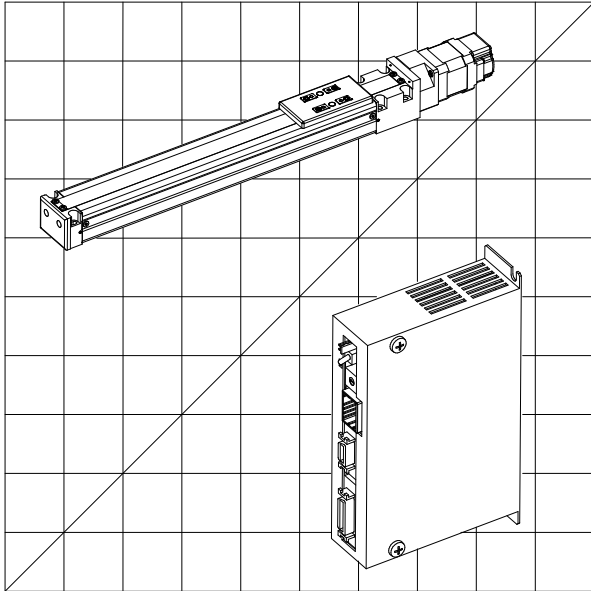


# Shibaura Machine



# ROIBOT

## BA-C SERIES

CONTROLLER

MODEL:CA01-M05

## Operating Manual (Basic Section)

### SHIBAURA MACHINE CO., LTD.

Keep this manual at hand after operators have read it thoroughly.







## Introduction

Thank you for selecting the ROlbot BA-C series.

To ensure correct usage, read this instruction manual before starting use of the ROlbot BA-C series.

For information on the actuators in ROlbot BA-C series, refer to the Actuator Operating Manual supplied with the actuator.

### **PRECAUTION**

1. The contents of this manual are subject to change without prior notice.
2. An effort has been made to ensure the contents of this manual.  
If you have any questions, or find any mistakes, please contact us.
3. Regardless of item 2 above, we will not be held responsible for any effect caused by using this robot.



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## Chapter 1 General Safety Instruction

### ■ 1.1 Important Safety Information

- To ensure safe usage of the ARM ROBOT/ROlbot BA-C, read this Operating Manual before installation, programming, operation, maintenance, and inspection.
- After reading this manual, keep it in an easily accessible location, such as near this equipment, where it can be referred to at all times.

Be sure to always follow the safety information to ensure safe usage of the ARM ROBOT/ROlbot BA-C.

The signal words below indicate important safety information and instructions displayed on this product (controller) and in this operating manual for preventing injuries to the operator and others and property damage and for ensuring safe usage of this equipment.

Be sure that you fully understand these signal words before reading the safety information.



This indicates a potentially hazardous situation which, if the displayed safety information is not followed, could result in death or serious injury.



This indicates a potentially hazardous situation which, if the displayed safety information is not followed, could result in injury or property damage (extended damage to buildings, household furnishings, and domestic animals and pets).

#### **NOTE**

This provides a brief description of important points and notes about the operating procedure for efficiently using this equipment.



The terminology description and reference page are instructed.





## WARNING

- A safety fence must be installed to prevent entry into the range of motion of the robot.  
If a door or other entrance is provided in the safety fence, an emergency stop must be applied to the robot when the door is opened.
- In case of emergencies, an emergency stop pushbutton switch must be connected to the emergency stop input terminal of the controller and installed in an easily accessible location.  
The emergency stop pushbutton is designed so that it does not reset automatically and cannot be unintentionally reset by the operator.
- All wiring work must be performed safely and in strict compliance with the electrical equipment technical standards and internal wiring codes.  
Improper wiring can result in an electric shock or fire.
- Do not repair or modify this equipment without permission of the manufacturer.  
This can result in an accident or damage to this equipment.
- Be sure to ground this equipment before using.  
Failure to ground this equipment can result in electric shock and increase the effects of electrical noise.
- Before maintenance and inspection work, turn off the main power supply switch to the controller and implement measures to prevent users other than the operator engaged in the robot adjustment work from accidentally turning on the power. (Lock-out and tag-out system)  
Also, wait at least three minutes before touching the internal components of the controller after the power is turned off.  
An electric shock can occur due to the residual voltage in the capacitor.
- Do not touch the heatsink and cement resistors inside the controller or the motor.  
These components can become extremely hot, and a burn can result.  
Before inspecting, be sure to wait sufficient time until the components cool down.
- Do not block the ventilation holes of this equipment.  
Blocking the ventilation holes can cause heat to build up inside this equipment and can result in a fire.
- Do not splash water in or outside this equipment, and do not wipe it with water or other liquids.  
This can result in an electric shock or breakdown of this equipment.  
[ If this equipment is dirty, wipe off the dirt with a cloth that has been firmly wrung out. ]  
[ Do not use thinners, benzene, or other organic solvents. ]
- Do not insert or drop metals, flammable items, or other foreign objects into the machine from the ventilation holes.  
This can result in a fire or electric shock.





## CAUTION

- Do not insert your fingers or hands into the openings or moving parts.  
This can result in an injury.
- When using the axis unit at an orientation other than the horizontal mounting, an axis with brake must be used.  
When the power is turned off, the slider can drop, and this can result in an injury.
- Perform regular checks on the brake functions of the axis with brake.  
A failure in the brake can cause the slider to drop and result in an injury.
- During a power outage, either turn off the circuit breaker, or set this equipment to emergency stop.  
Otherwise, the axis can move suddenly when the power is restored, and this can result in an injury or damage to the product.
- This product is heavy. When transporting it, check its weight and center of gravity before releasing the cables and carrying it.  
Also, do not grasp the sliders to take out this equipment when transporting it.  
The sliders can move and result in an injury.
- Do not use this equipment as a massage machine or for other applications on living subjects.  
A programming error or operation mistake can result in an injury.
- This equipment does not have an airtight structure.  
During usage, ball screw grease and dust from belt wear can spray out from the openings.  
If using for applications in food processing or pharmaceuticals, be sure to implement measures to prevent mixing with these substances.
- Do not put the battery or electrolytic capacitor in a fire.  
This can result in an explosion.
- Mount the supplied terminal block cover to the power supply terminal block.  
If the cover is not mounted, an electric shock can occur when touching the terminal block.
- Be sure to correctly enter the robot type and perform memory initialization.  
Entering the wrong robot type and improper memory initialization can cause the robot to move in an unexpected direction and result in an injury.
- Do not use this equipment in an environment where a flammable gas or explosive atmosphere is present.  
This equipment does not have an explosion-proof structure, and so an explosion can result.
- Do not damage, destroy, forcibly bend or pull, or place heavy objects on the cables (power supply cables, controller cables, axis connection cables, and flexible duct cables), or squeeze objects in between the cables.  
This can result in a fire, electric shock, or damage to this equipment.
- If smoke or an unusual smell is coming out from this equipment, or if another abnormal situation occurs, immediately turn off the power, and stop usage.  
Continuing to use this equipment can result in a fire or electric shock.





## CAUTION

- When using the motor reversal axis in a vertical orientation, perform periodic inspection of the belt, and replace the belt after every 3000 hours of operation. If the belt is used past its lifespan, it can break. This could cause the slider to unexpectedly drop, and result in an injury.
- Do not install this equipment in a location where the ambient temperature exceeds 40°C, where this equipment is subject to extreme variations in temperature that could cause condensation, or where this equipment is exposed to direct sunlight.  
Also, if this equipment is installed in a confined location, heat can build up in the controller itself and the external devices, causing the ambient temperature to rise, and result in a breakdown or malfunction of this equipment.
- Do not use in locations exposed to heavy shocks or vibrations.  
Also, do not use in environments where conductive dust, corrosive gas, oil, and other mist are present.  
This can result in a fire, electric shock, breakdown, malfunction, or other problems.
- Do not use in locations with large amounts of dust.  
This equipment does not have a dust-proof structure, and this can result in a breakdown.
- Use only manufacturer-authorized parts for repair.  
Usage of non-authorized parts can not only reduce this equipment performance, but can also result in a breakdown.
- Use an object with sufficient rigidity for the robot body installation frame.  
If the frame does not have sufficient rigidity, vibrations (resonance) can occur during robot operation and adversely affect the work.
- In the event of a power outage, this equipment will run freely. Therefore, use an axis with brake even when using a horizontal axis if there is a possibility of damage to the machines or workpieces.  
This machine does not include a dynamic brake system.
- Turn off the control power supply and drive power supply one second or more after the servo lock is freed.  
Failure to observe this timing can cause the vertical axis to drop by up to about 5 mm.
- Do not insert or remove the connectors when the controller power is turned on.  
This can result in a breakdown or malfunction of the controller.
- Implement safety protection for dropping or flying out of workpieces.  
A collision can cause a sudden deceleration of the axis and cause a workpiece to drop or fly out.
- Perform a risk assessment on the entire equipment, and implement any necessary safety measures.
- Properly dispose of this product as an industrial waste product.




**<IMPORTANT>**

Warning labels are affixed to the product body for particularly important safety information. If the label becomes peeled off, lost, or becomes illegible, order a new label from your nearest dealer or sales representative by specifying the part code, and affix it to its original position.


Controller warning label

Part code: 55560020

 <b>WARNING</b>
<ul style="list-style-type: none"><li>• To ensure safety, be sure to read the Operating Manual before installation, programming, operation, maintenance, and inspection.</li><li>• Before maintenance and inspection work, turn off the main power supply switch to the controller and implement measures to prevent users other than the operator engaged in the robot adjustment work from accidentally turning on the power. Also, wait at least three minutes before touching the internal components of the controller after the power is turned off. An electric shock can occur due to the residual voltage in the capacitor.</li><li>• A safety fence must be installed to prevent entry into the range of motion of the robot.</li><li>• In case of emergencies, an emergency stop pushbutton switch must be connected to the emergency stop input terminal of the controller and installed in an easily accessible location.</li><li>• Be sure to ground this equipment before using. Failure to ground this equipment can result in electric shock and increase the effects of electrical noise.</li><li>• Never modify this equipment.</li></ul>

Axis warning label

Part code: 55620157

 <b>WARNING</b>	<ul style="list-style-type: none"><li>• To ensure safety, be sure to read the Operating Manual before installation, programming, operation, maintenance, and inspection.</li><li>• A safety fence must be installed to prevent entry into the range of motion of the robot.</li><li>• Do not insert your fingers or hands into the openings or moving parts. This can result in an injury.</li><li>• When using at an orientation other than the horizontal mounting, an axis with brake must be used. When the power is turned off, the slider can drop, and this can result in an injury.</li></ul>
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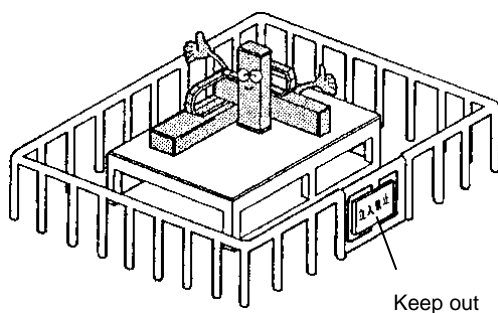


## ■ 1.2 Safe Operation

When using the ROlbot BA-C series, safety measures must be implemented to satisfy the items below. This equipment corresponds to an industrial robot as stipulated in article 36, item 31 of the Occupational Safety and Health Act regulations. Important safety information when using this equipment is contained in the sections "Selection", "Installation", "Usage", "Periodic Testing", and "Training" in the "Technical Guidelines for Safety Standards in Usage of Industrial Robots" based on article 28 of the Occupational Safety and Health Act. First, read this information carefully, and then implement the necessary measures. A portion of this safety information is presented below.

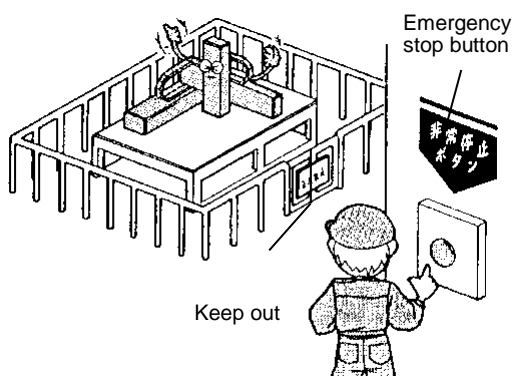
### ■ 1.2.1 Auxiliary safety precautions before robot installation

(1) Install a safety fence to prevent people from entering the area of robot operation.



1. The fence should be strong enough to withstand any force it might be expected to encounter during normal Robot or other operations. It should not be easy to breach, climb over or move.
2. It should be constructed of safe material with no sharp edges.
3. The foundation should be rigid and immobile.
4. Any door on the fence must be interlocked with the robot so that robot operations stop automatically when the door is opened.

(2) Install an emergency stop device in an easily accessible place to enable an operator to quickly stop the robot in case of an emergency.



1. When an emergency stop switch is operated the braking device must stop the robot quickly without fail.
2. The emergency stop button should be red.
3. The activating device must be readily accessible so the operator can easily trigger it by, for example, pressing, pulling, or touching a switch or by blocking a light beam.
4. Once triggered, the emergency stop device must be restorable only through deliberate action of an operator. It must not allow operations to be resumed automatically or through inattention on the part of an operator.

(3) No alteration or modification of the products is allowed.



### ■ 1.2.2 Precautions for installing the robot

Pay attention to the following points when installing the robot.

- (1) Allow ample clearance for teaching the robot, maintenance operations and inspection.
- (2) The robot controller, other control devices must be installed outside the robot's zone of operation, but within easy access of the operator.
- (3) The pressure gauge, oil pressure gauge and other indicators must be located so the operator can monitor them easily.
- (4) Cover electric cables, oil hydraulic lines and pneumatic pipe lines when necessary to protect them from damage.
- (5) Install an emergency stop switch at appropriate locations other than the operator's station to use in the emergency situation.

### ■ 1.2.3 Precautions for operation of the robot

Pay attention to the following points when operating the robot.

[Operation inside the actuator operating area]

- (1) Safety regulations for personnel working in the actuator's operating area  
Safety regulations for personnel working in the actuator's operating area should include, but not be limited to, the following:
  1. Basic robot operations such as starting, stopping and switch handling.
  2. Robot speed during teaching procedures.
  3. Communications, including signals, among operators when the robot is operated by more than one person.
  4. Emergency procedures to be taken for malfunctions or abnormal operations of the robot.
  5. Procedures to be taken for verifying recovery from abnormal conditions and confirming safety conditions before restarting the robot after it is stopped by an emergency stop device.
  6. Procedures to be taken to prevent accidents caused by inattentive operation or mishandling of the robot.
    - Notices on the operator's station.
    - Precautions as needed to assure the safety of personnel in the robot's area of operation.
    - The exact location of personnel during work.
    - Procedures to be taken to prevent malfunctions arising from electrical noise.
    - Communications, including signals, between personnel in the actuator operation area and operators of robot and other devices.
    - Procedures to determine the cause of a malfunction.
  7. The safety regulations must be appropriate for the robot type, installation place and work details, etc.
  8. When creating the safety regulations, an effort should be made to obtain the opinions of the related personnel, manufacturer's engineers and labor safety consultants, etc.
- (2) Notices on the operator's station  
Install notices on robot switches to alert personnel that work is underway in the robot operation area and lock the cover to the operator's station.



- (3) Precautions as needed to assure the safety of personnel in the robot's area of operation  
To secure the zone of robot operation, take measures such as but not limited to the following.
1. Assign a guard to watch the robot operating area to prevent unauthorized persons from entering the operating zone. The guard should be trained to activate emergency stop devices.
  2. Personnel working inside the operating zone should carry emergency stop switches.
  3. The operator should use a portable operator's station that can be used to turn ON or OFF power to the robot, oil pressure devices, and pneumatic devices.
- (4) Pre-operation inspections before teaching or other operations  
Make the following inspections before teaching or other operations, and take the measures:
1. Turn the power switch OFF, and check the external power supply for damage.
  2. Test the actuator to make sure it moves properly.
  3. Inspect the control devices and emergency stop devices.
  4. Check for leakage in pneumatic pressure lines and hydraulic oil lines.
- (5) Cleaning of tools  
Procedures for cleaning robot hand tools, such as paint spray nozzles, should be automated so operators do not have to enter the actuator's operating area.
- (6) Releasing of residual pressure  
Release residual pressure before disassembling or changing parts in a pneumatic system.
- (7) Operation for confirmation  
Do not enter the actuator's operating area zone to confirm proper operation.
- (8) Illuminance  
Maintain proper lighting at the work site.

[Automatic operation]

- (1) Notice at the start  
Before beginning operation, confirm the following items and confirm communication procedures including hand signals among operators.
1. Make sure no one is inside the actuator operating area.
  2. Portable operator stations, tools and devices are located at their assigned sites.
  3. Indicators on the robot and auxiliary devices are normal.
- (2) Procedures for automatic operation and malfunctions
1. After start, confirm that the indicator shows automatic operation is underway.
  2. Before personnel enter the robot's zone of operation to recover the robot or related devices from a malfunction, the operator must activate the emergency stop device and attach an "under repair" message to operation switches and take other measures to prevent others from starting the robot.



## ■ 1.3 Warranty

### ■ 1.3.1 Warranty period

The warranty period of the product is one of the periods below, whichever is reached first.

- (1) 12 months after our factory shipping
- (2) 4000 hours of operation

### ■ 1.3.2 Warranty coverage

- (1) This warranty covers this product. The scope of the warranty applies to the specifications and functions of this product that were stipulated in the specifications, catalog, instruction manual, and other documentation. We will not be liable for any secondary or incidental damage as a result of breakdowns of this product.
- (2) During the warranty period of this product, we will repair free of charge only breakdowns that occur for operation and usage performed in accordance with the instruction manuals provided with the product. Repairs will entail the return of the product to the factory. However, if service staff are sent or other measures taken based on the customer's specific circumstances, we reserve the right to invoice separately for transportation and lodging costs and for costs arising not directly related to product repair.

### ■ 1.3.3 Disclaimers

The cases below are outside the scope of the warranty.

- (1) Breakdowns and damage due to failure to use in accordance with the instruction manual or failure to pay attention during operation
- (2) Nonconformity due to the passage of time or usage wear (such as natural fading of paint and degradation of consumable parts\*1)
- (3) Nonconformity in sensory conditions (such as the occurrence of noises not affecting functionality)
- (4) When modifications or disassembly was performed without our authorization
- (5) Breakdowns or damage due to inadequate maintenance or inspection or improper repairs
- (6) Breakdowns and damage due to natural disasters, fires, or other external causes
- (7) Programs, points, and other internal data that was created or modified by the customer
- (8) When this product was purchased in Japan and taken outside the country

\*1) : Consumable parts refer to the maintenance and replacement parts (spare parts) and the parts that must be replaced periodically (such as backup batteries) shown in the instruction manual of each product.



#### ■ 1.3.4 Notes

- (1) We cannot guarantee basic performance of this product when it is used under conditions outside the product specifications.
- (2) We are not liable for any accidents, damage, or breakdowns that occur as a result of failing to follow the warning and caution information provided in this instruction manual.
- (3) The warning and caution information and other descriptions provided in this manual do not cover every possible situation imaginable.
- (4) The numerical values presented in the technical documentation were derived from calculations and are intended to serve as a reference for durability and do not constitute a warranty of any kind. Differences will arise based on the specific usage conditions.



## Chapter 2 Overview

### ■ 2.1 Features

This product is a single-axis robot controller with 24 V DC power supply that has been developed for providing a powerful features in a compact, low-cost design.

The main features and functions are shown below.

#### [Features of Axis Unit]

- Motor sensor with built-in resolver

The motor sensor incorporates a brushless resolver as standard for providing superior resistance to environmental conditions (high and low temperatures, vibrations, impact). This reduces the possibility of breakdowns under adverse operating conditions.

- Compact, high-output servo motor

A compact servo motor is used to enable high speed, high acceleration/deceleration, and high weight capacities. The high-speed performance enables reduced device cycle times.

- Absolute encoder support

This eliminates the need for troublesome origin return operations for shorter device startup times.

#### [Features of Controller]

- Program-free operation

The desired operation can be performed by simply setting the parameters and tables. Because there is no need to learn any complicated programming languages, this enables shorter system startup times and greater ease of maintenance.

- Includes torque limit function as standard, making it ideal for pressing against workpieces

Workpiece pressing operations, which required frequent use of the air cylinder before, can now be performed by the robot using the new torque limit function. This enables coordinated usage with regular positioning control for realizing energy savings and higher efficiency.

- Simple teaching

Functions are provided for jog operation and writing of the current position to the point table using system input signals only. Because teaching is possible without a computer or teach pendant, this simplifies the process of fine adjustment on-site and enables greater ease of maintenance.

- Greater range of expression

A three-color LED is used to indicate detailed information about the controller state. In particular, when an error occurs, the error code is indicated by the number of flashes by the LED for enabling quick assessment of the problem situation and shortening the time required for recovery.

- Individual settings for acceleration and deceleration

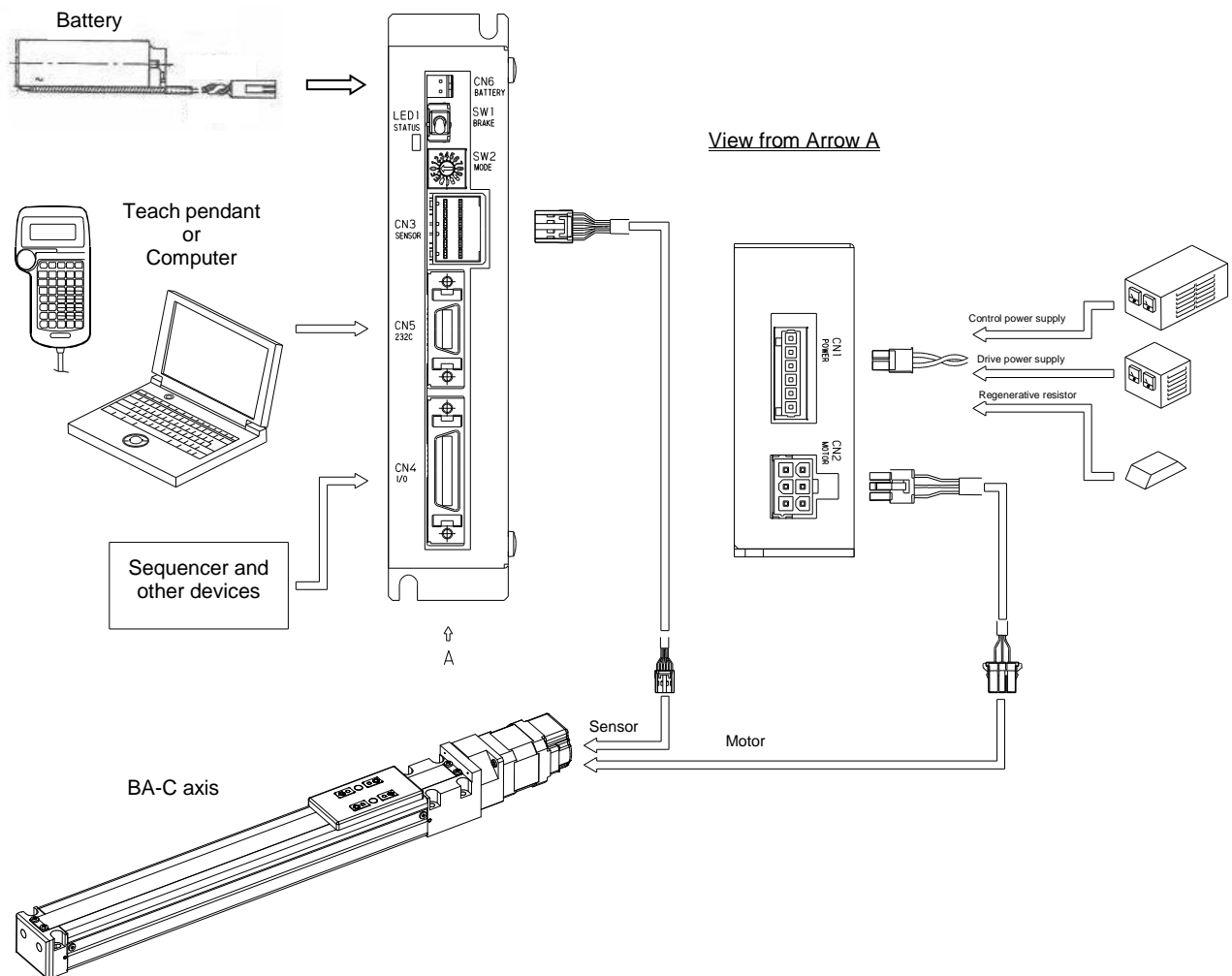
The acceleration and deceleration can now be set individually. This enables shorter tact times by allowing the setting of faster acceleration even in applications where slower deceleration is required.

- Brake release switch provided as standard

A brake release switch is included on the front of the controller.



## ■ 2.2 System Configuration



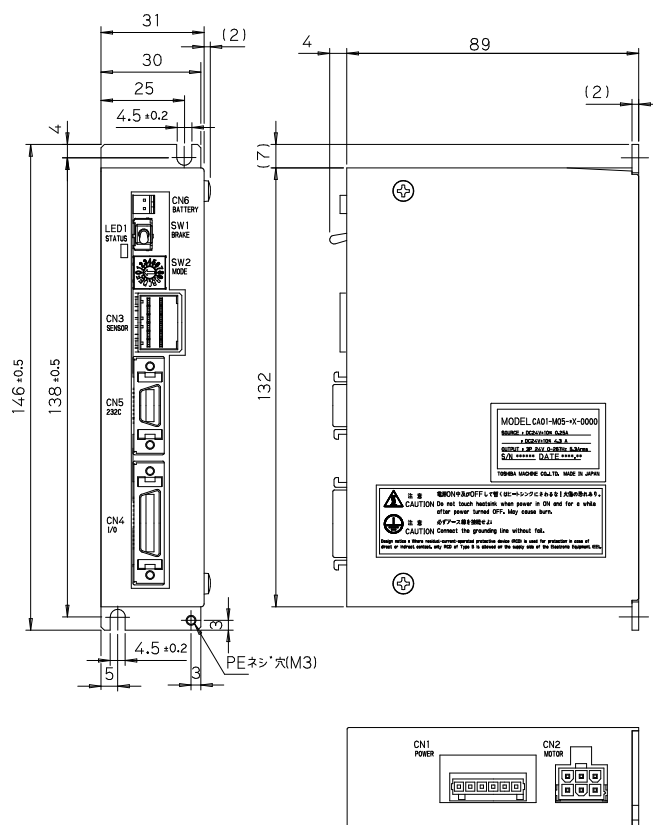


## ■ 2.3 Controller Specifications

Item		Description																				
Compatible robot		ROIbot BA-C series																				
Controller model		CA01-M05																				
Number of controllable axes		1 axis																				
Motor capacity		50 W																				
Control method		Semi-closed loop control																				
Teaching method		Remote teaching, Direct teaching or MDI																				
Speed setting		8 steps (variable)																				
Acceleration/deceleration setting		8 steps (variable)																				
Number of point tables		15 tables																				
Recording method		EEPROM (limit of 1 million rewrites)																				
Movement mode		Point mode																				
Special functions		Torque limit function																				
Emergency stop input		Included																				
Origin sensor input		Included																				
Regenerative function		Included (with external regenerative resistor mounted)																				
Dynamic brake function		None																				
Mechanical brake drive output		24 V DC -0.4 A or less (for non-excitation operation holding brake) Manual reset is possible by Brake Release Switch (SW1)																				
Protective functions	Hardware errors	Sensor error, Drive power supply error, Non-volatile memory error, Overheat error, and more																				
	Software errors	Overspeed, Overload, Positional deviation exceeded and more																				
	Warnings	Drive power supply shut off, Low battery voltage																				
Status indicators		Status LED (LED1) indicators <ul style="list-style-type: none"><li>Normal mode (SW2 is set to 0)<table><tr><td>Servo OFF</td><td>: Green (solid)</td><td>Servo ON</td><td>: Green (flashing)</td></tr><tr><td>Drive power OFF</td><td>: Orange (solid)</td><td>Low battery voltage</td><td>: Orange (flashing)</td></tr><tr><td>Power supply shutoff request</td><td>: Red (solid)</td><td>Error</td><td>: Red + Green (flashing)</td></tr></table></li><li>Boot mode (SW2 is set to F)<table><tr><td>Normal end</td><td>: Green (solid)</td><td>Abnormal end</td><td>: Red (solid)</td></tr><tr><td>Boot standby</td><td>: Red + Green (flashing)</td><td>Boot in progress</td><td>: Red + Green (flashing)</td></tr></table></li></ul>	Servo OFF	: Green (solid)	Servo ON	: Green (flashing)	Drive power OFF	: Orange (solid)	Low battery voltage	: Orange (flashing)	Power supply shutoff request	: Red (solid)	Error	: Red + Green (flashing)	Normal end	: Green (solid)	Abnormal end	: Red (solid)	Boot standby	: Red + Green (flashing)	Boot in progress	: Red + Green (flashing)
Servo OFF	: Green (solid)	Servo ON	: Green (flashing)																			
Drive power OFF	: Orange (solid)	Low battery voltage	: Orange (flashing)																			
Power supply shutoff request	: Red (solid)	Error	: Red + Green (flashing)																			
Normal end	: Green (solid)	Abnormal end	: Red (solid)																			
Boot standby	: Red + Green (flashing)	Boot in progress	: Red + Green (flashing)																			
System input		24 V      7 mA      10 inputs																				
System output		30 V max.   100 mA max.   8 outputs																				
Communication function		RS-232C   1 channel (9600 bps) For teach pendant, computer software (SF-98D)																				
Control power supply voltage		24 V DC   ±10%																				
Drive power supply voltage		24 V DC   ±10%																				
Control power supply capacity		0.25 A																				
Drive power supply capacity		Based on axis model. Rating 3 A (Max. 9 A)																				
Environmental conditions		Operating temperature range	0 to 40°C																			
		Operating humidity range	90% max. (no condensation)																			
		Storage temperature range	-10 to 85°C																			
		Storage humidity range	90% max. (no condensation)																			
		Environment	Indoor (not exposed to direct sunlight), maximum altitude of 1000 m, location not exposed to dust, dirt, corrosive gases, or flammable gases																			
		Vibrations/Impact	4.9 m/s² max. / 19.6 m/s² max.																			
Dimensions		31(W) × 146(H) × 89(D) (not including screw protrusions)																				
Weight		Approx. 0.25 kg																				

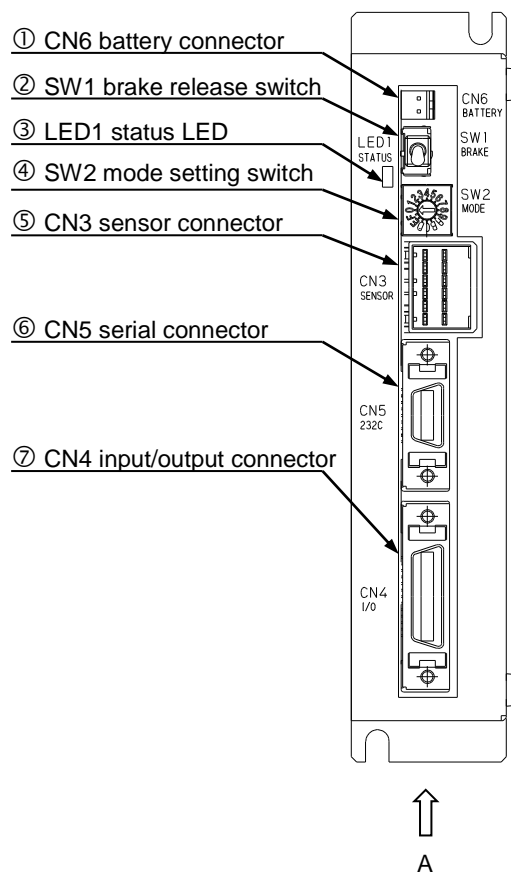


## ■ 2.4 External Dimensions

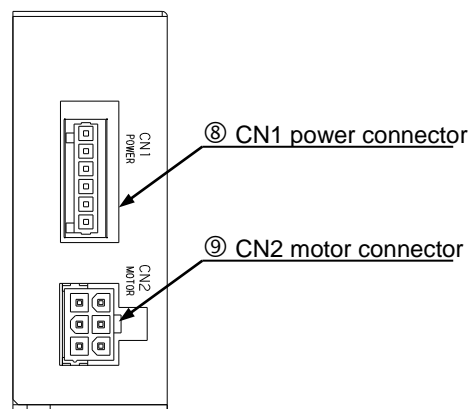


## ■ 2.5 Names and Functions of Each Part

### ■ 2.5.1 Explanation of the controller



View from Arrow A





### ① CN6 battery connector

This is a connector for connecting the resolver ABS backup battery.

For details on the battery connector, refer to section エラー! 参照元が見つかりません。.

### ② SW1 brake release switch

This is a momentary switch for manually releasing the brake.

The brake is manually released while the lever is raised to the up position, and the brake returns to normal brake control when the lever is released.



Use caution when manually releasing the brake. It could drop suddenly, resulting in damage to the workpiece or robot hand or entanglement of the operator's hand.

### ③ LED1 status LED

This uses three colors to indicate the controller status.

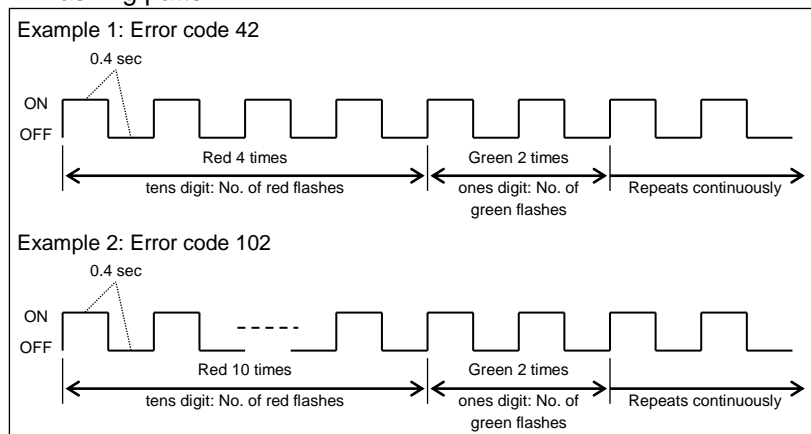
#### I. Normal mode (SW2 is set to 0)

Priority	Color	Status 1	Status 2	Flashing pattern
High	Flashing red + green	Error detected Error code: Flashes red to indicate value of tens digit. Flashes green to indicate value of ones digit		①
↓	Solid red	Power supply shutoff request (*1)		—
↓	Flashing orange	Low battery voltage (*2)		②
↓	Solid orange	Servo OFF	Drive power supply OFF	—
↓	Solid green		Drive power supply ON	—
Low	Flashing green	Servo ON		②

(\*1) If this status occurs, shut off the control power supply and drive power supply.

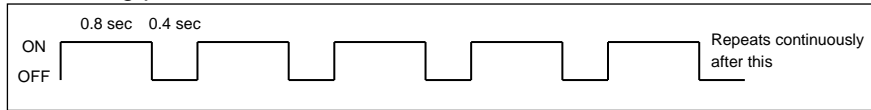
(\*2) This is enabled when the sensor type is set to 1 (refer to section ■ 3.4.15).

#### ● Flashing pattern ①





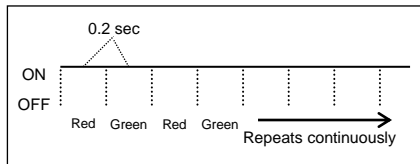
● Flashing pattern ②



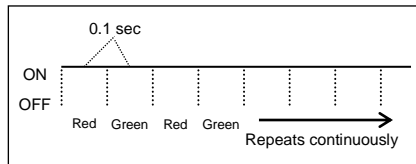
II. Boot mode (SW2 is set to F)

Color	Status	Flashing pattern
Flashing red + green	Boot standby	③
	Boot in progress	④
Solid green	Normal end	—
Solid red	Abnormal end	—

● Flashing pattern ③



● Flashing pattern ④



④ SW2 mode setting switch

This switch is for setting the operating mode.

Setting	Operating mode	Description
0 (*1)	Operation mode	This is the mode where operation is performed.
	Teaching mode	This is the mode where teaching is performed. The current position can also be written to the "② Coordinate value" of the point table.
1 to E	Not used	—
F	Boot mode	This is a mode for updating the firmware.

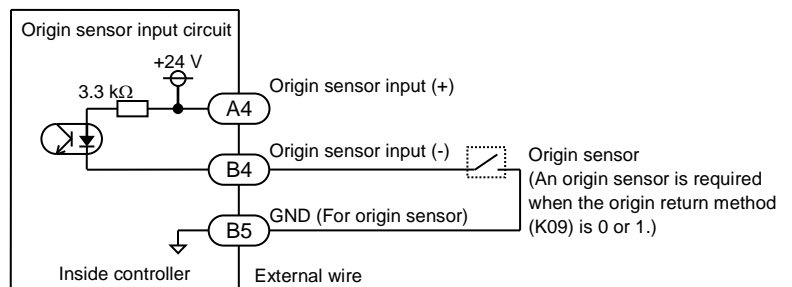
\*1) Operation mode or Teaching mode is selected by Operation/Teach switching input (IN6). (Refer to section ■ 4.2.5.)

⑤ CN3 sensor connector

This is a connector for connecting the motor sensor cable.

Pin No.	Signal name
A1	S2 (Resolver output)
B1	S4 (Resolver output)
A2	S1 (Resolver output)
B2	S3 (Resolver output)
A3	R1 (Resolver excitation)
B3	R2 (Resolver excitation)
A4	Origin sensor input (+)
B4	Origin sensor input (-)
A5	N.C.
B5	GND (For origin sensor)
A6	N.C.
B6	GND (Shield)

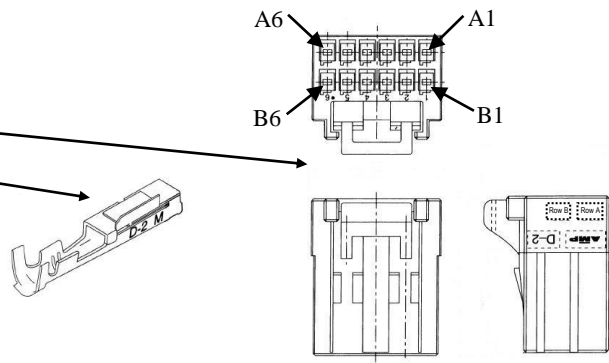
N.C.: No Connection





- Cable-side connector model

Receptacle housing 1-1318118-6  
 Terminal 1318108-1  
 Manufacturer Tyco Electronics AMP



- Controller-side connector model

Tab header 1376020-1  
 Manufacturer Tyco Electronics AMP

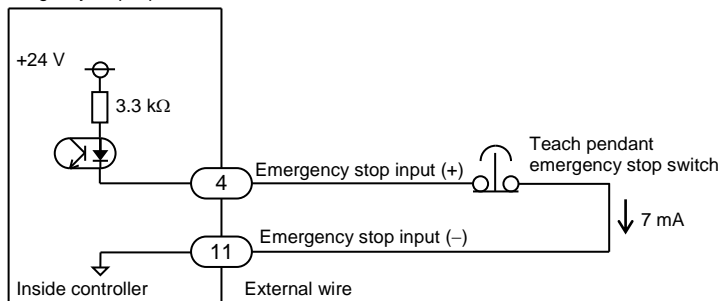
## ⑥ CN5 serial connector

This is an RS-232C connector for connecting the teach pendant (TPH-4C) or the communication cable (PCBL-31) for computer connection.

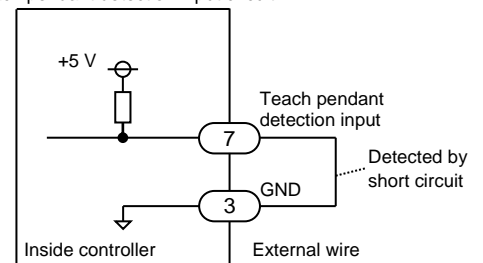
Pin No.	Signal name	Notes
1	+24 V	
2	GND	
3	GND	
4	Emergency stop input (+)	Enabled only during teach pendant detection
5	TXD	
6	RXD	
7	Teach pendant detection input	Teach pendant detection by short circuit with No. 3
8	GND	
9	N.C.	
10	N.C.	
11	Emergency stop input (-)	Enabled only during teach pendant detection
12	+5 V	
13	FG	
14	N.C.	

N. C.: No Connection

Emergency stop input circuit



Teach pendant detection input circuit



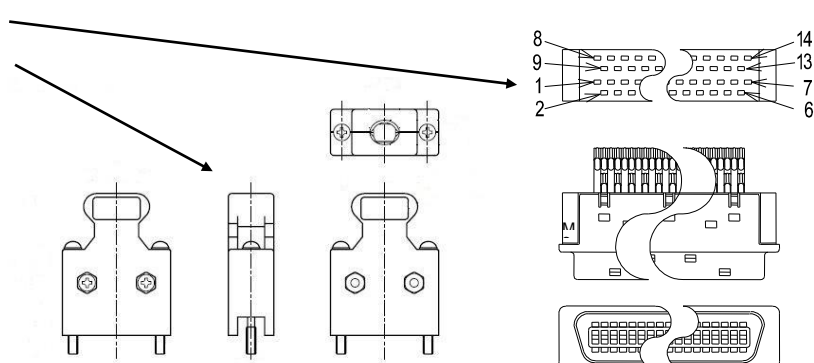


● Cable-side connector model

Plug 10114-3000PE  
Shell kit 10314-52A0-008  
Manufacturer 3M

● Controller-side connector model

Receptacle 10214-52A2PL  
Manufacturer 3M



⑦ CN4 input/output connector

This connector consists of system input/output and emergency stop input, and it is connected to a sequencer or other device for performing external control of the robot.

For details of the input/output connector, refer to Chapter 4.

⑧ CN1 power supply connector

This connector inputs the control power supply and drive power supply.

Pin No.	Signal name	Notes	Reference section
1	GND (Drive power supply)	Connected with pin No. 3 inside the controller	■ 2.7.3
2	24 V DC (Drive power supply)		
3	GND (Control power supply)	Connected with pin No. 1 inside the controller	
4	24 V DC (Control power supply)		
5	PA	Connected to external regenerative resistor	■ 2.7.8
6	JP1	Connected to external regenerative resistor	

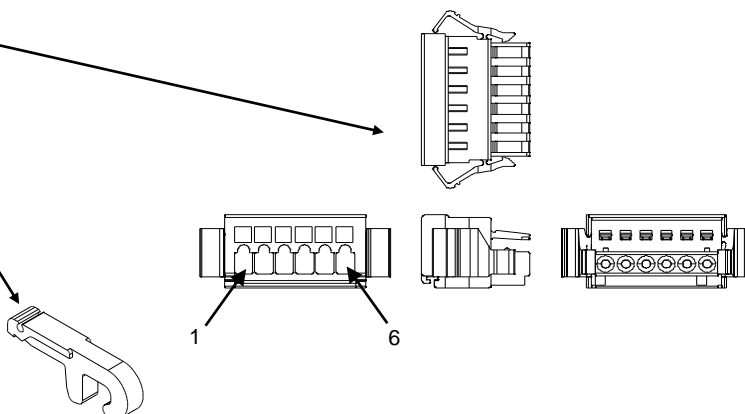
**NOTE** For the selection of power supply, refer to section ■ 2.7.1.

● Cable-side connector model

Plug 734-106/037-000  
Pushbutton 734-230  
Manufacturer WAGO

● Controller-side connector model

Header 734-166  
Manufacturer WAGO





### ⑨ CN2 motor connector

This is a connector for connecting the motor cable.

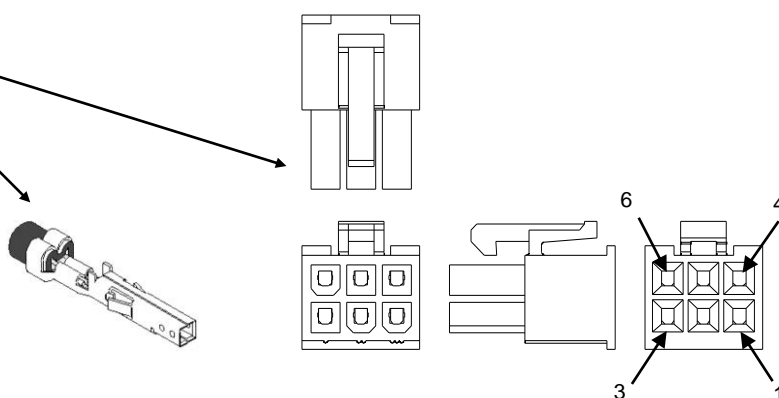
Pin No.	Signal name	Notes
1	U	
2	V	
3	W	
4	F.G	
5	BK+	Brake
6	BK-	Brake

#### ● Cable-side connector mode

Receptacle housing 5557-06R  
Terminal 5556TL  
Manufacturer MOLEX

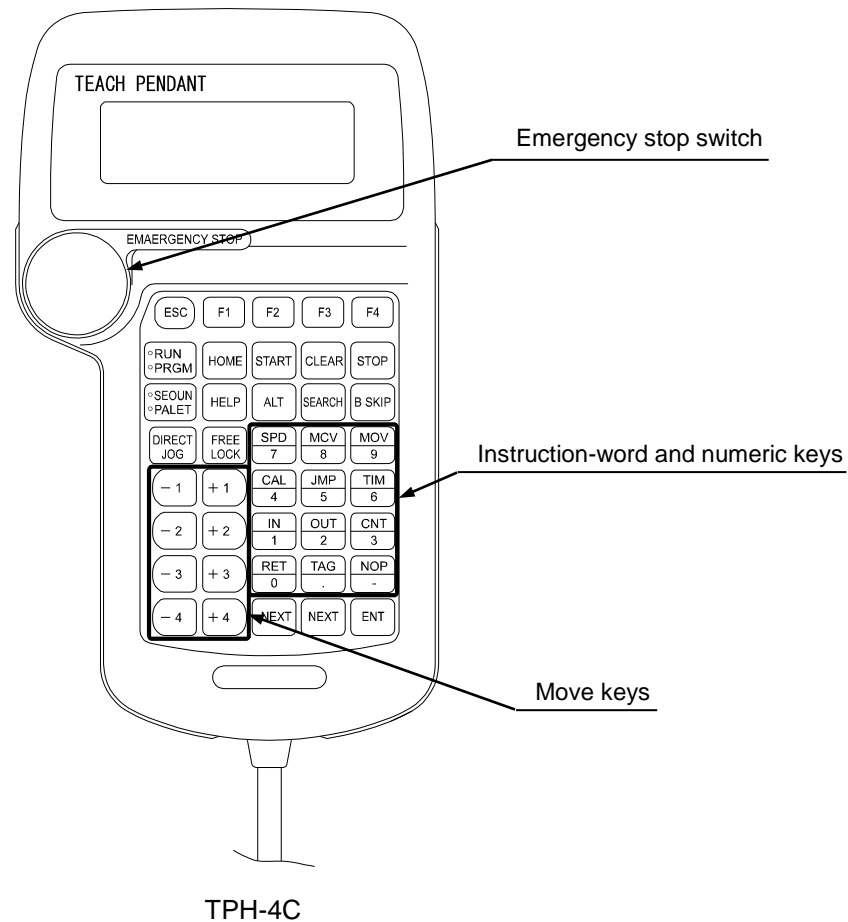
#### ● Controller-side connector model

Header 5569-06A1  
Manufacturer MOLEX





## ■ 2.5.2 Explanation of the teach pendant



- ESC key  
Exits the mode in which processing has been performed with a function key.
- F1-F4 keys  
Function keys to perform various types of processing.
- RUN/PRGM key  
Switches between RUN mode and PRGM mode. Pressing the key switches back and forth between RUN and PRGM.
- HOME key  
Returns to the origin.
- START key  
Executes the currently displayed point table.
- CLEAR key  
Clears the input items.  
Resets the error state.
- STOP key  
Stops the current operation.
- SEQUN/PALET key  
Not used with this controller



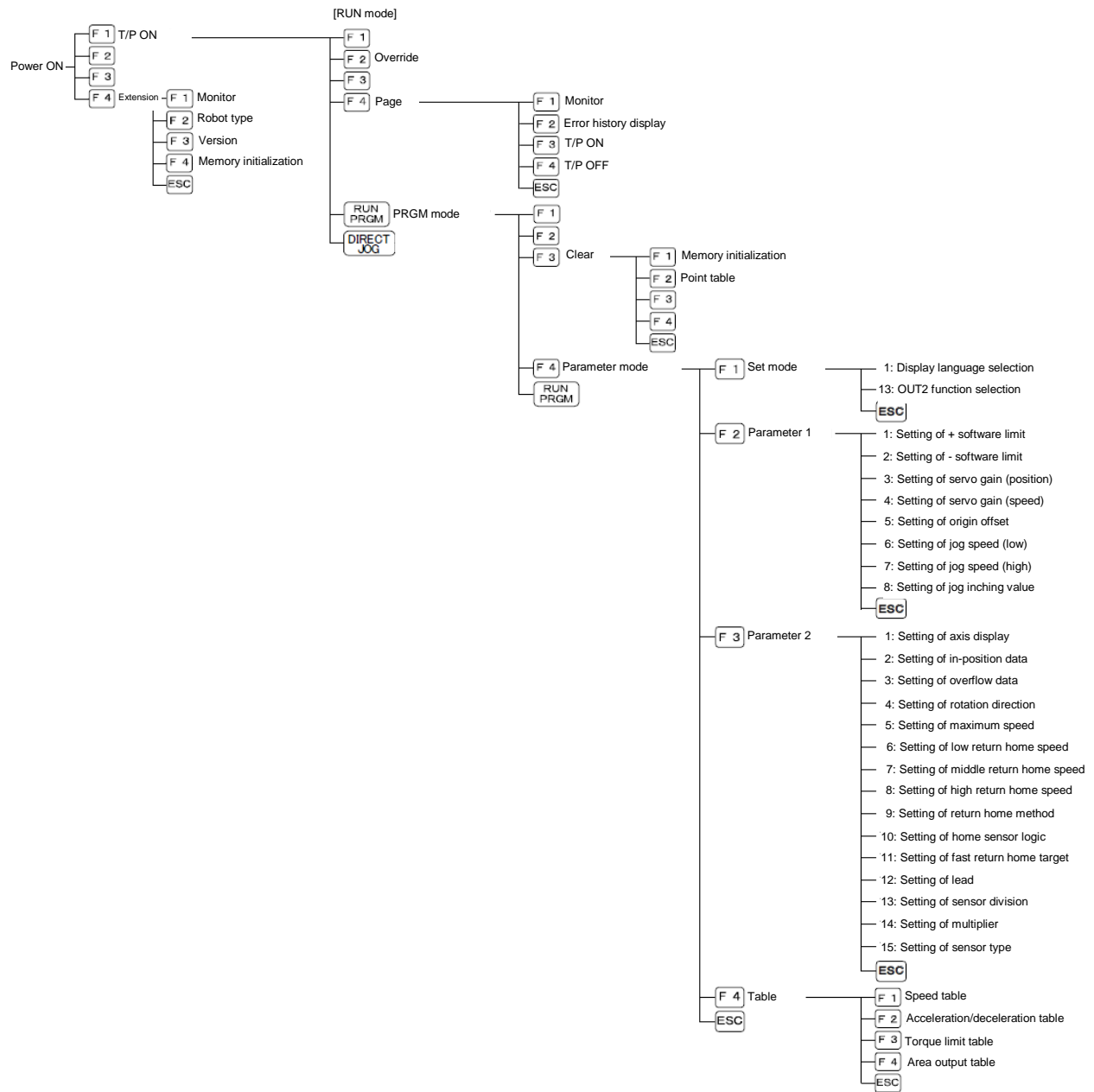
- **HELP key**  
Displays the explanation about the current function key.
- **ALT key**  
Use this key to select a new input item in place of the old one, except for numeric values, in the table and parameter mode.
- **SEARCH key**  
Use this key to search for a parameter number, table number, or error number.
- **B SKIP key**  
Moves the cursor backward.
- **DIRECT/JOG key**  
In RUN mode: When the servo lock is applied, the JOG mode (manual mode) is activated by pressing this key, so jog operation can be performed with a move key.  
In PRGM mode: When the servo lock is applied, remote teaching operation is enabled by pressing this key; when the servo lock is freed, direct teaching operation is enabled by pressing this key.
- **FREE/LOCK key**  
Applies and frees the robot servo lock.  
Before the servo can be turned on, servo-on input (IN3) must be turned on. (Refer to section ■ 4.2.3.)
- **Move keys**  
Move keys are used in the jog operation (manual operation) for the corresponding axis of the robot. While the key is held down, the corresponding axis moves, thus enabling the robot to move. The move key numbers correspond to the axes 1-4, and the plus and minus signs indicate the traveling directions of the axes.
- **Instruction-word and numeric keys**  
A numeric value is indicated on these keys which are to be used in table or parameter mode. No instruction words are used with this controller.
- **-NEXT key**  
Moves to the previous table or parameter screen.  
Moving backward by one screen consecutively can be done by holding down the key.
- **NEXT key**  
Moves to the next table or parameter screen.  
Moving forward by one screen consecutively can be done by holding down the key.
- **ENT key**  
Use this key to write a value into a table or parameter.
- **Emergency stop switch**  
This switch is of the push-lock turn-reset type. Pressing the switch stops the robot in emergency. To reset the emergency stop state, turn the switch clockwise to release the lock, and press the CLEAR key.



In the state where the servo lock is freed, the robot's moving axis is electrically disconnected from the control system, and the robot arm can be moved freely by hand. Conversely, in the state where the servo lock is applied, the robot's moving axis is connected with the control system, and it is electrically controlled in order to prevent it from being shifted. In this state, the robot arm cannot be moved easily by hand.



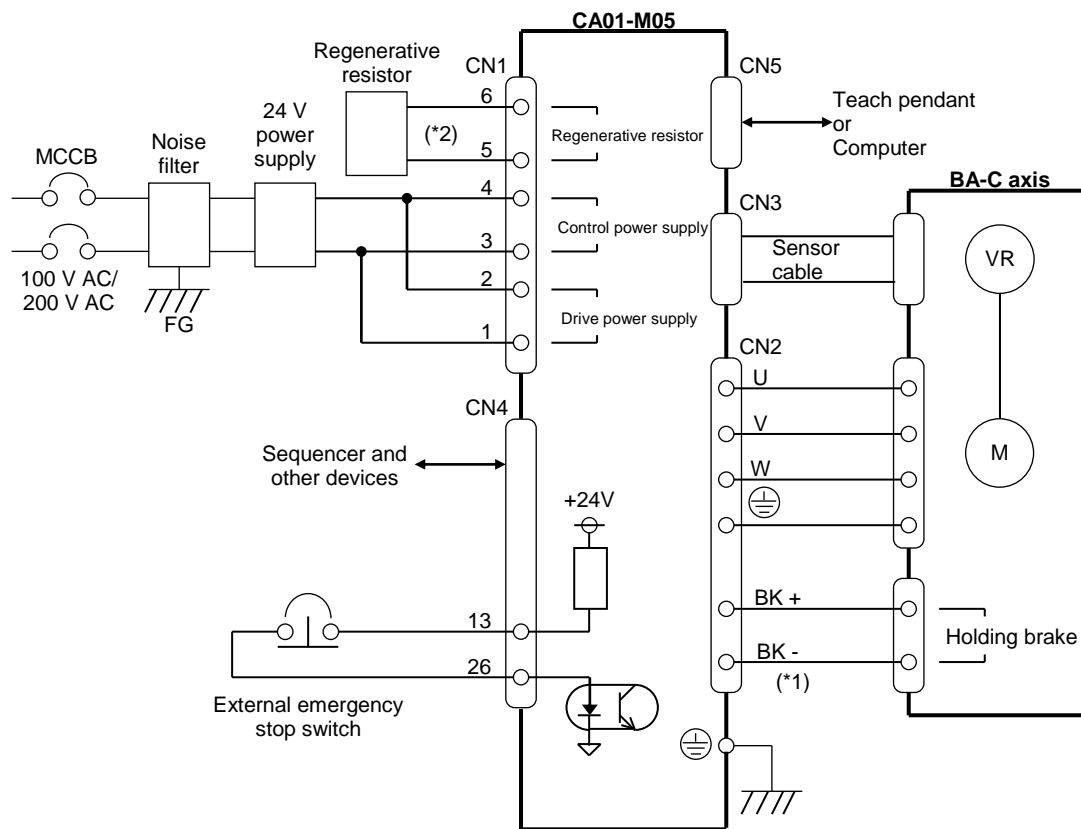
Shown below is the operation system diagram of the teach pendant.





## ■ 2.6 Connections

Please wire to CA01-M05 as shown below.



(\*1) This connection is not needed if using a motor without a holding brake.

(\*2) This connection is required when the regenerative energy is large. Refer to section ■ 2.7.8, "Regenerative Resistors".



## ■ 2.7 Procedures from Installation to Operation

The procedures for installing the robot to operating the robot are as follow.

Reference page
----------------

- |   |                                  |
|---|----------------------------------|
| 1) Selecting the power supply .....   | Section ■ 2.7.1                  |
| 2) Installing the axis .....  | Axis unit instruction manual     |
| 3) Installing the controller .....  | Section ■ 2.7.2                  |
| 4) Connecting the emergency stop circuit .....                                | Section ■ 4.1.2                  |
| 5) Connecting the axis and controller .....                                   | Section ■ 2.2                    |
| 6) Connecting with the external control unit (sequencer, etc.) .....          | Section ■ 4.1.5                  |
| 7) Connecting supply power and grounding wires .....                          | Section ■ 2.7.3                  |
| 8) Checking each wiring (Make sure that none of the polarities are mistaken.) |                                  |
| 9) Supplying the designated power supply (POWER ON) .....                     | Section ■ 2.7.4                  |
| 10) Setting the robot type .....  | Section ■ 2.7.6                  |
| 11) Setting the software limit .....  | Section ■ 3.3.1, Section ■ 3.3.2 |
| 12) Return to origin .....  | Section ■ 5.3                    |
| 13) Adjusting the servo gain .....  | Section ■ 2.7.7                  |
| 14) Setting the point table .....   | Section ■ 3.5.1                  |
| 15) Checking the point table settings (Recheck for errors.)                   |                                  |
| 16) Operation check .....   | Section ■ 5.1.1                  |
| 17) Trial operation   |                                  |
| 18) Adjustment  |                                  |
| 19) Operation   |                                  |

Operate robot with the above steps while referring to the reference page.



### ■ 2.7.1 Selecting the power supply

The power supplies for this controller are as shown in the following table. Note that, if capacity of the drive power supply is insufficient, low power output, low torque, and other problems can occur that prevent full performance during operation.

Power supply capacity

Power supply	Voltage	Capacity	Notes
Control power supply	24 V DC±10%	0.25 A	
Drive power supply	24 V DC±10%	3 A	Rated current (max. 9 A)
Input/output circuit	24 V DC±10%	0.13 A	The input and output circuits are calculated at 7 mA per input/output. However, the output circuit current varies depending on the input resistance of the connected device.

- When connecting multiple controllers

If multiple controllers are connected to a single power supply, a power capacity equivalent to the sum of the power capacities of the power supplies of each controller is required.

However, in cases where axes do not operate simultaneously, the power capacity can be reduced for the drive power supply based on the operation pattern.

Example: When connecting two controllers:

- Control-side power supply:  
 $(0.25 \text{ A (control power supply)} + 0.13 \text{ A (input/output circuits)}) \times 2 = 0.76 \text{ A or more}$
- Drive power supply:  
 $9 \text{ A} \times 2 = 18 \text{ A or more (if two robots are accelerated/decelerated at the same time)}$

- Regenerative operation

If the motor decelerates suddenly or rotary torque is applied externally, the regenerative operation can generate a back electromotive force, which can cause an increase in drive voltage.



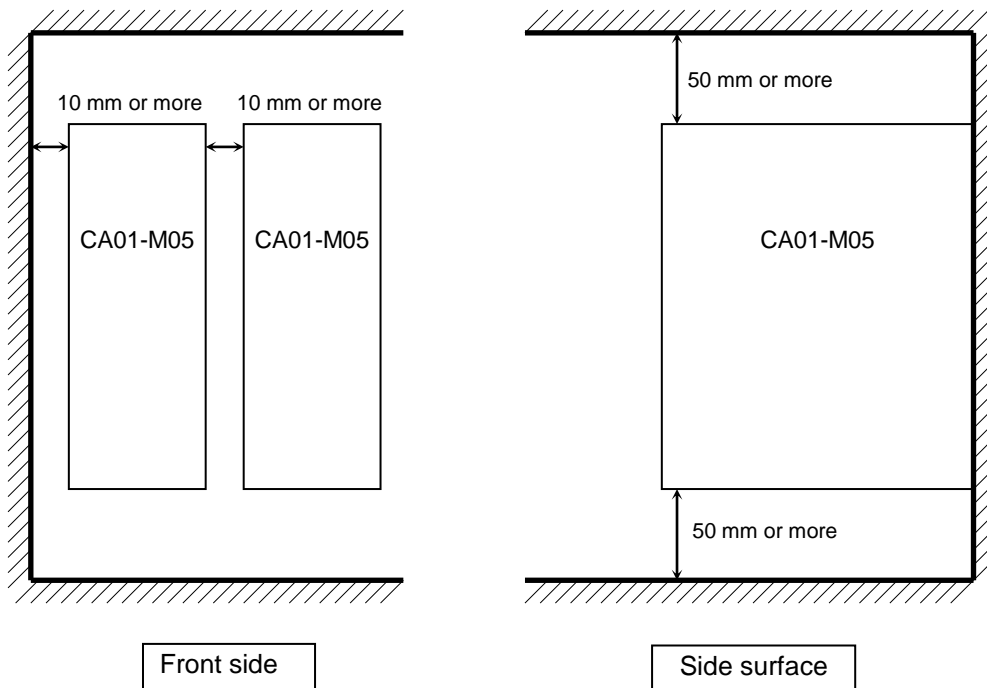
### ■ 2.7.2 Installing the controller

The controller uses a natural cooling method through convection. When installing the controller, place it in the vertical orientation as shown in the figure below, and leave a space of at least 10 mm right and left, 50 mm above and below it.

If the ventilation is insufficient, the sufficient performance will not be achieved, and faults could occur.

Make sure that foreign matter such as fluids or dust does not enter the controller from the ventilation holes. This unit does not have a dust proof structure. Avoid use in dusty places.

If the ambient temperature exceeds +40°C, install cooling fans or implement other cooling measures.





### ■ 2.7.3 Supply power and grounding

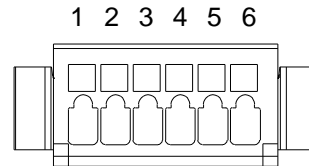
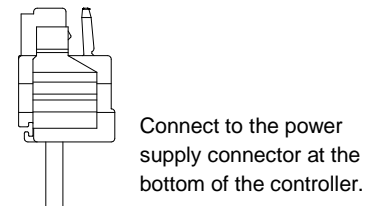
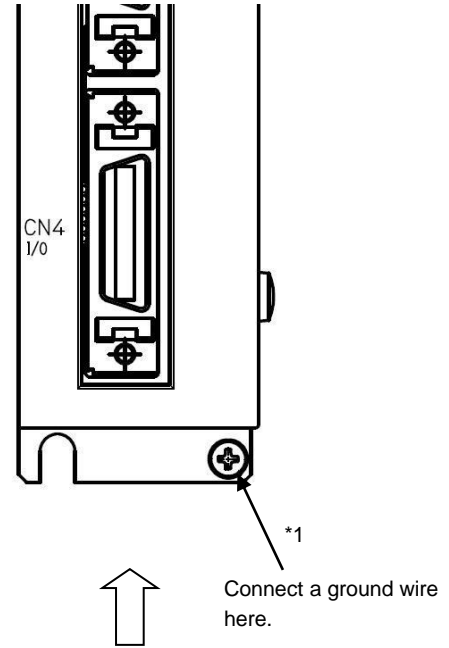
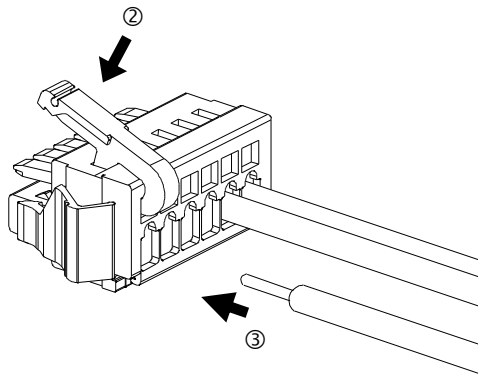
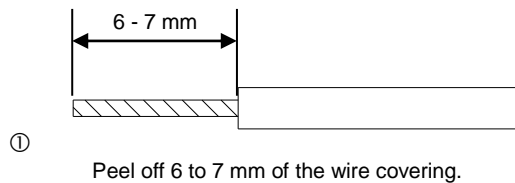
The power supply cable of the controller is connected as shown below.

#### Power supply connector wiring procedure

- ① Peel off the covering of the wires.  
Uncovered wire length: 6 to 7 mm
- ② Open the wire terminal pockets of the power supply connector.  
Fit on the connection lever supplied with the controller, and press it in the direction of the arrow in the figure below to open.
- ③ Insert the uncovered wire section into the opening.  
After inserting, release the pressure of the connection lever.

\* Insert the wire firmly all the way inside.

\* Be careful that you do not form a short-circuit with an adjacent wire.



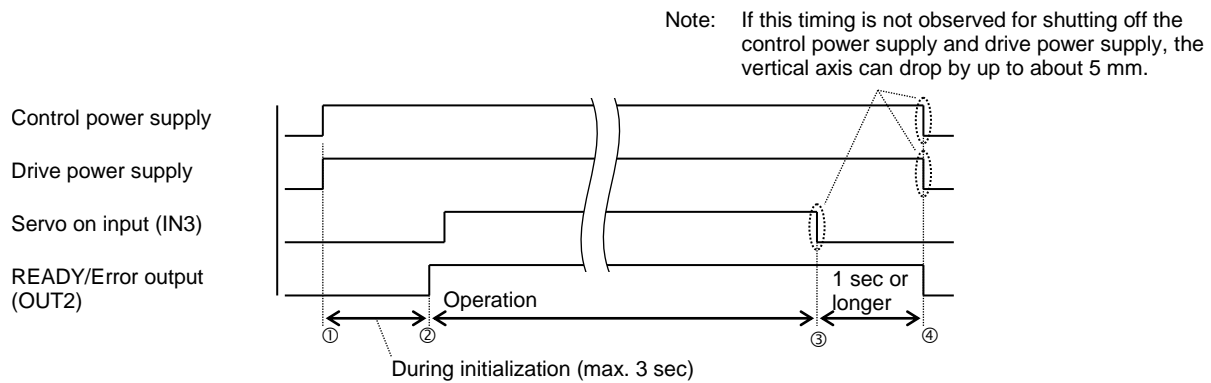
The pin number indicators are not shown on the wire connectors. As shown in the figure, they are numbered 1, 2, ... 6 from the left.

Pin No.	Signal name	Remarks
1	GND ( Drive power supply)	Internally connected with pin 3
2	24 V DC ( Drive power supply)	
3	GND ( Control power supply)	Internally connected with pin 1
4	24 V DC ( Control power supply)	
5	PA	Connected to external regenerative resistor
6	JP1	Connected to external regenerative resistor

\*1 Two plain washers are inserted to prevent dropping during transportation. Adjust based on your usage conditions.



## ■ 2.7.4 Power supply on/off timing



### Power-on sequence

- ① Turn on the control power supply and drive power supply.
- ② Start operation after at least 3 seconds has elapsed from ①.  
If OUT2 is assigned to READY/error output, start operation after OUT2 is set to ON.

### Power-off sequence

- ③ When operation is completed, set the servo on input (IN3) to OFF.
- ④ Shut off the control power supply and drive power supply after at least 1 second has elapsed from ③.

**Failure to observe this timing can cause the vertical axis to drop by up to about 5 mm.**



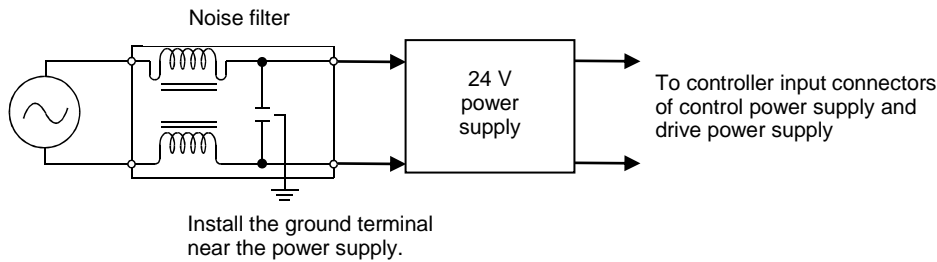
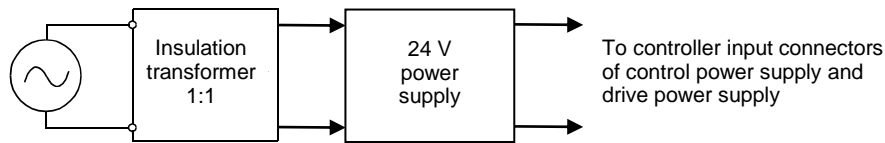
If the control power supply and drive power supply are shut off while the servo on input (IN3) is still ON, the vertical axis can drop by up to about 5 mm. The drop distance varies depending on the axis lead and load weight. Be sure to organize the sequence so that the servo on input (IN3) is always set to OFF before shutting off the control power supply and drive power supply.



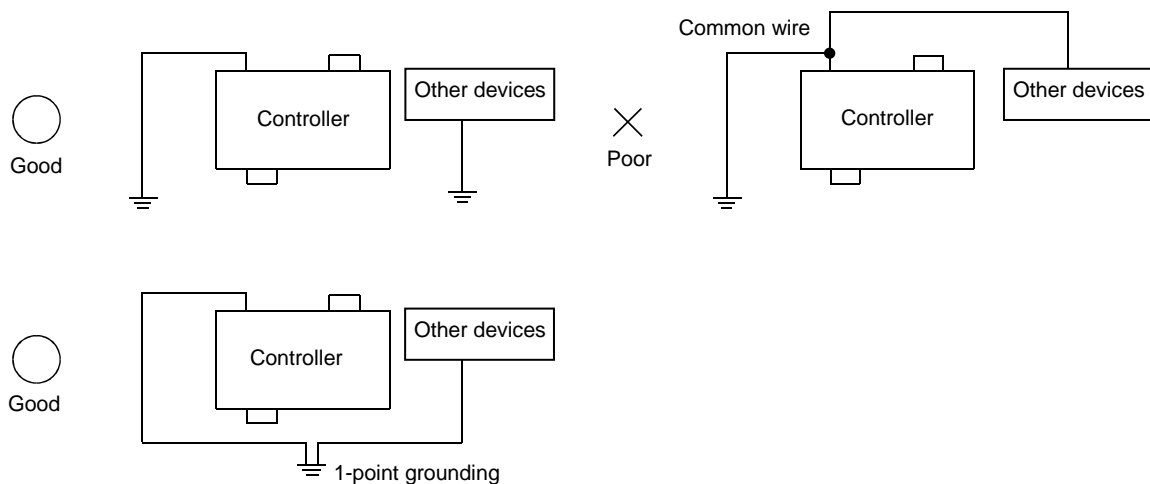
## ■ 2.7.5 Improvement of noise resistance

Using the following measures to further improve the noise resistance is recommended.

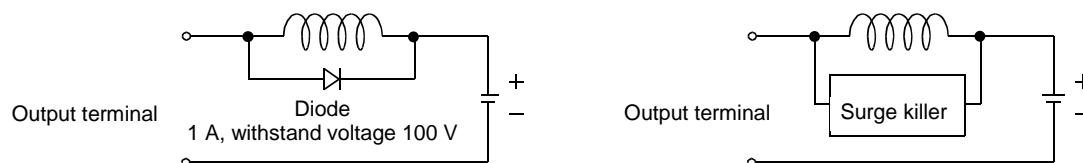
- Insert a power line insulation transformer (1:1) or noise filter.



- Avoid installing the controller near high-voltage devices (induction hardening machines, electric welding machines, etc.).
- Install the controller at a position 200 mm or more away from the power wire.
- When treating the input/output signal and controller cables, if the high voltage wires and power wires are bundled together, malfunctioning could occur due to induction. Thus, separately wire these wires.
- Use Class 3 or higher grounding (grounding resistance 100  $\Omega$  or less) for the controller grounding.
- If the grounding wire is used also for other devices, an adverse effect could occur.



- When connecting induction load to the output, connect a diode or surge killer in parallel.





### ■ 2.7.6 Setting the robot type

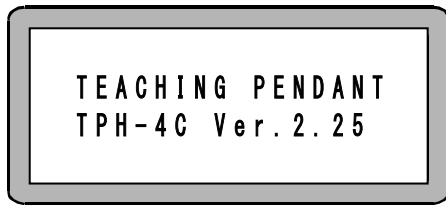
Setting the robot type enables automatic setting of various parameter values for the axes that are used.

- Setting range : 000000 to 999999
- Initial value : 700000
- For the robot type values, refer to the actuator instruction manual.
- When the robot type is changed, the parameters in the table below are automatically set. To change the parameters below individually, make the settings after changing the robot type.
- To return to the specific settings for that robot type after changing the parameters in the table below individually, set to a different robot type (such as 700000), and then set to the desired robot type.

Parameter No.	Parameter	Parameter No.	Parameter
P03	Servo gain (position)	K07	Medium return home speed
P04	Servo gain (speed)	K08	High return home speed
K02	In-position data	K09	Return home method
K03	Overflow data	K10	Home sensor logic
K04	Rotation direction	K12	Lead
K05	Maximum speed	K13	Sensor division
K06	Low return home speed		

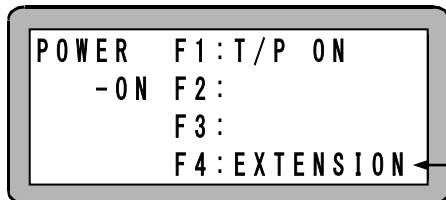


Set the robot type according to the following procedure:

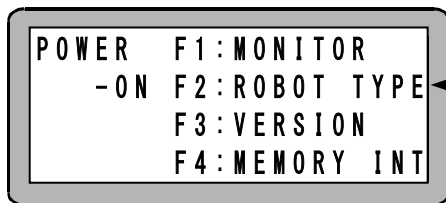


**STEP 1** The initial display is shown for two seconds after the power is turned on.

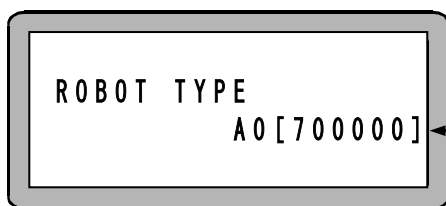
\* The display format and version vary depending on your teach pendant.



**STEP 2** When the next screen as shown here appears after the initial display, press the **F4** key.



**STEP 3** Press the **F2** key to select robot type input. Pressing the **ESC** key returns to STEP2.



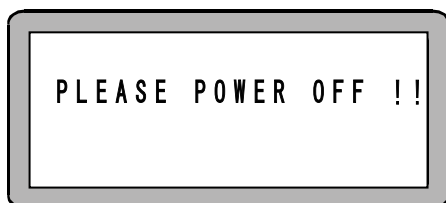
**STEP 4** Enter the robot types, using the numeric keys, and press the **ENT** key. The robot type is set by doing so. If the robot type has been changed, pressing the **ESC** key moves to STEP5. If the robot type is not changed, pressing the **ESC** key returns to STEP3.



- For the robot type (a 6-digit number), refer to the actuator instruction manual.

**NOTE**

- When only checking the robot type, do not press the **ENT** key in STEP4, and simply press the **ESC** key to return to STEP3.



**STEP 5** Turn off the controller according to the displayed message.

**NOTE**

- Turn off the controller after entering the robot type. Otherwise, the robot type is not written into the controller.
- If an attempt is made to set a non-existing robot type, the buzzer sounds and at the same time an error message (robot no. error) is displayed.



### ■ 2.7.7 Servo gain adjustment

There are two kinds of gain in the servo mechanism of this ROlbot BA-C: position gain (P03) and speed gain (P04). They are set through parameter 1.

Generally, a larger servo gain enables higher speed response in the servo mechanism and a smaller servo gain enables smooth movement of the ROlbot BA-C. An inappropriate gain setting can cause increased overshoot or undershoot. It can also result in vibration and noise. Normally, a relatively safer servo gain is set automatically when the Robot Type (six-digit figure) to use is entered. However, when you have to adjust the gain according to actual load conditions of the ROlbot BA-C, adjust it following the instruction below.

#### **NOTE**

There are 99 gain settings, 0 to 98. To change the gain, change the Robot Type's preset value (section ■ 2.7.6) one setting at a time while checking the ROlbot BA-C movement.

The gain of 99 is for manufacturer adjustment. Do not make this setting.

During gain adjustment, the machine can vibrate significantly or emit loud sound. Therefore, perform the adjustment in the state where the servo lock can be immediately freed or the drive power supply can be immediately turned off.

- Servo gain (position) (P03)

When high speed response is desired, set the value of the servo gain for positioning to a larger value. Note that if it is set too large, hunting (oscillation) can occur. If this happens, adjust it to a smaller setting. A smaller value will enable smoother movement of the ROlbot BA-C, but the positioning time increases with smaller values.

- Servo gain (speed) (P04)

Set the servo gain for speed at a value one lower than the level at which the motor begins to generate small vibration in servolock condition (the motor is stopped with the power ON.)

When the value is set too large, beat noise will be caused by small vibration of the motor. In this case, set it to a smaller value.

When the servo gain for speed is too low, low frequency hunting (oscillation) occurs in the motor. In this case, set the gain to a larger value. When the value is set too small, an overflow error can be generated because of the delayed response to a command of the motor.



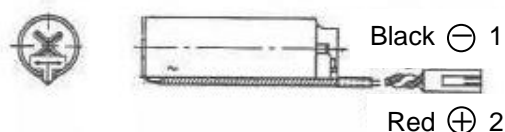
## ■ 2.7.8 Resolver ABS backup

All models of the BA-C axis AC servomotor include a resolver ABS. The power is driven by a battery to enable constant monitoring of motor operation even when the power supply to the controller is cut off and to allow smooth startup without returning to the origin when starting the system and recovering from an emergency stop.

**NOTE** If the sensor type was set to 0 (refer to section ■ 3.4.15), the absolute function does not operate even if the battery is connected.

- CN6 battery connector signal names and pin No.s.

Pin No.	Signal name
1	Gnd(-)
2	VB(+)



**NOTE** If the polarity is mistaken, the backup will not be possible and faults could occur.

- Controller-side connector model

Header IL-2P-S3FP2-1

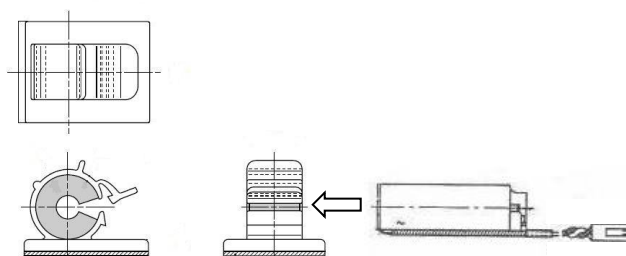
Manufacturer JAE

- Battery holder

Wire clamp SSP-518

Manufacturer Shinagawa Shoko

\* As shown in the figure at right, insert and secure the battery in the battery holder, and use by affixing to the controller top surface or other location.



- Lithium battery specifications

Item		Desciption	Remarks
Part name		Lithium battery	Thionyl chloride lithium battery
Model		ER17500V C	Manufactured by Toshiba Battery
Specification	Nominal voltage/capacity		3.6V 2700mAh
	Dimensions	Battery body	φ17×47mm (excluding protrusions)
		Harness length	50±5mm (excluding connectors)
	Weight		Approx. 20 g
Backup connection time (Note 1)		Approx. 1 year (Note 2)	25°C, Backup current 260μA

(Note 1) This is the cumulative time that the controller unit power remains in the OFF state.

(Note 2) The retention time of the battery varies depending on the temperature and other factors. Use these figures as a general guide only.



- Backup specifications

Item		Specification	Remarks
Backup voltage		3.6 V DC (Standard)	Controller front LED flashes in orange when at 3.1 V DC or less (low voltage warning) Battery error occurs at 2.5 V DC or less (Note 1)
Consumption current	When controller is in non conducting state	260 $\mu$ A (Maximum)	25°C Maximum instantaneous current: 2 mA
	When controller is in conducting state	1 $\mu$ A (Standard)	

Note 1: The LED remains flashing in orange even if the backup voltage is recovered while the power is on. Turn on the power again and check the LED indicator. And though a battery is not connected, the LED does not always flash in orange because of the impedance.



## ■ 2.8 Regenerative Resistors

Regenerative resistors are devices that absorb the energy generated when the axis unit motor is decelerated. These are used when the load inertia exceeds the allowable value or when a large load descends down a long stroke (generating a large amount of power) along the Z-axis. (The regenerative resistor prevents an overvoltage from occurring in the controller.)

\* A resistor type (CAR-0500) and a unit type (CAR-UN50) are available.

\* All discharged energy is converted to heat.

\* When the resistor generates an abnormal amount of heat, a contact output (N.C.) occurs.

\* This unit is for one axis.

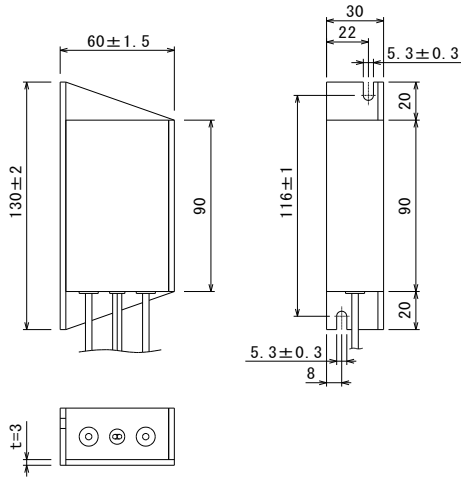
### ■ 2.8.1 Specifications

Item		Description	
Model		CAR-0500	CAR-UN50
Regenerative operation voltage		48 V DC (controller by controller)	
Cooling system		Natural air cooling	
Protective functions		Temperature relay is activated at a resistor internal temperature of 135°C Output contact: 1b Maximum switching voltage: 250 V AC/42 V DC Maximum switching current: 0.2 A AC/DC (Minimum switching current: 1 mA AC/DC)	Temperature relay is activated at a unit surface temperature of 120°C Output contact: 1b Maximum switching voltage: 110 V AC/DC Maximum switching current: 0.3 A AC/DC Maximum switching power: 6 W AC/DC (Minimum switching current: 0.1 mA/1 V DC)
Environmental conditions	Installation environment	Indoor (not exposed to direct sunlight), maximum altitude of 1000 m location not exposed to dust, dirt, corrosive gases, or flammable gases	
	Operating temperature	0 to 40°C	
	Operating humidity	90% max. No condensation	
	Operating atmosphere	No corrosive gases	
	Storage temperature	-10 to 85°C	
	Storage humidity	90% max. No condensation	
	Storage atmosphere	No corrosive gases	
	Vibrations	4.9 m/s <sup>2</sup> max.	
Dimensions		30(W) × 130(H) × 60(D)	30(W) × 146(H) × 88(D)
Weight		Approx. 0.39 kg	Approx. 0.22 kg

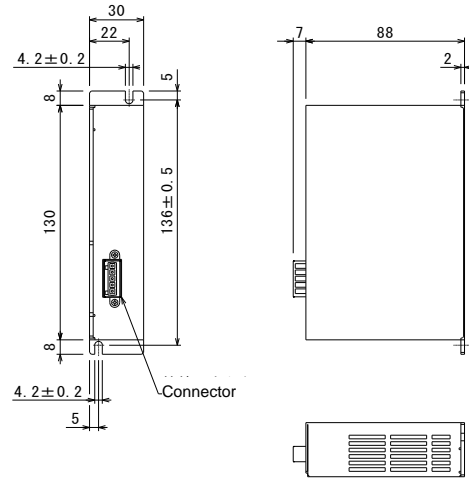


## ■ 2.8.2 External dimensions

**CAR-0500**



**CAR-UN50**



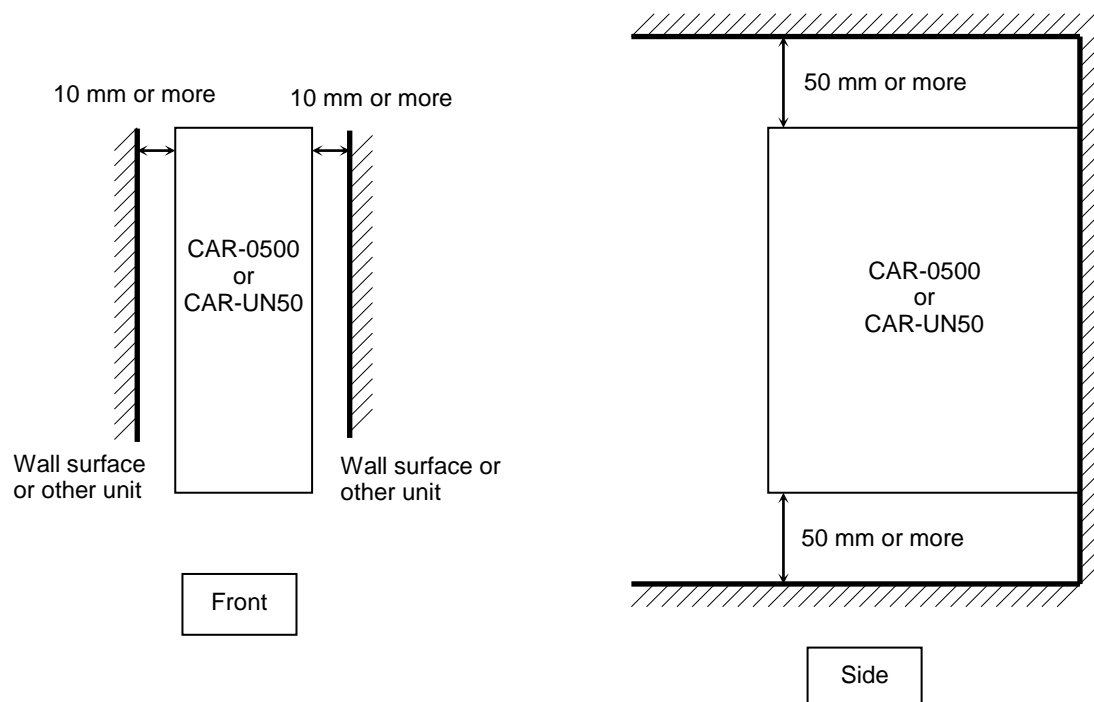
## ■ 2.8.3 Installation

The regenerative resistors use a natural cooling system based on convection currents. When installing the regenerative resistors, install it standing vertically as shown in the figure, and provide at least 10 mm of space on the right and left sides and at least 50 mm of space at the top and bottom.

If proper ventilation is not provided, the controller will not only fail to provide full performance, but a breakdown could also occur.

Be careful that liquids, dust, and other foreign objects do not get inside the regenerative resistors. The controller does not have a dust-proof structure. Therefore, avoid using it in locations with large amounts of dust or dirt.

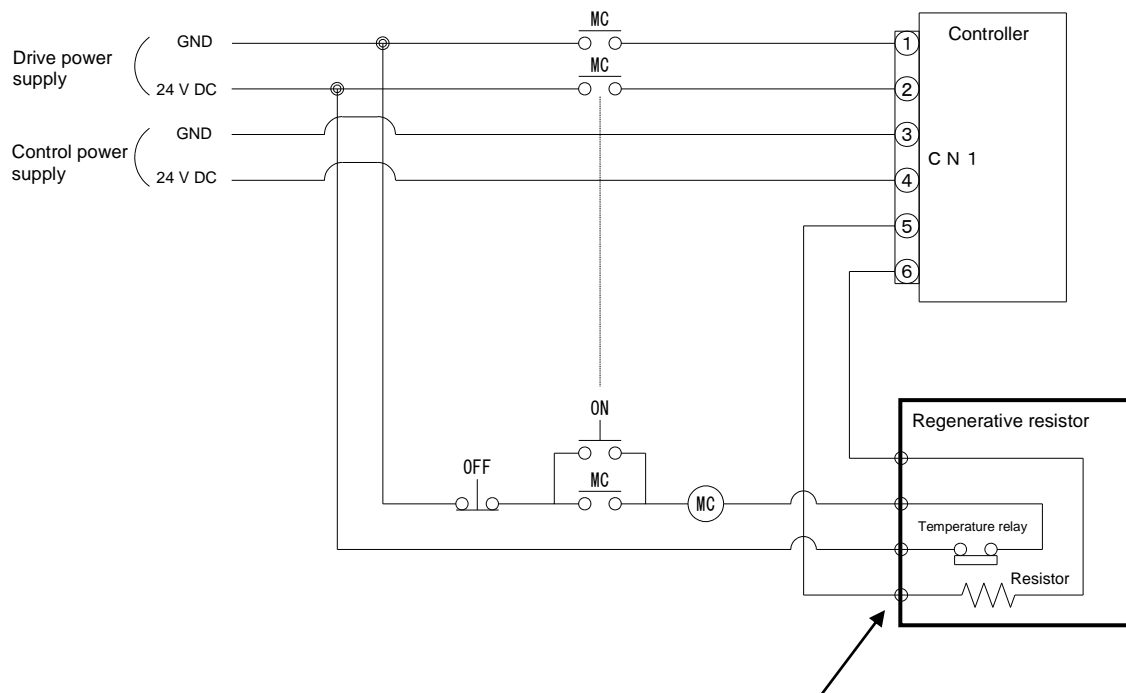
If the ambient temperature exceeds  $+40^{\circ}\text{C}$ , install cooling fans or implement other cooling measures.





## ■ 2.8.4 Connection example

Connect the controller and power supplies to the regenerative resistor as shown below.



### ● Usage Notes

- An internal temperature relay is activated when the CAR-0500 reaches 135°C and when the CAR-UN50 reaches 120°C.
- When this relay is activated, the outputs of the temperature relay are opened.
- Organize the sequence so that the drive power supply of the controller always turns off when the temperature relay is activated.
- If the temperature relay is activated momentarily, about three minutes are required until it is reset (restored to normal status).



**CAUTION**

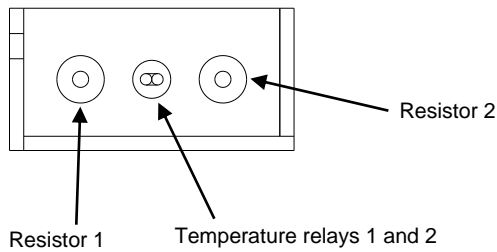
Do not touch the regenerative resistor because it becomes very hot, causing burns. Before starting inspection, let enough time pass for the regenerative resistor to cool down.



- Connection terminal

#### CAR-0500

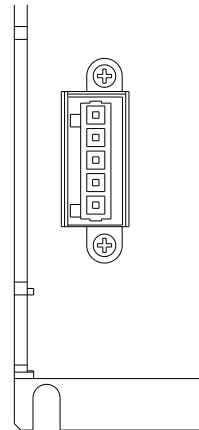
Bottom View



- \* If the length of the output lines of the temperature relay is not enough, use by connecting the supplied relay connector.
- \* The wires should be provided by the customer.

#### CAR-UN50

Front View



Pin No.	Name
1	Resistor 1
2	Resistor 2
3	Temperature relay 1
4	Temperature relay 2
5	FG

- \* The wires should be provided by the customer.

- Using the accessories

#### CAR-0500

Accessory: Relay connector × 2

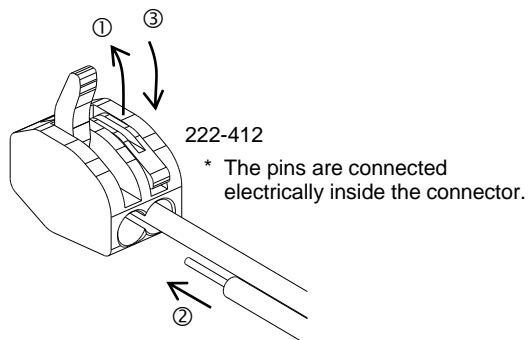
- Connector model

Plug 222-412  
Manufacturer WAGO

- Wiring procedure

- ① Raise the top lever by about 90°.
- ② Insert the wire all the way inside.
- ③ Return the top lever to its original position.
- ④ Gently pull on the wire to check that it is connected correctly.

- \* Peel off about 9 mm of the wire covering.



#### CAR-UN50

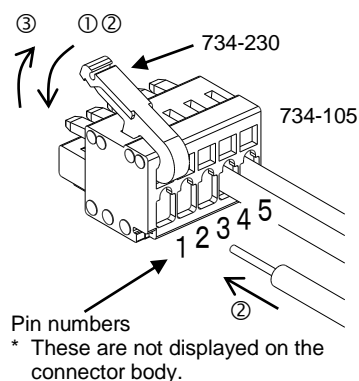
Accessory: Connector, wire connection lever

- Connector model

Plug 734-105  
Wire connection lever 734-230  
Manufacturer WAGO

- Wiring procedure

- ① Hook the supplied wire connection lever as shown in the figure below.
- ② Insert the wire all the way inside while pressing the wire connection lever downward as shown in the figure below.
- ③ Return the wire connection lever to its original position.
- ④ Gently pull on the wire to check that it is connected correctly.





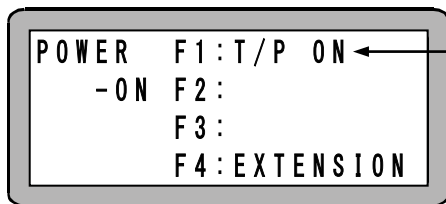
## ■ 2.9 Basic Knowledge

### ■ 2.9.1 Let's begin moving the robot.

Enter a simple program to move the robot. The following explains items 11-16 in section ■ 2.7:

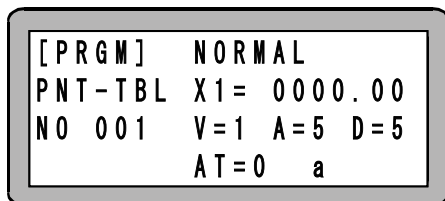
#### 11) Setting a software limit

In order to prevent the robot from overrunning, a software limit is to be set for the machine to limit the axis travel range. A software limit is the limitation of the motor drive shaft travel in the positive/negative direction by means of software, which can be easily changed unlike a limit by means of hardware.



#### STEP 1

Turn on the power. When the screen as shown here appears after the initial display, press the **F1** key. Then, activate the PRGM mode by pressing the **RUN/PRGM** key.



#### STEP 2

Enter the PARA mode (refer to section ■ 3.1), and then Parameter 1 (refer to section ■ 3.3), and set the software limit (refer to sections ■ 3.3.1 and ■ 3.3.2). After that, press the **ESC** key twice to return to this screen.

#### 12) Return to origin



#### STEP 1

Press the **HOME** key to return to the origin. The screen display is as shown here during origin return. The original display is returned when origin return is finished.



When the servo lock is freed, origin return and robot operations cannot be performed. Turn on the servo-on input (IN3) (refer to section ■ 4.2.3), and apply the servo lock with the **FREE LOCK** key.

#### 13) Adjusting the servo gain


Refer to section ■ 2.7.7.



#### 14) Setting a point table


The following is an example of setting to move the robot 100 mm in the positive direction from the origin.

```
[PRGM]  NORMAL
PNT-TBL X1= 0000.00
NO 001  V=1 A=5 D=5
        AT=0  a
```

**STEP 1** Check that the PRGM mode is active, and press the  key.

\* For point tables, refer to section ■ 3.5.1.

```
[PRGM]  NORMAL
PNT-TBL X1= 0100.00
NO 001  V=1 A=5 D=5
        AT=0  a
```



**STEP 2** Enter 100 as the coordinate value using the numeric keys, and press the  key.

#### 15) Checking the point table settings

Check for an error again.

#### 16) Operation check

```
[RUN]    NORMAL
PNT-TBL X1= 0100.00
NO 001  V=1 A=5 D=5
        AT=0  a
```

**STEP 1** Activate the RUN mode by pressing the  key. In this condition, press the  key.

```
R  U  N  !!!
```

**STEP 2** The program is executed, and the RUN screen is displayed.

This point table setting moves the robot to the specified coordinate point (100 mm) in normal operation.

```
[RUN]    NORMAL
PNT-TBL X1= 0100.00
NO 001  V=1 A=5 D=5
        AT=0  a
```

**STEP 3** The STEP1 screen is returned when the program execution is finished.



## ■ 2.9.2 Jog operation (axis operation in manual mode)

Jog operation is operating an axis in remote mode.

Use jog operation when stopping the automatic operation and moving an axis or when moving an axis during the editing of a point table.

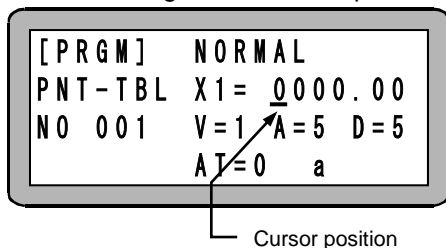
Particularly, if an axis having a brake is used, the brake is applied when the servo lock is freed, and the axis cannot be moved. Thus, use jog operation when moving the axis.




Refer to section ■ 2.9.3 for how to enter position data using jog operation.

When the teach pendant is ON, jog operation can be used in PRGM or RUN mode.


The following shows how to perform jog operation:

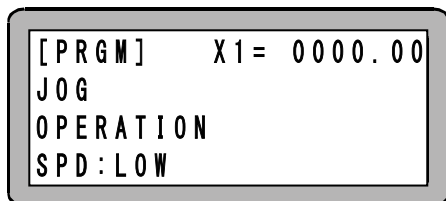


**STEP 1** Apply the servo lock in PRGM or RUN mode.


Press the  key when the cursor is not at the position on the screen at the left.

### NOTE

- If the  key is pressed when the cursor is at the above position in PRGM mode, the remote teaching mode is activated. (Refer to section ■ 2.9.3.)









**STEP 2** The jog operation screen is displayed, allowing jog operation.

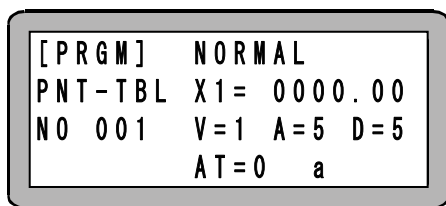
To change jog speed, use the  key.

LOW (low-speed movement), HIGH (high-speed movement)


### NOTE


- Use the / key to move an axis in jog operation. While the  key is held down, the axis is moved in the direction away from the origin; while the  key is held down, the axis is moved in the direction toward the origin.
- Jog operation can be performed even if the controller is unable to recognize the current axis position (before completion of origin return). In this condition, the software limit is not applied.
- Jog operation speed can be set by specifying the jog speed parameter of Parameter 1. (Refer to sections ■ 3.3.6 and ■ 3.3.7.)
- Inching movement in jog operation can be performed by pressing and immediately releasing the move key (/). The travel by performing inching operation once can be set by specifying the jog inching movement parameter of Parameter 1. (Refer to section ■ 3.3.8.)





### STEP 3

For example, the axis moves while the  key is held down.

Press the  key when the axis is moved to the specified point.

Now that the jog operation is released, the screen before jog operation is returned.

## ■ 2.9.3 Entering coordinate values

There are three methods to enter the coordinate value of a point table.

### (1) Remote teaching

This is a teaching method using jog operation to move the robot to a desired position.

If this is performed using system input signals, perform jog operation as shown in the example in section ■ 5.4, and enter the coordinate value of the point table as shown in section ■ 5.5.

### (2) Direct teaching

This is a direct teaching method for the position where the servo lock is freed, and the operator moves the robot directly to the desired position. If the axis has a brake, raise the SW1 (brake release switch) lever on the controller front upwards, and move the robot while releasing the brake.

If entering the coordinate value of the point table by the system input signals, refer to section ■ 5.5.

### (3) MDI (Manual data input)

In this method, numerical values are entered directly for the coordinate values.

The following explains how to enter coordinate values through the teach pendant:

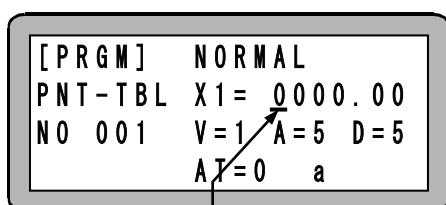


### CAUTION

Use caution when manually releasing the brake. It could drop suddenly, resulting in damage to the workpiece or robot hand or entanglement of the operator's hand.

### (1) Remote teaching method

The following shows the remote teaching method for position data:





### STEP 1

Apply the servo lock in PRGM mode.

Move the cursor to the position shown in the screen at the left, and press the  key.




**NOTE**

- Remote teaching cannot be performed when the cursor is not at the above position.  
If the  key is pressed when the cursor is not at the above position, jog operation to simply move the axis is performed. (Refer to section ■ 2.9.2.)
- If no origin return has been performed, the error buzzer bleeps when the  key is pressed, and the remote teaching mode cannot be activated.

```
[PRGM]  X1= 0000.00
REMOTE
TEACHING
SPD:LOW
```







**STEP 2**

The remote teaching screen is displayed, allowing jog operation in remote teaching mode.

To change jog speed, use the  key.



LOW (low-speed movement), HIGH (high-speed movement)

**NOTE**

- Use the / key to move an axis in jog operation. While the  key is held down, the axis is moved in the direction away from the origin; while the  key is held down, the axis is moved in the direction toward the origin.
- Jog operation speed can be set by specifying the jog speed parameter of Parameter 1. (Refer to sections ■ 3.3.6 and ■ 3.3.7.)
- Inching movement in jog operation can be performed by pressing and immediately releasing the move key (/). The travel by performing inching operation once can be set by specifying the jog inching movement parameter of Parameter 1. (Refer to section ■ 3.3.8.)

```
[PRGM]  NORMAL
PNT-TBL X1= 0010.48
NO 001  V=1 A=5 D=5
        AT=0  a
```

**STEP 3**

For example, hold down the  key and release it to stop the axis at a suitable position, and press the  key. The current coordinate will be entered.


**(2) Direct teaching method**

The following shows the direct teaching method for position data:

```
[PRGM]  NORMAL
PNT-TBL X1= 0000.00
NO 001  V=1 A=5 D=5
FREE    AT=0  a
```

Cursor position



**STEP 1**

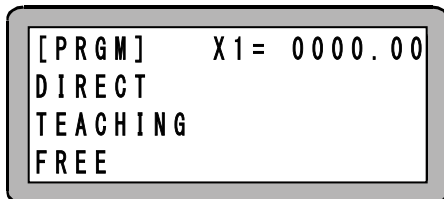
Free the servo lock by pressing the  key in PRGM mode.

Move the cursor to the position shown in the screen at the left, and press the  key.



**NOTE**

- Direct teaching cannot be performed when the cursor is not at the above position.
- When the  key is pressed, an axis having a brake is braked.
- If no origin return has been performed, the error buzzer bleeps when the  key is pressed, and the direct teaching mode cannot be activated.

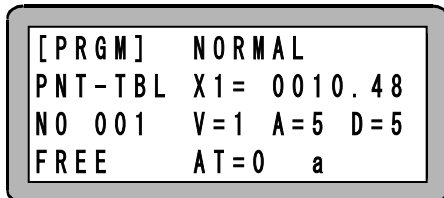


```

[PRGM]  X1= 0000.00
DIRECT
TEACHING
FREE

```


**STEP 2** The direct teaching screen is displayed, allowing direct teaching.

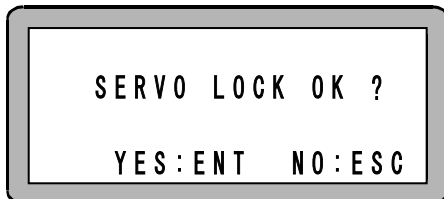


```

[PRGM]  NORMAL
PNT-TBL X1= 0010.48
NO 001  V=1 A=5 D=5
FREE    AT=0  a

```

**STEP 3** Move the axis to a suitable position by hand, and press the  key. The current coordinate will be entered.






```

SERVO LOCK OK ?

YES:ENT  NO:ESC

```

**STEP 4** This screen appears when the  key is pressed to release the servo-lock free state. The servo is locked by pressing the  key, and the STEP3 screen is returned.

To simply return to the STEP3 screen, press the  key.

**NOTE**

- An axis having a brake is braked when the servo lock is freed, so direct teaching cannot be performed. Use the remote teaching method for an axis having brake.

**(3) MDI (Manual data input) method**

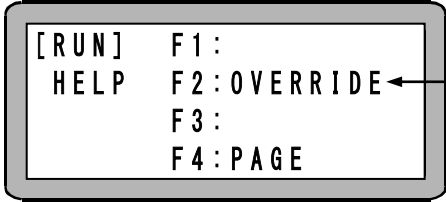
Refer to section ■ 3.5.1 for the teaching method for position data in MDI mode.



### ■ 2.9.4 Setting the override

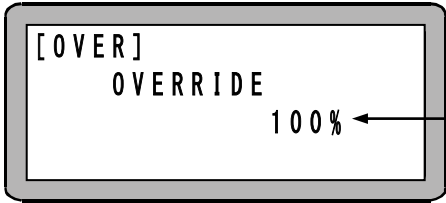
The override function can be used to slow down the overall movement speed. This can allow operation checks at device startup at low speed, for instance. However, note that the override function is disabled during jog operation, low-speed origin return, and medium-speed origin return.

- Setting range: 1 to 100
- Initial value: 100
- Units: %
- The setting value is retained even after the power is shut off.



**STEP 1** Activate the RUN mode, press the **HELP** key to display this screen, and then press the **F 2** key to activate the override mode.

---



**STEP 2** Enter a new override value, using the numeric keys, and press the **ENT** key. The old value changes to the new one, and the RUN mode is returned.  
When not changing the value, press the **ESC** key to return to the RUN mode.  
(Initial value: 100, Setting range: 1-100),

**NOTE** The override settings are enabled only when the output during operation (OUT1) is OFF.

### ■ 2.9.5 Initializing the memory

The nonvolatile memory which stores the parameters, tables, and other data can be initialized (cleared). Clear All Memory or Clear Point Table can be selected.

- After the Clear All Memory process is performed, turn off the control power supply and drive power supply, and then turn them on again. Clear All Memory cannot be enabled unless the control power supply and drive power supply are turned off first.

**NOTE** Be aware that performing the Clear All Memory process will return all data other than the error history in the memory to its initial values.

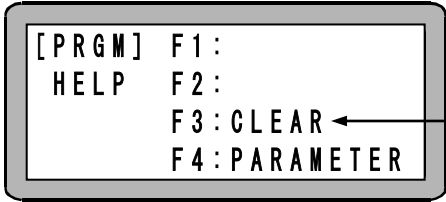
- There are two methods to perform Clear All Memory: one method performs it through the PRGM (program) mode, and the other performs it without turning on the teach pendant (T/P ON) after the power is turned on.



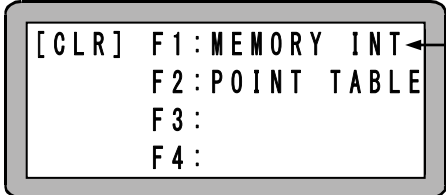
(1) Performing Clear All Memory through the PRGM (program) mode

Activate the PRGM (program) mode, and press the **HELP** key.

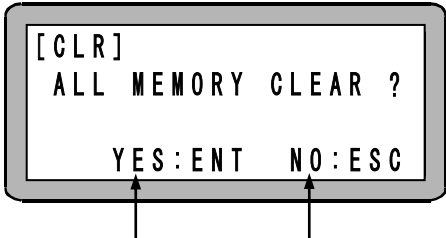
The following screen will be displayed:



**STEP 1** In this condition, press the **F3** key.



**STEP 2** In this condition, press the **F1** key.



**STEP 3** When clearing all the memory, press the **ENT** key; when not clearing it, press the **ESC** key. Pressing **ENT** key goes to STEP4.



**STEP 4** Turn off the controller according to the displayed message.

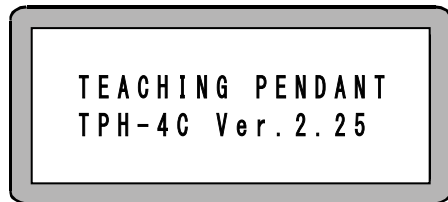
**NOTE**

- After memory initialization, the parameter of the robot type "700000" is set. Enter your robot type again.
- For the robot type value, refer to the actuator instruction manual.

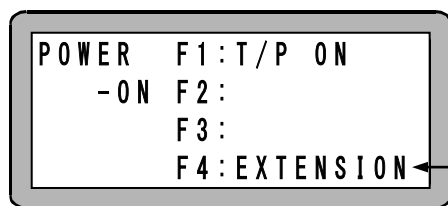


- (2) Performing Clear All Memory without turning on the teach pendant (T/P ON) after the power is turned on

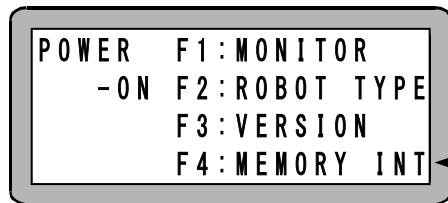
This machine can perform Clear All Memory without turning T/P ON after the power is turned on. If Clear All Memory cannot be performed through the PRGM mode when an error occurs, use the following method to clear the memory:



**STEP 1** The initial display is shown for two seconds after the power is turned on.



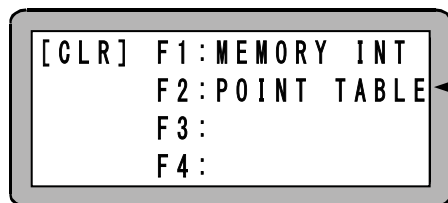
**STEP 2** When the next screen as shown here appears after the initial display, press the **F4** key.



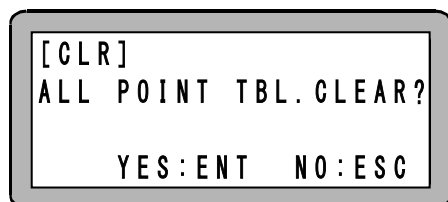
**STEP 3** In this condition, press the **F4** key.

The subsequent steps continue to the previous STEP3 and STEP 4.

- (3) Clearing a point table



**STEP 1** In the STEP2 condition of (1), press the **F2** key.



**STEP 2** When clearing the point table, press the **ENT** key; when not clearing it, press the **ESC** key. After key operation, STEP1 is returned.



### ■ 2.9.6 Monitor function

A function is provided for monitoring the controller and axis states.

The parameters that can be monitored are shown below.

1. X1 (\*1): Coordinate value (mm)
2. SP: Speed (mm/s)
3. MR: Motor rotational speed (rpm)
4. CR: Current (A rms)
5. DC: Deviation counter (pulses)
6. EL: Effective loading ratio (%)
7. DF: Driving force (N)
8. IN: Inputs (IN1 to IN10)
9. OUT: Outputs (OUT1 to OUT8)

(\*1) The value of K01 (axis display) of Parameter 2 is assigned. (Refer to section ■ 3.4.1.)

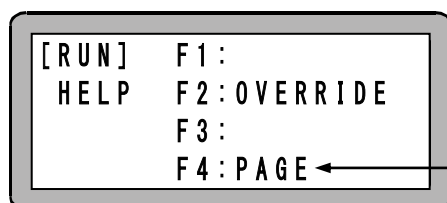
**NOTE** Teach-pendant stop input is invalid during monitoring.

There are two monitoring methods: one method performs monitoring through the RUN mode, and the other performs it without turning on the teach pendant (T/P ON) after the power is turned on.

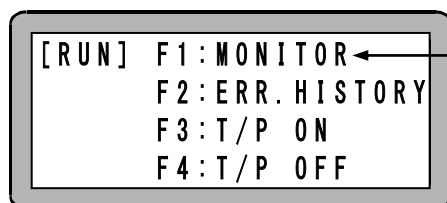
#### (1) Performing monitoring through the RUN mode

Activate the RUN mode, and press the **HELP** key.

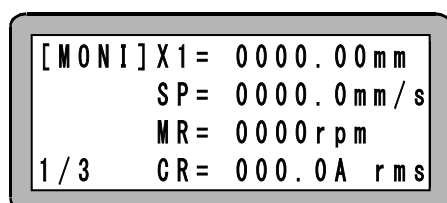
The following screen will be displayed:



**STEP 1** In this condition, press the **F4** key.



**STEP 2** In this condition, press the **F1** key to activate the monitoring mode.



**STEP 3** Page 1/3 is displayed. In this page, the following can be monitored:

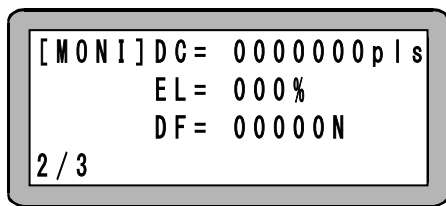
X1: Coordinate value (mm), SP: Speed (mm/s), MR: Motor rotational speed (rpm), and CR: Current (A rms)

Pressing the **NEXT** key displays the next page;

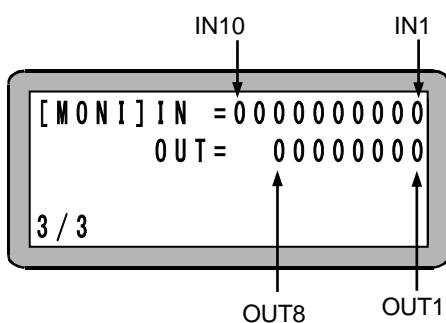
pressing **-NEXT** key displays the previous page.

Pressing the **ESC** key returns to STEP2.



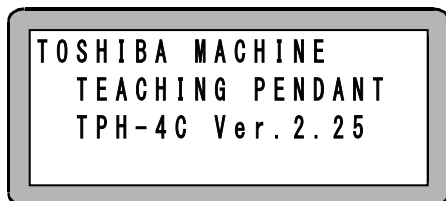


- STEP 4** In page 2/3, the following can be monitored:  
 DC: Deviation counter (pulses), EL: Effective loading ratio (%), and DF: Driving force (N)
- Pressing the **NEXT** key displays the next page;  
 pressing **-NEXT** key displays the previous page.  
 Pressing the **ESC** key returns to STEP2.

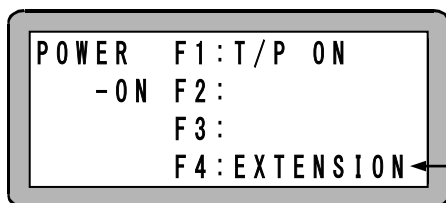


- STEP 5** In page 3/3, the following can be monitored:  
 IN: Inputs (IN1 to IN10), and OUT: Outputs (OUT1 to OUT8)
- Pressing the **NEXT** key displays the next page;  
 pressing **-NEXT** key displays the previous page.  
 Pressing the **ESC** key returns to STEP2.

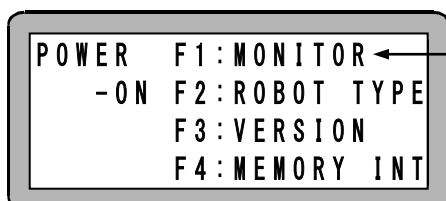
- (2) Performing monitoring without turning on the teach pendant (T/P ON) after the power is turned on  
 This machine can perform monitoring without turning T/P ON after the power is turned on. If monitoring cannot be performed through the RUN mode when an error occurs, use the following method to perform monitoring:



- STEP 1** The initial display is shown for two seconds after the power is turned on.



- STEP 2** When the next screen as shown here appears after the initial display, press the **F4** key.



- STEP 3** In this condition, press the **F1** key to activate the monitoring mode.

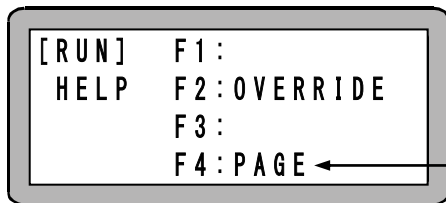
The subsequent steps continue to the previous STEP3.



## ■ 2.9.7 Turning on/off the teach pendant

This machine can logically disconnect the teach pendant through the following operation even while the teach pendant is connected, thus enabling system input.

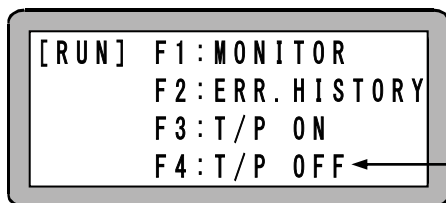
### ● Turning off the teach pendant



**STEP 1** Activate the RUN mode, and press the **HELP** key to display this screen.

Pressing the **F 4** key goes to STEP2.

Pressing the **ESC** key returns to the RUN mode screen.



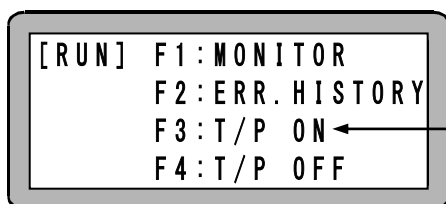
**STEP 2** Pressing the **F 4** key goes to STEP3.

Pressing the **ESC** key returns to the RUN mode screen.



**STEP 3** The teach pendant OFF screen is displayed, allowing the simulation of teach-pendant disconnection.

### ● Turning on the teach pendant



**STEP 1** Press the **HELP** key when the teach pendant is off. The screen at the left will be displayed.

Pressing the **F 3** key connects the teach pendant and returns to the RUN mode screen.

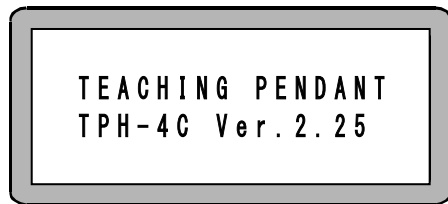
Pressing the **ESC** key returns to STEP3.

**NOTE** The start input (IN1) is invalid when the teach pendant is on. In addition, no input/output signals are set in the teaching status.



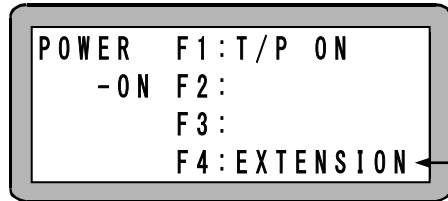
### ■ 2.9.8 Displaying the versions

The versions of the controller and teach pendant can be displayed on the screen.

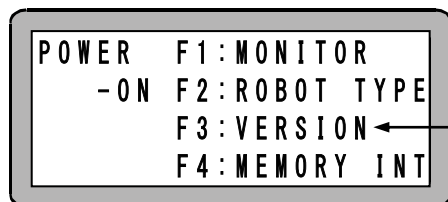


**STEP 1** The initial display is shown for two seconds after the power is turned on.

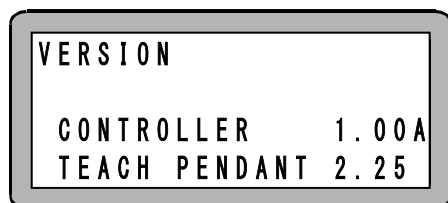
\* The display format and version vary depending on your teach pendant.



**STEP 2** When the next screen as shown here appears after the initial display, press the **F4** key.



**STEP 3** Pressing the **F3** key goes to STEP4.  
Pressing the **ESC** key returns to STEP2.



**STEP 4** The versions are displayed.  
Pressing the **ESC** key returns to STEP3.



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## Chapter 3 Parameter Settings

The parameters in this controller can be broadly divided into the four types below.

Type	Parameter No.	Description	Refer to
Mode setting	M01 to M19	This contains the parameters for the entire system.	Section ■ 3.2
Parameter 1	P01 to P08	This contains the axis parameters for settings that are changed relatively frequently.	Section ■ 3.3
Parameter 2	K01 to K15	This contains the axis parameters for settings that are changed less frequently than Parameter 1. After these parameters are changed, the control power and drive power must be turned off and then on again. These parameters will not be enabled unless the control power and drive power are turned off.	Section ■ 3.4
Table	T01 to T05	The point table, speed table, acceleration/deceleration table, torque limit table, and area output table are included.	Section ■ 3.5

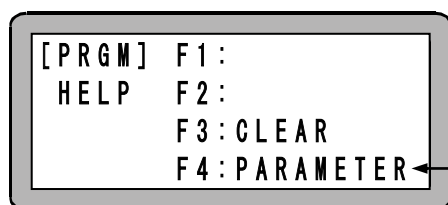
\*The T01 (Point Table) coordinate values can also be set by system input. (Refer to section ■ 5.5.)

### NOTE

- The parameters and tables are stored in the EEPROM. The EEPROM write count limit is 1 million. Because reading and writing may be unable to be performed normally if the number of writes exceeds 1 million, set the writes to the minimum count necessary.
- Data displayed on the teach pendant is input (transferred to the controller) when the screen is switched by pressing the **NEXT**, **-NEXT**, or **ESC** key.  
Keep in mind that pressing the **ENT** key does not input the data to the controller.

### ■ 3.1 Entering and Exiting the PARA Mode

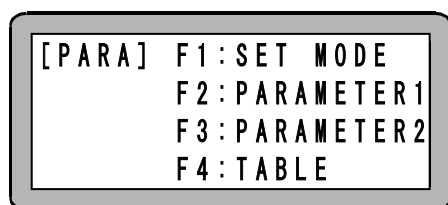
Activate the PRGM mode and press the **HELP** key. The following screen will be displayed:



#### STEP 1

In this condition, press the **F4** key to activate the PARA mode.

Pressing the **ESC** key returns to the PRGM mode screen.



#### STEP 2

To set a mode, press the **F1** key.

To set Parameter 1, press the **F2** key.

To set Parameter 2, press the **F3** key.

To set a table, press the **F4** key.

Pressing the **ESC** key returns to the PRGM mode screen.



## ■ 3.2 Mode Setting

The mode setting contains the parameters for the entire system.

Parameter No.	Parameter	Setting range	Initial value	Units	Refer to
M01	T/P Japanese/English switching	0, 1	0	-	Section ■ 3.2.1
M02	IN1 function selection	00 ~ 99	00	-	-
M03	IN2 function selection	00 ~ 99	00	-	-
M04	IN3 function selection	00 ~ 99	00	-	-
M05	IN4 function selection	00 ~ 99	00	-	-
M06	IN5 function selection	00 ~ 99	00	-	-
M07	IN6 function selection	00 ~ 99	00	-	-
M08	IN7 function selection	00 ~ 99	00	-	-
M09	IN8 function selection	00 ~ 99	00	-	-
M10	IN9 function selection	00 ~ 99	00	-	-
M11	IN10 function selection	00 ~ 99	00	-	-
M12	OUT1 function selection	00 ~ 99	00	-	-
M13	OUT2 function selection	00 ~ 99	00	-	Section ■ 3.2.2
M14	OUT3 function selection	00 ~ 99	00	-	-
M15	OUT4 function selection	00 ~ 99	00	-	-
M16	OUT5 function selection	00 ~ 99	00	-	-
M17	OUT6 function selection	00 ~ 99	00	-	-
M18	OUT7 function selection	00 ~ 99	00	-	-
M19	OUT8 function selection	00 ~ 99	00	-	-

\* M02 to M12 and M14 to M19 are not available.

Activate the PARA mode to set a mode. (Refer to section ■ 3.1.)

[ PARA ] F1: SET MODE ←

F2: PARAMETER1

F3: PARAMETER2

F4: TABLE

**STEP 1** In this condition, press the F1 key.

M01

DISPLAY 0: JAPANESE

1: ENGLISH

[ 0 ]

**STEP 2** In this condition, a target mode setting screen can be displayed by using the NEXT or -NEXT key.

To end parameter setting, press the ESC key.

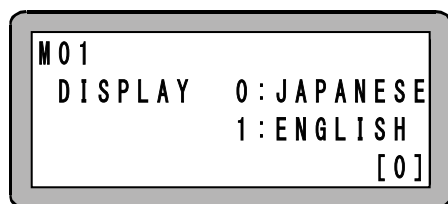
- Search function

To search for a target mode setting screen, press the SEARCH key and enter the corresponding parameter number.



### ■ 3.2.1 M01 (T/P Japanese/English switching)

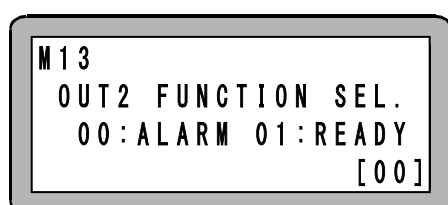
This parameter selects the T/P display language.



**STEP 1** Enter 0 (display in Japanese) or 1 (display in English) using the numeric keys, and press the **ENT** key. Pressing the **NEXT** key displays the next screen. Pressing the **ESC** key returns to the PARA mode screen.

### ■ 3.2.2 M13 (OUT2 Function Selection)

This selects the system output OUT2 function.



**STEP 1** Enter the numeric value using the numeric keys, and press the **ENT** key. Pressing the **-NEXT** key displays the previous screen. Pressing the **ESC** key returns to the PARA mode screen.



- 00 : Error output (Initial value) (Refer to section ■ 4.2.10.)
- Other than 00 : READY/Error output (Refer to section ■ 4.2.11.)



### ■ 3.3 Parameter 1

Parameter 1 contains the axis parameters for settings that are changed relatively frequently.

Parameter No.	Parameter	Setting range	Initial value	Units	Robot type (*1)	Refer to
P01	+ Software limit	-8000.00 to +8000.00	0.00	mm	×	Section ■ 3.3.1
P02	- Software limit	-8000.00 to +8000.00	0.00	mm	×	Section ■ 3.3.2
P03	Servo gain (position)	0 to 98	40	-	○	Section ■ 3.3.3
P04	Servo gain (speed)	0 to 98	23	-	○	Section ■ 3.3.4
P05	Origin offset	-8000.00 to +8000.00	0.00	mm	×	Section ■ 3.3.5
P06	Jog speed (low)	1.0 to 250.0	10.0	mm/sec	×	Section ■ 3.3.6
P07	Jog speed (high)	1.0 to 250.0	50.0	mm/sec	×	Section ■ 3.3.7
P08	Jog inching value	0.01 to 65.00	0.10	mm	×	Section ■ 3.3.8

(\*1) Items with a ○ mark are automatically set to the optimum value by setting the robot type (Section ■ 2.7.6).

**NOTE** Parameter 1 is stored in the EEPROM. The EEPROM write count limit is 1 million. Because reading and writing may be unable to be performed normally if the number of writes exceeds 1 million, set the writes to the minimum count necessary.

Activate the PARA mode to set Parameter 1. (Refer to section ■ 3.1.)

[ PARA ] F1:SET MODE  
F2:PARAMETER1  
F3:PARAMETER2  
F4:TABLE

**STEP 1** In this condition, press the F2 key.

P01  
+ SOFTWARE LIMIT  
  
A0= 0000.00

**STEP 2** In this condition, a target Parameter-1 setting screen can be displayed by using the NEXT or -NEXT key. To end parameter setting, press the ESC key.

- Search function

To search for a target Parameter-1 setting screen, press the SEARCH key and enter the corresponding parameter number.

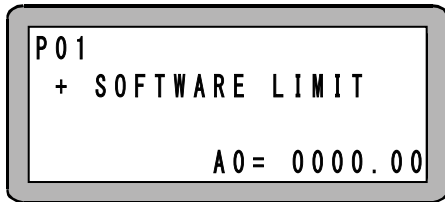
- Jump function

If the F1 key is pressed during editing on the screen P01-P08, this function jumps to the P01 screen.



### ■ 3.3.1 P01 (+ Software limit)

This indicates the maximum value of the robot movable range.

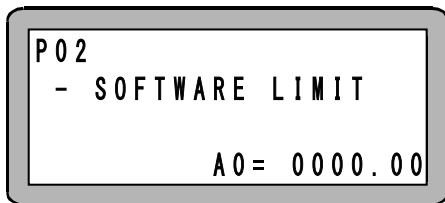


**STEP 1** Enter the coordinate value using the numeric keys, and press the **ENT** key.  
Pressing the **NEXT** key displays the next screen.  
Pressing the **ESC** key returns to the PARA mode screen.

- Setting range: -8000.00 to +8000.00
- Initial value: 0.00
- Units: mm
- If a movement command outside the + soft limit is received, a + software limit over error occurs before movement.
- If a jog operation is performed, it stops at the + soft limit.
- Set the + software limit value in the maximum stroke range.

### ■ 3.3.2 P02 (- Software limit)

This indicates the minimum value of the robot movable range.



**STEP 1** Enter the coordinate value using the numeric keys, and press the **ENT** key.  
Pressing the **NEXT** key displays the next screen;  
pressing the **-NEXT** key displays the previous screen.  
Pressing the **ESC** key returns to the PARA mode screen.

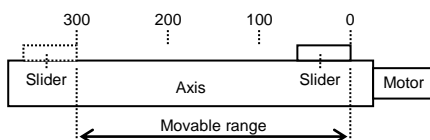
- Setting range: -8000.00 to +8000.00
- Initial value: 0.00
- Units: mm
- If a movement command outside the - soft limit is received, a - software limit over error occurs before movement.
- If a jog operation is performed, it stops at the - software limit.
- Set the - software limit value in the maximum stroke range.

Setting example:

When the robot movable range is 0 to 300 mm,

P01 + software limit: 300.00 mm

P02 – software limit: 0.00 mm





### ■ 3.3.3 P03 (Servo Gain (Position))

If the setting value is too small for the position gain of the servo system, the positioning time becomes longer. If the setting value is too large, hunting (vibration) occurs.



**STEP 1** Enter the servo gain using the numeric keys, and press

the **ENT** key.

Pressing the **NEXT** key displays the next screen;

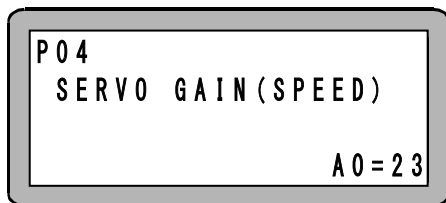
pressing the **-NEXT** key displays the previous screen.

Pressing the **ESC** key returns to the PARA mode screen.

- Setting range : 0 to 98
- Initial value : 40
- The value of 99 is for manufacturer adjustment. Do not set to 99.
- Entering the robot type (Section ■ 2.7.6) automatically sets a relatively safe value, but change this value if necessary.
- Servo gain adjustment (Section ■ 2.7.7)

### ■ 3.3.4 P04 (Servo Gain (Speed))

If the setting value is too small for the speed gain of the servo system, hunting (vibration) occurs. If the setting value is too large, noise is generated.



**STEP 1** Enter the servo gain using the numeric keys, and press

the **ENT** key.

Pressing the **NEXT** key displays the next screen;

pressing the **-NEXT** key displays the previous screen.

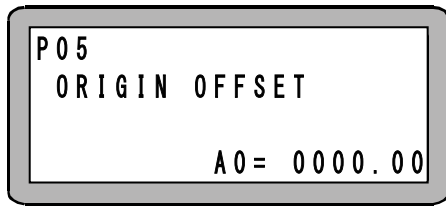
Pressing the **ESC** key returns to the PARA mode screen.

- Setting range : 0 to 98
- Initial value : 23
- The value of 99 is for manufacturer adjustment. Do not set to 99.
- Entering the robot type (Section ■ 2.7.6) automatically sets a relatively safe value, but change this value if necessary.
- Servo gain adjustment (Section ■ 2.7.7)



### ■ 3.3.5 P05 (Origin Offset)

If the robot coordinates were shifted in parallel from the coordinates that were taught due to replacement of the motor, ball screws, or other components, origin offset can be used to return to the original position.



**STEP 1** Enter the coordinate value of origin offset using the numeric keys, and press the **ENT** key.

Pressing the **NEXT** key displays the next screen;

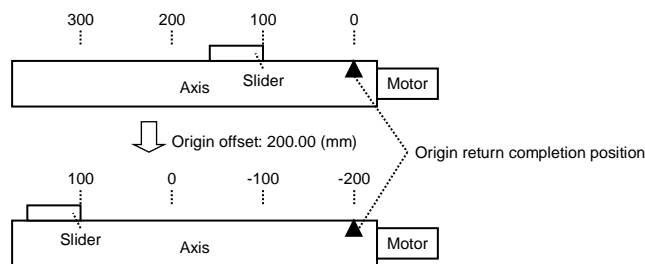
pressing the **-NEXT** key displays the previous screen.

Pressing the **ESC** key returns to the PARA mode screen.

- Setting range : -8000.00 to +8000.00
- Initial value : 0.00
- Units : mm
- Origin offset is the distance (mm) that the origin must be offset. This is used to move all points in parallel to the coordinate axes.
- Be sure to always return to the origin after changing the origin offset. The origin offset is not set unless the origin return operation is performed.
- The stop position after completion of the origin return does not change even after the origin offset is set.

The origin return operation is completed at either of the ▲ positions in the figure below.

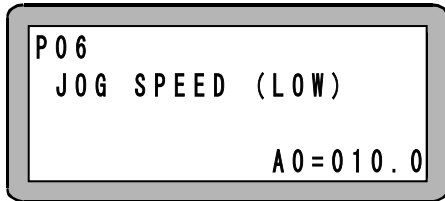
Example: If the 200.00 (mm) is set for the origin offset, and the origin return operation is performed, the coordinate system moves in parallel by 200.00 (mm). If the slider is moved to the 100.00 (mm) position, it moves to the position shown in the figure below.





### ■ 3.3.6 P06 (Jog Speed (Low))

This indicates the low-speed movement speed during jog operation.



#### STEP 1

Enter the jog speed (low speed) using the numeric keys, and press the **ENT** key.

Pressing the **NEXT** key displays the next screen;

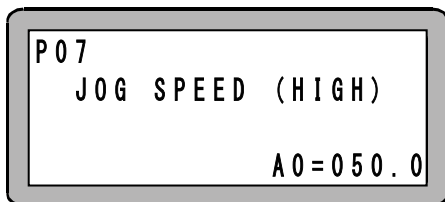
pressing the **-NEXT** key displays the previous screen.

Pressing the **ESC** key returns to the PARA mode screen.

- Setting range : 1.0 to 250.0
- Initial value : 10.0
- Units : mm/sec

### ■ 3.3.7 P07 (Jog Speed (High))

This indicates the high-speed movement speed during jog operation.



#### STEP 1

Enter the jog speed (high speed) using the numeric keys, and press the **ENT** key.

Pressing the **NEXT** key displays the next screen;

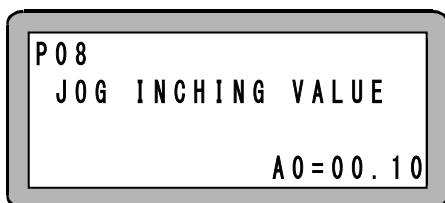
pressing the **-NEXT** key displays the previous screen.

Pressing the **ESC** key returns to the PARA mode screen.

- Setting range : 1.0 to 250.0
- Initial value : 50.0
- Units : mm/sec

### ■ 3.3.8 P08 (Jog Inching Value)

This indicates the inching movement during jog operation. This is the instantaneous movement amount when +Jog input (IN1) or –Jog input (IN2) is turned on.



#### STEP 1

Enter the jog inching movement using the numeric keys, and press the **ENT** key.

Pressing the **-NEXT** key displays the previous screen.

Pressing the **ESC** key returns to the PARA mode screen.

- Setting range : 0.01 to 65.00
- Initial value : 0.10
- Units : mm

#### NOTE

Because the motor movement units are pulses, an internal conversion is performed from mm to pulses. A small value after conversion results in a larger error, and some cases, operation may not be performed at the value that was set.



## ■ 3.4 Parameter 2

Parameter 2 contains the axis parameters for settings that are changed less frequently than Parameter 1.

**After these parameters are changed, the control power and drive power must be turned off and then on again. The parameters will not be enabled unless the control power and drive power are turned off.**

Parameter No.	Parameter	Setting range	Initial value	Units	Robot type (*1)	Refer to
K01	Axis display	1st character: X, Y, Z, R, ? 2nd character: 0 - 9, ?	X1	-	×	Section ■ 3.4.1
K02	In-position data	0.01 to 65.00	0.05	mm	○	Section ■ 3.4.2
K03	Overflow data	1 to 999999	5120	pulses	○	Section ■ 3.4.3
K04	Rotation direction	0, 1	1	-	○	Section ■ 3.4.4
K05	Maximum speed	1 to 9999	800	mm/sec	○	Section ■ 3.4.5
K06	Low return home speed	1.0 to 250.0	2.0	mm/sec	○	Section ■ 3.4.6
K07	Middle return home speed	1.0 to 250.0	20.0	mm/sec	○	Section ■ 3.4.7
K08	High return home speed	1.0 to 999.9	100.0	mm/sec	○	Section ■ 3.4.8
K09	Return home method	0 to 3	2	-	○	Section ■ 3.4.9
K10	Home sensor logic	0, 1	1	-	○	Section ■ 3.4.10
K11	Fast return home target	-8000.00 to +8000.00	20.00	mm	×	Section ■ 3.4.11
K12	Lead	0.001 to 999.999	12.000	mm	○	Section ■ 3.4.12
K13	Sensor division	1 to 999999	2048	Pulses/rev	○	Section ■ 3.4.13
K14	Multiplier	1 to 4	4	-	×	Section ■ 3.4.14
K15	Sensor type	0, 1	1	-	×	Section ■ 3.4.15

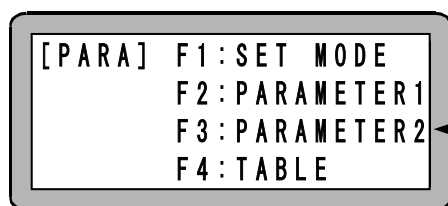
(\*1) Items with a ○ mark are automatically set to the optimum value by setting the robot type (Section ■ 2.7.6).

### NOTE

Parameter 2 is stored in the EEPROM. The EEPROM write count limit is 1 million. Because reading and writing may be unable to be performed normally if the number of writes exceeds 1 million, set the writes to the minimum count necessary.

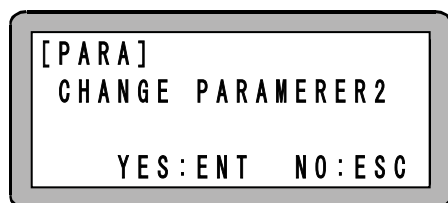


Activate the PARA mode to set Parameter 2. (Refer to section ■ 3.1.)



```
[ PARA ] F1: SET MODE
        F2: PARAMETER1
        F3: PARAMETER2
        F4: TABLE
```

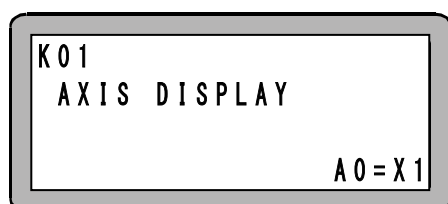
**STEP 1** In this condition, press the **F3** key.



```
[ PARA ]
CHANGE PARAMETER2

YES: ENT  NO: ESC
```

**STEP 2** When changing Parameter 2, press the **ENT** key; when not changing it, press the **ESC** key. Pressing the **ENT** key goes to STEP3; pressing the **ESC** key returns to the previous screen.



```
K01
AXIS DISPLAY

A0=X1
```

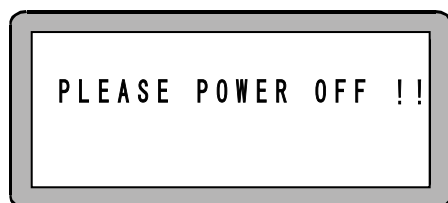
**STEP3** In this condition, a target Parameter-2 setting screen can be displayed by using the **NEXT** or **-NEXT** key. To end parameter setting, press the **ESC** key. Pressing the **ESC** key goes to STEP4.

- Search function

To search for a target Parameter-2 setting screen, press the **SEARCH** key and enter the corresponding parameter number.

- Jump function

If the **F1** key is pressed during editing on the screen K01-K09, this function jumps to the K10 screen; if the **F1** key is pressed during editing on the screen K10-K15, this function jumps to the K01 screen.



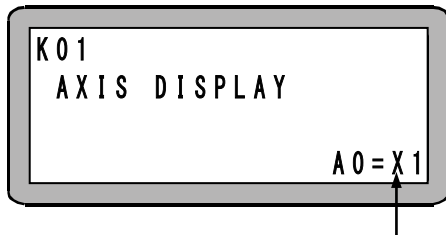
```
PLEASE POWER OFF !!
```

**STEP 4** Shown at the left is the Parameter-2 end screen. Turn off the controller according to the displayed message. The new Parameter-2 setting becomes valid when the power is turned on next time.



### ■ 3.4.1 K01 (Axis Display)

The axis display is the title of the axis displayed on the teach pendant.

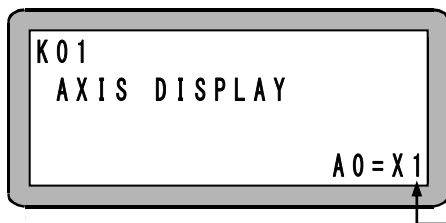


#### STEP 1

Select a target alphabetic character (X, Y, Z, R, ?) with the **ALT** key, and press the **ENT** key.

Pressing the **NEXT** key displays the next screen.

Pressing the **ESC** key displays the Parameter-2 end screen.



#### STEP 2

Enter a target number (0-9) using the numeric keys, and press the **ENT** key.

Pressing the **NEXT** key displays the next screen.

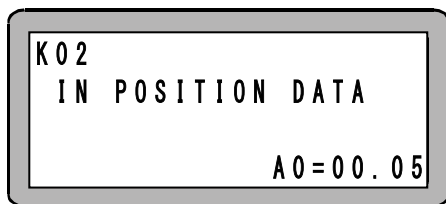
Pressing the **ESC** key displays the Parameter-2 end screen.

- Setting range : 1st character: X, Y, Z, R, ? 2nd character: 0 - 9, ?
- Initial value : X1
- If "?" is set as the first character, a number cannot be set as the second character.
- If a character other than "?" is set as the first character, "?" cannot be set as the second character.

### ■ 3.4.2 K02 (In-position Data)

The in-position is data that serves as one determinant for whether positioning was completed.

When the logic coordinates reach the target position, and the deviation counter (deviation between the target position and current position) drops to this value or less, the positioning complete output (OUT3) is turned on.



#### STEP 1

Enter the in-position data using the numeric keys, and press the **ENT** key.

Pressing the **NEXT** key displays the next screen;

pressing the **-NEXT** key displays the previous screen.

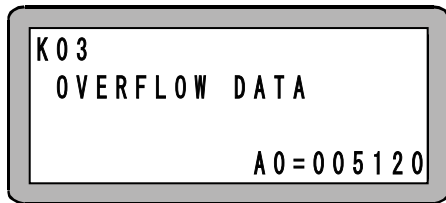
Pressing the **ESC** key displays the Parameter-2 end screen.

- Setting range : 0.01 to 65.00
- Initial value : 0.05
- Units : mm
- If "(10) In-position 2" of the point table (T01) is a value other than 0.00 mm, instead of the main data, "(10) In-position 2" of the point table (T01) is used as a determinant for whether positioning was completed.
- The units are converted internally (mm → pulses) for this value. The value after conversion is limited to 32,767 (pulses).
- This is automatically set by the robot type (Section ■ 2.7.6).



### ■ 3.4.3 K03 (Overflow Data)

When the value of the deviation counter (deviation between the target position and current position) reaches or exceeds this value, a positional deviation exceeded error occurs.



**STEP 1** Enter the overflow data using the numeric keys, and press the **ENT** key.

Pressing the **NEXT** key displays the next screen;

pressing the **-NEXT** key displays the previous screen.

Pressing the **ESC** key displays the Parameter-2 end screen.

- Setting range : 1 to 999999
- Initial value : 5120
- Units : pulses
- This is automatically set by the robot type (Section ■ 2.7.6).

### ■ 3.4.4 K04 (Rotation Direction)

This indicates the rotation direction of the motor output shaft as viewed from the load side when a command for the positive direction is issued.



**STEP 1** Enter the motor rotation direction (0: CW, 1: CCW) using the numeric keys, and press the **ENT** key.

Pressing the **NEXT** key displays the next screen;

pressing the **-NEXT** key displays the previous screen.

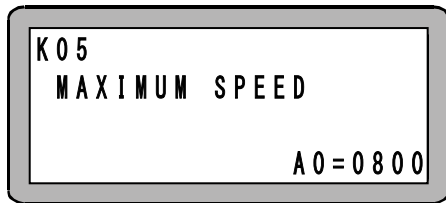
Pressing the **ESC** key displays the Parameter-2 end screen.

- Setting range : 0(CCW), 1(CW)
- Initial value : 1
- This is automatically set by the robot type (Section ■ 2.7.6).



### ■ 3.4.5 K05 (Maximum Speed)

This indicates the movement speed limit value. If the setting for the movement speed is set higher than this value, a speed limit is applied.

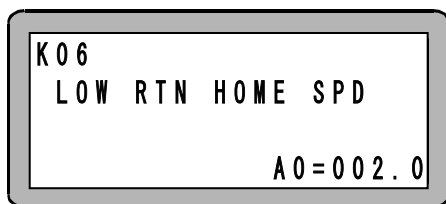


**STEP 1** Enter the maximum speed using the numeric keys, and press the **ENT** key.  
Pressing the **NEXT** key displays the next screen;  
pressing the **-NEXT** key displays the previous screen.  
Pressing the **ESC** key displays the Parameter-2 end screen.

- Setting range : 1 to 9999
- Initial value : 800
- Units : mm/sec
- This is automatically set by the robot type (Section ■ 2.7.6).

### ■ 3.4.6 K06 (Low return home speed)

This indicates the movement speed (low speed) during the origin return operation.



**STEP 1** Enter the low origin-return speed using the numeric keys, and press the **ENT** key.  
Pressing the **NEXT** key displays the next screen;  
pressing the **-NEXT** key displays the previous screen.  
Pressing the **ESC** key displays the Parameter-2 end screen.

- Setting range : 1.0 to 250.0
- Initial value : 2.0
- Units : mm/sec
- This is automatically set by the robot type (Section ■ 2.7.6).



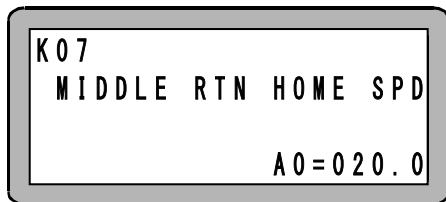
**CAUTION**

If setting a value bigger than the initial value, the origin return may be failed.



### ■ 3.4.7 K07 (Middle return home speed)

This indicates the movement speed (medium speed) during the origin return operation.



**STEP 1** Enter the medium origin-return speed using the numeric keys, and press the **ENT** key.

Pressing the **NEXT** key displays the next screen;

pressing the **-NEXT** key displays the previous screen.

Pressing the **ESC** key displays the Parameter-2 end screen.

- Setting range : 1.0 to 250.0
- Initial value : 20.0
- Units : mm/sec
- This is automatically set by the robot type (Section ■ 2.7.6).

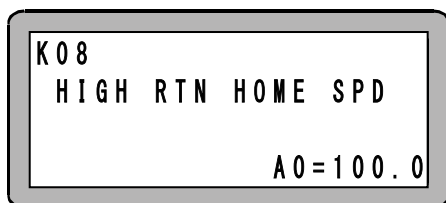


**CAUTION**

If setting a value bigger than the initial value, the origin return may be failed.

### ■ 3.4.8 K08 (High return home speed)

This indicates the movement speed (high speed) during the origin return operation.



**STEP 1** Enter the high origin-return speed using the numeric keys, and press the **ENT** key.

Pressing the **NEXT** key displays the next screen;

pressing the **-NEXT** key displays the previous screen.

Pressing the **ESC** key displays the Parameter-2 end screen.

- Setting range : 1.0 to 999.9
- Initial value : 100.0
- Units : mm/sec
- This is automatically set by the robot type (Section ■ 2.7.6).



# [Explanation of Origin Return Speed]

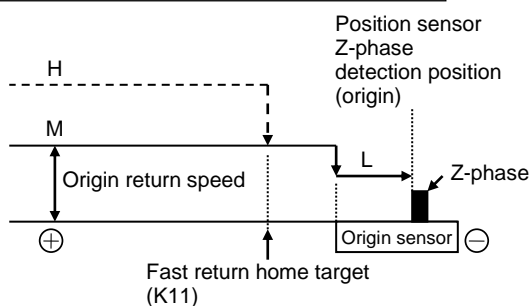
The robot has four origin return methods, and these are divided into two procedures: Initial origin return after power is turned on (start from origin return speed M) and origin return on the second time and after (start from origin return speed H).

L: Low return home speed (K06)

M: Middle return home speed (K07)

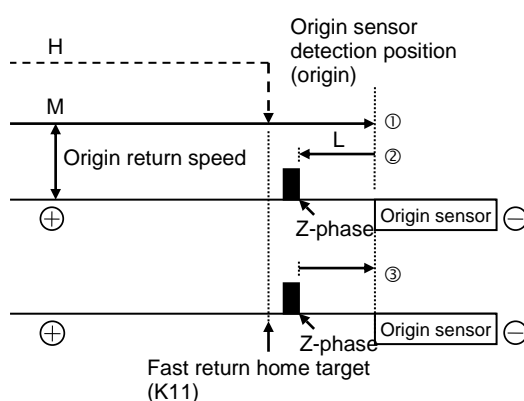
H: High return home speed (K08)

(1) When return home method (K09) is set to "0"

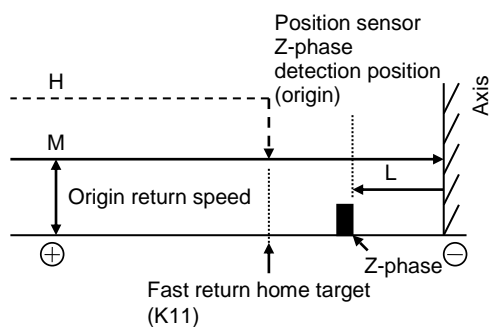


**NOTE** ● If the robot is located at the origin, it is moved out of the sensor range, and then the origin return operation is performed again.

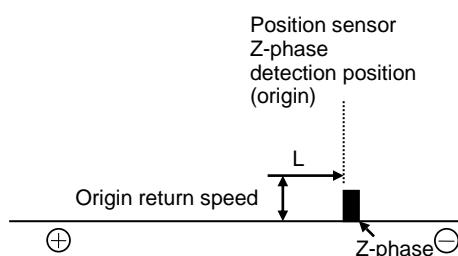
(2) When return home method (K09) is set to "1"



(3) When return home method (K09) is set to "2"



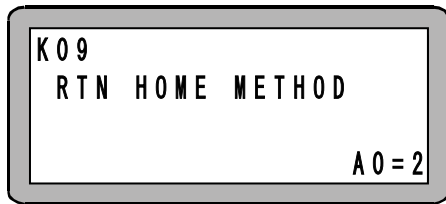
(4) When return home method (K09) is set to "3"





### ■ 3.4.9 K09 (Return home method)

This indicates the sequence during the origin return operation.



**STEP 1** Enter the origin return method (0-3) using the numeric keys, and press the **ENT** key.

Pressing the **NEXT** key displays the next screen;

pressing the **-NEXT** key displays the previous screen.

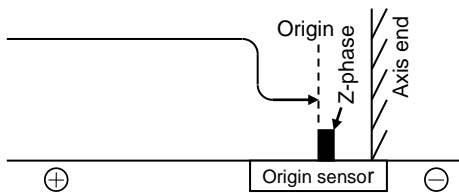
Pressing the **ESC** key displays the Parameter-2 end screen.

- Setting range : 0 to 3
- Initial value : 2
- This is automatically set by the robot type (Section ■ 2.7.6).

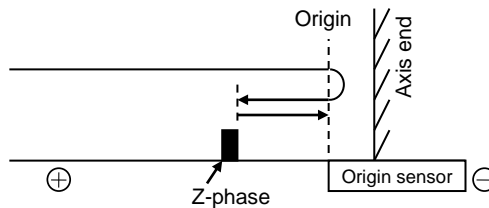


If an origin return method was set that does not match the axis model, the origin return operation may not be performed normally or the origin position may change. Therefore, do not change the value that was set by input of the robot type.

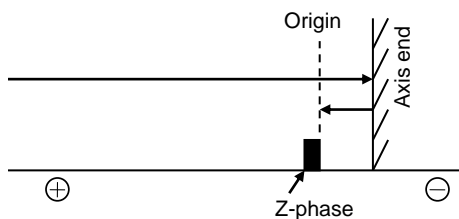
0 ----- After the origin sensor is set to ON, the position sensor Z-phase is detected at low speed to set the origin position.  
If the value of the middle return home speed (K07) is increased, the operation may pass over the Z-phase.



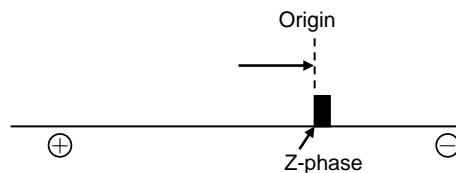
1 ----- After the origin sensor is set to ON, the operation advances (+ direction) and stops at the position sensor Z-phase, a search is made for the origin sensor at low speed again, and the origin position is set where the origin sensor turns ON.



2 ----- After moving to the axis end, the operation detects the position sensor Z-phase while advancing (+ direction) at low speed to set the origin position.



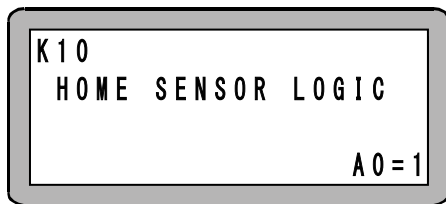
3 ----- After retracting (- direction) at low speed from the current position, the first position sensor Z-phase is detected to set the origin position.  
Do not use this mode. (It is for manufacturer adjustment.)





### ■ 3.4.10 K10 (Home Sensor Logic)

This selects if the output signal of the origin sensor incorporated in the axis turns OFF (NC) or ON (NO).



**STEP 1** Enter the origin sensor logic (0 or 1) using the numeric keys, and press the **ENT** key.

Pressing the **NEXT** key displays the next screen;

pressing the **-NEXT** key displays the previous screen.

Pressing the **ESC** key displays the Parameter-2 end screen.

- Setting range : 0(NO), 1(NC)
- Initial value : 1
- An origin sensor may not be incorporated for certain axis models.
- This is automatically set by the robot type (Section ■ 2.7.6).

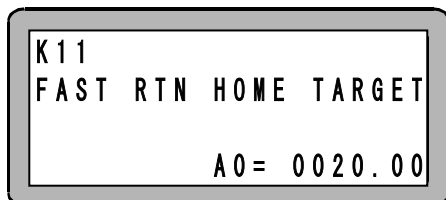


#### CAUTION

If an origin sensor logic was set that does not match the axis model, the origin return operation may not be performed normally or the origin position may change. Therefore, do not change the value that was set by input of the robot type.

### ■ 3.4.11 K11 (Fast return home target)

This indicates the target position when moving at the high-speed origin return speed (K08) while executing the origin return operation. Do not set to a value equal to or less than the initial value.



**STEP 1** Enter the high-speed origin return position using the numeric keys, and press the **ENT** key.

Pressing the **NEXT** key displays the next screen;

pressing the **-NEXT** key displays the previous screen.

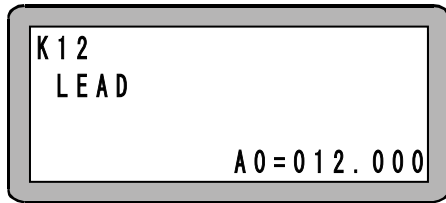
Pressing the **ESC** key displays the Parameter-2 end screen.

- Setting range : -8000.00 to +8000.00
- Initial value : 20.00
- Units : mm



#### ■ 3.4.12 K12 (Lead)

This indicates the distance that is advanced per motor revolution.



**STEP 1** Enter the axis lead using the numeric keys, and press the **ENT** key.

Pressing the **NEXT** key displays the next screen;

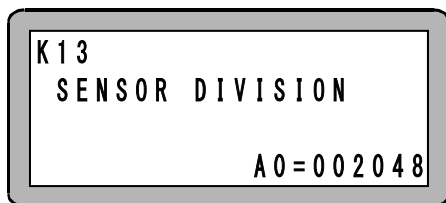
pressing the **-NEXT** key displays the previous screen.

Pressing the **ESC** key displays the Parameter-2 end screen.

- Setting range : 0.001 to 999.999
- Initial value : 12.000
- Units : mm
- This is automatically set by the robot type (Section ■ 2.7.6).

#### ■ 3.4.13 K13 (Number of Sensor Divisions)

This indicates the number of pulses per revolution of the sensor installed on the motor.



**STEP 1** Enter the number of sensor divisions using the numeric keys, and press the **ENT** key.

Pressing the **NEXT** key displays the next screen;

pressing the **-NEXT** key displays the previous screen.

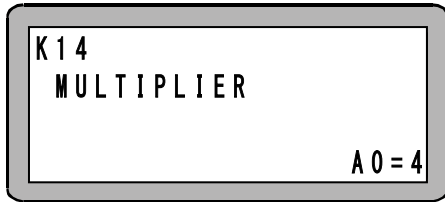
Pressing the **ESC** key displays the Parameter-2 end screen.

- Setting range : 1 to 999999
- Initial value : 2048
- Units : pulses/rev
- This is automatically set by the robot type (Section ■ 2.7.6).



#### ■ 3.4.14 K14 (Multiplier)

This indicates the multiplier factor for generating the pulses of the sensor installed on the motor. This is disabled in this controller.



##### STEP 1

Enter the multiplier factor using the numeric keys, and press the **ENT** key.

Pressing the **NEXT** key displays the next screen;

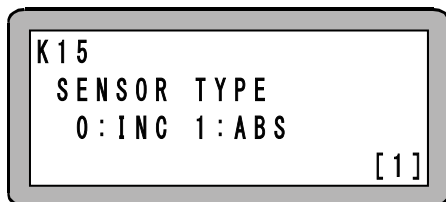
pressing the **-NEXT** key displays the previous screen.

Pressing the **ESC** key displays the Parameter-2 end screen.

- Setting range : 1 to 4
- Initial value : 4

#### ■ 3.4.15 K15 (Sensor Type)

This indicates the type of sensor installed on the motor.



##### STEP 1

Enter the type of sensor (0 or 1) using the numeric keys, and press the **ENT** key.

Pressing the **-NEXT** key displays the previous screen.

Pressing the **ESC** key displays the Parameter-2 end screen.

- Setting range : 0, 1 (0: Incremental sensor, 1: Absolute sensor)
- Initial value : 1



## ■ 3.5 Tables

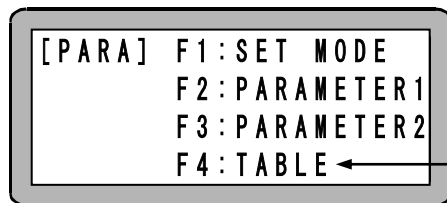
This controller has five types of tables available.

Parameter No.	Type	Number of tables	Refer to
T01	Point table	15 (No.1 to 15)	Section ■ 3.5.1
T02	Speed table	8 (No.1 to 8)	Section ■ 3.5.2
T03	Acceleration/deceleration table	8 (No.1 to 8)	Section ■ 3.5.3
T04	Torque limit table	8 (No.1 to 8)	Section ■ 3.5.4
T05	Area output table	8 (No.1 to 8)	Section ■ 3.5.5

### NOTE

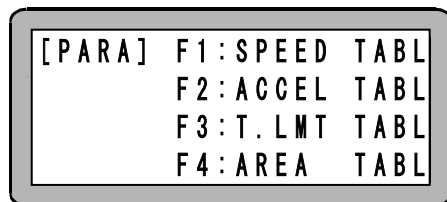
The tables are stored in the EEPROM. The EEPROM write count limit is 1 million. Because reading and writing may be unable to be performed normally if the number of writes exceeds 1 million, set the writes to the minimum count necessary.

Activate the PARA mode to set a speed table, acceleration/deceleration table, torque limit table, or area output table. (Refer to section ■ 3.1.)



### STEP 1

In this condition, press the **F4** key.



### STEP 2

To set a speed table, press the **F1** key.

To set an acceleration/deceleration table, press the

**F2** key.

To set a torque limit table, press the **F3** key.

To set an area output table, press the **F4** key.

Pressing the **ESC** key returns to STEP1.



### ■ 3.5.1 T01 (Point Table)

A total of 15 point tables are available, numbered from 1 to 15, and they are selected by command point number input (IN7 – IN10) when activated by system input operation.

One point table consists of 12 different types of data including coordinate value, speed table number, and other data.

Data Configuration in Point Table

No.	Data		Symbol	Setting range	Initial value	Units	
(1)	Operation method		-	NORMAL / TORQUE LIMIT	NORMAL	-	
(2)	Coordinate value		X1 (*1)	-8000.00 to +8000.00	0.00	mm	(*2)
(3)	Speed table number		V	1 to 8	1	-	
(4)	Acceleration table number		A	1 to 8	5	-	
(5)	Deceleration table number		D	1 to 8	5	-	
(6)	Area output table number		AT	0 to 8	0	-	
(7)	Movement mode	Absolute/Incremental movement	-	a / i	a	-	
		Aging operation (*3)	AGING	ON / OFF	OFF	-	
(8)	Not used		-	-	-	-	
(*4)	Torque limit table number		TT	1 to 8	8	-	
(9)	Timer value		TM	0.000 to 9.999	0.000	sec	
(*4)	Torque limit judgement time		TM				
(10)	In-position 2		IP	0.00 to 655.35	0.00	mm	
(*4)	Torque limit movement amount		TA				
(11)	Not used		-	-	-	-	
(*4)	Torque limit movement speed		TV	1.0 to 100.0	10.0	mm/sec	
(12) (*4)	Not used		-	-	-	-	
	Torque limit option	Torque limit end	TE	ON / OFF	OFF	-	
		Lock end	LE	ON / OFF	OFF	-	
		Arrival end	AE	ON / OFF	OFF	-	
		Positional deviation exceeded detection	DD	ON / OFF	ON	-	

(\*1) The value of K01 (axis display) of Parameter 2 is assigned. (Refer to section ■ 3.4.1.)

(\*2) Values can be overwritten by the system input/output signals. (Refer to section ■ 5.5.)

(\*3) Aging operation cannot be performed with torque limit operation.

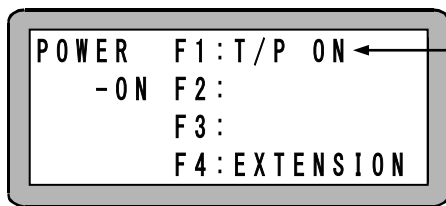
(\*4) This data has different meanings during normal operation (upper row) and torque limit operation (lower row).

#### NOTE

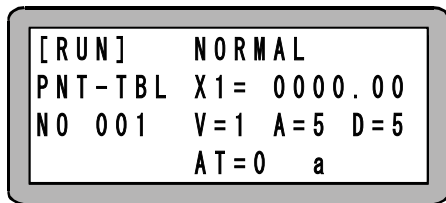
The point tables are stored in the EEPROM. The EEPROM write count limit is 1 million. Because reading and writing may be unable to be performed normally if the number of writes exceeds 1 million, set the writes to the minimum count necessary.

For details about a setting example, refer to section Chapter 5.

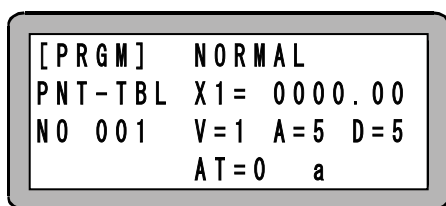




**STEP 1** The screen as shown here appears following the initial display after the power is turned on. In this condition, press the **F1** key.



**STEP 2** Shown at the left is the point table screen. The RUN mode is initially active. To edit the table, activate the PRGM mode by pressing the **RUN/PRGM** key.

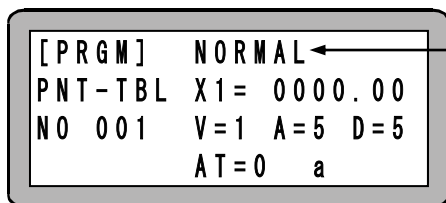


**STEP 3** The number of the table to be displayed can be changed with the **NEXT** and **-NEXT** keys.

If a table number is entered with the **SEARCH** key, a jump to the table is possible.

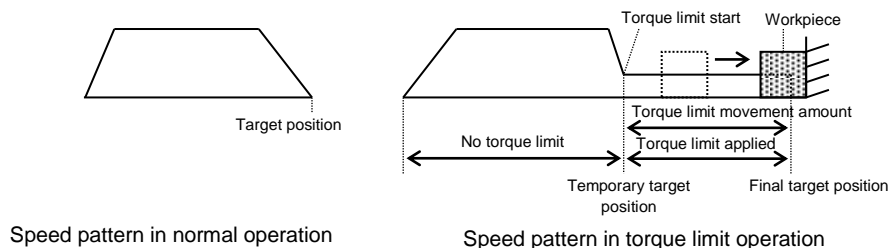
The following explains data input methods:

#### (1) Operation method



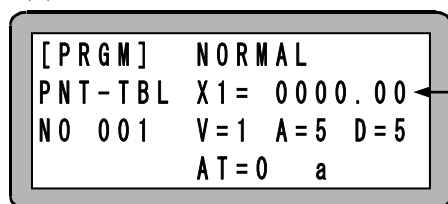
**STEP 1** Select the operation method (NORMAL or TORQUE LIMIT) with the **ALT** key, and press the **ENT** key.

- Setting range : NORMAL or TORQUE LIMIT
- Initial value : NORMAL
- Select a target operation method.  
NORMAL : Normal operation  
TORQUE LIMIT : Torque limit operation
- Normal operation moves the robot to the target position without torque limit.
- Torque limit operation moves the robot to the temporary target position without torque limit, and subsequently moves it to the final target position in the same direction with specified torque limit. When the robot reaches the final target position, the torque limit is released. Use torque limit operation in order to press or insert workpieces without excess force being applied to them.





## (2) Coordinate value

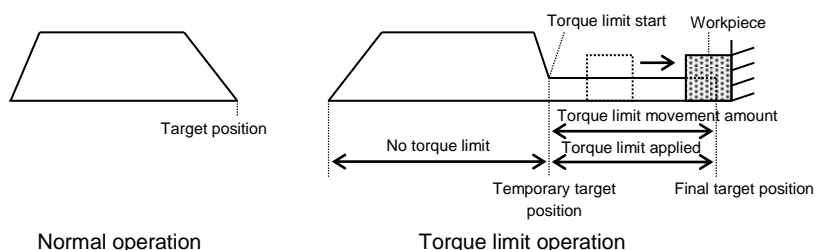


### STEP 1

Enter the coordinate value (X1) using the numeric keys, and press the **ENT** key.

\* "X1" is the value of K01 (axis display) of Parameter 2.  
(Refer to section ■ 3.4.1.)

- Setting range : -8000.00 to +8000.00 (mm)
- Initial value : 0.00 (mm)
- This indicates the target position of the movement operation. During torque limit operation, this indicates the temporary target position.
- When the Operation/Teach switchover input (IN6) is set to ON (Teaching mode), the current coordinates can be written to the coordinate values by the system input operation. (Refer to section ■ 5.5.)
- If absolute movement is specified for the coordinate system, absolute coordinate values are set based on the origin.
- If incremental movement is specified, movement amounts are based on the current position.
- If the **ALT** key is pressed instead of the numeric keys, the display turns into asterisks (\*\*\*\*\*).  
The coordinate is treated in the same manner as for the current coordinate values. If asterisks (\*\*\*\*\*) are specified in torque limit operation, no operation is performed because the torque limit movement direction is unknown.
- The meanings of the coordinate values are different in normal operation and torque limit operation.
  - During normal operation, this indicates the final target position.
  - During torque limit operation, this indicates the temporary position where the torque limit is started.

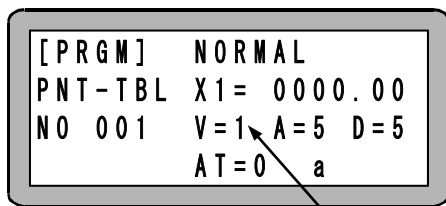


### NOTE

During torque limit operation, do not set the temporary target position to the same value as the current position. Because the torque limit movement direction is unknown, no operation is performed even if a start input (IN1) is input.

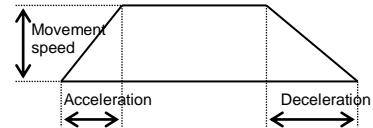


(3) Speed table number



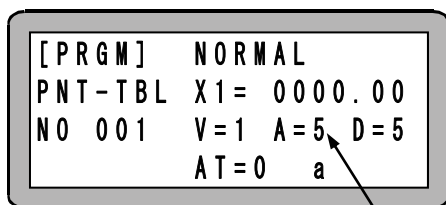
**STEP 1**

Enter the speed table number (V) using the numeric keys, and press the **ENT** key.



- Setting range : 1 to 8
- Initial value : 1
- This specifies the speed table number where the movement speed value was set.
- For details about the speed table (T02), refer to section ■ 3.5.2.

(4) Acceleration table number

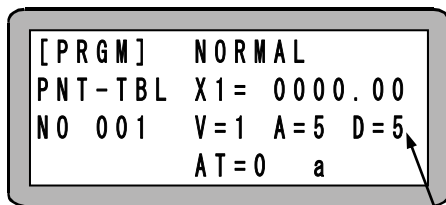


**STEP 1**

Enter the acceleration table number (A) using the numeric keys, and press the **ENT** key.

- Setting range : 1 to 8
- Initial value : 5
- This specifies the acceleration/deceleration table number where the acceleration value was set.
- For details about the acceleration/deceleration table (T03), refer to section ■ 3.5.3 .

(5) Deceleration table number



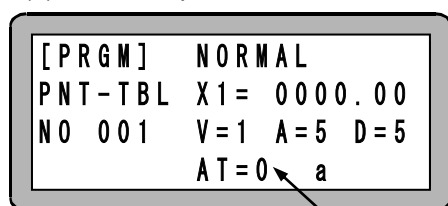
**STEP 1**

Enter the deceleration table number (D) using the numeric keys, and press the **ENT** key.

- Setting range : 1 to 8
- Initial value : 5
- This specifies the acceleration/deceleration table number where the deceleration value was set.
- For details about the acceleration/deceleration table (T03), refer to section ■ 3.5.3.



(6) Area output table number



**STEP 1**

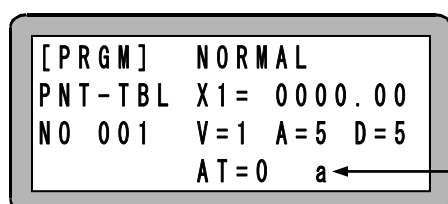
Enter the area output table number (AT) using the numeric keys, and press the **ENT** key.

- Setting range : 0 to 8
- Initial value : 0
- This indicates the area output table number where the area output conditions are set.
- If the area output conditions are satisfied, the output logic signal specified for area output (OUT4) is output.
- If the area output function is not used, set "0".
- The area output conditions are valid even after the completion of operation. However, note that the area output conditions become invalid when origin return is performed or when the control power supply is turned off.
- For details on the area output table (T05), refer to section ■ 3.5.5.

(7) Movement mode

This sets the functions in the table below.

Function	Initial value	Setting	Notes
Absolute/Incremental movement	a	a : Absolute movement i : Incremental movement	
Aging operation	OFF	ON : Valid OFF : Invalid	This function is enabled only during normal operation. Aging operation cannot be performed with torque limit operation.

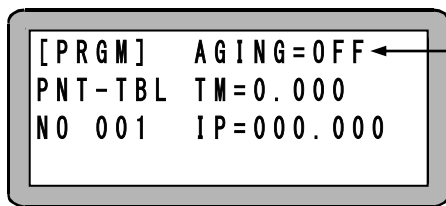


**STEP 1**

Select a (Absolute movement) or i (Incremental movement) with the **ALT** key, and press the **ENT** key.

The screen displayed after the **ENT** key is pressed is determined by the settings of "(1) Operation method."





## STEP 2

If normal operation (NORMAL) is selected in "(1) Operation method," select the aging operation (AGING) option (valid (ON) or invalid (OFF)) with the **ALT** key, and press the **ENT** key.

- Absolute movement

This moves to a coordinate position based on the origin.

- Incremental movement

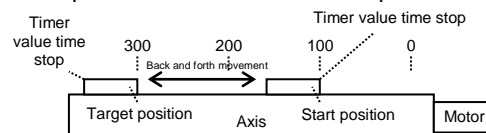
This moves to a coordinate position based on the current position.

- Aging operation

- This moves back and forth between the starting position and target position.
- The robot stops for the time of the "(9) Timer value" at each end.
- The robot stops at stop input (IN2) or when the STOP key is pressed.
- This is enabled only during normal operation. Aging operation is invalid during torque limit operation.

Example: As shown below, the robot keeps moving back and forth between the 100 mm and 300 mm positions in the following condition:

- 300 mm for "(2) Coordinate value"
- Aging operation valid (ON)
- Operation start at the 100 mm position



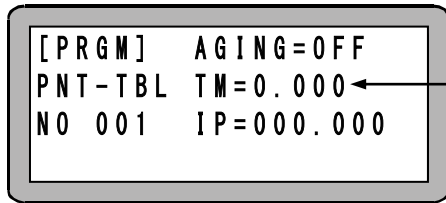
### NOTE

When aging operation is stopped and restarted, the stop position becomes a new start position.



{1} If normal operation (NORMAL) is selected in "(1) Operation method:"

(9) Timer value

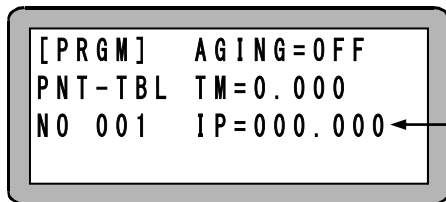


**STEP 1**

Enter the timer value (TM) using the numeric keys, and press the  key.

- Setting range : 0.000 to 9.999 sec
- Initial value : 0.000 sec
- This specifies the stop time at both ends during aging operation.
- This is enabled only during normal operation.

(10) In-position 2



**STEP 1**

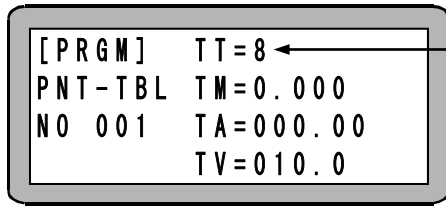
Enter the in-position value (IP) using the numeric keys, and press the  key.

- Setting range : 0.00 to 655.35 mm
- Initial value : 0.00 mm
- In-position 2 data is used as a determinant for whether positioning was completed.  
If the logical coordinates reach the target position, and the deviation counter (deviation between the target position and current position) drops to this value or less, the positioning complete output (OUT3) is turned on.
- If the setting value is 0.00 (mm), the in-position data (K02) value of parameter 2 is used to determine if positioning was completed. If the setting value is not 0.00 (mm), this data is used to determine if positioning was completed.
- The units are converted internally (mm → pulses) for this value. The value after conversion is limited to a maximum of 32,767 (pulses).
- This is enabled only during normal operation.



{2} If torque limit operation (TORQUE LIMIT) is selected in "(1) Operation method:"

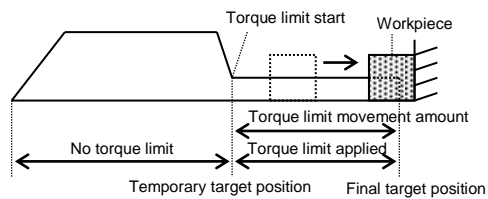
(8) Torque limit table number



**STEP 1**

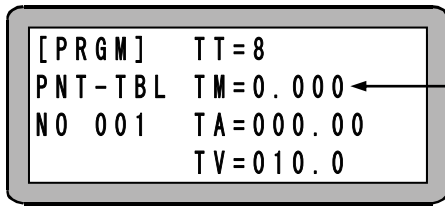
Enter the torque limit table number (TT) using the numeric keys, and press the **ENT** key.

- Setting range : 1 to 8
- Initial value : 8
- This specifies the torque limit table number where the torque limit value and load output standard value were set.
- This specifies the torque limit value and load output standard value for the section in the figure below where the torque limit is applied.
- When the robot reaches the final target position, the torque limit is released.
- For details about the torque limit table (T04), refer to section ■ 3.5.4.
- This is enabled only during torque limit operation.





### (9) Torque limit judgement time

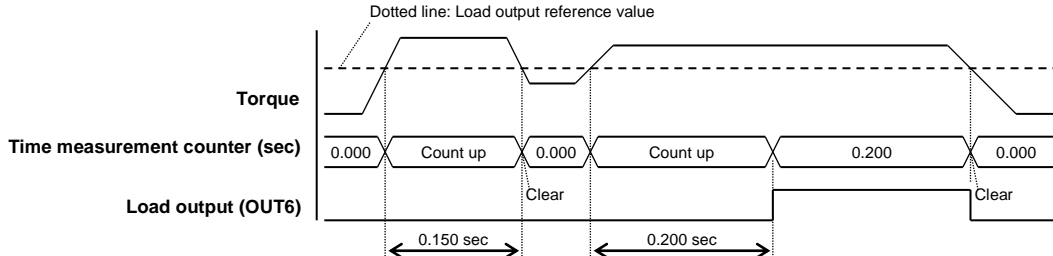


#### STEP 1

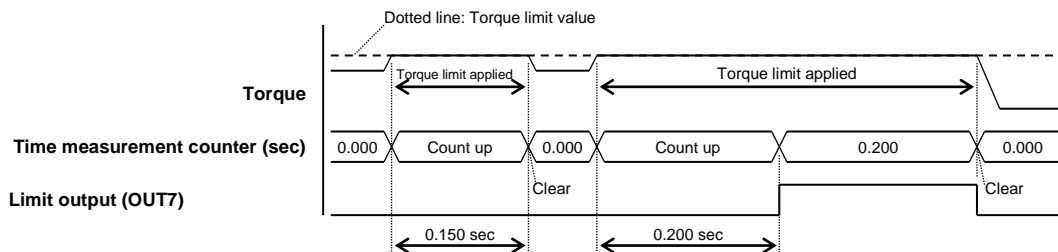
Enter the torque limit judgement time (TM) using the numeric keys, and press the **ENT** key.

- Setting range : 0.000 to 9.999 sec
- Initial value : 0.000 sec
- If the output torque exceeds the load output standard value (refer to section ■ 3.5.4) for a time period equal to or longer than the time that was set in this table, the load output (OUT6) is set to ON.
- If the output torque is less than the load output standard value (refer to section ■ 3.5.4) for a time period shorter than the time that was set in this table, the time measurement counter is cleared.
- If the torque limit is applied for a time period equal to or longer than the time that was set in this table, the limit output (OUT7) is set to ON.
- If the torque limit is cleared in a time period that is shorter than the time that was set in this table, the time measurement counter is cleared.
- Set the optimum value by taking into account the workpiece material, shape, and other conditions.
- This is enabled only during torque limit operation.
- An example when the Torque limit judgement time is 0.200 (sec) is shown below.

#### Example 1: Load output (OUT6) operation

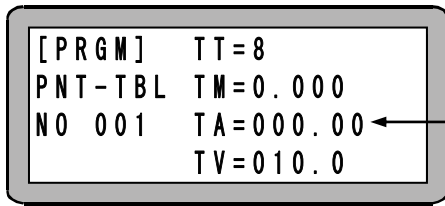


#### Example 2: Limit output (OUT7) operation





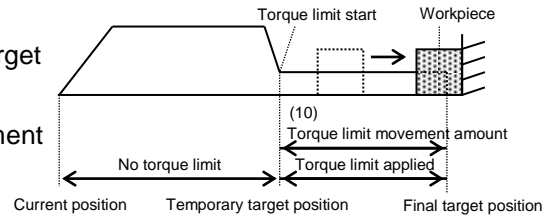
#### (10) Torque limit movement amount



#### STEP 1

Enter the torque limit movement amount (TA) using the numeric keys, and press the **ENT** key.

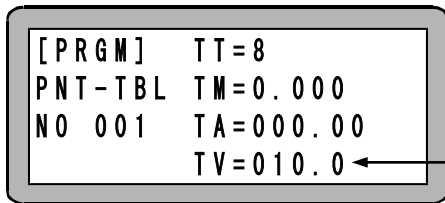
- Setting range : 0.00 to 655.35 mm
- Initial value : 0.00 mm
- This indicates the distance from the temporary target position to the final target position.
- The movement direction is identical to the movement direction before the torque limit is started.  
(See NOTE.)
- This is enabled only during torque limit operation.



#### NOTE

Because the torque limit movement direction is unknown, do not set the temporary target position to the same value as the current position. If the temporary target position is set to the same value as the current position, no operation is performed even if a start input (IN1) is input.

#### (11) Torque limit movement speed

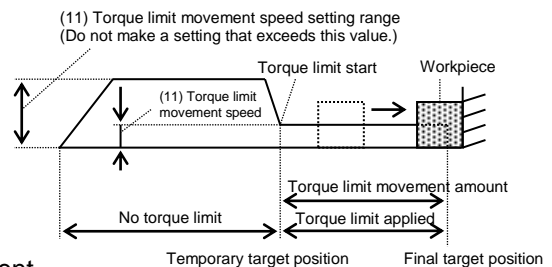


#### STEP 1

Enter the torque limit movement speed (TV) using the numeric keys, and press the **ENT** key.

Pressing the **ENT** key goes to the screen for "(12) Torque limit option."

- Setting range : 1.0 to 100.0 mm/sec
- Initial value : 10.0 mm/sec
- This is the movement speed from the start of the torque limit.
- This is enabled only during torque limit operation.



#### NOTE

Set the value for "(11) Torque limit movement speed" to a smaller value than the movement speed to the temporary target position.

#### (12) Torque limit option

The functions in the table below are set. (This is enabled only during torque limit operation.)

Function	Symbol	Initial value	Setting
Torque limit end	TE	OFF	ON : Valid OFF : Invalid
Lock end	LE	OFF	
Arrival end	AE	OFF	
Positional deviation exceeded detection	DD	ON	



```

[PRGM]  TE=OFF
PNT-TBL LE=OFF
NO 001  AE=OFF
        DD=ON

```

#### STEP 1

Select the torque limit end (TE) option (valid (ON) or invalid (OFF)) with the **ALT** key, and press the **ENT** key.

```

[PRGM]  TE=OFF
PNT-TBL LE=OFF
NO 001  AE=OFF
        DD=ON

```

#### STEP 2

Select the lock end (LE) option (valid (ON) or invalid (OFF)) with the **ALT** key, and press the **ENT** key.

```

[PRGM]  TE=OFF
PNT-TBL LE=OFF
NO 001  AE=OFF
        DD=ON

```

#### STEP 3

Select the arrival end (AE) option (valid (ON) or invalid (OFF)) with the **ALT** key, and press the **ENT** key.

```

[PRGM]  TE=OFF
PNT-TBL LE=OFF
NO 001  AE=OFF
        DD=ON

```

#### STEP 4

Select the positional deviation exceeded detection (DD) option (valid (ON) or invalid (OFF)) with the **ALT** key, and press the **ENT** key.

- Torque limit end (TE)

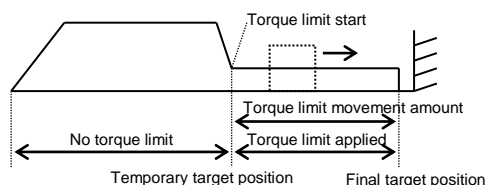
If this function is valid, the output-during-operation signal (OUT1) is turned off concurrently when the limit output signal (OUT7) is turned on.

- Lock end (LE)

If this function is set to ON, the output-during-operation signal (OUT1) is turned off concurrently when the output during locking (OUT8) is set to ON.

- Arrival end (AE)

If this function is set to ON, the output-during-operation signal (OUT1) is turned off concurrently when the final target position shown in the figure below is reached.



- Positional deviation exceeded detection (DD)

If this function is set to OFF, the positional deviation exceeded error is not detected.

Set to OFF when the positional deviation exceeded error occurs when pressing against the workpiece.



### ■ 3.5.2 T02 (Speed Table)

A total of eight speed tables are available, numbered from 1 to 8. They are selected "(3) Speed table number" in the point table (T01). The speed during operation is the value specified by a speed table.

Select a target speed table by pressing the **F1** key on the table selection screen in STEP2 of section ■ 3.5.

[ PARA ]			
SPD-TBL	N0	01:0100.0	
	N0	02:0200.0	
	N0	03:0300.0	

#### STEP 1

The speed table in the second line from top can be entered.

Enter the speed using the numeric keys, and press the **ENT** key.

Pressing the **NEXT** key scrolls the display as shown on the STEP2 screen.

[ PARA ]			
SPD-TBL	N0	01:0100.0	
	N0	02:0200.0	
	N0	03:0300.0	
	N0	04:0400.0	

#### STEP 2

The table display can be scrolled by using the **NEXT** and **-NEXT** keys.

If a table number is entered with the **SEARCH** key, a jump to the table is possible.

Pressing the **ESC** key returns to the table selection screen.

- Setting range : 1.0 to 3276.7
- Units : mm/sec
- Even if the speed is specified in this table, the speed limit at the value set in "Maximum speed (K05)" of Parameter 2 is applied.
- The initial values are shown below.

Table No.	1	2	3	4	5	6	7	8
Speed	100.0	200.0	300.0	400.0	500.0	600.0	700.0	800.0

#### NOTE

The speed tables are stored in the EEPROM. The EEPROM write count limit is 1 million. Because reading and writing may be unable to be performed normally if the number of writes exceeds 1 million, set the writes to the minimum count necessary.



### ■ 3.5.3 T03 (Acceleration/Deceleration Table)

A total of eight acceleration/deceleration tables are available, numbered from 1 to 8. They are selected "(4) Acceleration table number" or "(5) Deceleration table number" in the point table (T01). The acceleration (deceleration) time during operation is the value specified by a acceleration/deceleration table.

Select a target acceleration/deceleration table by pressing the **F 2** key on the table selection screen in STEP2 of section ■ 3.5.

[ PARA ]		
ACC-TBL	NO 01:	0.10
	NO 02:	0.15
	NO 03:	0.20

#### STEP 1

The acceleration/deceleration table in the second line from top can be entered.

Enter the acceleration using the numeric keys, and press the **ENT** key.

Pressing the **NEXT** key scrolls the display as shown on the STEP2 screen.

[ PARA ]		
ACC-TBL	NO 01:	0.10
	NO 02:	0.15
	NO 03:	0.20
	NO 04:	0.25

#### STEP 2

The table display can be scrolled by using the **NEXT** and **-NEXT** keys.

If a table number is entered with the **SEARCH** key, a jump to the table is possible.

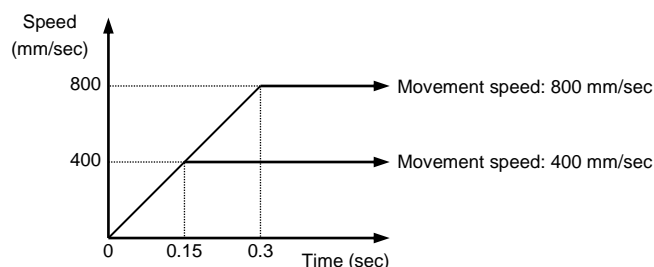
Pressing the **ESC** key returns to the table selection screen.

- Setting range : 0.01 to 9.99
- Units : sec
- The initial values are shown below.

Table No.	1	2	3	4	5	6	7	8
Acceleration/ deceleration time	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45

- This is the time that acceleration (deceleration) is performed up to the "Maximum speed (K05)" value of Parameter 2.

Example: The case when the "Maximum speed (K05)" is 800 mm/sec and acceleration time is 0.30 sec (Table 5) is shown in the figure below.



- Use the acceleration/deceleration table No. 5 for high-speed origin return.
- Units : sec



**NOTE** The acceleration/deceleration tables are stored in the EEPROM. The EEPROM write count limit is 1 million. Because reading and writing may be unable to be performed normally if the number of writes exceeds 1 million, set the writes to the minimum count necessary.

### ■ 3.5.4 T04 (Torque Limit Table)

A total of eight torque limit tables are available, numbered from 1 to 8. Each torque limit table consists of two types of data: torque limit values and load output standard values. Torque limit tables are selected by "(8) Torque limit table number" in the point table (T01). The torque limit value and the load output standard value during operation is the value specified by a torque limit table. This is enabled only during torque limit operation.

Select a target torque limit table by pressing the **F3** key on the table selection screen in STEP2 of section ■ 3.5.

```
[ PARA]  T.LMT L.STD
TRQ  N01  030.0 010.0
-TBL  N02  040.0 020.0
      N03  050.0 030.0
```

**STEP 1** The torque limit table in the second line from top can be entered.

Enter the torque limit value (T.LMT) using the numeric keys, and press the **ENT** key.

```
[ PARA]  T.LMT L.STD
TRQ  N01  030.0 010.0
-TBL  N02  040.0 020.0
      N03  050.0 030.0
```

**STEP 2** Enter the load output standard value (L.STD) using the numeric keys, and press the **ENT** key.

Pressing the **NEXT** key scrolls the display as shown on the STEP3 screen.

```
[ PARA]  T.LMT L.STD
TRQ  N02  040.0 020.0
-TBL  N03  050.0 030.0
      N04  060.0 040.0
```

**STEP3** The table display can be scrolled by using the **NEXT** and **-NEXT** keys.

If a table number is entered with the **SEARCH** key, a jump to the table is possible.

Pressing the **ESC** key returns to the table selection screen.

Data Configuration in Torque Limit Table

Data	Symbol	Setting range	Initial value	Units	Remarks
(1) Torque limit value	T.LMT	0.0 to 100.0	See the table below.	%	Motor instantaneous maximum torque is set to 100%
(2) Load output standard value	L.STD				

**NOTE** The area output tables are stored in the EEPROM. The EEPROM write count limit is 1 million. Because reading and writing may be unable to be performed normally if the number of writes exceeds 1 million, set the writes to the minimum count necessary.



(1) Torque limit value (T.LMT)

- During torque limit operation, Torque limit value = Motor maximum torque

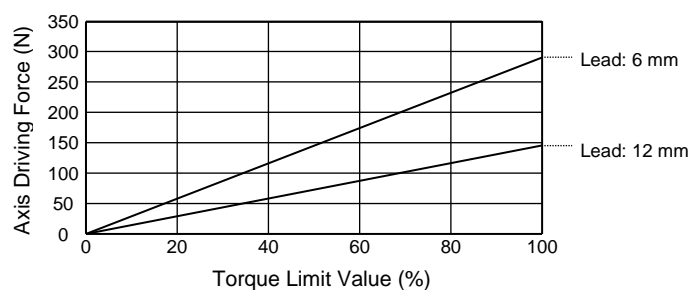
(2) Load output standard value (L.STD)

- If the output torque exceeds the load output standard value for the torque limit judgement time or longer, the load output (OUT6) is set to ON.

The initial values are shown below.

Table number	1	2	3	4	5	6	7	8
Torque limit value (T.LMT)	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0
Load output standard value (L.STD)	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0

Relationship Between Axis Driving Force and Torque Limit Value



**NOTE**

This is presented for reference purposes only, and no guarantees are made for the values presented here. Smaller torque limit values result in a larger error due to effect of sliding resistance. If operation continues at an output where the motor rating torque (approx. 33.0%) is exceeded, an overload error occurs.



### ■ 3.5.5 T05 (Area Output Table)

A total of eight area output tables are available, numbered from 1 to 8. Each area output table consists of four types of data: Coordinate value 1 (P1), Coordinate value 2 (P2), Comparison condition, and Output logic. Area output tables are selected by "(6) Area output table number" in the point table (T01). If the condition specified by an area output table is met, the specified output logic signal is output to the area output (OUT4).

Select a target area output table by pressing the **F4** key on the table selection screen in STEP2 of section ■ 3.5.

[ PARA ]	P1= 0000.00
ARE-TBL	P2= 0000.00
NO 01	P1<=X1<=P2
	OUT4=1

**STEP 1**

Enter the value for the coordinate 1 (P1) using the numeric keys, and press the **ENT** key.

[ PARA ]	P1= 0000.00
ARE-TBL	P2= 0000.00
NO 01	P1<=X1<=P2
	OUT4=1

**STEP 2**

Enter the value for the coordinate 2 (P2) using the numeric keys, and press the **ENT** key.

[ PARA ]	P1= 0000.00
ARE-TBL	P2= 0000.00
NO 01	P1<=X1<=P2
	OUT4=1

**STEP 3**

Using the **ALT** key, select the comparison condition (P1<=X1<=P2, X1<=P1, X1>=P1), and press the **ENT** key.

\* "X1" is the value of K01 (axis display) of Parameter 2.  
(Refer to section ■ 3.4.1.)

[ PARA ]	P1= 0000.00
ARE-TBL	P2= 0000.00
NO 01	P1<=X1<=P2
	OUT4=1

**STEP 4**

Enter the output logic (0 or 1) using the numeric keys, and press the **ENT** key.

Pressing the **NEXT** key displays the next table as shown on the STEP5 screen.

[ PARA ]	P1= 0000.00
ARE-TBL	P2= 0000.00
NO 02	P1<=X1<=P2
	OUT4=1

**STEP 5**

The number of the table to be displayed can be changed with the **NEXT** and **-NEXT** keys.

If a table number is entered with the **SEARCH** key, a jump to the table is possible.

Pressing the **ESC** key returns to the table selection screen.



#### Data Configuration in Area Output Table

Data	Setting range	Initial value	Units
(1) Coordinate value 1 (P1)	-8000.00 to +8000.00	0.00	mm
(2) Coordinate value 2 (P2)			
(3) Comparison condition	$\leq \leq$ / $\leq$ / $\geq$	$\leq \leq$	-
(4) Output logic	0/1	1	-

**NOTE** The area output tables are stored in the EEPROM. The EEPROM write count limit is 1 million. Because reading and writing may be unable to be performed normally if the number of writes exceeds 1 million, set the writes to the minimum count necessary.

#### (1) Coordinate value 1 (P1)

- This is a coordinate value for comparing with the current position.
- This is used for comparison condition  $\leq \leq$ ,  $\leq$ , and  $\geq$ .

#### (2) Coordinate value 2 (P2)

- This is a coordinate value for comparing with the current position.
- This is used for comparison condition  $\leq \leq$ .

#### (3) Comparison condition

- Comparison is made using the conditions in the table below for determining if the condition is met.

Comparison condition	Current position when condition is met	Remarks
$\leq \leq$	Current position is equal to or greater than coordinate value 1 and equal to or less than coordinate value 2 (Coordinate value 1 $\leq$ Current position $\leq$ Coordinate value 2)	
$\leq$	Current position is equal to or less than coordinate value 1 (Current position $\leq$ Coordinate value 1)	Coordinate value 2 is not used
$\geq$	Current position is equal to or greater than coordinate value 1 (Current position $\geq$ Coordinate value 1)	Coordinate value 2 is not used



(4) Output logic

- This specifies the output logic to the area output (OUT4) when the condition is met.

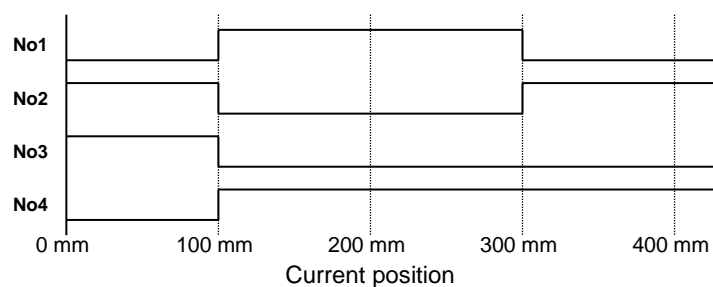
0: Output OFF when condition is met, Output ON when condition isn't met

1: Output ON when condition is met, Output OFF when condition isn't met

[Setting example]

No.	(1) Coordinate value 1 (P1)	(2) Coordinate value 2 (P2)	(3) Comparison conditions	(4) Output logic
1	100.00	300.00	$\leq \leq \leq$	1
2	100.00	300.00	$\leq \leq \leq$	0
3	100.00	0.00	$\leq$	1
4	100.00	0.00	$\geq$	1

In case of the setting example above, area output (OUT4) status changes as shown below, depending on current position.





## Chapter 4 Connection with External Devices

### ■ 4.1 Input/Output Signals

The input/output connector (CN4) consists of a system input/output and emergency stop input for connecting to a sequencer or other device for use in external control of the robot.

#### ■ 4.1.1 Input/output connector (CN4) signal names and pin numbers

Pin No.	I/O	Signal name
1	-	+COM
2	-	+COM
3	IN	IN1
4	IN	IN2
5	IN	IN3
6	IN	IN4
7	IN	IN5
8	IN	IN6
9	IN	IN7
10	IN	IN8
11	IN	IN9
12	IN	IN10
13	IN	Emergency stop input (+)
14	OUT	OUT1
15	OUT	OUT2
16	OUT	OUT3
17	OUT	OUT4
18	OUT	OUT5
19	OUT	OUT6
20	OUT	OUT7
21	OUT	OUT8
22	-	-COM
23	-	-COM
24	-	N.C.
25	-	N.C.
26	IN	Emergency stop input (-)

N. C. : No Connection

Use the supplied connector.

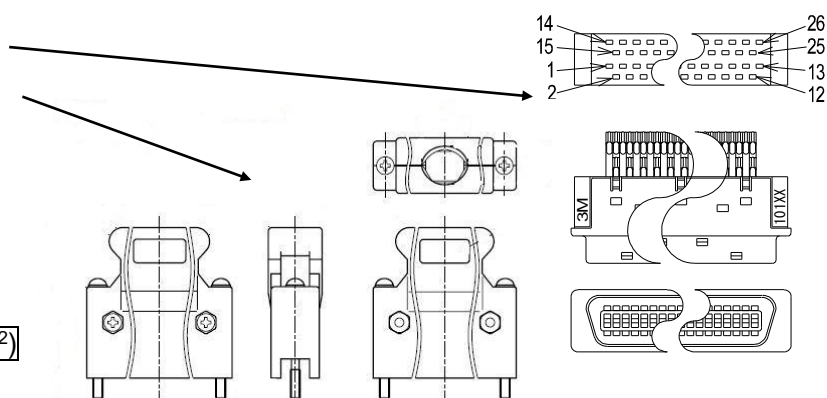
- Cable-side connector model

Plug 10126-3000PE  
 Shell kit 10326-52A0-008  
 Manufacturer 3M

- Controller-side connector model

Receptacle 10226-52A2PL  
 Manufacturer 3M

Compatible wire size: AWG24 (0.22 mm<sup>2</sup>)

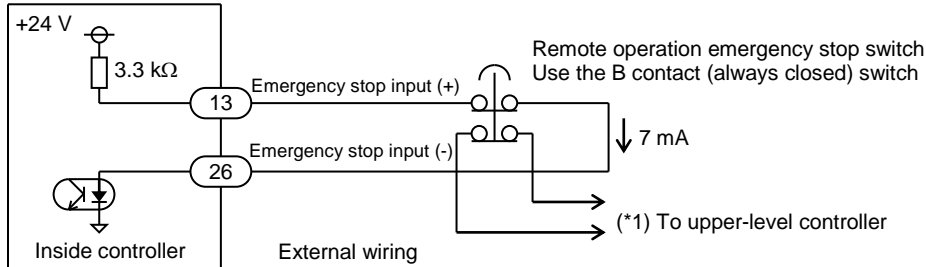




### ■ 4.1.2 Emergency stop input

This is an input for setting the controller to an emergency stop state. When this circuit is not connected, the controller is set to an emergency stop.

#### ● Emergency stop input



(\*1) Because this controller does not have an emergency stop output, to confirm the emergency stop input state at an upper-level controller, make a connection such as by using the emergency stop switch of the 2B contact to connect a contact on one side to the upper-level controller.

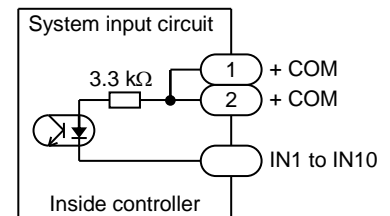


If this signal is set to OFF, an emergency stop is applied to the robot. However, be aware that the stop distance may vary depending on the load size, speed, inertia, and other factors.

### ■ 4.1.3 System input

System input consists of 10 inputs, numbered from IN1 to IN10. Each input function varies depending on the operating status and teaching status.

Operation mode	Operating status (*1)	Teaching status (*2)
IN1	Start input	+ Jog input
IN2	Stop input	- Jog input
IN3	Servo on input	
IN4	Not used	Write input
IN5	Error reset input	
IN6	Operation/Teach switching input	
IN7	Command point number input	
IN8		
IN9		
IN10		



- 1) Voltage: 24 V DC
- 2) Current: 7 mA
- 3) Photocoupler isolation

(\*1) Operation/Teach switching input (IN6) is enabled by OFF (Refer to section ■ 4.2.5).

(\*2) Operation/Teach switching input (IN6) is enabled by ON (Refer to section ■ 4.2.5).

#### NOTE

Switching to Teaching status is not possible during turning on the teach pendant or execution, sending and receiving the parameters, coordinate entry by computer software (SF-98D).



#### ■ 4.1.4 System output

System output consists of 8 outputs, numbered from OUT1 to OUT8. Each output function is different during normal operation and during torque limit operation.

Operation mode	Operating status (*1)		Teaching status (*2)
Control mode	During normal operation (*3)	During torque limit operation (*3)	—
OUT1	Output during operation	←	←
OUT2 (*4)	Error output	←	←
	READY/Error output		
OUT3	Positioning complete output	←	←
OUT4	Area output	←	←
OUT5	Completion point number output	Torque limit operation output	Completion point number output *Immediately after switching to Teaching status, OUT5 to OUT8 are all turned on.
OUT6		Load output	
OUT7		Limit output	
OUT8		Output during locking	

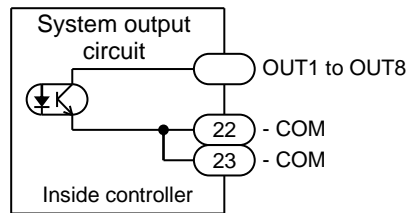
(\*1) Operation/Teach switching input (IN6) is enabled by OFF (Refer to section ■ 4.2.5).

(\*2) Operation/Teach switching input (IN6) is enabled by ON (Refer to section ■ 4.2.5).

(\*3) Switching is performed by "(1) Operation method" in the point table (T01).  
(Refer to section ■ 3.5.1 – (1).)

(\*4) The function is selected by the parameter M13. (Refer to section ■ 3.2.2.)

- 1) Voltage: 30 V max.
- 2) Current: 100 mA max.
- 3) Photocoupler isolation
- 4) Open collector output

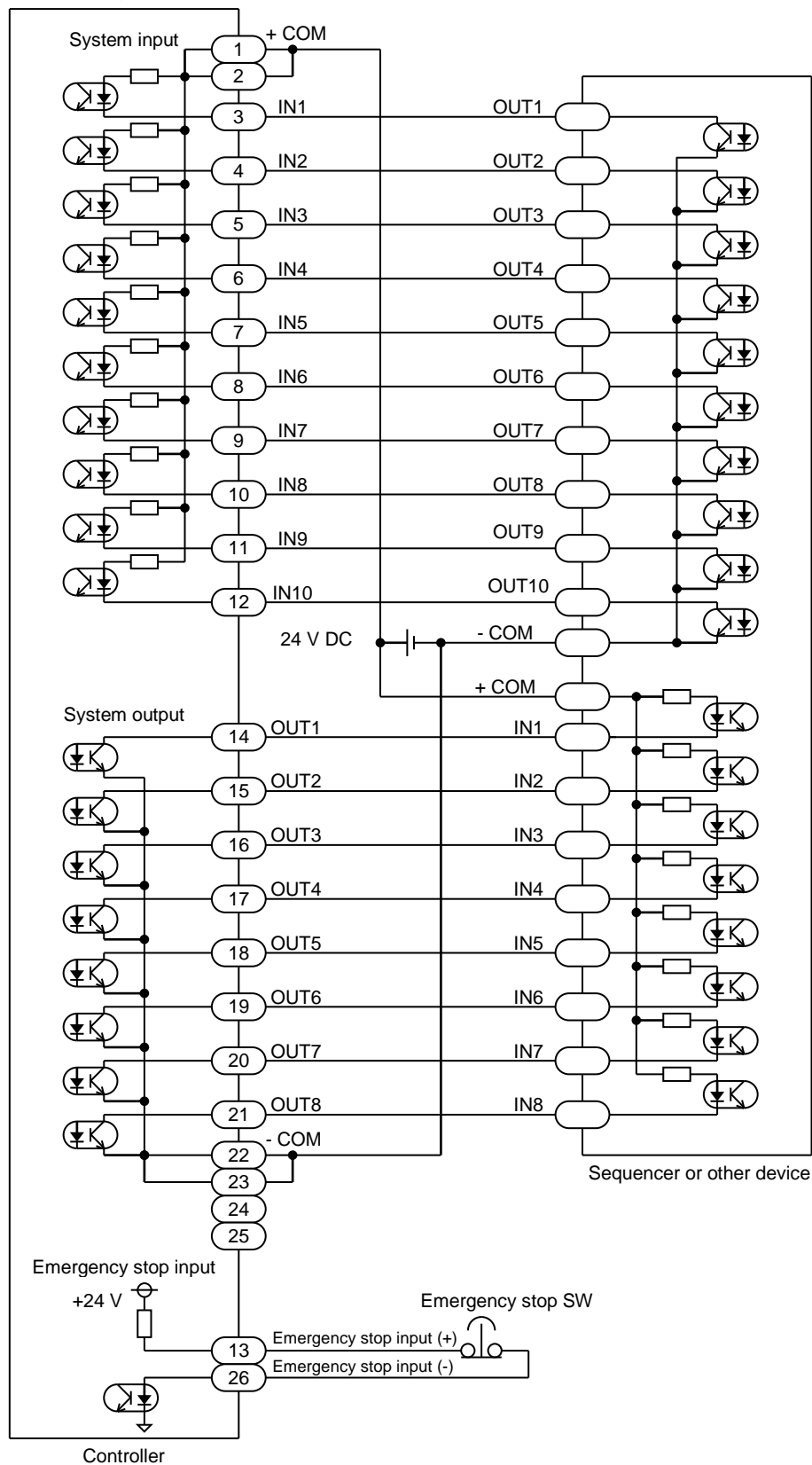


#### **NOTE**

Switching to Teaching status is not possible during turning on the teach pendant or execution, sending and receiving the parameters, coordinate entry by computer software (SF-98D).



#### ■ 4.1.5 Input/Output signal connection example





## ■ 4.2 System Input/Output Signals

The input signals of the controller use a 10 msec filter for preventing malfunctions due to chattering, noise, or other causes. Once an input signal is switched, a period of 10 msec elapses before the controller recognizes the switching of the input signal. Set the pulse width to 10 msec or longer to enable recognition of a pulse-shaped signal by the controller.

### ■ 4.2.1 Start input (IN1)

- Signal name: START
- If the rising edge of this input from OFF to ON is detected, operation is started based on the point table (T01) that was specified by the command point number input (IN7 to IN10).
- Set the start input (IN1) to ON 10 msec or more after determining the value of the command point number input (IN7-IN10). If it is set to ON before 10 msec passes, the robot may move to an unintended point.
- This input is valid when Operation/Teach switching input (IN6) is OFF.
- The start input is invalid while T/P ON is selected on the teach pendant, or while operation or parameter transfer is being performed through the computer software (SF-98D).
- The start input is invalid when the stop input (IN2) is ON.

### ■ 4.2.2 Stop input (IN2)

- Signal name: STOP
- This is an input that abnormally terminates a movement operation that is in progress. When this input is set to ON, the robot decelerates and stops, and all later movement amounts are canceled.
- This input is disabled during the origin return operation.
- This functions as the torque limit operation end signal during torque limit operation.
- The start input (IN1) is disabled when this input is ON.
- This input is valid when Operation/Teach switching input (IN6) is OFF.

### ■ 4.2.3 Servo on input (IN3)

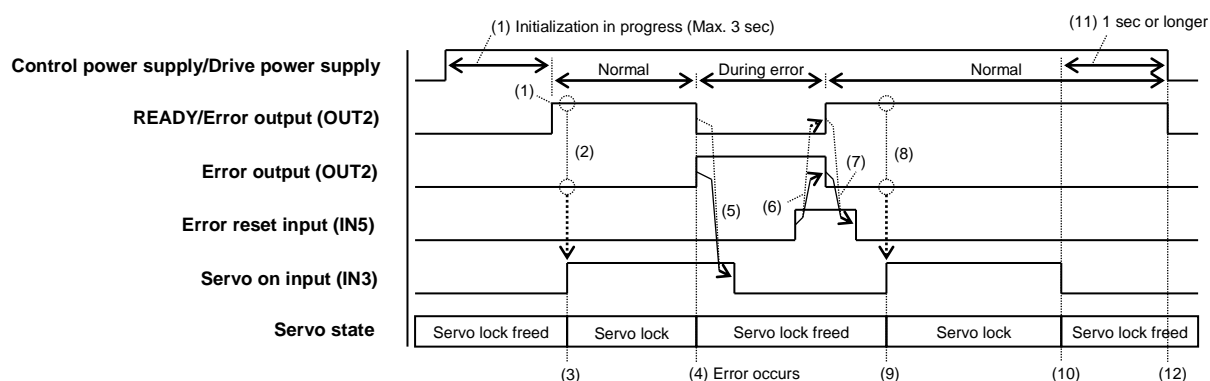
- Signal name: SVON
- The servo-on input is used for the motor to be servo-locked. The servo lock is applied at the rising edge; it is freed at the falling edge.
- When the servo lock is applied upon recovery from an error or the like, set the servo-on input to OFF, and set it back to ON after 10 msec or more has passed.
- Set this input to ON after at least 3 seconds have elapsed after the control power supply and drive power supply were turned on. If OUT2 is assigned to READY/error output, set OUT2 to ON before setting this input to ON.
- If the servo-on input is ON before the control power supply or drive power supply is turned on, the motor is not servo-locked.
- The servo-on input is invalid while T/P ON is selected on the teach pendant, or while operation or parameter transfer is being performed through the computer software (SF-98D). Thus, the motor is not servo-locked at detection of the rising edge in that condition.
- Before the motor can be servo-locked through the teach pendant or the computer software (SF-98D), the servo-on input must be set to ON.



- Before shutting off the control power supply and drive power supply, set this input to OFF, and allow at least 1 second to elapse. If the control power supply and drive power supply are shut off while this input is set to ON, the vertical axis can drop up to about 5 mm.



If the control power supply and drive power supply are shut off while this input is set to ON, the vertical axis can drop up to about 5 mm. The drop distance varies depending on the axis lead and load weight. Be sure to organize the sequence so that this input is always set to OFF before shutting off the control power supply and drive power supply.



- (1) After the control power supply and drive power supply are turned on, wait 3 seconds until initialization is complete. If OUT2 is assigned to READY/Error output, wait until it is set to ON.
- (2) Before setting servo on input (IN3) to ON, check that the error output (OUT2) is in the OFF state. If OUT2 is assigned to READY/Error output, check that it is set to ON.
- (3) The servo lock is applied when the servo-on input (IN3) is set to ON.
- (4) If an error occurs, the error output (OUT2) is set to ON. If OUT2 is assigned to READY/Error output, this output is set to OFF. At the same time, the servo lock is freed.
- (5) Once error output (OUT2) is set to ON, set the servo on input (IN3) to OFF. If OUT2 is assigned to the READY/Error output, once the READY/Error output (OUT2) is set to OFF, set the servo on input (IN3) to OFF.
- (6) Once the error reset input (IN5) is set to ON, the error output (OUT2) is set to OFF. If OUT2 is assigned to the READY/Error output, once the error reset input (IN5) is set to ON, the READY/Error output (OUT2) is set to ON. Note that, if the cause of the error is not removed, the error output (OUT2) will remain at ON, and the READY/error output (OUT2) will remain at OFF.
- (7) After the error output (OUT2) is set to OFF, return the error reset (IN5) to OFF. If OUT2 is assigned to the READY/error output, return the error reset (IN5) to OFF after the READY/error output (OUT2) is set to ON, or return it to OFF after at least 10 msec has elapsed after the error reset input (IN5) was set to ON.
- (8) Same as (2).
- (9) Same as (3).
- (10) The servo lock is freed when the servo-on input (IN3) is set to OFF.
- (11) Wait at least 1 second.
- (12) Shut off the control power supply and drive power supply.

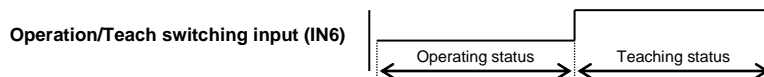


#### ■ 4.2.4 Error reset input (IN5)

- Signal name: ALRST
- This is an input that resets an error state.
- This signal can be received only when the controller is stopped (when it is not operating).

#### ■ 4.2.5 Operation/Teach switching input (IN6)

- Signal name: RTSEL
- This is an input that switches between Operating status and Teaching status.
- Operating status is set at OFF, and Teaching status is set at ON.



- Operating status is the status where automatic operation is performed. System input operation is used to operate the robot.
- Teaching status is the status where teaching operations are issued to the robot. Jog operations by system input operation and writing of the current position to the "(2) Coordinate value" of the point table (T01) are possible. (Refer to section ■ 5.4 and section ■ 5.5.)

#### ■ 4.2.6 + Jog input, - Jog input (IN1, IN2)

- Signal name: +JOG,-JOG
- This is an input that performs jog movement. Movement is started when set to ON, and movement stops when set to OFF. Note that the robot always moves the distance that is specified in the jog inching value (P08) parameter.
- The movement speed is set by the jog low-speed (P06) parameter.
- After movement is started, the robot moves the distance that was set by the jog inching value amount (P08) parameter and then stops temporarily. Then, after stopping for 500 msec, movement is restarted.
- During movement, the output during operation (OUT1) is set to ON, and the positioning completion output (OUT3) is set to OFF.
- This input is valid when Operation/Teach switching input (IN6) is OFF.
- For details on the jog operation method, see section ■ 5.4.
- The start input is invalid while T/P ON is selected on the teach pendant, or while operation or parameter transfer is being performed through the computer software (SF-98D).



Because the soft limit check is not enabled before the origin return operation is completed, there is a danger of the robot colliding with the mechanical ends. Use caution during this operation.



#### ■ 4.2.7 Write input (IN4)

- Signal name: WRITE
- This is an input for writing the coordinate value to the point table (T01).
- The coordinate value cannot be written before completion of origin return. An attempt to write it causes an error indicating that origin return is incomplete.
- The write input is invalid while T/P ON is selected on the teach pendant, or while operation or parameter transfer is being performed through the computer software (SF-98D). An attempt to set the write input to ON in that condition causes an error indicating that writing is not permitted.
- The point table (T01) that is written to is specified by command point number input (IN7 - IN10).
- For details on writing data, see section ■ 5.5.

#### **NOTE**

The point tables are stored in the EEPROM. The EEPROM write count limit is 1 million.

Because reading and writing may be unable to be performed normally if the number of writes exceeds 1 million, set the writes to the minimum count necessary.

#### ■ 4.2.8 Command point number input (IN7 - IN10)

- Signal name: PIN1, PIN2, PIN4, PIN8
- This is an input for specifying the number of the point table (T01).
- If the start input (IN1) is set to ON when IN7 to IN10 are all ON, the origin return operation is performed.
- Set the value 10 msec before the start input (IN1) is set to ON.

If it is set to ON before 10 msec passes, the robot may move to an unintended point.

Specified table	IN10 (PIN8)	IN9 (PIN4)	IN8 (PIN2)	IN7 (PIN1)	Notes
1	0	0	0	0	
2	0	0	0	1	
3	0	0	1	0	
4	0	0	1	1	
5	0	1	0	0	
6	0	1	0	1	
7	0	1	1	0	
8	0	1	1	1	
9	1	0	0	0	
10	1	0	0	1	
11	1	0	1	0	
12	1	0	1	1	
13	1	1	0	0	
14	1	1	0	1	
15	1	1	1	0	
Not specified	1	1	1	1	For origin return

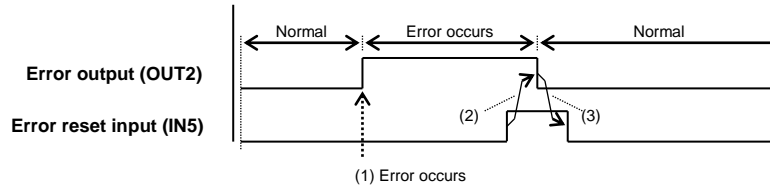
#### ■ 4.2.9 Output during operation (OUT1)

- Signal name: RUN
- This signal is ON during robot operation.  
It is also ON during the origin return operation and during jog movement.



#### ■ 4.2.10 Error output (OUT2)

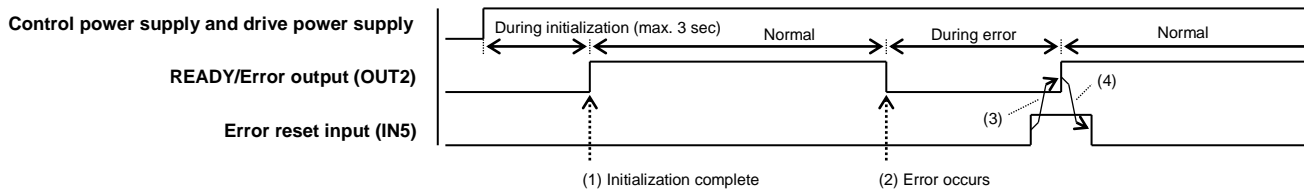
- Signal name: ERROR
- This signal is ON when an error occurs in the controller.
- For details on the error types and their troubleshooting procedures, refer to section ■ 6.2.
- The function of OUT2 is selected by the parameter M13. (Refer to section ■ 3.2.2.)



- (1) When an error occurs, the error output (OUT2) is set to ON.
- (2) When the error reset input (IN5) is set to ON, the error output (OUT2) is set to OFF.  
Note that, if the cause of the error is not removed, the error output (OUT2) will remain at ON.
- (3) Return the error reset (IN5) to OFF after the error output (OUT2) is set to OFF, or return it to OFF after at least 10 msec has elapsed after the error reset input (IN5) was set to ON.

#### ■ 4.2.11 READY/Error output (OUT2)

- Signal name: RDY/ERR
- This is set to ON when controller initialization is completed after the control power supply is turned on.
- It is set to OFF during an error.
- If this signal is used for controller error detection, organize the upper-level controller sequence so that an error is not determined for 3 seconds after the control power supply is turned on.
- The function of OUT2 is selected by the parameter M13. (Refer to section ■ 3.2.2.)



- (1) After the control power supply and drive power supply are turned on, this is set to ON once the controller initialization is completed. The initialization time is a maximum of 3 seconds.
- (2) When an error occurs, the READY/Error output (OUT2) is set to OFF.
- (3) When the error reset input (IN5) is set to ON, the READY/Error output (OUT2) is set to ON.  
Note that, if the cause or the error is not removed, the READY/Error output (OUT2) will remain at OFF.
- (4) Return the error reset (IN5) to OFF after the READY/Error output (OUT2) is set to ON, or return it to OFF after at least 10 msec has elapsed after the error reset input (IN5) was set to ON.



#### ■ 4.2.12 Positioning complete output (OUT3)

- Signal name: POSI
- This is a signal that indicates that the target position was reached and positioning was completed.
- This is in the OFF state after the control power supply and drive power supply are turned on and before the origin return operation is completed. After the origin return operation is completed, this is set to ON when the positional deviation is within the in-position width.
- This is in the OFF state during movement, and after the target position is reached, it is set to ON when the positional deviation is within the in-position width.
- The positioning complete output is set to OFF when the servo lock is freed.

#### ■ 4.2.13 Area output (OUT4)

- Signal name: AREA
- If the axis slider position is within the specified coordinates, the signal with the specified output logic is output during that time.
- The specified coordinates and output logic are set by the output table (T05).
- To enable this function, set the area table number (1-8) that is to be specified for "(6) Area output table number (AT)" of the point table (T01).
- This output is disabled before the origin return operation is completed.

#### ■ 4.2.14 Completion point number output (OUT5 - OUT8)

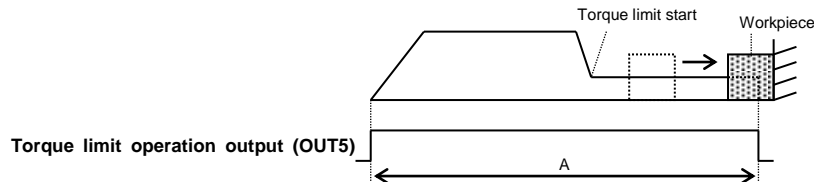
- Signal name: POUT1, POUT2, POUT4, POUT8
- When movement is completed, the point table number specified by the command point number input (IN7 - IN10) is output.
- During movement, F(=1111) is output.
- During the origin return operation, 0(=0000) is output.
- If the target position was not reached by a deceleration stop, emergency stop, or other operation by stop input (IN2), F(=1111) continues to be output.
- This output is valid only during normal operation. A different signal is output during torque limit operation.

(For details on how to specify normal operation, refer to section ■ 3.5.1 – (1).)



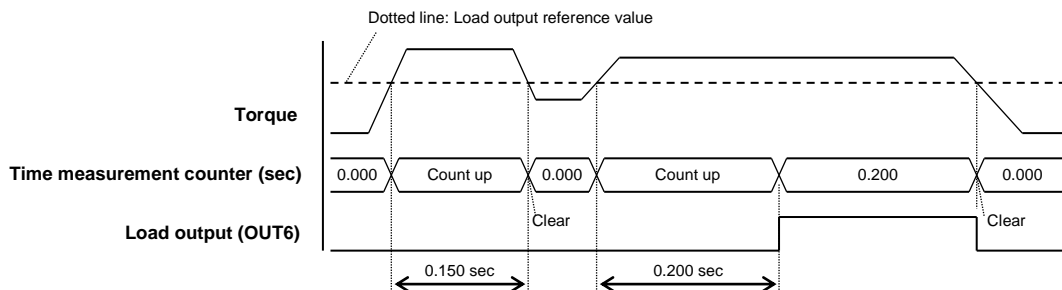
#### ■ 4.2.15 Torque limit operation output (OUT5)

- Signal name: TQCON
  - This is ON during the torque limit operation. (Section A in the figure below)
  - This output is valid only during torque limit operation. A different signal is output during normal operation.
- (For details on how to specify torque limit operation, refer to section ■ 3.5.1 – (1).)



#### ■ 4.2.16 Load output (OUT6)

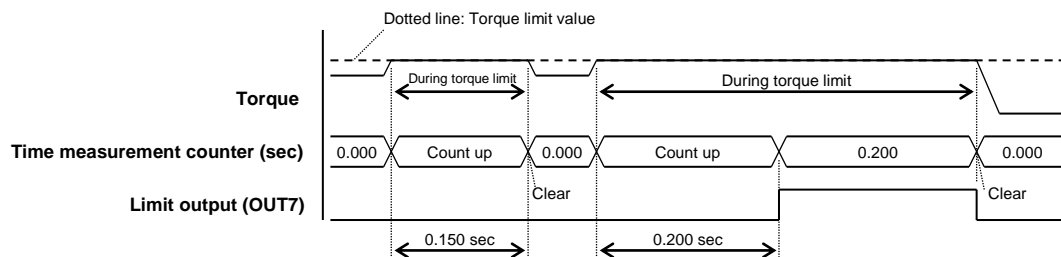
- Signal name: TQLOAD
  - This is ON when the output torque exceeds the load output standard value (refer to section ■ 3.5.4) for the Torque limit judgement time or longer (section ■ 3.5.1 – (9)).
  - This is set to OFF if the output torque drops below the load output standard value even after if it was set to ON momentarily.
  - This output is valid only during torque limit operation. A different signal is output during normal operation.
- (For details on how to specify torque limit operation, refer to section ■ 3.5.1 – (1).)
- An example when the Torque limit judgement time (section ■ 3.5.1 – (9)) is 0.200 sec is shown below.





#### ■ 4.2.17 Limit output (OUT7)

- Signal name: TQLIM
- This is ON when the torque limit continues for the Torque limit judgement time or longer (section ■ 3.5.1 – (9)).
- This is set to OFF if the output torque drops below the torque limit value even after it was set to ON momentarily.
- This output is valid only during torque limit operation. A different signal is output during normal operation.  
(For details on how to specify torque limit operation, refer to section ■ 3.5.1 – (1).)
- An example when the Torque limit judgement time (section ■ 3.5.1 – (9)) is 0.200 sec is shown below.



#### ■ 4.2.18 Output during locking (OUT8)

- Signal name: TQLOCK
- This is set to ON when the slider lock is detected.  
(The lock detection conditions are (1) Stopping of motor and (2) Limit output (OUT7) set to ON.)
- This output is valid only during torque limit operation. A different signal is output during normal operation.  
(For details on how to specify torque limit operation, refer to section ■ 3.5.1 – (1).)



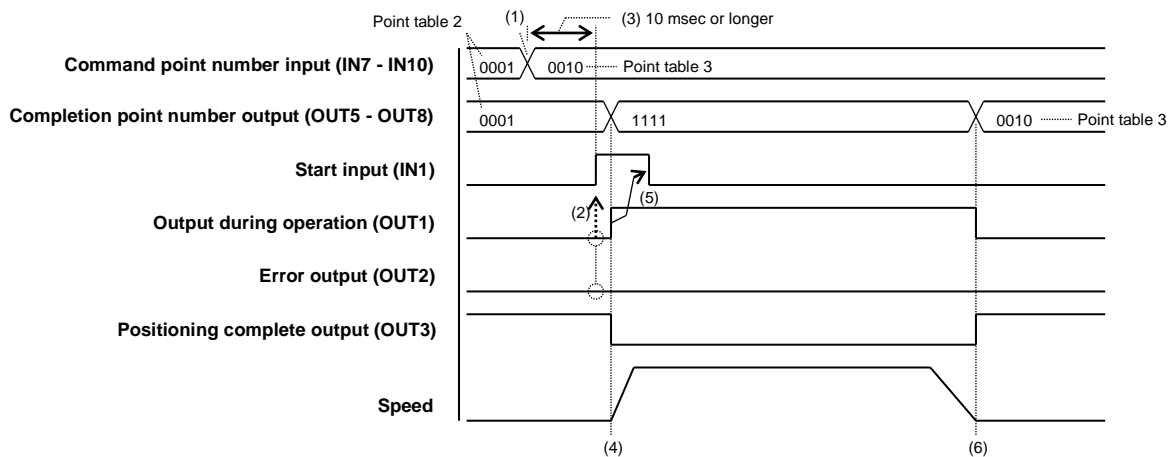
## Chapter 5 Operation

This chapter describes the robot operating procedures using system input. Robot operation and system output are the same when the robot is operated by the teach pendant and computer software (SF-98D).

### ■ 5.1 Normal Operation

#### ■ 5.1.1 Moving to target position

Example: Moving to point table 3 when stopped at point table 2



- (1) Point table 3(=0010) is specified by command point number input (IN7 - IN10).
- (2) Before setting start input (IN1) to ON, check that the output during operation (OUT1) is OFF and the error output (OUT2) is OFF.  
If OUT2 is assigned to READY/Error output, check that it is ON.
- (3) Set start input (IN1) to ON after at least 10 msec has elapsed from (1).  
If it is set to ON before 10 msec passes, the robot may move to an unintended point.
- (4) Movement is started when the start input (IN1) is received.  
At the same time, the completion point number outputs (OUT5 - OUT8) are all set to ON(=1111). Also, output during operation (OUT1) is set to ON, and the positioning complete output (OUT3) is set to OFF.
- (5) After the output during operation (OUT1) is set to ON, return the start input (IN1) to OFF, or return it to OFF after at least 10 msec has elapsed after the start input (IN1) was set to ON.
- (6) When movement is completed, the output during operation (OUT1) is set to OFF, and the positioning complete output (OUT3) is set to ON. At the same time, the completion point number outputs (OUT5 - OUT8) send the values of point table 3(=0010).  
If an error or other problem occurs, and operation stops before the target position, the completion point number outputs (OUT5 - OUT8) all remain at ON(=1111).



Point table 3 setting example (Refer to section ■ 3.5.1)

Item	Symbol	Setting value
(1) Operation method	-	NORMAL (Normal operation)
(2) Coordinate value	X1(*1)	300.00 [mm]
(3) Speed table number	V	1 ( = 100.0 [mm/sec] )
(4) Acceleration table number	A	5 ( = 0.30 [sec] )
(5) Deceleration table number	D	7 ( = 0.40 [sec] )
(6) Area output table number	AT	0 (Area output not used)
(7) Movement mode	Absolute/Incremental movement	- (Absolute movement)
	Aging operation	AGING OFF
(8) Not used	-	Not used
(9) Timer value	TM	0.000 [sec]
(10) In-position 2	IP	0.00 [mm]
(11) Not used	-	Not used
(12) Not used	-	Not used

Other input signals

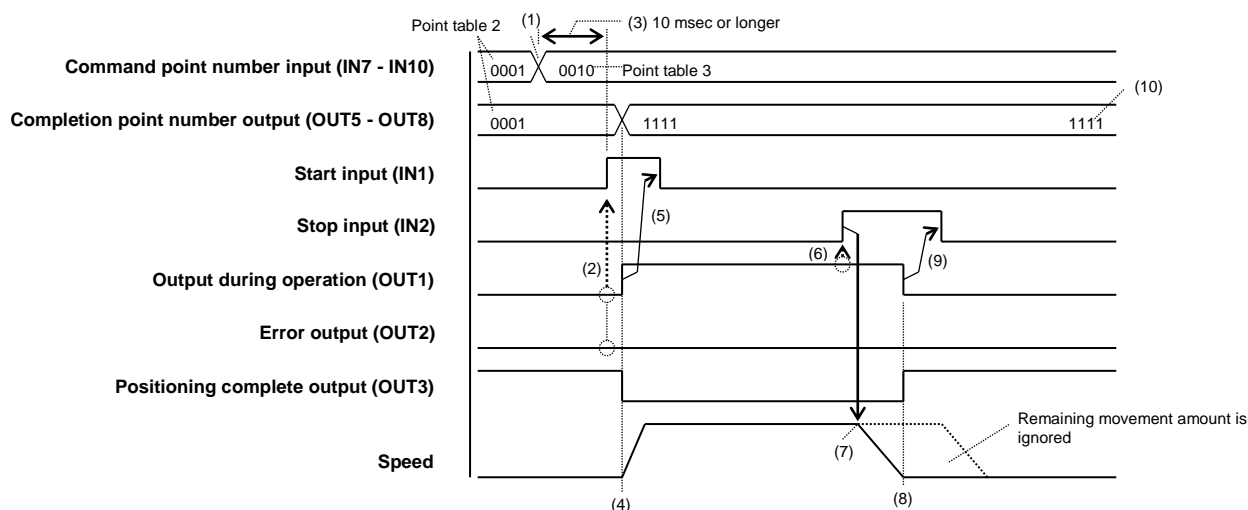
Signal name	Function	State
IN2	Stop input	OFF
IN3	Servo on input	ON
IN5	Error reset input	OFF
IN6	Operation/Teach switching input	OFF

(\*1) The value of K01 (axis display) of Parameter 2 is assigned. (Refer to section ■ 3.4.1.)

## ■ 5.1.2 Deceleration stop during movement

A stop input (IN2) is used to perform a deceleration stop during movement.

Example: Deceleration stop during movement from point table 2 to 3



- (1) Point table 3(=0010) is specified by command point number input (IN7 - IN10).
- (2) Before setting start input (IN1) to ON, check that the output during operation (OUT1) is OFF and the error output (OUT2) is OFF.  
If OUT2 is assigned to READY/Error output, check that it is ON.
- (3) Set start input (IN1) to ON after at least 10 msec has elapsed from (1).  
If it is set to ON before 10 msec passes, the robot may move to an unintended point.



- (4) Movement is started when the start input (IN1) is received.  
At the same time, the completion point number outputs (OUT5 - OUT8) are all set to ON(=1111). Also, output during operation (OUT1) is set to ON, and the positioning complete output (OUT3) is set to OFF.
- (5) After the output during operation (OUT1) is set to ON, return the start input (IN1) to OFF, or return it to OFF after at least 10 msec has elapsed after the start input (IN1) was set to ON.
- (6) After checking that the output during operation (OUT1) is set to ON, set the stop input (IN2) to ON.
- (7) The robot starts to decelerate.
- (8) When deceleration is completed, the output during operation (OUT1) is set to OFF, and the positioning complete output (OUT3) is set to ON.
- (9) After the output during operation (OUT1) is set to OFF, return the stop input (IN2) to OFF, or return it to OFF after at least 10 msec has elapsed after the stop input (IN2) was set to ON.
- (10) The completion point number outputs (OUT5 - OUT8) all remain at ON(=1111).

Point table 3 setting example (Refer to section ■ 3.5.1)

Item	Symbol	Setting value
(1) Operation method	-	NORMAL (Normal operation)
(2) Coordinate value	X1(*1)	400.00 [mm]
(3) Speed table number	V	2 ( = 200.0 [mm/sec] )
(4) Acceleration table number	A	3 ( = 0.20 [sec] )
(5) Deceleration table number	D	6 ( = 0.35 [sec] )
(6) Area output table number	AT	0 (Area output not used)
(7) Movement mode	Absolute/Incremental movement	- a (Absolute movement)
	Aging operation	AGING OFF
(8) Not used	-	Not used
(9) Timer value	TM	0.000 [sec]
(10) In-position 2	IP	0.00 [mm]
(11) Not used	-	Not used
(12) Not used	-	Not used

Other input signals

Signal name	Function	State
IN3	Servo on input	ON
IN5	Error reset input	OFF
IN6	Operation/Teach switching input	OFF

(\*1) The value of K01 (axis display) of Parameter 2 is assigned. (Refer to section ■ 3.4.1.)



## ■ 5.2 Torque Limit Operation

Torque limit operation moves the robot to the temporary target position without torque limit, and subsequently moves it to the final target position in the same direction, with specified torque limit. There are two methods to end torque limit operation: one method ends it through an external signal, and the other ends it automatically.

### ■ 5.2.1 Ending torque limit operation by an external signal

This is a method for ending the torque limit operation from an upper-level controller. It is ended by a stop input (IN2).

Determine if an upper-level controller can end the torque limit operation using the status output from the controller.

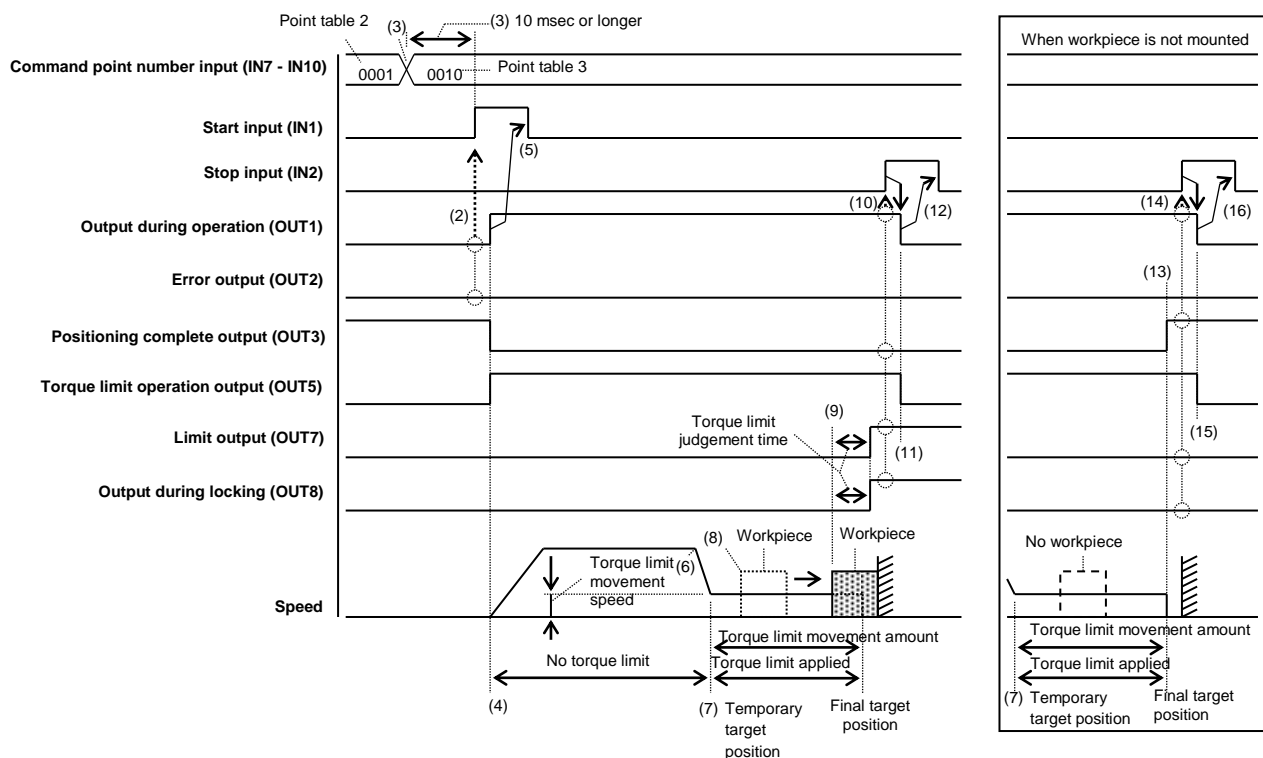
Because upper-level controller information can also be used to determine if the operation can be ended, this enables determination based on an even higher degree of freedom.

Determine whether a workpiece is present using the status of the positioning complete output (OUT3), limit output (OUT7), and output during locking (OUT8). If necessary, the area output function can also be used to determine if a workpiece is present.

Example: When moving to point table 3 when stopped at point table 2

(Set the "(12) Torque limit option" in the point table (T01) as shown in the table below.)

Function	Symbol	Setting	Refer to
Torque limit end	TE	OFF: Invalid	Section ■ 3.5.1 – (12)
Lock end	LE	OFF: Invalid	
Arrival end	AE	OFF: Invalid	
Positional deviation exceeded detection	DD	ON : Valid	





- (1) Point table 3(=0010) is specified by command point number input (IN7 - IN10).
- (2) Before setting start input (IN1) to ON, check that the output during operation (OUT1) is OFF and the error output (OUT2) is OFF.  
If OUT2 is assigned to READY/Error output, check that it is ON.
- (3) Set start input (IN1) to ON after at least 10 msec has elapsed from (1).  
If it is set to ON before 10 msec passes, the robot may move to an unintended point.
- (4) Movement is started when the start input (IN1) is received. At this point, the torque limit is not activated.  
At the same time, the output during operation (OUT1) is set to ON, positioning complete output (OUT3) is set to OFF, and the torque limit operation output (OUT5) is set to ON.
- (5) After the output during operation (OUT1) is set to ON, return the start input (IN1) to OFF, or return it to OFF after at least 10 msec has elapsed after the start input (IN1) was set to ON.
- (6) When the robot comes close to the temporary target position, it starts decelerating.
- (7) When the temporary target position is reached, the torque limit is activated. The movement speed is the value specified in "(11) Torque limit movement speed (TV)" of the point table (T01), and the movement distance from the temporary target position is the value set by "(10) Torque limit movement amount (TA)" of the point table (T01).
- (8) The robot contacts the workpiece and starts pressing against it.
- (9) The workpiece is locked. The limit output (OUT7) and the output during locking (OUT8) are set to ON when the torque limit judgement time passed. The output during operation (OUT1) remains at ON, and the positioning complete output (OUT3) remains at OFF.
- (10) Before the stop input (IN2) is set to ON, check that the output during operation (OUT1) is set to ON, the positioning complete output (OUT3) is set to OFF, the limit output (OUT7) is set to ON, and the output during locking (OUT8) is set to ON. (If necessary, use the area output function to check the workpiece position.)
- (11) The output during operation (OUT1) and torque limit operation output (OUT5) are set to OFF. Position control where the final target position is set as the target position is continued, and the torque limit also remains activated (\*1). The positioning complete output (OUT3), limit output (OUT7), and output during locking (OUT8) each continue to output in their respective states.
- (12) After the output during operation (OUT1) is set to OFF, return the stop input (IN2) to OFF, or return it to OFF after at least 10 msec has elapsed after the stop input (IN2) was set to ON.
- (\*1) To eliminate shock to the workpiece, the limit of the output torque continues until the actual output torque at the next movement falls below the torque limit value.

Skip from (7) to (13) if no workpiece is present.
---

- (13) When the final target position is reached, the positioning complete output (OUT3) is set to ON.
- (14) Before the stop input (IN2) is set to ON, check that the output during operation (OUT1) is set to ON, the positioning complete output (OUT3) is set to ON, the limit output (OUT7) is set to OFF, and the output during locking (OUT8) is set to OFF. (If necessary, use the area output function to check that the workpiece is not present.)
- (15) The output during operation (OUT1) and torque limit operation output (OUT5) are set to OFF.
- (16) After the output during operation (OUT1) is set to OFF, return the stop input (IN2) to OFF, or return it to OFF after at least 10 msec has elapsed after the stop input (IN2) was set to ON.



Point table 3 setting example (Refer to section ■ 3.5.1)

Item		Symbol	Setting value
(1) Operation method		-	TORQUE LIMIT (Torque limit operation)
(2) Coordinate value		X1(*1)	400.00 [mm]
(3) Speed table number		V	8 ( = 800.0 [mm/sec] )
(4) Acceleration table number		A	5 ( = 0.30 [sec] )
(5) Deceleration table number		D	3 ( = 0.20 [sec] )
(6) Area output table number		AT	0 (Area output not used)
(7) Movement mode	Absolute/Incremental movement	-	a (Absolute movement)
	Aging operation	AGING	-
(8) Torque limit table number		TT	2 ( = 40.0[%], 20.0[%] )
(9) Torque limit judgement time		TM	0.050 [sec]
(10) Torque limit movement amount		TA	20.00 [mm]
(11) Torque limit movement speed		TV	10.0 [mm/sec]
(12) Torque limit option	Torque limit end	TE	OFF
	Lock end	LE	OFF
	Arrival end	AE	OFF
	Positional deviation exceeded detection	DD	ON

Other input signals

Signal name	Function	State
IN3	Servo on input	ON
IN5	Error reset input	OFF
IN6	Operation/Teach switching input	OFF

(\*1) The value of K01 (axis display) of Parameter 2 is assigned. (Refer to section ■ 3.4.1.)



- After completion, if start input (IN1) is set to ON by specifying the same point table, the robot returns back to the temporary target position and moves the torque limit movement amount in the reverse direction.

## WARNING

If the workpiece is removed by hand when the workpiece is being pressed against, the robot moves to the final target position. Be extremely careful because this can result in damage to the robot hand or an operator's hand becoming entangled.



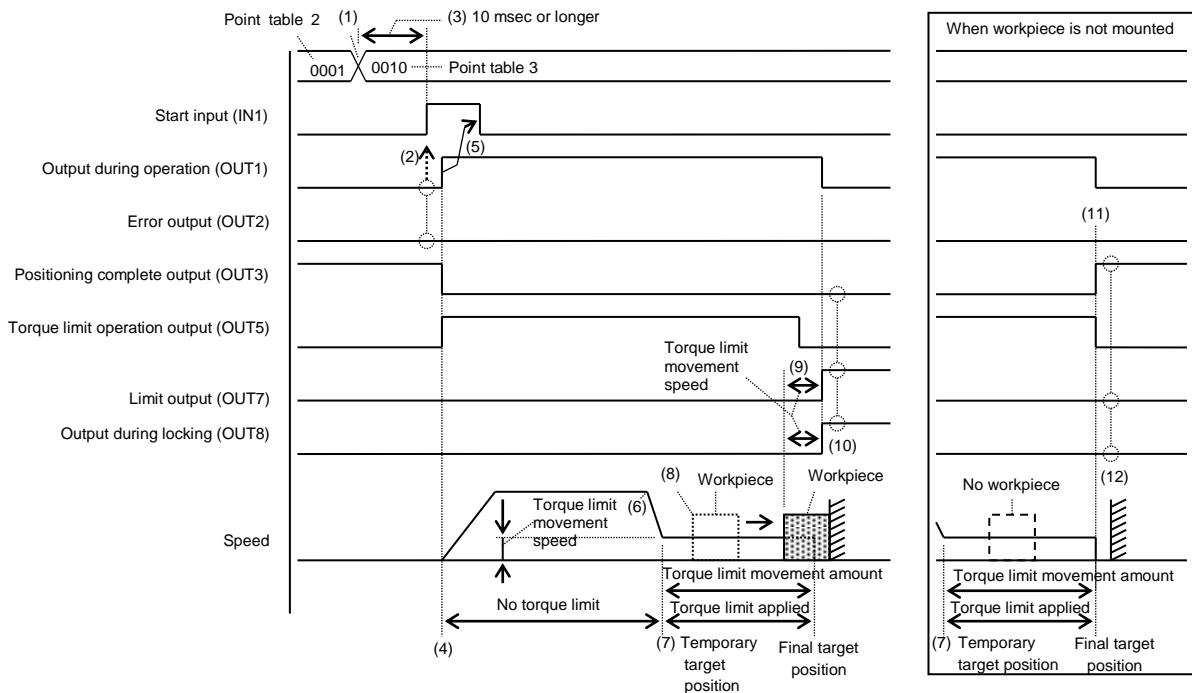
## ■ 5.2.2 Ending torque limit operation automatically

This is a method for ending the torque limit operation automatically by the controller. In the controller, detect that the torque limit operation has ended by setting the output during operation (OUT1) to OFF. Determine whether a workpiece is present using the status of the positioning complete output (OUT3), limit output (OUT7), and output during locking (OUT8). If necessary, the area output function can also be used to determine if a workpiece is present.

Example: When moving to point table 3 when stopped at point table 2

(Set the "(12) Torque limit option" in the point table (T01) as shown in the table below.)

Bit	Function	Symbol	Setting	Refer to
0	Torque limit end	TE	ON: Valid	Section ■ 3.5.1 – (12)
1	Lock end	LE	OFF: Invalid	
2	Arrival end	AE	ON: Valid	
3	Positional deviation exceeded detection	DD	ON: Valid	



- (1) Point table 3(=0010) is specified by command point number input (IN7 - IN10).
- (2) Before setting start input (IN1) to ON, check that the output during operation (OUT1) is OFF and the error output (OUT2) is OFF.  
If OUT2 is assigned to READY/Error output, check that it is ON.
- (3) Set start input (IN1) to ON after at least 10 msec has elapsed from (1).  
If it is set to ON before 10 msec passes, the robot may move to an unintended point.



- (4) Movement is started when the start input (IN1) is received. At this point, the torque limit is not activated.
- At the same time, the output during operation (OUT1) is set to ON, positioning complete output (OUT3) is set to OFF, and the torque limit operation output (OUT5) is set to ON.
- (5) After the output during operation (OUT1) is set to ON, return the start input (IN1) to OFF, or return it to OFF after at least 10 msec has elapsed after the start input (IN1) was set to ON.
- (6) When the robot comes close to the temporary target position, it starts decelerating.
- (7) When the temporary target position is reached, the torque limit is activated. The movement speed is the value specified in "(11) Torque limit movement speed (TV)" of the point table (T01), and the movement distance from the temporary target position is the value set by "(10) Torque limit movement amount (TA)" of the point table (T01).
- (8) The robot contacts the workpiece and starts pressing against it.
- (9) The workpiece is locked. The limit output (OUT7) and the output during locking (OUT8) are set to ON when the torque limit judgement time passed. The output during operation (OUT1) remains at ON, and the positioning complete output (OUT3) remains at OFF.
- At the same time, the output during operation (OUT1) and torque limit operation output (OUT5) are set to OFF.
- Position control where the final target position is set as the target position is continued, and the torque limit also remains activated (\*1). The positioning complete output (OUT3), limit output (OUT7), and output during locking (OUT8) each continue to output in their respective states.
- (10) Determine in the upper-level controller whether a workpiece is present using the status of the positioning complete output (OUT3), limit output (OUT7), and output during locking (OUT8). (If necessary, use the area output function to check the workpiece position.)
- (\*1) To eliminate shock to the workpiece, the limit of the output torque continues until the actual output torque at the next movement falls below the torque limit value.

<p>Skip from (7) to (11) if no workpiece is present.</p>
--

- (11) When the robot reaches the final target position, the positioning complete output (OUT3) is set to ON, and the torque limit is released.
- At the same time, the output during operation (OUT1) and torque limit operation output (OUT5) are set to OFF.
- (12) Determine in the upper-level controller whether a workpiece is present using the status of the positioning complete output (OUT3), limit output (OUT7), and output during locking (OUT8). (If necessary, use the area output function to check that the workpiece is not present.)



Point table 3 setting example (Refer to section ■ 3.5.1)

Item		Symbol	Setting value
(1) Operation method		-	TORQUE LIMIT (Torque limit operation)
(2) Coordinate value		X1 (*1)	200.00 [mm]
(3) Speed table number		V	5 ( = 500.0 [mm/sec] )
(4) Acceleration table number		A	5 ( = 0.30 [sec] )
(5) Deceleration table number		D	5 ( = 0.30 [sec] )
(6) Area output table number		AT	0 (Area output not used)
(7) Movement mode	Absolute/Incremental movement	-	a (Absolute movement)
	Aging operation	AGING	-
(8) Torque limit table number		TT	3 ( = 50.0 [%], 30.0 [%] )
(9) Torque limit judgement time		TM	0.020 [sec]
(10) Torque limit movement amount		TA	6.00 [mm]
(11) Torque limit movement speed		TV	12.0 [mm/sec]
(12) Torque limit option	Torque limit end	TE	ON
	Lock end	LE	OFF
	Arrival end	AE	ON
	Positional deviation exceeded detection	DD	ON

Other input signals

Signal name	Function	State
IN2	Stop input	OFF
IN3	Servo on input	ON
IN5	Error reset input	OFF
IN6	Operation/Teach switching input	OFF

(\*1) The value of K01 (axis display) of Parameter 2 is assigned. (Refer to section ■ 3.4.1.)



- If the limit output (OUT7) is set to ON while the workpiece is being pressed, and the torque limit operation is ended, instead of the torque limit end (TE) of "(12) Torque limit option" of the point table (T01), set the lock end (LE) to ON.
- If you do not want to automatically end when there is no workpiece, set the arrival end (AE) of "(12) Torque limit option" of the point table (T01) to OFF.
- After completion, if start input (IN1) is set to ON by specifying the same point table, the robot returns back to the temporary target position and moves the torque limit movement amount in the reverse direction.

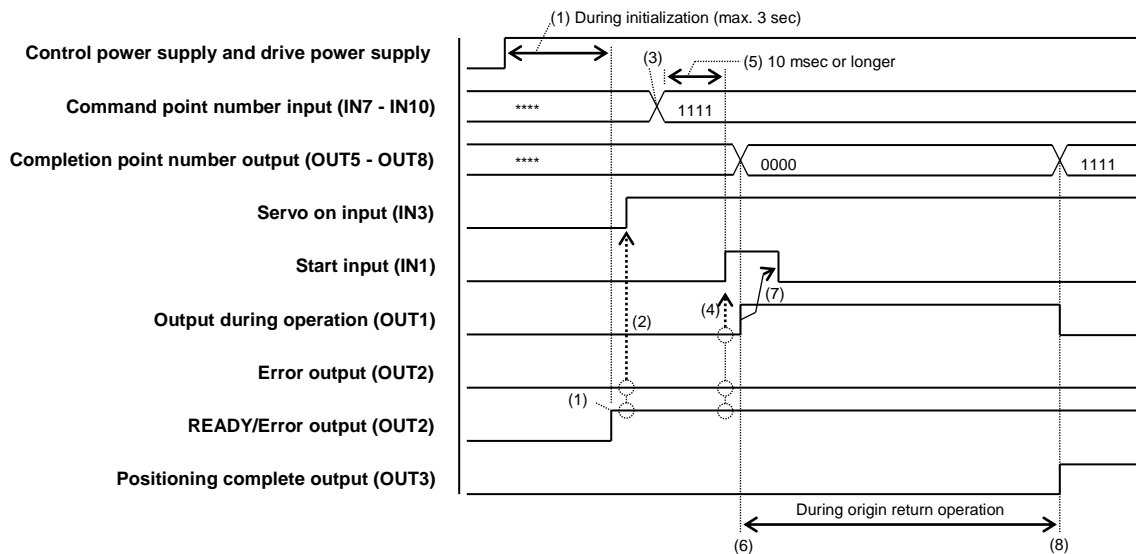


If the workpiece is removed by hand when the workpiece is being pressed against, the robot moves to the final target position. Be extremely careful because this can result in damage to the robot hand or an operator's hand becoming entangled.



## ■ 5.3 Origin Return

If the start input (IN1) is set to ON(=1111) when the command point number inputs (IN7 - IN10) are all set to ON, the origin return operation is started.



- (1) After the control power supply and drive power supply are turned on, wait 3 seconds until initialization is complete. If OUT2 is assigned to READY/Error output, wait until it is set to ON.
- (2) Before setting servo on input (IN3) to ON, check that the error output (OUT2) is in the OFF state. If OUT2 is assigned to READY/Error output, check that it is set to ON. The servo lock is applied when the servo-on input (IN3) is set to ON.
- (3) Set all the command point number inputs (IN7 - IN10) to ON(=1111).
- (4) Before setting start input (IN1) to ON, check that the output during operation (OUT1) is OFF and the error output (OUT2) is OFF. If OUT2 is assigned to READY/Error output, check that it is ON.
- (5) Set start input (IN1) to ON after at least 10 msec has elapsed from (3). If it is set to ON before 10 msec passes, the robot may move to an unintended point.
- (6) Origin return operation is started when the start input (IN1) is received. At the same time, the output during operation (OUT1) is set to ON, and the completion point number outputs (OUT5 - OUT8) are all set to OFF(=0000).
- (7) After the output during operation (OUT1) is set to ON, return the start input (IN1) to OFF, or return it to OFF after at least 10 msec has elapsed after the start input (IN1) was set to ON.
- (8) When the origin return operation is completed, the output during operation (OUT1) is set to OFF, and the positioning complete output (OUT3) is set to ON. At the same time, the completion point number outputs (OUT5 - OUT8) are all set to ON(=1111).

Set the other input signals to the states shown in the table below.

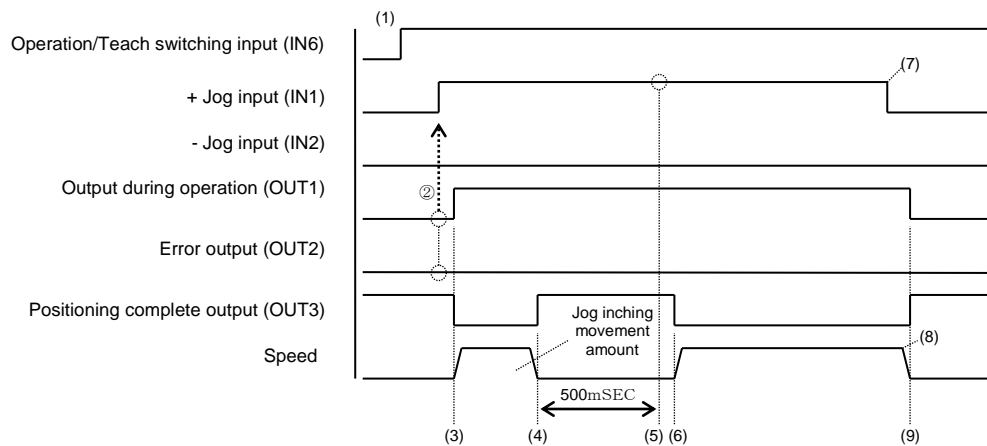
Signal name	Function	State
IN2	Stop input	OFF
IN5	Error reset input	OFF
IN6	Operation/Teach switching input	OFF



## ■ 5.4 Jog Operation

To perform jog operation, set the Operation/Teach switching input (IN6) to ON to switch to Teaching status.

### Example 1: Jog movement in + direction



- (1) Set the Operation/Teach switching input (IN6) to ON to switch to Teaching status.
- (2) Before setting the +Jog input (IN1) to ON, check that the output during operation (OUT1) is set to OFF and the error output (OUT2) is set to OFF.  
If OUT2 is assigned to READY/Error output, check that it is in the ON state.
- (3) Movement is started when the +Jog input (IN1) is received. The movement speed is based on the jog speed (low speed) (P06) parameter.  
At the same time, the output during operation (OUT1) is set to ON, and the positioning complete output (OUT3) is set to OFF.
- (4) The robot moves the distance that was set by the jog inching movement amount (P08) parameter and then stops temporarily.  
At the same time, the positioning complete output (OUT3) is set to ON.
- (5) After 500 msec elapses, if the +Jog input (IN1) is held in the ON state, the jog operation continues. If it was changed to the OFF state, the jog operation is ended.
- (6) Movement is restarted.  
At the same time, the positioning complete output (OUT3) is set to OFF.
- (7) To stop, set the +Jog input (IN1) to OFF.
- (8) Deceleration is started.
- (9) The robot is stopped.  
At the same time, the output during operation (OUT1) is set to OFF, and the positioning complete output (OUT3) is set to ON.

Set the other input signals to the states shown in the table below.

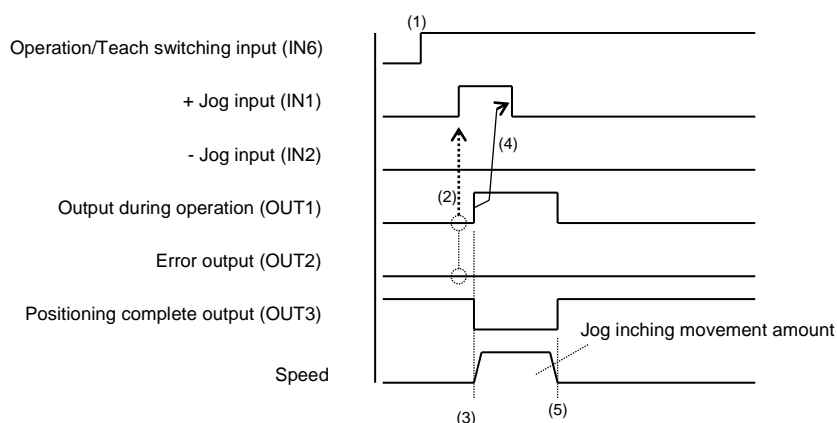
Signal name	Function	State
IN3	Servo on input	ON
IN5	Error reset input	OFF



Because the soft limit check is not enabled before the origin return operation is completed, there is a danger of the robot colliding with the mechanical ends. Use caution during this operation.



## Example 2: Jog inching movement in the + direction (For fine adjustment)



- (1) Set the Operation/Teach switching input (IN6) to ON to switch to Teaching status.
- (2) Before setting the +Jog input (IN1) to ON, check that the output during operation (OUT1) is set to OFF and the error output (OUT2) is set to OFF.  
If OUT2 is assigned to READY/Error output, check that it is in the ON state.
- (3) Movement is started when the +Jog input (IN1) is received. The movement speed is based on the jog speed (low speed) (P06) parameter.  
At the same time, the output during operation (OUT1) is set to ON, and the positioning complete output (OUT3) is set to OFF.
- (4) After the output during operation (OUT1) is set to ON, return the +Jog input (IN1) to OFF, or return it to OFF after at least 10 msec has elapsed from +Jog input (IN1) being set to ON.
- (5) After the robot moves the distance that was set by the jog inching movement amount (P08) parameter, it stops.  
At the same time, the output during operation (OUT1) is set to OFF, and the positioning complete output (OUT3) is set to ON.

Set the other input signals to the states shown in the table below.

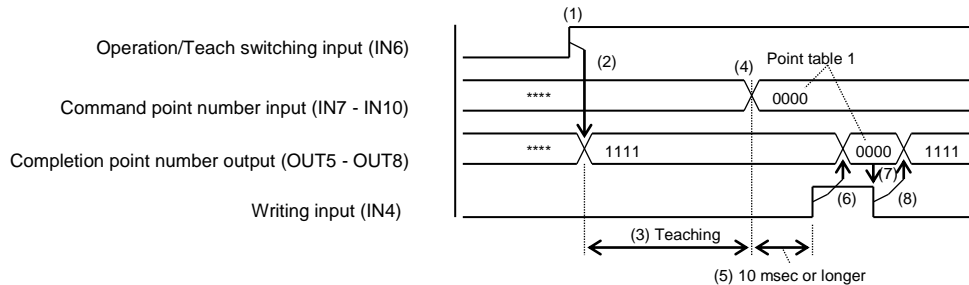
Signal name	Function	State
IN3	Servo on input	ON
IN5	Error reset input	OFF



## ■ 5.5 Writing Coordinate Values to the Point Table

This controller can change the data of the coordinate values in the point table (T01) by the system input/output signals.

Example: When writing the current coordinates to the coordinate value of point table 1



- (1) Set the Operation/Teach switching input (IN6) to ON to switch to Teaching status.
- (2) All of the completion point number outputs (OUT5 - OUT8) are set to ON(=1111).
- (3) Guide the robot to the target position through jog operation. (Refer to section ■ 5.4.)  
Alternatively, free the servo lock, and move the robot to the target position by hand.
- (4) Use the command point number inputs (IN7 - IN10) to specify point table 1(=0000).
- (5) Set writing input (IN4) to ON after at least 10 msec has elapsed from (5).  
If it is set to ON before 10 msec passes, the robot may move to an unintended point.
- (6) When writing input (IN4) is received, the "(2) Coordinate value" of the point table (T01) is overwritten by the current position, and the completion point number outputs (OUT5 - OUT8) send the values of point table 1(=0000).
- (7) After the completion point number outputs (OUT5 - OUT8) send the values of point table 1(=0000), return the writing input (IN4) to OFF.
- (8) When the writing input (IN4) is set to OFF, the completion point number outputs (OUT5 - OUT8) are all set to ON(=1111).

To continue by changing "(2) Coordinate value" of another point table, start from (3).

Set the other input signals to the states shown in the table below.

Signal name	Function	State
IN1	+Jog input	Any state
IN2	-Jog input	Any state
IN3	Servo on input	Any state
IN5	Error reset input	OFF

### NOTE

- The coordinate value cannot be written before completion of origin return. An attempt to write it causes an error indicating that origin return is incomplete.
- The point tables are stored in the EEPROM. The EEPROM write count limit is 1 million. Because reading and writing may be unable to be performed normally if the number of writes exceeds 1 million, set the writes to the minimum count necessary.



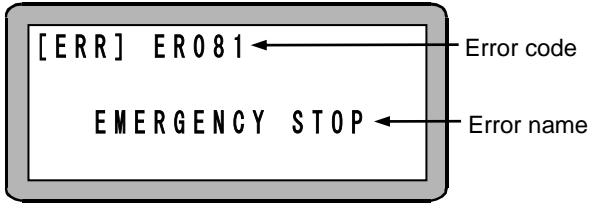
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## Chapter 6 Errors

When an error is detected, the controller changes to Fault status, and a servo off is used to stop the robot. If an error is detected, check the details/cause of the error according to the error list and take proper action to eliminate the error cause.

### (1) Error detection

No	Detection method	Description	Refer to
1	Status LED	The error is indicated by green and red flashing of the LED based on the error status.	Section ■ 2.5 – (3)
2	Error output (OUT2)	This is set to ON when an error occurs.	Section ■ 4.2.10
3	READY/Error output (OUT2)	This is set to OFF when an error occurs.	Section ■ 4.2.11
4	Teach pendant	<p>The error is displayed on the teach pendant screen.</p> 	
5	Computer software (SF-98D)	The error is displayed on the robot execution operation screen.	

### (2) Checking the error code

No	Checking method	Description	Refer to
1	Status LED	When an error is detected, the error code is indicated by green and red flashing of the LED. When checking the error code using the LED, count the number of red and green flashes of the LED.	Section ■ 2.5 - (3)
2	Teach pendant	The error code and error name are displayed on the teach pendant screen.	
3	Computer software (SF-98D)	The error code and error name are displayed on the robot execution operation screen.	

### (3) Clearing the error

No	Checking method	Description	Refer to
1	Error reset input (IN5)	After the cause of the error is removed, setting to ON clears the error.	Section ■ 4.2.4 Section ■ 4.2.10 Section ■ 4.2.11
2	Teach pendant	After the cause of the error is removed, pressing the CLEAR button on the teach pendant clears the error.	
3	Computer software (SF-98D)	After the cause of the error is removed, pressing the CLEAR button on the robot execution operation screen clears the error.	



(4) Error history

No	Checking method	Description	Refer to
1	Teach pendant	The past 16 errors can be viewed in the history.	Section ■ 6.1
2	Computer software (SF-98D)	The past 16 errors can be viewed in the history.	



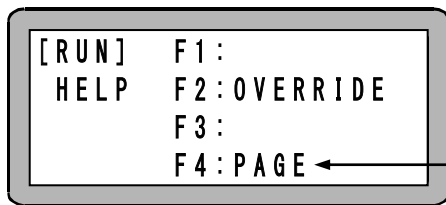
If more than one errors occur, the first-detected error is displayed.

All the errors are cleared by setting the error reset input to ON. If an error which cannot be cleared is included, the error is displayed, so turn on the power again.



## ■ 6.1 Error History Display

The 16 errors most recently occurred can be displayed.

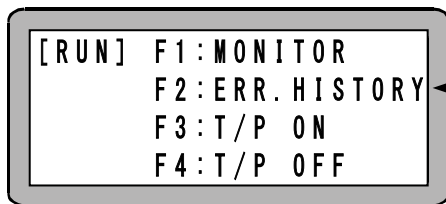


### STEP 1

Activate the RUN mode, and press the **HELP** key to display this screen.

Pressing the **F 4** key goes to STEP2.

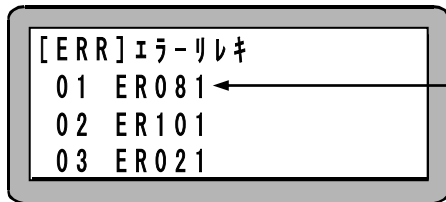
Pressing the **ESC** key returns to the RUN mode screen.



### STEP 2

Pressing the **F 2** key goes to the error history screen.

Pressing the **ESC** key returns to the RUN mode screen.



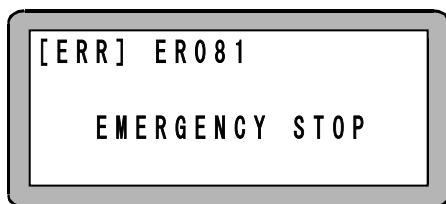
### STEP 3

This screen shows only error codes, but pressing the **F 1** key goes to the STEP4 screen that shows the name of the error code in the second line.

The error history number display is scrolled by using the **NEXT** and **-NEXT** keys.

If an error history number is entered with the **SEARCH** key, a jump to the error history number is possible.

Pressing the **ESC** key returns to the STEP2 screen.



### STEP 4

The error code and name are displayed.

Pressing the **ESC** key returns to the STEP3 screen.

#### NOTE

Incompatible controller error, TP communication error and robot no. error are not retained in the error history list.



## ■ 6.2 Error Code List

Error code	Error name	State	Primary cause	Remedy
02	Incompatible controller	Occurs when T/P was connected to the controller	An incompatible type of T/P was connected to the controller	Check the T/P and controller model, and use the correct type
11	Over current	Occurs only when power is turned on	Controller failure	Replace controller
		Occurs when servo is turned on	Motor wiring short-circuit	Check the motor wiring
			Motor coil short-circuit	Replace motor
			Controller breakdown	Replace controller
		Occurs during acceleration or deceleration	Improper controller adjustment	Lower the gain
			Controller breakdown	Replace controller
21	Over load	Motor vibrates when the servo is turned on or during operation	Improper adjustment	Readjust the gain
		Occurs during acceleration or deceleration	Acceleration or deceleration is too large	Reduce the acceleration or deceleration
		Occurs when pressing against the workpiece	Torque limit value is too large	Reduce the torque limit value
			Pressing time is too long	Reduce the pressing time
31	Over speed	Occurs during operation	Speed overshoot (9000 rpm or higher)	Readjust the gain
41	Position counter overflow	Occurs during operation	Position counter in the controller has exceeded the stipulated value	Set the movement amount from the origin to less than or equal to 57344 rotations
42	Positional deviation exceeded	Occurs during acceleration or deceleration	Acceleration or deceleration is too large	Reduce the acceleration or deceleration
		Occurs during operation	Weight capacity was exceeded	Reduce the load weight
			Contact was made with a mechanical stopper	Review operation
			Contact was made with a foreign object	Remove the foreign object
			Gain is too low	Increase the gain
			Unsuitable settings for overflow data (K03)	Set the correct value
51	Over heat	Occurs during operation	Frequent use under an overloaded condition (Power drive unit detected a temperature at 85°C or higher)	Reduce the operating conditions
			Ambient temperature is too high	Install fans or other devices to improve the heat-dissipation conditions
61 (*1)	Sensor error (Disconnection while power is on)	During normal operation	<ul style="list-style-type: none"> <li>Sensor cable not connected</li> <li>Sensor cable failure or broken wire</li> </ul>	<ul style="list-style-type: none"> <li>Connect the sensor cable</li> <li>Replace the sensor cable</li> </ul>
62 (*2)	Sensor error (Disconnection during backup)	Occurs when power is turned on		
63	Sensor error (1-rotation count)	Occurs during operation	<ul style="list-style-type: none"> <li>Controller breakdown</li> <li>Sensor failure</li> </ul>	<ul style="list-style-type: none"> <li>Replace controller</li> <li>Replace motor</li> </ul>
64	Sensor error (Mixing)	Occurs when power is turned on		
65	Sensor error (Overflow)	Occurs during operation	Position counter in the controller has exceeded the stipulated value	Set the movement amount from the origin to less than or equal to 32768 rotations
66 (*2)	Battery error	Occurs when power is turned on	Backup voltage became 2.5V DC while the control power supply was off	Replace the old battery with a new one
67	Backup error	Occurs when power is turned on	Origin return operation was not completed after error 61 to 66 occurs	Perform the origin return operation



Error code	Error name	State	Primary cause	Remedy
71	Over voltage	Occurs during operation	Insufficient regenerative performance (Drive voltage has exceeded 55 V or more)	Insufficient power capacity Add regenerative protection circuits to power supply Insufficient regenerative protection performance Lower the deceleration
		Occurs when power is turned on	Controller breakdown	Replace controller
72	Voltage down	Occurs during operation	Insufficient power capacity (Drive voltage has dropped to 18 V or less)	Review the power capacity
			Shutting off the drive power supply line	Check the wiring
		When power is turned on	Shutting off the drive power supply line	Check the wiring
80 (*1)	TP communication error	Occurs when T/P was connected to the controller	Boot mode is set	Turn off the power, set normal mood, and then turn the power on again.
		During normal operation	Communication cannot be established using the teach pendant or RS-232C cable	Check if the connector is connected securely, there is a bad contact, or the cable has a broken wire
81	Emergency stop	During emergency stop	Emergency stop switch or emergency stop input was activated	Clear the emergency stop switch or emergency stop input
		During normal operation	Broken wire in emergency stop wiring	Check the emergency stop wiring
			Emergency stop switch failure	Replace the emergency stop switch
91	Nonvolatile memory read error	When power is turned on	Failure of CPU or nonvolatile memory in integrated circuitry	Replace controller
92	Nonvolatile memory write error	When parameter is changed		
98	CPU error	Occurs during operation	Malfunction due to noise	Install a noise filter Check the ground
		When power is turned on	Controller failure	Replace controller
99	Parameter error	When parameter is changed	Error in value when writing the parameter data to the nonvolatile memory (Writing is not performed)	Check the values in the parameter
101	Execution Impossible	When origin return operation or movement is started	Attempted to move while the servo was off	Turn on the servo
102	Return To Origin Not Completed	When movement is started When overwriting the point table from system input	Origin return operation was not completed	Perform the origin return operation
103	+ Soft limit over	When movement is started	Specified coordinates have exceeded the soft limit in the positive direction	Check the value at the movement target and the + soft limit (P01) value
104	- Soft limit over	When movement is started	Specified coordinates have exceeded the soft limit in the negative direction	Check the value at the movement target and the – soft limit (P02) value
105	Writing Impossible	When overwriting the point table from system input	Writing was attempted while T/P ON was selected on the teach pendant, or while operation or parameter transfer was being performed through the computer software (SF-98D).	Select T/P OFF for the teach pendant. Don't do execution, sending and receiving the parameters by computer software (SF-98D).
B8	Robot number error	When robot type is input	Robot type is out of range	Set the correct robot type

(\*1) This error cannot be cleared. Turn off the power, remove the cause of the error, and then turn the power on again.

(\*2) An error may not be cleared. In this case, check the sensor cable for being unconnected, defected or disconnected, and turn on the power supply again.



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## Chapter 7 Maintenance and Inspection

### ■ 7.1 Procedures Before and After Inspection and Maintenance

#### (1) Before inspection and maintenance

- 1) Be sure maintenance and inspection personnel are adequately trained. If none of your personnel has adequate training, ask your manufacturer's representative to carry out inspection and maintenance or to train your personnel.
- 2) Make sure the ROlbot BA-C operating area is adequately illuminated.
- 3) Put a note on the start switch and other devices at the operator's stationary panel informing that inspection or maintenance is underway.

Before personnel enter the operating area of the ROlbot BA-C, the ROlbot BA-C's power switch must be locked open to prevent power being supplied to the ROlbot BA-C. Also, if the entrance to the fence around the operating area is equipped with a safety plug, personnel should carry it when entering the fenced area.

- 4) Before personnel enter fenced areas of cabinets for inspection or maintenance of control circuits, cut off power to all drive units.
- 5) If inspection or maintenance must be done within the operating area while the ROlbot BA-C is moving, take the following precautions:
  - Do not enter the area alone. Work in pairs. One person might act as a watchman while the other performs the inspection.
  - Operate the ROlbot BA-C at the slowest speed practical to accomplish its job to give personnel time to avoid being struck by any unexpected movement by the ROlbot BA-C.
  - Have an operator closely monitor the ROlbot BA-C, so he can immediately activate emergency stop if the ROlbot BA-C makes any unexpected movement or if inspection personnel appear endangered.
- 6) Discharge residual pneumatic pressure in the cylinder before disassembling or changing parts in the pneumatic gauge.
- 7) When disassembling or changing parts in hydraulic and pneumatic lines, be very careful to prevent dust or other foreign matter from contaminating them.

#### (2) Procedures after inspection or maintenance

- 1) Return tools and instruments to their designated place.
- 2) Always perform a test run. Make sure all personnel are out of the operating area before starting the test.
- 3) Report completion of inspection and maintenance work and the test run to the appropriate person in charge.



## ■ 7.2 Inspection Before Operation

- (1) Check the following before operation:
  1. Braking device performance
  2. Emergency stop device performance
  3. Interlock device between bumpers and the ROlbot BA-C
  4. Interlock devices between the ROlbot BA-C and auxiliary devices
  5. External cables and piping for damage
  6. Power source voltage, hydraulic oil pressure and pneumatic pressure
  7. ROlbot BA-C movement
  8. Presence of abnormal sound or vibration
  9. Bumpers
- (2) Determine the positions from which personnel will perform the inspection or maintenance.  
They should remain as far out of the ROlbot BA-C operating area as possible.

## ■ 7.3 Periodic Inspection

Make an inspection standard including inspection items, method, criteria and timing considering the installation location, operating frequency, parts durability and other conditions and factors of the ROlbot BA-C, and conduct periodic inspections.

Check the following during inspection work:

1. Loose parts on the main components
2. Lubrication and other conditions of moving parts
3. Power transmission components
4. Hydraulic and pneumatic systems
5. Electric systems
6. Fault detection systems
7. Encoder resolver sensor section
8. Servo system

[Controller inspection places]

9. Check that the voltage supplied to the controller is in the usage range ( $\pm 10\%$  of rated voltage).
10. Inspect the ventilation holes to the controller, and remove any dirt or dust, etc., that is adhered.
11. Inspect the controller cable (controller to axis), and confirm that none of the screws, etc., are loose.
12. Confirm that the controller installation screws, etc., are not loose.
13. Inspect each connector (power supply connector motor connector, sensor connector, serial connector), and confirm that there is no looseness or play, etc.



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