2-2 Delete

- Press the DEL key to delete the numerical value at the cursor ■ position.
- Every time the numerical value is deleted, it is shifted to the right.
- When all digits are shifted to the right and deleted, "?" is displayed.



4-2-3 Numerical input

- If the number of numerical values input is less than the maximum number of digits for input, it is shifted to the left when the numerical value is input.
- When it reaches the maximum number of digits for input, further input including overwriting will not be possible.
- When changing the numerical value, delete (DEL key) up to the digit to be changed to re-enter.
- When changing the positive and negative of the numerical value for input, −/+ key should be pressed to confirm input.
  For the definition of the positive and negative of the numerical value, see **12-5 Positive/negative of the position and travel distance(→P.2-54)**.
- After setting the numerical value, ↵ key should be pressed to confirm input.

4-2-4 Select

- When selecting from multiple items, follow one of the methods.
  ① Move the ■ cursor using the ▲ ▼ key and then press the ↵ key.
  ② Enter the item number and press the ↵ key.

4-2-5 Other

- There is no function to move the cursor ■ to any digit to input the numerical value (The cursor cannot be moved from side to side).

4-3 Operation

4-3-1 Operation mode of TSC/TLC/THC

- Mode change switches of TSC, TLC and THC (front panel)
  are in AUTO mode, only Monitor Mode and Alarm Mode can be selected.
  In MANU mode, all modes can be selected.

4-3-2 AUTO/MANU

- Even when TSC, TLC and THC are in AUTO mode, it can be changed to MANU mode with the AUTO/MANU key.
  Furthermore, it can be returned to AUTO mode.
- Press the AUTO/MANU key, and the screen is displayed to confirm the change.

```
Change to
     MANU mode?
  1 => Yes
  9 => No
```

- When TSC, TLC and THC are in MANU mode, the AUTO/MANU key is invalid (It cannot be changed to AUTO mode).
- For parameter No.38 (Inhibit MANU input)**{TSC: (→P.2-67), TLC: (→P.2-72), THC: (→P.2-77)}**,
  if it is set to Valid, AUTO/MANU key will be invalid.
  if it is set to Invalid, AUTO/MANU key will be valid.

4-3-3 SRVO

- You can turn the servo ON/OFF with the SRVO ON/OFF key of the operating portion only on the following screens:
  ① Test Mode → 2 => Manual operation → 1 => Jog → Jog Mode
  ② Test Mode → 2 => Manual operation → 2 => Inching → Inching Mode
  ③ Teaching screen
- Press and hold the SRVO ON/OFF key to turn the servo ON.
  The display changes like [-] Servo → [*] Servo. The servo is ON with [*].
  If you are using driver controller TSC, it moves back and forth for the distance about a half length of the lead of the actuator you use in order to improve reading accuracy of the encoder. You cannot change the move direction, which is the reverse of zero return.
- Press the SRVO ON/OFF key briefly to turn the servo OFF.
  The display changes like [*] Servo → [-] Servo. The servo is OFF with [-].
- The servo can also be turned ON when returning to zero point from Test Mode → 1 => Zero return screen.

4. Basic operations

4-3-4 BRK

- The brake of the actuator with brake can be turned ON (Valid)/OFF (Invalid) separately.
- Usually, the brake ON/OFF interlocks with the servo ON/OFF.
  The brake is OFF when the servo is ON, and the brake is ON when the servo is OFF.
  However, if it will not interlock if deactivated with the BRK ON/OFF key, and it remains deactivated even if the servo is turned OFF. In this case, it must be returned to Valid with the BRK ON/OFF key.
- You can turn the brake ON/OFF with the BRK ON/OFF key of the operating portion only on the following screens:
  ① Test Mode → 2 => Manual operation → 1 => Jog → Jog Mode
  ② Test Mode → 2 => Manual operation → 2 => Inching → Inching Mode
  ③ Teaching screen
- BRK ON/OFF key is pressed, and the brake is turned OFF, and the confirmation screen is displayed.
  When 1 => YES is selected, the brake is turned OFF. Then the display changes like [*] Brake → [-] Brake. The brake is OFF with [-].

	R	e	l	e	a	s	e		t	h	e						
								b	r	a	k	e	?				
		1		=	>		Y	E	S								
		9		=	>		N	O									

- When returning the brake to ON, the confirmation screen is not displayed and immediately the brake returns to ON. Then the display changes like [-] Brake → [*] Brake. The brake is ON with [*].

⚠ WARNING

General precaution

- **Note that if the brake is manually released when using it in the vertical direction, the moving part may fall freely.**
- **Note that if the mode change switch is turned AUTO with BKRL input (pin.12) of external input and output ON, the moving part may fall freely.**
- **If the brake is manually released, return it to Valid manually. The brake remains released until it is returned to Valid, and it does not interlock with the servo ON/OFF. Also, note that if the brake is stopped with the emergency stop switch, it is released when the switch is back.**

4. Basic operations

4-3-5 Enable switch

- To operate the actuator (including zero return), the enable switch must be turned ON.
- The enable switch becomes OFF by releasing it, ON by holding it lightly by one steps, OFF by holding it tightly.
- If you turned the enable switch OFF by completely holding it, release it completely once, and turn it ON by completely hold it lightly.
- Even if the enable switch is turned OFF, the servo remains ON and retains the information on the zero return.
- For the enable switch, Valid/Invalid can be selected by the parameter No.48 (Enable function) **{TSC: (→ P.2-68), TLC: (→ P.2-72), THC: (→ P.2-78)}**, but for your safety, we recommend the use with Valid. This instruction manual provides the description based on using Valid for the enable switch.

4-3-6 Emergency stop switch

Important

- **An external relay circuit is required to use the emergency stop switch of TDO by connecting to THC.** For more information, see the separate THC instruction manual.
- **Note that by releasing the brake manually, it is released at the same time as the emergency stop is released.**

- When the emergency stop switch is pressed, the motor drive current is interrupted, and the actuator stops.
- In the emergency stop status, the LEDs of all mode keys blink, and the status is displayed on the screen too.
- Turn OFF the servo, and turn ON the brake for the actuator with the brake.
- Turn the red knob to the arrow direction (clockwise) for the release the emergency stop switch. The lock is released, and the knob returns to the original protruded position.
- If the cause of the emergency stop is resolved, and the safety is secured, reset the alarm with the ALM RSET key.

4-4 Alarm display

- When the alarm is generated, the previous screen display is interrupted, the alarm screen is displayed, and the LEDs of five mode change switches will blink.
- If the beep is set to ON on Option, the beep tone will sound.
  For more information, see **9-4 Option settings(→P.2-38)**.
- ALM RSET Pressing the key resets the alarm, and the screen returns to the one before interruption or the further upper hierarchy.
- For more information on the alarm, see **13-19 Alarm lists(→ P.2-79)**.

```
******Alarm******
  No. 22
  Move comm. before OR
**********************
```

4-5 Other

4-5-1 Operation sound

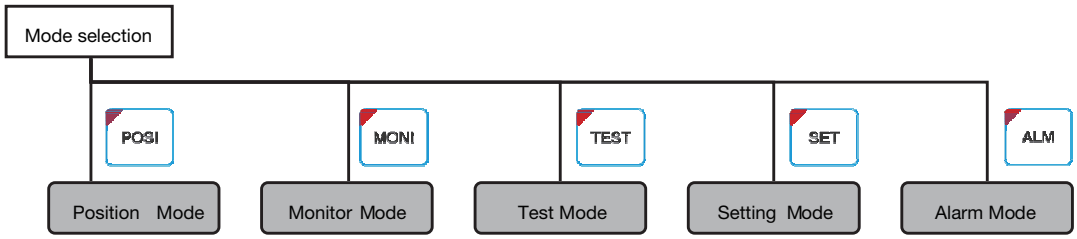
- The sound of key operation can be turned ON/OFF. When it is ON, the beep tone will sound also if the alarm is generated.
- You can change the settings from "2 => Option" of Setting Mode "SET".
  For more information, see **9-4 Option settings(→P.2-38)**.

5. Mode

5-1 Overview

5-1-1 Five modes

- The following five modes are available for the digital operator TDO:
  - ① Position Mode → **(→ P.2-23)**
  - ② Monitor Mode → **(→ P.2-28)**
  - ③ Test Mode → **(→ P.2-30)**
  - ④ Setting Mode → **(→ P.2-36)**
  - ⑤ Alarm Mode → **(→ P.2-40)**
- You can always migrate between modes. However, if you migrate during an operation, the operations you have done will be invalid.



5-1-2 Difference between the operation modes of TSC/TLC/THC

- An executable mode depends on the operation modes of TSC/TLC/THC.
  In the table below, ○: Executable -: Not executable

Operation mode	Mode of TDO				
	Position Mode	Monitor Mode	Test Mode	Setting Mode	Alarm Mode
AUTO	-	○	-	-	○
MANU	○	○	○	○	○

- Even when TSC, TLC and THC are in AUTO mode, it can be changed to MANU mode.
  For more information, see **4-3-2 AUTO/MANU(→P.2-18)**.

5-2 Overview of each mode

5-2-1 Position Mode

- Confirm and change the contents of program data.
- The current value can be given teaching in Teach mode.
- For more information, see **(→ P.2-23)**.

5. Mode

5-2-2 Monitor Mode

- Monitoring can be performed without affecting operations.
- The following three types of items can be monitored:
  - ① I/O monitor : ON/OFF state of the external input and output of TSC, TLC and THC
  - ② Operation monitor : Load factor, position command value, current position value
  - ③ Version display : Versions of TDO, TSC, TLC, and THC
- For more information, see **(→ P.2-28)**.

5-2-3 Test Mode

- TSC, TLC and THC can be manually operated.
- The following three types of items can be operated:
  - ① Zero return : Zero return of the actuator
  - ② Manual operation : Manual operation of jog or inching
    Also, the servo and brake can be turned ON/OFF.
  - ③ Program execution : Program execution of given steps
- For more information, see **(→ P.2-30)**.

5-2-4 Setting Mode

- Confirm and change the contents of various settings.
- The following two types of items can be set:
  - ① Parameters : Parameters of TSC, TLC and THC
  - ② Option : Options of TDO
- For more information, see **(→ P.2-36)**.

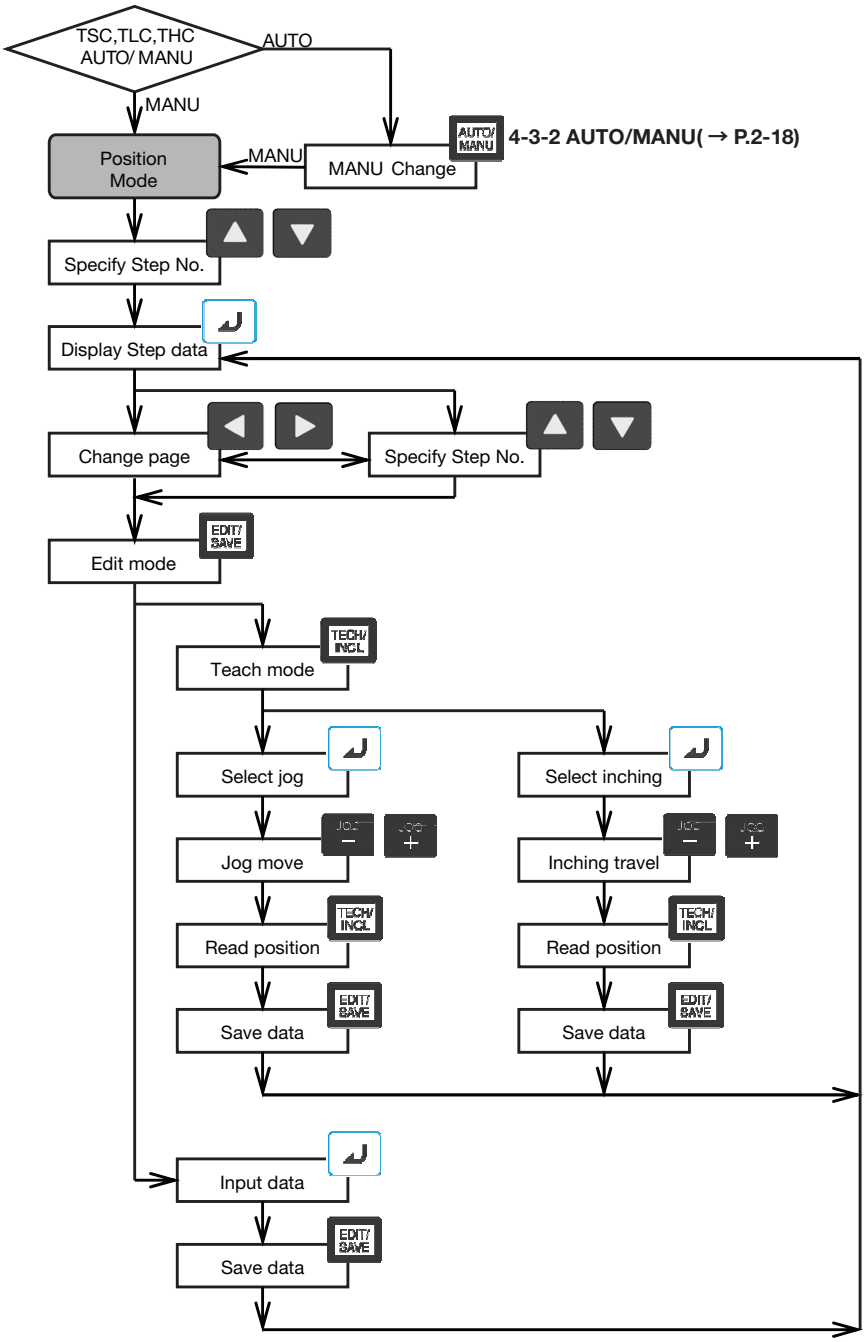
5-2-5 Alarm Mode

- Display and clear alarm histories.
  The alarm history includes Power ON.
- For more information, see **(→ P.2-40)**.

6. Position Mode

- When TSC, TLC and THC are in MANU mode, migrate with the POS key.
  In AUTO mode, change to MANU mode with the AUTO/MANU key.
  See **4-3-2 AUTO/MANU(→P.2-18)** for how to change AUTO and MANU.
- In this mode, you can confirm the contents of program data, and make changes in Edit mode.
  Also, the current value can be given teaching in Teach mode

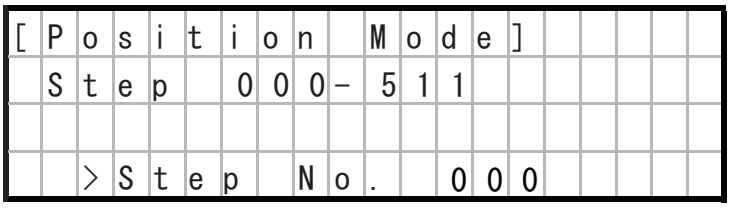
6-1 Transition diagram



6-2 Display program data

6-2-1 Specify Step No.

- In Position Mode, the screen to specify Step No. is displayed.



- There are the following two way to specify Step No.:

  For either method, press the [↵] key when the No. you want to display appears. Display the data.

  ① Increase or decrease No. one by one with the [▲] [▼] key. Press and hold the key, and you can change No. by 10 Step.

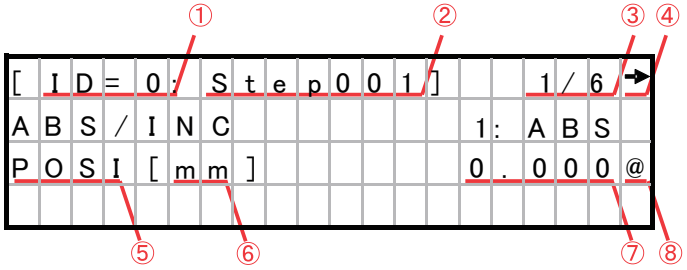
  ② Directly specify No. with the numeric keys [0] to [9] ([DEL] also can be used).

- Note that the number of the valid steps depends on the operation mode, but is always displayed up to the maximum value 511. In that case, if the greater number than the valid steps is set, it will not be reflected on the operation.

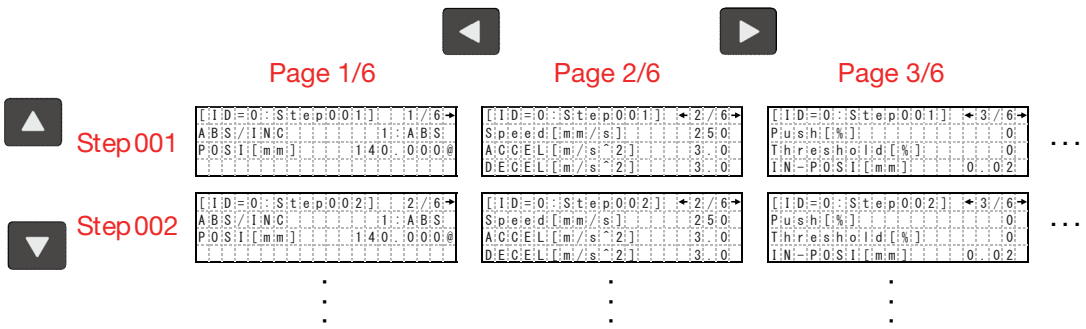
6-2-2 Change the page of program data

- A piece of program data consists of six pages.
- Change the page with the [◀] [▶] key.
- The page feed symbol (← , →) appears only in the direction where the page exists.
- While data is displayed, Step No. can also be changed with the [▲] [▼] key.
  Press and hold the key, and you can change No. by 10 Step.

6-2-3 Summary of display



① Axis ID
② Number of steps
③ Number of pages
④ Page feed direction
⑤ Data item
⑥ Unit
⑦ Value
⑧ Teachable mark



- See **13-1 Program data list(→ P.2-61)** for the details of each data item.

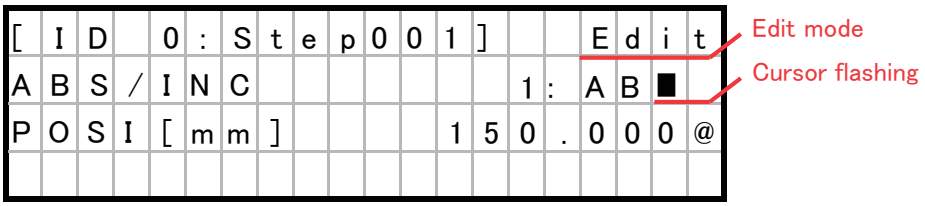
6. Position Mode

6-3 Edit mode

- In edit mode, you can change program data.
- Note that if an invalid item is set in the operation mode, it will not be reflected on operations.
  Example) "Push" or "Threshold" by Function mode 1

6-3-1 Migrate to Edit mode

- When program data is displayed, press and hold the EDIT/SAVE key.
  The part where the number of pages is displayed changes to Edit, the cursor ■ flashes at the data position of the second line.



6-3-2 Move the cursor

- Navigate a page with the ◀ ▶ key.
- Move up and down between items in the page with the ▲ ▼ key. Step No. cannot be changed.

6-3-3 Input and change program data

- See **13-1 Program data list(→ P.2-61)** for the details of each data item.
- See **4-2-3 Numerical input(→ P.2-17)** for numerical input.
- Switch "ABS/INC"

  0 key → Change to INC

  1 key → Change to ABS

  For more information, see **11-1 ABS/INC(→P.2-42)**.
- "ACCEL/DECEL mode" will be switched to the 0, 1 and 2, but do not select other than 0.
- Change "Standstill mode"

  DEL Display "?" with the key, and input the mode number you want to change.

  0: Invalid <<Invalid>>
  1: Off time 0 <<Automatic turn off 1>>
  2: Off time 1 <<Automatic turn off 2>>
  3: Off time 3 <<Automatic turn off 3>>
  4: Full <<Full servo>>

  For more information, see **11-3 Standstill mode(→P.2-43)**.
- Input "Jump[Step No.]"

  DEL Display "?" with the key, and input the Jump destination number.

  When you enter "E", input "999".

  For more information, see **13-14 JUMP(→P.2-64)**.

6. Position Mode

6-3-4 Exit edit mode

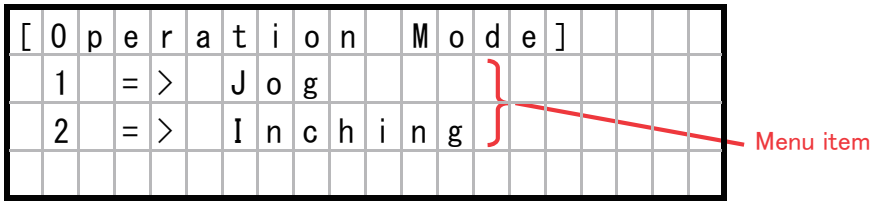
- You can exit the edit mode using the following two ways:
  ① Pressing the EDIT/SAVE key immediately saves the change and exits the Edit mode. Note that this operation is performed without confirmation.
  ② Press the ESC key again to return to the upper hierarchy than Edit mode.

6-4 Teach mode

- In Teach mode, the current value can be given teaching by operating the actuator manually.
- The three items POSI, AreaA, AreaB can be given teaching.
  "@" is displayed at the end of each numerical value.
- Make sure to return to zero point before teaching. Otherwise, the positioning repeatability is not guaranteed. See **12-4 Zero return operation(→ P.2-49)** for zero return.
- The input position is always the absolute position. You cannot input the relative position.
  For more information, see **11-1 ABS/INC (→P.2-42)**.

6-4-1 Migrate to Teach mode

- Move the cursor ■ over the items that can be given teaching in Edit mode, and press the TECH/INCL key.
  You are asked about Manual operation method, so select either method.



- See **12-3 Manual operation(→ P.2-48)** for manual operation.

6. Position Mode

6-4-2 Teaching of the current value data

- When the TECH/INCL key is pressed after manual operations, the current position data is acquired, and the mode returns to Edit.
- The data is saved, and written to the driver controller. See **6-3-4 Save Changes (→ P.2-26).**

⚠ WARNING

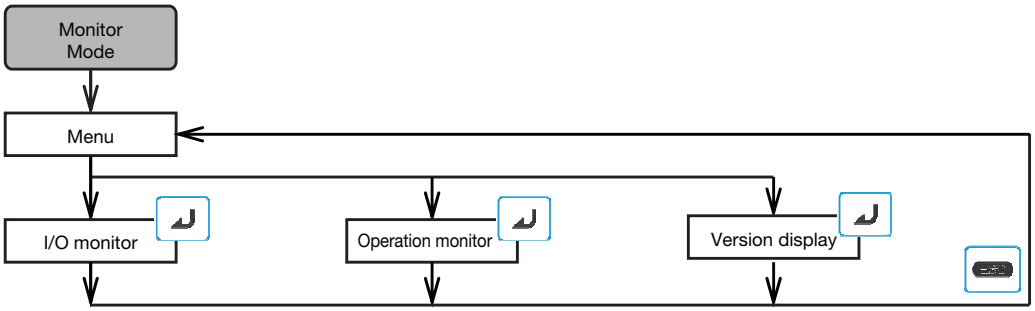
Obligatory

- **Make sure to return to zero point before teaching.**
  Otherwise, the position repeatability cannot be guaranteed.
- **If the servo is turned ON without ever returning to zero point after power activation, the position will become the zero point causing the error of the teaching position.**

7. Monitor Mode

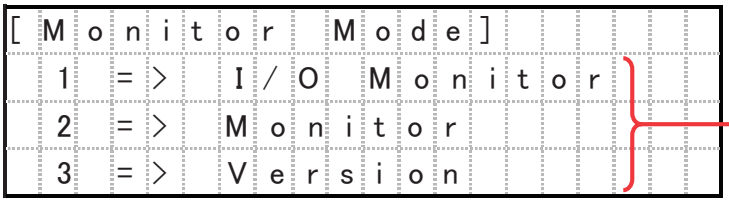
- Migrate to this mode using the MONI key regardless of whether TSC, TLC, or THC is AUTO mode or MANU mode.
- In this mode, various monitoring can be performed for TSC. The following three items can be monitored:
  - ① I/O monitor : ON/OFF state of the external input and output of TSC, TLC and THC
  - ② Operation monitor : Load factor, position command value, current position value
  - ③ Version display : Versions of TDO, TSC, TLC, and THC

7-1 Transition diagram



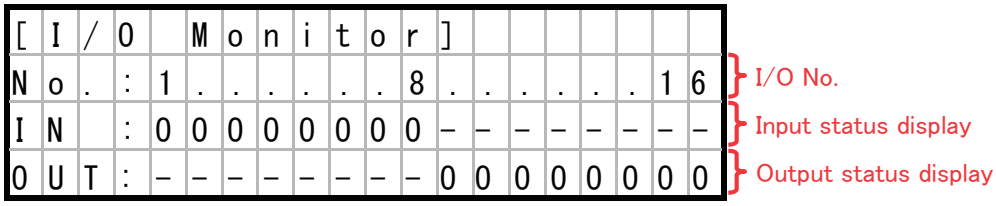
7-2 Monitor Mode menu

- Select an item to monitor. To select, use either of the following ways:
  - ① Move the ■ cursor using the ▲ ▼ key and then press the ↵ key.
  - ② Enter the item number and press the ↵ key.



7-3 I/O monitor

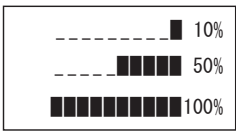
- ON/OFF state of the CN1 external input and output of TSC, TLC, and THC can be monitored.
- "0" for ON (shorted to 0V) or "-" for OFF (released from 0V) is displayed.

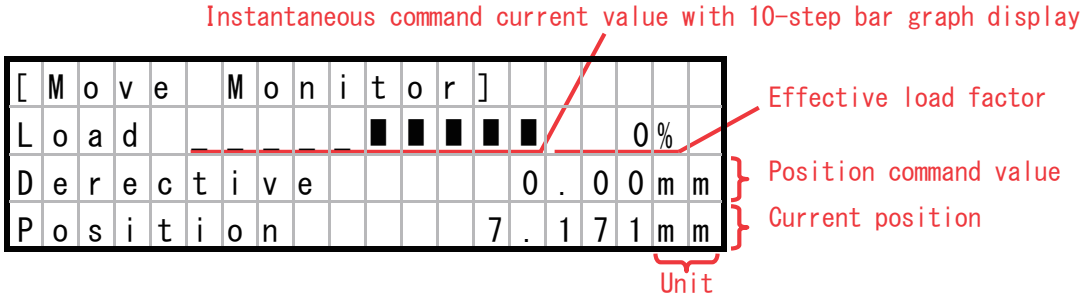


7. Monitor Mode

7-4 Operation monitor

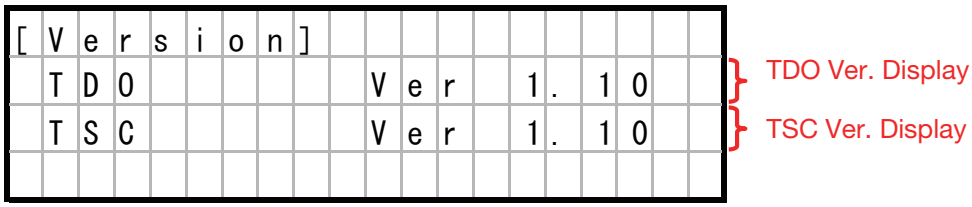
- Effective load factor, position command value and current position value of TSC, TLC, or THC can be monitored.
- The display is updated at any time, so the current TSC status and actuator position can be monitored.
- Load displays 10-step bar graph together (see the right figure).





7-5 Version display

- The version numbers of TDO and TSC, TLC, or THC are displayed.
- When you contact us, please inform the version number.

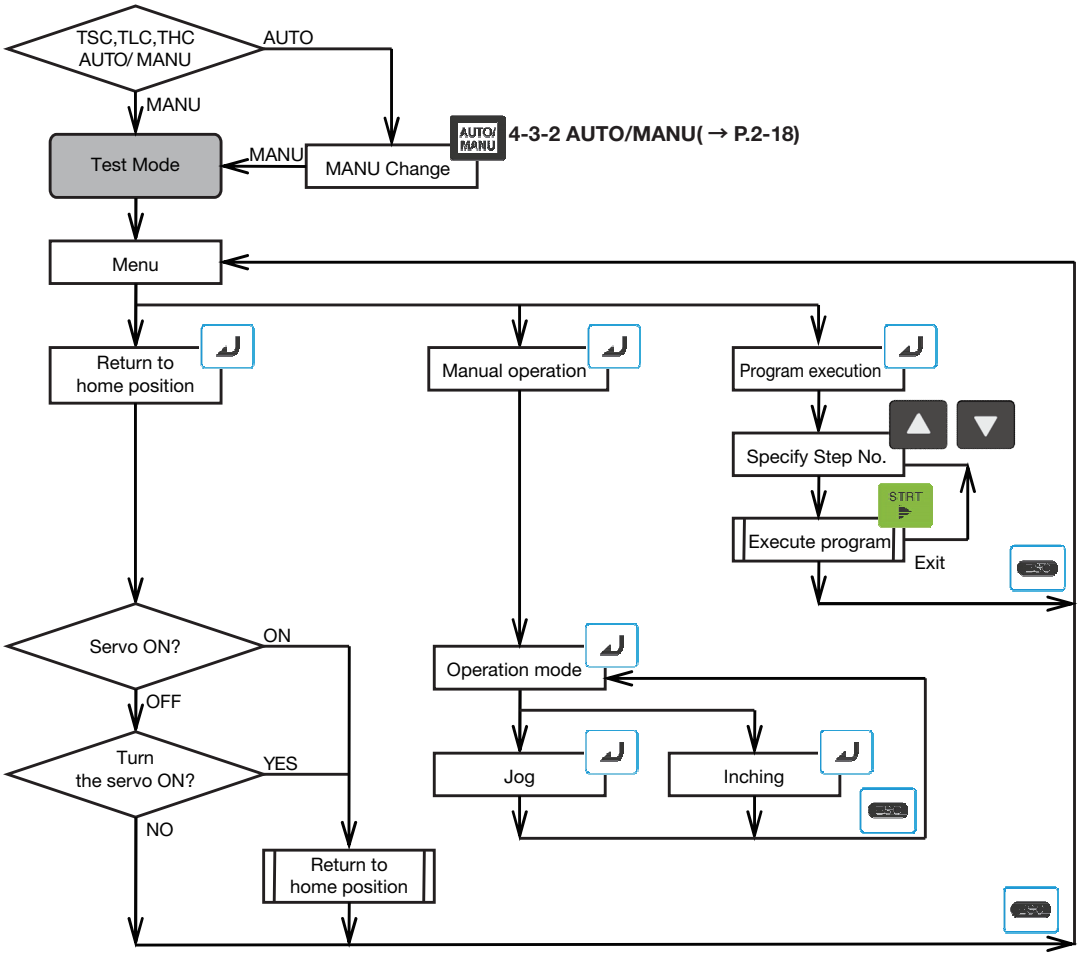


* The representative examples are for TSC.

8. Test Mode

- When TSC, TLC, and THC are in MANU mode, use the TEST key for migration.
  In AUTO mode, change to MANU mode with the AUTO/MANU key.
  See **4-3-2 AUTO/MANU(→P.2-18)** for how to change the mode between AUTO and MANU.
- In this mode, various operations can be performed. The following three items of operation can be performed:
  ①Zero return : Zero return of the actuator
  ②Manual operation : Manual operation of jog or inching
  Also, the servo and brake can be turned ON/OFF.
  ③Program execution : Program execution of given steps

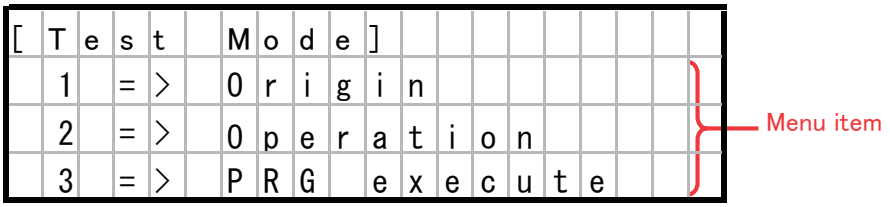
8-1 Transition diagram



8. Test Mode

8-2 Test Mode menu

- Select an operation item. To select, use either of the following ways:
  ① Move the ■ cursor using the ▲ ▼ key and then press the ↵ key.
  ② Enter the item number and press the ↵ key.



⚠ WARNING

Obligatory

- **To prevent unexpected accidents, perform the operation after ensuring that the power can be shut off by the TDO emergency stop switch.**
  Otherwise, you may get injured.
- **If any abnormal heating, odor, smoke or fire is observed in TSC, TLC, THC and the actuator, shut the power off immediately since there is a risk of fire, etc.**
  Please contact us after confirming that the abnormal condition is stopped.

Prohibited

- **While this product is operating a program or manually operable, do not enter the working area of any moving part.**
  Doing so may cause you to touch the moving part and injure you.

⚠ CAUTION

Obligatory

- **Configure and check appropriate settings of parameter before operation.**
  Otherwise, unexpected operation may occur.
- **Setting a small value to the parameter No.20 (Speed override) {TSC: (→ P.2-66), TLC: (→ P.2-70), and THC:(→ P.2-75)} limits the speed temporarily and you can ensure the safety.**
- **If an alarm of TSC, TLC, or THC is generated, remove the cause, ensure the safety, and reset the alarm before restarting the operation.**
- **When a part generates heat, restart the operation after taking sufficient cooling time.**
  Continuing the operation without removing the cause may cause malfunction, resulting in damage and injury.

Prohibited

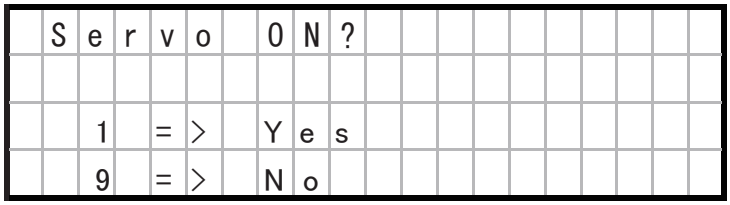
- **In the event of instantaneous power failure during actuator operation, the unit may be restarted immediately after restoration. So do not enter into the moving range of the unit for personnel's safety.**

8-3 Zero return

- Perform zero return of the actuator.
- Before teaching and program execution, zero return need to be completed.
- Zero return can be performed as may times as necessary at any time.

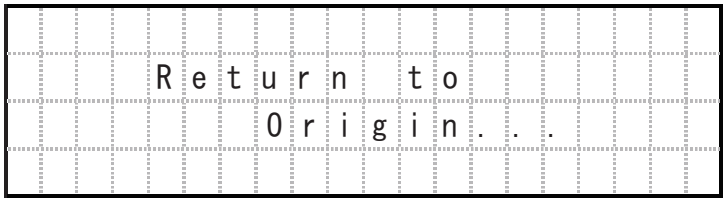
8-3-1 Servo ON

- Zero return operation will be started promptly if the servo is ON when the zero return is performed.
- When the servo is OFF, the confirmation screen to turn the servo ON is displayed, so select Yes. At this point, for the driver controller TSC, the actuator moves back and forth over a distance by about a half length of its lead to use in order to improve the accuracy of reading by the encoder. You cannot change the move direction, which is the reverse of zero return.
- Selecting No returns the display to the Test Mode menu screen.



8-3-2 Zero return operation

- To perform zero return, the enable switch must be turned ON (hold it lightly by one step). Turning it OFF during the zero return operation returns the display to the menu screen.
  For enable switch, see **4-3-5 Enable switch(→P.2-20) {TSC: (→P.2-68), TLC: (→P.2-72), THC: (→P.2-78)}**.
- During the zero return operation, the following screen is displayed. When completed, it will return to the menu screen.

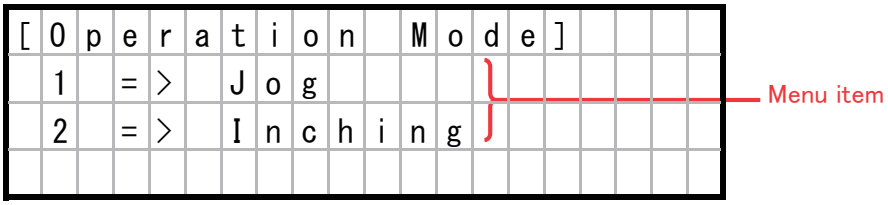


8-4 Manual operation

- Jog and inching can be operated manually.
- The servo can be turned ON/OFF.
- The brake can be turned ON/OFF.

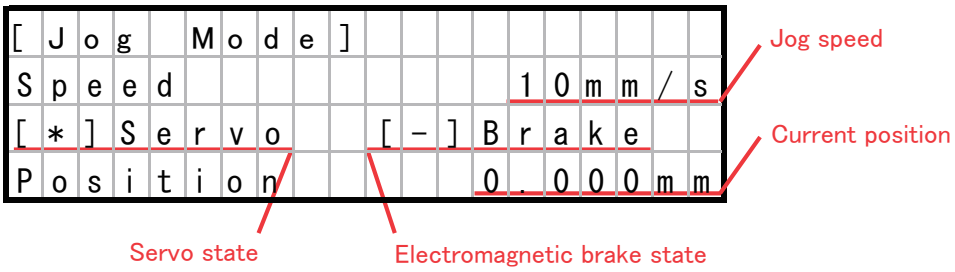
8-4-1 Manual operation menu

- Select a manual operation item. To select, use either of the following ways:
  ① Move the ■ cursor using the ▲ ▼ key and then press the ↵ key.
  ② Enter the item number and press the ↵ key.



8-4-2 Jog

- While pressing the JOG + / JOG − key, move the actuator in a corresponding direction.
  For the definition of positive and negative directions, see **12-5 Positive/negative of the position and travel distance(→P.2-54)**.
- You can change the jog speed in the parameter No.16 (Jog speed) **{TSC: (→ P.2-65), TLC: (→ P.2-70), THC: (→ P.2-75)}.**



- To operate the actuator
  ① The servo must be ON
  ② The enable switch must be ON.
- Press and hold the SERVO ON/OFF key to turn the servo ON.
  The display changes like [-] Servo → [*] Servo. The servo is ON with [*].
  At this point, the actuator moves back and forth over a distance by about a half length of its lead to use in order to improve the accuracy of reading by the encoder. You cannot change the move direction, which is the reverse of zero return.
- Press the SERVO ON/OFF key briefly to turn the servo OFF.
  The display changes like [*] Servo → [-] Servo. The servo is OFF with [-].
- The brake can be turned OFF (disabled) in this screen (for actuator with brake).
  For more information, see **4-3-4 BRK(→P.2-19)**.
- Pressing and holding the EDIT/SAVE key displays a cursor ■ on the jog speed indication and enables you to change the speed on this screen.

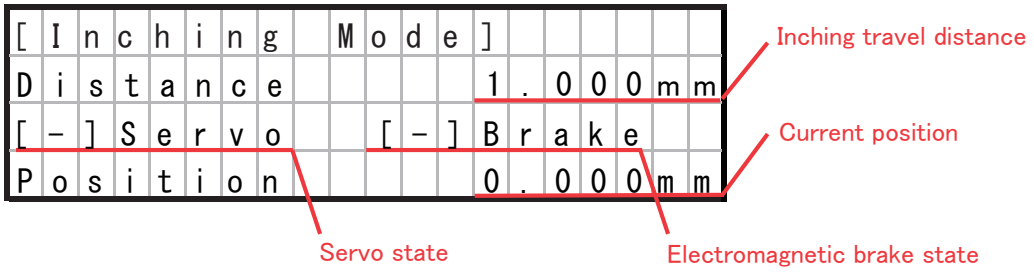
⚠ WARNING

General precaution

- **Note that if the brake is manually released when using it in the vertical direction, the moving part may fall freely.**
- **Note that if the mode change switch is turned AUTO with BKRL input (pin.12) of external input and output ON, the moving part may fall freely.**
- **If the brake is manually released, return it to Valid manually. The brake remains released until it is returned to Valid, and it does not interlock with the servo ON/OFF. Also, note that if the brake is stopped with the emergency stop switch, it is released when the switch is back.**

8-4-3 Inching

- Each pressing of the JOG+ JOG− key will move the actuator in a corresponding direction at the configured speed (same as the jog speed) for the configured travel distance.
- For the definition of positive and negative directions, see **12-5 Positive/negative of the position and travel distance(→ P.2-54)**.
- You can change the inching speed in the same parameter as the jog speed, parameter No.16 **{TSC: (→ P.2-65), TLC: (→ P.2-70), THC: (→ P.2-75)}.**
- You can change the inching travel distance in the parameter No.31 (Inching distance) **{TSC: (→ P.2-67), TLC: (→ P.2-71), THC: (→ P.2-76)}.**



- To operate the actuator
  ① The servo must be ON
  ② The enable switch must be ON.
- Press and hold the SRVO ON/OFF key to turn the servo ON.
  The display changes like [-] Servo → [*] Servo. The servo is ON with [*].
  At this point, the actuator moves back and forth over a distance by about a half length of its lead to use in order to improve the accuracy of reading by the encoder. You cannot change the move direction, which is the reverse of zero return.
- Press the SRVO ON/OFF key briefly to turn the servo OFF.
  The display changes like [*] Servo → [-] Servo. The servo is OFF with [-].
- The brake can be turned OFF (disabled) in this screen (for actuator with brake).
  For more information, see **4-3-4 BRK(→P.2-19)**.
- Pressing and holding the EDIT/SAVE key displays a cursor ■ on the inching travel distance indication and enables you to change the distance on this screen.

⚠ WARNING

General precaution

- **Note that if the brake is manually released when using it in the vertical direction, the moving part may fall freely.**
- **Note that if the mode change switch is turned AUTO with BKRL input (pin.12) of external input and output ON, the moving part may fall freely.**
- **If the brake is manually released, return it to Valid manually. The brake remains released until it is returned to Valid, and it does not interlock with the servo ON/OFF. Also, note that if the brake is stopped with the emergency stop switch, it is released when the switch is back.**

8-5 Program execution

- Specify the Step No. to execute the program written to the TSC, TLC, or THC.
- It is necessary to write a program by using TDO or D-STEP beforehand.
- For D-STEP, see the separate instruction manual.

8-5-1 Specify Step No.

- Selecting Program execution displays the Step No. specification screen.
- There are the following two way to specify Step No.:

  ①Increase or decrease No. one by one with the ▲ ▼ key. Press and hold the key, and you can change No. by 10 Step.

  ②Directly specify No. with the numeric keys 0 to 9 (DEL also can be used).
  After specifying it, use the ↵ key to confirm it.

```
[Execute  Mode]
 Step  000- 511
>Step No.  000
```

8-5-2 Execution of program

- After specifying the Step No., press the START key to execute a program.

```
[Execute  Mode]
Step No.      005
Position      15.500mm
****  Execute  *****
```

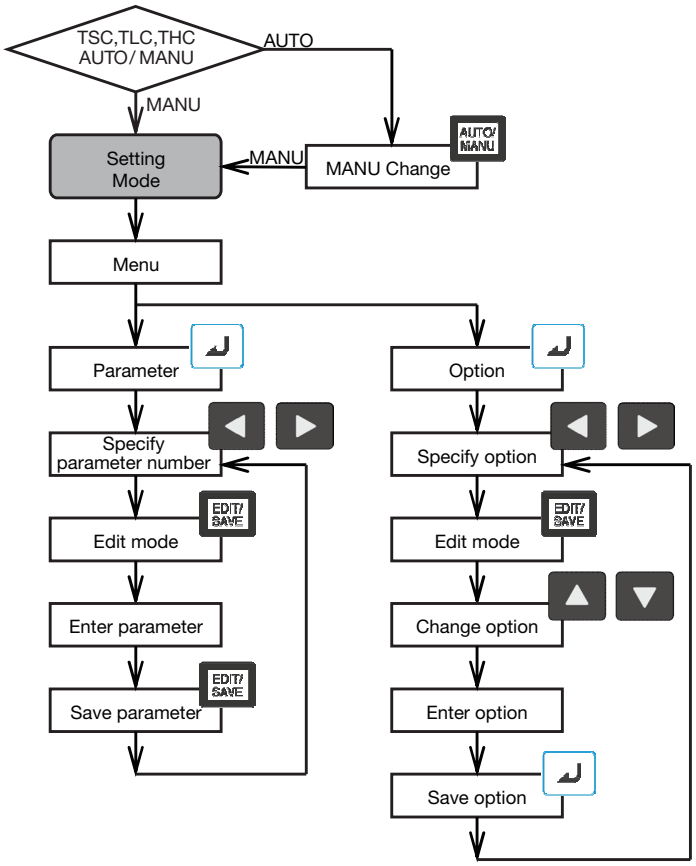
Step No.
Current position
Flashing while executing program

- Pressing the STOP key pauses the operation.
  During pause, "Pause" indicator is flashing at the bottom of the screen instead of "Execute."
- Pressing the START key again resumes the operation.
- Turning OFF the enable switch during program execution returns the display to the Step No. specification screen.
  When the operation is in pause, that state will be kept without returning.

9. Setting Mode

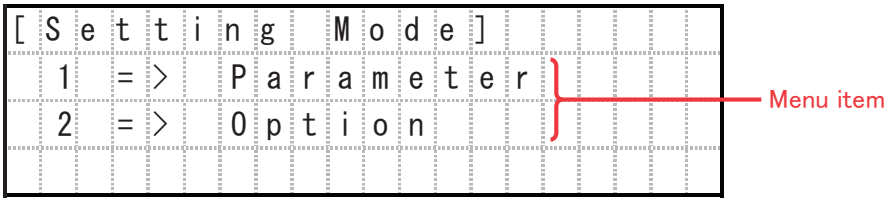
- When TSC, TLC, and THC are in MANU mode, use the SET key for migration.
  In AUTO mode, change to MANU mode with the AUTO/MANU key.
  See **4-3-2 AUTO/MANU(→P.2-18)** for how to change the mode between AUTO and MANU.
- In this mode, various confirmation and changing operations can be performed. The following two items of operation can be performed:
  ① Parameters : Parameters of TSC, TLC and THC
  ② Option : Options of TDO

9-1 Transition diagram



9-2 Setting Mode menu

- Select an item to set. To select, use either of the following ways:
  ① Move the ■ cursor using the ▲ ▼ key and then press the ↵ key.
  ② Enter the item number and press the ↵ key.

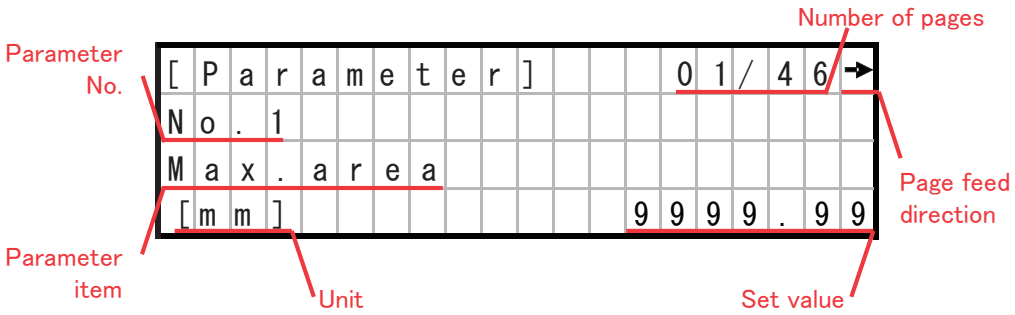


9. Setting Mode

9-3 Parameter settings

9-3-1 Specify Parameter No.

- After migrating to the Parameter Mode, one parameter is displayed for each page.
- You can specify the Parameter No. by increasing or decreasing pages one by one using the ◀ ▶ key.
  Press and hold the key, and you can change No. by 10 pages.
- The page feeding symbol (← , →) appears only in the direction where the page exists.
- There are some missing numbers or non-disclosed parameters due to circumstances.
- For details of each parameter, see **13-15 Overview of parameters(→ P.2-64)**.



9-3-2 Edit mode

- In the Edit mode, you can change the parameter setting values.
- When a parameter is displayed, press and hold the EDIT/SAVE key.
  The part where the number of pages is displayed changes to Edit and the cursor ■ flashes at the setting value position of the fourth line.
- In this state, you can still use the ◀ ▶ key to switch pages. 10-page feeding by pressing and holding is also allowed.
- See **4-2-3 Numerical input(→ P.2-17)** for numerical input.
- Use the ▲ ▼ key to switch options.

9. Setting Mode

9-3-3 Save changes

- After changing parameters, the change must be saved to TSC, TLC, or THC.
- Pressing the EDIT/SAVE key immediately saves the change and exits the Edit mode. Note that this operation is performed without confirmation.
- To exit without saving, press the ESC key.

9-4 Option settings

9-4-1 Specify Option

- After migrating to the Option Mode, multiple options are displayed for each page.
- You can change the page by increasing or decreasing pages one by one using the ◀ ▶ key.
- The page feeding symbol (← , →) appears only in the direction where the page exists.
- In the Edit mode, also use the ▲ ▼ key to specify the items.

9-4-2 Option items

No.	Display item	Range of values to display (Meaning of the value)	Display unit	Default value
1	Backlight luminance	0 to 255 (0: OFF to 255: Maximum luminance)		255
2	Backlight off	0 to 1800 (0: Always ON to Automatic OFF after 1800 seconds)	s	300
3	Contrast	0 to 60 (0: Dark to 60: Light)		20
4	Beep	0, 1 (0: OFF (no sound), 1: ON (with key touch sound/alarm generation sound))		0
5	Language	0, 1 (0: JPN (Japanese), 1: ENG (English)		0

9-4-3 Edit mode

- In the Edit mode, you can change the option setting values.
- When a option is displayed, press and hold the EDIT/SAVE key.
  The part where the number of pages is displayed changes to Edit and the cursor ■ flashes at the setting value position of the second line.
- In this state, you can still use the ◀ ▶ key to switch pages.
- In addition, use the ▲ ▼ key to specify in-page item.
- See **4-2-3 Numerical input(→ P.2-17)** for numerical input.
- When specifying options of No.4 and 5, enter 0 or 1.

9. Setting Mode

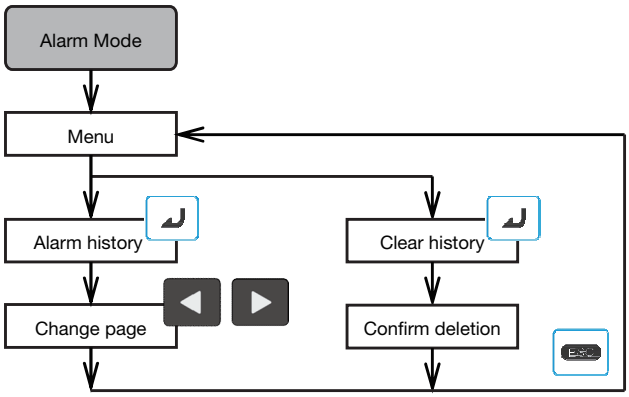
9-4-4 Save changes

- After changing parameters, the change must be saved to TDO.
- Pressing the ↵ key immediately saves the change and exits the Edit mode. Note that this operation is performed without confirmation.
- Note that the EDIT/SAVE key operates the same as the ESC key (exit without saving).
- To exit without saving, press the ESC key.

10. Alarm Mode

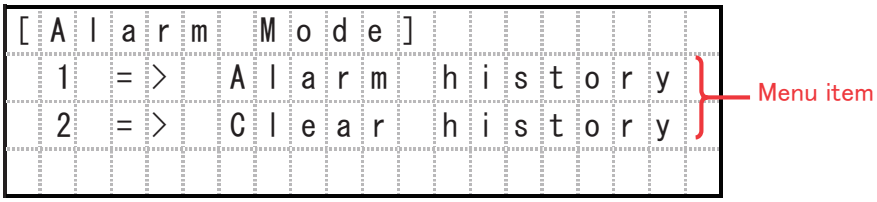
- Migrate to this mode using the ALM key regardless of whether TSC, TLC, or THC is AUTO mode or MANU mode.
- In this mode, the alarm-related operations can be performed. The following two items can be operated:
  ① Displaying alarm history
  ② Clearing alarm history

10-1 Transition diagram



10-2 Alarm Mode menu

- Select an item to operate. To select, use either of the following ways:
  ① Move the ■ cursor using the ▲ ▼ key and then press the ↵ key.
  ② Enter the item number and press the ↵ key.



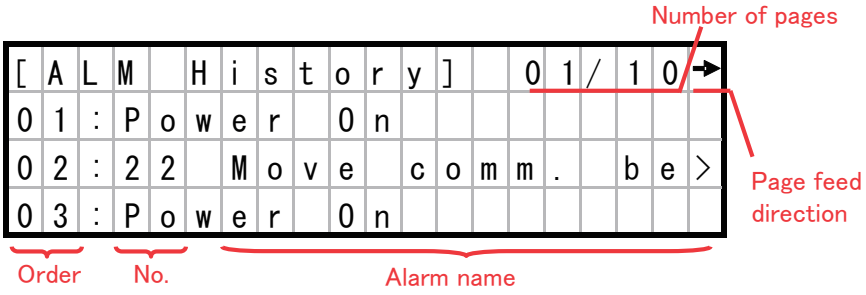
10-3 Alarm history

- The history of recent 50 alarms is displayed.
- The 50 events include Power ON.
- New alarm is assigned to a smaller number.
- The oldest one (50th alarm) is deleted when the 51st one is added.

10-3-1 Change page

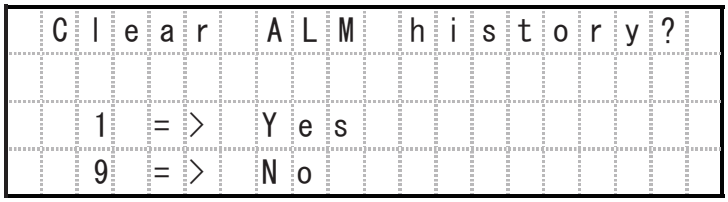
- 3 alarms are displayed in 1 page.
- You can change the page by increasing or decreasing pages one by one using the ◀ ▶ key. You cannot change the page by 10 pages if you press and hold the key.
- The page feeding symbol (← , →) appears only in the direction where the page exists.
- For more information on alarms, see **13-19 Alarm lists(→ P.2-79)**.

10. Alarm Mode



10-4 Clear history

- All the alarm history is cleared. You cannot delete individual records.
- After the confirmation screen appears, select Yes to clear the history. Select No to cancel the deletion.



11. Program data input

- For the data not described in this chapter, see **13. Appendix (→ P.2-61)**.
- Names in << >> of the following description are Japanese notation containing both Kana and Kanji, and are used for TSC and D-STEP.

11-1 ABS/INC

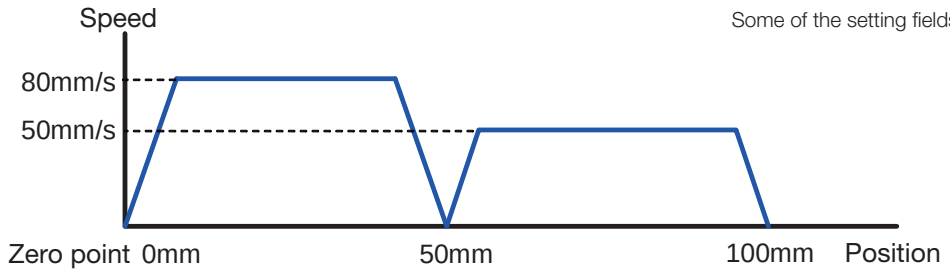
- When you set a "POSI" in positioning operation, operation method varies depending on the coordinate system.
- Select "ABS" for the operation mode 5.

11-1-1 ABS

- <<Absolute position>>
- The position in the absolute coordinate considering the position after zero return as the zero point.
- If you have configured the parameter No.6 (ORG offset) **{TSC: (→ P.2-64), TLC: (→ P.2-69), THC: (→ P.2-74)}** the offset position becomes the zero point.
- In the Teach mode, the absolute coordinate position is always entered.
- **Select "ABS" for the operation mode 5.**
  * If you select "INC," the alarm code No.25 (Position data anomaly) will be generated after completing zero return.

Step No.	ABS/INC	POSI[mm]	Speed[mm/s]	ACCEL[m/s^2]	DECEL[m/s^2]	Push[%]	Jump[Step No.]
0	ABS	50.00	80	3	3	0	1
1	ABS	100.00	50	3	3	0	E

Some of the setting fields are omitted.

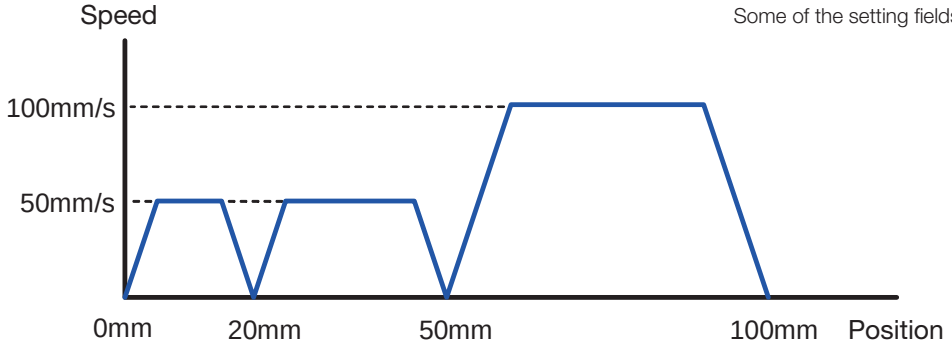


11-1-2 INC

- <<Relative position>>
- Relative position that considers the "position command" position at the time as a base point. The position where the movement has been completed after executing a program will be the next base point.
- **Select "ABS" for the operation mode 5.**
  * If you select "INC," the alarm code No.25 (Position data anomaly) will be generated after completing zero return.
- Entry is not allowed in the Teach mode (because the indicated value is always the absolute position).

Step No.	ABS/INC	POSI[mm]	Speed[mm/s]	ACCEL[m/s^2]	DECEL[m/s^2]	Push[%]	Jump[Step No.]
0	INC	20.00	50	3	3	0	1
1	INC	30.00	50	3	3	0	2
2	INC	50.00	100	3	3	0	E

Some of the setting fields are omitted.



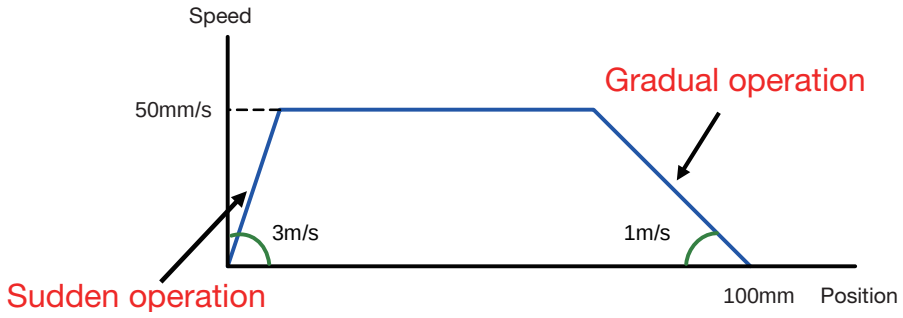
11. Program data input

11-2 ACCEL/DECEL

- <<ACC>>/<<DCC>>
- You can set acceleration and deceleration separately.
- The larger value results in sudden operation and the smaller value results in gradual operation.

Step No.	ABS/INC	POSI[mm]	Speed[mm/s]	ACCEL[m/s^2]	DECEL[m/s^2]	Push[%]	Jump[Step No.]
0	ABS	100.00	50	3	1	0	E

Some of the setting fields are omitted.



11-3 Standstill mode

- <<Stop mode>>
- You can select a stop mode to enter after reaching the target point.
- Selecting an appropriate mode reduces heat generation and power usage.
- You can check the current passing through the motor on the "Operation monitor" screen (see **7-4 Operation monitor(→ P.2-29)**.)
- You can change the output method of the signal for positioning completion, "INPS" output (pin.30), in the parameter No.37 (IN-POSI signal type) **{TSC: (→ P.2-67), TLC: (→ P.2-72), THC: (→ P.2-77)}**.
- You can set the initial value in the parameter No.25 (Default standstill mode) **{TSC: (→ P.2-66), TLC: (→ P.2-71), THC: (→ P.2-76)}**.

11-3-1 0: Invalid

- <<Invalid>>

<Driver controller TSC>

- The servo will be turned OFF immediately after reaching and the current set in the parameter No.11 (Cur. limit at stop) **{TSC: (→ P.2-65), TLC: (→ P.2-69), THC: (→ P.2-74)}** continues to flow.
- Although the actuator maintains the current position with the torque generated by this current, the position will not be re-adjusted in the event of misalignment since the servo is OFF.

<Driver controller TLC/THC>

- Selecting invalid makes the same result as that of "11-3-5 Full<<Full servo control>>."
- The servo continues to control the actuator.
- If position deviation is caused due to external force, a torque to correct it will be generated (the current will increase).

11. Program data input

11-3-2 1: Off time 0

- <<Auto servo OFF 1>>

<Driver controller TSC/TLC/THC>

- Once reached, the servo will be turned OFF after the elapse of the time set in the parameter No.17 (Auto servo OFF 1) **{TSC: (→ P.2-65), TLC: (→ P.2-70), THC: (→ P.2-75)}**.
- The present position cannot be retained because the current becomes 0 after the servo is turned OFF.
- If the position deviation caused by external force (difference between the position command and the current position) exceeds the parameter No.30 (Position deviation) **{TSC: (→ P.2-67), TLC: (→ P.2-71), THC: (→ P.2-76)}**, the alarm of the alarm code No.32 (Posi deviation error) **{TSC: (→ P.2-79), TLC: (→ P.2-80), THC: (→ P.2-81)}** will be generated.
  Note that the alarm will be generated only when the next move command is executed.
- If the position deviation is within the permissible position deviation, the operation can be continued by specifying and starting the next Step No.
  You also can continue to use the current Step No. to start an operation (returning to the "POSI" of this Step No.).

11-3-3 2: Off time 1

- <<Auto servo OFF 2>>

<Driver controller TSC/TLC/THC>

- Once reached, the servo will be turned OFF after the elapse of the time set in the parameter No.18 (Auto servo OFF 2) **{TSC: (→ P.2-65), TLC: (→ P.2-70), THC: (→ P.2-75)}**.
- Other operations are same as (1: Off time 0).

11-3-4 3: Off time 2

- <<Auto servo OFF 3>>

<Driver controller TSC/TLC/THC>

- Once reached, the servo will be turned OFF after the elapse of the time set in the parameter No.19 (Auto servo OFF 2) **{TSC: (→ P.2-66), TLC: (→ P.2-70), THC: (→ P.2-75)}**.
- Other operations are same as (1: Off time 0).

11-3-5 4: Full

- <<Full servo control>>

<Driver controller TSC/TLC/THC>

- The servo continues to control the actuator.
- If position deviation is caused due to external force, a torque to correct it will be generated (the current will increase).

<Driver controller TSC>

- Vibration or abnormal noise may occur depending on the status at stop.
  Do not use the controller if vibration or abnormal noise affects the performance.

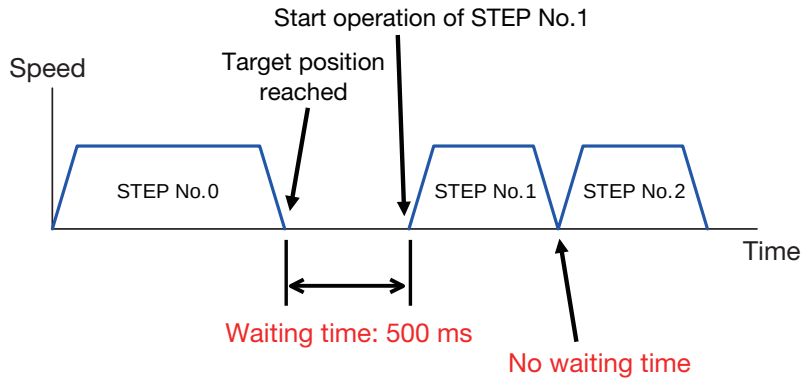
11. Program data input

11-4 Wait time

- <<Waiting time>>
- The waiting time between the completion of one STEP operation and the execution of the next program operation can be specified (provided that other than "E" is set for "Jump").
- This setting will be ignored for pressing operation because of possible additional move after the end of pressing.
  Pressing is continued with the specified "Push" until the next execution command is performed.

Step No.	ABS/INC	POSI[mm]	Speed [mm/s]	Wait time [ms]	Jump [Step No.]
0	ABS	60.00	50	500	1
1	ABS	90.00	50	0	2
2	ABS	120.00	50	0	E

Some of the setting fields are omitted.

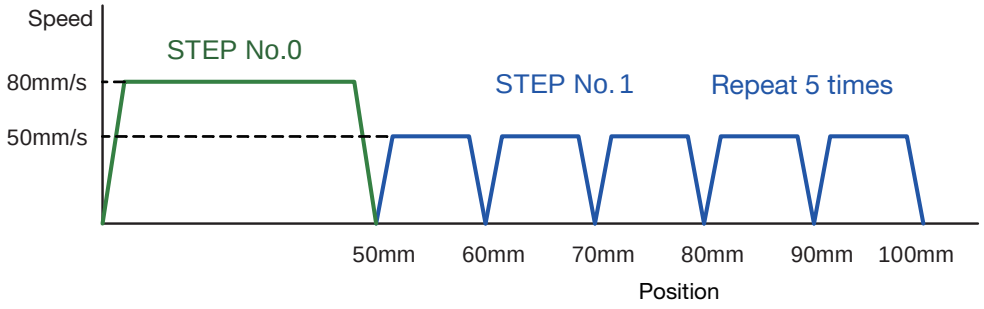


11-5 Repeat

- <<Repetition>>
- When setting INC<<Relative coordinate>>, you can configure the number of Repeat <<Repetition>> when you want to repeat the same operation.

Step No.	ABS/INC	POSI[mm]	Speed [mm/s]	Wait time [ms]	Repeat	JUMP [Step No.]
0	ABS	50.00	80	0	1	1
1	INC	10.00	50	0	5	E

Some of the setting fields are omitted.

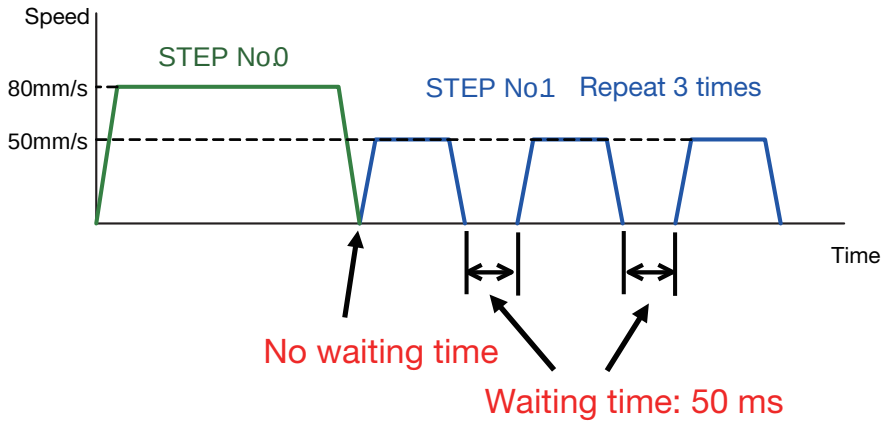


11. Program data input

- Since STEP operation is repeated in repeat operation, so the "Wait time" is also repeated.

Step No.	ABS/INC	POSI[mm]	Speed [mm/s]	Wait time [ms]	Repeat	JUMP [Step No.]
0	ABS	50.00	80	0	1	1
1	INC	10.00	50	50	3	E

Some of the setting fields are omitted.



11-6 JUMP

- <<JUMP (No.)>>
- Specify the number (STEP No.) to perform after the completion of an operation.
  If you want to finish the operation at the program, enter "E." To enter "E," enter **"999."**

12. Operations

⚠ WARNING

Obligatory

- **For vertical application, note that the moving part may fall if the torque is not sufficient.**
- **Note that the driver controller TSC moves back and forth in the opposite direction to the zero return over a distance by about half-lead right after turning the servo ON.**

12-1 Servo ON

- To operate the actuator, be sure to turn the servo ON.
  Turn the servo ON from the "ORG" or "manual operation"
- At this point, for the driver controller TSC, the actuator moves back and forth over a distance by about a half length of its lead to use in order to improve the accuracy of reading by the encoder. You cannot change the move direction, which is the reverse of zero return.
- For the actuator with a brake, the brake is released simultaneously with the servo ON.
  When using the actuator in a vertical direction, take extra care because a falling accident may be occurred if the torque is not sufficient.
- When you turn the servo OFF while the actuator is running, motor current will be interrupted and the actuator will stop. Leave it ON unless you need to turn it OFF. For more information on current limit during the actuator stop, see "**11-3 Standstill mode(→ P.2-43)**."

12-2 Execution of program

- This section explains the procedure before program execution. For more information, see each reference page.

12-2-1 Parameter settings

- Set parameters according to operation conditions.
  See "**9-3 Parameter settings(→ P.2-37)**" for setting procedures, and "**13-15 Overview of parameters(→P.2-64)**" for details of each parameter.

12-2-2 Program data settings

- Set the program data required for operations.
  See "**6-3 Edit mode(→ P.2-25)**" for setting procedures, and "**13-1 Program data list(→P.2-61)**" for details of each program data.

12-2-3 Execution of program data

① TEST MODE → 1 => Perform zero return from ORG
For more information, see "**8-3 Zero return(→P.2-32)**."
* If you execute a program without zero return, the alarm with the alarm code No.22 (Move comm. befor ORG) **{TSC: (→P.2-66), TLC:(→P.2-70), THC: (→P.2-75)}** occurs.

② TEST MODE → 3 => Specify and execute Step No. from PRG execute.
For more information, see "**8-5 Program execution(→P.2-35)**."

12. Operations

⚠ WARNING

Obligatory

- **To prevent unexpected accidents, make sure to have the driver controller power ready to be shut down at any time before executing a program.**
  Otherwise, you may get injured.

Prohibited

- **Do not touch the actuator while it is running.**
  Otherwise, you may get injured.

⚠ CAUTION

Obligatory

- **Configure and check appropriate driver parameters before operation.**
  Otherwise, unexpected operation may occur.

12-3 Manual operation

- TEST MODE → 2 => Perform manual operations from manual operation or the Teach mode.

12-3-1 Manual operation settings

- The moving speed with the TDO connected can be set by the parameter No.16 (Jog speed) **{TSC: (→ P.2-65), TLC:(→ P.2-702-75), THC: (→ P.2-78)}**.
- This speed is common to both "Jog" and "inching" operations.
- The inching movement distance with the TDO connected can be set by the parameter No.31 (inching distance) **{TSC: (→ P.2-67), TLC:(→ P.2-71), THC: (→ P.2-76)}**.

12-3-2 Manual operation

- Jog operation :The actuator operates at the set speed only while the JOG + JOG − key is kept pressed.
- Inching operation :Each2-48 time you press the JOG + JOG − key, the actuator will operate at the set speed (the same as jog speed) by the set travel distance.
- For +/- of the direction, refer to "**12-5 Positive/negative of the position and travel distance(→ P.2-54)**."
- You can check the current position from Monitor Mode → 2 = > operation monitor.
  For more information, see "**7-4 Operation monitor(→P.2-29)**."

12. Operations

12-4 Zero return operation

- The zero return type varies depending on the driver controller. See the corresponding table below.
- For THC, you can choose pressing zero return or sensor zero return in the parameter No.14 (Method of ORG) **(→ P.2-75)**.

Driver controller	Pressing zero point	Sensor zero point
TSC	○	×
TLC	○	×
THC	○	○

12-4-1 INC/ABS encoder

- TSC is an incremental encoder. If the control power of the driver controller is shut down, the present position of the actuator will be lost. Zero return operation is required each time.
- TLC/THC are absolute encoders. After performing zero return once, the present position is recognized by the battery provided with the driver controller even after the shutdown of the control power of the driver controller. You can also change the encoder type to incremental in the parameter No.47 (Encoder type) **(TLC: (→ P.2-71), THC: (→ P.2-77))**.

Driver controller	INC	ABS
TSC	○	×
TLC	○	○
THC	○	○

Important

- **Note that you may lose the present position and the zero point even when you are using an absolute encoder if:**
  - **① Battery power is dead**
  - **② Battery connector CN6 is removed and then inserted**
  - **③ Battery cable is disconnected**
  - **④ Encoder cable connector is removed and then inserted**
  - **⑤ Encoder cable is disconnected**
  - **⑥ Motor (encoder) has a fault**
  - **⑦ Driver controller board has a fault**

12-4-2 Pressing zero return

<Pressing zero return (without OT sensor)>

- Return to the zero point must be performed in the Teach mode or before program execution. For details of the operations, see "**8-3 Zero return(→P.2-32)**."

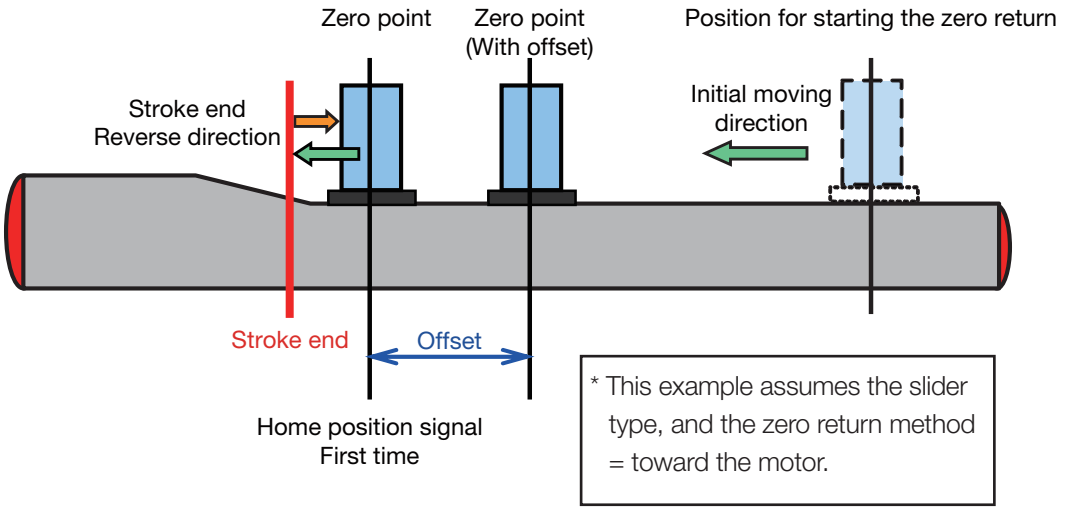
① The actuator (slider/cylinder) starts moving in the preset direction (toward the motor or the reverse of the motor).

* You cannot change the moving direction or speed.
* The current in moving can be set by the parameter No.12 (Cur. limit at origin) **{TSC: (→P.2-65), TLC: (→P.2-69), THC: (→P.2-74)}**.

② When the actuator reaches the stroke end, it turns around and starts moving in the opposite direction.

③ The position where the first zero point signal (included in the encoder/one output per rotation) is input after inversion will become the zero point.

④ When the parameter No.6 (ORG offset) **{TSC: (→P.2-64), TLC: (→P.2-69), THC: (→P.2-74)}** is set, the offset position as set by the parameter becomes the zero point.



12-4-3 Sensor zero return

<Zero point sensor only; a sensor dog is located between the zero point sensor and the reverse motor side OT sensor>

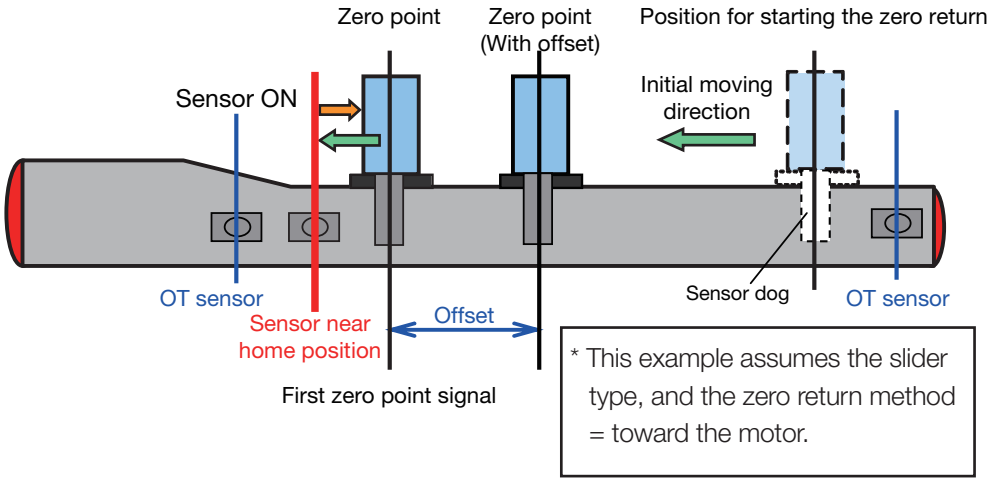
- Return to the zero point must be performed in the Teach mode or before program execution. For details of the operations, see "**8-3 Zero return(→P.2-32)**."

① The actuator (slider/cylinder) starts moving in the preset direction (toward the motor or the reverse of the motor).
* You cannot change the moving direction or speed.

② When the near zero point sensor of the actuator turns ON, the actuator turns around and starts moving in the reverse direction.
* Type of a near zero point sensor varies depending on each actuator.

③ The position where the first zero point signal (included in the encoder/one output per rotation) is input after the move direction was inverted and the near zero point sensor was turned OFF will become the zero point.

④ When the parameter No.6 (ORG offset) **{TSC: (→P.2-64), TLC: (→P.2-69), THC: (→P.2-74)}** is set, the offset position as set by the parameter becomes the zero point.



12. Operations

<Sensor dog is located between the zero point sensor and the motor side OT sensor, or on the motor side OT sensor>

- Return to the zero point must be performed in the Teach mode or before program execution. For details of the operations, see "**8-3 Zero return(→P.2-32)**."

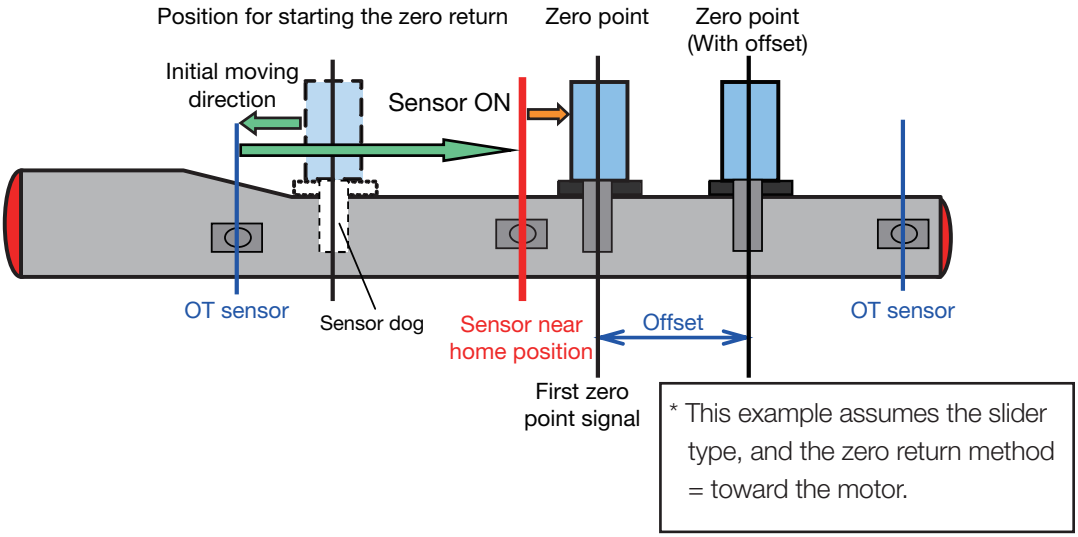
① The actuator (slider/cylinder) starts moving in the preset direction (toward the motor or the reverse of the motor).
* You cannot change the moving direction or speed.

② When the motor side OT sensor turns ON, the actuator turns around and starts moving in the reverse direction.
* Type of an OT sensor varies depending on each actuator.

③ When the near zero point sensor of the actuator turns ON, the actuator continues to move in the traveling direction.
* Type of a near zero point sensor varies depending on each actuator.

④ The position where the first zero point signal (included in the encoder/one output per rotation) is input after the near zero point sensor was turned OFF will become the zero point.

⑤ When the parameter No.6 (ORG offset) **{TSC: (→P.2-64), TLC: (→P.2-69), THC: (→P.2-74)}** is set, the offset position as set by the parameter becomes the zero point.



<Sensor dog is located on the reverse motor side OT sensor>

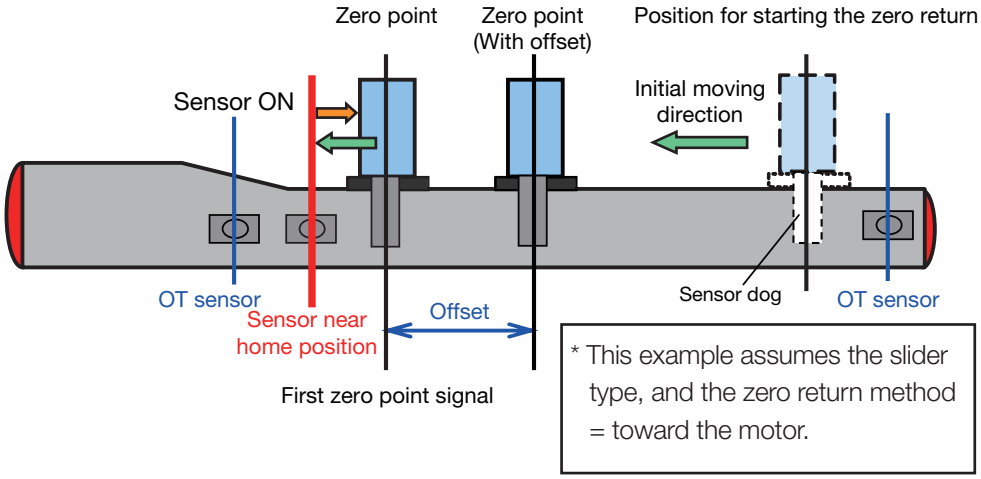
- Return to the zero point must be performed in the Teach mode or before program execution. For details of the operations, see "**8-3 Zero return(→P.2-32)**."

① The actuator (slider/cylinder) starts moving in the preset direction (toward the motor or the reverse of the motor).
* You cannot change the moving direction or speed.

② When the near zero point sensor of the actuator turns ON, the actuator turns around and starts moving in the reverse direction.
* Type of a near zero point sensor varies depending on each actuator.

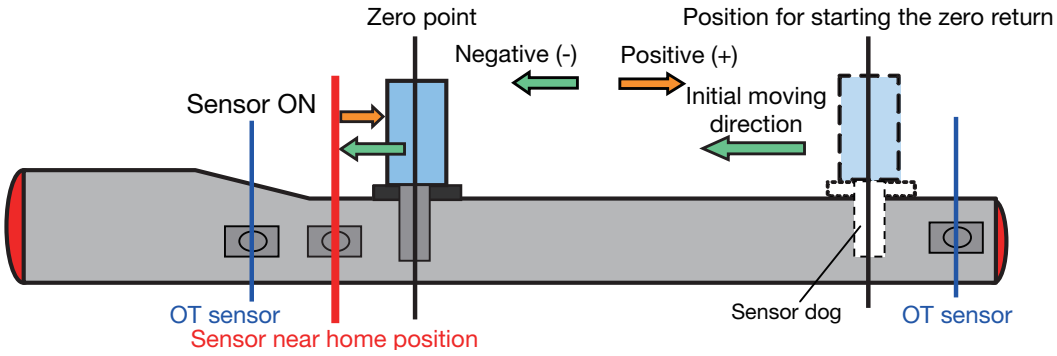
③ The position where the first zero point signal (included in the encoder/one output per rotation) is input after the move direction was inverted and the near zero point sensor was turned OFF will become the zero point.

④ When the parameter No.6 (ORG offset) **{TSC: (→P.2-64), TLC: (→P.2-69), THC: (→P.2-74)}** is set, the offset position as set by the parameter becomes the zero point.



12-5 Positive/negative of the position and travel distance

- For definition of positive and negative in configuring the position and travel distance, the direction after the actuator's inversion because of the zero point sensor ON or at the stroke end in performing zero return is considered as positive (+) direction.



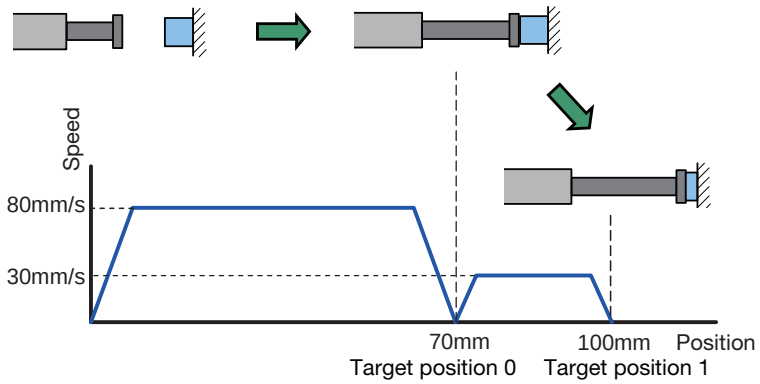
Note) If the zero return direction is reverse motor side, the positive (+) and negative (-) will be opposite of the figure above.

12-6 Positioning operation

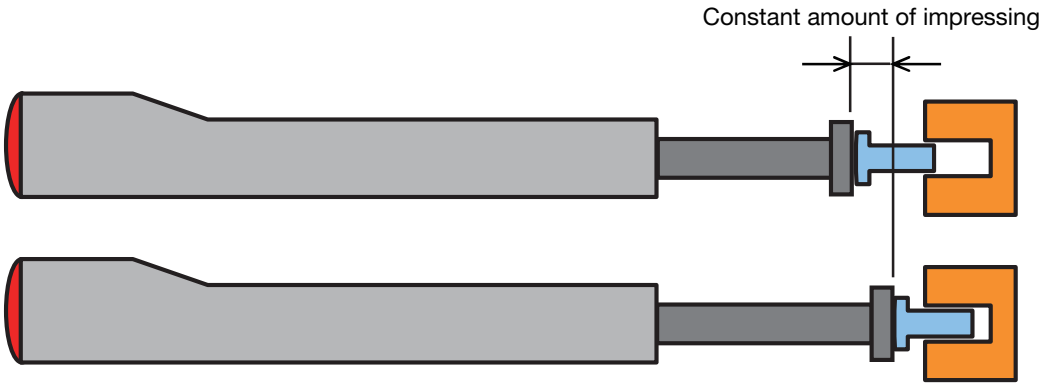
- You can perform this in all operation modes.
- When "Push" is "0," a positioning operation will be performed to move the actuator to the target

Step No.	ABS/INC	POSI [mm]	Speed [mm/s]	ACCEL [m/s^2]	DECEL [m/s^2]	JUMP [Step No.]
0	ABS	70.00	80	3	3	1
1	ABS	100.00	30	3	3	E

Some of the setting fields are omitted.

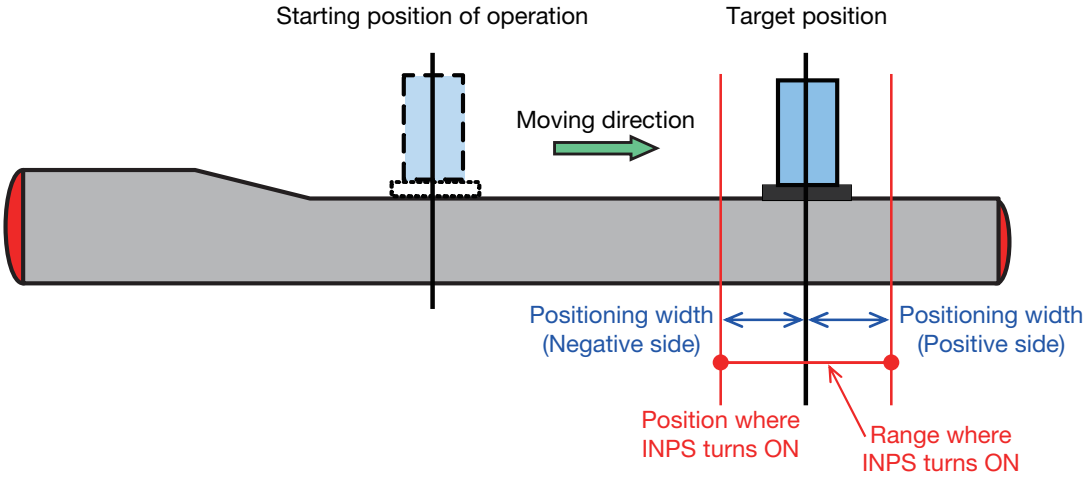


- If "Push" is "0," you can also use this as a constant amount of impressing operation.
  Note that this is just a position control (impressing end position control), which is different from the pressing operation with torque control.



12-6-1 Signal for positioning completion

- When the actuator reaches the position which is the target "POSI" minus "IN-POSI", the signal for positioning completion "INPS" output (pin.30) is turned ON (on the negative side of the target position.)
- Until the actuator travels the distance of the "IN-POSI" from the target "POSI", the signal for positioning completion "INPS" output (pin.30) remains ON (on the positive side of the target position.)
- The "INPS" output method can be changed by the parameter No.37 (IN-POSI signal type) **{TSC: (→ P.2-67), TLC: (→ P.2-72), THC: (→ P.2-77)}**.
- Operation mode 5 does not have "INPS" output.

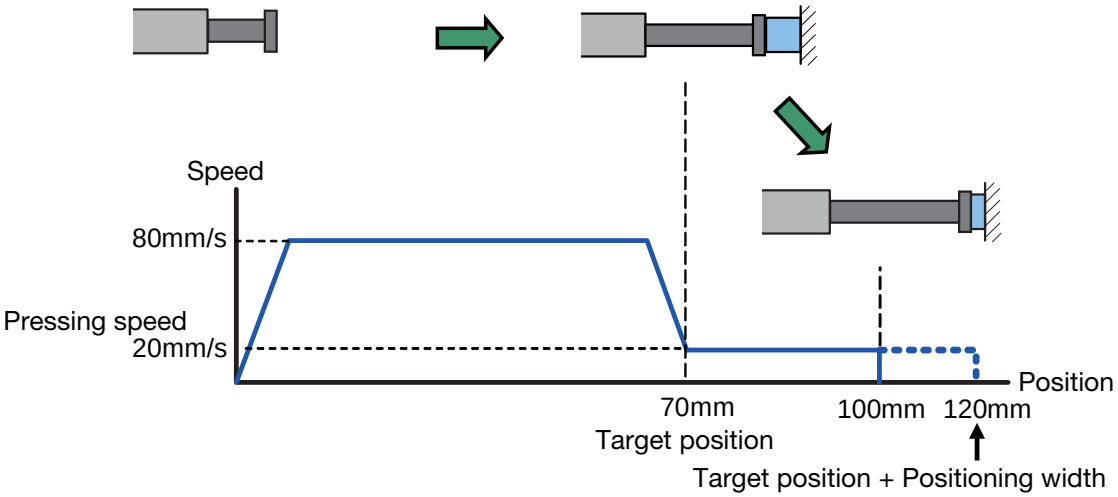


12-7 Pressing operation

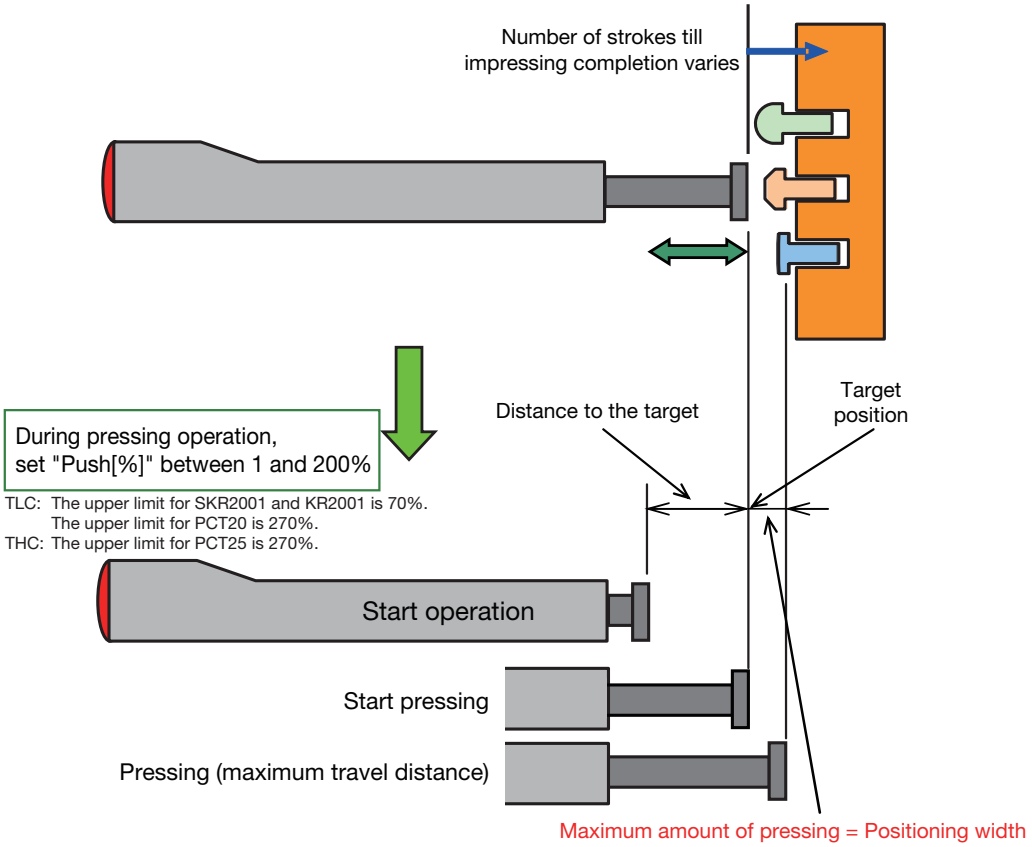
- You can perform this in the operation mode 0, 2, 3, and 4.
- When "Push" is other than "0," the pressing operation will be performed to press an object with thrust limit (current limit.)
- The "standstill mode" of the pressing operation is limited to "4:Full."

StepNo.	ABS/INC	POSI[mm]	Speed[mm/s]	Push[%]	IN-POSI[mm]	JUMP[StepNo.]
0	ABS	70.00	80	70	50.00	E

Some of the setting fields are omitted.



- Even when the amount of impressing is not constant, you can perform pressing by controlling the thrust force.



12. Operations

12-7-1 Pressing operation settings

- The value set to "Push" represents a percentage of a current limit.
  The larger set value results in the greater current flow and thus the larger pressing force.
- Set the pressing speed by the parameter No.15 (push speed) **{TSC: (→P.2-65), TLC: (→P.2-70), THC: (→ P.2-75)}**.

12-7-2 Sign of positioning range

- The "IN-POSI" sign depends on the positional relationship between the current position and target position.
  ① If the target position is located before the current position, the "IN-POSI" is "+" (the sign can be omitted.)
  Example) Current position: 50, Target position: 100, "IN-POSI" should be +30.
  ② If a target position is located after a current position, the "IN-POSI" should be "-" (the sign can be omitted).
  Example) Current position: 100, Target position: 50, "IN-POSI" should be -30.
- Specifying a wrong sign will cause the alarm code No.25 (Position error) **{TSC: (→ P.2-79), TLC: (→ P.2-80), THC: (→ P.2-81)}**.

12-7-3 Pressing operation determination

① Pressing complete
When the current set to "Push" continues during the time set by the parameter No.7 (push judgment time) **{TSC: (→P.2-65), TLC: (→P.2-69), THC: (→P.2-74)},** "pressing is completed" is determined and the signal for positioning completion "INPS" output (pin.30) is turned ON.

② Pressing failed (missed)
If pressing is not completed even after traveling the distance set by the "IN-POSI," the signal for positioning completion "INPS" output (pin.30) is not turned ON.
Because no alarm signal is output, you should consider the upper controller as Pressing failed if the "INPS" output is not turned ON and the "MOVE" output (pin.25) is turned OFF after the estimated time has elapsed.
*"MOVE" output (pin.25) is only available in the operation mode 1. In the mode 2, 3, and 4, only the time is determined.

③ Moved after pressing complete
In the case of moving to the pressing direction after pressing is completed, the actuator follows it within the range of the "IN-POSI." At this time, the signal for positioning completion "INPS" output (pin.30) is turned OFF, but it will turn ON again when the conditions for the determination are met again.

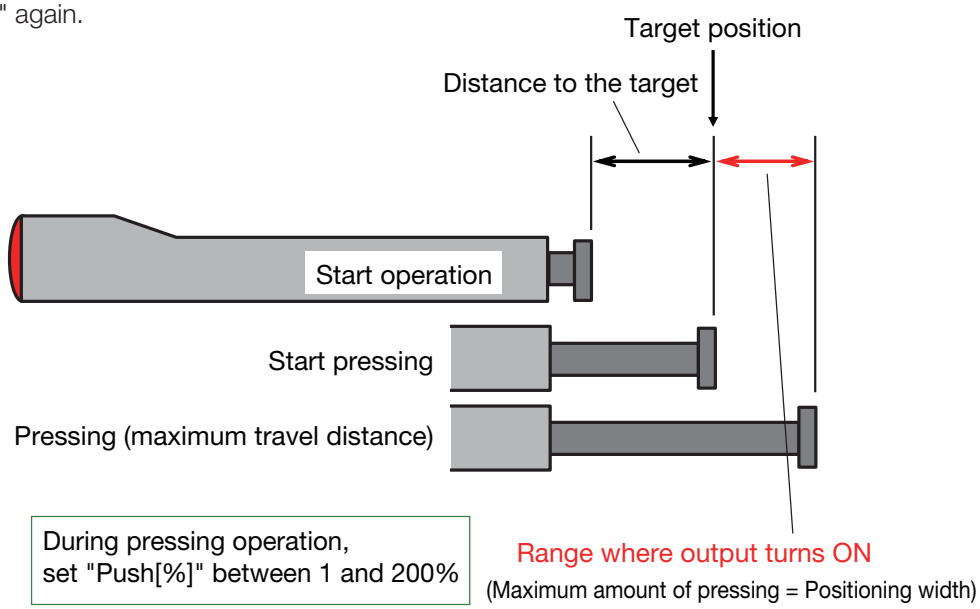
④ Pushed back because of large reactive force
If the work is pushed back by large reactive force after the pressing has completed, it will be pushed back until the pressing force and the reactive force balance out. At this time, the signal for positioning completion "INPS" output (pin.30) remains ON.
When it is forced back to the target position. the alarm code No.34 (Push range over) **{TSC: (→P.2-79), TLC: (→P.2-80), THC: (→P.2-81)}** will be generated.

12-8 Torque determining operation

- You can perform this in the operation mode 0, 2, 3, and 4.
- The current in "pressing operation" can be set as "Push", and the "threshold" can be set as a reference for a torque determination.
- This "threshold" can be set as the percentage (%) of an output current for "threshold" of program data.

12-8-1 If you do not configure the determination range

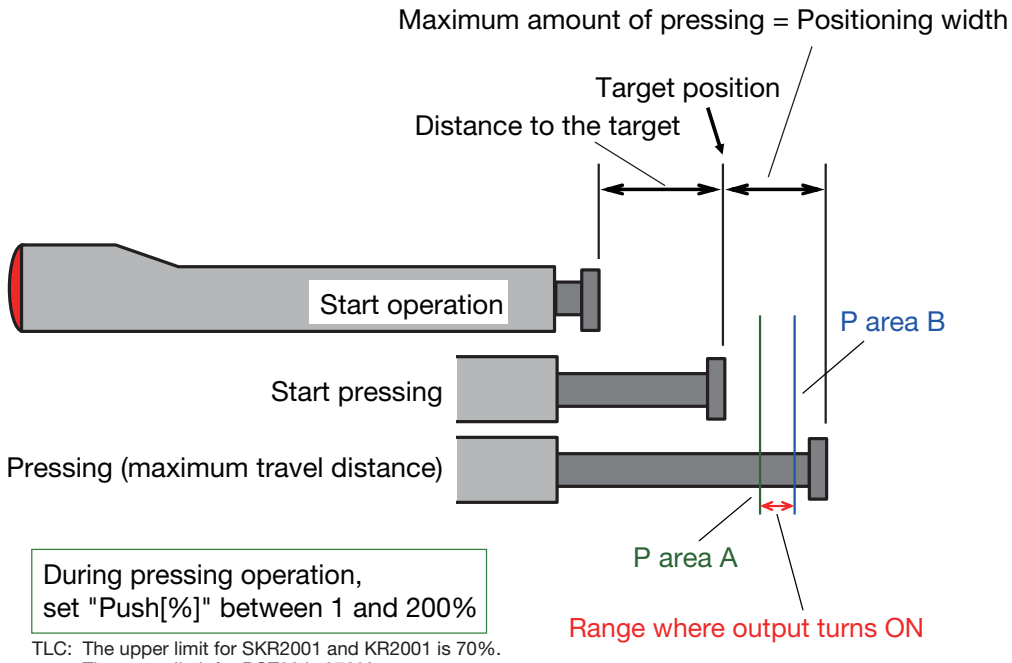
- When the parameter No.24 (Judgment range) **{TSC: (→ P.2-66), TLC: (→ P.2-71), THC: (→ P.2-76)}** is set to "Invalid", the range from the start position of the pressing operation (POSI) to the maximum amount of impressing (IN-POSI) becomes the determination range (the entire area of pressing operation).
- When the current greater than that configured in "Threshold" continues for the period set by the parameter No.23 (Judgment time) **{TSC: (→ P.2-66), TLC: (→ P.2-70), THC: (→ P.2-76)}**, the torque level signal "TRQS" output (pin.31) is turned ON.
- If the current falls below "Threshold" during the determination, the time that is below the previous continuous time is deducted, the accumulation will be started when the current reaches "Threshold" again.



TLC: The upper limit for SKR2001 and KR2001 is 70%.
The upper limit for PCT20 is 270%.
THC: The upper limit for PCT25 is 270%.

12-8-2 If you configure the determination range

- When the parameter No.24 (Judgment range) **{TSC: (→ P.2-66), TLC: (→ P.2-71), THC: (→ P.2-76)}** is set to "Valid", the range between "AreaA" to "AreaB" in the program data becomes the determination range.
- Enter the "AreaA" and "AreaB" by ABS<<Absolute coordinate system>>.
- Within the judgment range, when the current greater than that configured in "threshold" continues for the period set by the parameter No.23 (Judgment time) **{TSC: (→ P.2-66), TLC: (→ P.2-70), THC: (→ P.2-76)},** the load output signal "LOAD" output (pin.31) is turned ON.
- If the current falls below "Threshold" during the determination, the time that is below the previous continuous time is deducted, the accumulation will be started when the current reaches "Threshold" again.



During pressing operation,
set "Push[%]" between 1 and 200%

TLC: The upper limit for SKR2001 and KR2001 is 70%.
The upper limit for PCT20 is 270%.
THC: The upper limit for PCT25 is 270%.

12-9 Area determining operation

12-9-1 Area output "AREA"

- You can perform this in the operation mode 0, 4, and 5.
- When the actuator enters into the range set by the parameter No.1 (Max. area)**{TSC: (→P.2-64), TLC: (→P.2-69), THC: (→P.2-74)}** and No.2 (Min. area)**{TSC: (→P.2-64), TLC: (→P.2-69), THC: (→P.2-74)}**, the "AREA" output (pin.26) is turned ON.
- "AREA" output (pin.26) is also output during jog/inching operations.

12-9-2 P area output signal "P AREA"

- You can perform this in the operation mode 0, 1, 2, 4, and 5.
- While the actuator is executing "program", when it enters into the range between "AreaA"and "AreaB" set by each STEP No., "P AREA" output (pin.27) is turned ON.

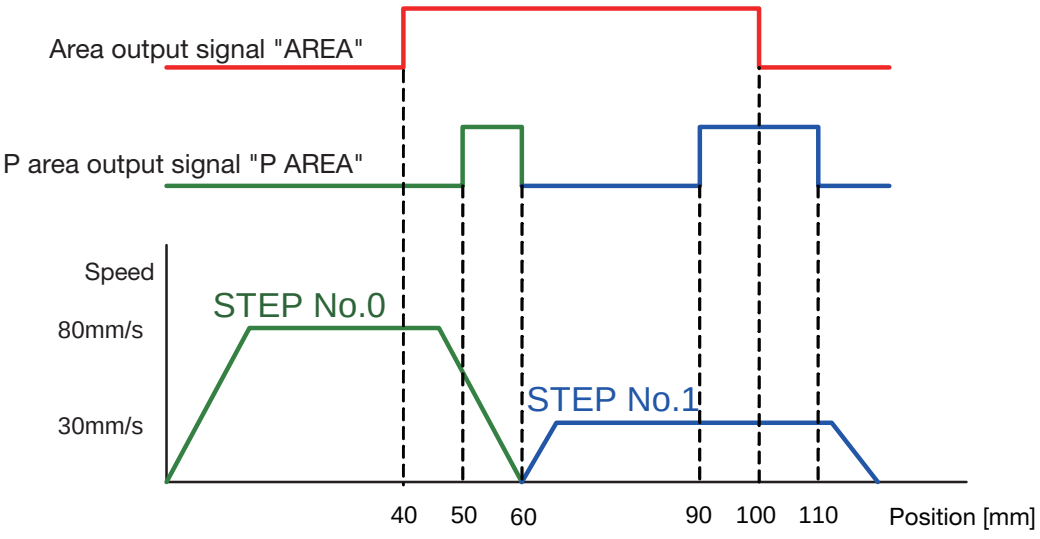
12-9-3 Difference of output signals

- "AREA" output (pin.26) is commonly determined for all the Step No.
- "P AREA" output (pin.27) is determined only at the time of an execution of the "STEP No." that it is set to.

No.	Parameter name	Set value
1	Max. area	100.00
2	Min. area	40.00

STEP No.	ABS/INC	POSI (mm)	Speed (mm/s)	P area A (mm)	P area B (mm)	JUMP (No.)
0	ABS	60.00	80	50.00	70.00	1
1	ABS	120.00	30	90.00	110.00	E

Some of the setting fields are omitted.



13. Appendix

13-1 Program data list

Display item	Range of values to display	Display unit	Teachable items
ABS/INC	0: INC, 1: ABS		
POSI *1	-9999.999 to 9999.999	mm	○
Speed *2	1 to **	mm/s	
ACCEL	0.1 to 9.9	m/s^2	
DECEL	0.1 to 9.9	m/s^2	
Push *3	0 to**	%	
Threshold *3	0 to **	%	
IN-POSI	0.00 to 999.99	mm	
AreaA	-9999.99 to 9999.99	mm	○
AreaB	-9999.99 to 9999.99	mm	○
ACCEL/DECEL mode	0 to 1		
Standstill mode	0 to 4		
Wait time	0 to 10000	ms	
Repeat	1 to 99		
JUMP	0 to 511 and E (999)		

*1. In the "POSI", two decimal places can be entered for TSC, three decimal places can be entered for TLC or THC.
*2. "Speed" is 1000 for TSC or TLC, or up to 3000 for THC.
*3. The upper limits for "Push" and "Threshold" depend on each actuator to be connected.

- For some data, the details are described in "**11. Program data input (→ P.2-42)**." See this section, too.
- Below is the detailed description of each item. The names<< >>which are described in Japanese containing both Kana and Kanji are used in the instruction manuals and PC screens for TSC, TLC, THC and D-STEP.
- Note that if an invalid item is set in the operation mode, it will not be reflected on operations.
  Example) "Push" or "Threshold" by the operation mode 1

13-2 ABS/INC

- <<ABS/INC>>
- Select the destination position from ABS<<Absolute coordinate>> or INC<<Relative coordinate>>.
  For more information, see "**11-1 ABS/INC(→P.2-42)**."
- For ABS<<Absolute coordinate>>, set the target position considering the point returned to zero point as the zero point.
- For INC<<Relative coordinate>>, set the travel distance considering the "Position comm." position as the zero point.
- Select "ABS<<Absolute>>" for the operation mode 5.

13-3 POSI

- <<Position>>
- Note that the operation depends on "ABS<<Absolute>>/INC<<Relative>>."
  For more information, see "**11-1 ABS/INC(→P.2-42)**."
- For ABS<<Absolute coordinate>>, set the destination position.
- For INC<<Relative coordinate>>, set the travel distance from the "Position comm." position.
- You can enter an input value to two decimal places for TSC and to three decimal places for TLC/THC.

13. Appendix

13-4 Speed

- <<Speed>>
- Set the moving speed.
- If any value other than 100% is set for the parameter No.20 (Speed override) **{TSC: (→ P.2-66), TLC: (→ P.2-70), THC: (→ P.2-75)}**, the speed decreases accordingly.
- You cannot enter any value with decimal places.

13-5 ACCEL/DECEL

- <<Acceleration>>, <<Deceleration>>
- Set ACCEL<<Acceleration>>/DECEL<<Deceleration>> separately.
  For more information, see "**11-2 ACCEL/DECEL(→P.2-43)**."
- The larger value results in sudden operation and the smaller value results in gradual operation.
- You can enter a value to one decimal place.

13-6 Push

- <<Pressing>>
- Set the current limit for pressing operation.
  For more information, see "**12-7 Pressing operation(→P.2-56)**."
- The larger value results in the larger pressing force.
- When the set value is "0," positioning operation will be performed without pressing operation.

13-7 Threshold

- <<Threshold>>
- Set the threshold current value for outputting load output determination signal or torque level signal.
  For more information, see "**12-8 Torque determining operation(→P.2-58)**."

13-8 IN-POSI

- <<Positioning width>>
- In case of the positioning operation, the signal for arrival completion "INPS" (pin.30) is output when the current value is within the range between the positioning width and the target position (except the operation mode 5).
  For more information, see "**12-6-1 Signal for positioning completion(→P.2-55)**."
- For pressing operation, this value is configured as the impressing range from the target point.
  For more information, see "**12-7 Pressing operation(→P.2-56)**."
- You can enter a value to two decimal places.

13. Appendix

13-9 AreaA, AreaB

- <<P area A>>, <<P area B>>
- For positioning operation, set the range where "P AREA" output (pin.27) is turned ON by "AreaA" and "AreaB."
- "P AREA" output signal is only valid in the operation modes 0, 1, 2, 4 and 5.
  For more information, see "**12-9-2 P area output signal "P AREA"(→P.2-60)**."
- For pressing operation, set the judgment range of the threshold with "AreaA" and "AreaB" if the parameter No.24 (Judgment range) **{TSC: (→P.2-66), TLC: (→P.2-71), THC: (→P.2-76)}** is "Valid."
- Pressing operation can be performed in the operation mode 0, 2, 3 and 4.
  For more information, see "**12-8-2 If you configure the determination range(→P.2-59)**."
- You can enter a value to two decimal places.

13-10 ACCEL/DECEL mode

- <<Acceleration/deceleration mode>>
- Select operation pattern of acceleration and deceleration rate. 0: Trapezoid, 1: S-shape motion
  * For TSC, only 0: Trapezoid can be selected.
  * S-shape motion: acceleration and deceleration rate configured for STEP No. become the maximum travel speed for sine wave.
  You can compute acceleration/deceleration time using the formula shown below. Configure appropriate value for S-shape by adjusting the acceleration and deceleration rate. * Configure a value that does not exceed the maximum acceleration of the actuator.

$$t = \frac{\pi}{2} \times \frac{v}{\alpha}$$

t : Acceleration/deceleration time [s]
v : Velocity [m/s]
α : Acceleration and deceleration rate [m/s^2]

13-11 Standstill mode

- <<Stop mode>>
- Select a stop mode (power-saving method) to enter after reaching the target point.
  0: Invalid, 1: Off time 0, 2: Off time 1, 3: Off time 2, 4: Full
- For more information, see "**11-3 Standstill mode(→ P.2-43)**."

13-12 Wait time

- <<Waiting time>>
- Configure the waiting time after the end of an operation. Execute the next operation (Step No.) after the waiting time elapsed.
- For details, see "**11-4 Wait time (→ P.2-45)**."

13-13 Repeat

- <<Repetition>>
- Configure the number of times to repeat an operation. However, this is valid only when the relative coordinate is selected.
- For details, see "**11-5 Repeat (→ P.2-45)**."

13. Appendix

13-14 JUMP

- <<JUMP (No.)>>
- Specify the number (STEP No.) to perform after the completion of an operation.
- If you want to finish the operation at the program, enter "E." To enter "E," enter "999."

13-15 Overview of parameters

- You can configure and save following items as the parameters.
  ① Basic operations/constants of the driver controller/actuator
  ② Initial values entered into "program table."
  The items indicated with * mark in the following list (No.8,9,10,25,39) are not relevant to TDO operations. Only when a value is entered for D-STEP.
  ③ Constants related to servo operations
- Depending on the operation modes, some parameters do not function. (For details, see the instruction manual of the driver controller.)
  Example) "No.1 Max. area" and "No.2 Min. area" of the operation mode 1← Due to the lack of area output
- There are some missing numbers or non-disclosed parameters due to circumstances.
- The names of the parameter name field ( ) in the following list which are described in Japanese containing both Kana and Kanji are used in the description and PC screens for TSC, TLC, THC and D-STEP.

13-16 TSC parameters

13-16-1 TSC parameter: Actuator information

No.	Parameter name	Unit	Setting range	Default value
1	Max. area (Max. area)	mm	-9999.99 to 9999.99	9999.99
	Description: Sets the + side (MAX side) of the area where the AREA signal (pin.26) turns ON.			
2	Min. area (Min. area)	mm	-9999.99 to 9999.99	-9999.99
	Description: Sets the - side (MIN side) of the area where the AREA signal (pin.26) turns ON.			
3	Soft limit + (Soft limit + side)	mm	0.00 to 9999.99	9999.99
	Description: Sets the + side (MAX side) of the actuator-movable area.			
4	Soft limit - (Soft limit - side)	mm	-9999.99 to 0.00	-9999.99
	Description: Sets the - side (MIN side) of the actuator-movable area.			
6	ORG offset (Zero-point offset)	mm	-9999.99 to 9999.99	0.00
	Description: Enables the zero point of absolute coordinate system to be set in an arbitrary position.			

Note: The parameter with "*" attached in "No." are not active in TDO. It can be active when D-STEP is used.

13-16-2 TSC parameter: Actuator operation settings

No.	Parameter name	Unit	Setting range	Default value
7	Push judgment time (Push judgment time)	ms	1 to 99999	100
	Description: Sets the time from when the actuator hits a work in the pressing operation until when the operation is judged to be completed.			
8*	Default speed (Default speed)	mm/s	1 to 1000	100
	Description: Inputs the default value of "Speed" entered when double-clicking an arbitrary row of the "program table" in D-STEP.			
9*	Default ACCEL/DECEL (Default acceleration/deceleration)	m/s^2	1 to 100	3
	Description: Inputs the default values of "ACC" and "DCC" entered when double-clicking an arbitrary row of the "program table" in D-STEP.			
10*	IN-POSI range (Initial value of positioning completion width)	mm	0.00 to 999.99	0.02
	Description: Inputs the default value of "Pos Range" entered when double-clicking an arbitrary row of the "program table" in D-STEP.			
11	Cur. limit at stop (Current limit on stop status)	%	1 to 70	70
	Description: Sets the current applied to the motor when the actuator is in stop status. Increasing the value increases the stoppage holding torque (settable to the linear), but also increases the heat generation and the electric power usage. The current value tailored to the standard specification of the actuator is set before shipment.			
12	Cur. limit at origin (Current limit on zero return)	%	1 to 100	80
	Description: Sets the current applied to the motor when the actuator returns to zero point. Increasing the value increases the zero return torque (settable to the linear), but also increases the heat generation and the electric power usage. The current value tailored to the standard specification of the actuator is set before shipment.			
13	Move command type (Move command method)	[Select]	Level / Edge	Level
	Description: Selects the method of inputting move command (ST 0 to 6) (pin. 3 to 9) for operation mode 4. Level: The movement is started when turning the input signal ON and is stopped when turning it OFF on the way. Edge: The movement is started at the rising edge of the input signal and is not stopped even when turning it OFF on the way.			
15	Push speed (Pressing speed)	mm/s	1 to 20	10
	Description: Defines the pressing speed after reaching the target position during pressing operation. A default value tailored to the actuator characteristics is set before shipment.			
*16	Jog speed (Jog speed)	mm/s	1 to 250	10
	Description: Sets the jog speed for use with the TDO. For the speed setting by I/O input, see No. 21.			
17	Auto servo OFF 1 (Auto servo OFF time 1)	s	0 to 9999	9999
	Description: Sets the time after completing the positioning until the servo turns OFF when "Standstill mode" of the program data is "1". **11-3-2 1: Off time 0 (→ P.2-44) should be referenced.**			
18	Auto servo OFF 2 (Auto servo OFF time 2)	s	0 to 9999	9999
	Description: Sets the time after completing the positioning until the servo turns OFF when "Standstill mode" of the program data is "2". **11-3-3 2: Off time 1 (→ P.2-44)** should be referenced.			

Note: The parameter with "*" attached in "No." are not active in TDO. It can be active when D-STEP is used.
Note: The parameter with "*" attached in "No." can be changed while keeping the servo ON.
Note: [Select] in the "Unit" field is selected from the items displayed in "Setting range."

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No.	Parameter name	Unit	Setting range	Default value
19	Auto servo OFF 3 (Auto servo OFF time 3)	s	0 to 9999	9999
	Description: Sets the time after completing the positioning until the servo turns OFF when "Standstill mode" of the program data is "3". **11-3-4 3: Off time 2 (→ P.2-44)** should be referenced.			
*20	Speed override (Speed override)	%	1 to 100	100
	Description: For protection against the danger in trial operation, this is used when you want to operate the actuator at a low speed. In the operation, it is possible to multiply the movement speed in the "Speed" field of the program data by the ratio of the value set here.			
*21	I/O jog speed (External input jog speed)	mm/s	1 to 250	10
	Description: Sets the speed in jog operation when external input teaching by I/O (Operation mode 1) is selected. For the speed setting by TDO, see No. 16.			
*22	I/O inching distance (External input inching distance)	mm	1 to 5000	10
	Description: Sets the movement distance by inching operation when external input teaching by I/O (Operation mode 1) is selected. For the speed setting by TDO, see No. 31.			
23	Judgment time (Threshold judgment time)	ms	1 to 9999	10
	Description: When performing the torque determination in pressing operation, this sets the time after reaching the "Threshold" until the condition is judged to be met.			
24	Judgment range (Threshold judgment range)	[Select]	Invalid / Valid	Invalid
	Description: When performing the torque determination in pressing operation, Valid: Sets the judgment range. Invalid: Does not set the judgment range.			
25*	Standstill mode (Default standstill mode)	[Select]	Invalid / Off time 0 to 2 / Full	Invalid
	Description: Sets the default value of "Standstill mode" after reaching the target position of each STEP. Selecting an appropriate mode reduces heat generation and power usage. Invalid :The servo turns OFF but No. 11 current continues to flow. Off time 0:After the elapse of the time in No. 17, the servo turns OFF and the flowing current becomes 0. Off time 1:After the elapse of the time in No. 18, the servo turns OFF and the flowing current becomes 0. Off time 2:After the elapse of the time in No. 19, the servo turns OFF and the flowing current becomes 0. Full:The servo is always turned ON even when in stop status. (The current increases or decreases depending on the external force) See **11-3 Standstill mode(→ P.2-43)**.			
26	Ball screw lead (Ball screw lead length)	mm	0.0 to 99.9	Depends on models
	Description: Sets the length of ball screw lead. A value tailored to the actuator is set before shipment.			
28	Cur. select at miss (Selection of current in in-vain stop status)	[Select]	Current at stop / Current at push	Current at stop
	Description: Sets the current limit after the pressing operation being in vain. Current at stop: Current set in No.11 Current at push: Current set in "Push"			

Note: The parameter with "*" attached in "No." are not active in TDO. It can be active when D-STEP is used.

Note: The parameter with "*" attached in "No." can be changed while keeping the servo ON.

Note: [Select] in the "Unit" field is selected from the items displayed in "Setting range."

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No.	Parameter name	Unit	Setting range	Default value
29	Max. speed (Maximum speed)	mm/s	1 to 1000	Depends on models
	Description	Sets the maximum speed settable in the "Speed" field of the program data.		
30	Position deviation (Allowable position deviation)	mm	0.00 to 999.99	Depends on models
	Description	Set the value to output the alarm code No.32 (Posi deviation error) **(→ P.2-79)**.		
*31	Inching distance (Inching distance)	mm	0.1 to 200.0	10.0
	Description	D-STEP: Sets the inching distance on the PROGRAM screen. For the distance setting by I/O input, see No. 22.		

Note: The parameter with "*" attached in "No." are not active in TDO. It can be active when D-STEP is used.
Note: The parameter with "*" attached in "No." can be changed while keeping the servo ON.
Note: [Select] in the "Unit" field is selected from the items displayed in "Setting range."

13-16-3 TSC parameter: External interface

No.	Parameter name	Unit	Setting range	Default value
33	Pause input (Selection of invalid for pause input)	[Select]	Invalid / Valid	Valid
	Description	The "PAUSE" input of the driver controller is configured to be N.C. contact from the viewpoint of fail safe. Therefore, this should be turned ON (shorted to 0V) during the operation. However, if it is not used, setting "Invalid" does not require the contact to turn ON. Valid: "PAUSE" input (pin. 16) will be valid. Invalid: "PAUSE" input (pin. 16) will be invalid.		
*34	Communication speed (Communication speed)	[Select]	38400/57600/115200	115200
	Description	Sets the speed for communication between PC and TDO via RS-485. The change will be valid by turning on the power again.		
35	Servo ON input (Selection of servo ON input method)	[Select]	External input / Always ON	External input
	Description	Selects the method to turn the servo ON. External input: Turning on the "SV-ON" (pin. 18) input turns the servo ON. Always ON: Turning on the power turns the servo ON.		
36	Function mode (Operation mode selection)	[Select]	Type 0 to 5	Type 0
	Description	Selects the driver controller operation mode.		
37	IN-POSI signal type (Positioning completion signal output method)	[Select]	PEND/INP	INP
	Description	Selects the output method for positioning completion signal "INPS" (pin. 30). When the servo is OFF, this is unconditionally turned OFF regardless of the current position. PEND: Servo ON → Once "INPS" is turned ON, this remains in ON status even when the position is out of "IN-POSI." INP: Servo On → Turns ON only when the position is within "Pos Range."		
38	Inhibit MANU input (MANU input prohibition)	[Select]	Invalid / Valid	Invalid
	Description	Selects the operation when the driver controller is in AUTO mode and the "MANU" (pin. 14) input turns ON. Invalid: The driver controller will be in MANUAL mode. Valid: The driver controller remains in AUTO mode.		

Note: The parameter with "*" attached in "No." field are not active in TDO. It can be active when D-STEP is used.
Note: The parameter with "*" attached in "No." can be changed while keeping the servo ON.
Note: [Select] in the "Unit" field is selected from the items displayed in "Setting range."
Note: [- -] in the "Unit" field is any character input specified in "Setting range."

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No.	Parameter name		Unit	Setting range	Default value
*39	Comment (Comment on axis)		--	16 one-byte alphanumeric characters	----------
	Description	Enter any comment on the axis displayed on the Connect Start and PROGRAM screens in the D-TSEP.			
48	Enable function (TDO enable function)		[Select]	Invalid / Valid	Valid
	Description	When TDO is connected to the driver controller, this selects the TDO enable switch operation. Valid: The enable switch will be valid. (Turning it OFF stops the operation) Invalid: The enable switch will be invalid. (Even when turning it OFF, the operation does not stop)			

Note: The parameter with "*" attached in "No." field are not active in TDO. It can be active when D-STEP is used.

Note: The parameter with "*" attached in "No." can be changed while keeping the servo ON.

Note: [Select] in the "Unit" field is selected from the items displayed in "Setting range."

Note: [- -] in the "Unit" field is any character input specified in "Setting range."

13-16-4 TSC parameter: Servo gain

No.	Parameter name		Unit	Setting range	Default value
*40	Position gain (Position gain)		1/s	1 to 100	Depends on models
	Description	This is a parameter to determine the responsiveness of position control loop. Increasing the setting value improves the follow-up performance to the position command but is likely to cause the overshoot.			
*41	Speed loop P gain (Speed loop proportional gain)		Hz	1 to 65536	Depends on models
	Description	This is a parameter to determine the responsiveness of speed control loop. As the load inertia increases, the setting value should be increased. Increasing the value improves the follow-up performance to the speed command (the servo rigidity is enhanced), but is likely to cause the overshoot and oscillation, resulting in mechanical vibration.			
*42	Speed loop I gain (Speed loop integral gain)		0.01ms	1 to 65536	Depends on models
	Description	This is a parameter to determine the responsiveness of speed control loop. Increasing the value reduces the responsiveness to the speed command and the repulsion force against the load change. Decreasing the value increases the responsiveness and repulsion force, but excessive decreasing is likely to cause the overshoot and oscillation, resulting in mechanical vibration.			

Note: The parameter with "*" attached in "No." can be changed while keeping the servo ON.

13-17 TLC parameters

13-17-1 TLC parameter: Actuator information

No.	Parameter name	Unit	Setting range	Default value
1	Max. area (Max. area)	mm	-9999.99 to 9999.99	9999.99
	Description: Sets the + side (MAX side) of the area where the AREA signal (pin.26) turns ON.			
2	Min. area (Min. area)	mm	-9999.99 to 9999.99	-9999.99
	Description: Sets the - side (MIN side) of the area where the AREA signal (pin.26) turns ON.			
3	Soft limit + (Soft limit + side)	mm	0.00 to 9999.99	9999.99
	Description: Sets the + side (MAX side) of the actuator-movable area.			
4	Soft limit - (Soft limit - side)	mm	-9999.99 to 0.00	-9999.99
	Description: Sets the - side (MIN side) of the actuator-movable area.			
6	ORG offset (Zero-point offset)	mm	-9999.99 to 9999.99	0.00
	Description: Enables the zero point of absolute coordinate system to be set in an arbitrary position.			

Note: The parameter with "*" attached in "No." are not active in TDO. It can be active when D-STEP is used.

13-17-2 TLC parameter: Actuator operation settings

No.	Parameter name	Unit	Setting range	Default value
7	Push judgment time (Push judgment time)	ms	1 to 99999	100
	Description: Sets the time from when the actuator hits a work in the pressing operation until when the operation is judged to be completed.			
8*	Default speed (Default speed)	mm/s	1 to 9999	100
	Description: Inputs the default value of "Speed" entered when double-clicking an arbitrary row of the "program table" in D-STEP.			
9*	Default ACCEL/DECEL (Default acceleration/deceleration)	m/s^2	1.0 to 99.9	Depends on models
	Description: Inputs the default values of "ACC" and "DCC" entered when double-clicking an arbitrary row of the "program table" in D-STEP.			
10*	IN-POSI range (Initial value of positioning completion width)	mm	0.01 to 999.99	Depends on models
	Description: Inputs the default value of "Pos Range" entered when double-clicking an arbitrary row of the "program table" in D-STEP.			
11	Cur. limit at stop (Current limit on stop status)	%	1 to 70	70
	Description: Sets the current applied to the motor when the actuator is in stop status. Increasing the value increases the stoppage holding torque (settable to the linear), but also increases the heat generation and the electric power usage. The current value tailored to the standard specification of the actuator is set before shipment.			
12	Cur. limit at origin (Current limit on zero return)	%	1 to Depends on models	Depends on models
	Description: Sets the current applied to the motor when the actuator returns to zero point. Increasing the value increases the zero return torque (settable to the linear), but also increases the heat generation and the electric power usage. The current value tailored to the standard specification of the actuator is set before shipment.			

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No	Parameter name	Unit	Setting range	Default value
13	Move command type (Move command method)	[Select]	Level / Edge	Level
	Description: Selects the method of inputting move command (ST 0 to 6) (pin. 3 to 9) for operation mode 4. Level: The movement is started when turning the input signal ON and is stopped when turning it OFF on the way. Edge: The movement is started at the rising edge of the input signal and is not stopped even when turning it OFF on the way.			
15	Push speed (Pressing speed)	mm/s	1 to 20	10
	Description: Defines the pressing speed after reaching the target position during pressing operation. A default value tailored to the actuator characteristics is set before shipment.			
*16	Jog speed (Jog speed)	mm/s	1 to 250	10
	Description: Sets the jog speed for use with the TDO. For the speed setting by I/O input, see No. 21.			
17	Auto servo OFF 1 (Auto servo OFF time 1)	s	0 to 9999	9999
	Description: Sets the time after completing the positioning until the servo turns OFF when "Standstill mode" of the program data is "1". **11-3-2 1: Off time 0 (→ P.2-44)** should be referenced.			
18	Auto servo OFF 2 (Auto servo OFF time 2)	s	0 to 9999	9999
	Description: Sets the time after completing the positioning until the servo turns OFF when "Standstill mode" of the program data is "2". **11-3-3 2: Off time 1 (→ P.2-44)** should be referenced.			
19	Auto servo OFF 3 (Auto servo OFF time 3)	s	0 to 9999	9999
	Description: Sets the time after completing the positioning until the servo turns OFF when "Standstill mode" of the program data is "3". **11-3-4 3: Off time 2 (→ P.2-44)** should be referenced.			
*20	Speed override (Speed override)	%	1 to 100	100
	Description: For protection against the danger in trial operation, this is used when you want to operate the actuator at a low speed. In the operation, it is possible to multiply the movement speed in the "Speed" field of the program data by the ratio of the value set here.			
*21	I/O jog speed (External input jog speed)	mm/s	1 to 250	10
	Description: Sets the speed in jog operation when external input teaching by I/O (Operation mode 1) is selected. For the speed setting by TDO, see No. 16.			
*22	I/O inching distance (External input inching distance)	mm	0.000 to 5000.000	1.000
	Description: Sets the movement distance by inching operation when external input teaching by I/O (Operation mode 1) is selected. For the speed setting by TDO, see No. 31.			
23	Judgment time (Threshold judgment time)	ms	1 to 9999	10
	Description: When performing the torque determination in pressing operation, this sets the time after reaching the "Threshold" until the condition is judged to be met.			

Note: The parameter with "*" attached in "No." are not active in TDO. It can be active when D-STEP is used.
Note: The parameter with "*" attached in "No." can be changed while keeping the servo ON.
Note: [Select] in the "Unit" field is selected from the items displayed in "Setting range."

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No.	Parameter name		Unit	Setting range	Default value
24	Judgment range (Threshold judgment range)		[Select]	Invalid / Valid	Invalid
	Description	When performing the torque determination in pressing operation, Valid: Sets the judgment range. Invalid: Does not set the judgment range.			
25*	Standstill mode (Default standstill mode)		[Select]	Invalid / Off time 0 to 2 / Full	Full
	Description	Sets the default value of "Standstill mode" after reaching the target position of each STEP. Selecting an appropriate mode reduces heat generation and power usage. Invalid :The servo turns OFF but No. 11 current continues to flow. Off time 0:After the elapse of the time in No. 17, the servo turns OFF and the flowing current becomes 0. Off time 1:After the elapse of the time in No. 18, the servo turns OFF and the flowing current becomes 0. Off time 2:After the elapse of the time in No. 19, the servo turns OFF and the flowing current becomes 0. Full:The servo is always turned ON even when in stop status. (The current increases or decreases depending on the external force) See **11-3 Standstill mode(→ P.2-43)**.			
26	Ball screw lead (Ball screw lead length)		mm	0.000 to 99.999	Depends on models
	Description	Sets the length of ball screw lead. A value tailored to the actuator is set before shipment.			
28	Cur. select at miss (Selection of current in in-vain stop status)		[Select]	Current at stop / Current at push	Current at stop
	Description	Sets the current limit after the pressing operation being in vain. Current at stop: Current set in No.11 Current at push: Current set in "Push"			
29	Max. speed (Maximum speed)		mm/s	1 to 9999	Depends on models
	Description	Sets the maximum speed settable in the "Speed" field of the program data.			
30	Position deviation (Allowable position deviation)		mm	0.00 to 999.99	Depends on models
	Description	Set the value to output the alarm code No.32 (Posi deviation error) **(→ P.2-80)**.			
*31	Inching distance (Inching distance)		mm	0.000 to 5000.000	10.0
	Description	D-STEP: Sets the inching distance on the PROGRAM screen. For the distance setting by I/O input, see No. 22.			
43	Numerator of ratio (Reduction ratio numerator)		-	1 to 999	Depends on models
	Description	The numerator of the reduction ratio			
44	Denominator of ratio (Reduction ratio denominator)		-	1 to 999	Depends on models
	Description	The denominator of the reduction ratio			
47	Encoder type (Encoder type)		[Select]	ABS/INC	ABS
	Description	Sets the actuator encoder type. Incremental:When the control power turns OFF, the current position will be lost. In this case, zero return is required. This is selected when the battery is dead or is not used. Absolute: When the control power turns OFF, the current position will not be lost.			
119	Load inertia ratio (Load inertia ratio)		-	0.000~100.000	Depends on models
	Description	Sets inertia ratio between the motor and load. Basically, this is not need to be changed.			

Note: The parameter with "*" attached in "No." are not active in TDO. It can be active when D-STEP is used.
Note: The parameter with "*" attached in "No." can be changed while keeping the servo ON.
Note: [Select] in the "Unit" field is selected from the items displayed in "Setting range."

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13-17-3 TLC parameter: External interface

No.	Parameter name	Unit	Setting range	Default value
33	Pause input (Selection of invalid for pause input)	[Select]	Invalid / Valid	Valid
	Description: The "PAUSE" input of the driver controller is configured to be N.C. contact from the viewpoint of fail safe. Therefore, this should be turned ON (shorted to 0V) during the operation. However, if it is not used, setting "Invalid" does not require the contact to turn ON. Valid: "PAUSE" input (pin. 16) will be valid. Invalid: "PAUSE" input (pin. 16) will be invalid.			
*34	Communication speed (Communication speed)	[Select]	38400/57600/115200	115200
	Description: Sets the speed for communication between PC and TDO via RS-485. The change will be valid by turning on the power again.			
35	Servo ON input (Selection of servo ON input method)	[Select]	External input / Always ON	External input
	Description: Selects the method to turn the servo ON. External input: Turning on the "SV-ON" (pin. 18) input turns the servo ON. Always ON: Turning on the power turns the servo ON.			
36	Function mode (Operation mode selection)	[Select]	Type 0 to 5	Type 0
	Description: Selects the driver controller operation mode.			
37	IN-POSI signal type (Positioning completion signal output method)	[Select]	PEND/INP	INP
	Description: Selects the output method for positioning completion signal "INPS" (pin. 30). When the servo is OFF, this is unconditionally turned OFF regardless of the current position. PEND: Servo ON → Once "INPS" is turned ON, this remains in ON status even when the position is out of "IN-POSI." INP: Servo On → Turns ON only when the position is within "Pos Range."			
38	Inhibit MANU input (MANU input prohibition)	[Select]	Invalid / Valid	Invalid
	Description: Selects the operation when the driver controller is in AUTO mode and the "MANU" (pin. 14) input turns ON. Invalid: The driver controller will be in MANUAL mode. Valid: The driver controller remains in AUTO mode.			
*39	Comment (Comment on axis)	--	16 one-byte alphanumeric characters	----------
	Description: Enter any comment on the axis displayed on the Connect Start and PROGRAM screens in the D-TSEP.			
48	Enable function (TDO enable function)	[Select]	Invalid / Valid	Valid
	Description: When TDO is connected to the driver controller, this selects the TDO enable switch operation. Valid: The enable switch will be valid. (Turning it OFF stops the operation) Invalid: The enable switch will be invalid. (Even when turning it OFF, the operation does not stop)			

Note: The parameter with "*" attached in "No." field are not active in TDO. It can be active when D-STEP is used.

Note: The parameter with "*" attached in "No." can be changed while keeping the servo ON.

Note: [Select] in the "Unit" field is selected from the items displayed in "Setting range."

Note: [- -] in the "Unit" field is any character input specified in "Setting range."

13-17-4 TLC parameter: Servo gain

No.	Parameter name	Unit	Setting range	Default value
*40	Position gain (Position gain)	1/s	1 to 65536	Depends on models
	Description: This is a parameter to determine the responsiveness of position control loop. Increasing the setting value improves the follow-up performance to the position command but is likely to cause the overshoot.			
*41	Speed loop P gain (Speed loop proportional gain)	Hz	1 to 65536	Depends on models
	Description: This is a parameter to determine the responsiveness of speed control loop. As the load inertia increases, the setting value should be increased. Increasing the value improves the follow-up performance to the speed command (the servo rigidity is enhanced), but is likely to cause the overshoot and oscillation, resulting in mechanical vibration.			
*42	Speed loop I gain (Speed loop integral gain)	ms	1 to 65536	Depends on models
	Description: This is a parameter to determine the responsiveness of speed control loop. Increasing the value reduces the responsiveness to the speed command and the repulsion force against the load change. Decreasing the value increases the responsiveness and repulsion force, but excessive decreasing is likely to cause the overshoot and oscillation, resulting in mechanical vibration.			

Note: The parameter with "*" attached in "No." can be changed while keeping the servo ON.

13-18 THC parameters

13-18-1 THC parameter: Actuator information

No.	Parameter name	Unit	Setting range	Default value
1	Max. area (Max. area)	mm	-9999.99 to 9999.99	9999.99
	Description	Sets the + side (MAX side) of the area where the AREA signal (pin.26) turns ON.		
2	Min. area (Min. area)	mm	-9999.99 to 9999.99	-9999.99
	Description	Sets the - side (MIN side) of the area where the AREA signal (pin.26) turns ON.		
3	Soft limit + (Soft limit + side)	mm	0.00 to 9999.99	9999.99
	Description	Sets the + side (MAX side) of the actuator-movable area.		
4	Soft limit - (Soft limit - side)	mm	-9999.99 to 0.00	-9999.99
	Description	Sets the - side (MIN side) of the actuator-movable area.		
6	ORG offset (Zero-point offset)	mm	-9999.99 to 9999.99	0.00
	Description	Enables the zero point of absolute coordinate system to be set in an arbitrary position.		

Note: The parameter with "*" attached in "No." are not active in TDO. It can be active when D-STEP is used.

13-18-2 THC parameter: Actuator operation settings

No.	Parameter name	Unit	Setting range	Default value
7	Push judgment time (Push judgment time)	ms	1 to 99999	100
	Description	Sets the time from when the actuator hits a work in the pressing operation until when the operation is judged to be completed.		
8*	Default speed (Default speed)	mm/s	1 to 9999	100
	Description	Inputs the default value of "Speed" entered when double-clicking an arbitrary row of the "program table" in D-STEP.		
9*	Default ACCEL/DECEL (Default acceleration/deceleration)	m/s^2	1.0 to 99.9	Depends on models
	Description	Inputs the default values of "ACC" and "DCC" entered when double-clicking an arbitrary row of the "program table" in D-STEP.		
10*	IN-POSI range (Initial value of positioning completion width)	mm	0.01 to 999.99	Depends on models
	Description	Inputs the default value of "Pos Range" entered when double-clicking an arbitrary row of the "program table" in D-STEP.		
11	Cur. limit at stop (Current limit on stop status)	%	1 to 70	70
	Description	Sets the current applied to the motor when the actuator is in stop status. Increasing the value increases the stoppage holding torque (settable to the linear), but also increases the heat generation and the electric power usage. The current value tailored to the standard specification of the actuator is set before shipment.		
12	Cur. limit at origin (Current limit on zero return)	%	1 to Depends on models	Depends on models
	Description	Sets the current applied to the motor when the actuator returns to zero point. Increasing the value increases the zero return torque (settable to the linear), but also increases the heat generation and the electric power usage. The current value tailored to the standard specification of the actuator is set before shipment.		

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No.	Parameter name	Unit	Setting range	Default value
13	Move command type (Move command method)	[Select]	Level / Edge	Level
	Description	Selects the method of inputting move command (ST 0 to 6) (pin. 3 to 9) for operation mode 4. Level: The movement is started when turning the input signal ON and is stopped when turning it OFF on the way. Edge: The movement is started at the rising edge of the input signal and is not stopped even when turning it OFF on the way.		
14	Method of ORG (Zero return method)	[Select]	Sensor / Push	Depends on models
	Description	Sets the zero return method for the actuator. Push: When it moves in a preset direction and reaches the stroke end, it turns around and treats the position where the first zero point signal (included in the encoder/one output per rotation) is input as the zero point. Sensor: When it moves in a predetermined direction and the zero-point sensor turns ON, it turns around and treats the position where the first zero point signal (included in the encoder/one output per rotation) is input as the zero point.		
15	Push speed (Pressing speed)	mm/s	1 to 20	10
	Description	Defines the pressing speed after reaching the target position during pressing operation. A default value tailored to the actuator characteristics is set before shipment.		
*16	Jog speed (Jog speed)	mm/s	1 to 250	10
	Description	Sets the jog speed for use with the TDO. For the speed setting by I/O input, see No. 21.		
17	Auto servo OFF 1 (Auto servo OFF time 1)	s	0 to 9999	9999
	Description	Sets the time after completing the positioning until the servo turns OFF when "Standstill mode" of the program data is "1". **11-3-2 1: Off time 0 (→ P.2-44)** should be referenced.		
18	Auto servo OFF 2 (Auto servo OFF time 2)	s	0 to 9999	9999
	Description	Sets the time after completing the positioning until the servo turns OFF when "Standstill mode" of the program data is "2". **11-3-3 2: Off time 1 (→ P.2-44)** should be referenced.		
19	Auto servo OFF 3 (Auto servo OFF time 3)	s	0 to 9999	9999
	Description	Sets the time after completing the positioning until the servo turns OFF when "Standstill mode" of the program data is "3". **11-3-4 3: Off time 2 (→ P.2-44)** should be referenced.		
*20	Speed override (Speed override)	%	1 to 100	100
	Description	For protection against the danger in trial operation, this is used when you want to operate the actuator at a low speed. In the operation, it is possible to multiply the movement speed in the "Speed" field of the program data by the ratio of the value set here.		
*21	I/O jog speed (External input jog speed)	mm/s	1 to 250	10
	Description	Sets the speed in jog operation when external input teaching by I/O (Operation mode 1) is selected. For the speed setting by TDO, see No. 16.		
*22	I/O inching distance (External input inching distance)	mm	0.000 to 5000.000	1.000
	Description	Sets the movement distance by inching operation when external input teaching by I/O (Operation mode 1) is selected. For the speed setting by TDO, see No. 31.		

Note: The parameter with "*" attached in "No." are not active in TDO. It can be active when D-STEP is used.
Note: The parameter with "*" attached in "No." can be changed while keeping the servo ON.
Note: [Select] in the "Unit" field is selected from the items displayed in "Setting range."

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No.	Parameter name	Unit	Setting range	Default value
23	Judgment time (Threshold judgment time)	ms	1 to 9999	10
	Description: When performing the torque determination in pressing operation, this sets the time after reaching the "Threshold" until the condition is judged to be met.			
24	Judgment range (Threshold judgment range)	[Select]	Invalid / Valid	Invalid
	Description: When performing the torque determination in pressing operation, Valid: Sets the judgment range. Invalid: Does not set the judgment range.			
25*	Standstill mode (Default standstill mode)	[Select]	Invalid / Off time 0 to 2 / Full	Full
	Description: Sets the default value of "Standstill mode" after reaching the target position of each STEP. Selecting an appropriate mode reduces heat generation and power usage. Invalid: The servo turns OFF but No. 11 current continues to flow. Off time 0: After the elapse of the time in No. 17, the servo turns OFF and the flowing current becomes 0. Off time 1: After the elapse of the time in No. 18, the servo turns OFF and the flowing current becomes 0. Off time 2: After the elapse of the time in No. 19, the servo turns OFF and the flowing current becomes 0. Full: The servo is always turned ON even when in stop status. (The current increases or decreases depending on the external force) See **11-3 Standstill mode(→ P.2-43)**.			
26	Ball screw lead (Ball screw lead length)	mm	0.000 to 99.999	Depends on models
	Description: Sets the length of ball screw lead. A value tailored to the actuator is set before shipment.			
27	OT sensor logic	[Select]	Positive/Negative	Depends on models
	Description: Sets the contact method of OT sensors. If you do not use OT sensors, select Positive. Positive: N.O. contact (normally open contact point) Negative: N.C. contact (normally open contact point)			
28	Cur. select at miss (Selection of current in in-vain stop status)	[Select]	Current at stop / Current at push	Current at stop
	Description: Sets the current limit after the pressing operation being in vain. Current at stop: Current set in No.11 Current at push: Current set in "Push"			
29	Max. speed (Maximum speed)	mm/s	1 to 9999	Depends on models
	Description: Sets the maximum speed settable in the "Speed" field of the program data.			
30	Position deviation (Allowable position deviation)	mm	0.00 to 999.99	Depends on models
	Description: Set the value to output the alarm code No.32 (Posi deviation error) **(→ P.2-81)**.			
*31	Inching distance (Inching distance)	mm	0.000 to 5000.000	1.000
	Description: D-STEP: Sets the inching distance on the PROGRAM screen. For the distance setting by I/O input, see No. 22.			
43	Numerator of ratio (Reduction ratio numerator)	-	1 to 999	Depends on models
	Description: The numerator of the reduction ratio			
44	Denominator of ratio (Reduction ratio denominator)	-	1 to 999	Depends on models
	Description: The denominator of the reduction ratio			

Note: The parameter with "*" attached in "No." are not active in TDO. It can be active when D-STEP is used.
Note: The parameter with "*" attached in "No." can be changed while keeping the servo ON.
Note: [Select] in the "Unit" field is selected from the items displayed in "Setting range."

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No.	Parameter name	Unit	Setting range	Default value
47	Encoder type (Encoder type)	[Select]	ABS / INC	ABS
	Description	Sets the actuator encoder type. Incremental: When the control power turns OFF, the current position will be lost. In this case, zero return is required. This is selected when the battery is dead or is not used. Absolute: When the control power turns OFF, the current position will not be lost.		
49	EMG function (Selection of emergency stop circuit function)	[Select]	Invalid / Valid	Valid
	Description	Enables the valid/invalid setting of EMG stop circuit input (CN7 and TDO). Valid: The emergency stop circuit (CN7 and TDO) will be valid. Invalid: The emergency stop circuit (CN7 and TDO) will be invalid.		
119	Load inertia ratio (Load inertia ratio)	-	0.000 to 100.000	Depends on models
	Description	Sets inertia ratio between the motor and load. Basically, this is not need to be changed.		

13-18-3 THC parameter: External interface

No.	Parameter name	Unit	Setting range	Default value
33	Pause input (Selection of invalid for pause input)	[Select]	Invalid / Valid	Valid
	Description	The "PAUSE" input of the driver controller is configured to be N.C. contact from the viewpoint of fail safe. Therefore, this should be turned ON (shorted to 0V) during the operation. However, if it is not used, setting "Invalid" does not require the contact to turn ON. Valid: "PAUSE" input (pin. 16) will be valid. Invalid: "PAUSE" input (pin. 16) will be invalid.		
*34	Communication speed (Communication speed)	[Select]	38400/57600/115200	115200
	Description	Sets the speed for communication between PC and TDO via RS-485. The change will be valid by turning on the power again.		
35	Servo ON input (Selection of servo ON input method)	[Select]	External input / Always ON	External input
	Description	Selects the method to turn the servo ON. External input: Turning on the "SV-ON" (pin. 18) input turns the servo ON. Always ON: Turning on the power turns the servo ON.		
36	Function mode (Operation mode selection)	[Select]	Type 0 to 5	Type 0
	Description	Selects the driver controller operation mode.		
37	IN-POSI signal type (Positioning completion signal output method)	[Select]	PEND/INP	INP
	Description	Selects the output method for positioning completion signal "INPS" (pin. 30). When the servo is OFF, this is unconditionally turned OFF regardless of the current position. PEND: Servo ON → Once "INPS" is turned ON, this remains in ON status even when the position is out of "Pos Range." INP: Servo On → Turns ON only when the position is within "Pos Range."		
38	Inhibit MANU input (MANU input prohibition)	[Select]	Invalid / Valid	Invalid
	Description	Selects the operation when the driver controller is in AUTO mode and the "MANU" (pin. 14) input turns ON. Invalid: The driver controller will be in MANUAL mode. Valid: The driver controller remains in AUTO mode.		

Note: The parameter with "*" attached in "No." field are not active in TDO. It can be active when D-STEP is used.

Note: The parameter with "*" attached in "No." can be changed while keeping the servo ON.

Note: [Select] in the "Unit" field is selected from the items displayed in "Setting range."

Note: [- -] in the "Unit" field is any character input specified in "Setting range."

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No.	Parameter name		Unit	Setting range	Default value
*39	Comment (Comment on axis)		--	16 one-byte alphanumeric characters	----------
	Description	Enter any comment on the axis displayed on the Connect Start and PROGRAM screens in the D-TSEP.			
48	Enable function (TDO enable function)		[Select]	Invalid / Valid	Valid
	Description	When TDO is connected to the driver controller, this selects the TDO enable switch operation. Valid: The enable switch will be valid. (Turning it OFF stops the operation) Invalid: The enable switch will be invalid. (Even when turning it OFF, the operation does not stop)			

Note: The parameter with "*" attached in "No." field are not active in TDO. It can be active when D-STEP is used.

Note: The parameter with "*" attached in "No." can be changed while keeping the servo ON.

Note: [Select] in the "Unit" field is selected from the items displayed in "Setting range."

Note: [- -] in the "Unit" field is any character input specified in "Setting range."

13-18-4 THC parameter: Servo gain

No.	Parameter name		Unit	Setting range	Default value
*40	Position gain (Position gain)		1/s	1 to 65536	Depends on models
	Description	This is a parameter to determine the responsiveness of position control loop. Increasing the setting value improves the follow-up performance to the position command but is likely to cause the overshoot.			
*41	Speed loop P gain (Speed loop proportional gain)		Hz	1 to 65536	Depends on models
	Description	This is a parameter to determine the responsiveness of speed control loop. As the load inertia increases, the setting value should be increased. Increasing the value improves the follow-up performance to the speed command (the servo rigidity is enhanced), but is likely to cause the overshoot and oscillation, resulting in mechanical vibration.			
*42	Speed loop I gain (Speed loop integral gain)		ms	1 to 65536	Depends on models
	Description	This is a parameter to determine the responsiveness of speed control loop. Increasing the value reduces the responsiveness to the speed command and the repulsion force against the load change. Decreasing the value increases the responsiveness and repulsion force, but excessive decreasing is likely to cause the overshoot and oscillation, resulting in mechanical vibration.			

Note: The parameter with "*" attached in "No." can be changed while keeping the servo ON.

13. Appendix

13-19 Alarm lists

13-19-1 TSC alarm list

- "*" indicate the THC status when alarm is generated.
  ○: The servo keeps ON status
  × : The servo changes to OFF status

Code	Alarm name	*	Content
1	Motor overvolt	×	Overvoltage is applied to the motor power supply
2	Control overvolt	×	Overvoltage is applied to the input power supply
3	Control low-volt	×	The input power supply voltage is being reduced
11	Parameter error	×	The value set in the parameter exceeds the effective range
21	Move comm. at SV OFF	×	Move command has been entered with the servo OFF
22	Move comm. befor ORG	○	① Position move command had been entered when zero return was not completed ② Move command has been entered during the movement for zero return
23	ORG time out	×	After starting the zero return operation, it has not been completed even after the elapse of preset time
24	Writing error on move	○	During manual movement in Operation mode 1, writing signal (PWRT signal) has been entered
25	Position data anomaly	○	① There is no data in the specified program table ② In Operation mode 5, target position in the "Position" field is specified using a relative coordinate ③ "Pos Range" sign for pressing operation has unrighteously been set
31	Position comm. error	○	Actual speed has exceeded the preset maximum value
32	Excessive position error (deviation)	×	The deviation between commanded position and current position has exceeded the parameter No. 30 Note: When the Standstill mode is ASO1 to 3, alarm generates when the following move command is executed (usually generates immediately after exceeding the parameter)
33	Soft limit over	○	The current position has exceeded the parameter No. 3 or 4
34	Push & hold operation range over-error	×	During the pressing operation, the unit has been pushed back to the target position due to the too strong push-back force
51	EEPROM error	×	Abnormal data was detected in non-volatile memory checking during the start-up operation
52	Detection error	×	① There is no encoder feedback when performing the excitation detection ② Since there is an obstacle during the initial servo behavior after turning on the power, the servo cannot be successfully turned on
53	Encoder error	×	The encoder was disconnected.
54	Servo error	×	After receiving the move command, the motor operation cannot be performed for 2 seconds or more before reaching the target position
55	Overheat in driver controller	×	The surrounding temperature of the power transistor within the driver controller is too high
63	EMG stop	×	EMG stop has been entered

13-19-2 TLC alarm list

- "*" indicate the THC status when alarm is generated.
  ○: The servo keeps ON status
  × : The servo changes to OFF status

Code	Alarm name	*	Content
1	Motor overvolt	×	Overvoltage is applied to the motor power supply
2	Control overvolt	×	Overvoltage is applied to the input power supply
3	Control low-volt	×	The input power supply voltage is being reduced
4	Motor supply voltage drop	×	The motor power supply voltage is being reduced
5	Serial communication error	○	Error in CN3 communication
11	Parameter error	×	The value set in the parameter exceeds the effective range
21	Move comm. at SV OFF	×	Move command has been entered with the servo OFF
22	Move comm. befor ORG	○	① Position move command had been entered when zero return was not completed ② Move command has been entered during the movement for zero return
23	ORG time out	×	After starting the zero return operation, it has not been completed even after the elapse of preset time
24	Writing error on move	○	During manual movement in Operation mode 1, writing signal (PWRT signal) has been entered
25	Position data anomaly	○	① There is no data in the specified program table ② In Operation mode 5, target position in the "Position" field is specified using a relative coordinate ③ "Pos Range" sign for pressing operation has unrighteously been set
31	Position comm. error	○	Actual speed has exceeded the preset maximum value
32	Excessive position error (deviation)	×	The deviation between commanded position and current position has exceeded the parameter No. 30 Note: When the Standstill mode is ASO1 to 3, alarm generates when the following move command is executed (usually generates immediately after exceeding the parameter)
33	Soft limit over	○	The current position has exceeded the parameter No. 3 or 4
34	Push & hold operation range over-error	×	During the pressing operation, the unit has been pushed back to the target position due to the too strong push-back force
35	Encoder communication error	×	Error in communication with encoder
36	Encoder error	×	Failure of encoder unit
37	Battery error	×	① The battery is not connected ② The battery power is dead
38	Battery low-volt	○	Low battery voltage
51	EEPROM error	×	Abnormal data was detected in non-volatile memory checking during the start-up operation
52	Detection error	×	There is no encoder feedback when performing the excitation detection
54	Servo error	×	After receiving the move command, the motor does not operate for 2 seconds or more before reaching the target position.
55	Overheat in driver controller	×	The surrounding temperature of the power transistor within the driver controller is too high
56	Thermal error	×	Current has flowed exceeding the protective characteristic
57	Motor overcurrent	×	Overcurrent has flowed into the motor
58	Abnormal operation	×	When thrust force has been generated in a direction opposite to the velocity direction when accelerating or at constant velocity
59	System alarm	×	Microcomputer error
61	Regenerative overload	×	Overload has been applied to the regenerative circuit within the TLC
62	IPM Module error	×	Failure of motor drive circuit
63	EMG stop	×	EMG stop has been entered

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13-19-3 THC alarm list

- "*" indicate the THC status when alarm is generated.
  ◯: The servo keeps ON status
  × : The servo changes to OFF status

Code	Alarm name	*	Content
1	Motor overvolt	×	Overvoltage is applied to the motor power supply
3	Control low-volt	×	The input power supply voltage is being reduced
4	Motor supply voltage drop	×	The motor power supply voltage is being reduced
5	Serial communication error	◯	Error in CN3 communication
11	Parameter error	×	The value set in the parameter exceeds the effective range
21	Move comm. at SV OFF	×	Move command has been entered with the servo OFF
22	Move comm. befor ORG	◯	① Position move command had been entered when zero return was not completed ② Move command has been entered during the movement for zero return
23	ORG time out	×	After starting the zero return operation, it has not been completed even after the elapse of preset time
24	Writing error on move	◯	During manual movement in Operation mode 1, writing signal (PWRT signal) has been entered
25	Position data anomaly	◯	① There is no data in the specified program table ② In Operation mode 5, target position in the "Position" field is specified using a relative coordinate ③ "Pos Range" sign for pressing operation has unrighteously been set
31	Position comm. error	◯	Actual speed has exceeded the preset maximum value
32	Excessive position error (deviation)	×	The deviation between commanded position and current position has exceeded the parameter No. 30 Note: When the Standstill mode is ASO1 to 3, alarm generates when the following move command is executed (usually generates immediately after exceeding the parameter)
33	Soft limit over	◯	The current position has exceeded the parameter No. 3 or 4
34	Push & hold operation range over-error	×	During the pressing operation, the unit has been pushed back to the target position due to the too strong push-back force
35	Encoder communication error	×	Error in communication with encoder
36	Encoder error	×	Failure of encoder unit
37	Battery error	×	① The battery is not connected ② The battery power is dead
38	Battery low-volt	◯	Low battery voltage
39	OT detection	×	When detected by the OT sensor
51	EEPROM error	×	Abnormal data was detected in non-volatile memory checking during the start-up operation
52	Detection error	×	There is no encoder feedback when performing the excitation detection
53	Motor overload	×	When overload is applied to the motor
54	Servo error	×	After receiving the move command, the motor does not operate for 2 seconds or more before reaching the target position.
55	Overheat in driver controller	×	The surrounding temperature of the power transistor within the driver controller is too high
56	Thermal error	×	Current has flowed exceeding the protective characteristic
57	Motor overcurrent	×	Overcurrent has flowed into the motor
58	Abnormal operation	×	When thrust force has been generated in a direction opposite to the velocity direction when accelerating or at constant velocity
59	System alarm	×	Microcomputer error
61	Regenerative overload	×	Overload has been applied to the regenerative circuit within the THC
62	IPM Module error	×	Failure of motor drive circuit
63	EMG stop	×	EMG stop has been entered

13-20 Causes and counter measures of alarms

- After removing the alarm cause and then implementing the counter measure, clicking the ALM RESET key allows the alarm to be reset.
  If the alarm cannot be reset, the alarm cause is not removed.

13-20-1 Causes and counter measures of TSC alarms

No.	Alarm name	Generation status	Causes	Counter measures
1	Motor overvolt	When 24 V power is activated (Opening of CN4 and MPI to MPO is used)	Driver controller board has a fault	Replace the driver controller with new one
		When MPO power is activated (Short-circuiting of CN4 and MPI to MPO is used)	The input voltage is high	Set the input voltage within the product specification range
			Driver controller board has a fault	Replace the driver controller with new one
		During normal operation	The input voltage is high (depending on excessive voltage variation)	Set the input voltage within the product specification range
			Driver controller board has a fault	Replace the driver controller with new one
		When the motor decelerates in speed	The motor speed is high and load mass is too large	Reconsider the load condition and driving condition
2	Control overvolt	During 24 V power energizing	The input voltage is high	Set the input voltage within the product specification range
3	Control low-volt	During 24 V power energizing	The input voltage is low	Set the input voltage within the product specification range
11	Parameter error	When 24 V power is activated	Driver controller board has a fault	Replace the driver controller with new one
		When reading out or writing in the parameter file	An inappropriate parameter file has been selected	Select an appropriate parameter file
21	Move comm. at SV OFF	When starting the normal operation	Operation starting procedures are not appropriate	Issue directive to move after servo ON and zero return
22	Move comm. befor ORG	When starting the normal operation	Operation starting procedures are not appropriate	Issue directive to move after zero return
23	ORG time out	When in zero return	Actuator has a fault	Replace the actuator with new one
			Motor has a fault	Replace the actuator with new one
			Encoder has a fault	Replace the actuator with new one
			Actuator connection cable has a fault	Replace the cable with new one
			Driver controller board has a fault	Replace the driver controller with new one
24	Writing error on move	When entering external input instruction mode writing signal PWRT	Zero return is not completed	Execute the zero return
			The movement is going on by manual operation	Enter the signal after the operation completely stops
25	Position data anomaly	The program is being executed	There is some fault (omission, non-conformity, unreason, etc.) in the data to be executed	Correct the fault
			Specify the target point with operation mode 5 in the relative coordinate	Specify the target point in the absolute coordinate
31	Position comm. error	During normal operation	Driver controller board has a fault	Replace the driver controller with new one
32	Excessive position error (deviation)	Positioning operation is going on	Inhibition of operation by external force	Remove the inhibitor
			Actuator has a fault	Replace the actuator with new one
			Motor has a fault	Replace the actuator with new one
			Encoder has a fault	Replace the actuator with new one
			Actuator connection cable has a fault	Replace the cable with new one
			Lack of gain adjustment	Readjust the gain
			Driver controller board has a fault	Replace the driver controller with new one
33	Soft limit over	Positioning operation is going on	Position setting is out of limit	Set the position within the limit
34	Push & hold operation range over-error	During the pressing operation	The amount of pressing is not enough	Increase the Push[%]

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No.	Alarm name	Generation status	Causes	Counter measures
51	EEPROM error	When 24 V power is activated	Driver controller board has a fault	Replace the driver controller with new one
52	Detection error	When the servo is turned ON	Encoder has a fault	Replace the actuator with new one
			Actuator connection cable has a fault	Replace the cable with new one
			Driver controller board has a fault	Replace the driver controller with new one
			The unit hits an obstacle etc	Remove the obstacle
53	Encoder error	At 24 V power ON	Actuator connection cable fault	Replace the cable with new one
54	Servo error	When in positioning operation	Inhibition of operation by external force	Remove the inhibitor
			Actuator has a fault	Replace the actuator with new one
			Motor has a fault	Replace the actuator with new one
			Brake has a fault (when a brake is provided)	Replace the actuator with new one
			Actuator connection cable has a fault	Replace the cable with new one
			Driver controller board has a fault	Replace the driver controller with new one
55	Overheat	While energizing	Ambient temperature is hot	Set the ambient temperature within the product specification range
			Bad ventilation is likely to cause the heat to be stayed inside the unit	Set the surrounding space according to the product specifications
			Driver controller board has a fault	Replace the driver controller with new one
63	EMG stop	While energizing	External emergency stop switch has operated	Restore the external emergency stop to the normal status
			Motor supply voltage drop	Set the input voltage within the product specification range
			Driver controller board has a fault	Replace the driver controller with new one

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13-20-2 Causes and counter measures of TLC alarms

No.	Alarm name	Generation status	Causes	Counter measures
1	Motor overvolt	When 24 V power is activated (Opening of CN4 and MPI to MPO is used)	Driver controller board has a fault	Replace the driver controller with new one
		When MPO power is activated (Opening of CN4 and MPI to MPO is used)	The input voltage is high	Set the input voltage within the product specification range
			Driver controller board has a fault	Replace the driver controller with new one
		During normal operation	The input voltage is high (depending on excessive voltage variation)	Set the input voltage within the product specification range
			Driver controller board has a fault	Replace the driver controller with new one
		When the motor decelerates in speed	The motor speed is high and load mass is too large	Reconsider the load condition and driving condition
2	Control overvolt	During 24 V power energizing	The input voltage is high	Set the input voltage within the product specification range
3	Control low-volt	During 24 V power energizing	The input voltage is low	Set the input voltage within the product specification range
4	Motor supply voltage drop	During the servo ON	The input voltage is low	Set the input voltage within the product specification range
5	Serial communication error	When communicating by CN3	Noise from outside	Isolate with a noise source
11	Parameter error	When 24 V power is activated	Driver controller board has a fault	Replace the driver controller with new one
		When reading out or writing in the parameter file	An inappropriate parameter file has been selected	Select an appropriate parameter file
21	Move comm. at SV OFF	When starting the normal operation	Operation starting procedures are not appropriate	Issue directive to move after servo ON and zero return
22	Move comm. befor ORG	When starting the normal operation	Operation starting procedures are not appropriate	Issue directive to move after zero return
23	ORG time out	When in zero return	Actuator has a fault	Replace the actuator with new one
			Motor has a fault	Replace the actuator with new one
			Encoder has a fault	Replace the actuator with new one
			Actuator connection cable has a fault	Replace the cable with new one
			Driver controller board has a fault	Replace the driver controller with new one
24	Writing error on move	When entering external input instruction mode writing signal PWRT	Zero return is not completed	Execute the zero return
			The movement is going on by manual operation	Enter the signal after the operation completely stops
25	Position data anomaly	The program is being executed	There is some fault (omission, non-conformity, unreason, etc.) in the data to be executed	Correct the fault
			Specify the target point with operation mode 5 in the relative coordinate	Specify the target point in the absolute coordinate
31	Position comm. error	During normal operation	Driver controller board has a fault	Replace the driver controller with new one
32	Excessive position error (deviation)	Positioning operation is going on	Inhibition of operation by external force	Remove the inhibitor
			Actuator has a fault	Replace the actuator with new one
			Motor has a fault	Replace the actuator with new one
			Encoder has a fault	Replace the actuator with new one
			Actuator connection cable has a fault	Replace the cable with new one
			Lack of gain adjustment	Readjust the gain
			Driver controller board has a fault	Replace the driver controller with new one
33	Soft limit over	Positioning operation is going on	Position setting is out of limit	Set the position within the limit
34	Push & hold operation range over-error	During the pressing operation	The amount of pressing is not enough	Increase the Push[%]
35	Encoder communication error	When in start-up operation	Disconnection of encoder cable	Connect the encoder cable in proper way Replace the encoder cable with new one
			Encoder has a fault	Replace the motor (with the encoder)
36	Encoder error	While energizing	Fault in encoder	Restart
			Encoder has a fault	Replace the motor (with the encoder)
37	Battery error *	While energizing	A battery is not connected to CN6	Connect the cable to CN6 in proper way
			Battery power is dead	Replace the battery
38	Battery low-volt	While energizing	Battery power is consumed	Replace the battery

* A battery error occurs at the initial power ON when you connect/disconnect the battery or the encoder cable with the control power shut off. In this case, please execute an alarm reset.

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No.	Alarm name	Generation status	Causes	Counter measures
51	EEPROM error	When power is activated	Driver controller board has a fault	Replace the driver controller with new one
52	Detection error	When the servo is turned ON	Encoder has a fault	Replace the actuator with new one
			Actuator connection cable has a fault	Replace the cable with new one
			Driver controller board has a fault	Replace the driver controller with new one
			The unit hits an obstacle etc	Remove the obstacle
53	Motor overload	During the servo ON	Exceeds the motor's maximum torque	Reduce the load Reduce the acceleration and deceleration rate
54	Servo error	When in positioning operation	Inhibition of operation by external force	Remove the inhibitor
			Actuator has a fault	Replace the actuator with new one
			Motor has a fault	Replace the actuator with new one
			Brake has a fault (when a brake is provided)	Replace the actuator with new one
			Actuator connection cable has a fault	Replace the cable with new one
			Driver controller board has a fault	Replace the driver controller with new one
			Gain value is not appropriate	Adjust the gain value (parameter No. 40, 41, 42) to appropriate one
55	Overheat	While energizing	Ambient temperature is hot	Set the ambient temperature within the product specification range
			Bad ventilation is likely to cause the heat to be stayed inside the unit	Set the surrounding space according to the product specifications
			Driver controller board has a fault	Replace the driver controller with new one
56	Thermal error	During the servo ON	The motor is overheated	Turn off the power and wait until the motor becomes cooled Reduce the load Reduce the acceleration and deceleration rate Reduce the tact
57	Motor overcurrent	During the servo ON	Excessive current has flowed to the motor	Reduce the load Reduce the acceleration and deceleration rate
			Motor has a fault	Replace the motor with new one
58	Abnormal operation	During the operation	Encoder has a fault	Replace the motor (with the encoder)
			False wiring in motor cable	Connect the motor cable in proper way
59	System alarm	While energizing	Fault in CPU	Restart Isolate with a noise source Replace the driver controller with new one
61	Regenerative overload	During the operation	Excessive regeneration power has generated	Reduce the load Reduce the acceleration and deceleration rate
62	IPM Module error	During the servo ON	Driver controller board has a fault	Replace the driver controller board with new one
		While energizing	The input power supply capacity is not sufficient	Check the input power supply capacity
63	EMG stop	While energizing	External emergency stop switch has operated	Restore the external emergency stop to the normal status
			Motor supply voltage drop	Set the input voltage within the product specification range
			Driver controller board has a fault	Replace the driver controller with new one

13. Appendix

13-20-3 Causes and counter measures of THC alarms

No.	Alarm name	Generation status	Causes	Counter measures
1	Motor overvolt	When power is activated	The input voltage is high	Set the input voltage within the product specification range
			Driver controller board has a fault	Replace the driver controller with new one
		During normal operation	The input voltage is high (depending on excessive voltage variation)	Set the input voltage within the product specification range
			Driver controller board has a fault	Replace the driver controller with new one
		When the motor decelerates in speed	The motor speed is high and load mass is too large	Reconsider the load condition and driving condition Attach an external regeneration resistance
3	Control low-volt	During power energizing	The input voltage is low	Set the input voltage within the product specification range
4	Motor supply voltage drop	During the servo ON	The input voltage is low	Set the input voltage within the product specification range
5	Serial communication error	When communicating by CN3	Noise from outside	Isolate with a noise source
11	Parameter error	When power is activated	Driver controller board has a fault	Replace the driver controller with new one
		When reading out or writing in the parameter file	An inappropriate parameter file has been selected	Select an appropriate parameter file
21	Move comm. at SV OFF	When starting the normal operation	Operation starting procedures are not appropriate	Issue directive to move after servo ON and zero return
22	Move comm. befor ORG	When starting the normal operation	Operation starting procedures are not appropriate	Issue directive to move after zero return
23	ORG time out	When in zero return	Actuator has a fault	Replace the actuator with new one
			Motor has a fault	Replace the actuator with new one
			Encoder has a fault	Replace the actuator with new one
			Actuator connection cable has a fault	Replace the cable with new one
			Driver controller board has a fault	Replace the driver controller with new one
24	Writing error on move	When entering external input instruction mode writing signal PWRT	Zero return is not completed	Execute the zero return
			The movement is going on by manual operation	Enter the signal after the operation completely stops
25	Position data anomaly	The program is being executed	There is some fault (omission, non-conformity, unreason, etc.) in the data to be executed	Correct the fault
			Specify the target point with operation mode 5 in the relative coordinate	Specify the target point in the absolute coordinate
31	Position comm. error	During normal operation	Driver controller board has a fault	Replace the driver controller with new one
32	Excessive position error (deviation)	Positioning operation is going on	Inhibition of operation by external force	Remove the inhibitor
			Actuator has a fault	Replace the actuator with new one
			Motor has a fault	Replace the actuator with new one
			Encoder has a fault	Replace the actuator with new one
			Actuator connection cable has a fault	Replace the cable with new one
			Lack of gain adjustment	Readjust the gain
			Driver controller board has a fault	Replace the driver controller with new one
33	Soft limit over	Positioning operation is going on	Position setting is out of limit	Set the position within the limit
34	Push & hold operation range over-error	During the pressing operation	The amount of pressing is not enough	Increase the Push[%]
35	Encoder communication error	When in start-up operation	Disconnection of encoder cable	Connect the encoder cable in proper way Replace the encoder cable with new one
			Encoder has a fault	Replace the motor (with the encoder)
36	Encoder error	While energizing	Fault in encoder	Restart
			Encoder has a fault	Replace the motor (with the encoder)
37	Battery error *	While energizing	A battery is not connected to CN6	Connect the cable to CN6 in proper way
			Battery power is dead	Replace the battery
38	Battery low-volt	While energizing	Battery power is consumed	Replace the battery

* A battery error occurs at the initial power ON when you connect/disconnect the battery or the encoder cable with the control power shut off. In this case, please execute an alarm reset.

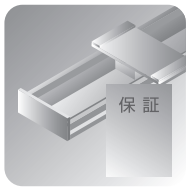
13. Appendix

No.	Alarm name	Generation status	Causes	Counter measures
39	OT detection	While energizing	The unit gets in over-travel status	Put the actuator back within a stroke range
			Sensor has a fault	Replace the sensor
			Disconnection of sensor cable	Replace the sensor cable
51	EEPROM error	When power is activated	Driver controller board has a fault	Replace the driver controller with new one
52	Detection error	When the servo is turned ON	Encoder has a fault	Replace the actuator with new one
			Actuator connection cable has a fault	Replace the cable with new one
			Driver controller board has a fault	Replace the driver controller with new one
			The unit hits an obstacle etc	Remove the obstacle
53	Motor overload	During the servo ON	Exceeds the motor's maximum torque	Reduce the load Reduce the acceleration and deceleration rate
54	Servo error	When in positioning operation	Inhibition of operation by external force	Remove the inhibitor
			Actuator has a fault	Replace the actuator with new one
			Motor has a fault	Replace the actuator with new one
			Brake has a fault (when a brake is provided)	Replace the actuator with new one
			Actuator connection cable has a fault	Replace the cable with new one
			Driver controller board has a fault	Replace the driver controller with new one
			Gain value is not appropriate	Adjust the gain value (parameter No. 40, 41, 42) to appropriate one
55	Overheat	While energizing	Ambient temperature is hot	Set the ambient temperature within the product specification range
			Bad ventilation is likely to cause the heat to be stayed inside the unit	Set the surrounding space according to the product specifications
			Driver controller board has a fault	Replace the driver controller with new one
56	Thermal error	During the servo ON	The motor is overheated	Turn off the power and wait until the motor becomes cooled Reduce the load Reduce the acceleration and deceleration rate Reduce the tact
57	Motor overcurrent	During the servo ON	Excessive current has flowed to the motor	Reduce the load Reduce the acceleration and deceleration rate
			Motor has a fault	Replace the motor with new one
58	Abnormal operation	During the operation	Encoder has a fault	Replace the motor (with the encoder)
			False wiring in motor cable	Connect the motor cable in proper way
59	System alarm	While energizing	Fault in CPU	Restart Isolate with a noise source Replace the driver controller with new one
61	Regenerative overload	During the operation	Excessive regeneration power has generated	Reduce the load Reduce the acceleration and deceleration rate Attach an external regeneration resistance
62	IPM Module error	During the servo ON	Driver controller board has a fault	Replace the driver controller board with new one
63	EMG stop	While energizing	External emergency stop switch has operated	Restore the external emergency stop to the normal status
			Motor supply voltage drop	Set the input voltage within the product specification range
			Driver controller board has a fault	Replace the driver controller with new one

3. Warranty

About this chapter

This chapter describes the maintenance, repair and replacement procedures of this product, and warranty.



This chapter describes the warranty of this product.

1. Product warranty

Described in this section are the details of the warranty applicable to the product you purchased.

1-1 Free warranty period

The warranty period shall be 12 months from the product delivery date or 18 months from the date of shipping (based on the manufacture date), whichever is earlier.
If the free warranty period has been expired at the time of receiving notice of any defect, repair works will be charged.

1-2 Usage conditions (range)

The normal usage conditions (range) specified in our catalogs and/or instruction manuals shall apply.

1-3 Warranty scope

1-3-1 Failure diagnosis

Please inform our Customer Support (refer to back cover) of the trouble description, content, and model and serial number indicated on the product label. Then we will perform the initial diagnosis of the product failure.
When we recognize that the failure occurred within the free warranty period set forth above and the responsibility of the cause rests on us, the warranty is applied without charge. Otherwise any repair or replacement will be charged.
The final judgment of the warranty qualification is determined when we check the product in our site.

Location of the product label: **2-4. Product label (→ P.2-10)**

1-3-2 Consumables and spare parts

- Cables and connectors are consumables.
- It is recommended to prepare spare parts.

1. Product warranty

1-3-3 Repair

We will perform free repair works or replacement for any failure occurred within the free warranty period set forth above.
However, it is our discretion whether we provide repair or replacement.
Free warranty is not applicable even within the warranty period for any of the following cases:

- Failure arising out of improper storage or handling by the customer, or software and/or hardware installed by the customer.
- Failure arising out of any alteration of our products by the customer.
- Failure arising out of any use of our products out of the usage conditions set forth in section 1-2 of this manual.
- Failure arising out of any use of the product without taking appropriate water-, oil-, and dust-proof measures.
- Lack of maintenance works specified in our instruction manual.
- Wearing caused by usage conditions.
- Wearing of consumables including cables and connectors.
- Failure arising out of any convulsion of nature such as earthquake, lightening, flood and wind damage.
- Failure arising out of any factor that is not recognized as our responsibility.

* In case of any free repair work within the free warranty period, the warranty period of the pertinent product shall still be the period set forth in section 1-1, not the period originating from the time of free repair work.

* In case of any paid repair work, the warranty period of the repaired section shall be 6 months from the repair work regardless of the warranty period of the product itself.

* Repair works are performed in our plant. Whether free or paid repair work, cost of returning the product to our site shall be customer's responsibility.
The cost of delivering the repaired or replacing product to customer's site is our responsibility in case of free warranty, or included in the repair charge in case of a paid repair service. However, the destination must be in Japan.

3-3-4 Repair period

For digital operator TDO, we do not support repair services out of the warranty coverage. Please prepare a spare TDO in advance or purchase new TDO.

1-4 Exclusion of warranty liability

- Regardless of whether it is within the free warranty period or not, any damage to the equipment other than our products and opportunity loss incurred by the customer due to the failure of the products are not covered by the warranty.
- We hold no responsibility for removal of the product for repair work, reinstallation after repair work and the other costs caused thereby.
- We hold no responsibility for any damage arising out of any use of the product without taking appropriate water-, oil-, and dust-proof measures.

1-5 Delivery conditions

Delivery products will be shipped by mixed cargo and passed on the car.
Unpacking, transportation, installation, on-site adjustment and commissioning after delivery are not our responsibility.

MEMO

Appendix

Revision history

The instruction manual No. is described on the back cover.

Date of issue	Instruction manual No.	Details
February 2012	No.364M	First edition
January 2013	No.6110-1(0) E	• Edition published in parts of the instruction manual No.364M → No.364M ES/EC+TSC → No.1030-1(0) ES/EC → No.6060-1(0) TSC → No.6100-1(0) D-STEP → No.6110-1(0) TDO • Full text → Added the items concerning Driver controller TLC and THC
June 2014	No.6110-1(1) E	Changed the parameter setting range by the TLC/THC software version changes Added notes on the battery alarm
April 2018	No.6100-2(0) E	Errors corrected

The Mark of Linear Motion

THK Electric Actuator Controller series
Digital operator

TDO

INSTRUCTION MANUAL

No.6110-2(0)E 201804