



# Instruction Manual

## ESG1 Series Controller

### ESC11-B




<<For safe use of product>>

Wrong operation of the product may result in unavailability of exhibition of full performance of the product or lead to a serious accident. To prevent occurrence of an accident, be sure to read the Instruction Manual of the product carefully to completely understand the contents given therein before operating the product. If you find any unclear point, contact us.

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## **Preface**

Thank you for purchasing our ESG1 Series Electric Gripper. The ESC11 controller is a small and high-performance product designed based on our high-level control engineering and abundant experience. Those described as precautions are items to which your careful attention has to be paid. To prevent any accident, be sure to read this instruction manual carefully, and fully understand the contents before operation. After reading this instruction manual, be sure to keep it where those using this product have an easy access to it. Before starting operation or during operation, make sure that the product functions and performs normally. Keep it carefully for your later reference.

## 1. FOR SAFE USE

Cautionary descriptions given here are for correct use of the products and for prevention of hazard on you and other people in vicinity and damage with equipment. These descriptions are divided into three items of “DANGER”, “WARNING” and “CAUTION” depending on the severity of hazard or damage and level of imminence. All bear important descriptions pertaining to safety. Strictly observe the instructions in addition to those of ISO 10218\*<sup>1)</sup> and other safety rules.

	<b>DANGER</b>	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
	<b>WARNING</b>	Indicates a potentially hazardous situation which could result in death or serious injury, if the equipment is operated wrongly.
	<b>CAUTION</b>	Indicates a potentially hazardous situation which may result in injury and machine damage, if the equipment is operated wrongly.

1) ISO 10218: Manipulating industrial robots -- safety

- This product is designed and manufactured as a component for use in general industrial machinery.
- Devices must be selected and handled by a system designer, personnel in charge of the actual operation using the product or similar individual with sufficient knowledge and experience.
- Be sure to read the catalogue and operation manual before handling the product. Mishandling of the product poses a risk. Please read the operation manuals for all devices, including the gripper, controller, and support software.
- It is the user's responsibility to verify and determine the compatibility of this product with the user's system, and to use them properly.
- After reading the catalog, operation manual and other materials, be sure to keep them in a convenient place easily accessible to the personnel using this product.
- The danger, warning and caution directions in this “Safety Precautions” do not cover every possible case. Please read the catalog and operation manual for the given device, particularly for descriptions unique to it, to ensure its safe and proper handling.
- If the gripper embedded in a system (machine, robot, etc.) is used, the system needs to meet the regulations and standards for safety measures. Check if the system satisfies the regulations and standards first. If so, properly handle the product in accordance with the regulations and standards. The gripper is not applicable to “miniature robots”.

- Do not use the product for the following applications:
  1. Medical equipment used to maintain, control or otherwise affect human life or physical health
  2. Mechanisms and machinery designed for the purpose of moving or transporting people
  3. Important safety parts of machinery

This product has not been planned or designed for applications requiring high levels of safety. Use of this product in such applications may jeopardize the safety of human life.

1.1.  CAUTION

**1.1.1. General**

Do not use the product outside the specifications. Using the product outside the specifications may cause it to fail, stop functioning or sustain damage. It may also significantly reduce the service life of the product.

**1.1.2. Design**

- If the machine will stop in the case of system problem such as emergency stop or power failure, design a safety circuit or other device that will prevent equipment damage or injury.
- Be sure to provide Class D grounding for the gripper and controller (formerly Class 3 grounding: Grounding resistance at 100 ohm or less). Leakage current may cause electric shock or malfunction.

**1.1.3. Operating Environment**

- Do not use this product in a place exposed to ignitable, inflammable or explosive substances. The product has not been designed with explosion protection. The product may explode or ignite, resulting in product damage or injury.
- Avoid using the product in a place where the main unit or controller may come in contact with water or oil droplets.

**1.1.4. Installation**

Wire the product correctly by referring to the operation manual. Securely connect the cables and connectors so that they will not be disconnected or come loose. Failure to do so may cause the product to malfunction or cause fire.

### **1.1.5. Operation**

- When operating or adjusting the gripper after it was mounted to the system, be sure to observe safety measures for the system. Failure to do so may result in serious injury.
- Before supplying power to and operating the product, always check the operation area of the equipment to ensure safety. Supplying power to the product carelessly may cause electric shock or injury due to contact with the moving parts.
- Do not touch the connectors or other parts power being supplied to the product. It may result in electric shock or malfunction.
- If you are using a pace maker or other mechanical implant, do not come within one meter of the product. The strong magnetic field generated by the product may cause the pace maker, etc., to malfunction. Keep pacemaker wearers one meter away from the product. The pacemaker may not work properly due to strong magnetic affection.
- Do not pour water onto the product. Spraying water over the product, washing it with water or using it in water may cause the product to malfunction, resulting in injury, electric shock, fire, etc.

### **1.1.6. Maintenance and Inspection**

- When using the gripper embedded in a system (machinery, robot, etc.), strictly observe the regulations and standards for safety measures of a system.
- Do not disassemble and reassemble the components relating to the basic structure of the product or its performance and function. Doing so may result in injury, electric shock, fire, etc.
- Never cut and/or reconnect the cables supplied with the product for the purpose of extending or shortening the cable length. Doing so may result in fire.

## **1.2. WARNING**

### **1.2.1. Operating Environment**

- Do not use the product under direct sunlight or ultraviolet ray.
- Do not expose the product to radiant heat generated from a heat source.
- Use the product within the ambient temperature range of 0 to 40 .
- Use the product in the place having humidity range of 35% to 90% (without dew condensation).
- Do not use the product in an atmosphere of corrosive gases (sulfuric acid or hydrochloric acid). Rust may form and reduce the structural strength of the product.

- Do not use the product in a place exposed to dust, iron powder. If dust enters the product through small openings and gaps, the product may suffer damage.
- Do not use the product in a place where it may come in contact with water droplets, cutting oil, cleansing liquid, organic solvent, and operating oil. If expected, sufficiently protect the product with a cover or panel. Since the product has not been designed with waterproof, water droplets or other liquid may enter the product, resulting in product damage.
- Do not install the product in a place subject to large vibration or impact (5.0 m/s<sup>2</sup>). Doing so may result in the malfunctioning of the product.
- Do not use the product in the place where high magnetic field may cause electromagnetic interference. Failure to do so may result in malfunction.
- Do not use the product in the places where large current or high magnetic field is present, welding or other operations are performed that cause arc discharge, subject to electrostatic noise, and with potential exposure to radiation. Failure to do so may result in malfunction.

### **1.2.2. Installation**

- Provide an emergency-stop device in a readily accessible position so the device can be actuated immediately upon occurrence of a dangerous situation during operation. Lack of such device in an appropriate position may result in injury.
- When installing the product including fingers, be sure to securely support and mount them. Failure to do so may cause the product or workpiece to tip over, drop or malfunction, resulting in injury.
- Provide sufficient maintenance space when installing the product. Routine inspection and maintenance cannot be performed without sufficient space, which will eventually cause the equipment to stop or the product to sustain damage.
- Before installing or adjusting the product or performing other operations on the product, display a sign that reads, "WORK IN PROGRESS. DO NOT TURN ON POWER." If the power is turned on inadvertently, injury may result due to electric shock or sudden activation of the controller.
- Do not hold the moving parts of the product or its cables during installation. It may result in injury.

### **1.2.3. Operation**

- Keep your fingers away from the product to prevent you from being caught into the other devices.
- Do not touch the connectors or exposed terminals of the controller. Doing so may result in electric shock.
- Turn off the power to the product in the event of power failure. Failure to do so may cause the product to suddenly start moving when the power is restored, thus resulting in injury or product damage.
- Before operating the moving parts of the product by hand for the purpose of manual positioning, etc., confirm that the servo is turned off (using the support software). Failure to do so may result in injury.
- If the product is generating heat, smoke or a strange smell, turn off the power immediately. Continuing to use the product may result in product damage or fire.
- If any of the internal protective devices (alarms) of the product has actuated, turn off the power immediately. Continuing to use the product may result in product damage or injury due to malfunction. Once the power supply is cut off, investigate and remove the cause and then turn on the power again.

### **1.2.4. Maintenance and Inspection**

- Before conducting maintenance/inspection, parts replacement, or other operations on the product, completely shut down the power supply. At this time, take the following measures:
  1. Display a sign that reads, "WORK IN PROGRESS. DO NOT TURN ON POWER" at a conspicuous place, in order to prevent a person other than the operator from accidentally turning on the power while the operation is working.
  2. When two or more operators are to perform maintenance/inspection together, always call out every time the power is turned on/off or a moving part is moved in order to ensure safety.
- Perform inspection or maintenance work with a thorough understanding of the specific tasks. Insufficient maintenance/inspection by the user may result in reduction of service life of the moving parts and malfunction. If any abnormalities are detected, stop the operation immediately.

### **1.2.5. Disposal**

Do not throw the product into fire. The product may burst or generate toxic gases.

## **1.3. CAUTION**

### **1.3.1. General**

If you are planning to use the product under a condition or environment not specified in the catalogs or operation manual, or in an application requiring strict safety such as aircraft facility, combustion system, entertainment machine, clean room, safety device, or other equipment having significant impact on human life or property, design operating ranges with ample margins from the ratings and design specifications, or provide sufficient safety measures such as fail-safes. Whatever you do, always consult us.

- Always use the cable supplied with the product for connection between the gripper and controller
- The gripper must be combined with our designated components, including the gripper, controller, motor cable, serial converter, and jog switch.

### **1.3.2. Working Environment**

- Provide sufficient space when performing maintenance and inspection safely.
- Do not bring a floppy disk or other magnetic media within one meter of the product. The magnetic field generated by the magnet may destroy the data in the floppy disk, etc.

### **1.3.3. Fixing the Product**

- When handling the product, wear protective gloves, protective goggles, safety shoes, or other necessary gear to ensure safety.
- Protect the product from excessive impact load such as bumping or throwing.
- After opening the package, hold the main body of the gripper. Do not hold cables or connectors when transporting
- Do not step onto the package or place on the package a heavy object that allows the load concentrate.
- Once the product is unpacked, handle the controller itself. Be careful not to hold cables and connectors when transporting the product.
- The cables supplied with the product are flexible, but do not store the cables in a movable cable duct (cable bearer, etc.) that bends more than the specified bending radius.

- Do not scratch the motor cable. Scratching, forcible bending, straining, winding, and pinching may cause short circuit and insulation failure, which results in electric shock and malfunction.
- Do not place any objects that block ventilation around the controller. Doing so may result in damage to the controller.
- Do not configure a control circuit that will cause the workpiece to drop in case of power failure. Configure a control circuit that will prevent the workpiece from dropping when the power to the machine is cut off or an emergency stop is actuated.

#### **1.3.4. Operation**

- Turn on the power to individual equipment one by one, starting from the equipment at the highest level in the system hierarchy. Failure to do so may cause the product to start suddenly, resulting in injury or product damage
- Do not insert a finger or object in the openings in the product. It may cause fire, electric shock, or injury.
- The motor generates a large amount of heat during operation, and the product surface temperature is high. Take care not to affect the workpiece or other objects around the gripper.

#### **1.3.5. Maintenance and Inspection**

Never touch terminals while performing insulation resistance test. Doing so may result in electric shock. (Do not perform dielectric strength test, because DC power is supplied with the product.)

#### **1.3.6. Storage Environment**

The environment in which the gripper is stored must be:

- Not exposed to direct sunlight and moisture
- Be dark cool and 30 cm higher or more than the floor surface to prevent occurrence of dew condensation
- Be free from large vibration and impact

#### **1.3.7. Disposal**

When the product no longer becomes usable or necessary, dispose of it properly as an industrial waste.

## 2. Overview

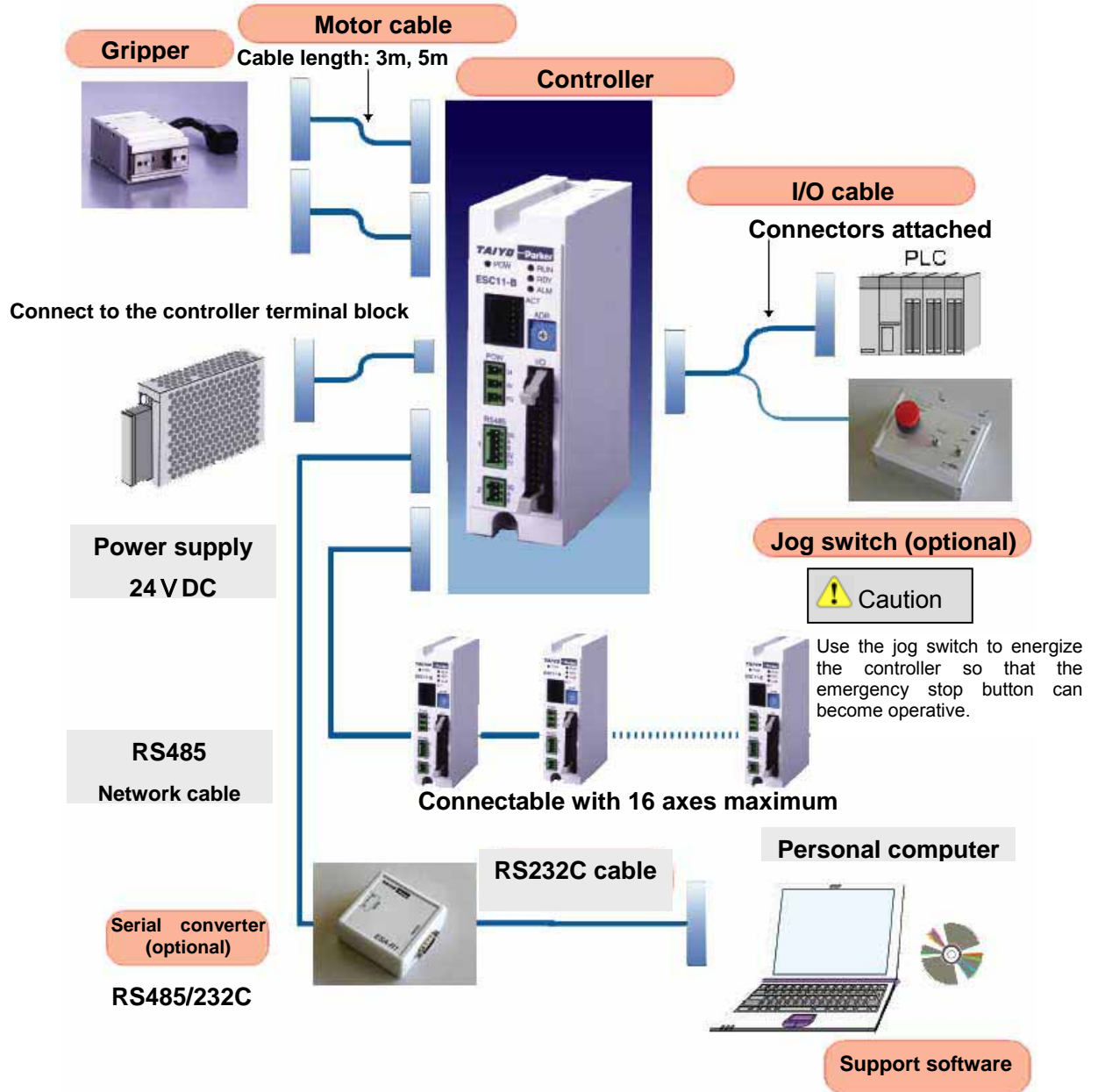
### 2.1. Overview

The ESC11-B series controller is a high-performance product that has been designed to build application systems of assembling and transferring works by increasing/decreasing gripping operation speed in combination with the electric gripper.

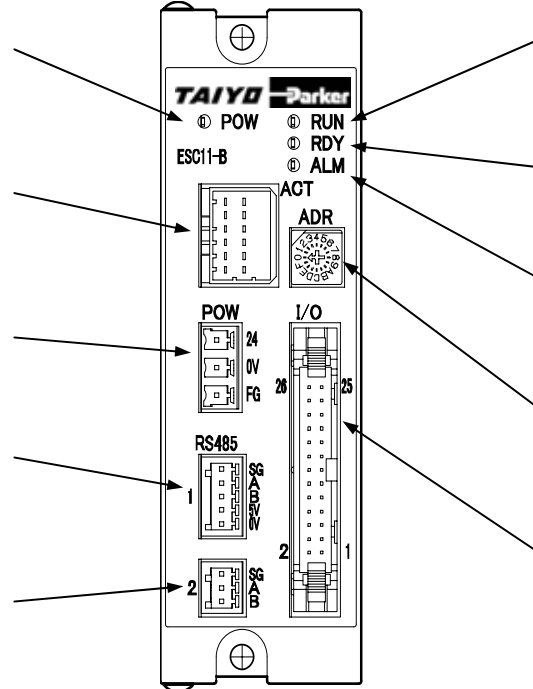
### 2.2. Features

- Compatible with commercially available PLC
- Support Software
  - Makes it easy to set parameters
  - Provided free of charge (but optional serial converter needed)
- Communication function
  - Networks by connecting to controllers at highest level (16 controllers maximum)
- Jog switch
  - Allows users to open/close the fingers and assemble/adjust the controller without parameter settings
- Passport-size controller
  - The miniature controller is compatible with all types of grippers.
- Alarm/Monitoring
- Simple troubleshooting utilizing its abundant alarm and monitoring features
- Easy control of gripping force by connecting to the gripper

## 2.3. System Configuration



## 2.4. Names and Functions of Connectors and LEDs



No	Name	Connector/LED	Function
1	POW	LED	Lights when the controller is being energized
2	RUN	LED	Lights when the actuator is operating and communication is established
3	RDY	LED	Lights when the controller is properly working
4	ALM	LED	Lights or flashes when alarm signal is output
5	ACT	Connector	A connector which is used for connecting to the gripper
6	POW	Connector	A connector which is used for supplying power to the controller
7	RS485-1	Connector	A connector for RS485 communication
8	RS485-2	Connector	A connector that is used for controlling multiple grippers using one PC
9	ADR	Connector	A switch that is designated to specify the address of the controller
10	I/O	Connector	Input/output connector

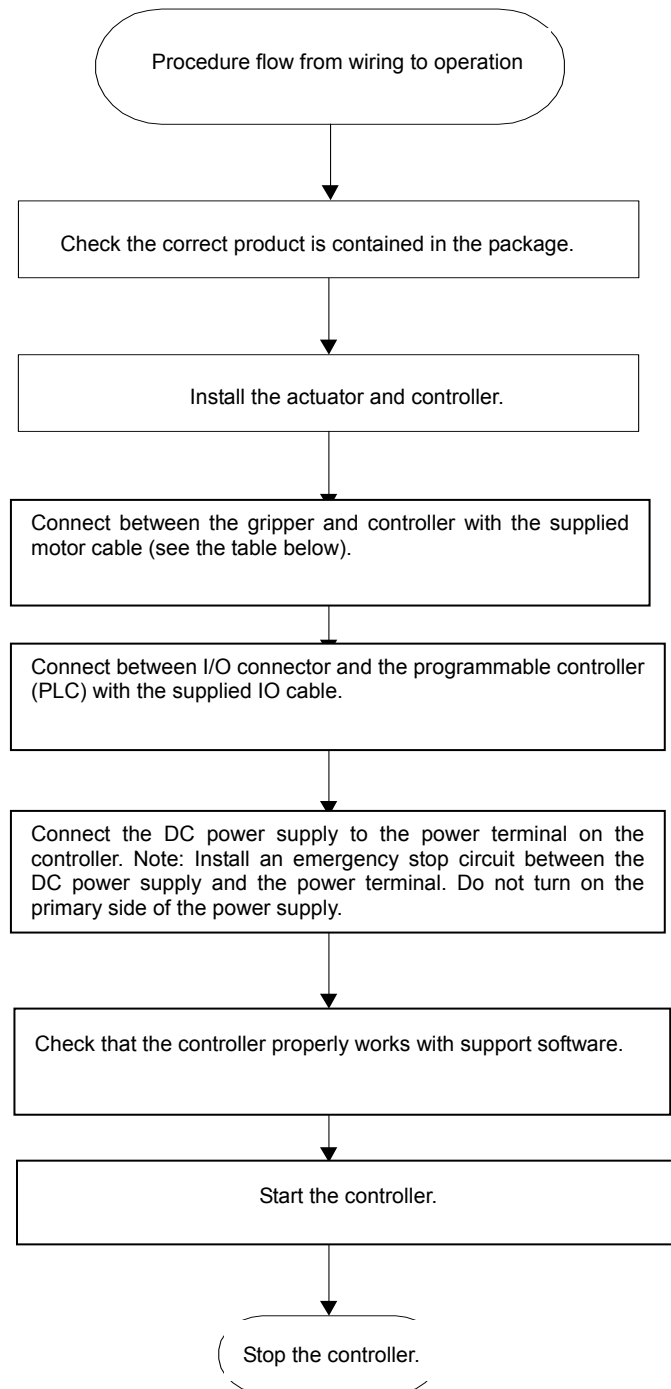
## 2.5. Communication

- Using support software through RS485 communication enables you to edit point data and parameters easily.
- You can edit point data and parameters by connecting one computer and one controller. Also, you can control the gripper with a multi-drop connection, through which allows you to connect up to 16 controllers through connectors “RS485-1” and “RS485-2”.
- You can recognize the current position of a workpiece in real time by sending a communication command from the connected computer.

### 3. Handling Procedures and Cautions

#### 3.1. Installation and Connection with External Equipment

Refer to the basic flowchart showing the process that contains identification, installation, wiring, trial operation, and actual operation of the purchased product. In this chapter, the procedure flow from identification to installation and wiring of the product is described.



### 3.1.1. Handling the Packed Controller

#### ! CAUTION

- Do not apply excessive impact on the package by dropping or hitting.
- When setting down the package, keep it horizontal
- Do not step onto the package.
- Do not place a heavy object that can deform the package on the package or article of a shape that allows the load to concentrate.

### 3.1.2. Handling the Unpacked Controller

#### ! CAUTION

- When taking out the product from the package, hold the controller by its frame.
- When transporting the controller, take care not to hit it against other object.
- Do not apply an excessive force to each part of the controller.
- Never directly touch the power terminals and signal terminals.
- When unpacking, a special care should be taken not to drop the controller. It may cause injury or product damage.
- Should you find any part of the controller damaged or missing during transportation, please contact us immediately.

### 3.1.3. Inspection after Opening the Package

After you unpacked, check that all of the items shown in the table below are contained in the package and that they are in good condition.

Items in the package

No	Name	Name of Accessory	Q'ty	Remark
	Actuator			
	Controller	Plug connector for power supply	1	Manufacturer: PHONETIC CONTACT
		Plug connector for communication, 3 pins	1	Manufacturer: PHONETIC CONTACT
		Plug connector for communication, 5 pins	1	Manufacturer: PHONETIC CONTACT
		I/O cable	1	1-m flat cable (26pins), a connector attached at the end of the cable
		Support software	1	Stored in the supplied startup guide CD
		Controller instruction manual	1	Stored in the supplied startup guide CD
		Actuator instruction manual	1	Stored in the supplied startup guide CD
	Motor cable			

### 3.1.4. Installation and Operation Environment

#### CAUTION

Install the controller in an environment meeting the conditions listed below.

Install the product in an operating environment meeting the conditions shown in the table below:

No	The environment in which the controller is used must
1	Not expose the product to direct sunlight.
2	Be free from radiant heat coming from equipment that generates a large amount of heat, such as a heat treatment furnace.
3	Have ambient temperature of 0°C to 40°C
4	Humidity of 85% or below (without dew condensation).
5	Be free from corrosive gas or flammable gas.
6	Be suitable for normal assembly work and free from excessive dust.
7	Be free from oil mist or cutting fluid.
8	Be free from vibrations exceeding 0.5G.
9	Be free from strong electromagnetic wave, ultraviolet light, radiation.
10	Chemical resistance is not considered in the design of the product. Be free from chemical vapors and gases.

### 3.1.5. Storage Environment

#### CAUTION

The storage environment should basically conform to the installation environment. If the controller is to be stored for an extended period of time, provide appropriate measures to prevent dew condensation. The controller is not packed with desiccating agent, until otherwise specified by the user. If the controller is to be stored in an environment where dew condensation may occur, take appropriate measure to protect the entire package, or the controller itself after unpacking it, from detrimental effects of dew condensation. The controller can withstand an ambient temperature of up to 65 for a short period. If the controller is to be stored for over one month, keep the ambient temperature at 50 or below.

### 3.1.6. Installation

When installing the controller, mount it to a housing, such as a control panel, with M4 bolts utilizing the holes located at the top and bottom of the controller.

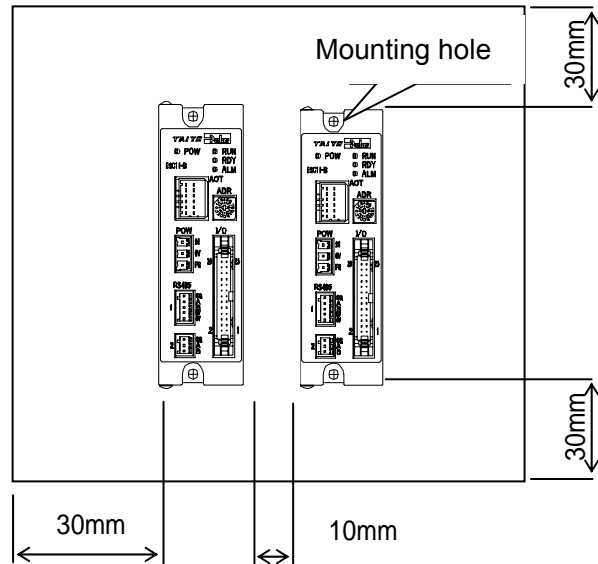
#### **! CAUTION**

Some of the tapped holes used for installing the controller are through holes. Therefore, never use long screws exceeding the effective thread length. They may damage the mechanical or electrical parts inside the controller. (The length of screws should be kept within 4mm or less).

Provide sufficient maintenance space in

accordance with the conditions of system layout when installing the product Routine inspection and maintenance cannot be performed without sufficient space, which will eventually cause the equipment to stop or the product to sustain damage.

Before installing the controller, see Section 4.1.4, **Installation and Operation Environment** and Section 4.1.11, **Other Notice on Wiring**.



- Keep more than 30mm space above and below the controller, and take care not to block airflow coming from the radiator.
- In the case where heat stagnates above the controller, use a fan to agitate it.
- Separate the controllers more than 10mm.
- Do not apply impact or load onto the connectors or other parts located on the front side of the controller. The baseboard in the controller may be damaged.
- Avoid applying an excessive force to the connectors by forcibly pulling the cables.
- Avoid installing the controller in the locations where the product may come in contact with oil or water. Should the controller be used in such a place, put it in the waterproof control box (with a cooling unit).
- Place the controller on the stable surface. Avoid placing it in the locations with a lot of vibrations.
- Avoid installing the controller in the locations where ambient temperature could be high.

### 3.1.7. Wiring

Wire the controller using the supplied cables and general-purpose cables.

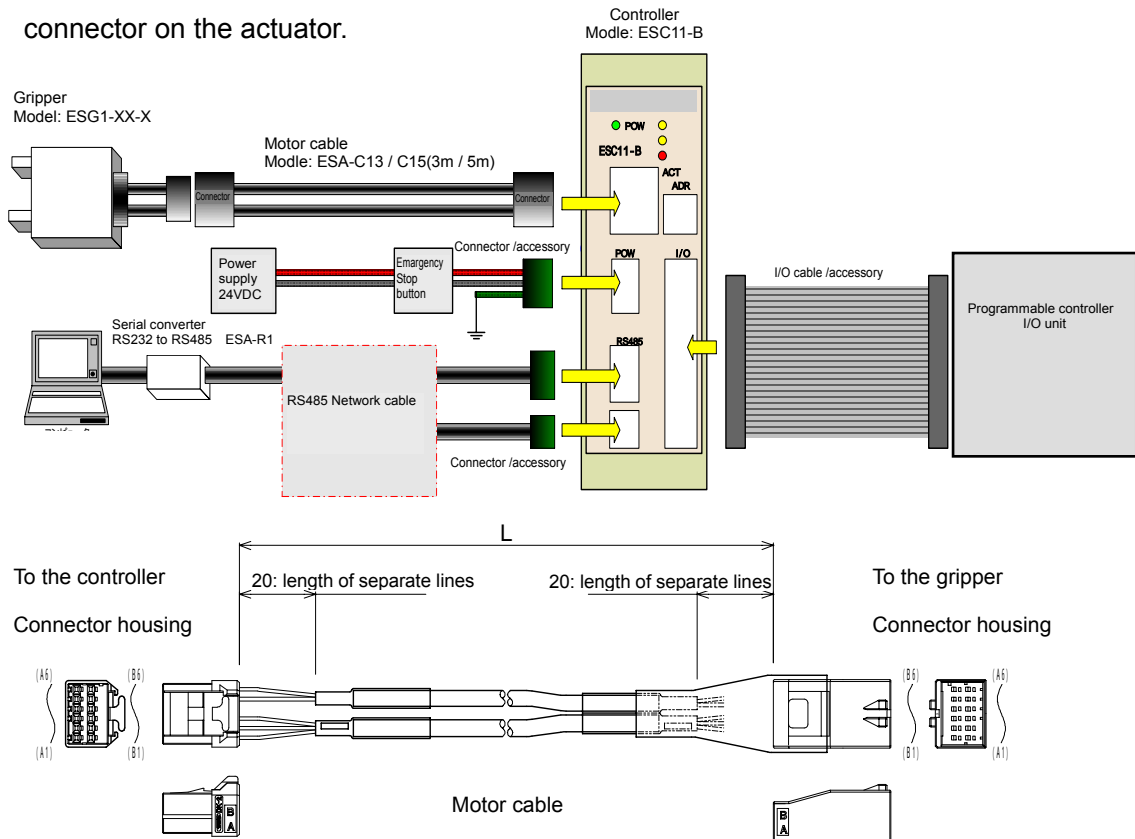
**! WARNING** Do not turn on the power while wiring the controller.

Wire the controller by referring to the wiring diagram and check for proper wiring.

#### Cable Connection

The details of cable connection are described below.

Always use the supplied motor cable for connecting between the actuator and connector on the actuator.



#### ! CAUSE

Special care should be taken not to bend or pull the cable with a strong force when wiring the controller.

A SG shielded cable is employed to the encoder cable, but avoid laying the encoder cable that may cause malfunction together with a large current cable. Failure to do so may result in malfunction.

Wiring length should be kept within 5m.

#### Connector Pin Numbers (for reference)

N o	Symbol	Function
A1	EA	Encoder signal input A phase
A2	EZ	Encoder signal input Z phase
A3	0V	Encoder 0V power output
A4	-	NC
A5	BN	Motor output B phase-
A6	B	Motor output B phase
B1	EB	Encoder signal input B phase
B2	+5V	Encoder +5V power output
B3	SLD	Shield cable
B4	-	NC
B5	A	Motor output A phase
B6	AN	Motor output A phase

**Connection to I/O connector**

Always use the supplied I/O cable for connecting between the I/O connector of the controller and controlling device (IO unit such as PLC). See Section 4.2, I/O interface.



**3.1.8. Connecting to Power Supply**

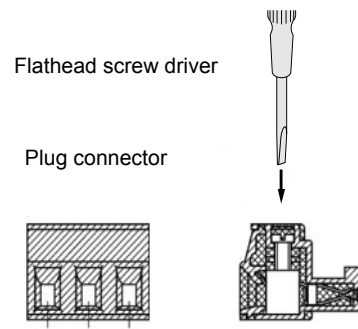
Power-supply voltage is as shown in the table below:

	Specification
Power Supply	24V DC±10% 1A MAX (power supply for both actuator and control)

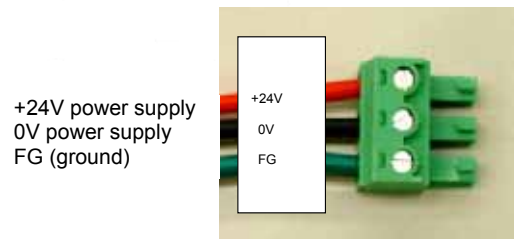
Remove the plug connector from the header connector of the controller and screw the power-supply cables to the plug connector with a flathead screwdriver

Power supply terminals terminal block: PHOENIX MC1.5/-G-5.08

No	Symbol	Function
1	+24V	Power supply for motor and control
2	0V	Power supply 0V
3	FG	Frame ground (for Class D grounding )



Applicable power supply cables: AWG28 – 16



**! CAUTION**

The controller needs to receive the above power and I/O power via I/O connector. See Section 4.2.2, [External Wiring Diagram](#).

**! CAUTION**

Incorrect connection of power supply may cause serious danger such as fire. The controller has no power switch. Be sure to install proper (insulation) equipment that can cut off the power to the controller. Use a power supply that is double insulated between primary side and secondary side.

- Before wiring the controller, turn off the controller power. Failure to do so may result in an electric shock.

**3.1.9. Grounding Work**

**! DANGER**

Motor current is controlled by PWM. Incorrect connection to the ground may cause switching noise coming from a transistor. There is an electric circuit such as a CPU in the controller. Therefore, wire the controller properly so that external noise will not enter the controller. To eliminate these troubles with noise, wire and ground the product. Be sure to provide Class D or higher grounding for the controller. The controller must be grounded to one ground point.

In the case where there is motor wiring in a metal conduit or metal box, ground the metal parts to the one ground point.

**3.1.10. Prevention of Malfunction by**

**Noise**

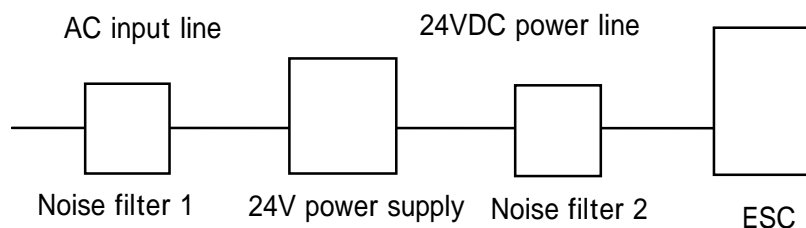
**! CAUTION**

Observe the following to prevent malfunctions to be occurred by noise.

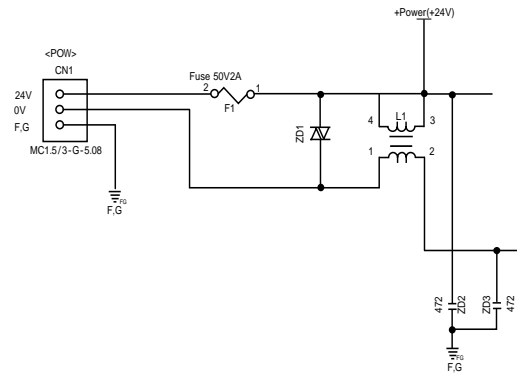
If using the product in the place where inductive load parts such as a motor or electromagnetic valve exist, be sure to install a noise filter to the power supply line. Failure to do so may result in malfunctions. Be sure to keep among the noise filter, controller, and controller at the highest level in the system hierarchy closely.

Power supply terminal Terminal block:  
PHOENIX MC1.5/-G-5.08

No	Symbol	Function
1	+24V	Power supply for motor and control
2	0V	Power supply
3	FG	Frame ground ( for Class D grounding)



Be sure to install a surge absorber circuit to a coil such as a relay, electromagnetic contacting machine, induction motor, and break solenoid. Do not bundle the power supply line, motor line, and signal lines together or do not lay them in the same duct. Do not bundle the lines from primary and ones from secondary sides of noise filter. Do not extend the earth cable.



Power-supply circuit in the controller

### 3.1.11. Other Notice on Wiring

#### Wrong wiring

Wrong connection to the controller and actuator may cause product damage. Thoroughly check for proper connection.

#### Fuse

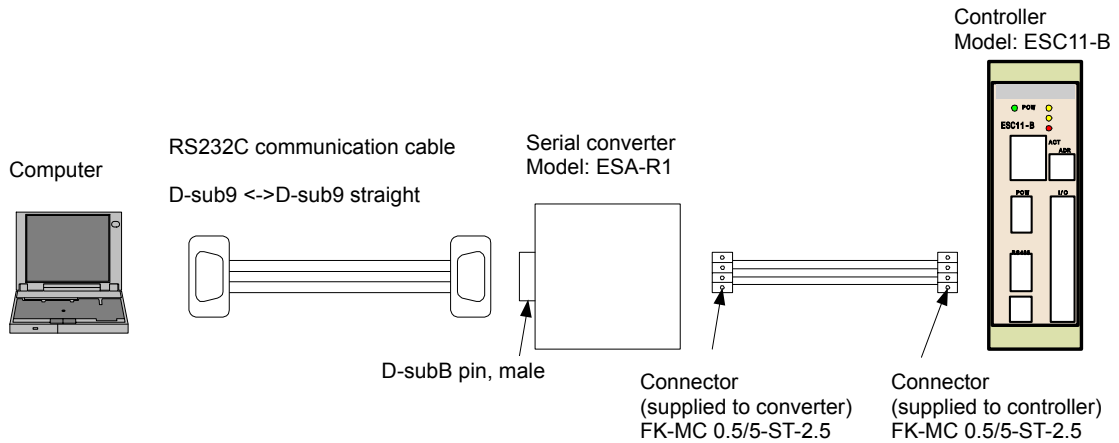
There is a fuse in the controller. The fuse is not for protecting the controller itself but for preventing a secondary disaster in the case where controller damage was caused by earth fault.

#### Emergency-stop circuit

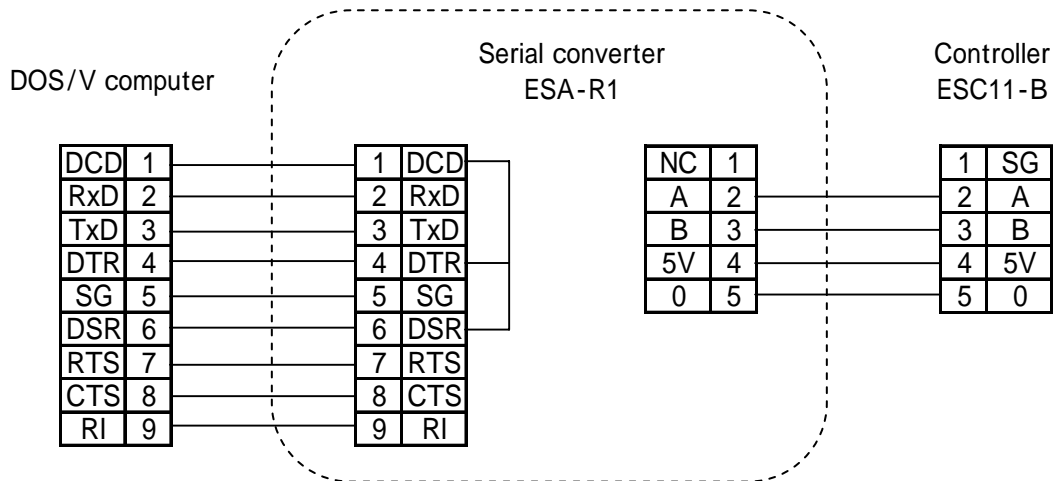
Be sure to install an emergency-stop circuit in a readily accessible external position so that the device can be stopped and power supply to the controller can be shut down immediately upon occurrence of a dangerous situation during operation.

### 3.1.12. Connecting to Computer

Using a serial converter (separately sold) and support software enables you to set parameters, read conditions of the controller, and check for proper operation. For more details, see the Support Software Manual.



Connect between the controller and converter as the wiring diagram illustrated above. Use a straight cable (commercially available) for connecting between the computer and serial converter.



### 3.1.13. Connecting to Jog Switch

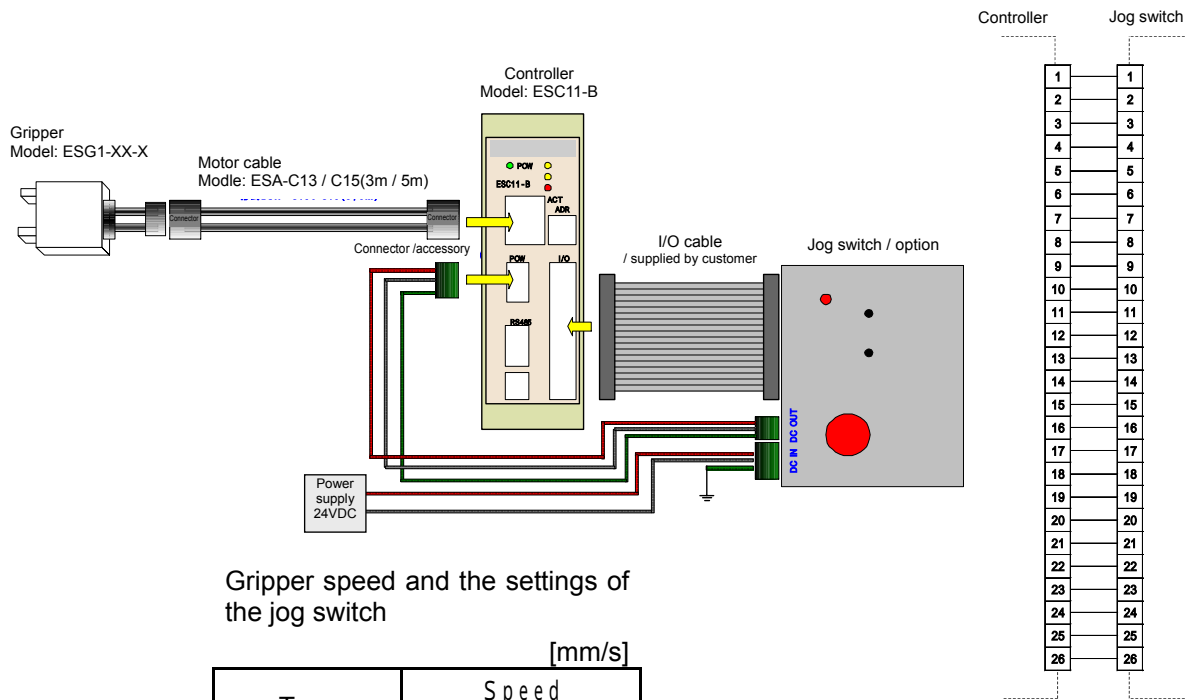
Connecting the jog switch to the controller enables you to open and close the actuator without editing point data or parameters. After wiring the jog switch, connect the power supply cables to the controller.

Placing the JOG switch in “Open” position moves the fingers in the opening direction and “Close” in the closing direction.

Gripper speed can be changed by placing the SPEED switch in “Low” or “High”.



Jog Switch cannot be used with a single cam type gripper, because its axle ratio is low.



Gripper speed and the settings of the jog switch

Type	Speed [mm/s]	
	Low	High
SD-20	0.8	8
SD-28	1.4	14
SD-42	1.9	19
FS(T)-20	0.8	8.3
FS(T)-28	1.25	12.5

Jog speed differs depending on the type of controller.



If you use the controller by operating the jog switch connected to the controller, the controller cannot identify the position of the gripper. Therefore, the controller does not track the position of a workpiece. Avoid bumping at the end of stroke.

## 3.2. I/O interface

### 3.2.1. Operating Power Supply

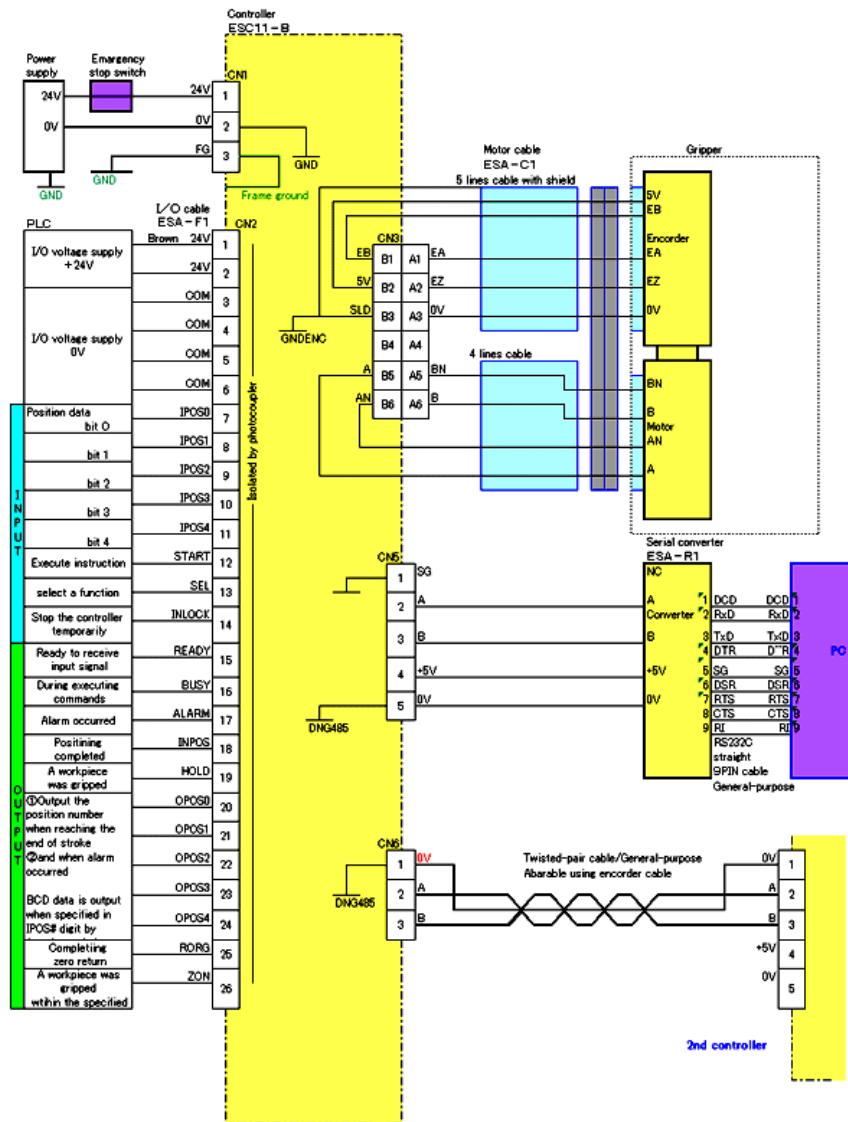
The controller requires both internal control power supply and I/O power supply.

### 3.2.2. External Wiring Diagram

CN1, 2, 3, 5, and 6, are used for external wiring and CN2 for I/O wiring.

Connect the +24V power supply to CN 2-1 and -2 and 0V power supply to CN2-3 and -4.

Input and output terminals of I/O interface connector are completely insulated by photo couplers. The product accepts open collector output that input (INPUT) is + common and output (OUTPUT) is -common.



### 3.2.3. I/O connector

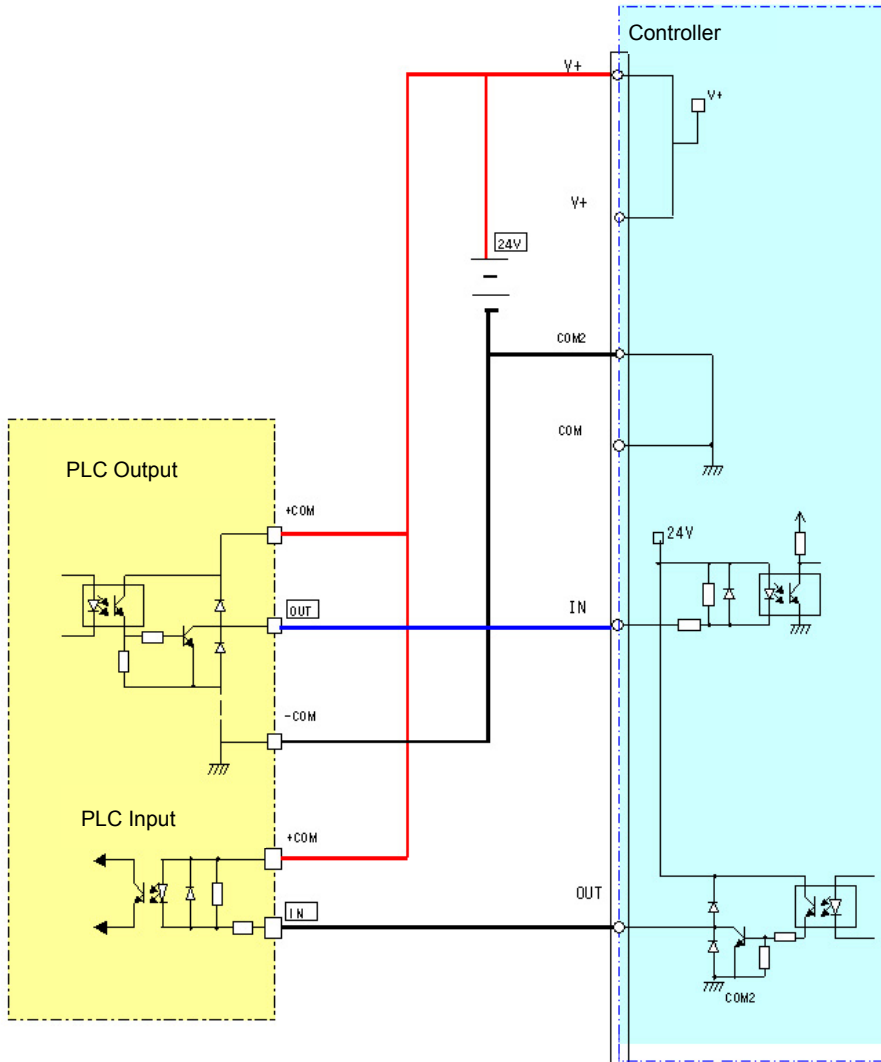
The MIL type I/O connector is employed to the controller. The pin numbers and arrangement are as shown right below.

I/O connector				Cable connector AXM226011 (Matsushita Electric Works)
No	Symbol	I/O	Logic	Description
1,2	+V24		-	I/O voltage supply + (supplied externally)
3-6	COM		-	I/O voltage supply 0V (supplied externally)
7	IPOS0	I	Positive	Position data bit 0
8	IPOS1	I	Positive	Position data bit 1
9	IPOS2	I	Positive	Position data bit 2
10	IPOS3	I	Positive	Position data bit 3
11	IPOS4	I	Positive	Position data bit 4
12	START	I	Positive	Execute instructions
13	SEL	I	Positive	Select a function
14	INLOCK	I	Negative	Stop the controller temporarily
15	READY	O	Positive	Send signal "1" when ready to receive input signal
16	BUSY	O	Positive	Send signal "1" during executing commands
17	ALARM	O	Negative	Send signal "0" when alarm occurred
18	INPOS	O	-	Send signal "1" when positioning completed
19	HOLD	O	-	Send signal "1" when a workpiece was gripped
20	OPOS0	O	-	Output the position number when reaching the end of stroke. BCD data is output when operation completed position is specified in IPOS# digit by function switch.
21	OPOS1	O	-	
22	OPOS2	O	-	
23	OPOS3	O	-	
24	OPOS4	O	-	
25	RORG	O	-	Send signal "1" when completing zero return
26	ZON	O	-	Send signal "1" when a workpiece was gripped within the specified zone

26	25
24	23
22	21
20	19
18	17
16	15
14	13
12	11
10	9
8	7
6	5
4	3
2	1



### 3.2.4. Input/Output Equivalent Circuit and Features Table



#### Input

Item		Specification
Number of points		5
Input voltage		24V DC +10 , -10%
Input current	Rating	5mA at 24V DC
	ON	3mA minimum
Operating current	OFF	1mA maximum
	Insulation	

#### Output

Item		Specification
Number of points		12
Switching voltage		24V DC +10%
Switching current	Rating	30mA maximum at 24V DC
	Residual voltage	ON 0.5V maximum at 24V DC
Leakage current	OFF	100μA MAX
Insulation		Photo coupler

### 3.2.5. Description of I/O connector

External I/O connector, Cable Connector AXM226011 (manufacturer: Matsushita Electric Works)

Terminal board No.		I/O
No.	Symbol	Description
1, 2	+V24	I/O supply voltage + (supplied externally)
3-6	COM	I/O supply voltage 0V (supplied externally)

- IPOS / Input Position Data

IPOS are the input signals that specify a point number, such as position and force. The signals are input from the outside in 4 bit binary (binary number). Up to 31 points plus an original point can be specified, but the point number 00 is for the original position only. If an output signal from the controller is asserted, the logical value is “1”.

See the logic table below.

#	Symbol	I/O	Logic	Description
7	IPOS0	I	Positive	Position data bit 0
8	IPOS1	I	Positive	Position data bit 1
9	IPOS2	I	Positive	Position data bit 2
10	IPOS3	I	Positive	Position data bit 3
11	IPOS4	I	Positive	Position data bit 4

Logic table

Input signal					Point No.
IPOS 4	IPOS 3	IPOS 2	IPOS 1	IPOS 0	Decimal
0	0	0	0	0	0
0	0	0	0	1	1
0	0	0	1	0	2
0	0	0	1	1	3
0	0	1	0	0	4
0	0	1	0	1	5
1	1	1	1	1	31

- START

START is an input signal that brings the actuator into operation. When the output signal from the controller is asserted, the actuator works. If START is input for approximately 50 ms or more, internal operation starts and the controller sends BUSY.

No	Symbol	I/O	Logic	Description (summary)
12	START	I	Positive	Executes command

- SEL

SEL is a signal that is used for selecting a function. Normally this signal is deasserted.

No	Symbol	I/O	Logic	Description (summary)
13	SEL	I	Positive	Selects a function

- INLOCK

No	Symbol	I/O	Logic	Description (summary)
14	INLOCK	I	Negative	Temporarily stops the gripper

- **READY**

READY is a signal that tells the controller is ready to receive a signal.

No	Symbol	I/O	Logic	Description (summary)
15	READY	O	Positive	Outputs signal "1" when the controller is ready to receive input signal

- **BUSY**

BUSY signal is asserted when the controller is in operation. When the controller received START signal, the BUSY is asserted.

No	Symbol	I/O	Logic	Description (summary)
16	BUSY	O	Positive	Outputs signal "1" during executing command

- **ALARM**

Refer to the details of Section 4.7, Table of Alarm and Error Messages.

No	Symbol	I/O	Logic	Description (summary)
17	ALARM	O	Negative	Outputs signal "0" when alarm occurred

- INPOS / In Position

INPOS is a signal that tells the fingers reached a target position. When they reached the target value after returning to their original positions and positioning, the INPOS signals are asserted.

No	Symbol	I/O	Logic	Description (summary)
18	INPOS	O	-	Outputs signal "1" when completing positioning

- HOLD

HOLD is a signal that tells the fingers are gripping a workpiece.

No	Symbol	I/O	Logic	Description (summary)
19	HOLD	O	-	Outputs signal "1" when a workpiece was gripped

- OPOS / Out Position number

OPOS is a signal that tells the operational status in 5-bit pattern of 0 to 4.

No	Symbol	I/O	Logic	Description (summary)
20	OPOS0	O	-	The position numbers that are output when the fingers finished moving  In the event of occurrence of an alarm, the position number is output in BCD. When the movement completion position was specified using IPOS signals, the position is output in BCD.
21	OPOS1	O	-	
22	OPOS2	O	-	
23	OPOS3	O	-	
24	OPOS4	O	-	

- RORG / Origin Return completion

No	Symbol	I/O	Logic	Description (summary)
25	RPRG	O	-	Outputs signal "1" when returning to the original position

- ZON / Zone

No	Symbol	I/O	Logic	Description (summary)
26	ZON	O	-	Outputs signal "1" when a workpiece was gripped within the specified zone

### 3.3. Serial Communication

#### 3.3.1. Overview

Input of point data and edition of parameters can be done through RS485 communication port that the controller has. Using the supplied support software (ESA-S01) that eliminates the need for complex command configuration enables users to input point data or parameters easily.

Specifications of serial communication

Communication method	Complied with RS485 standard ( two-wire half duplex polling system)
Baud rate	9600bit/sec, asynchronous communication method
Data bit	8 bits
Parity bit	Even
Stop bit	1 bit
Maximum length of cable	20m
Number of slave stations	0–15

#### 3.3.2. Specifications of Connector

The types of supplied connectors and signals are as shown in the table below.

- RS485 terminal 1 (PHOENIX MC0.5/5-G-2.5)

No.	Symbol	Function
1	SG	Signal ground
2	A	RS485 signal A
3	B	RS485 signal B
4	+5V	Supplies +5V power to the serial converter
5	0V	Supplies 0V power to the serial converter

- RS485 terminal 2 PHOENIX MC0.5/3-G-2

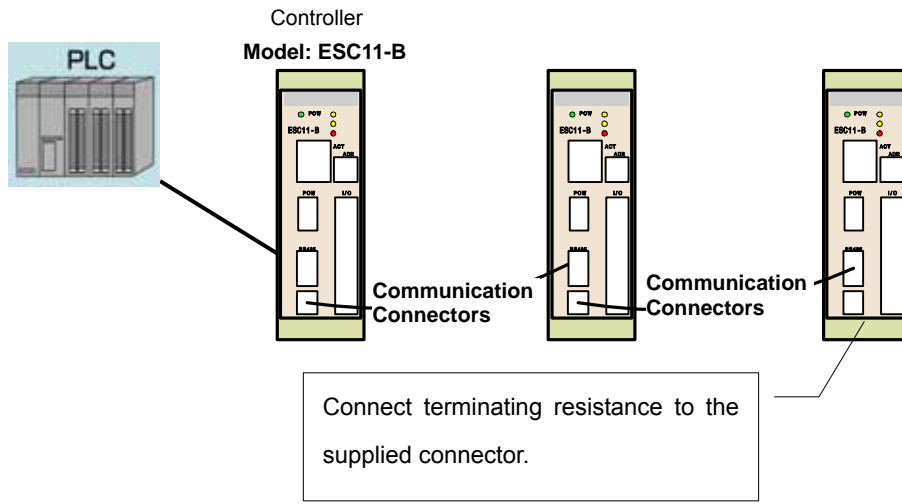
No.	Symbol	Function
1	SG	Signal ground
2	A	RS485 signal A
3	B	RS485 signal B

### 3.3.3. Wiring

#### Connection to computer

Connect between a D-subconnector of the serial converter and a computer with a general-purpose RS232C communication cable (straight). See Section 4.1.12, [Connecting to Computer](#).

#### Linkage between the controllers



#### Recommended cable

For maintaining transmission quality, it is recommended that the controller be wired in accordance with the following methods. Use a twisted pair shield communication cable.

#### Recommended cable

Type	Manufacturer
CO-SPEV-SB(A) 4P×0.2SQLF	Hitachi Cable

Connect the shield of a communication cable to SG of the RS485 connector 1 of the controller.

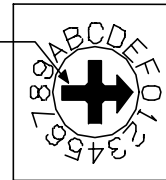
### 3.3.4. Specifying Address with Rotary Switch

Specify address of the controller by using the rotary switch.

Default address:

To change the preset address, turn off the power first and turn on the power again; otherwise, the address will not be changed.

Set to the desired number by turning the rotary switch with a flathead screwdriver.



## 3.4. Operating Support Software

### 3.4.1. Setting Parameters

Set a parameter referring to the Support Software manual.

### 3.4.2. Descriptions of Parameters

#### Initial Settings

- **Actuator Type**

This parameter is used for setting the type of a gripper currently used. This is a read-only parameter. When changing the parameter, initialize the system parameter using the Support Software.

- **( + ) Soft limit**

This parameter is used for setting a positive movable range.

Input range: 0-999.9 (unit: 0.1mm)

Initial value: differs depending on the actuator type

If you set the direction in which the fingers return to their original positions to OPEN, the closing direction becomes positive direction.

If you set the direction in which the fingers return to their original positions to CLOSE, the opening direction becomes positive direction.

After point data were specified, prevent the fingers from moving out of the soft limit range when inputting an operation instruction.

When point data out of soft limit range is specified, the controller immediately stops.

- **( - ) Soft limit**

This parameter is used for setting a negative movable range

Input range: -999.9 – 0 (unit: 0.1mm)

Initial value: differs depending on the actuator type

If you set the direction in which the fingers return to their original positions to OPEN, the closing direction becomes positive direction.

If you set the direction in which the fingers return to their original positions to CLOSE, the opening direction becomes positive direction.

This parameter prevents the fingers from moving out of the soft limit range when inputting an operation instruction after point data were specified.

When operation is instructed by specifying point data out of soft limit range, the controller stops working immediately after the error stop was triggered.

- **Stroke**

This parameter is used for setting actuator stroke length.

Initial value: differs depending on the actuator type

Input range: 0 – 999.9 (in 0.1mm)

Input range differs depending on the actuator type.

Note: If the gripper is used as a main body, stroke value is always an initial value.

- **Positioning completion distance**

When the fingers travel to the specified point, the INPOS signals for representing movement completion are asserted just before the fingers reach the specified point.

Increase the parameter to shorten tact time of the system.

Input range: 0.01-655.35 (in 0.01mm)

Initial value: 0.01

## **Operations**

- **Acceleration**

This parameter is used for setting actuator acceleration.

Optimum acceleration is automatically set by setting actuator type and mass of moving parts. To decrease acceleration in consideration of the installation place of the actuator and rigidity of fingernails, change the acceleration parameter value.

Input range: 1-100(%)

Initial value: 100

- **Maximum program speed**

This parameter is used for setting maximum speed stored as point data

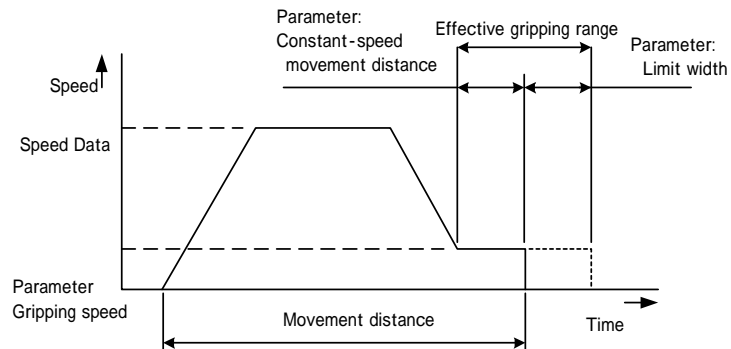
Input range: 20-100(%)

Initial value: 100

If decreasing movement speed of all point data without changing the point data when adjusting the device, this parameter will become effective.

- **Gripping Speed**

This parameter is used for setting gripping speed within the effective gripping range in the Accelerated/Decelerated Absolute (or Relative) Movement and Grip mode. The parameter sets constant movement speed in the mode.



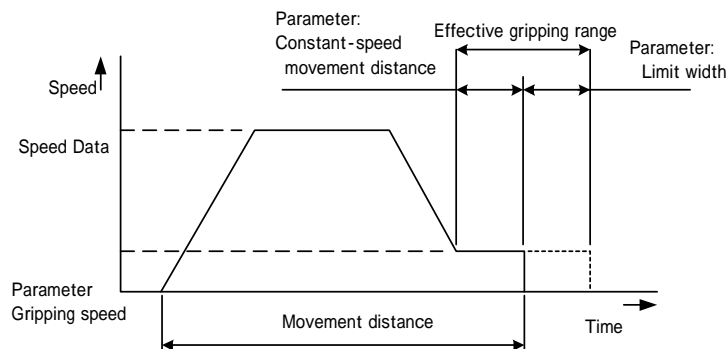
Input range: 20- 50(%)

Initial value: 20(%)

Note: If gripping speed is set over the maximum speed, the maximum speed becomes gripping speed.

- **Constant-speed movement zone**

This parameter is used for setting the distance of constant-speed movement in the Accelerated/Decelerated Absolute (or Relative) Movement and Grip mode. The fingers move from the beginning point of constant-speed movement zone to the target position at gripping speed.

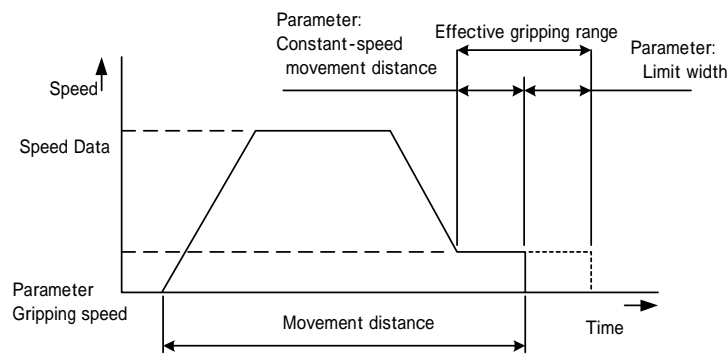


Input range: 0.01 ~ 99.99 (in 0.01mm)

Initial value: 2 (mm)

- **Limit width**

This parameter is used for setting limit width during constant-speed movement in the Accelerated/Decelerated Absolute (or Relative) Movement and Grip mode. The fingers move from the target position to the end of limit width at gripping speed. If the fingers moved beyond the effective gripping range, they stop at the point (movement distance + limit width) and the INPOS signals are asserted while the HOLD signal is deasserted.



Input range: 0.01-99.99 (in 0.01mm)

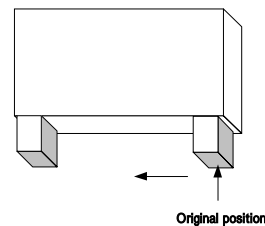
### **Original Position**

- **Direction for returning the fingers to their original positions**

This parameter is used for specifying the direction in which the fingers return to their original positions.

0: Opening direction

1: Closing direction



If the direction in which the fingers return to their original positions is set to the opening direction, the closing direction will become positive direction.

If setting the direction in which the fingers return to their original positions to "0: OPEN", the closing direction will become a positive direction, then the fingers move in the closing direction.

- **Speed for returning the fingers to their original positions**

This parameter is used for setting the speed at which the fingers move back to their original positions.

Input range: 20 ~ 50 (%)

Initial value: 20%

- **Original position shift**

This parameter is used for shifting the coordinate position of original data by the parameter value specified as original position shift.

Input range: -99.99 ~ 99.99 (in 0.01mm)

Initial value: 0

If this parameter is specified, there is no need to reentry point data in the case of misalignment of original positions during product maintenance. Zero point shift should be set within the soft limit.

- **Original position return system**

This parameter is used for changing the method in which the fingers return to their original positions.

0: Stroke end

1: S stroke end + Z phase detection system

Initial value: 1

After a stroke end is detected, the fingers are reversed until Z phase is detected. If the reversed distance until Z phase is detected is important, change the parameter value of the method for returning to original positions to "0: stroke end" to adjust the reversed distance to 0.5mm (0.7mm for SS-42 model).

### **3.4.3. Point Setting**

Up to 31 points (1-31 points) can be set using the controller. Point 0 is an original position.

There are three methods for inputting point data: Manual Data In, Teaching Playback, and Direct Teach. Manual Data In is used for setting a target position by directly specifying a numeric value.

Teaching Playback is used for specifying the target position by jogging the fingers of a gripper up to the position to which they actually move.

Direct Teach is used for specifying the target position by moving the robot by hand up to the position to which the fingers of a gripper actually move after turning off the actuator servo (this method is available for single cam type only).

For details of point settings, refer to the Support Software Instruction Manual.

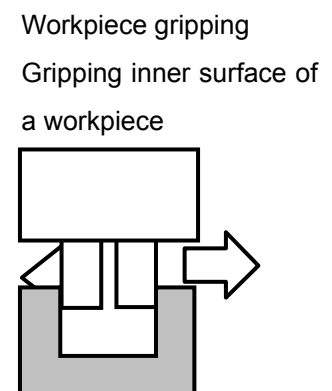
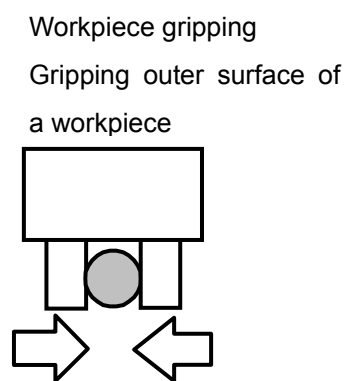
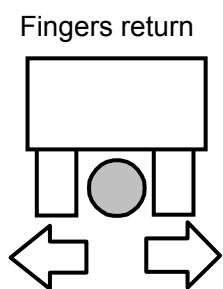
**Point Data**

Point Data consists of the following data.

Number	Operation Mode	Movement Distance	Speed	Force	ZON Range 1	ZON Range 2
--------	----------------	-------------------	-------	-------	-------------	-------------

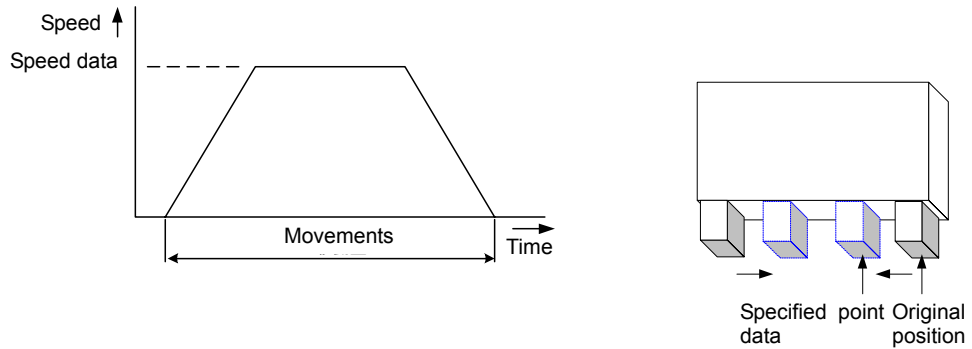
**Operation Modes and Applications**

Mode		Gripping	Movement
Accelerated/Decelerated movement	Absolute	Workpiece gripping <input type="checkbox"/> Fast tact and small impact <input type="checkbox"/> Small variance in workpiece shape	Fingers return
	Relative	Workpiece gripping <input type="checkbox"/> Fast tact and small impact <input type="checkbox"/> Small variance in workpiece shape	Fingers return
Constant speed	Open	Gripping inner surface of a workpiece <input type="checkbox"/> Unclear workpiece shape (large variance) <input type="checkbox"/> Large impact on a workpiece	
	Close	Gripping outer surface of a workpiece <input type="checkbox"/> Unclear workpiece shape (large variance) <input type="checkbox"/> Impact applied to a workpiece	
Constant-speed movement and grip with ZON output	Open	Gripping inner surface of a workpiece <input type="checkbox"/> Large variance in workpiece shape <input type="checkbox"/> Judgment of acceptance/rejection of gripping measurement <input type="checkbox"/> Impact applied to a workpiece	
	Close	Gripping outer surface of a workpiece <input type="checkbox"/> Large variance in workpiece shape <input type="checkbox"/> Judgment of acceptance/rejection of gripping measurement <input type="checkbox"/> Impact applied to a workpiece	



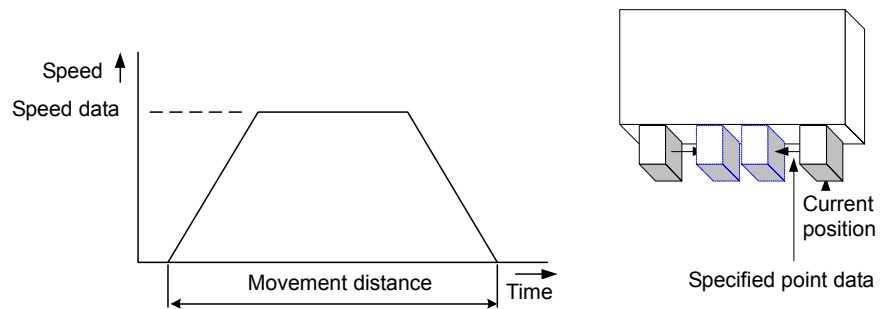
### Absolute Movement mode

In Absolute Movement mode, the fingers can move from their original positions by the specified point data.



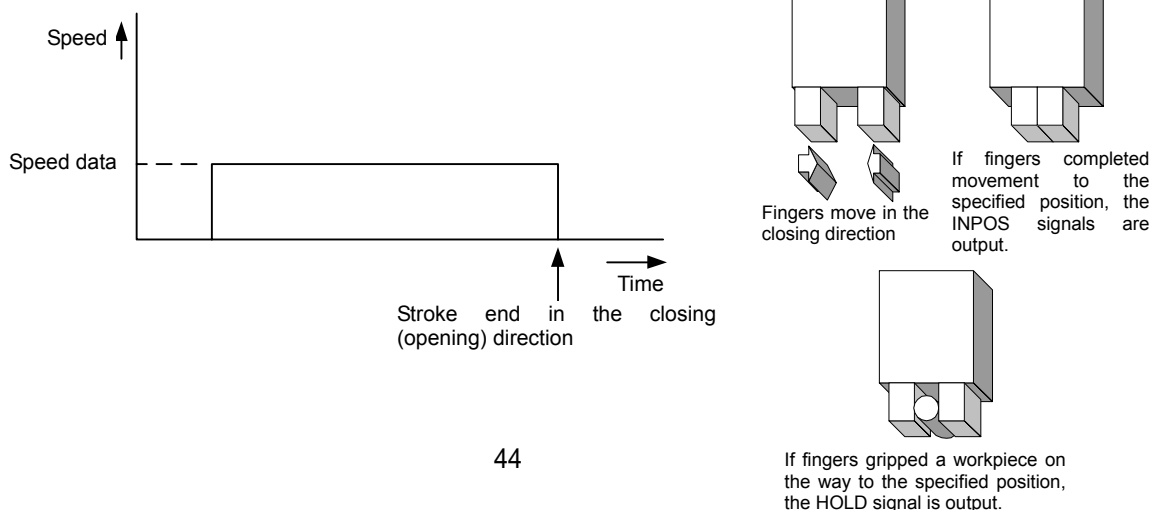
### Relative Movement mode

In Movement in Relative Position mode, the fingers can move from their current positions by the specified point data.



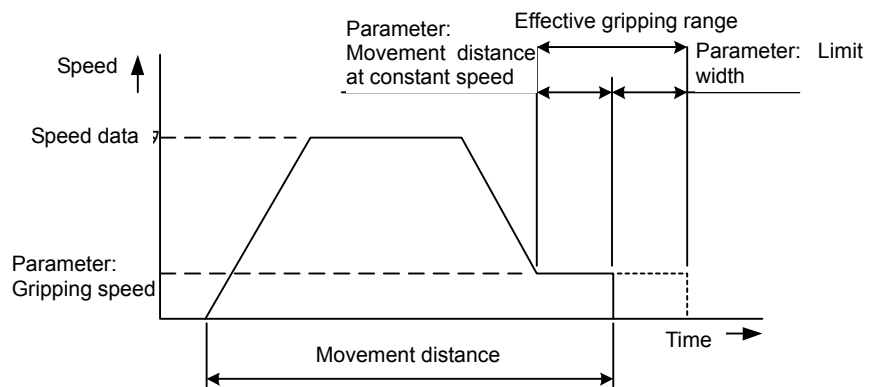
### Constant-Speed Movement and Grip (OPEN/CLOSE) mode

In the Constant-Speed Move and Grip (OPEN/CLOSE) mode, the fingers can move in the closing or opening direction at the specified speed and grip a workpiece with the specified gripping force. After they finish traveling to the stroke end in the closing (or opening) direction, the INPOS signals are output. If they grip a workpiece during the stroke, the HOLD signal is output.



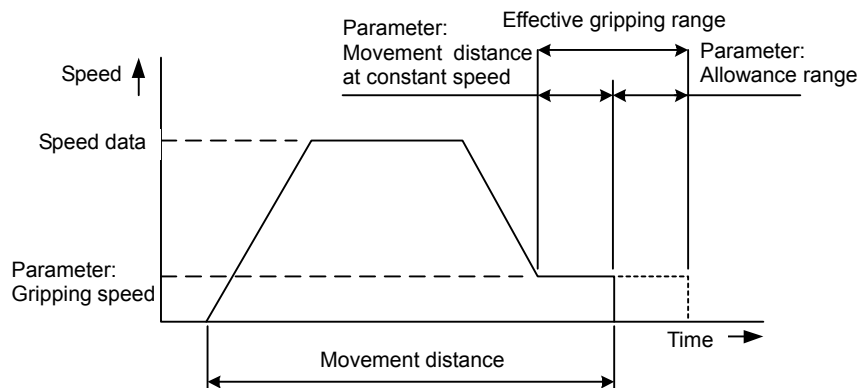
### Accelerated/Decelerated Relative Movement and Grip mode

In the Accelerated/Decelerated Relative Movement and Grip mode, the fingers can move until they almost get to the position specified as a current position utilizing trapezoidal speed control. The gripping force specified in parameter becomes valid. If the fingers grip a workpiece within the specified limit width and constant-speed movement zone, the HOLD and ZON signals are output. If the fingers grip the workpiece exceeding the effective gripping range, they stop moving at the position (movements + limit width) and the INPOS signals are asserted while the HOLD signal is deasserted. Parameters can be checked and edited. If the fingers grip the workpiece out of the effective gripping range, the ZON signal is deasserted after the HOLD signal is asserted.



### Accelerated/Decelerated Absolute Movement and Grip mode

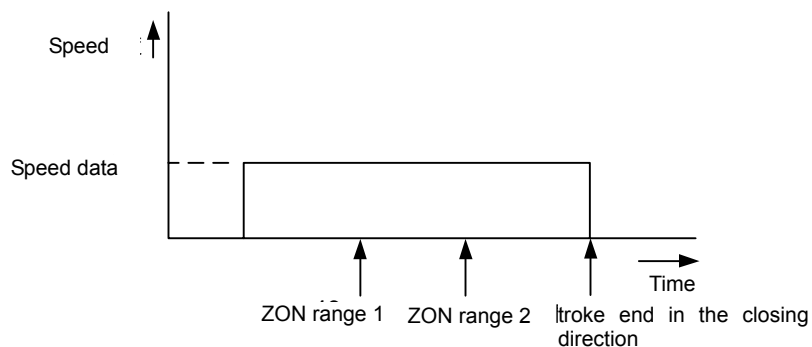
In the Accelerated/Decelerated Absolute Movement and Grip mode, the fingers move until they almost get to the position specified as a current position utilizing trapezoidal speed control. The gripping force specified in parameter becomes valid. If the fingers grip the workpiece within the specified limit width and constant-speed movement zone, HOLD and ZON signals are output. If the fingers grip the workpiece exceeding the effective gripping range, the fingers stop moving at the position (movement distance + limit width) and INPOS signals are asserted while the HOLD signal is deasserted. Parameters can be checked and edited. If the fingers grip a workpiece out of the effective gripping range, the ZON signal is deasserted after the HOLD signal is asserted.

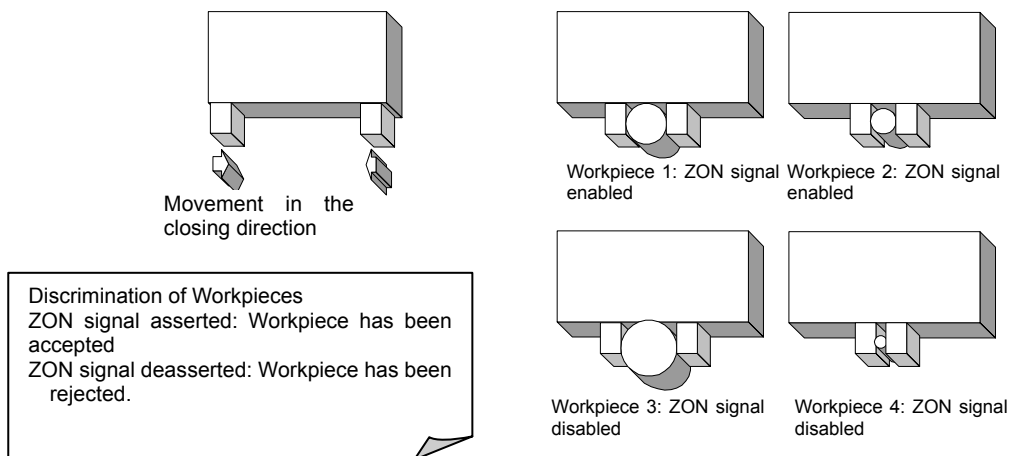


### Constant-speed movement and grip with ZON output (CLOSE) mode

In this Constant-Speed Move and Grip with ZON output (CLOSE) mode, the fingers can move in the closing direction at the specified speed and grip a workpiece with specified gripping force.

When the fingers finished traveling to the stroke end in the closing direction, the INPOS signals are output. If they grip the workpiece during the stroke, the HOLD signal is output. In addition, if the fingers grip the workpiece within the range between ZON 1 and ZON 2, the controller sends the ZON signal. Input gripping speed, gripping force, ZON 1, and ZON 2. This mode is useful for checking if the workpiece is within the preset range.





### Constant-speed movement and grip with ZON output (OPEN) mode

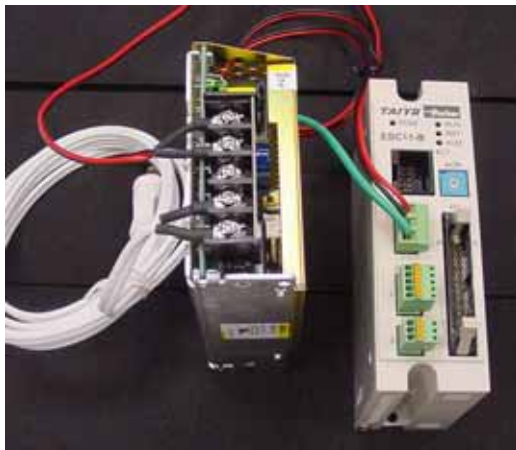
In this Constant-Speed Movement and Grip with ZON output (OPEN) mode, the fingers can move in the opening direction at the specified speed and grip a workpiece with specified gripping force. When the fingers finished moving to the stroke end in the closing direction, the INPOS signals are output. If they grip the workpiece during the stroke, the HOLD signal is output. In addition, if the fingers grip the workpiece within the range between ZON 1 and ZON 2, ZON signals are asserted. Input speed, gripping force, ZON 1, and ZON 2. This mode is useful for checking if the workpiece is within the preset range.

### 3.5. Trial Operation

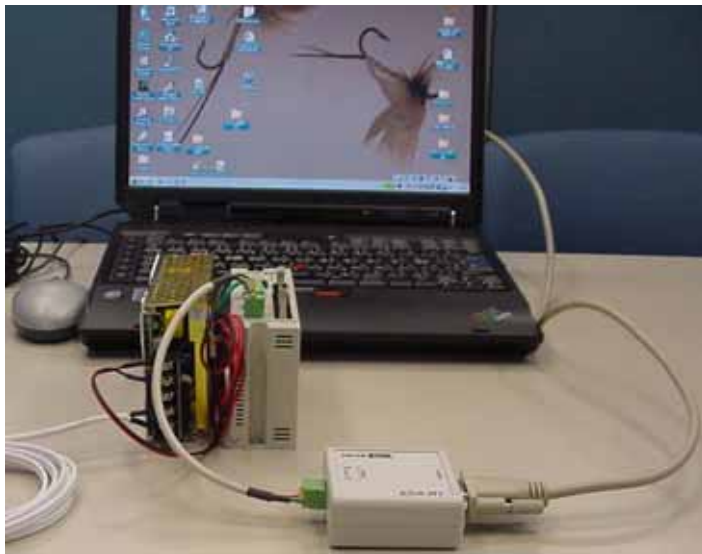
Example items (actuator, controller, serial cable (optional), serial converter (optional) and job switch (optional)) contained a package are as shown in the picture below.



Connect between the DC power supply and controller with general-purpose cables.



Connect between the controller and computer through the serial converter.



Check for proper controller address (address: 0).



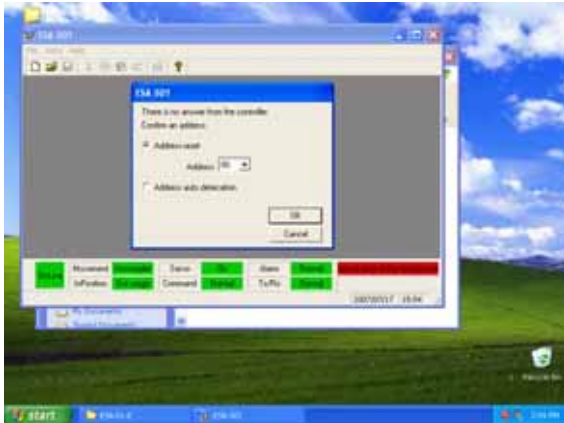
Turn on the controller.



Start the preinstalled support software.

Initialize the parameter settings according to the connected actuator type using the

support software.

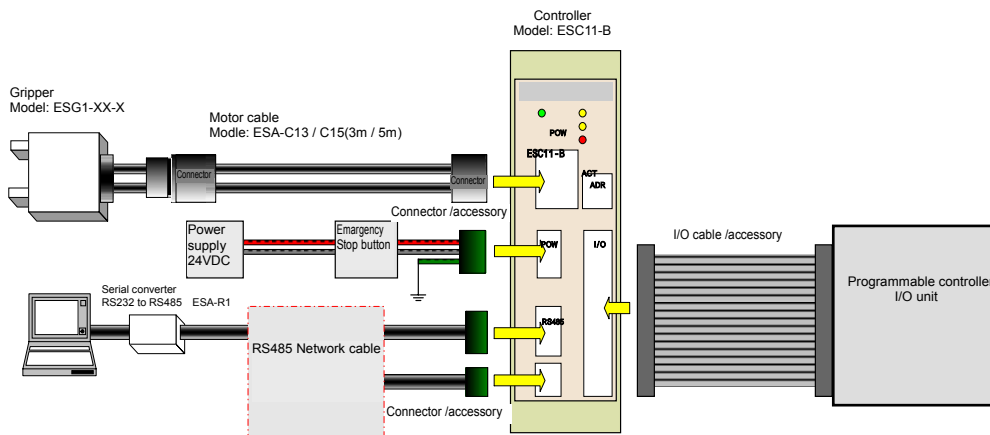


Shut down the power supply to the controller.

Connect between the gripper and controller.

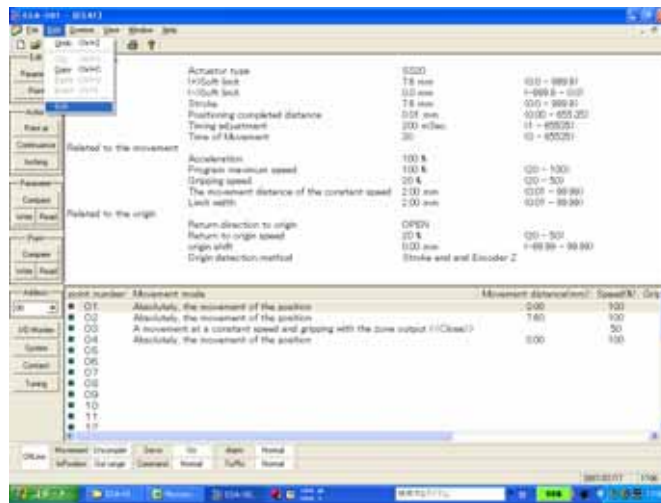


Connect the controller with the I/O cable.



Turn on the controller.

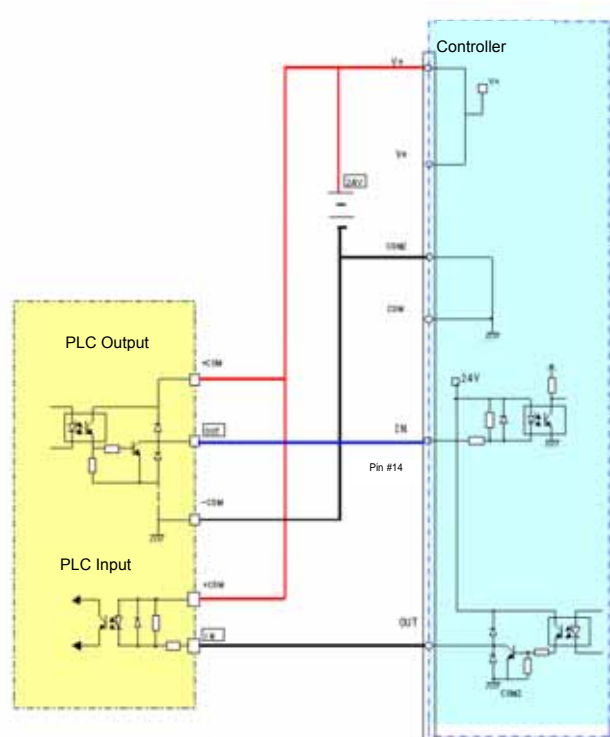
Edit and write parameters and point data.



Cancel interlock.

In this step, our IO checker is used for canceling interlock, but interlock can be cancelled by outputting instructions from the PLC.

Input the signal to PIN14 (INLOCK) of I/O connector.

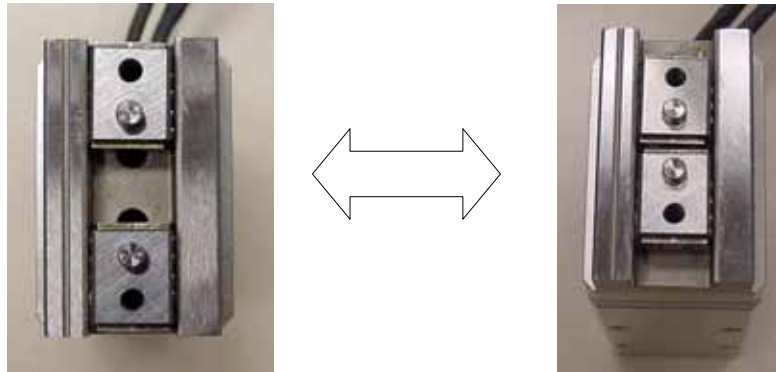


Operation—After clicking the **Point designation** button, click the **ORG** button to let the fingers return to the original positions.

Specify the point and click the **GO** button.

Point designated movement		
Address	00	
PointNo	01	
GO	STOP	ORG
Speed	Present position	Origin return condition
50 %	0.00 mm	Complete
Close		

Check that the actuator is properly working.



That's all for trial operation.

### 3.6. Operation of Actuator

Basic operating procedures and timing charts are as shown below.

Signal level defines photo coupler ON and OFF as HI and LO, respectively.

#### 3.6.1. Turning on the Power

Basic operation and operational timing chart are shown below.

The operational timing charts are for general operation, not for actual example

Relationships among Interlock signal (INLOCK), ready signal (READY), and alarm signal (ALARM) are as the table shown below .

OUT Signal \ IN Signal	Interlock signal	
	Cancel	Valid
Normal	READY	ON
	ALARM	ON
Error	READY	OFF
	ALARM	ON

Cancel (ON)    Valid (OFF)

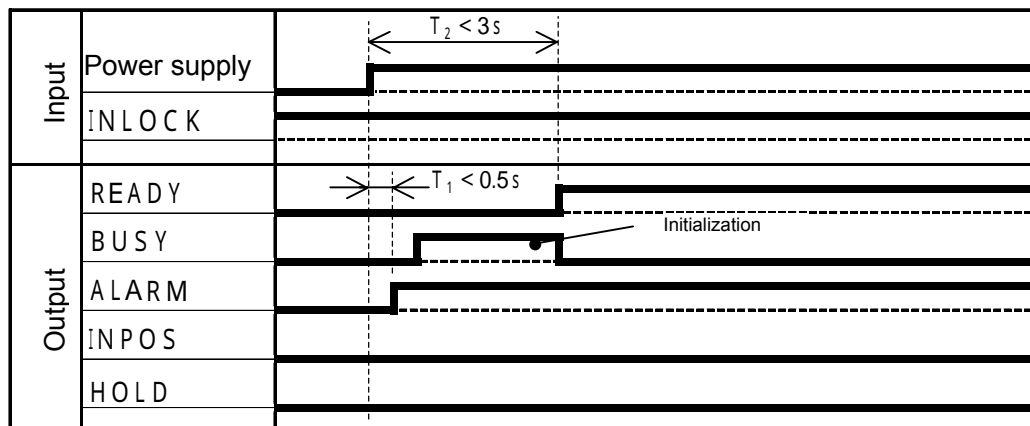
#### Normal Performance After the Power Was Turned On

Turn on the controller power.

If no errors are detected, the ALARM signal is asserted within 0.5 sec after turning on the controller power. At this time, the ALM lamp on the front of the controller is off.

Robot starts initialization and automatically enters the servo-on state, but it does not execute initialization when the INLOCK function is activated (INLOCK is deasserted).

When the READY signal is asserted within 3 seconds after completion of initialization, the RDY lamp on the front side of the controller normally comes on. The controller enters the state in which it can receive a command in the form of I/O input or serial signals.



**Initial Operation**

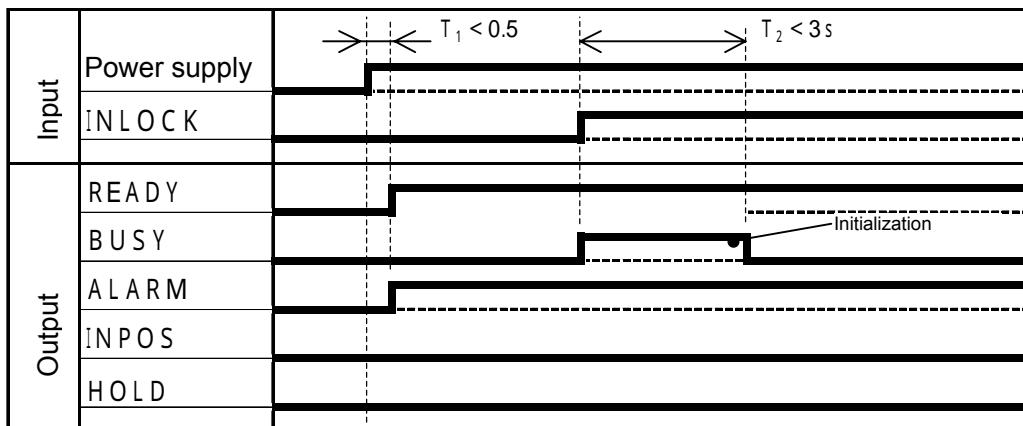
The maximum operable time of the controller is up to around 3 seconds, because it initializes position detection after turning on the power. The actuator performs minute operations for initializing position detection.

**Normal Operation After the Power Was Turned On and Interlock Operation Status (INLOCK deasserted)**

If the controller is in the Interlock Operation status when control power was turned on, the actuator does not perform initialization.

After canceling the interlock function (INLOCK is asserted), initial operation is automatically performed.

If no errors are detected, initial operation is performed within 3 sec after cancellation of the interlock function (INLOCK is asserted).



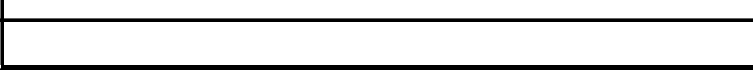




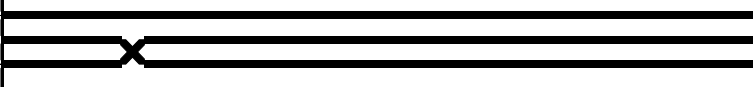


**For the Circuit Designed to Turn the Power Off with Alarm Signal in Power Alarm State**

To assert ALARM output by canceling interlock function (INLOCK signal is asserted)

Turn the power on while the interlock function is cancelled. (INLOCK signal is asserted).

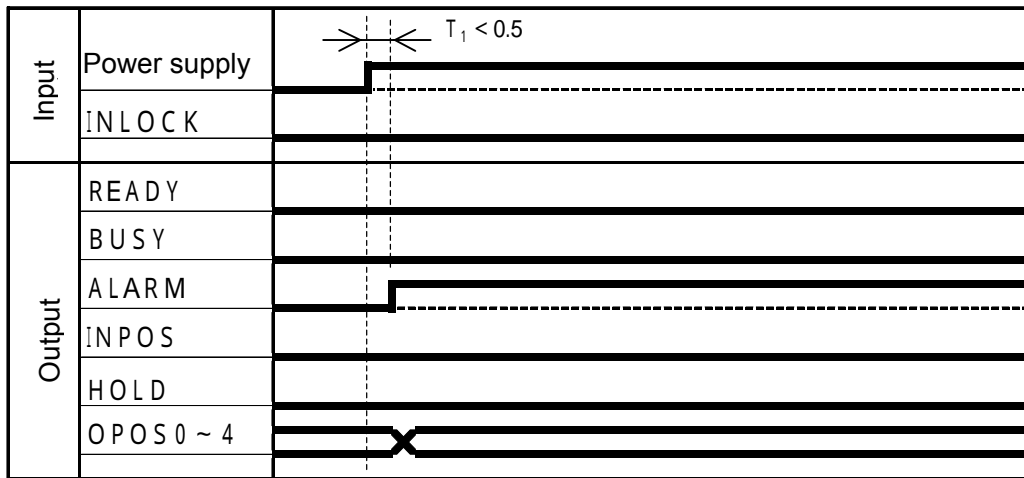
If an alarm occurred when turning on the controller power, the ALARM signal remains deasserted. The ALM lamp on the front side of the controller comes on. The READY signal remains deasserted.

Input	Power supply	
	INLOCK	
Output	READY	
	BUSY	
	ALARM	
	INPOS	
	HOLD	
	OPOS0 ~ 4	

Users should take measures into consideration referring to Section 4.8, Troubleshooting.  
To cancel the alarm function, turn off the power first and on the power again.

**When Alarm Occurred in Power Alarm (or Interlock) State**

- Turn on the power while interlock signal (INLOCK) is input.
- The ALARM signal is asserted within 0.5 sec after turning on the power.
- Check alarm history to initialize the parameter.
- The READY signal remains deasserted.



### 3.6.2. Original Position Return

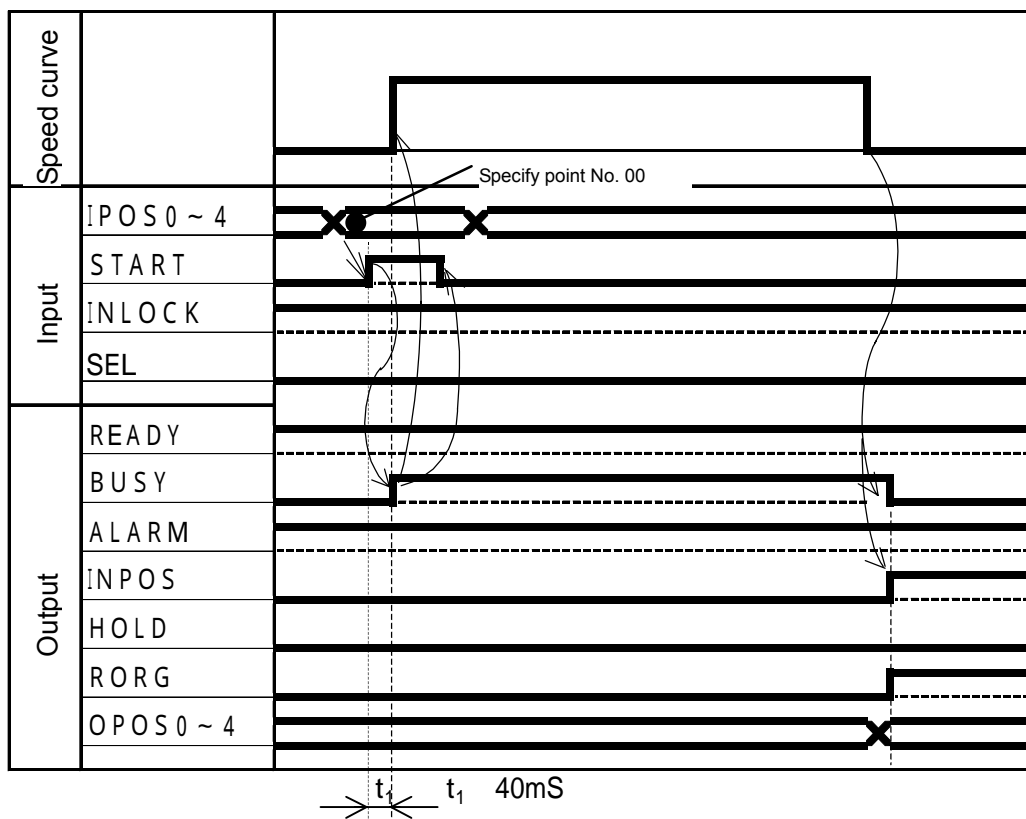
#### Original Position Return

Assert the START after specifying the point number 00 by using IPOS[0:4]

When the controller received the START signal, the fingers start returning to their original positions after the BUSY signal is asserted.

After checking the BUSY signal is asserted, deassert the START signal.

When the fingers finished returning to their original positions, the INPOS signals and RORG signal are asserted, OPOS[0:4] specify the point data 00.



### 3.6.3. Positioning Operation

Basic operations and operation timing charts for positioning are shown below.

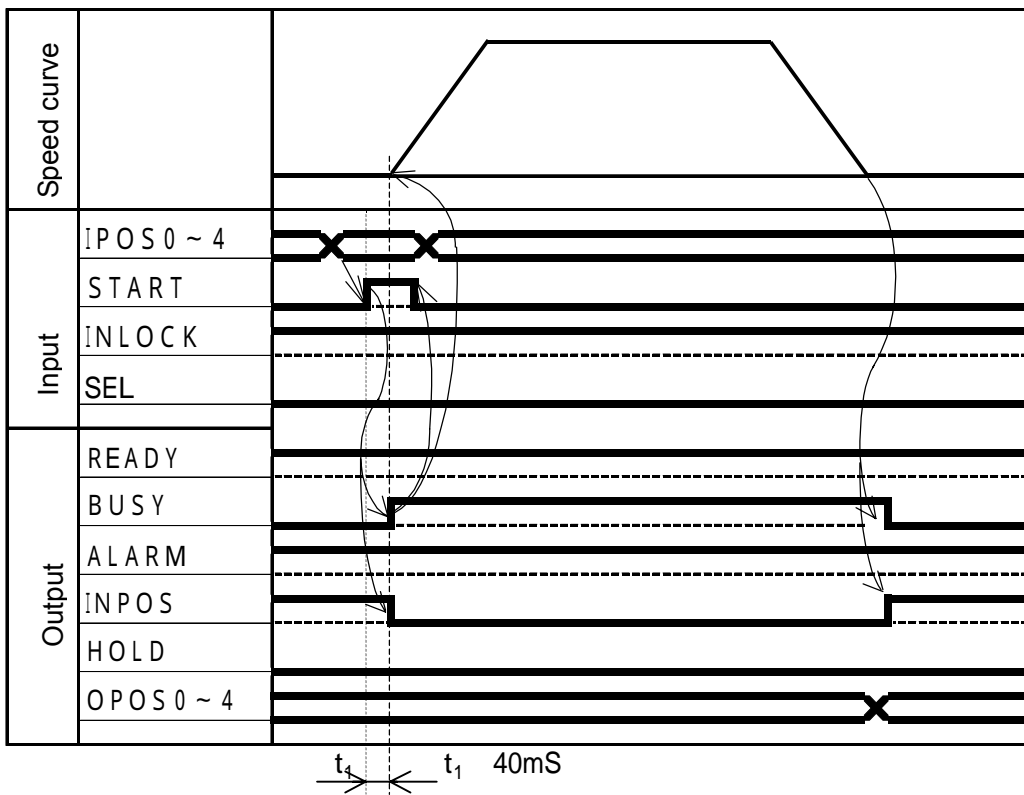
**Normal Positioning Operation**

After specifying a point number by using IPOS[0:4], assert the START signal

When the controller received the START signal, the BUSY signal is asserted and the fingers start to move. Once the fingers start moving, the INPOS signals are deasserted.

After checking the BUSY signal is asserted, deassert the START signal.

When the fingers reached the target position, power supply to the motor stops, the BUSY signal is deasserted, and the INPOS signals are asserted. The point number is output by using OPOS[0:4].



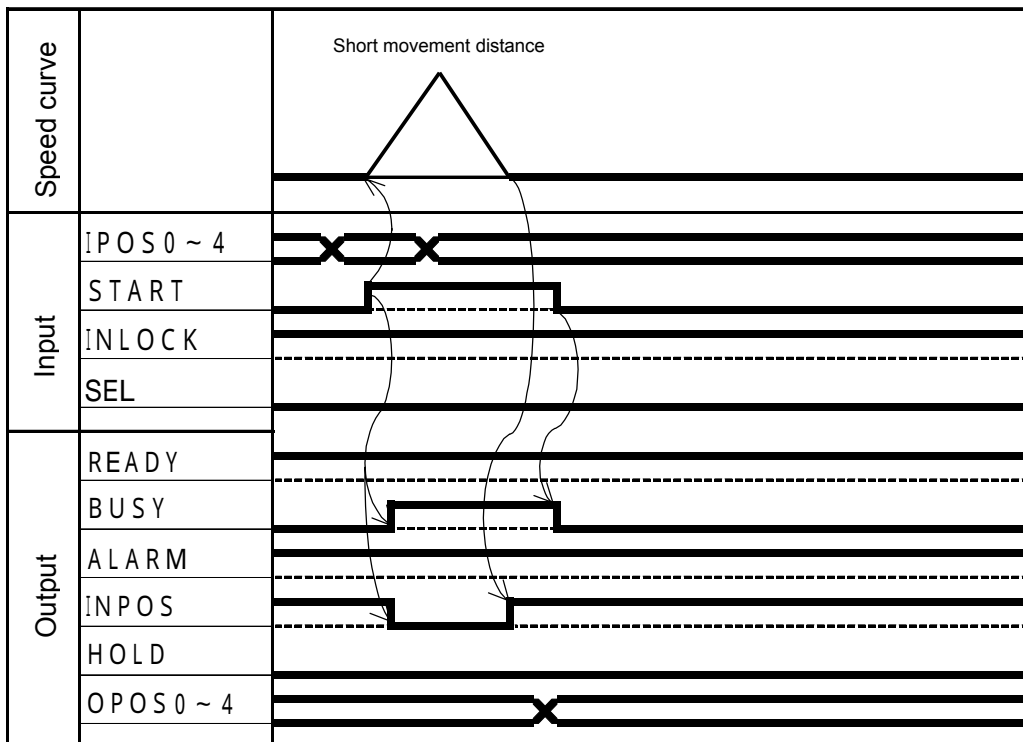
**Positioning Operation for Short Movement Time**

When movement distance is short and the time when the START signal is asserted is longer than movement time:

After the controller receives the START signal, the BUSY signal is asserted and the INPOS signals are deasserted.

When the fingers reached their target positions, the INPOS signals are asserted.

After the START signal is deasserted, the BUSY signal is deasserted.



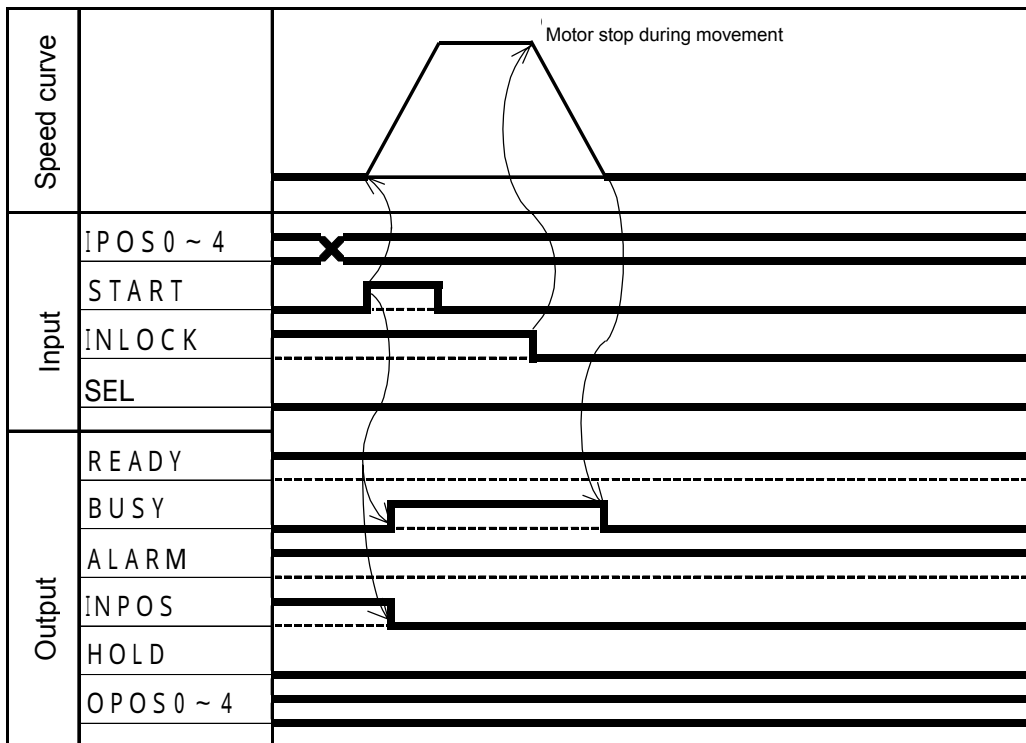
**When INLOCK Signal Was Asserted during Movement**

When the controller received the START signal, the BUSY signal is asserted. After the INPOS signals are deasserted, the fingers start to move.

If the INLOCK signal is asserted during moving, the motor decelerates and stops.

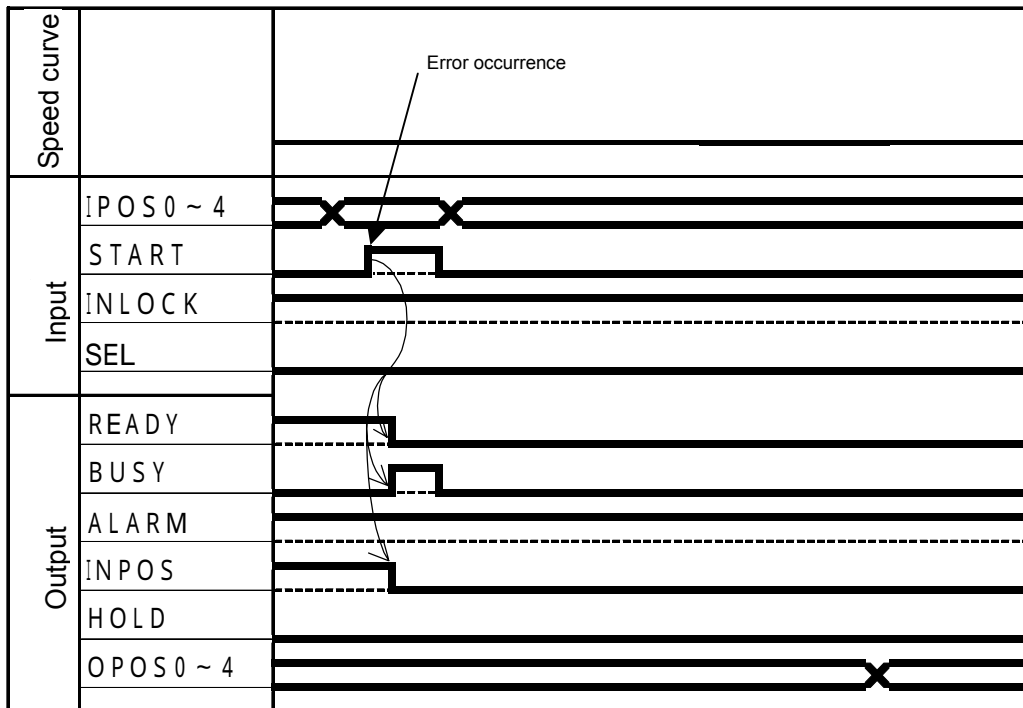
When the motor stops, the BUSY signal is deasserted. The INPOS signals remain deasserted.

a



**When Error Occurred Before Move**

If errors occurred when the controller received the START signal, the READY signal and INPOS signals are deasserted and the motor stops. When the START signal was deasserted, the BUSY signal is also deasserted. Even though errors occurred, the controller can let the fingers start to move by receiving the START signal after eliminating the errors.



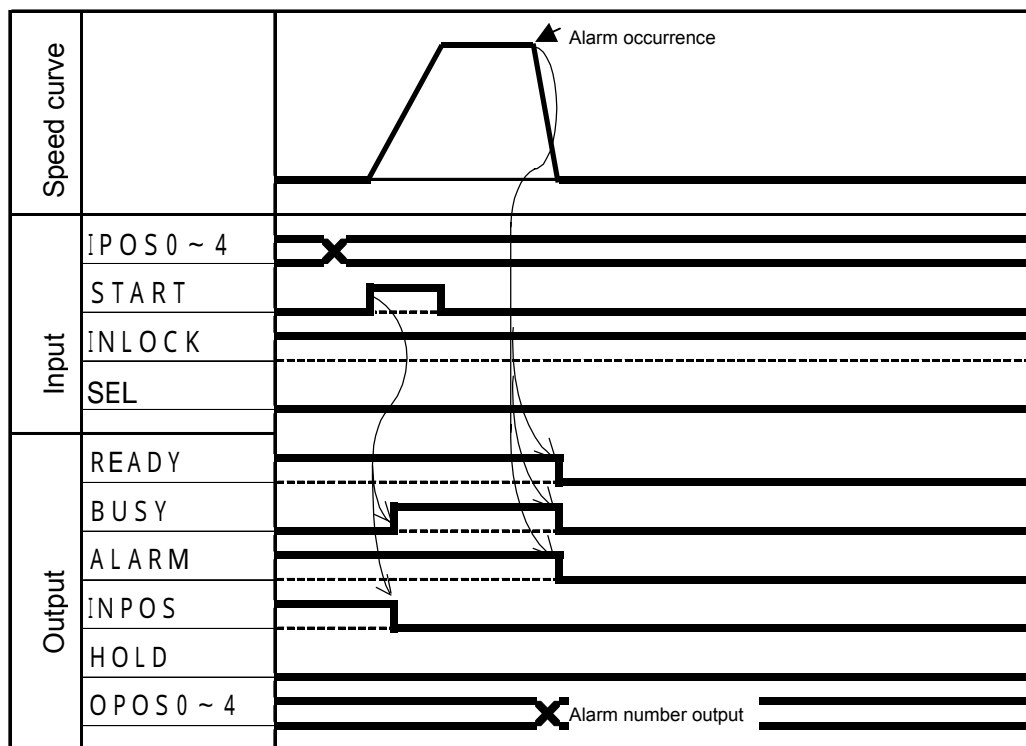
**When Alarm Occurred during Movement**

When the controller received the START signal, the BUSY signal is asserted, the INPOS signals are deasserted, and the fingers start to move.

When alarm occurred, the motor stops.

After the motor stops, the READY signal, BUSY signal, and ALARM signal are deasserted. The alarm number is output by using the OPOS [0:4] signals. Users should take measure into consideration referring to Section 4.8, Troubleshooting.

To cancel the alarm function, turn off the power first and turn on the power again.



### Gripping Operation

After specifying a point number by using IPOS[0:4], assert the START signal.

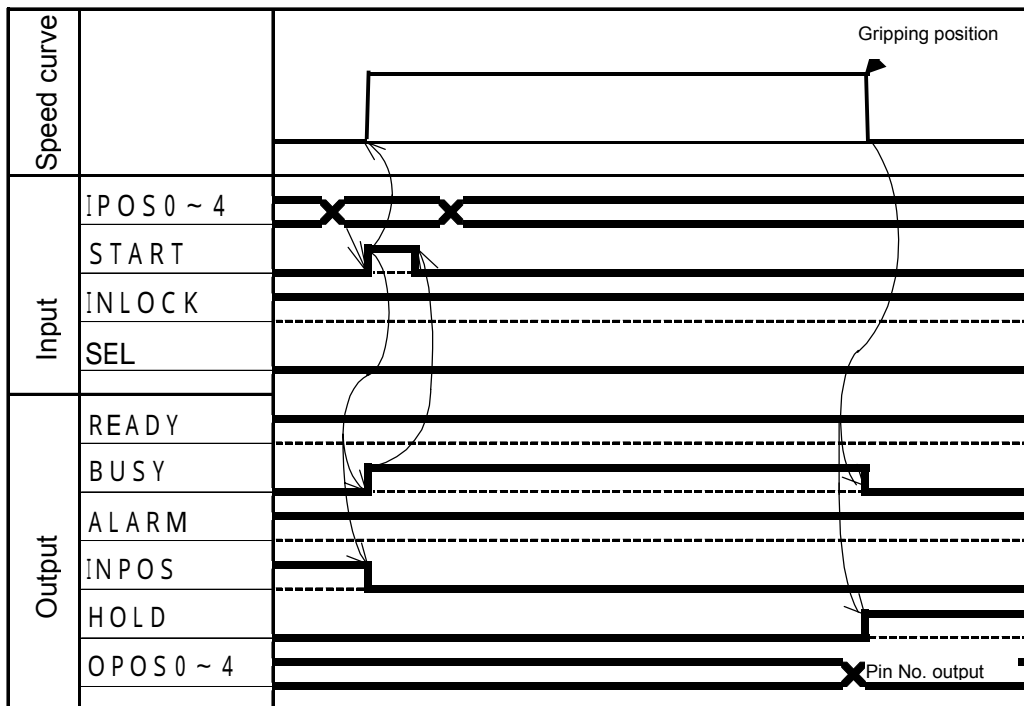
When the controller received the START signal, the BUSY signal is asserted and the fingers start to move.

After the fingers start to move, the INPOS signals are deasserted

After checking the BUSY signal is asserted, deassert the START signal.

When the fingers gripped a workpiece, the HOLD signal is asserted after the BUSY signal is deasserted.

After the fingers grip the workpiece, the point number is output by using OPOS[0:4].



**Gripping Operation (within specified zone) and ZON Output**

After a point number is specified by using IPOS[0:4], the START signal is asserted.

When the controller received the START signal, the BUSY signal is asserted. The fingers start to move after the ZON signal is deasserted.

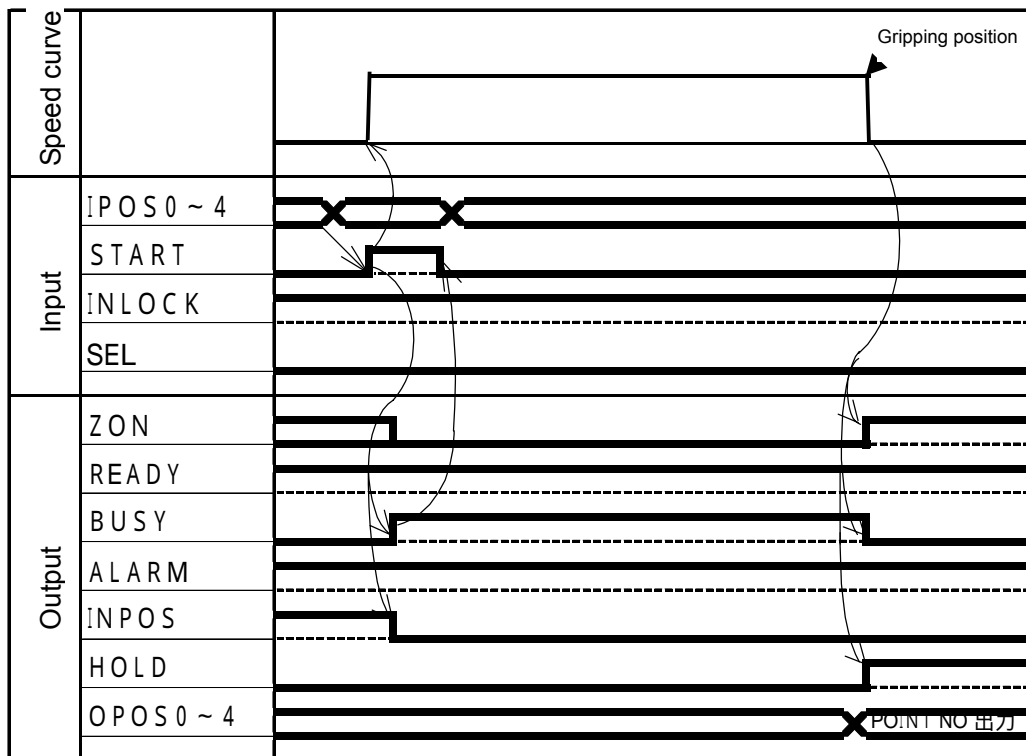
When the fingers started to move, the INPOS signals are deasserted.

After checking the BUSY signal is asserted, deassert the START signal.

When the fingers gripped a workpiece, the BUSY signal is deasserted and the HOLD signal is asserted

If the gripper grips the workpiece within the ZON range, the ZON signal is asserted. If not, it keeps deasserted.

After the fingers gripped the workpiece, the point number is output by using OPOS[0:4].



**Accelerated/Decelerated Movement and Grip mode (When a Workpiece Was Gripped**

**within Specified Gripping Range)**

After a point number is specified by using IPO[0:4], assert the START signal.

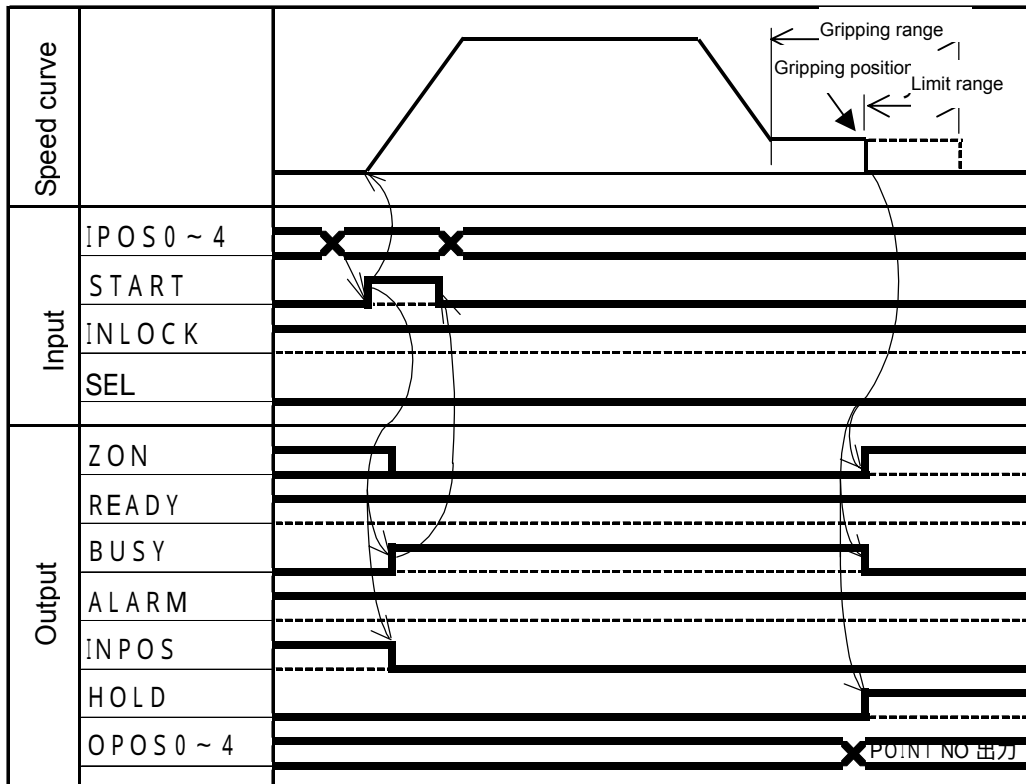
When the controller received the START signal, the BUSY signal is asserted and the ZON signal is deasserted, and the fingers start to move.

When the fingers started to move, the INPOS signals are deasserted.

After checking the BUSY signal is asserted, deassert the START signal.

When the fingers gripped a workpiece within the effective gripping range, the HOLD and ZON signals are asserted.

After the fingers gripped the workpiece, the point number is output by using OPOS[0:4].



**Accelerated/Decelerated Movement and Grip mode (When A Workpiece Was Gripped out of Specified Gripping Range)**

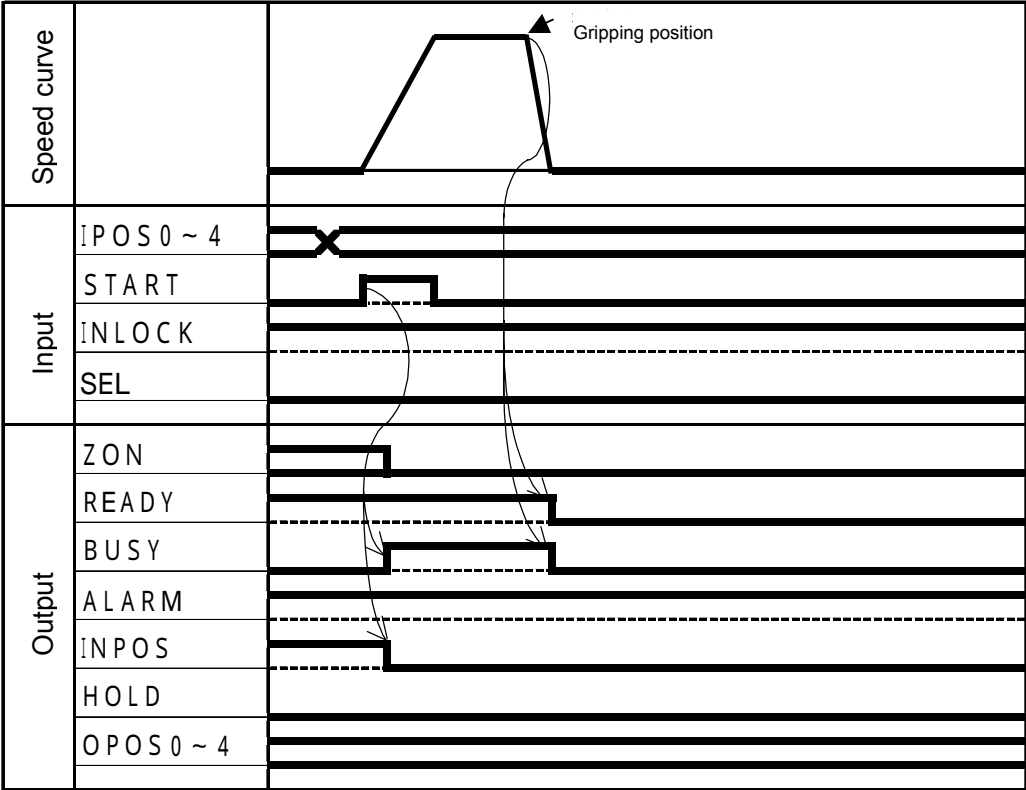
Specify a point number by using the IPOS[0:4] signals and assert the START signal.

When the controller received the START signal, the BUSY signal is asserted and the fingers start to move.

When the fingers started to move, the INPOS signals are deasserted.

After checking BUSY is asserted, deassert the START signal.

When the fingers gripped a workpiece out of the effective gripping range, the BUSY signal and READY signal are deasserted. The HOLD and ZON signals keep asserted.



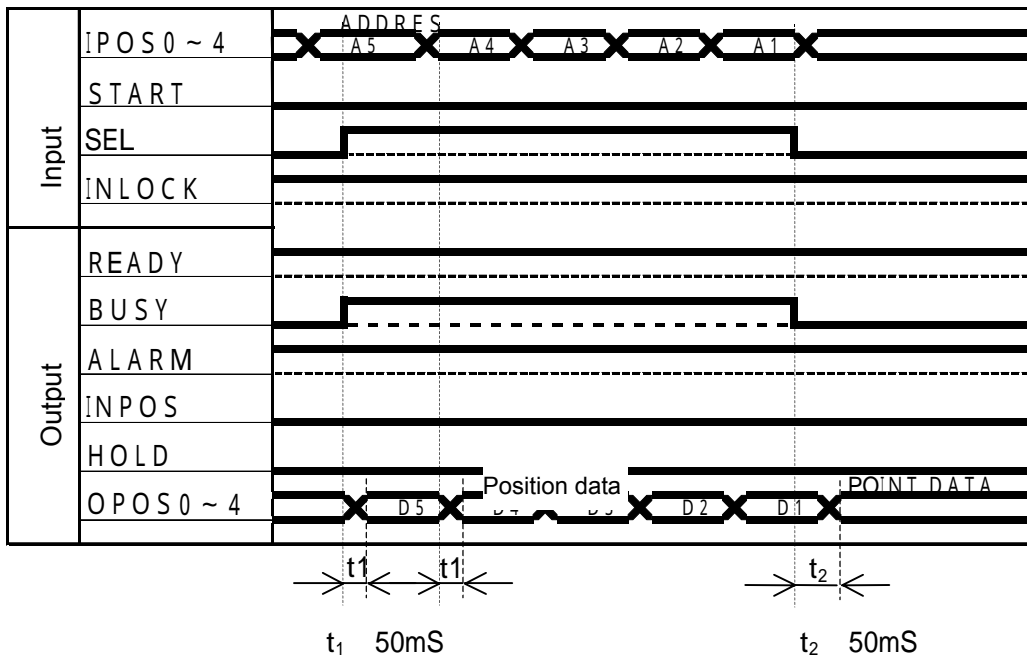
### Position Data Output

Assert the SEL signal.

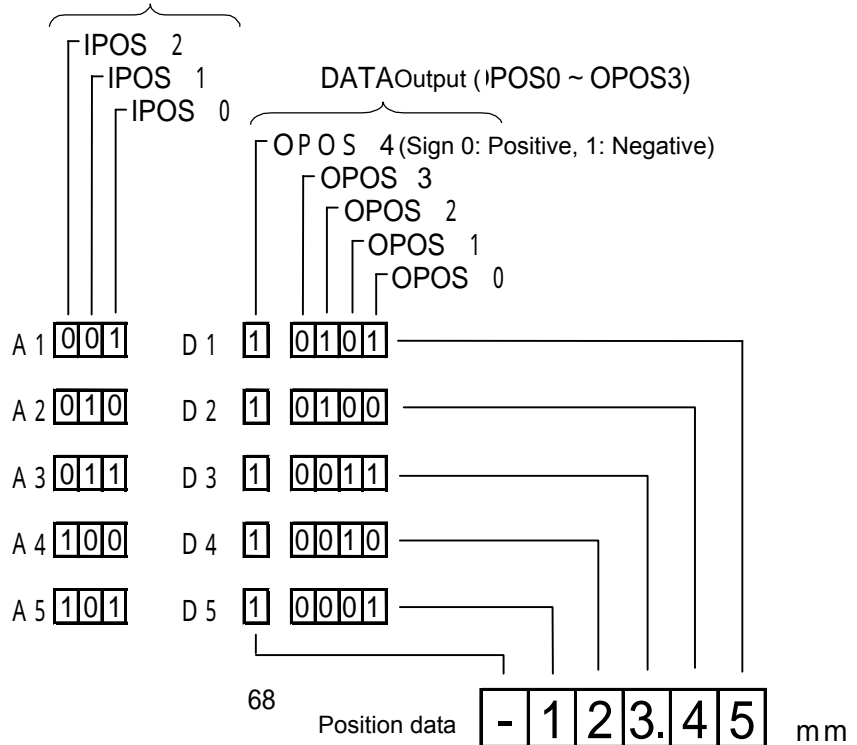
Set the number of displayed digits for the current position (address) by using the IPO[0:2] signals.

The current position in the specified digit is output by using the OPOS[0:4] signals.

The OPOS4 signal represents a sign.



ADDRESS input (IPOS 0 ~ IPOS 2)



### 3.7. Table of Alarm and Error Messages

#### 3.7.1. Alarm Messages

No.	Message	Definition	Possible cause	What to do
01h	OVER LOAD	Motor overload	<p>Problem in use</p> <p>Motor failure</p> <p>Parameter failure</p> <p>Capacity shortage of the power line</p> <p>Large friction of the working part</p>	<p>Reduce operation duty of the working part.</p> <p>Specify lower acceleration parameter.</p> <p>Specify proper parameter of mass of the moving parts.</p> <p>Replace motor assay if armature resistance of the motor is low, or if you feel it is extremely heavy to turn the handle by hand.</p> <p>Initialize parameters (check working part number).</p> <p>Check capacity of the power supply.</p> <p>If it is lacking, increase capacity of the power supply.</p>
02h	OVER CURRENT	Motor overcurrent	<p>Shorted motor cable</p> <p>Motor failure</p> <p>Controller failure</p> <p>Parameter failure</p>	<p>Check motor cable for conductivity. If any abnormalities are found, replace the motor assay.</p> <p>In the event of short circuit, replace motor.</p> <p>In the case where resistance is less than X ohm between motor terminal <math>\phi A</math> and <math>\phi \underline{A}</math> or between <math>\phi B</math> and <math>\phi \underline{B}</math>, replace the controller due to output transistor failure.</p> <p>Initialize the parameters (check the working part number).</p>

03h	MACHINE REFERENCE OVER	Phase lag of Z phase of encoder	Replaced gripper Nails were replaced when original position is set to closing direction. Broken or damaged line for sending Z phase signal to encoder.	Initialize parameters Initialize parameters Set original positions in the closing direction  Replace the gripper
04h	POWER SUPPLY VOLTAGE LOW	Power supply voltage dropped down to less than 80% of rated one.	Capacity shortage of power line	Check power capacity. If it is lacking, increase capacity of the power supply (largest amount of power is consumed when making a bump at end of stroke, starting moving parts, mechanical section, and accelerating/decelerating the gripper).
05h	DATA NOT WRITE	Writing data into ROM is not possible.	End of service life of ROM or ROM failure	Replace controller.
06h	P.E. COUNTER OVER	Overflow of position deviation	Mechalock  Broken motor cable and wrong connection of motor cable Parameter failure	Check the moving parts of mechanical parts are mechanically locked. Check connection between the motor cable and encoder signal cable. Initialize parameters (check mechanical part number).
07h	PNT DATA DESTROY	Point data are broken.	Backup circuit failure	Check point data after supplying power to gripper. If some data are damaged, correct the data. If all data are damaged, reload

			Power was shut down during data writing Data broken by external noise	data after initializing point data. Even though no damaged data are found, rewrite any data to check to make sure data are not damaged. Check noise environment.
08h	PRM DATA DESTROY	Parameter data are broken.	Backup circuit failure Power was shut down during data writing. Data was damaged by external noise	Turn on power and initialize parameters  Check noise environment
09h	SYSTEM FAULT1	Software went out of control at M16C side	External noise or other causes made software uncontrolled.	Check noise environment
0ah	FEEDBACK ERROR1	Motor control and force control is impossible	Misalignment between excitation position and encoder position is caused by initial process errors at the time of turning power on. When external force was applied to nails, they were positioned out of	Turn off and on the power and make sure to check no external load is applied to nails and return fingers to their original positions Check noise environment

			soft limit. Encoder count error was caused by external noise.	
0bh	FEEDBACK ERROR2	Encoder signal cable is broken.	Encoder signal cable is broken.	Check connection with encoder signal cable
0ch	ABNORMAL VOLTAGE	Over voltage	Surge of power supply voltage was caused by regeneration. Wrong power supply settings	Reduce operation duty of mechanical parts Check power supply pressure.
0dh	SYSTEM FAULT2	Software went out of control at H8S side	External noise or other causes made software uncontrolled.	Check noise environment
0eh	FEEDBACK ERROR3	Motor cable is broken, misconnected, overloaded.	Broken motor cable and incorrect connection	Check connection with motor cable.

### **3.7.2. Error messages**

No.	Message	Definition	Possible cause	What to do
20h	OVER SOFT LIMIT	Exceeded Soft limit	During jog feeding, direct teaching, or teaching playback, position out of soft limit range was specified.	Review the soft limit.

21h	PULSE OVERFLOW	Yielded pulse has been overflowed.	The machine did not perform operations according to preset operation pattern.	Review the settings of acceleration/deceleration speed, maximum limit of speed, load, and regeneration load.
22h	I/O LOGIC ERROR	Wrong logic signal was input to I/O connector.	Signal other than interlock signal was input during operation.	Check input signal.
23h	RETURN ERROR	Movement instruction was executed before the fingers complete returning to their original positions	The fingers failed to return to their original positions.	Return the fingers to their original positions.
24h	SERVO OFF	Movement instruction was executed when servo is off.	Movement instruction was executed before servo is turned on.	Make the controller enter in servo on communication status.
25h	INTERLOCK	Movement command was executed when interlock function was asserted.	Interlock function is not cancelled.	Check interlock signal input is cancelled. (input ON: deasserted.)
26h	NO POINT DATA	Operation cannot be performed, since point having no point data is specified.	Point having no point data is specified.	Check specified point has point data.
27h	OPERATION IN PROGRESS	Execution instruction was input in operation.	Execution instruction was input during	Check input signal.

			operation.	
30h	NETWORK COMMUNICATION ERROR	Check sum error Parity error Timeout  Overflow	Check sum computing program, parity setting, noise affection, overlong cable Data length of output command is longer than specified. Commands are sent in a row.	Review program. Check parity setting, ambient noise, and cable length.  Check command. Check response from controller.
31h	COMMUNICATION COMMAND ERROR	Controller received communication commands in unspecified format. Data length of the communication command is incorrect.	Communication command in specified format was not sent. Data length of the communication command is incorrect.	Check commands.  Check data length.
32h	DATA ERROR	Data value out of range was specified.	Incorrect data value	Check data value

## 3.8. Troubleshooting

### 3.8.1. If You Have a Problem with the Controller

When you contact us for a problem with the controller, please provide the following information as exactly as possible.

Item	Details
What has the problem?	Type of controller Serial No. of controller. Model of gripper Number of gripper
When the problem occurred?	Date purchased Service duration and operating condition
Why the problem occurred?	Conditions where the problem occurred
What problem occurred?	Detailed symptom of the problem
How often the problem occurred?	Frequency of occurrence of the problem

### 3.8.2. Measures against Problems

If you faced a problem while using the controller, solve the problem referring to the following table. If you still cannot solve the problem after doing so, please contact a local dealer or us.

No.	Symptom	Possible cause	Items checked	Measure
1	When turning on controller, motor is not excited or fingers cannot return to their original positions.	No power is supplied.	<ul style="list-style-type: none"> <li>· Check the POW LED on front panel of controller.</li> <li>· Check wiring of 24V power supply.</li> <li>· Check power pressure using a tester.</li> <li>· Remove the power connector to measure resistance between the power terminals</li> </ul>	<ul style="list-style-type: none"> <li>· Replace the controller if power is properly supplied to the controller.</li> <li>· If resistance is immeasurable between the power terminals, fuse may be blown. Replace controller.</li> </ul>
		Alarm error may be occurred.	When ALM (LED lamp) on the controller is on,	Check detailed information of alarm error with support software.
2	Support Software cannot work.	Wrong wiring	Check wiring numbers. Section 4.1.12, <b>Connecting to Computer</b> .	Change the wiring.
		Terminating resistance is not connected.	Check the terminating resistance.	When one or more controllers are used at the same time, provide terminating resistance.
		Wrong settings of communication port on computer	Check the number of port connecting to the converter.	Set the port number in support software
		Inconsistent address setting	Inconsistent address setting between controller and support software	Match the controller address with the support software address.

No.	Symptom	Possible cause	Items checked	Measure
3	When inputting special instructions, controller cannot work.	Incorrect external wiring	Check wiring number. Section 4.2, I/O interface.	Correct wiring.
		Interlock signal remains deasserted.	Check signal status displayed on the monitor of the support software.	Assert interlock function.
		Original position return has not been completed.	Check operating conditions in support software. Check the RPRG signal is asserted.	Perform original position return.
		Point movement is not feasible.	Check the IPOS signals are asserted on the monitor of the support software.	Set correct point number.
			Check settings of point data.	Input correct point data.
		Input signals for other special instructions are asserted.	Check signal status displayed on the monitor of support software.	Deassert the input signals for other special instructions.
Pulse width of signal is too narrow.	After BUSY signal is asserted, input signal for specific instruction is deasserted.	After the BUSY signal is asserted, deassert input signal for specific instructions.		
4	Abnormal sound and vibration are generating.	Incorrect parameter settings	Check actuator type, model, and parameter data displayed in support software.	Initialize parameters with support software.
		Failure to tightly fix the gripper	Fixing screws	Tighten screws for loose fixing
		Problem with the guide	Check foreign objects exist in the guide. Check any damage or deformation on the guide.	Replace guide. Check to make sure that the controller is not handled forcibly.
		Controller failure	Try to use another controller.	If it properly worked, replace controller.
		Motor failure	Try to use another gripper.	If it properly worked, replace gripper.
5	Since the fingers made a bump at stroke end while returning to their original positions, the machine stops due to occurrence of alarm.	Inconsistent settings	Check the actuator type and gripper model displayed in support software.	Initialize the parameters with the support software.
		Incorrect parameter settings or failure	Check the parameters with support software.	Initialize parameters with the support software.
6	Misalignment of original position occurs.	Damaged ball screws ( FS/FT type)	Check the ball screws.	Replace the ball screw.
		Connection failure of pulley ( FS/FT type)	Check the fixing parts.	Tighten for loose fixing.
		Some teeth of belt are missing. ( FS/FT type)	Movement speed was increased too much. Check how much the belt is bent.	Modify the parameters. Adjust the belt.

		Malfunction caused by noise.	<ul style="list-style-type: none"> <li>· Check the ground terminal on controller is utilized for ground. Refer to section 4.1.9, <u>Grounding Work</u>.</li> <li>· Check for the connection with cable connectors.</li> <li>· Check for RS485 terminating resistance.</li> <li>· Check if there are a welding machine, electric discharge machine, etc. near the controller.</li> <li>· Check if the relay which turns on/off a huge motor exists near controller.</li> </ul>	<ul style="list-style-type: none"> <li>· Keep controller as far away from noise source as possible.</li> <li>· Consider installation of a noise filter and insulated transformer.</li> <li>· Attach a noise killer to relay contact.</li> <li>· Keep the motor and encoder cable away from the power cable.</li> </ul>
7	Gripper speed is too fast or too slow.	Incorrect the parameter setting values.	Check the actuator type and gripper model displayed in support software.	Initialize the parameters with support software.
		Change the speed setting.	Check speed parameter (PRM9)	Modify parameters.

## 4. Specifications and External Dimensions

### 4.1. Specifications

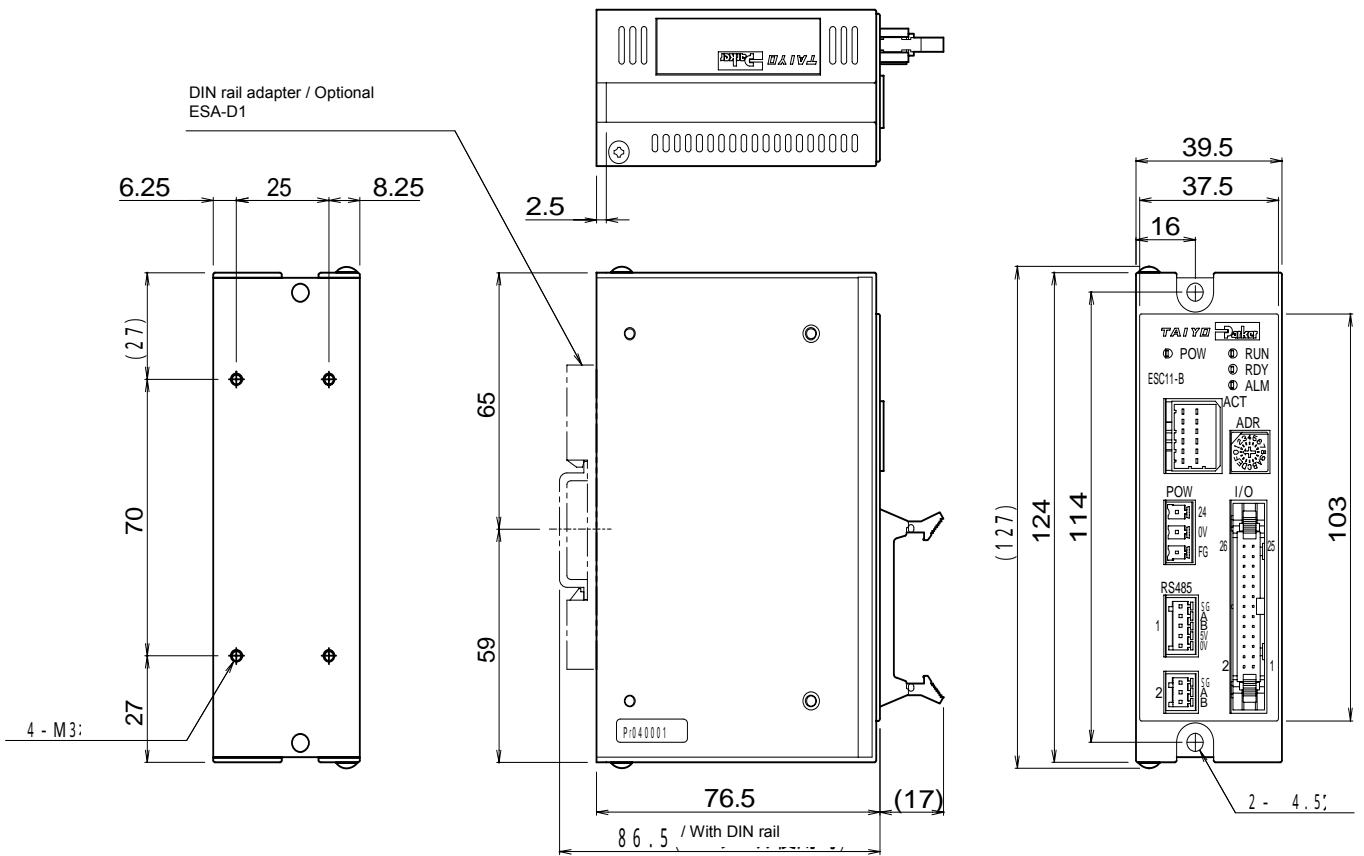
#### Controller Specifications

Item		Specification
Axis control	Number of control axes	1 axis
	Position detection method	Optical rotary encoder
	Minimum setting distance	0.01mm
	Speed setting	Automatically sets maximum speed. Speed can be set for each point.
Memory	Number of points	32 points (including one original point)
	Teaching method	MDI (coordination value input), teaching playback, direct teach (support software for computer)
Protective function (alarm)		Overcurrent, overload, abnormal voltage, voltage reduction, system error, machine reference error, position deviation error, feedback error, point data error, data writing error
Monitor		Alarm history, I/O status, alarm, motor electric current, power supply voltage
External input/output	Input Photo coupler insulation 5mA TYP/1 input	5 inputs: Instructive point setting (5 bit binary)
		3 inputs: Control input
	Output Photo coupler insulation 30mA MAX./1 input	5 outputs: Completion point setting (5 bit binary)
		7 outputs: Control output
Network	RS485 2 ports (1 channel: no power supply, 1 channel: power supply, multi-drop connection with up to 16 axes)	
LED indicator	4 indicators: Power supply (green), RDY (yellow), RUN (yellow), ALM(red)	
Power supply		24V DC $\pm$ 10% 1A MAX (Common for Motor and I/O power supply)
General	Operating temperature	0 ~ +40° C
	Operating humidity	35 ~ 85%RH (without dew condensation)
	Storage temperature	-10 ~ +65° C
	Insulation resistance	500V DC, 10M $\Omega$
	Vibration resistance	0.5G 10 ~ 55Hz
	Mass	260g
	Accessory	I/O cable (with a connector attached at the end of the cable), CD-ROM (PC support software), connector (I/O, power supply, serial), terminating resistance

## 4.2. External Dimensions

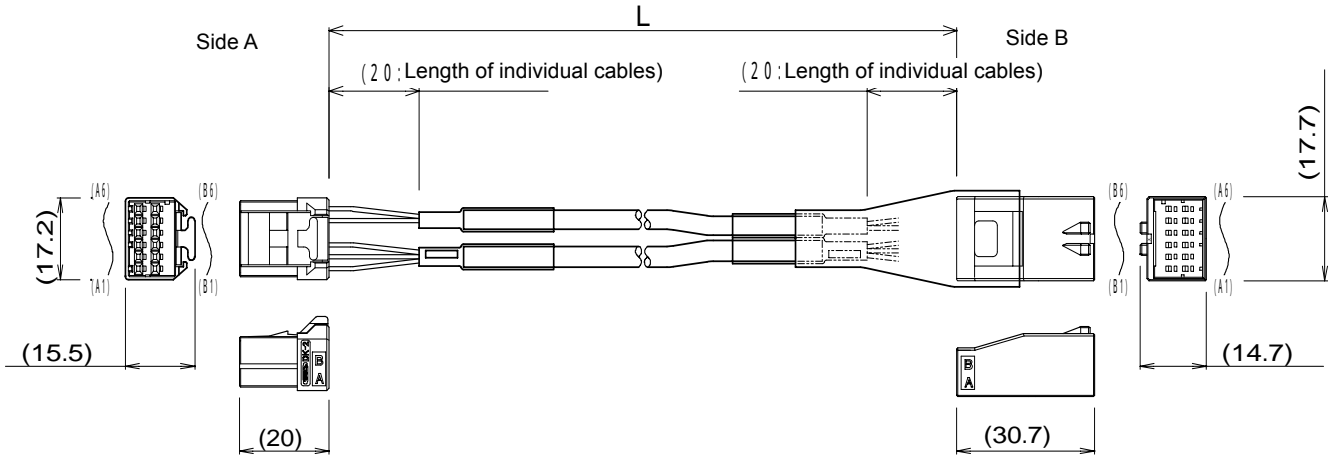
### 4.2.1. Controller

Type: ESC11-B



## 4.2.2. Motor Cable

Type: ESA-C1



### Wire Connection

Side A  
Terminal No.

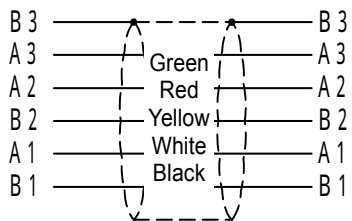
A 6  
B 6  
A 5  
B 5  
A 4 NC  
B 4 NC

Green  
Red  
White  
Black  
NC  
NC  
Green  
Red  
Yellow  
White  
Black

Side A  
Terminal No.

A 6  
B 6  
A 5  
B 5  
NC A 4  
NC B 4

Green  
Red  
White  
Black  
Green  
Red  
Yellow  
White  
Black

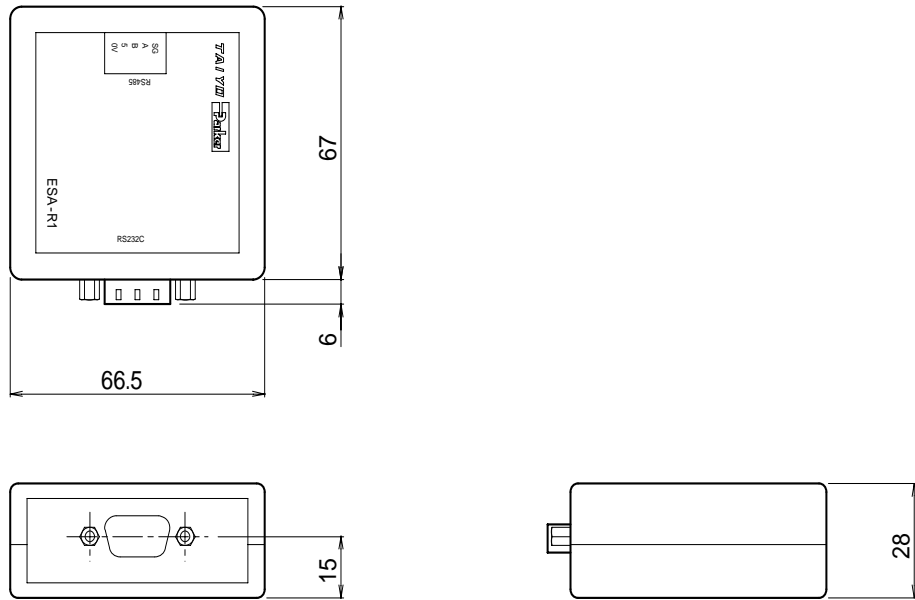


### Cable length (L)

Length	L	Type
3m	$3000 \pm 150$	ESA-C13
5m	$5000 \pm 300$	ESA-C15

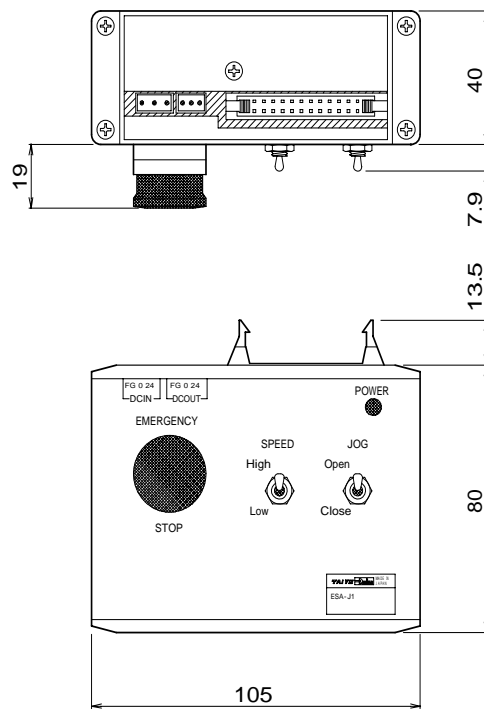
### 4.2.3. Serial Converter

TYPE: ESA-R1 (optional)



### 4.2.4. Jog Switch

TYPE: ESA-J1 (optional)



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