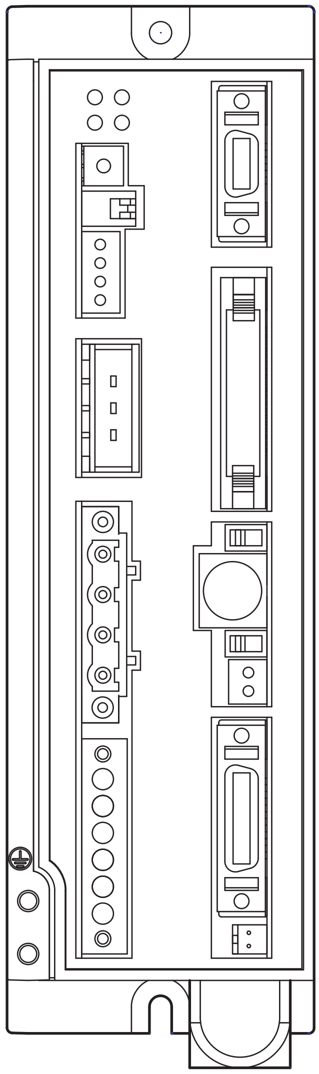
SCON-CA Controller

Instruction Manual First Edition



IAI America, Inc.

Please Read Before Use

Thank you for purchasing our product.

This Instruction Manual describes all necessary information items to operate this product safely such as the operation procedure, structure and maintenance procedure.

Before the operation, read this manual carefully and fully understand it to operate this product safely. The enclosed CD/DVD in this product package includes the Instruction Manual for this product. For the operation of this product, print out the necessary sections in the Instruction Manual or display them using the personal computer.

After reading through this manual, keep this Instruction Manual at hand so that the operator of this product can read it whenever necessary.

[Important]

- This Instruction Manual is original.
- The product cannot be operated in any way unless expressly specified in this Instruction Manual. IAI shall assume no responsibility for the outcome of any operation not specified herein.
- Information contained in this Instruction Manual is subject to change without notice for the purpose of product improvement.
- If you have any question or comment regarding the content of this manual, please contact the IAI sales office near you.
- Using or copying all or part of this Instruction Manual without permission is prohibited.
- The company names, names of products and trademarks of each company shown in the sentences are registered trademarks.

Contents

Safety Guide

"Safety Guide" has been written to use the machine safely and so prevent personal injury or property damage beforehand. Make sure to read it before the operation of this product.

Safety Precautions for Our Products

The common safety precautions for the use of any of our robots in each operation.

No.	Operation Description	Precautions
1	Model Selection	● This product has not been planned and designed for the application where high level of safety is required, so the guarantee of the protection of human life is impossible. Accordingly, do not use it in any of 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 (For vehicle, railway facility or air navigation facility) 3) Important safety parts of machinery (Safety device, etc.) ● Do not use it in any of the following environments. 1) Location where there is any inflammable gas, inflammable object or explosive 2) Place with potential exposure to radiation 3) Location with the ambient temperature or relative humidity exceeding the specification range 4) Location where radiant heat is added from direct sunlight or other large heat source 5) Location where condensation occurs due to abrupt temperature changes 6) Location where there is any corrosive gas (sulfuric acid or hydrochloric acid) 7) Location exposed to significant amount of dust, salt or iron powder 8) Location subject to direct vibration or impact ● Do not use the product outside the specifications. Failure to do so may considerably shorten its life and cause a product breakdown or facility operation stop.
2	Transportation	● When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. ● Consider well so that it is not bumped against anything or dropped during the transportation. ● Transport it using an appropriate transportation measure. ● Do not step or sit on the package. ● Do not put any heavy thing that can deform the package, on it. ● When using a crane capable of 1t or more of weight, have an operator who has qualifications for crane operation and sling work. ● When using a crane or equivalent equipments, make sure not to hang a load that weighs more than the equipment's capability limit. ● Use a hook that is suitable for the load. Consider the safety factor of the hook in such factors as shear strength. ● Do not get on the load that is hung on a crane. ● Do not leave a load hung up with a crane. ● Do not stand under the load that is hung up with a crane.

No.	Operation Description	Precautions
3	Storage and Preservation	● The storage and preservation environment conforms to the installation environment. However, especially give consideration to the prevention of condensation.
4	Installation and Start	(1) Installation of Robot Main Body and Controller, etc. ● Make sure to securely hold and fix the product (including the work part). A fall, drop or abnormal motion of the product may cause a damage or injury. ● Do not get on or put anything on the product. Failure to do so may cause an accidental fall, injury or damage to the product due to a drop of anything, malfunction of the product, performance degradation, or shortening of its life. ● When using the product in any of the places specified below, provide a sufficient shield. 1) Location where electric noise is generated 2) Location where high electrical or magnetic field is present 3) Location with the mains or power lines passing nearby 4) Location where the product may come in contact with water, oil or chemical droplets
		(2) Cable Wiring ● Use our company's genuine cables for connecting between the actuator and controller, and for the teaching tool. ● Do not scratch on the cable. Do not bend it forcibly. Do not pull it. Do not coil it around. Do not insert it. Do not put any heavy thing on it. Failure to do so may cause a fire, electric shock or malfunction due to leakage or continuity error. ● Perform the wiring for the product, after turning OFF the power to the unit, so that there is no wiring error. ● When the direct current power (+24V) is connected, take the great care of the directions of positive and negative poles. If the connection direction is not correct, it might cause a fire, product breakdown or malfunction. ● Connect the cable connector securely so that there is no disconnection or looseness. Failure to do so may cause a fire, electric shock or malfunction of the product. ● Never cut and/or reconnect the cables supplied with the product for the purpose of extending or shortening the cable length. Failure to do so may cause the product to malfunction or cause fire.
		(3) Grounding ● Make sure to perform the grounding of type D (Former Type 3) for the controller. The grounding operation should be performed to prevent an electric shock or electrostatic charge, enhance the noise-resistance ability and control the unnecessary electromagnetic radiation.

No.	Operation Description	Precautions
4	Installation and Start	(4) Safety Measures ● When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. ● When the product is under operation or in the ready mode, take the safety measures (such as the installation of safety and protection fence) so that nobody can enter the area within the robot's movable range. When the robot under operation is touched, it may result in death or serious injury. ● Make sure to install the emergency stop circuit so that the unit can be stopped immediately in an emergency during the unit operation. ● Take the safety measure not to start up the unit only with the power turning ON. Failure to do so may start up the machine suddenly and cause an injury or damage to the product. ● Take the safety measure not to start up the machine only with the emergency stop cancellation or recovery after the power failure. Failure to do so may result in an electric shock or injury due to unexpected power input. ● When the installation or adjustment operation is to be performed, give clear warnings such as "Under Operation; Do not turn ON the power!" etc. Sudden power input may cause an electric shock or injury. ● Take the measure so that the work part is not dropped in power failure or emergency stop. ● Wear protection gloves, goggle or safety shoes, as necessary, to secure safety. ● Do not insert a finger or object in the openings in the product. Failure to do so may cause an injury, electric shock, damage to the product or fire. ● When releasing the brake on a vertically oriented actuator, exercise precaution not to pinch your hand or damage the work parts with the actuator dropped by gravity.
5	Teaching	● When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. ● Perform the teaching operation from outside the safety protection fence, if possible. In the case that the operation is to be performed unavoidably inside the safety protection fence, prepare the "Stipulations for the Operation" and make sure that all the workers acknowledge and understand them well. ● When the operation is to be performed inside the safety protection fence, the worker should have an emergency stop switch at hand with him so that the unit can be stopped any time in an emergency. ● When the operation is to be performed inside the safety protection fence, in addition to the workers, arrange a watchman so that the machine can be stopped any time in an emergency. Also, keep watch on the operation so that any third person can not operate the switches carelessly. ● Place a sign "Under Operation" at the position easy to see. ● When releasing the brake on a vertically oriented actuator, exercise precaution not to pinch your hand or damage the work parts with the actuator dropped by gravity. * Safety protection Fence : In the case that there is no safety protection fence, the movable range should be indicated.

No.	Operation Description	Precautions
6	Trial Operation	● When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. ● After the teaching or programming operation, perform the check operation one step by one step and then shift to the automatic operation. ● When the check operation is to be performed inside the safety protection fence, perform the check operation using the previously specified work procedure like the teaching operation. ● Make sure to perform the programmed operation check at the safety speed. Failure to do so may result in an accident due to unexpected motion caused by a program error, etc. ● Do not touch the terminal block or any of the various setting switches in the power ON mode. Failure to do so may result in an electric shock or malfunction.
7	Automatic Operation	● Before the automatic operation is started up, make sure that there is nobody inside the safety protection fence. ● Before the automatic operation is started up, make sure that all the related peripheral machines are ready for the automatic operation and there is no error indication. ● Make sure to perform the startup operation for the automatic operation, out of the safety protection fence. ● In the case that there is any abnormal heating, smoke, offensive smell, or abnormal noise in the product, immediately stop the machine and turn OFF the power switch. Failure to do so may result in a fire or damage to the product. ● When a power failure occurs, turn OFF the power switch. Failure to do so may cause an injury or damage to the product, due to a sudden motion of the product in the recovery operation from the power failure.
8	Maintenance and Inspection	● When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. ● Perform the work out of the safety protection fence, if possible. In the case that the operation is to be performed unavoidably inside the safety protection fence, prepare the "Stipulations for the Operation" and make sure that all the workers acknowledge and understand them well. ● When the work is to be performed inside the safety protection fence, basically turn OFF the power switch. ● When the operation is to be performed inside the safety protection fence, the worker should have an emergency stop switch at hand with him so that the unit can be stopped any time in an emergency. ● When the operation is to be performed inside the safety protection fence, in addition to the workers, arrange a watchman so that the machine can be stopped any time in an emergency. Also, keep watch on the operation so that any third person can not operate the switches carelessly. ● Place a sign "Under Operation" at the position easy to see. ● For the grease for the guide or ball screw, use appropriate grease according to the Instruction Manual for each model. ● Do not perform the dielectric strength test. Failure to do so may result in a damage to the product. ● When releasing the brake on a vertically oriented actuator, exercise precaution not to pinch your hand or damage the work parts with the actuator dropped by gravity. * Safety Protection Fence : In the case that there is no safety protection fence, the movable range should be indicated.

No.	Operation Description	Precautions
9	Modification and Dismantle	● Do not modify, disassemble, assemble or use of maintenance parts not specified based at your own discretion.
10	Disposal	● When the product becomes no longer usable or necessary, dispose of it properly as an industrial waste. ● Do not put the product in a fire when disposing of it. The product may burst or generate toxic gases.

Alert Indication

The safety precautions are divided into “Danger”, “Warning”, “Caution” and “Notice” according to the warning level, as follows, and described in the Instruction Manual for each model.

Level	Degree of Danger and Damage	Symbol
Danger	This indicates an imminently hazardous situation which, if the product is not handled correctly, will result in death or serious injury.	Danger
Warning	This indicates a potentially hazardous situation which, if the product is not handled correctly, could result in death or serious injury.	Warning
Caution	This indicates a potentially hazardous situation which, if the product is not handled correctly, may result in minor injury or property damage.	Caution
Notice	This indicates lower possibility for the injury, but should be kept to use this product properly	Notice

Precautions in Operation

1. Use the following teaching tools.
   Use the PC software and the teaching pendant stated in the next clause as the applicable for this controller.
   [Refer to 1.1.2 Teaching Tool.]

2. Backup the data to secure for breakdown.
   A non-volatile memory is used as the backup memory for this controller. All the registered position data and parameters are written into this memory and backed-up at the same time. Therefore, you will not usually lose the data even if the power is shut down. However, make sure to save the latest data so a quick recovery action can be taken in case when the controller is broken and needs to be replaced with another one.

   How to Save Data
   (1) Save the data to CD-R or hard disk with using the PC software
   (2) Hard-copy the information of position tables and parameters on paper

3. Set the operation patterns.
   This controller processes 9 types of control logics (including 8 types of PIO patterns and pulse train control) to meet various ways of usage, and changes the role of each PIO signal following the selected control logic.
   The setup can be performed by using the operation mode change switch or parameter No.25 “PIO pattern selection” on the front panel.
   [Refer to Chapter 3 Operation and Chapter 8 I/O Parameter.]
   The PIO pattern is set to “0” (Standard Type) when the unit is delivered. Set the operation pattern setting to the logic that suits to your use after the power is turned on.

⚠ Warning :
Please note it is very risky when the control sequence and PIO pattern setting do not match to each other. It may not only cause the normal operation disabled, but also may cause an unexpected.

4. Clock Setting in Calendar Function
   There may be a case that Alarm Code 069 “Real Time Clock Vibration Stop Detect” is issued at the first time to turn the power on after the product is delivered. In the case this happens, set the current time with a teaching tool.
   If the battery is fully charged, the clock data is retained for approximately 10 days after the power is turned OFF. Even though the time setting is conducted before the product is shipped out, the battery is not fully charged. Therefore, there may be a case that the clock data is lost even with fewer days than described above passed since the product is shipped out.

5. In pulse train control mode, actuator operation is unavailable through serial communication.
   In the pulse train control mode, the actuator operation is unavailable through serial communication. (The field bus specification does not meet the pulse train control mode.)
   However, it is possible to monitor the current status.

6. Attempt not to exceed the actuator specifications in the pulse train control mode.
   In the pulse train control, the acceleration/deceleration speed is also controlled by the change of the command pulse frequency from the host controller. The use of the actuator with exceeding acceleration/deceleration speed may cause a malfunction.

7. Actuator would not operate without servo-on and pause signals.

   (1) Servo ON Signal (SON)
   Servo ON signal (SON) is selectable from “Enable” or “Disable” by using a parameter.
   It is settable by parameter No.21 “selection of servo-on signal disable”.
   [Refer to Chapter 8 I/O Parameter.]
   If it is set to “Enable”, the actuator would not operate unless turning this signal on.
   If parameter No.21 is set to “1”, SON is made disable.
   If it is set to “Disable”, the servo becomes on and the actuator operation becomes enabled as soon as the power supply to the controller is turned on and the emergency stop signal is cancelled.
   [Refer to 3.2.3 [3] or 3.3.2 [5] Emergency Stop Circuit.]
   This parameter is set to “0” (Enable) at delivery. Have the setting that suits to the desirable control logic.

   (2) Pause Signal (*STP)
   The input signal of the pause signal (*STP) is always on considering the safety. Therefore, in general, the actuator would not operate if this signal is not on.
   It is available to make this signal to “Disable”, if this signal is undesirable.
   It is settable by parameter No.15 “Pause input disable”.
   [Refer to Chapter 8 I/O Parameter.]
   If parameter No.15 is set to “1” (Disable), the actuator can operate even if this signal is not on.
   This parameter is set to “0” (Enable) at delivery.

8. Note that there are some frictions and/or torsions in through-hole of rotary actuator when it is used.
   When using rotary actuator with a through hole in the center of the revolution and using the hole to put cables through, have a treatment to prevent wear from rubbing or wire break due to the cables getting twisted.

9. For rotary actuator, note cable disconnections due to distortions.
   Take particular note on actuators of 360-degree specification because they can be rotated infinitely in a single direction.

10. Limitations on operation of rotary actuator in index mode

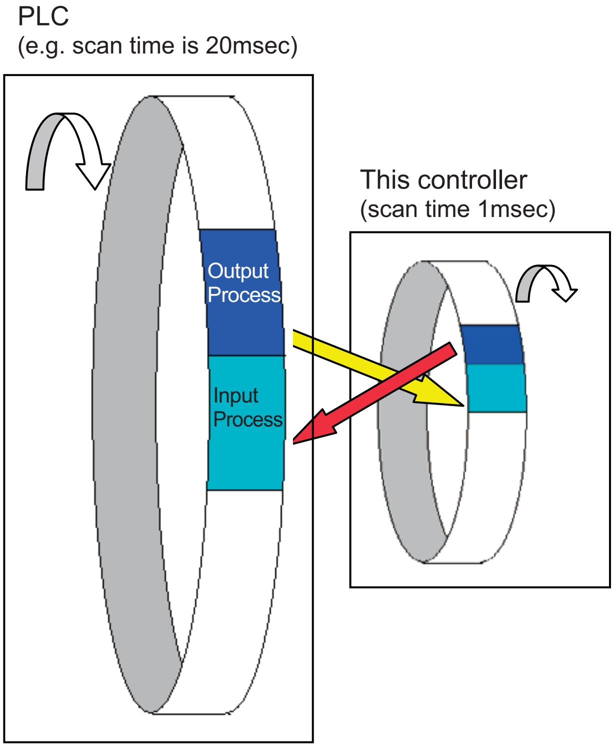
Rotary actuators of 360-degree specification can select the normal mode for finite rotations or the index mode enabling multi-rotation control by using parameter No.79 "Rotational axis mode selection". [Refer to Chapter 8 I/O Parameter.]
The following limitations are applied to the index mode:

1) Controllers of absolute specification cannot select the index mode. If selected, alarm code 0A1 "parameter data error" is issued.
2) Index Mode cannot be selected in Pulse Train Control Mode. It will generate Alarm Code 0A1 "Parameter Error".
3) The command range in the jog operation with PC software, teaching pendant or PIO signal is 0 to 360.00°.
4) Pressing is unavailable. The pressing torque can only be set to 0.
5) Do not issue positioning command around 0° repeatedly during movement near 0°. Failure to follow this may cause the actuator to rotate in the direction reverse to the specified rotation direction or operate indefinitely.
6) Software stroke limit is invalid in the index mode.

11. According to Sequence Program Creation

Please note the following things when creating a sequence program.
When data transfer is necessary between two devices that have a different scan time from each other, duration more than the longer scan time is required to certainly read the signal. (It is recommended to have at least twice of the longer scan time for the timer setting to conduct the reading process on the PLC side safely.)

● Operation Image



As shown in the diagram, the input and output timings of two devices that have different scan time do not match, of course, when transferring a signal.
There is no guarantee that PLC would read the signal as soon as this controller signal turns on.
In such a case, make the setting to read the signal after a certain time that is longer than the longer scan time to ensure the reading process to succeed on the PLC side.
It is the same in the case this controller side reads the signal.
In such a case, it is recommended to ensure 2 to 4 times of the scan time for the timer setting margin.
It is risky to have the setting below the scan time since the timer is also processed in the scan process.
In the diagram, PLC can only read the input once in 20msec even though this controller output once in 1msec.
Because PLC only conducts output process once in 20msec, this controller identifies the same output status for that while.

Also, if one tries to read the signal that is being re-written by the other, the signal may be read wrongly. Make sure to read the signal after the rewriting is complete. (It is recommended to have more than 2 scan periods to wait.) Make sure not to have the output side to change the output until the other side completes the reading. Also, a setting is made on the input area not to receive the signal less than a certain time to prevent a wrong reading of noise. This duration also needs to be considered.

12. PLC Timer Setting

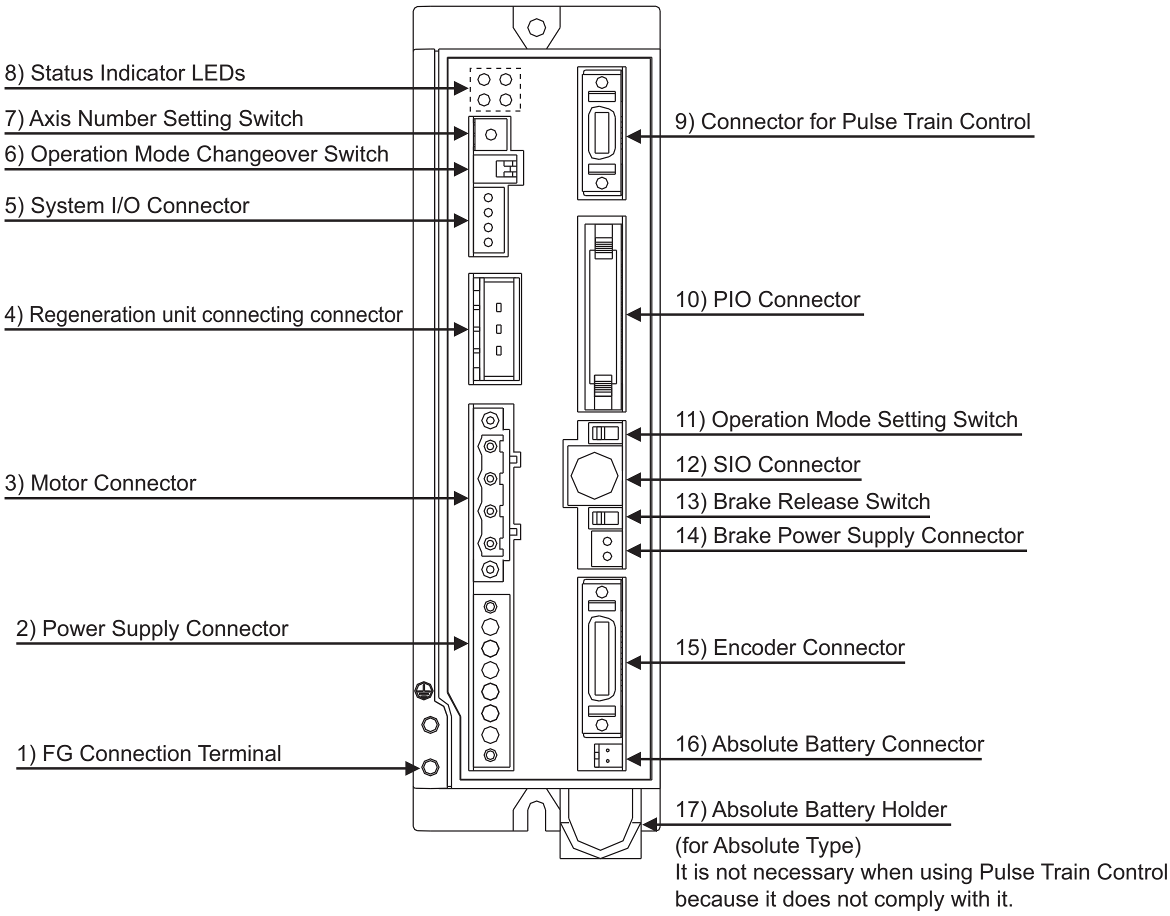
Do not have the PLC timer setting to be done with the minimum setting.
Setting to “1” for 100msec timer turns ON at the timing from 0 to 100msec while 10msec timer from 0 to 10msec for some PLC.
Therefore, the same process as when the timer is not set is held and may cause a failure such as the actuator cannot get positioned to the indicated position number in Positioner Mode.
Set “2” as the minimum value for the setting of 10msec timer and when setting to 100msec, use 10msec timer and set to “10”.

International Standards Compliances

SCON-CA comply with the following international standards:
Refer to Overseas Standard Compliance Manual (ME0287) for more detailed information.

RoHS Directive	CE Marking
○	○ Except for MECHATROLINK Connection Type, EtherCAT Type and EtherNet/IP

Name for Each Parts and Their Functions



1) FG Connection Terminal [Refer to 1.7 Noise Elimination and Mounting Method.]
   It is the terminal for the connection of ground cable to prevent electric shock and noise. It is connected with the PE of the power connector in the controller.

2) Power Supply Connector [Refer to 2.3.1 Wiring of Power Circuit.]
   It is the connector to supply the power to the controller and to the control board.

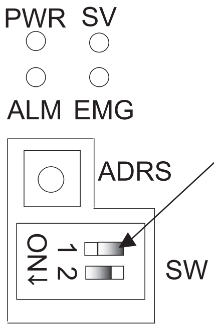
3) Motor Connector (MOT) [Refer to 2.3.3 Connection to Actuator.]
   It is the connector to connect the actuator's motor cable.

4) Regeneration Unit Connecting Connector [Refer to 2.3.6 Connectable Regenerative Units.]
   This connector is used to connect with an external regenerative unit.

5) System I/O Connector [Refer to 2.3.2 Wiring for Emergency Stop Circuit (System I/O).]
   This connector is used to connect with the emergency stop switch.

6) Operation Mode Changeover Switch [Refer to 3.3 Operation in Pulse Train Control Mode.]
This switch is used to change from the positioner mode to the pulse train control mode or vice versa.

Front Panel

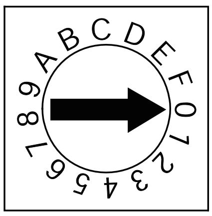


Name	Description
1	Operation mode changeover switch OFF : Positioner mode (including field bus specification) ON : Pulse train control mode (Note) This switch becomes effective at power-on.
2	Used by the manufacturer for adjustment purposes. Do not turn it ON. (Changing the setting of the switch is invalid even in the power-on status.)

⚠ Caution : For operation directed pulse trains from PLC, always set the operation mode setting switch 11) on the front panel to "AUTO".

7) Axis Number Setting Switch
This switch is used to set an axis number in multi-axis operation through serial communication.
Using the SIO converter allows multiple axes to be controlled on a teaching tool such as a PC without connection/disconnection of the connection cable connector. The SIO converter can specify up to 16 axes with hexadecimal numbers 0 to F.
The setting of the switch is read at power-on of the controller. Changing the setting after the power-on is invalid.

Point the arrow at a desired number with a flat-head screwdriver



⚠ Caution : Note duplicate axis number setting, which causes a communication error (alarm code 30C: no connection axis error) to occur and disables normal communication.

8) Status Indicator LEDs (PWR, SV, ALM, EMG)
Following show the controller operation status:

○ : Illuminating × : OFF △ : Illuminating/OFF

LED				Operation status
PWR (GN)	SV (GN)	ALM (OR)	EMG (RD)	
×	×	×	×	Control Power OFF
○	×	×	×	Normal Controller Start
○	×	×	×	Servo OFF
○	○ (Note 1)	×	×	Servo ON
○	×	○	△	In the Alarm Issue
○	×	△	○	In the Emergency Stop

Note 1 Blinking in auto servo-off state

9) Connector for Pulse Train Control [Refer to Chapter 3.3 Operation in Pulse Train Control Mode.]
The pulse train I/O connector is used in the pulse train control mode.
Feedback Pulse is also effective in Positioner Mode

10) PIO Connector [Refer to 2.3.4 Connection of PIO.]
The PIO connector is used for control I/O signals.

11) Operation Mode Setting Switch (MANU/AUTO)
This switch is used for interlock so that a moving command from PIO (PLC) and a command from the teaching tool such as a PC may not be issued at a time.
AUTO ··· Allows auto operation by PIO signals. The teaching tool such as a PC can only operate the monitor.
MANU ··· Allows the teaching tool such as a PC to operate the controller.

12) SIO Connector (SIO) [Refer to 2.3.7 SIO Connector Connection.]
The SIO connector is used to connect the controller with a teaching tool such as PC software or a gateway unit through a proper communication cable.

13) Brake Release Switch (BK RLS/NOM)
For the actuator equipped with a brake, the switch is used to release the brake forcibly.

> Warning : Always set the switch to “NOM” in normal operation.
> The brake would not work even with the servo OFF condition if the switch is on the RLS side. In the vertical oriented mount, the work may drop and cause an injury or the work to be damaged.

14) Brake Power Supply Connector [Refer to 2.3.1 Wiring of Power Circuit.]
For the actuator equipped with a brake, the connector supplies the power (24V DC) to release the brake.

15) Encoder Connector (PG) [Refer to 2.3.3 Connection to Actuator.]
This connector is used to connect the encoder cable of the actuator.

16) Absolute Battery Connector
In the absolute specification, the connector is connected with the absolute battery.

17) Absolute Battery Holder (for absolute type)
This is the holder for the storage of the absolute battery.

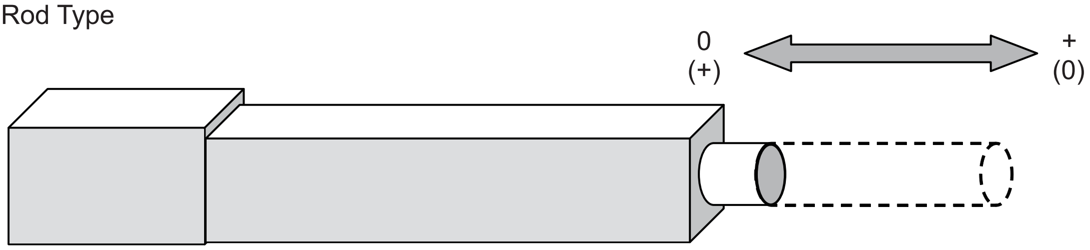
⚠ Caution : If it is Pulse Train Control, it would not comply with absolute type.

Actuator Axes

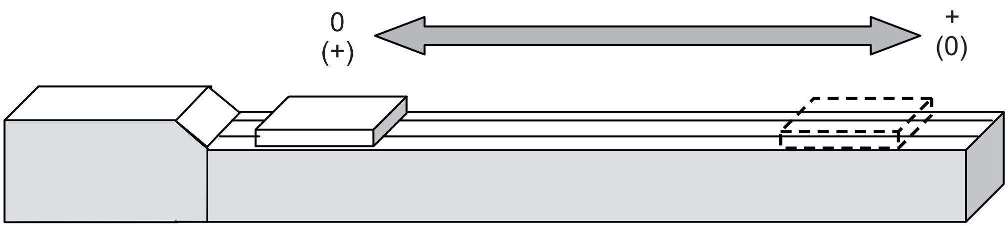
Refer to the pictures below for the actuator axes that can be controlled by SCON-CA.
0 defines the home position, and items in ( ) are for the home-reversed type (option).

> ⚠ Caution : There are some actuators that are not applicable to the origin reversed type. Check further on the catalog or the Instruction Manual of the actuator.

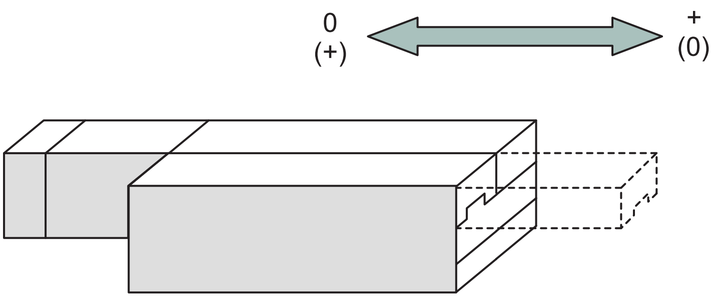
(1) Rod Type



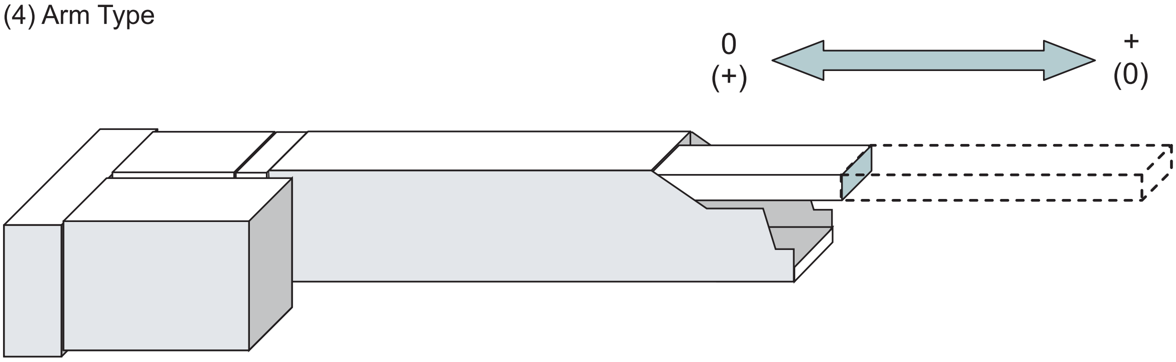
(2) Slider Type



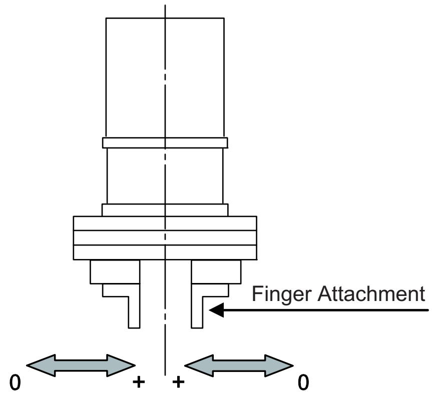
(3) Flat Type



(4) Arm Type

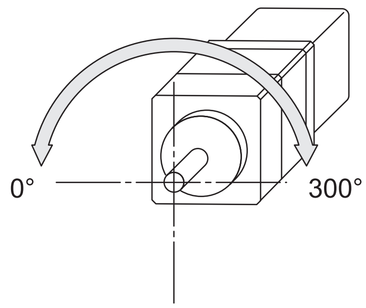


(5) Gripper Type

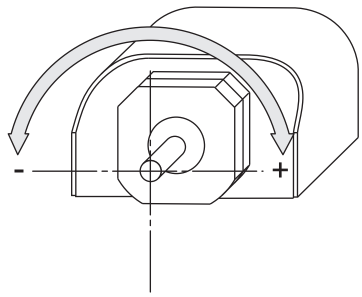


(6) Rotary Type

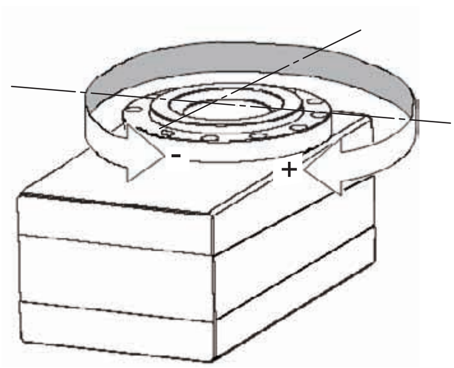
(300° Rotation Specification)



(360° Rotation Specification)



(360° Rotation Specification)



For Multiple Rotation Type with the origin reversed type, the directions of + and – are the other way around.

Starting Procedures

1. Positioner Mode

When using this product for the first time, make sure to avoid mistakes and incorrect wiring by referring to the procedure below. “PC” stated in this section means “PC software”.

Check of Packed Items
Are there all the delivered items?

No → Contact us or our distributor.

↓ Yes

Installation and Wiring [Refer to Chapter 1, 2.1, 2.3]
Perform the installation of and wiring for the actuator and controller.

→ **Point Check Item**
- Is frame ground (FG) connected?
- Has the noise countermeasure been taken?

←Yes

Operation Mode Setting [Refer to 3.2]
Set the operation mode based on the operation mode and major function.

↓

Power Supply and Alarm Check
Connect a teaching tool such as PC, turn the operation mode setting switch to “MANU” side and turn the power ON for each unit.
Select [Teaching Mode 1 Safety Speed Activated / PIO Operation Invalid] in the teaching tool such as PC.

→ **Check Item**
Is the orange light [ALM] on the LED status display OFF?

No → Connect the teaching tool such as PC to confirm the content of alarm and have an appropriate treatment.

↓ Yes

Safety Speed Setting
Set the Parameter No.35 if necessary.
The safety speed is set to 100mm/s at the delivery.

Servo ON
Turn the servo ON with the operation on the teaching tool such as PC.

→ **Check Item**
Is the green light [SV] on the LED status display ON?

No → If an alarm is generated, connect the PC or teaching pendant and check the content of the alarm to have the right treatment.

↓ Yes

⚠ Caution
Please perform this process with the actuator away from the mechanical end or interfering subjects as much as possible.
Put the actuator away if it interferes with surroundings. It may generate an alarm if the actuator hit the mechanical end or interfering subjects when the servo is turned ON.
The slider may get slightly dropped by self-weight if servo ON and OFF is repeatedly performed at the same position. Be careful not to pinch the hand or damage the work.

Safety Circuit Check
Does the emergency stop circuit (drive cutoff circuit) work properly and turn the servo OFF?

No → Check the emergency stop circuit.

↓ Yes

Target Position Setting
Set the target position in “Position” Box in each position table.
Perform a home-return operation first when Direct Teaching is to be performed. When moving the actuator manually, set the Brake Release Switch to “BK RLS” side for the brake equipped type. Put the switch back after the setting is complete.

⚠ Warning : In the case the actuator is installed in vertical orientation and put the brake release switch to [BK RLS] side, be careful not to drop it with self-weight and pinch your hand or damage the work.

↓ ⚠ Caution To ensure safety, it is recommended that safety speed be enabled during initial movements.

Test Run Adjustment 1
Check the operation without mounting a work and set the safety speed invalid on the teaching tool such as PC, and then check the operation with a work mounted.

→ **Check Item**
Any vibration or abnormal noise?

No → Check if there is any problem with the installation of the actuator and the condition of the actuator use exceeds the ranges of the rated values.
Adjust the servo if necessary.

↓ Yes

Check Item
Use the pressing operation using force sensor?

Yes→ **Initial Setting for Pressing Operation Using Force Sensor [Refer to 3.2.7]**
Perform the initial settings such as the loadcell calibration.

←No

Test Run Adjustment 2
1) Set the operation mode setting switch to “AUTO”.
2) Output the operation command from PLC to the controller and check the system operation.

2. Pulse Train Control Mode

This product is capable for the positioning control using the pulse train of IAI actuators.
It is necessary to have the positioning control function able to output the pulse train on the host controller (PLC).
When using this product for the first time, make sure to avoid mistakes and incorrect wiring by referring to the procedure below. “PC” stated in this section means “PC software”.

Check of Packed Items
Are there all the delivered items?

No → Contact us or our distributor.

↓ Yes

Installation and Wiring [Refer to Chapter 1, 2.2, 2.3]
Perform the installation of and wiring for the actuator and controller.

→ **Point Check Item**
- Is frame ground (FG) connected?
- Has the noise countermeasure been taken?

←Yes

Power Supply and Alarm Check
Connect a teaching tool such as PC, turn the operation mode setting switch to “MANU” side and turn the power ON for each unit.
Select [Teaching Mode 1 Safety Speed Activated / PIO Operation Invalid] in the teaching tool such as PC.

→ **Check Item**
Is the orange light [ALM] on the LED status display OFF?

No → Connect the teaching tool such as PC to confirm the content of alarm and have an appropriate treatment.

↓ Yes

Set the Electronic Gear [Refer to 3.3.4 [1]]
Set the electronic gear ratio based on the amount of actuator operation per pulse in Parameters No.65 and 66.

→ **Check Item**
Is the minimum unit of operation set to the value bigger than the minimum resolution of the encoder?
Is the fraction of the electronic gear ratio reduced to its lowest terms?

←Yes

Pulse Train Input Output Mode Setting [Refer to 3.3.4 [2]]
Input set the command pulse train input status for the parameter No.63 and No.64.
For the output, set the feedback pulse train output form using the parameters No.68, 69 and 70.
Put Operation Mode Setting Switch to “AUTO” side when the setting is complete.

Servo ON
Input servo ON signal from PLC.

→ **Check Item**
Is the green light [SV] on the LED status display ON?

No → Confirm the content of alarm on the teaching tool such as PC to have an appropriate treatment.

←Yes

Safety Circuit Check
Check that the emergency stop circuit (or motor drive-power cutoff circuit) operates normally to turn OFF the servo.

No → Check the emergency stop circuit.

↓ Yes

Test Run Adjustment 1
[Operation Mode MANU]
Check the operation without mounting a work and set the safety speed invalid on the teaching tool such as PC, and then check the operation with a work mounted.

→ **Check Item**
Any vibration or abnormal noise?

No → Check the actuator if it is installed properly, the condition for use is below the rated values, etc.
Adjust the servo if necessary.

↓ Yes

Test Run Adjustment 2
[Operation Mode AUTO]
Output the pulse train from PLC to the controller and check the system operation.

→ Can the positioning operation be performed normally?

No → Check the electronic gear ratio setting.
Confirm the command pulse train input mode setting.

↓ Yes

Is it in condition without any vibration and abnormal noise?

No → Confirm that there is no problem in the actuator installation, the actuator operation condition demands a voltage more than rated voltage, and appropriate pulse trains are input.

↓ Yes

Test Run Adjustment 3
Check the system operation conducted by PLC.

Chapter 1 Specifications Check

1.1 Product Check

1.1.1 Parts

This product is comprised of the following parts if it is of standard configuration.
If you find any fault in the contained model or any missing parts, contacts us or our distributer.

No.	Part Name	Model	Remarks
1	Controller	Refer to “How to read the model plate”, “How to read the model of the controller”.	
Accessories			
2	I/O Flat cable	CB-PAC-PIO***	***shows the cable length (Example) *** : 020 = 2 [m]
3	Service Connector for Pulse Train Control	Plug : 10114-3000PE (Supplier : 3M) Shell : 10314-52F0-008 (Supplier : 3M)	
4	System I/O Plug	FMC1.5/4-ST-3.5 (Supplier : Phoenix Contact)	AWG16 to 20 (1.25 to 0.5mm^2)
5	Brake Power Supply Plug	MC1.5/2-ST-3.5 (Supplier : Phoenix Contact)	
6	AC Power Supply Plug	MSTB2.5/6-STF-5.08 (Supplier : Phoenix Contact)	
7	Absolute Battery	AB-5	For absolute type
8	First Step Guide		
9	Instruction Manual (CD/DVD)		
10	Safety Guide		

1.1.2 Teaching Tool

A teaching tool such as PC software is necessary when performing the setup for position setting, parameter setting, etc. that can only be done on the teaching tool.
Please prepare either of the following teaching tools such as PC software.

No.	Part Name	Model
1	PC Software (Includes RS232C Exchange Adapter + Peripheral Communication Cable)	RCM-101-MW
2	PC Software (Includes USB Exchange Adapter + USB Cable + Peripheral Communication Cable)	RCM-101-USB
3	Touch Panel Teaching	CON-PTA
4	Touch Panel Teaching (with deadman switch)	CON-PDA
5	Touch Panel Teaching (with deadman switch + TP adapter (RCB-LB-TG))	CON-PGA
6	Teaching Pendant	CON-T
7	Teaching Pendant (with deadman switch + TP adapter (RCB-LB-TG))	CON-TG
8	Touch Panel Teaching	CON-PT
9	Touch Panel Teaching (with deadman switch)	CON-PD
10	Touch Panel Teaching (with deadman switch + TP adapter (RCB-LB-TG))	CON-PG

1.1.3 Instruction manuals related to this product, which are contained in the instruction manual (CD/DVD).

No.	Name	Manual No.
1	SCON-CA Controller Instruction Manual	ME0243
2	PC Software RCM-101-MW/ RCM-101-USB Instruction Manual	ME0155
3	CON-PTA/PDA/PGA Instruction Manual	ME0295
4	Touch Panel Teaching CON-PT/PD/PG Instruction Manual	ME0227
5	Teaching Pendant CON-T/TG Instruction Manual	ME0178
6	DeviceNet (High Performance Type) Instruction Manual	ME0256
7	CC-Link (High Performance Type) Instruction Manual	ME0254
8	PROFIBUS-DP (High Performance Type) Instruction Manual	ME0258
9	CompoNet (High Performance Type) Instruction Manual	ME0220
10	MECHATROLINK (High Performance Type) Instruction Manual	ME0221
11	EtherCAT Instruction Manual	ME0273
12	EtherNet/IP Instruction Manual	ME0278
13	Instruction Manual for the serial communication [for Modbus]	ME0162
14	ROBONET Instruction Manual	ME0208

1.1.4 How to read the model plate

Model → MODEL SCON-CA-60A-NP-2-1

Serial number → SERIALNo. 800056144 L11 MADE IN JAPAN

1.1.5 How to read the model of the controller

SCON – CA - 20 I HA - NP - 2 - 2

<Series>

<Type>
- C : Standard type [Refer to each ME0202]
- CA : High Performance Type

<Actuator Characteristics>

[Motor Type]
- 20 : 20W
- 30D : 30W (Excluding RS)
- 30R : 30W (for RS)
- 60 : 60W
- 100 : 100W
- 100S : 100W (LSA)
- 150 : 150W
- 200 : 200W
- 200S : 200W (LSA)
- 300S : 300W (LSA)
- 400 : 400W
- 600 : 600W
- 750 : 750W
- 750S : RCS2-RA13R with loadcell

[Encoder Type]
- I : Incremental
- A : Absolute

[Option]
- Not Indication : Standard Type
- HA : High Accel/Decel Type

<I/O Signal Pattern>
- NP : NPN Type (Sync. Type) (Standard)
- PN : PNP Type (Source Type)
- DV : DeviceNet Connection Type
- CC : CC-Link Connection Type
- PR : PROFIBUS Connection Type
- CN : CompoNet Connection Type
- ML : MECHATROLINK Connection Type
- EC : EtherCAT Connection Type
- EP : EtherNet/IP Connection Type

<I/O Cable Length>
- 0 : Equipped with no cable
- 2 : 2m (Standard)
- 3 : 3m 5 : 5m

<Power-supply Voltage>
- 1 : Single-phase 100V AC
- 2 : Single-phase 200V AC

1.2 Basic Specifications

1.2.1 Specifications

Item		Less than 400W	400W or more(Note 4)
Corresponding Motor		20W to 399W	400W to 750W
Power-supply Voltage		Single-Phase 100 to 115V AC ±10% Single-Phase 200 to 230V AC ±10%	Single-Phase 200 to 230V AC ±10%
Rush Current(Note 1)	Power-supply Voltage 100V AC	20A (Controller side), 70A (Drive side)	
	Power-supply Voltage 200V AC		20A (Controller side), 80A (Drive side)
Load Capacity		Refer to Power Capacity and Heat Generation	
Leak Current(Note 2)		3.0mA Primary side when noise filter is connected to power supply line	
Heat Generation		Refer to Power Capacity and Heat Generation	
Power Supply Frequency		50/60Hz	
PIO Power Supply(Note 3)		24V DC ±10%	
Power Supply for Electromagnetic Brake (for actuator equipped with brake)		24V DC ±10% 1A (MAX.) (supplied from external equipment)	
Transient Power Cutoff Durability		20ms (50Hz), 16ms (60Hz)	
Motor Control System		Sine Wave PWM Vector Current Control	
Corresponding Encoder		Incremental Serial Encoder Absolute Serial Encoder ABZ (UVW) Parallel Encoder	
Actuator Cable Length		MAX. 20m	
Serial Communication Interface (Teaching Port)		RS485 : 1CH (based on Modbus Protocol RTU/ASCII) Speed : 9.6 to 230.4Kbps Control available with serial communication in the modes other than the pulse train (Cable length MAX. 100m)	
External Interface	PIO Specifications	Signal I/O dedicated for 24V DC (selected from NPN/PNP) … Input 16 ports max., output 16 ports max. Cable length MAX. 10m	
	Fieldbus Specification	DeviceNet/CC-Link/PROFIBUS/CompoNet/MECHATROLINK/EtherCAT/EtherNet/IP … Each dedicated controller [Refer to each Fieldbus Instruction Manual]	
Data Setting and Input		PC Software, Touch Panel Teaching, Teaching Pendant	
Data Retention Memory		Saves position data and parameters to non-volatile memory (There is no limitation in number of writing)	
Operation Mode		Positioner Mode/Pulse Train Control Mode (selected by Pulse Train Mode Changeover Switch ON Front Panel)	
Number of Positions in Positioner Mode		Standard 64 points, MAX. 512 points (PIO Type), 768 points (only for Fieldbus Type) (Note) Number of positions differs depending on the selection in PIO pattern and fieldbus operation mode.	
Pulse Train Interface	Input Pulse	Differential System (Line Driver System) : MAX. 2.5Mpps Cable length MAX. 10m	
		Open Collector Type : MAX. 200Kpps (under condition AK-04 is used) Cable length MAX. 2m	
	Command Pulse Multiplying Factor (Electrical Gear : A/B)	1/50 < A/B < 50/1 Setting Range of A and B (set to parameter) : 1 to 4096	
	Feedback Pulse Output	Differential System (Line Driver System) : MAX. 2.5Mpps Cable length MAX. 10m	
		Open Collector Type : MAX. 500Kpps (under condition JM-08 is used) Cable length MAX. 2m	
LED Display (mounted on Front Panel)		PWR (green) : Controller in normal condition, SV (green) : Servo ON, ALM (orange) : Alarm generated, EMG (red) : Emergency Stop	
Electromagnetic Brake Compulsory Release Switch (mounted on Front Panel)		Switching NOM (standard)/BK RLS (compulsory release)	
Insulation Resistance		500V DC 10MΩ or more	
Insulation Strength		1500V AC for 1 min. (Note) Withstand voltage of pressing operation using force sensor loadcell is 50V DC	

Item		Less than 400W	400W or more(Note 4)
Weight		Approx. 900g	Approx. 1200g
Cooling Method		Natural Air-Cooling	Forced Air Cooling
External Dimensions		58W × 194H × 121D [mm]	72W × 194H × 121D [mm]
Environ-ment	Surrounding air temperature	0 to 40°C	
	Surrounding humidity	85%RH or less (non-condensing)	
	Surrounding environment	[Refer to Installation Environment]	
	Surrounding storage temperature	-10 to 65°C	
	Surrounding storage humidity	85%RH or less (non-condensing)	
	Usage Altitude	1000m or lower above sea level	
	Vibration Durability	XYZ Each direction 10 to 57Hz Pulsating amplitude 0.035mm (continuous) 0.075mm (intermittent) 57 to 150Hz 4.9m/s^2 (continuous) 9.8m/s^2 (intermittent)	
	Protection Class	IP20	

Note 1 In-rush current will flow for approximately 20ms after the power is turned ON (at 40°C).
Note that the value of in-rush current differs depending on the impedance of the power supply line.

Note 2 Leak current varies depending on the capacity of connected motor, cable length and the surrounding environment. Measure the leak current at the point where a ground fault circuit interrupter is to be installed when leakage protection is conducted.
A ground fault circuit interrupter needs to be selected carefully considering the purposes of prevention of fire and protection of human.
Use the harmonic type (for inverter) for the ground fault circuit interrupter.

Note 3 It is not necessary to supply power to PIO when operating with using ROBONET, Gateway Unit or SIO Converter without using PIO. In this case, set the parameter No.74 "PIO Power Supply Monitor" to "1" (Invalid). It will generate the error code No. 0CF "I/O 24V Power Supply Error" if the setting is not done.

Note 4 Some types of linear actuators require a controller of 400W or more even though the motor capacity is less than 400W.
[Refer to the list of the applicable controllers on the catalog.]

1.2.2 Power Capacity and Heat Generation

Rated Power Capacity = Motor Power Capacity + Control Power Capacity
Peek Max. Power Capacity = Peek Max. Motor Power Capacity + Control Power Capacity

Actuator Motor Wattage	Motor Power Capacity [VA]	Peek Max. Motor Power Capacity [VA]	Control Power Capacity [VA]	Rated Power Capacity [VA]	Peek Max. Power Capacity [VA]	Heat Generation [W]
20	26	78	48	74	126	30
30D (Excluding RS)	46	138		94	186	31
30R (for RS)	138	414		186	462	33
60	138	414		186	462	33
100	234	702		282	750	35
100S (LSA)	283	851		331	899	36
150	328	984		376	1032	37
200	421	1263		469	1311	38
200S (Excluding LSA-N15H)	486	1458		534	1506	38
200S (LSA-N15H)	773	2319		821	2367	56
300S (LSA)	662	1986		710	2034	40
400	920	2760		968	2808	45
600	1164	2328		1212	2376	56
750	1521	3042		1569	3090	58
750S		4563			4611	

RS : Rotary Shaft
LSA : Linear Actuator

1.2.3 Selection of Circuit Interrupter

For the selection of the circuit breaker, perform it according to the following items.

- 3 times of the rated current flows to the controller during the acceleration/deceleration. Select an interrupter that does not trip with this value of current. If a trip occurs, select an interrupter that possesses the rated current of one grade higher. (Check the operation characteristics curves in the product catalog.)
- Select an interrupter that does not trip with the in-rush current. (Check the operation characteristics curves in the product catalog.)
- Consider the current that enables to cutoff the current even when a short circuit current is flown for the rated cutoff current.
  Rated Interrupting Current > Short Circuit Current = Primary Power Capacity / Power Voltage
  Consider margin for the rated current on the circuit breaker.

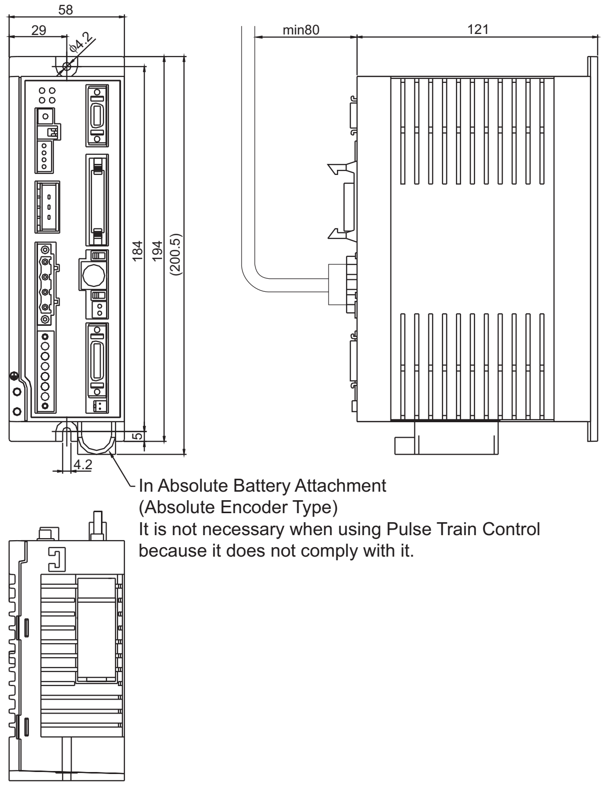
Rated Current for Circuit Interrupter > (Rated Motor Power Capacity [VA] + Control Power Capacity [VA]) / AC Input Voltage × Safety Margin (reference 1.2 to 1.4 times)

1.2.4 Selection of Leak Current Breaker

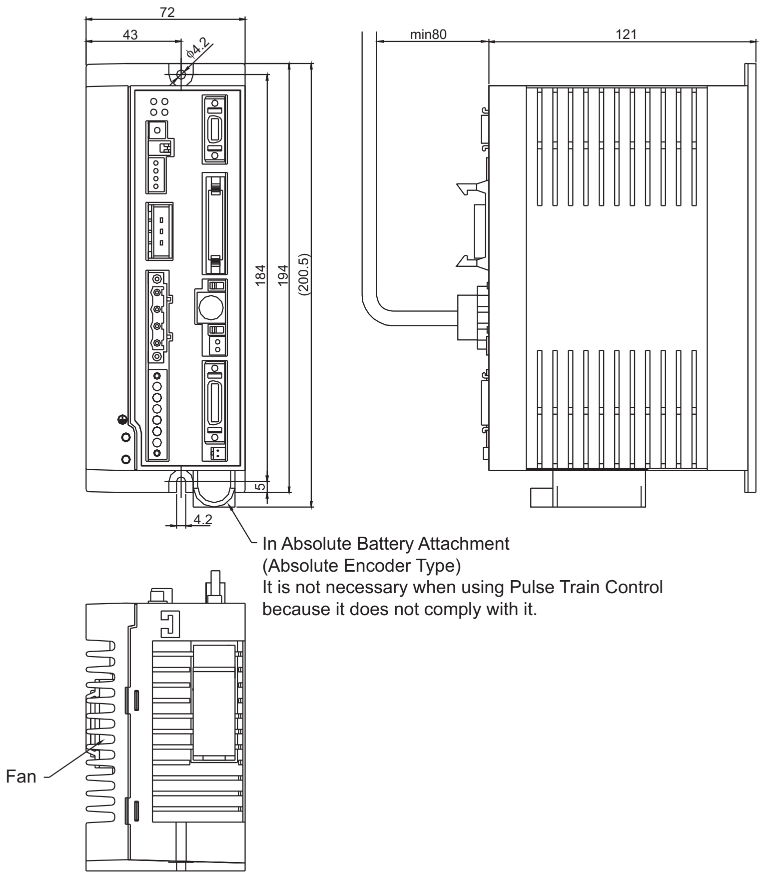
- A ground fault circuit interrupter needs to be selected carefully considering the purposes of prevention of fire and protection of human.
- Leak current varies depending on the capacity of connected motor, cable length and the surrounding environment. Measure the leak current at the point where a ground fault circuit interrupter is to be installed when leakage protection is conducted.
- Use the harmonic type (for inverter) for the ground fault circuit interrupter.

1.3 Appearance

1.3.1 Less than 400W

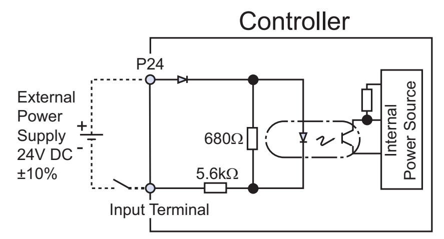
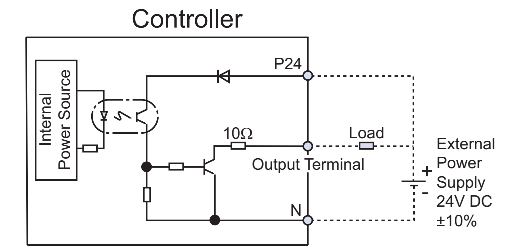
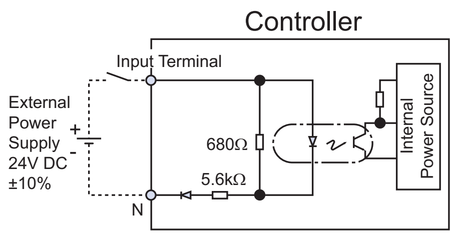
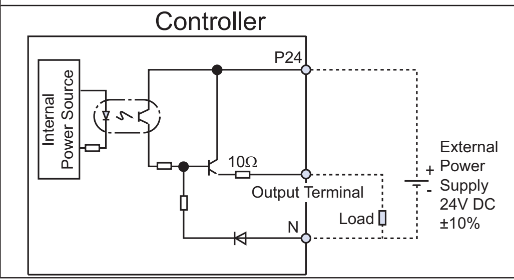


1.3.2 400W or more

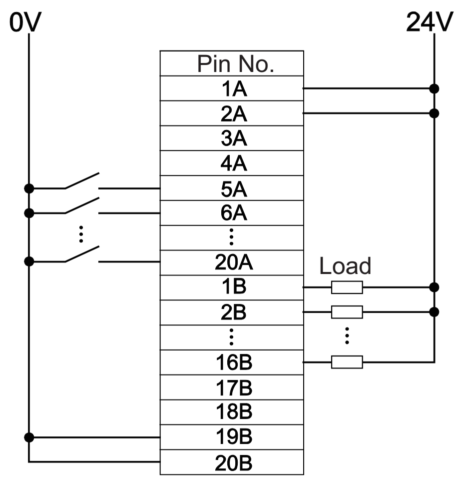


1.4 I/O Specifications

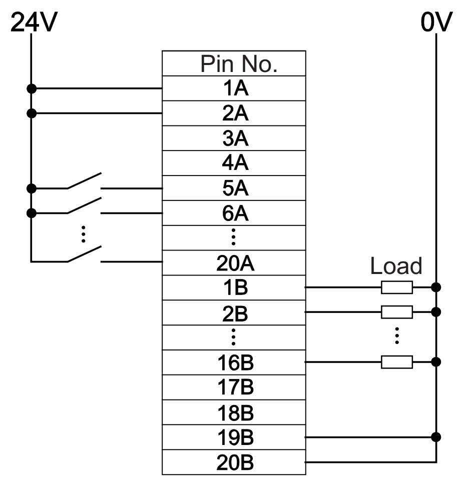
1.4.1 PIO Input and Output Interface

<table>
<tr><th></th><th colspan="2">Input Section</th><th colspan="2">Output Section</th></tr>
<tr><td rowspan="3">Specification</td><td>Input Voltage</td><td>24V DC ±10%</td><td>Load Voltage</td><td>24V DC</td></tr>
<tr><td>Input Current</td><td>4mA 1circuit</td><td>Peak Load Electric Current</td><td>100mA/1point
400mA/(Load current total)</td></tr>
<tr><td>ON/OFF Voltage</td><td>ON Voltage MIN. 18V DC
OFF Voltage MAX. 6V DC</td><td>Leakage Current</td><td>MAX. 0.1mA/1point</td></tr>
<tr><td>NPN</td><td colspan="2">
</td><td colspan="2">
</td></tr>
<tr><td>PNP</td><td colspan="2">
</td><td colspan="2">
</td></tr>
<tr><td>I/O Cable</td><td colspan="4">Refer to 2.1.3 [5] PIO Circuit</td></tr>
</table>

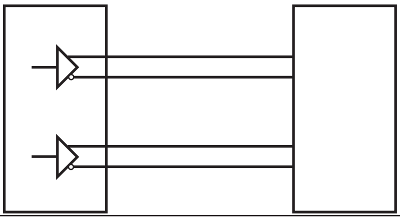
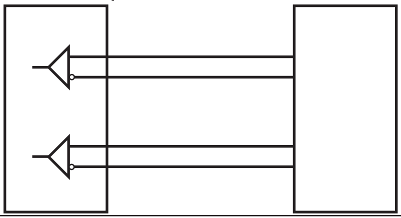
NPN Type



PNP Type



1.4.2 Pulse Train Input Output Interface

	Line Driver Input	Output
Specification	Input pulse equivalent to Line Driver 26C31 26C31 or equiv Controller 	Output pulse equivalent to Line Receiver 26C32 26C32 or equiv Controller 
Pulse Train Form	Including active high and active low	

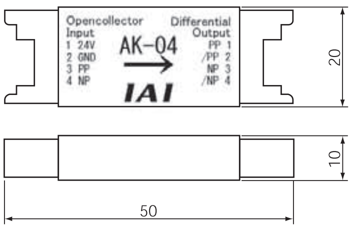
1.5 Options

1.5.1 Pulse converter : AK-04

The pulse converter converts command pulses in the open collector mode to those in the differential mode.

Use this converter if the host controller sends output pulses in the open collector mode.

Item	Specification
Input Power Supply	24V DC ±10% (MAX. 50mA)
Input Pulse	O/C (Collector current MAX. 12mA)
Input Frequency	200KHz or less
Output Pulse	Differential output equivalent to 26C31 (MAX. 10mA)
Mass	10g or less (excluding cable connector)
Accessories	37104-3122-000FL (e-CON Connector) 2 Units Cover Color : YW Applicable wire AWG No.24 to 26 (Less than 0.14 to 0.3mm^2, finished O.D. ϕ1.0 to 1.2mm)



⚠ Caution

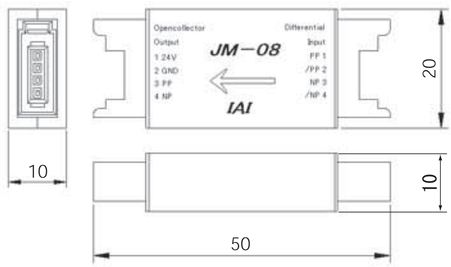
1) Use the pulse converter in the ambient temperature range between 0°C and 40°C.
2) The temperature increase of about 30°C occurs during operation. Accordingly, neither install several pulse converters in close contact nor install them within a duct. Do not install the pulse converter near other heating devices.
3) If more than one pulse converter is installed, set a pulse converter apart from another by 10mm or more.

1.5.2 Pulse converter : JM-08

The pulse converter converts feedback pulses in the differential mode into those in the open collector mode.
Use this converter if the host controller sends input pulses in the open collector mode.

[Specification]

Item	Specification
Input Power Supply	24V DC ±10% (MAX. 50mA)
Input Pulse	Differential output equivalent to 26C32 (MAX. 10mA)
Input Frequency	500KHz or less
Output Pulse	24V DC O/C (Collector current MAX. 25mA)
Mass	10g or less (excluding cable connector)
Accessories	37104-3122-000FL (e-CON Connector) 2 Units Applicable wire AWG No.24 to 26 (Less than 0.14 to 0.3mm^2, finished O.D. ϕ1.0 to 1.2mm)



External Dimensions

⚠ Caution

1) Use the pulse converter in the ambient temperature range between 0°C and 40°C.
2) The temperature increase of about 30°C occurs during operation. Accordingly, neither install several pulse converters in close contact nor install them within a duct. Do not install the pulse converter near other heating devices.
3) If more than one pulse converter is installed, set a pulse converter apart from another by 10mm or more.

1.5.3 Regenerative Unit : REU-1, REU-2 (Option)

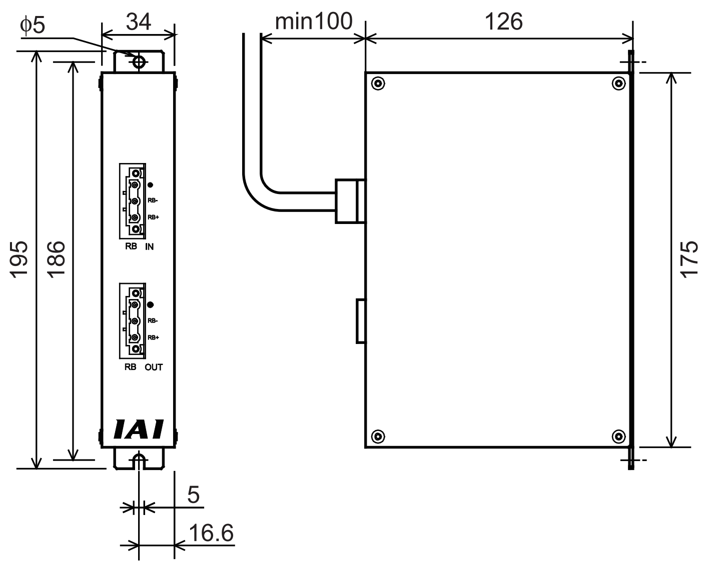
This is a unit that converts the regenerative current to heat when the motor decelerates.

[Specification]

Item		Specification
Body Size		W34mm × H195mm × D126mm
Body Weight		0.9kg
Internal Regenerative Resistor		235Ω 80W
Accessories	REU-1 (Note)	Controller Connection Cable (Model Code CB-ST-REU010) 1m
	REU-2	Controller Connection Cable (Model Code CB-SC-REU010) 1m

Note : REU-1 is used as the second and following units when more than one regeneration unit is used.

[Appearance]



[Connectable Quantity]

Motor Output		Connectable Number of Regenerative Units
Horizontal Mount	Vertical Mount	
to 99W		Not Required
100 to 399W		1
400 to 750W		2

⚠ Caution : 1. This is a reference for the case when the actuator is ran forward and backward on 1,000mm stroke with the operation duty 50% under the rated acceleration/deceleration speed and rated load.

2. Regenerative energy is absorbed inside the controller and when it exceeds the limit, Error Code 0CA “Overheat Error” is generated. Add an external regenerative unit if this occurs.
It is necessary to have the regenerative resistor listed above when the operation duty is above 50%. The maximum quantity of the external regenerative resistor units that can be connected is as stated below:
Less than 400W • • • 2 units
400W or more • • • 4 units
(Do not connect regenerative units over the number of units specified above. Failure to follow this may cause some failure to occur.)

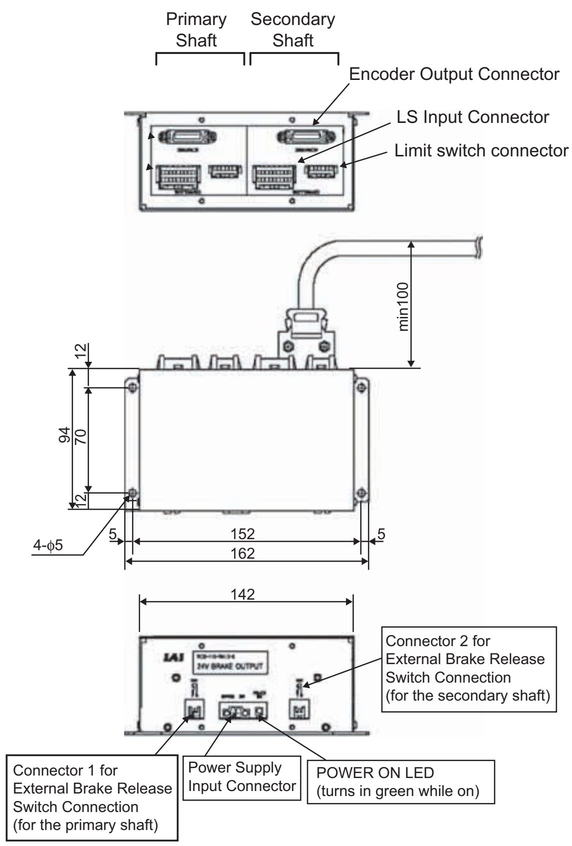
1.5.4 Brake Box : RCB-110-RA13-0 (Option)

1 unit of Brake Box possesses brakes for 2 shafts.

[Specification]

Item	Specification
Body Size	162 × 94 × 65.5mm
Power Voltage and Current	24V DC ±10% 1A
Connection Cable	Encoder Cable (Model Code CB-RCS2-PLA010) 1m
Number of Controlled Axes	2

[Appearance]



[24V Power Supply Connector]

Connector on Cable Side (Enclosed in standard package)	MC1.5/2-STF-3.5 (Phoenix Contact)		
Applicable Cable	AWG28 to 16		
Terminal Assignment	Pin No.	Signal	Explanation
	1	0V	Power Supply Grounding for Terminal Brake Excitation
	2	24VIN	For Brake Excitation and 24V Power Supply

[Connectors 1 and 2 for external brake release switch connection]

Short circuit of pin No. 1 and 2 of this connector releases the brake compulsorily.
Same as the brake release switch ON controller unit, it is possible to release the brake.
Do not keep the compulsory release condition while in automatic operation.

Connected Equipment	Brake Release Switch		
Connector on Cable Side (Please prepare separately)	XAP-02V-1 (Contact BXA-001T-P0.6) (JST)		
Switch Rating	30V DC Minimum Current 1.5mA		
Terminal Assignment	Pin No.	Signal	Explanation
	1	BKMRL	Brake Release Switch Input
	2	COM	Power Supply Output for Brake Release Switch Input

1.5.5 Loadcell (Option)

This is the pressing force detection unit that is used for the pressing operation using force sensor. This is used by connecting to the actuator corresponding to the pressing operation using force sensor.

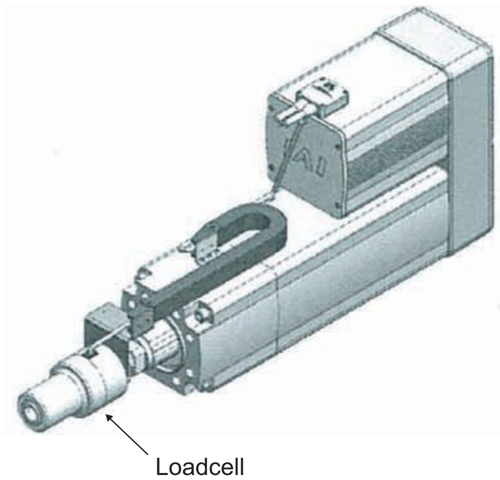
[Specification]

Item		Specification
Loadcell System		Strain Gauge
Rated Capacity		20000N
Allowable Overload		200%R.C* An alarm occurs if: Pressing force exceeds 150% of R.C*. Tensile force exceeds 25% of R.C*.
Lordcell Accuracy		±1%R.C*
Temperature drift	Zero	±0.2%R.C* /10°C
	Output	±0.1%R.C* /10°C
Ambient temperature range		0 to 40°C
Dielectric strength voltage		50V DC

* R.C : Rated Capacity

[Installation Drawing]

Installation of loadcell on RCS2-RA13R



Check the Instruction Manual for details of how to attach and the dimensions.

⚠Caution :
1) Do not give excess shock (caused by dropping it, etc.) to the loadcell. Failure to follow it may cause the loadcell to be damaged.
2) The life of the loadcell is about two million pressing operation.

1.6 Installation and Storage Environment

This product is capable for use in the environment of pollution degree 2*1 or equivalent.
*1 Pollution Degree 2 : Environment that may cause non-conductive pollution or transient conductive pollution by frost (IEC60664-1)

[1] Installation Environment

Do not use this product in the following environment.

- Location where the surrounding air temperature exceeds the range of 0 to 40°C
- Location where condensation occurs due to abrupt temperature changes
- Location where relative humidity exceeds 85%RH
- Location exposed to corrosive gases or combustible gases
- Location exposed to significant amount of dust, salt or iron powder
- Location subject to direct vibration or impact
- Location exposed to direct sunlight
- Location where the product may come in contact with water, oil or chemical droplets
- Environment that blocks the air vent [Refer to 1.7 Noise Elimination and Mounting Method]

When using the product in any of the locations specified below, provide a sufficient shield.

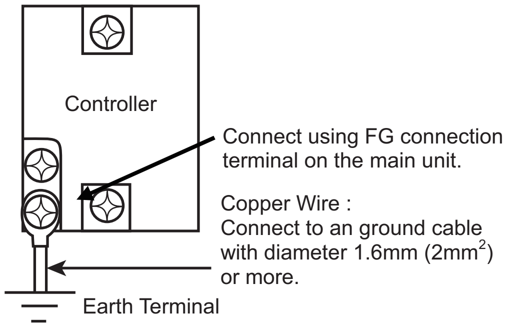
- Location subject to electrostatic noise
- Location where high electrical or magnetic field is present
- Location with the mains or power lines passing nearby

[2] Storage Environment

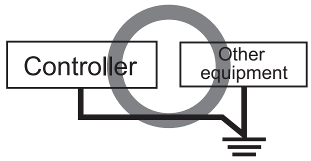
- Storage environment follows the installation environment. Especially in a long-term storage, consider to avoid condensation of surrounding air.
  Unless specially specified, moisture absorbency protection is not included in the package when the machine is delivered. In the case that the machine is to be stored in an environment where dew condensation is anticipated, take the condensation preventive measures from outside of the entire package, or directly after opening the package.

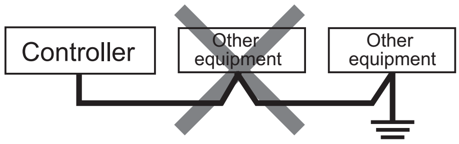
1.7 Noise Elimination and Mounting Method

(1) Noise Elimination Grounding (Frame Ground)



Class D grounding
(Formerly Class-III grounding :
Grounding resistance at 100Ωor less)

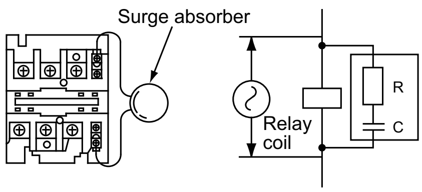


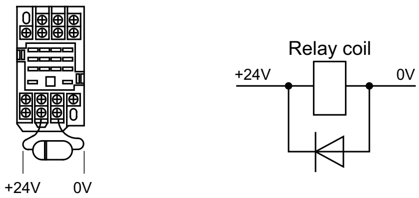


Do not share the ground wire with or connect to other equipment. Ground each controller.

(2) Precautions regarding wiring method
1) Wire is to be twisted for the power supply.
2) Separate the signal and encoder lines from the power supply and power lines.

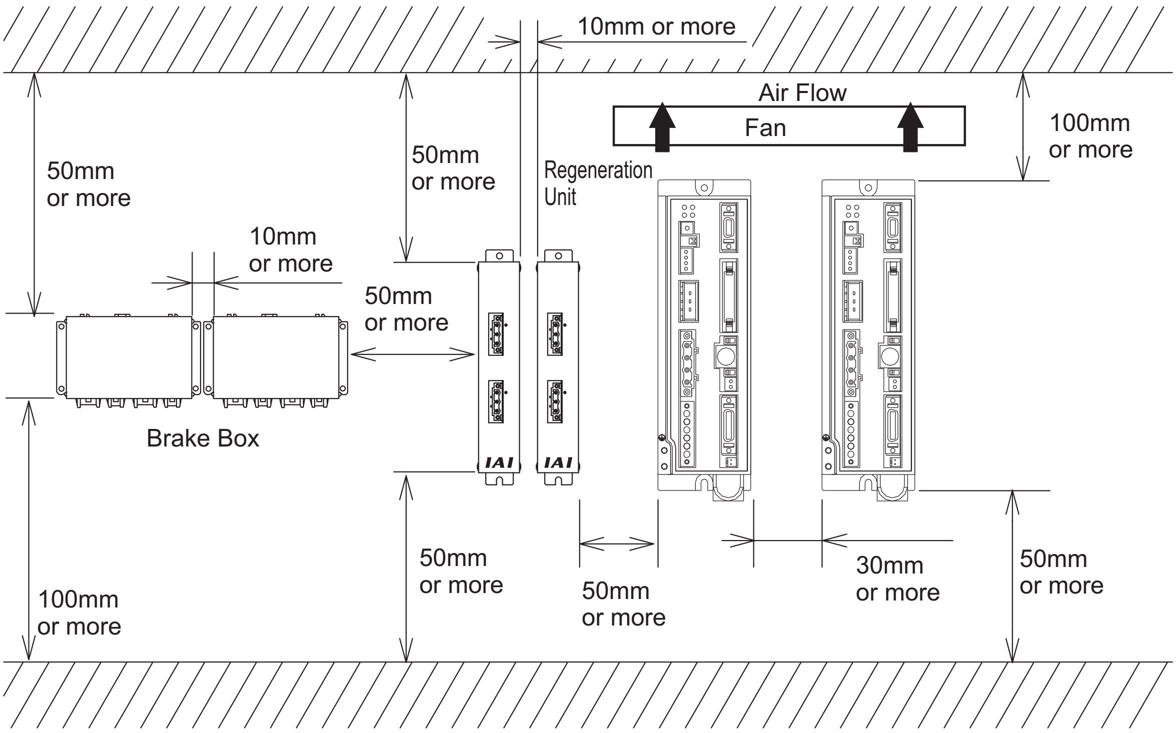
(3) Noise Sources and Elimination
Carry out noise elimination measures for electrical devices on the same power path and in the same equipment. The following are examples of measures to eliminate noise sources.
1) AC solenoid valves, magnet switches and relays
[Measure] Install a Surge absorber parallel with the coil.
2) DC solenoid valves, magnet switches and relays
[Measure] Mount the windings and diodes in parallel. Select a diode built-in type for the DC relay

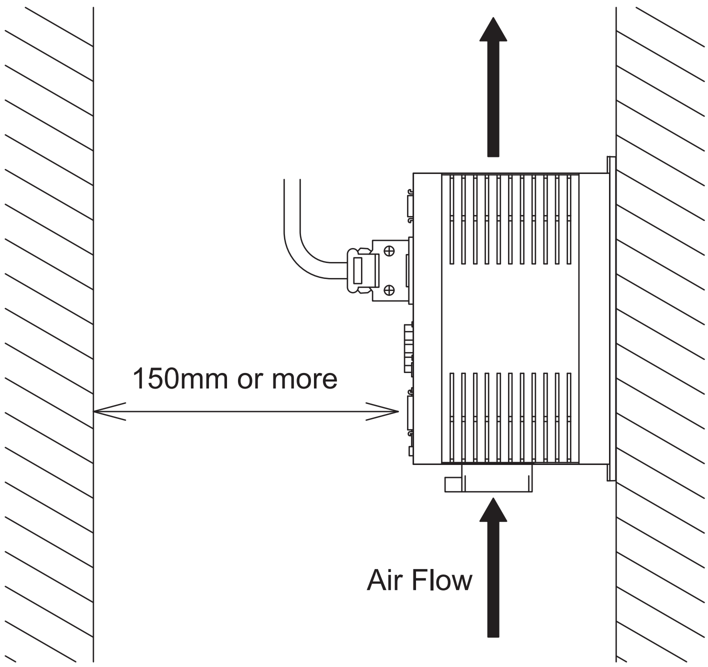




(4) Heat Radiation and Installation

Design and Build the system considering the size of the controller box, location of the controller and cooling factors to keep the ambient temperature around the controller below 40°C





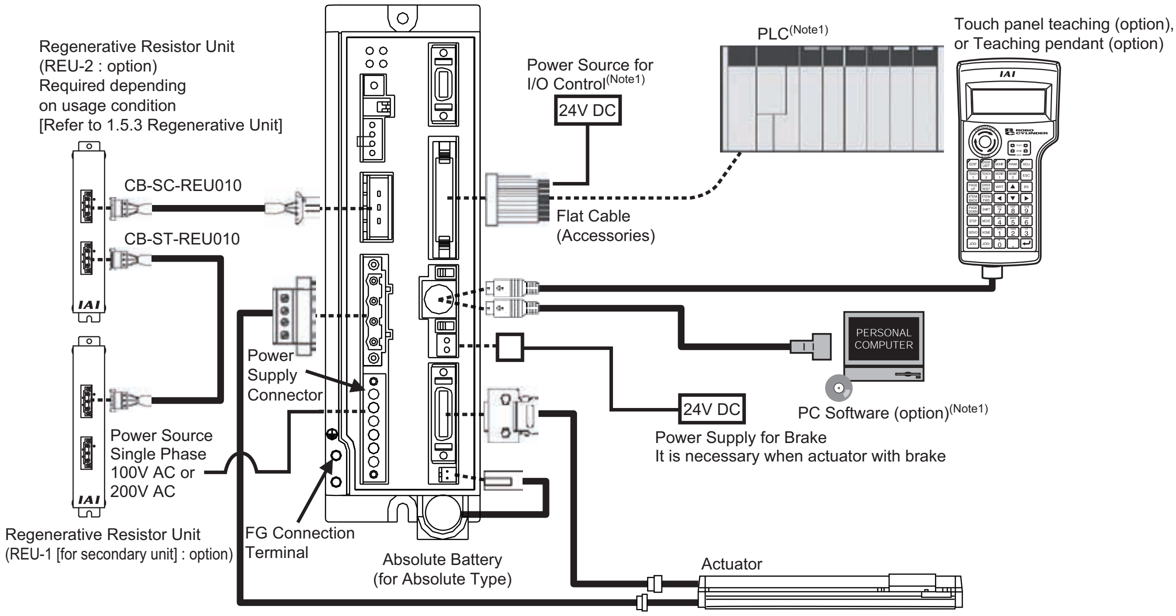
Place a fan to make the ambient temperature even.

Chapter 2 Wiring

2.1 Positioner Mode (PIO Control)

2.1.1 Wiring Diagram (Connection of construction devices)

[1] Basic Wiring Diagram



Note 1 Please prepare separately.

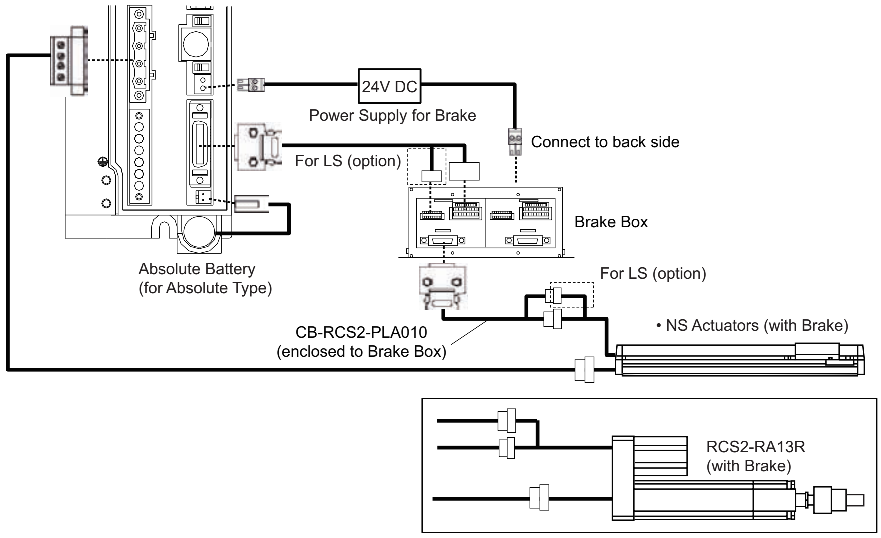
If using RCS-RA13R or NS Type for the actuator and the option shown in the table is applied, the wiring between the actuator and the controller will differ from the basic wiring layout. Shown in the table is the relation of the option and wiring layout.

Model Name	Option		Wiring Layout between Actuator and Controller
	Brake	Loadcell	
RS-RA13R	○	×	(1)
	×	○	(2)
	○	○	(3)
	×	×	Basic Wiring Diagram
NS	○	-	(1)
	×	-	Basic Wiring Diagram

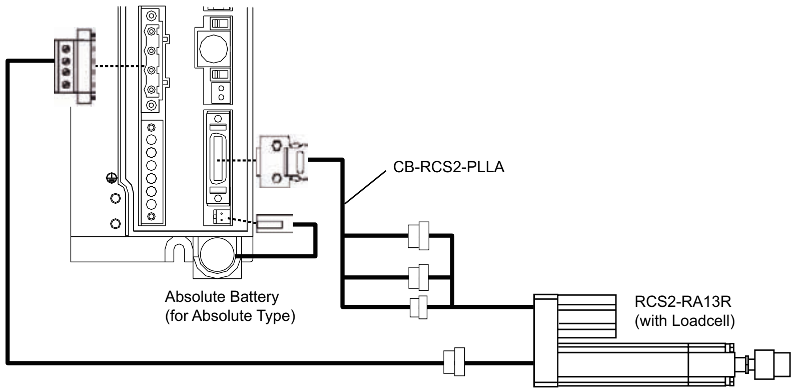
⚠ Caution : Turn OFF the power to the controller before inserting or removing the connector for connection between the teaching tool and controller.
Inserting or removing the connector while the power is turned ON causes a controller failure.

[2] Wiring Layout for RCS-RA13R or NS Type with Option (between actuator and controller)

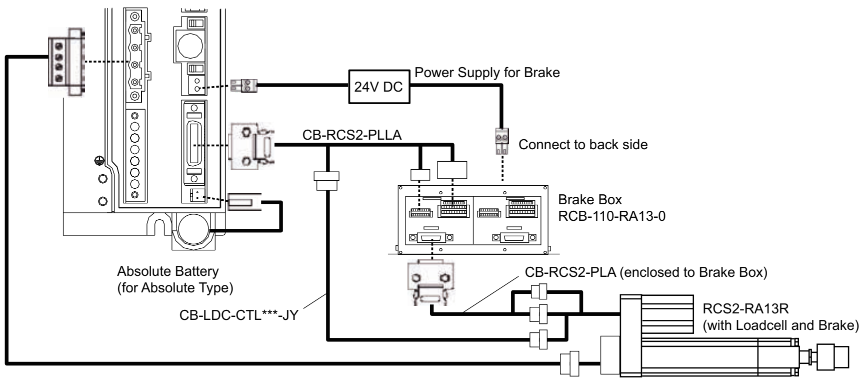
(1) RCS2-RA13R Equipped with Brake, with no Loadcell, or NS Actuators with Brake



(2) RCS2-RA13R Equipped with no Brake, with Loadcell



(3) RCS2-RA13R Equipped with Brake and Loadcell



2.1.2 PIO Pattern Selection and PIO Signal

(1) PIO Pattern (Control Pattern) Selection

The controller provides eight PIO patterns (control patterns). Set the most suitable PIO pattern with the actual use to Parameter No. 25 “PIO Pattern Select”.

Refer to “3.2 Operation in Positioner Mode” for the details of PIO patterns.

Type	Value set in parameter No. 25	Mode	Overview
PIO Pattern 0	0 (at the delivery)	Positioning Mode (Standard Type)	• Number of positioning points : 64 points • Position command : binary code • Zone signal output*1 : 1 point • Position zone signal output*2 : 1 point
PIO Pattern 1	1	Teaching mode (Teaching type)	• Number of positioning points : 64 points • Position command : binary code • Position zone signal output*2 : 1 point • Jog operation enabled by PIO signal • Writing current position data to position table enabled by PIO signal
PIO Pattern 2	2	256-point mode (Number of positioning points : 256-point type)	• Number of positioning points : 256 points • Position command : binary code • Position zone signal output*2 : 1 point
PIO Pattern 3	3	512-point mode (Number of positioning points : 512-point type)	• Number of positioning points : 512 points • Position command : binary code • Zone signal output : None
PIO Pattern 4	4	Solenoid Valve Mode 1 (7-point type)	• Number of positioning points : 7 points • Position command : Individual number signal ON • Zone signal output*1 : 1 point • Position zone signal output*2 : 1 point
PIO Pattern 5	5	Solenoid Valve Mode 2 (3-point type)	• Number of positioning points : 3 points • Position command : Individual number signal ON • Completion signal : Signal equivalent to LS (limit switch) enabled • Zone signal output*1 : 1 point • Position zone signal output*2 : 1 point
PIO Pattern 6	6	Pressing Operation Using Force Sensor Mode 1	• Number of positioning points : 32 points • Position command : binary code • Position zone signal output*2 : 1 point • Judgment of pressing force enabled
PIO Pattern 7	7	Pressing Operation Using Force Sensor Mode 2 (Solenoid Valve Type)	• Number of positioning points : 5 points • Position command : Individual number signal ON • Position zone signal output*2 : 1 point • Judgment of pressing force enabled

*1 Zone signal output : Set the zone range in parameter No.1 and 2. The signal is always effective after home return is completed.

*2 Position zone signal output : This feature is associated with the specified position number. The zone range is set in the position table. The zone range is enabled only when the position is specified but disabled if another position is specified.
Position Zone Signal can be changed to Zone Signal in Parameter No.149.

(2) PIO Patterns and Signal Assignment

The signal assignment of I/O flat cable by the PIO pattern is as shown below. Follow the following table to connect the external equipment (such as PLC).

Pin No.	Category	PIO Functions	Parameter No.25 (PIO Pattern) Selection			
			0	1	2	3
			Positioning Mode	Teaching mode	256-point mode	512-point mode
	Input	Number of positioning points	64 points	64 points	256 points	512 points
		Home return signal	○	○	○	○
		Jog Signal	×	○	×	×
		Teaching Signal (Current Position Writing)	×	○	×	×
		Brake Release	○	×	○	○
	Output	Moving Signal	○	○	×	×
		Zone Signal	○	(○) (Note1)	(○) (Note1)	×
		Position zone signal	○	○	○	×
1A	24V	P24				
2A	24V	P24				
3A	–	–				
4A	–	–				
5A	Input	IN0	PC1	PC1	PC1	PC1
6A		IN1	PC2	PC2	PC2	PC2
7A		IN2	PC4	PC4	PC4	PC4
8A		IN3	PC8	PC8	PC8	PC8
9A		IN4	PC16	PC16	PC16	PC16
10A		IN5	PC32	PC32	PC32	PC32
11A		IN6	–	MODE	PC64	PC64
12A		IN7	–	JISL	PC128	P128
13A		IN8	–	JOG+	–	PC256
14A		IN9	BKRL	JOG-	BKRL	BKRL
15A		IN10	RMOD	RMOD	RMOD	RMOD
16A		IN11	HOME	HOME	HOME	HOME
17A		IN12	*STP	*STP	*STP	*STP
18A		IN13	CSTR	CSTR/PWRT	CSTR	CSTR
19A		IN14	RES	RES	RES	RES
20A		IN15	SON	SON	SON	SON
1B	Output	OUT0	PM1	PM1	PM1	PM1
2B		OUT1	PM2	PM2	PM2	PM2
3B		OUT2	PM4	PM4	PM4	PM4
4B		OUT3	PM8	PM8	PM8	PM8
5B		OUT4	PM16	PM16	PM16	PM16
6B		OUT5	PM32	PM32	PM32	PM32
7B		OUT6	MOVE	MOVE	PM64	PM64
8B		OUT7	ZONE1	MODES	PM128	PM128
9B		OUT8 (Note1)	PZONE/ZONE2	PZONE/ZONE1	PZONE/ZONE1	PM256
10B		OUT9	RMDS	RMDS	RMDS	RMDS
11B		OUT10	HEND	HEND	HEND	HEND
12B		OUT11	PEND	PEND/WEND	PEND	PEND
13B		OUT12	SV	SV	SV	SV
14B		OUT13	*EMGS	*EMGS	*EMGS	*EMGS
15B		OUT14	*ALM	*ALM	*ALM	*ALM
16B		OUT15	*BALM	*BALM	*BALM	*BALM
17B	–	–				
18B	–	–				
19B	0V	N				
20B	0V	N				

(Note) "*" in codes above shows the signal of the active low.
PM1 to PM8 indicate the alarm binary code output signal when an alarm is generated. [Refer to 3.2.3 [7] Binary Alarm]

(Note 1) PZONE can be switched over to ZONE with the setting of Parameter No.149 except for PIO Pattern 3.

(Reference) Signal of Active Low

Signal with "*" expresses the signal of active low. A signal of active low is a signal that the input signal is processed when it is turned OFF, output signal is ordinary on while the power is ON, and turns OFF when the signal is output.

Pin No.	Category	PIO Functions	Parameter No.25 (PIO Pattern) Selection			
			4	5	6	7
			Solenoid Valve Mode 1	Solenoid Valve Mode 2	Pressing Operation Using Force Sensor Mode 1	Pressing Operation Using Force Sensor Mode 2
	Input	Number of positioning points	7 points	3 points	32 points	5 points
		Home return signal	○	×	○	○
		Jog Signal	×	×	×	×
		Teaching Signal (Current Position Writing)	×	×	×	×
		Brake Release	○	○	○	○
	Output	Moving Signal	×	×	×	×
		Zone Signal	○	○	(○) (Note1)	(○) (Note1)
		Position zone signal	○	○	○	○
1A	24V	P24				
2A	24V	P24				
3A	–	–				
4A	–	–				
5A	Input	IN0	ST0	ST0	PC1	ST0
6A		IN1	ST1	ST1 (JOG+)	PC2	ST1
7A		IN2	ST2	ST2(Note2)	PC4	ST2
8A		IN3	ST3	–	PC8	ST3
9A		IN4	ST4	–	PC16	ST4
10A		IN5	ST5	–	–	–
11A		IN6	ST6	–	–	–
12A		IN7	–	–	–	–
13A		IN8	–	–	CLBR	CLBR
14A		IN9	BKRL	BKRL	BKRL	BKRL
15A		IN10	RMOD	RMOD	RMOD	RMOD
16A		IN11	HOME	–	HOME	HOME
17A		IN12	*STP	–	*STP	*STP
18A		IN13	–	–	CSTR	–
19A		IN14	RES	RES	RES	RES
20A		IN15	SON	SON	SON	SON
1B	Output	OUT0	PE0	LS0	PM1	PE0
2B		OUT1	PE1	LS1 (TRQS)	PM2	PE1
3B		OUT2	PE2	LS2(Note2)	PM4	PE2
4B		OUT3	PE3	–	PM8	PE3
5B		OUT4	PE4	–	PM16	PE4
6B		OUT5	PE5	–	TRQS	TRQS
7B		OUT6	PE6	–	LOAD	LOAD
8B		OUT7	ZONE1	ZONE1	CEND	CEND
9B		OUT8(Note1)	PZONE/ZONE2	PZONE/ZONE2	PZONE/ZONE1	PZONE/ZONE1
10B		OUT9	RMDS	RMDS	RMDS	RMDS
11B		OUT10	HEND	HEND	HEND	HEND
12B		OUT11	PEND	–	PEND	PEND
13B		OUT12	SV	SV	SV	SV
14B		OUT13	*EMGS	*EMGS	*EMGS	*EMGS
15B		OUT14	*ALM	*ALM	*ALM	*ALM
16B		OUT15	*BALM	*BALM	*BALM	*BALM
17B	–	–				
18B	–	–				
19B	0V	N				
20B	0V	N				

(Note) Shown in ( ) after the signal names above tell the functions performed before the home-return operation. “*” in codes above shows the signal of the active low.
PM1 to PM8 indicate the alarm binary code output signal when an alarm is generated. [Refer to 3.2.3 [7] Binary Alarm]

(Note 1) PZONE can be switched over to ZONE with the setting of Parameter No.149 except for PIO Pattern 3.
(Note 2) It is invalid before home-return operation.

(3) List of PIO Signals

The table below lists the functions of PIO signals. Refer to the section shown in Relevant Sections for the details of the control of each signal.

Category	Signal Abbreviation	Signal Name	Function Description	Relevant Sections
Input	CSTR	PTP Strobe (Start Signal)	The actuator will start to move to the position set by the command position number.	3.2.4
	PC1 to PC256	Command Position Number	Input (in binary) a number of the position that is desired to move.	3.2.4
	BKRL	Brake Forcible Release	The brake will forcibly be released.	3.2.3
	RMOD	Operation Mode Changeover	The operating mode is selectable when the MODE switch of the controller is set to AUTO. (The setting is AUTO when signal is OFF, and MANU when ON.)	3.2.3
	*STP	Pause	When this signal turns OFF while the actuator is moving, the actuator will decelerate to stop. The remaining movement is in a hold while the actuator is stopped and will resume when the signal turns back ON.	3.2.4 3.2.5
	RES	Reset	An alarm will be reset when this signal is turned ON. Also, when it is turned ON in the pause mode (*STP is turned OFF), the remaining movement amount can be cancelled.	3.2.3 3.2.4 3.2.5
	SON	Servo ON	The servo remains ON while this signal is ON, or OFF while this signal is OFF.	3.2.3
	HOME	Home return	The controller will perform home return operation when this signal is turned ON	3.2.3
	MODE	Teaching mode	The operating mode will change to the teaching mode when this signal is turned ON. The mode will not be switched over unless CSTR, JOG+ and JOG- are all OFF and the actuator operation is stopped.	3.2.4
	JISL	Jog/inching selector	Jog Operation can be performed with JOG+ and JOG- while this signal is OFF. Inching Operation is performed with JOG+ and JOG- when it is ON.	3.2.4
	JOG + JOG -	Jog	Jog Operation is performed to positive direction by detecting ON edge of JOG+ signal and to negative direction by JOG- signal while JISL signal is OFF. The actuator will decelerate and stop if OFF edge is detected while in each Operation. Inching Operation is performed while JISL signal is ON.	3.2.4
	PWRT	Current Position Write	When the write position is specified in the teaching mode and this signal has remained ON for 20 msec or longer, the controller will write the current position in the specified position field.	3.2.4
	CLBR	Loadcell Calibration Command	Turn this signal ON for more than 20ms to perform calibration of loadcell.	3.2.7
	ST0 to ST6	Start Signal	The actuator moves to the commanded position with this signal ON during the electromagnetic valve mode.	3.2.5

Signal with "*" expresses the signal of active low. In the controller, the process is held when the input signal is turned OFF.

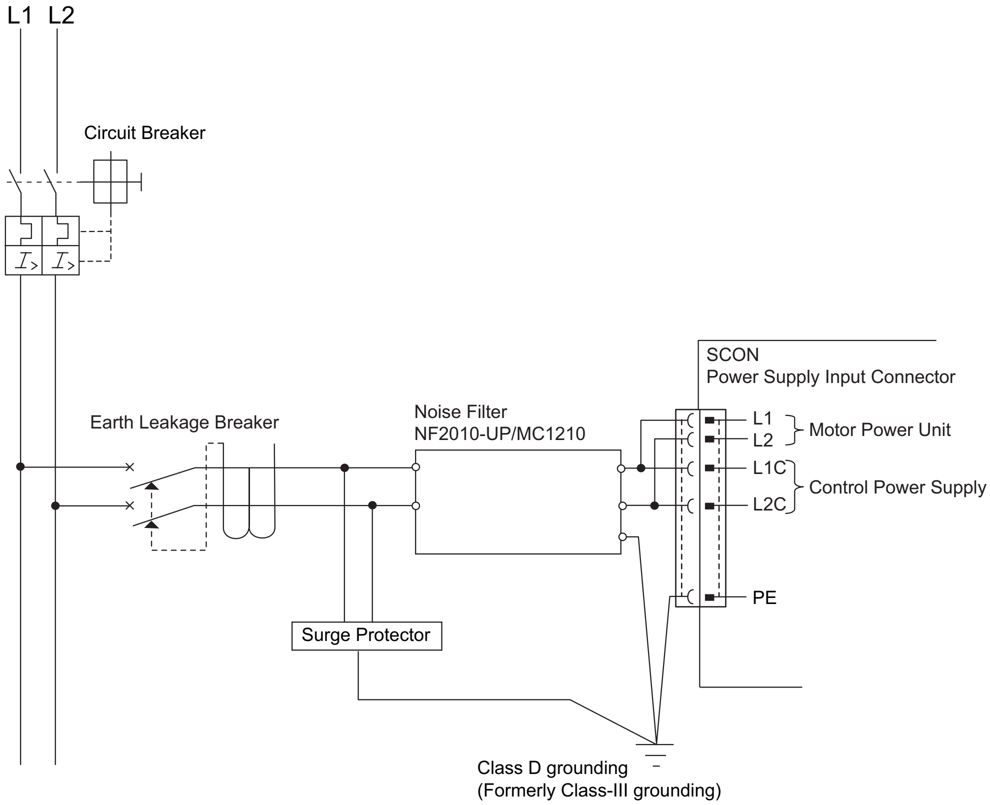
Category	Signal Abbreviation	Signal Name	Function Description	Relevant Sections
Output	PEND/INP	Position complete	Turns ON in the positioning band range after actuator operation. The INP signal will turn OFF if the position deviation exceeds the in-position range. PEND and INP can be switched over by the parameter.	3.2.3 3.2.4 3.2.5
	PM1 to PM256	Completion Position No.	The position No. reached after the positioning completion, is output (binary output).	3.2.4
	HEND	Home return completion	This signal will turn ON when home return has been completed. It will be kept ON unless the home position is lost.	3.2.3
	ZONE1	Zone	Turns ON if the current actuator position is within the range set to the parameter.	3.2.3
	PZONE	Position Zone	This signal will turn ON when the current actuator position enters the range specified the position data after position movement. Even though it can be used together with ZONE1, PZONE will become only available for operation by the set position number.	3.2.3
	RMDS	Operation Mode Status Output	Outputs the operation mode status. It turns on when the controller is on Manual Mode.	3.2.3
	*ALM	Alarm	Turns ON when the controller is in normal condition, and turns OFF when an alarm is generated.	3.2.3
	MOVE	Moving	Turns ON during the actuator is moving (including home-return operation and pressing operation).	3.2.3 3.2.4
	SV	Servo ON	This signal will remain ON while the servo is ON.	3.2.3
	*EMGS	Emergency Stop Output	This signal remains ON while the controller is under the emergency stop reset condition and turns OFF when the emergency stop condition is enabled. (Regardless of alarms.)	3.2.3
	MODES	Teaching Mode Output	This signal will turn ON while the teaching mode is enabled by the input of the mode signal and will turn OFF when the mode changes to the normal mode.	3.2.4
	WEND	Writing Complete	It is OFF during the teaching mode and turns ON when the writing by PWRT Signal is complete. It turns OFF when PWRT Signal turns OFF.	3.2.4
	PE0 to PE6	Current Position Number	In the electromagnetic valve mode, this signal will turn ON when the actuator completes moving to the target position.	3.2.5
	LS0 to LS2	Limit Switch Output	Turns ON when the current actuator position is within the range of positioning band (+/-) of the target position. It is output even before the movement command and the servo is OFF if the home-return operation is completed.	3.2.6
	CEND	Loadcell Calibration Complete	Turns ON after loadcell calibration is complete. This signal turns OFF if CLBR signal is turned OFF.	3.2.7
	*BALM	Warning for Absolute Battery Voltage Drop	Turns ON when the battery voltage for the absolute type actuator is within the normal voltage range. This signal is always ON for the incremental type actuator. Also, it turns OFF if exceeded the overload warning threshold when the overload warning function is used. By the setting in Parameter No.151, apart from the above, it is able to turn it OFF also when the message level alarm is generated.	Chapter 7
	LOAD	Load Output Judgment Signal	Outputs when current exceeds the value set to “threshold” within range of position data “ZONE+” or “ZONE-” during the pressing operation. Utilize this signal for a judgment of a press-fitting process being properly performed.	3.2.4 3.2.5
	TRQS	Torque Level Output	Outputs when current of motor reaches the value set to “threshold” by the slider (or rod) being hit to an obstacle during the pressing movement.	3.2.4 3.2.5

Signal with “*” expresses the signal of active low. It is ON when the power is applied to the controller, and turns OFF when the signal is output.

2.1.3 Circuit Diagram

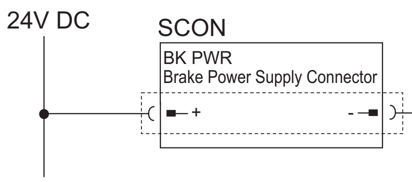
Sample circuit diagrams are shown below.

[1] Main Power Circuit



(Note) The power voltage of the controller (100V AC or 200V AC) cannot be changed.

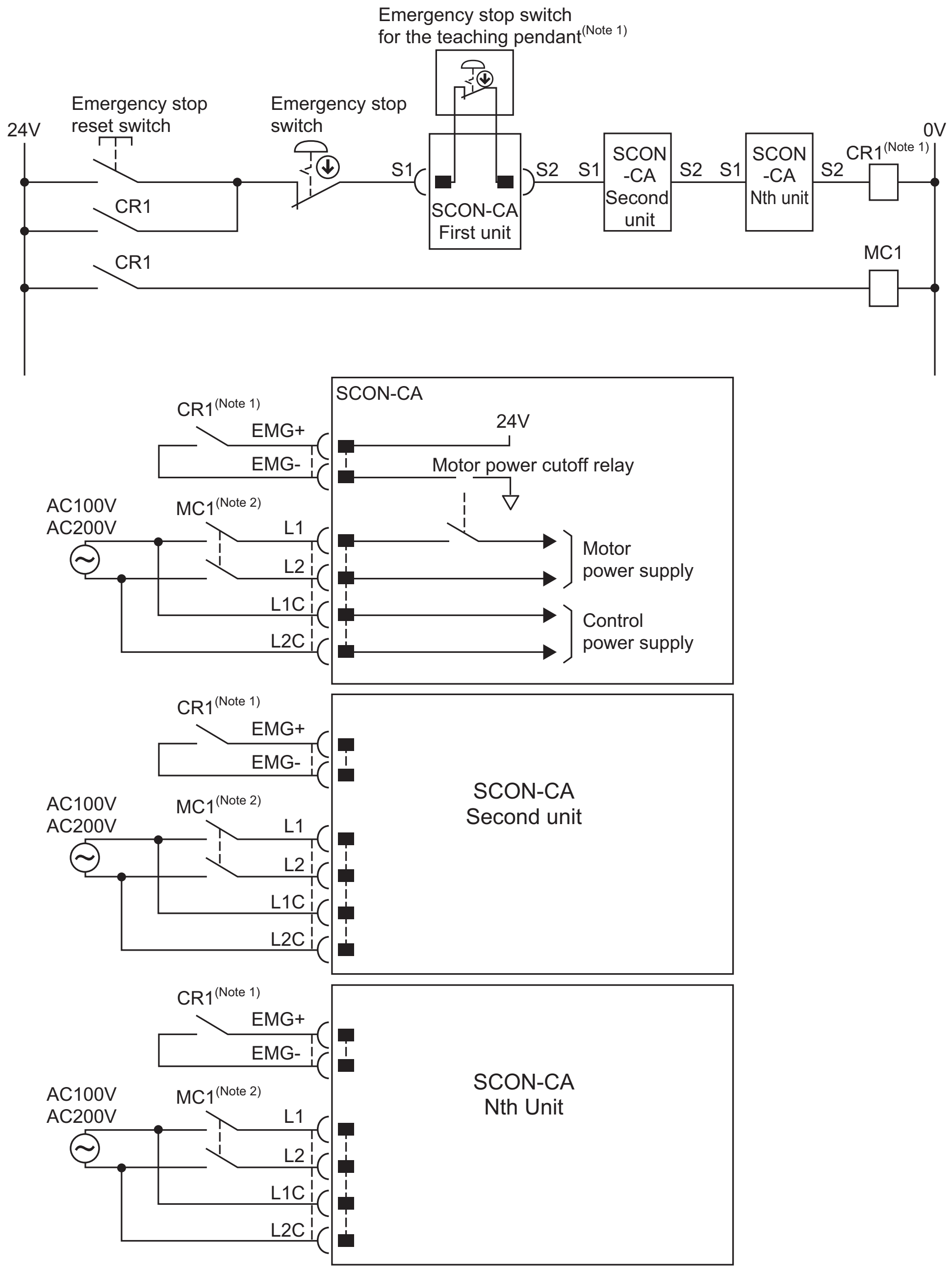
[2] Brake Power Supply Circuit



(Note) Supply 24V DC if the used actuator is equipped with a brake.

[3] Emergency Stop Circuit

It is the example of circuit layout when an emergency switch of the touch panel teaching or the teaching pendant is used to the emergency stop circuit of the equipment.



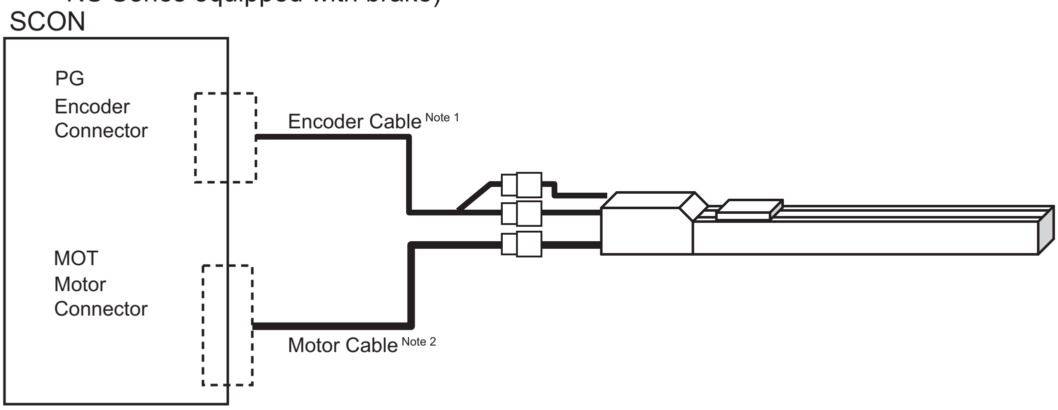
Note 1 The power rating of the motor power-off relay turning ON/OFF with contact CR is 24V DC and 10mA or less.

Note 2 To turn OFF motor drive power suit to Safety Category 2, connect contactors to the L1/L2 terminals.

Note 3 Controller automatically confirms the teaching tool is inserted.

[4] Motor • Encoder Circuit

1) Connection of Short-Axis Robot (excluding RCS2-RA13R equipped with brake/loadcell and NS Series equipped with brake)



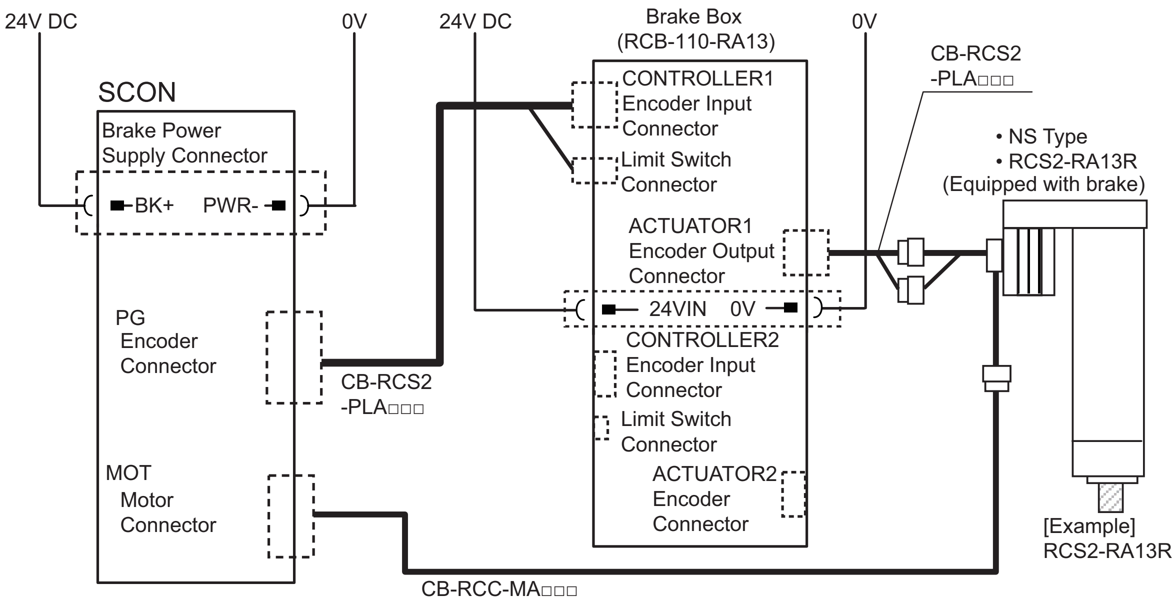
Note 1 Applicable Encoder Cable types □□□ : cable length Example) 030 = 3m

Actuator Type	Cable
For Single Axis Robot Connection	CB-X1-PA□□□
For connection of Short-Axis Robot with LS type	CB-X1-PLA□□□
For ISWA Connection	CB-X1-PA□□□-WC
For connection of NS/Linear Servo/RCS2	CB-X3-PA□□□
For connection of NS/Linear Servo/RCS2 equipped with LS	CB-X2-PLA□□□
For RCS2	CB-RCS2-PA□□□
For RCS2-RT/RA13R	CB-RCS2-PLA□□□
For RCS2-RA13R equipped with loadcell	CB-RCS2-PLLA□□□

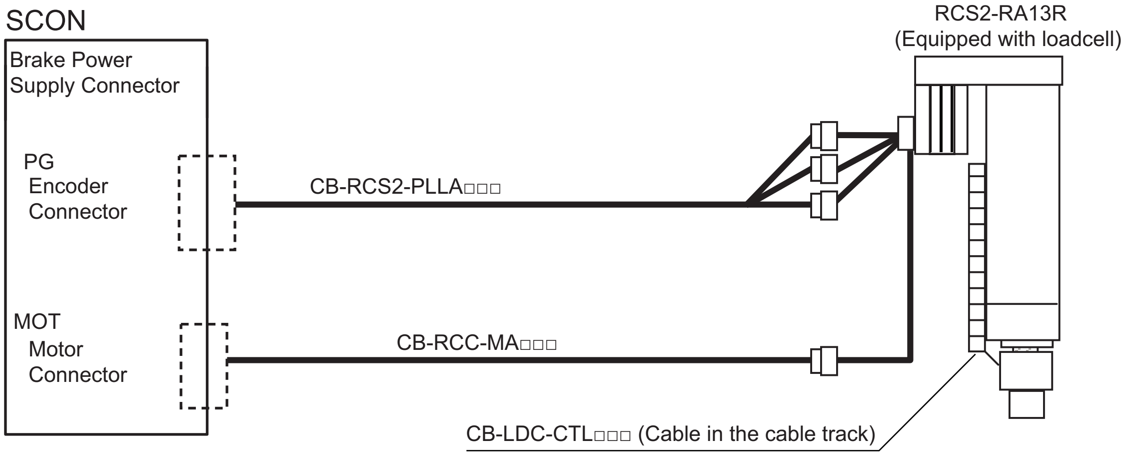
Note 2 Applicable Moter Cable types □□□ : cable length Example) 030 = 3m

Actuator Type	Cable
For Linear (except for Large Type)	CB-X-MA□□□
For Large Type Linear	CB-XMC-MA□□□
For Single Axis Robot Connection	CB-RCC-MA□□□
For Single Axis Robot Connection	CB-RCC-MA□□□-RB
For ISWA	CB-X-PA□□□-WC

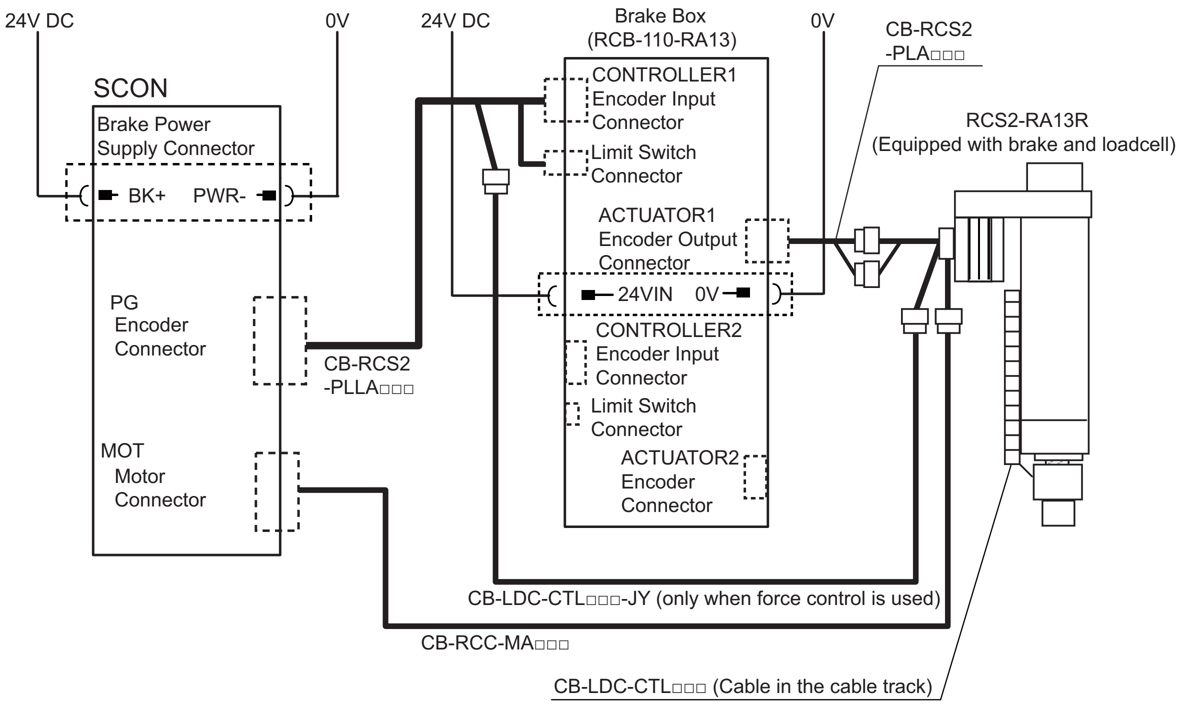
2) Connection of RCS2-RA13R actuator equipped with brake or NS-type equipped with brake



3) Connection of actuator RCS2-RA13R equipped with loadcell but not equipped with brake

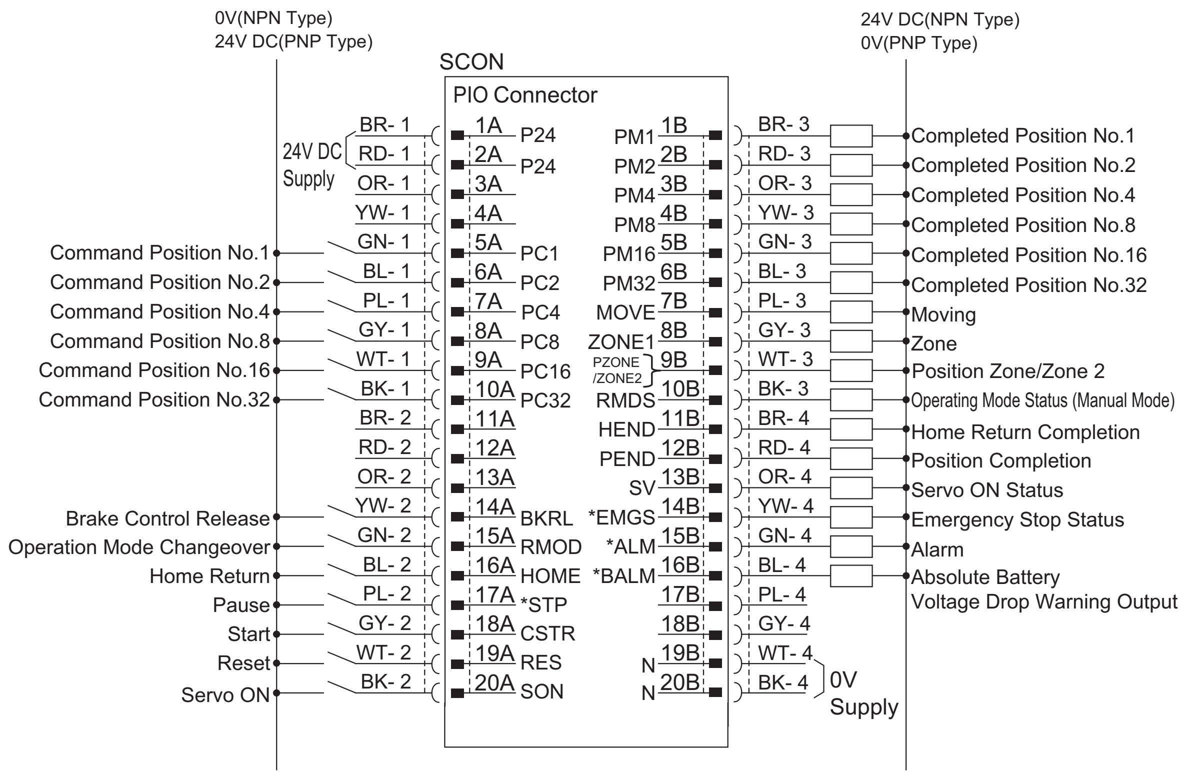


4) Connection of actuator RCS2-RA13R equipped with loadcell and brake



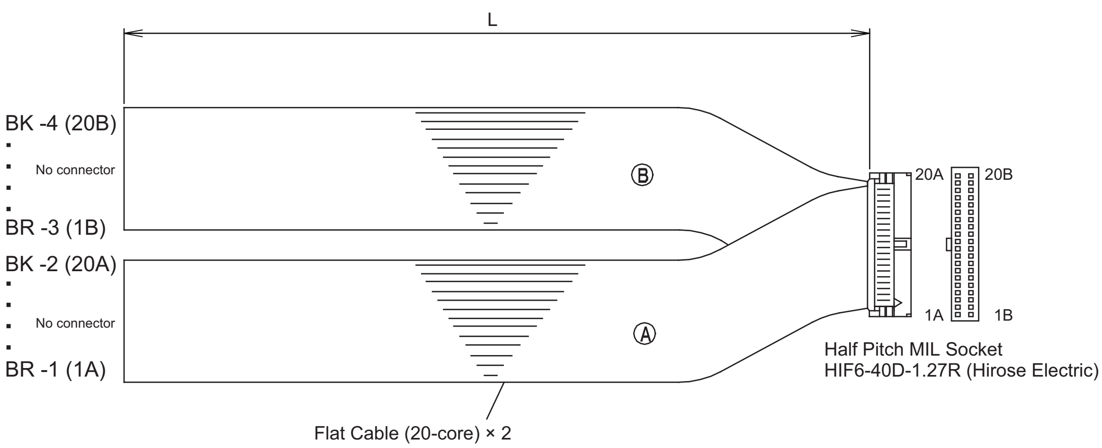
[5] PIO Circuit

1) PIO Pattern 0 ··············· Positioning Mode (Standard Type)

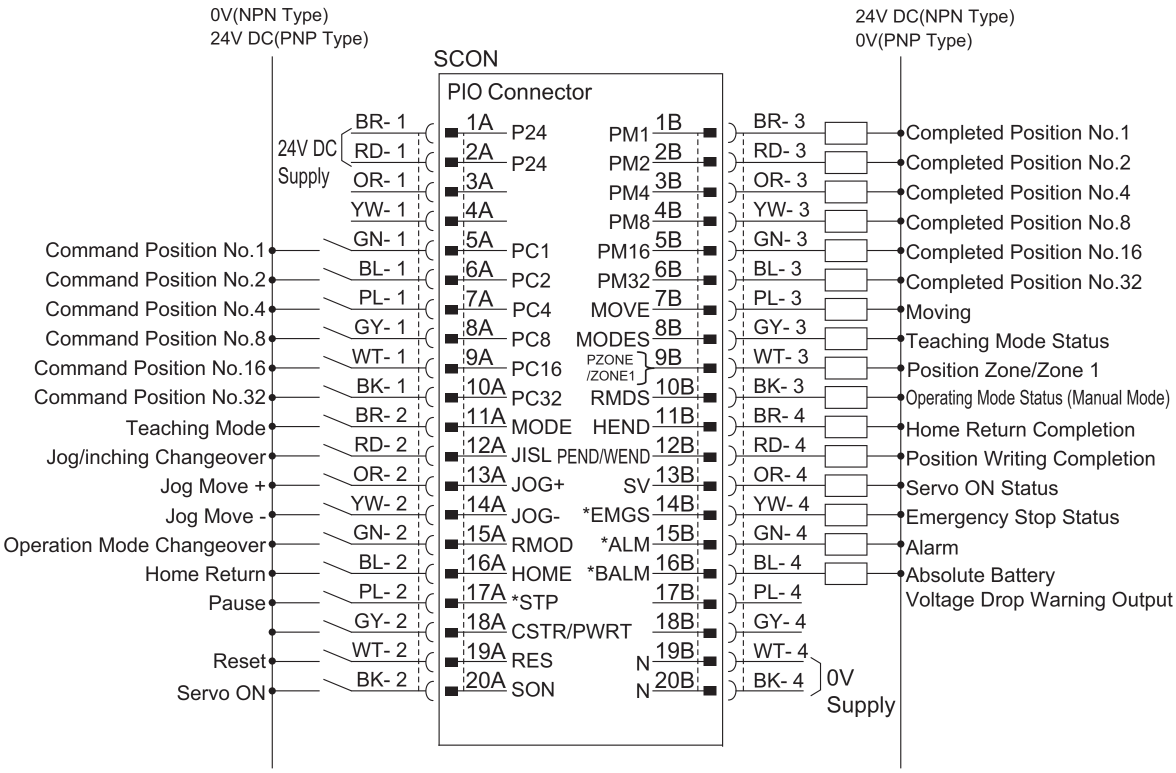


"*" in codes above shows the signal of the active low. Processing occurs when an input signal of the type is turned OFF. An output signal of the type is normally ON in the power-on status and turned OFF at signal output.

- Use the attached cable for the I/O connection.
  Model : CB-PAC-PIO□□□ (□□□ indicates the cable length L. Example. 020 = 2m)

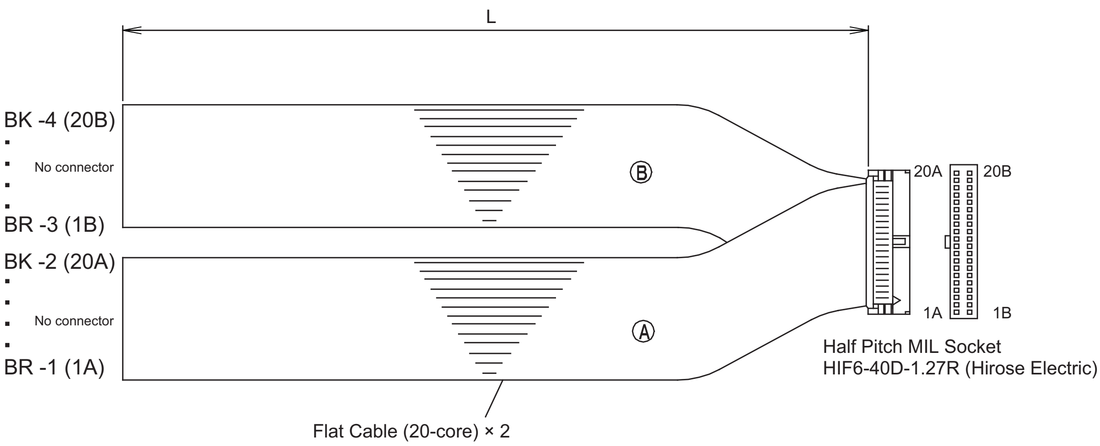


2) PIO Pattern 1 ··············· Teaching mode (Teaching type)

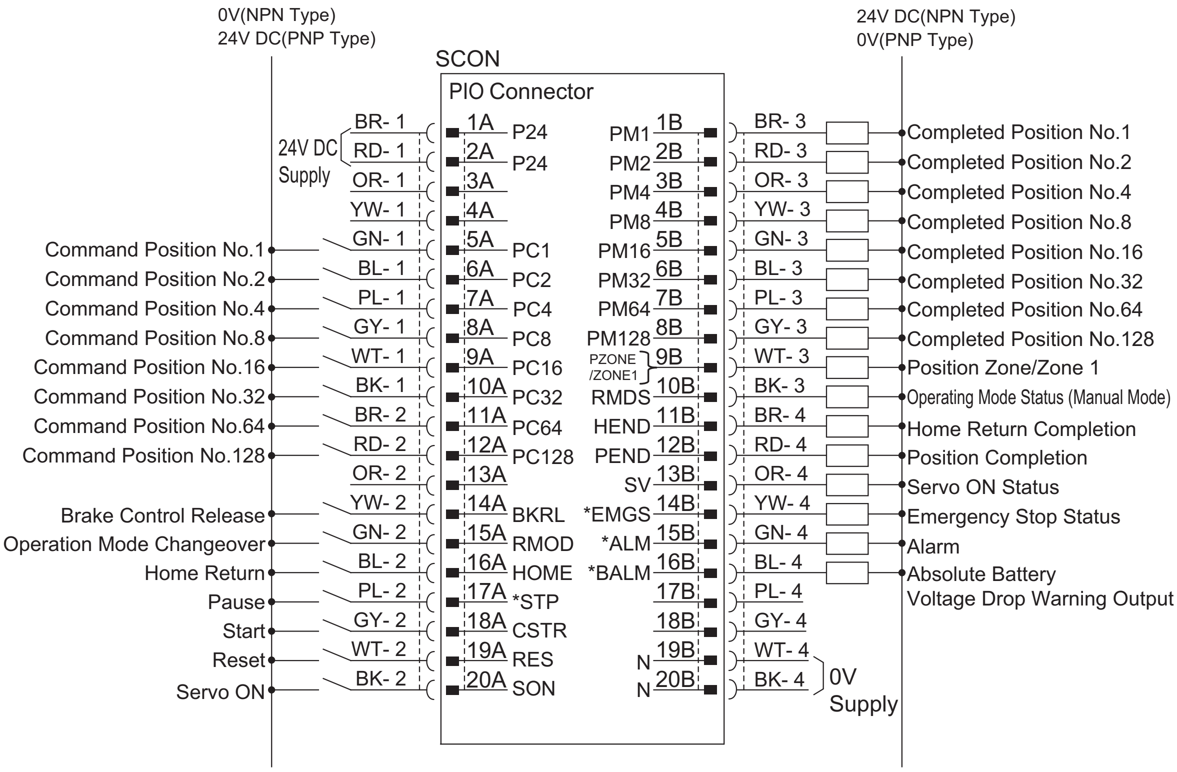


"*" in codes above shows the signal of the active low. Processing occurs when an input signal of the type is turned OFF. An output signal of the type is normally ON in the power-on status and turned OFF at signal output.

- Use the attached cable for the I/O connection.
  Model : CB-PAC-PIO□□□ (□□□ indicates the cable length L. Example. 020 = 2m)

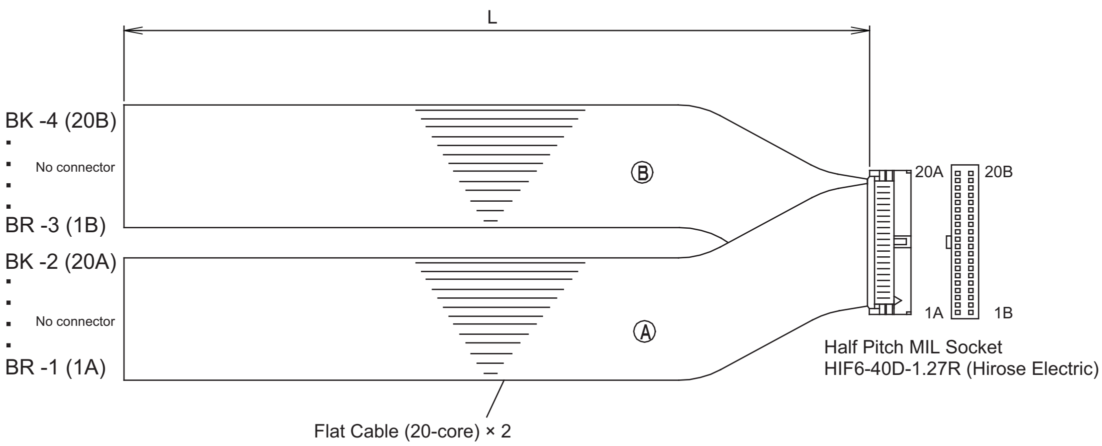


3) PIO Pattern 2 ··············· 256-point mode (Number of positioning points : 256-point type)

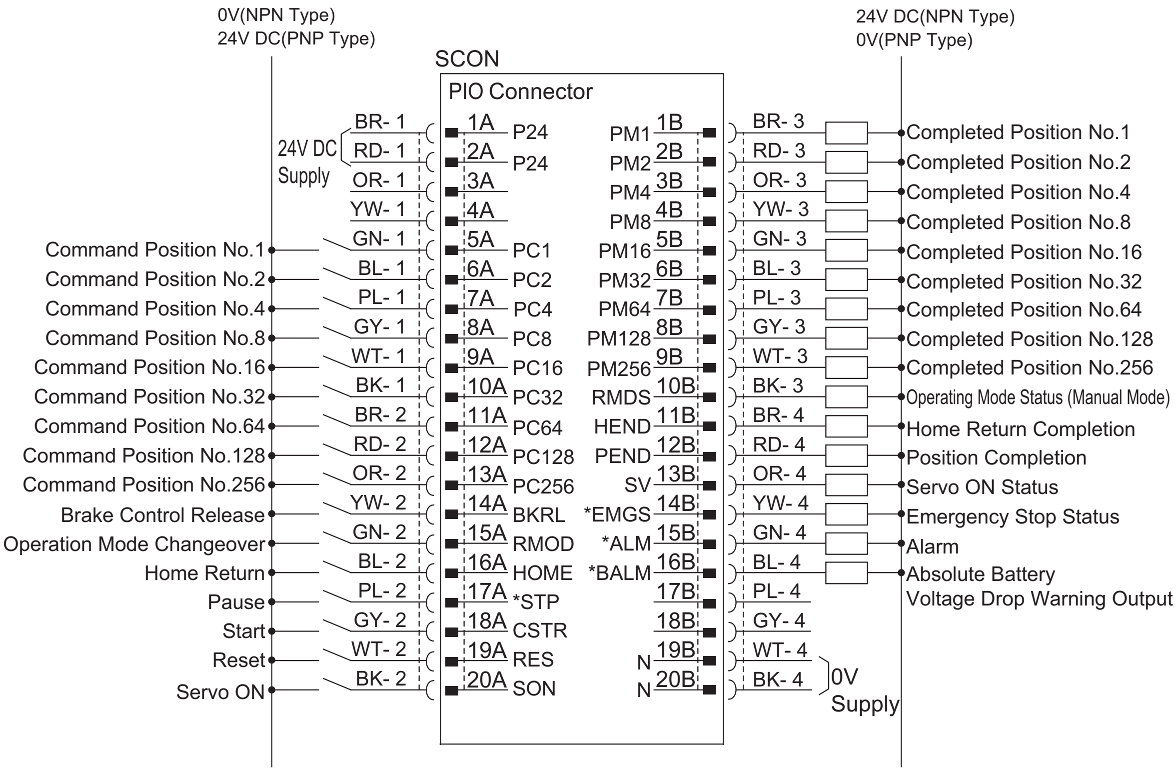


"*" in codes above shows the signal of the active low. Processing occurs when an input signal of the type is turned OFF. An output signal of the type is normally ON in the power-on status and turned OFF at signal output.

- Use the attached cable for the I/O connection.
  Model : CB-PAC-PIO□□□ (□□□ indicates the cable length L. Example. 020 = 2m)

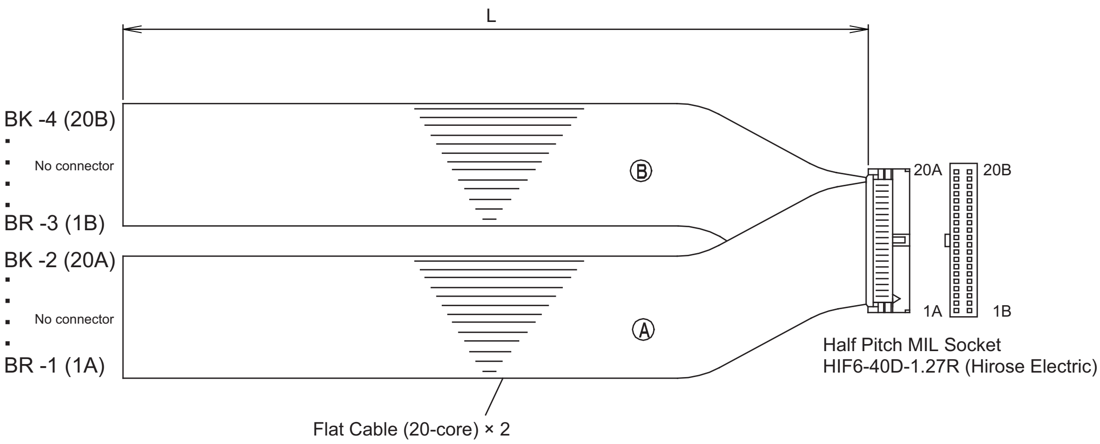


4) PIO Pattern 3 ··············· 512-point mode (Number of positioning points : 512-point type)

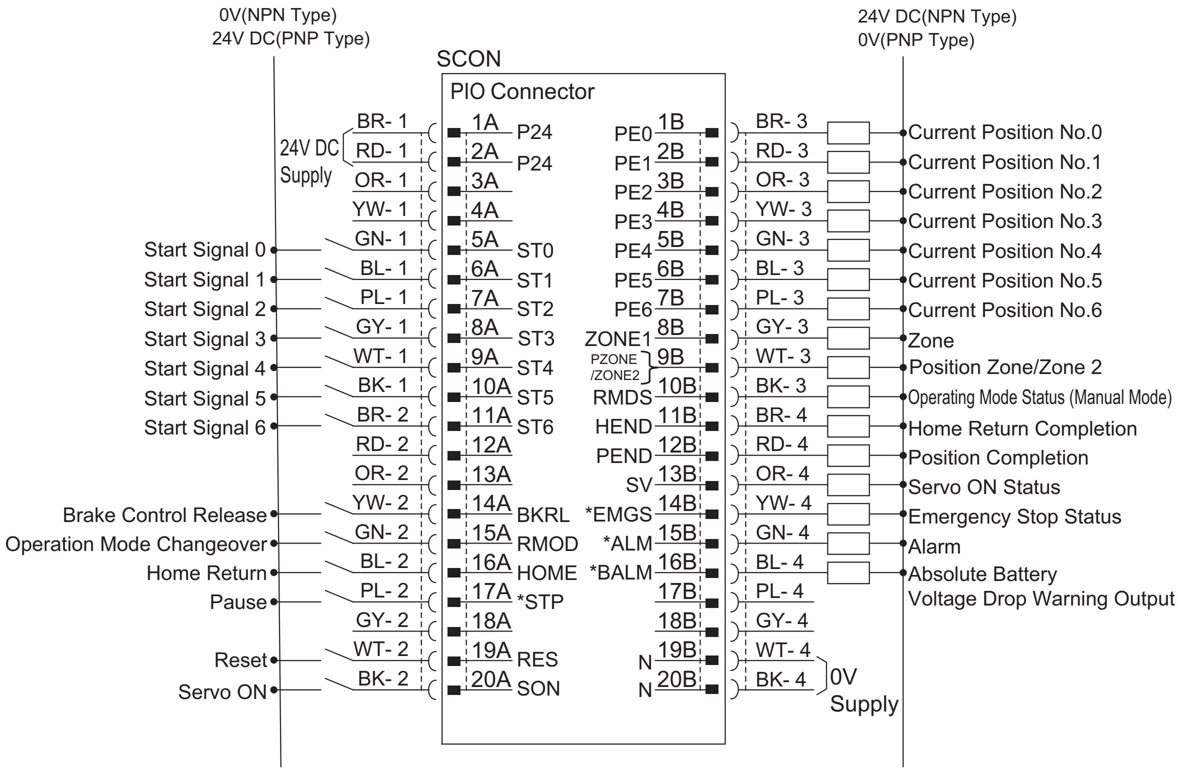


"*" in codes above shows the signal of the active low. Processing occurs when an input signal of the type is turned OFF. An output signal of the type is normally ON in the power-on status and turned OFF at signal output.

- Use the attached cable for the I/O connection.
  Model : CB-PAC-PIO□□□ (□□□ indicates the cable length L. Example. 020 = 2m)

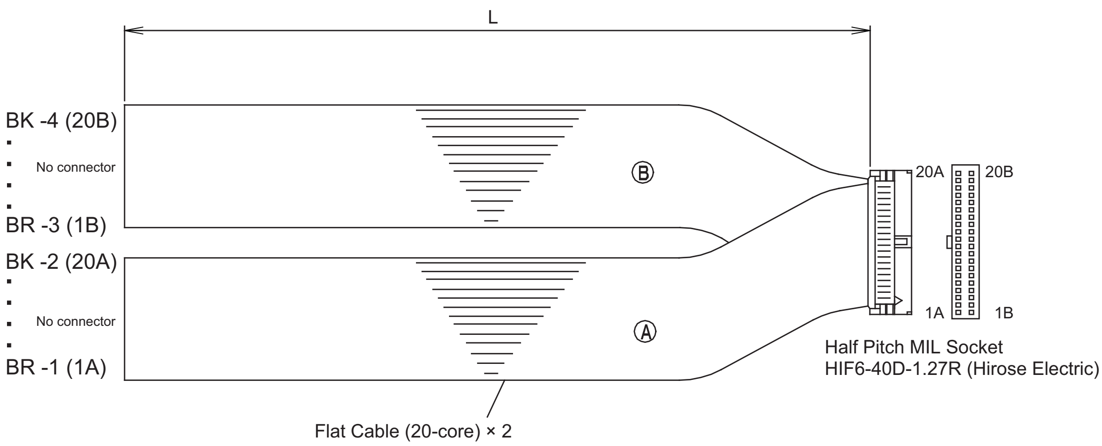


5) PIO Pattern 4 ················Solenoid Valve Mode 1 (7-point type)

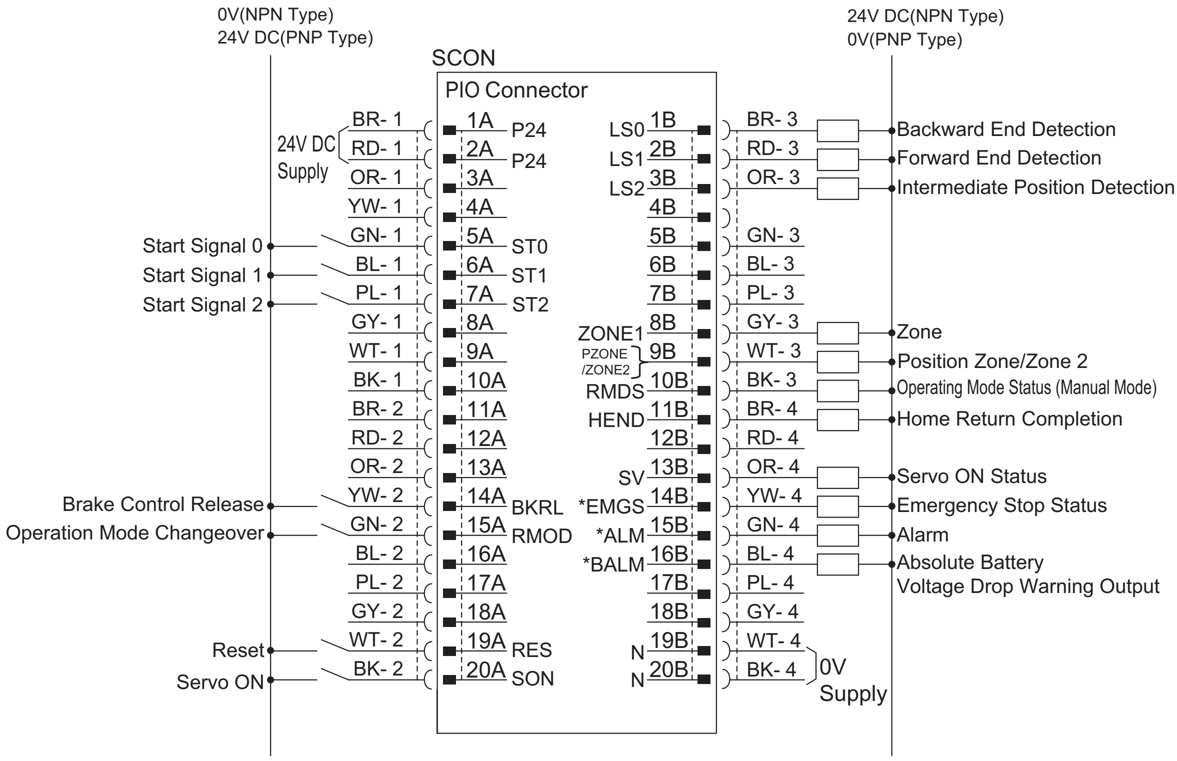


"*" in codes above shows the signal of the active low. Processing occurs when an input signal of the type is turned OFF. An output signal of the type is normally ON in the power-on status and turned OFF at signal output.

- Use the attached cable for the I/O connection.
  Model : CB-PAC-PIO□□□ (□□□ indicates the cable length L. Example. 020 = 2m)

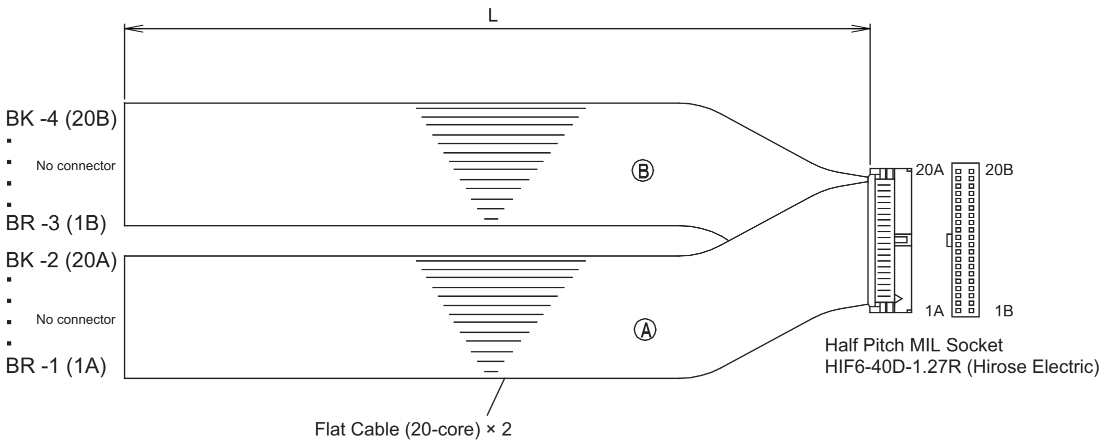


6) PIO Pattern 5 ················Solenoid Valve Mode 2 (3-point type)

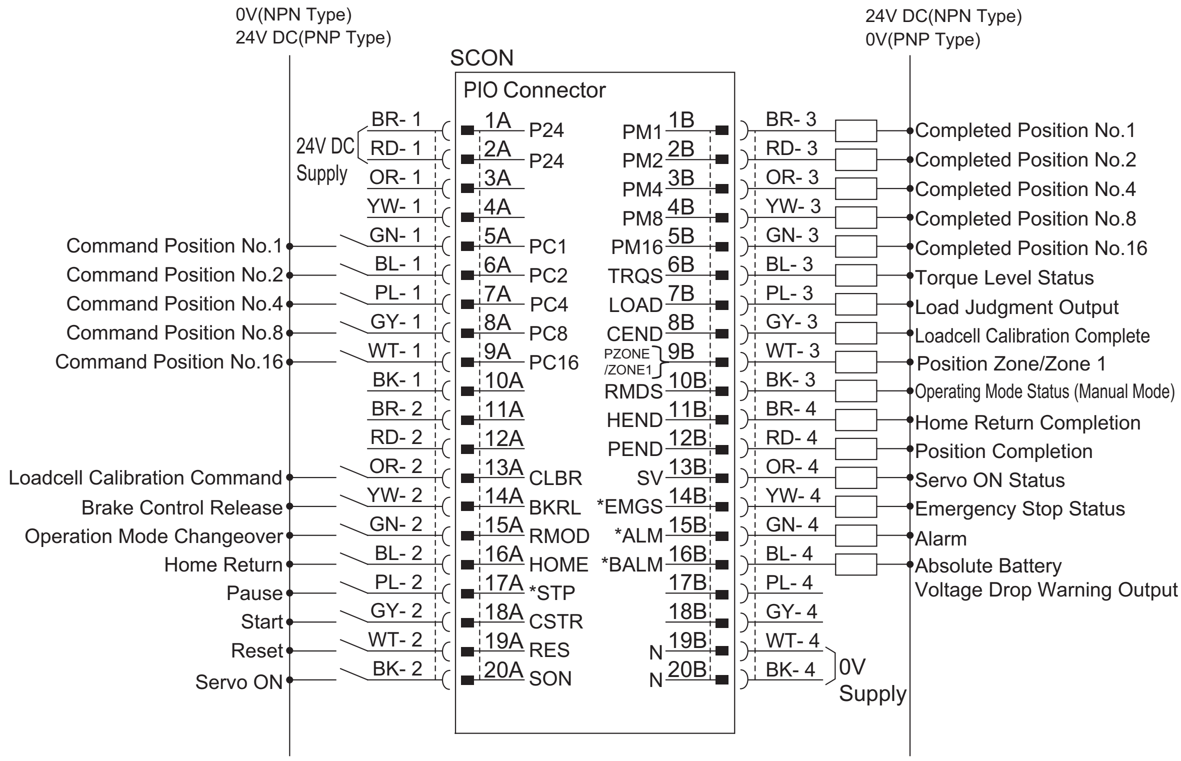


"*" in codes above shows the signal of the active low. Processing occurs when an input signal of the type is turned OFF. An output signal of the type is normally ON in the power-on status and turned OFF at signal output.

- Use the attached cable for the I/O connection.
  Model : CB-PAC-PIO□□□ (□□□ indicates the cable length L. Example. 020 = 2m)

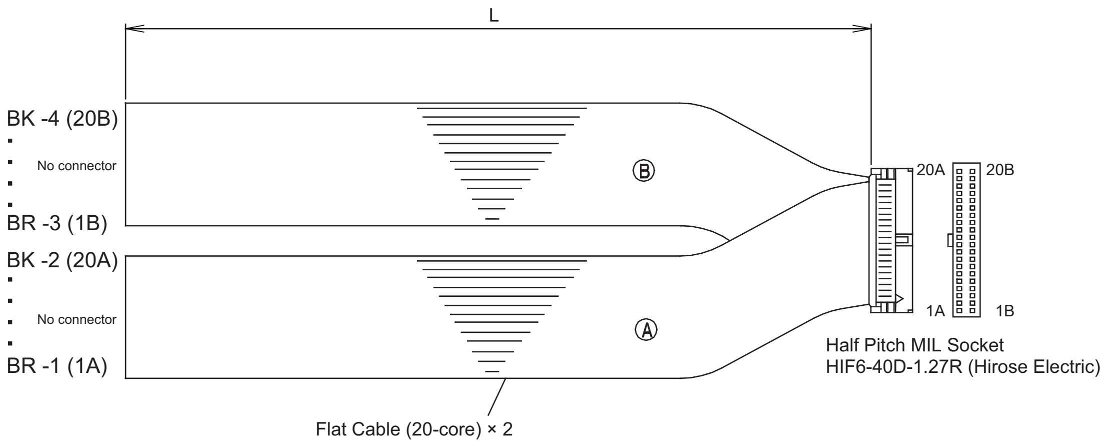


7) PIO Pattern 6 ················Pressing Operation Using Force Sensor Mode 1 (Standard type)

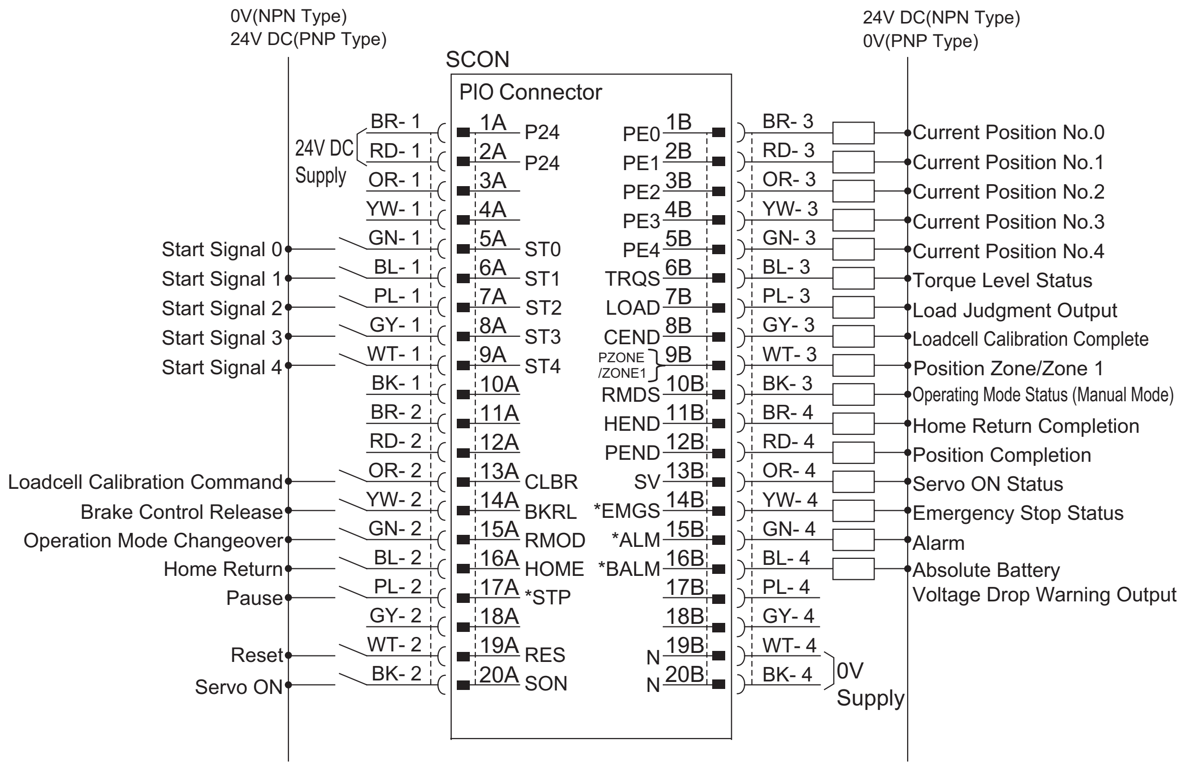


"*" in codes above shows the signal of the active low. Processing occurs when an input signal of the type is turned OFF. An output signal of the type is normally ON in the power-on status and turned OFF at signal output.

- Use the attached cable for the I/O connection.
  Model : CB-PAC-PIO□□□ (□□□ indicates the cable length L. Example. 020 = 2m)

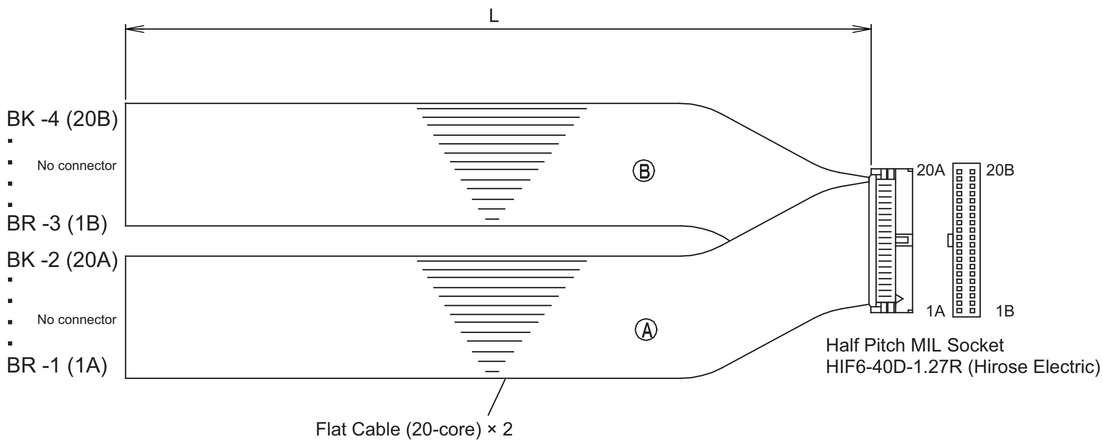


8) PIO Pattern 7 ················Pressing Operation Using Force Sensor Mode 2 (Solenoid valve type)

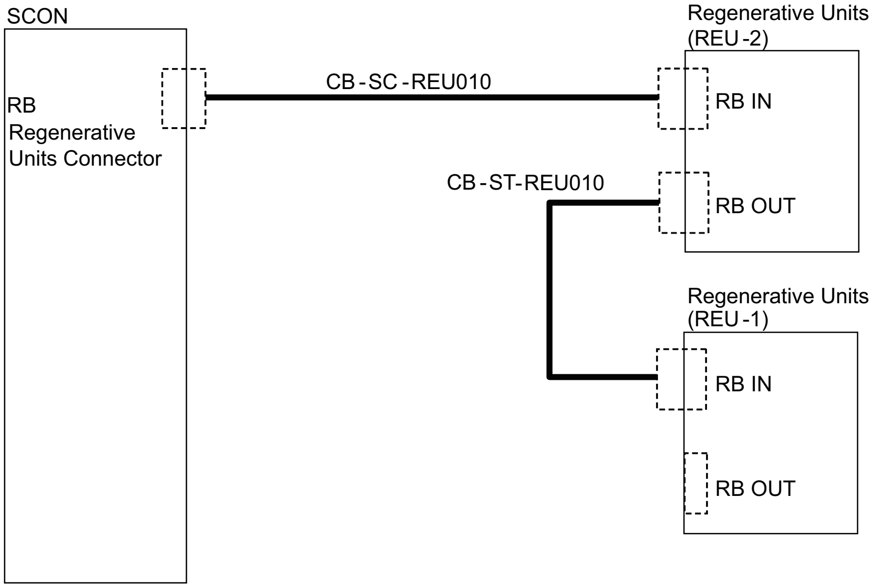


"*" in codes above shows the signal of the active low. Processing occurs when an input signal of the type is turned OFF. An output signal of the type is normally ON in the power-on status and turned OFF at signal output.

- Use the attached cable for the I/O connection.
  Model : CB-PAC-PIO□□□ (□□□ indicates the cable length L. Example. 020 = 2m)



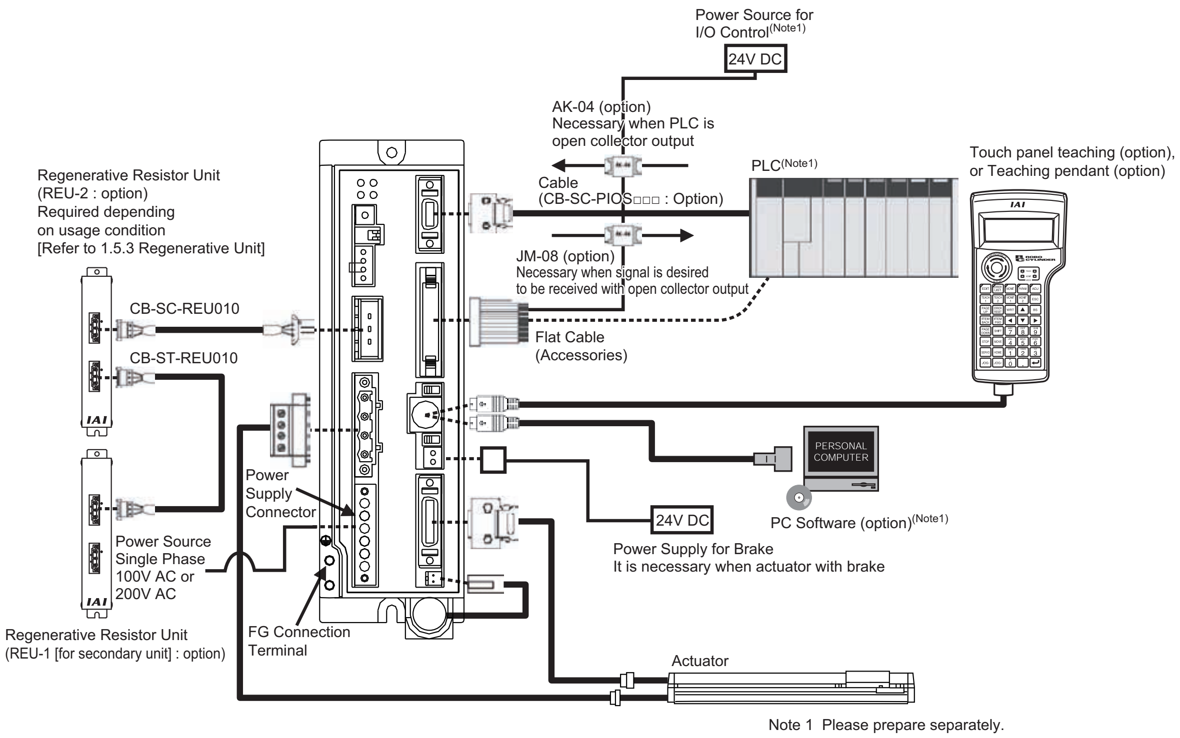
[6] Regenerative Units Circuit



2.2 Pulse Train Control Mode

2.2.1 Wiring Diagram (Connection of construction devices)

[1] Basic Wiring Diagram

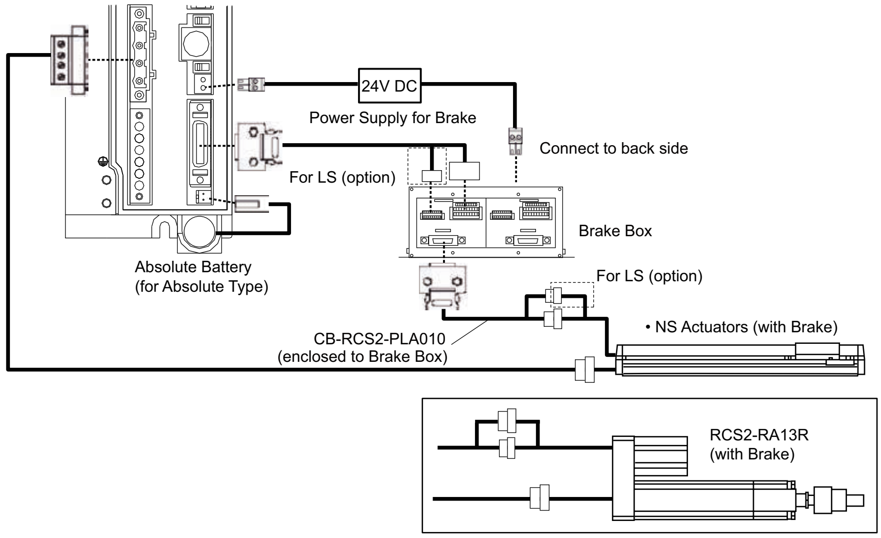


If using RCS-RA13R or NS Type for the actuator and the option shown in the table is applied, the wiring between the actuator and the controller will differ from the basic wiring layout. Shown in the table is the relation of the option and wiring layout.

Model Name	Option		Wiring Layout between Actuator and Controller
	Brake	Loadcell	
RS-RA13R	○	×	(1)
	×	×	Basic Wiring Diagram
NS	○	-	(1)
	×	-	Basic Wiring Diagram

⚠ Caution : Turn OFF the power to the controller before inserting or removing the connector for connection between the teaching tool and controller.
Inserting or removing the connector while the power is turned ON causes a controller failure.

1) RCS2-RA13R Equipped with Brake, with no Loadcell, or NS Actuators with Brake



2.2.2 I/O Signals in Pulse Train Control Mode

The table below shows the signal assignment of the flat cable in the pulse train control mode.
Follow the following table to connect the external equipment (such as PLC).

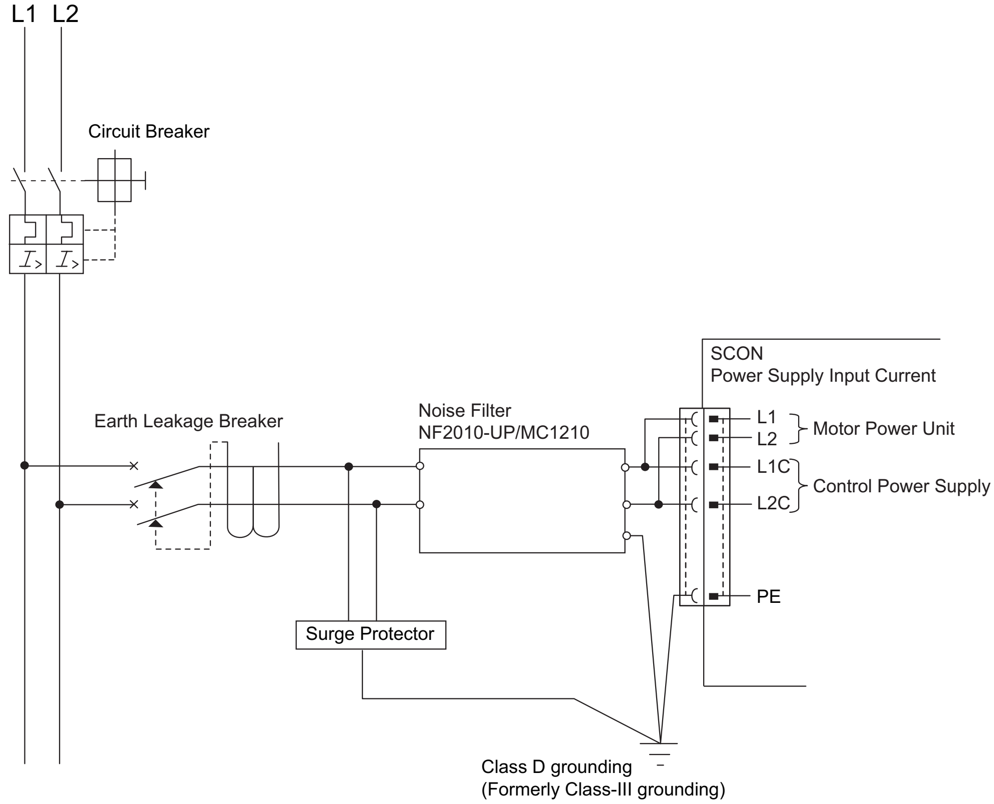
Pin No.	Category	I/O No.	Signal Abbreviation	Signal Name	Function Description	Relevant Sections
1A	24V		P24	Power Supply	Power Supply for I/O +24V	
2A	24V		P24	Power Supply	Power Supply for I/O +24V	
3A	–		NC	–	Not used	
4A	–		NC	–	Not used	
5A	Input	IN0	SON	Servo ON	The servo remains ON while this signal is ON, or OFF while this signal is OFF.	3.3.2
6A		IN1	RES	Reset	Turn the signal ON to reset the alarm.	3.3.2
7A		IN2	HOME	Home Return	The controller will perform home return operation when this signal is turned ON.	3.3.2
8A		IN3	TL	Torque Limit Select	Puts torque limitation to the motor with the signal ON and the value set to the parameter.	3.3.3
9A		IN4	CSTP	Compulsory Stop	Turning it ON continuously for more than 10ms compulsorily stops the actuator. The actuator decelerates then stops with the torque set in the controller and then turns the servo OFF.	3.3.2
10A		IN5	DCLR	Deviation Counter Clear	Clears the deviation counter.	3.3.3
11A		IN6	BKRL	Brake Forcible Release	The brake will forcibly be released.	3.3.2
12A		IN7	RMOD	Operation Mode Changeover	The operating mode is selectable when the MODE switch of the controller is set to AUTO. (The setting is AUTO when signal is OFF, and MANU when ON.)	3.3.2
13A		IN8	NC	–	Not used	
14A		IN9	NC	–	Not used	
15A		IN10	NC	–	Not used	
16A		IN11	NC	–	Not used	
17A		IN12	NC	–	Not used	
18A		IN13	NC	–	Not used	
19A		IN14	NC	–	Not used	
20A		IN15	NC	–	Not used	
1B	Output	OUT0	PWR	System Ready	This signal turns ON if SCON is controllable after main power ON.	3.3.2
2B		OUT1	SV	Servo ON Status	This signal will remain ON while the servo is ON.	3.3.2
3B		OUT2	INP	Position Complete	Turned ON when the remaining moving pulses in the deviation counter enters within the positioning band.	3.3.3
4B		OUT3	HEND	Home return completion	This signal will turn ON when home return has been completed.	3.3.2
5B		OUT4	TLR	Torque Under Control	Turns ON if the torque reaches the limit value during torque limit.	3.3.3
6B		OUT5	*ALM	Controller Alarm Status	Turns ON when controller in normal condition, and OFF when alarm is generated.	3.3.2
7B		OUT6	*EMGS	Emergency Stop Status	Turns ON when the controller emergency stop is cancelled, and OFF during the emergency stop.	3.3.2
8B		OUT7	RMDS	Operation Mode Status	The operating mode status will be output. It turns ON when the controller is on Manual Mode.	3.3.2
9B		OUT8	ALM1	Alarm Code Output Signal	The alarm code is output together with the alarm signal output. Refer to Alarm List for details.	3.3.2
10B		OUT9	ALM2			
11B		OUT10	ALM4			
12B		OUT11	ALM8			
13B		OUT12	*OVLW/ *ALML	Overload Alarm/ Light Error Alarm	Turns OFF if exceeded the overload warning threshold (set in Parameter No.143) when Parameter No.151 is set to 0 (Overload Warning). It turns OFF when the message level alarm is generated if Parameter No.151 is set to 1 (Light Error Alarm).	3.3.2
14B		OUT13	NC	–	Not used	
15B		OUT14	ZONE1	Zone Signal 1	This signal will turn ON when the current actuator position enters the range set by the parameters.	3.3.2
16B		OUT15	ZONE2	Zone Signal 2		
17B	–		NC	–	Not used	
18B	–		NC	–	Not used	
19B	0V		N	Power Supply	Power Supply for I/O 0V	
20B	0V		N	Power Supply	Power Supply for I/O 0V	

Signal with "*" expresses the signal of active low. It is ON when the power is applied to the controller, and turns OFF when the signal is output.

2.2.3 Circuit Diagram

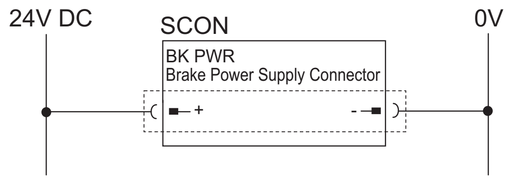
Sample circuit diagrams are shown below.

[1] Main Power Circuit



(Note) The power voltage of the controller (100V AC or 200V AC) cannot be changed.

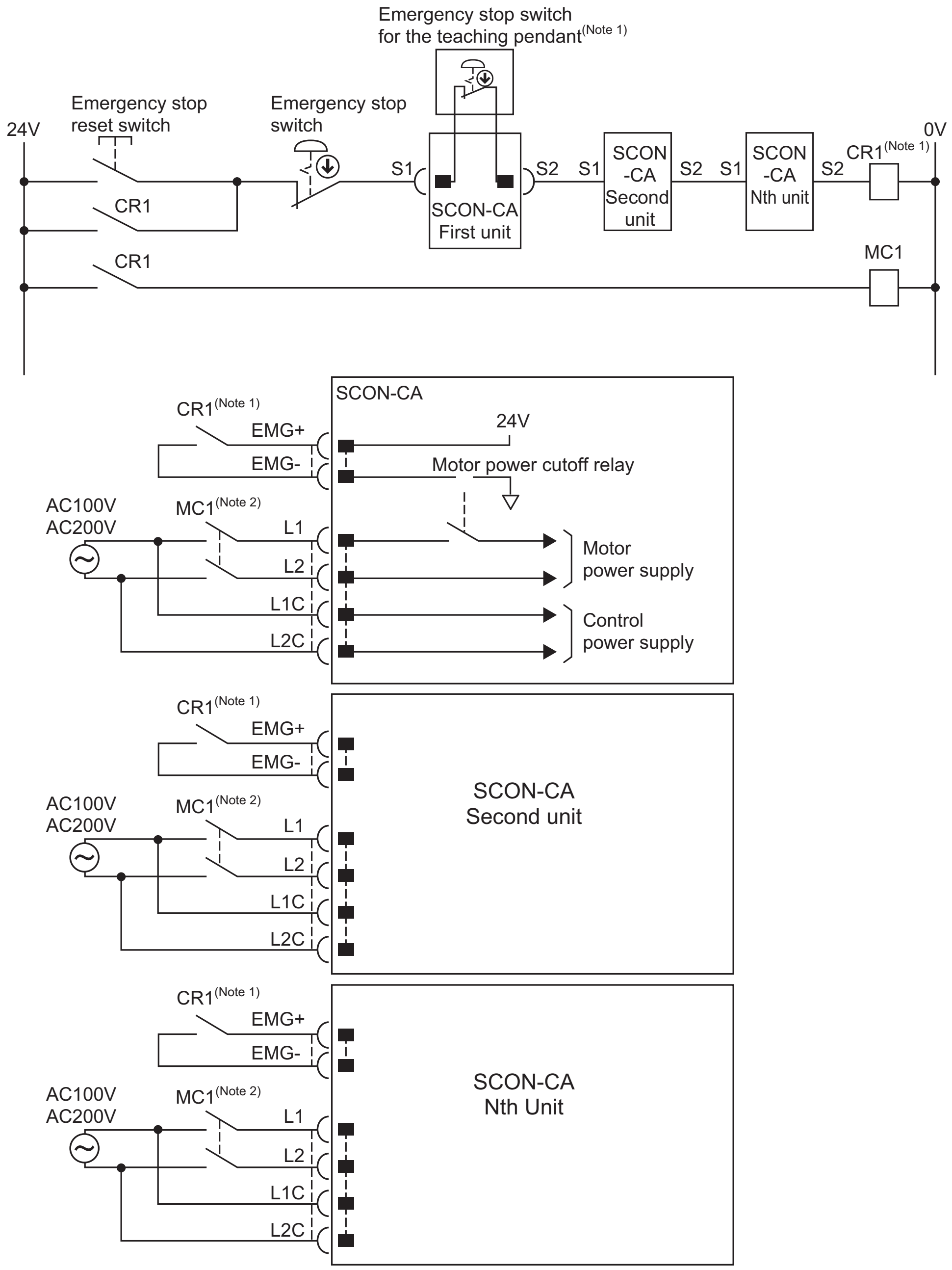
[2] Brake Power Supply Circuit



(Note) Supply 24V DC if the used actuator is equipped with a brake.

[3] Emergency Stop Circuit

It is the example of circuit layout when an emergency switch of the touch panel teaching or the teaching pendant is used to the emergency stop circuit of the equipment.



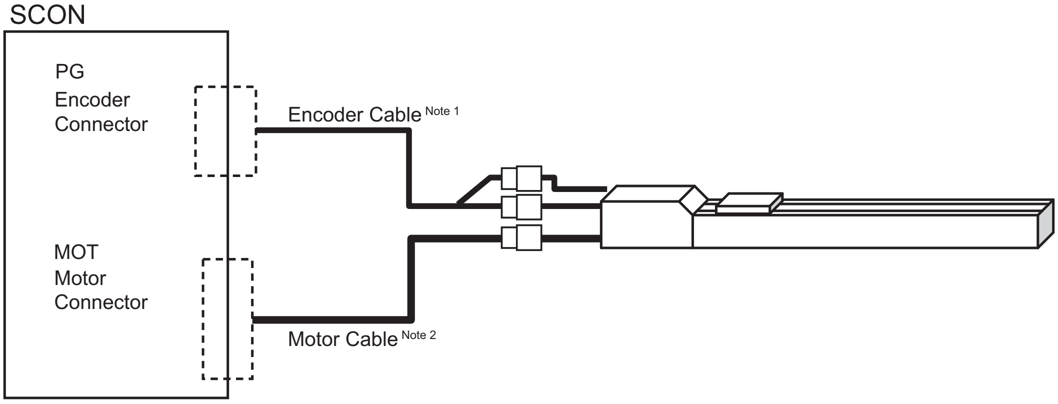
Note 1 The power rating of the motor power-off relay turning ON/OFF with contact CR is 24V DC and 10mA or less.

Note 2 To turn OFF motor drive power suit to Safety Category 2, connect contactors to the L1/L2 terminals.

Note 3 Controller automatically confirms the teaching tool is inserted.

[4] Motor • Encoder Circuit

1) Connection of Short-Axis Robot (excluding RCS2-RA13R equipped with brake/loadcell and NS Series equipped with brake)



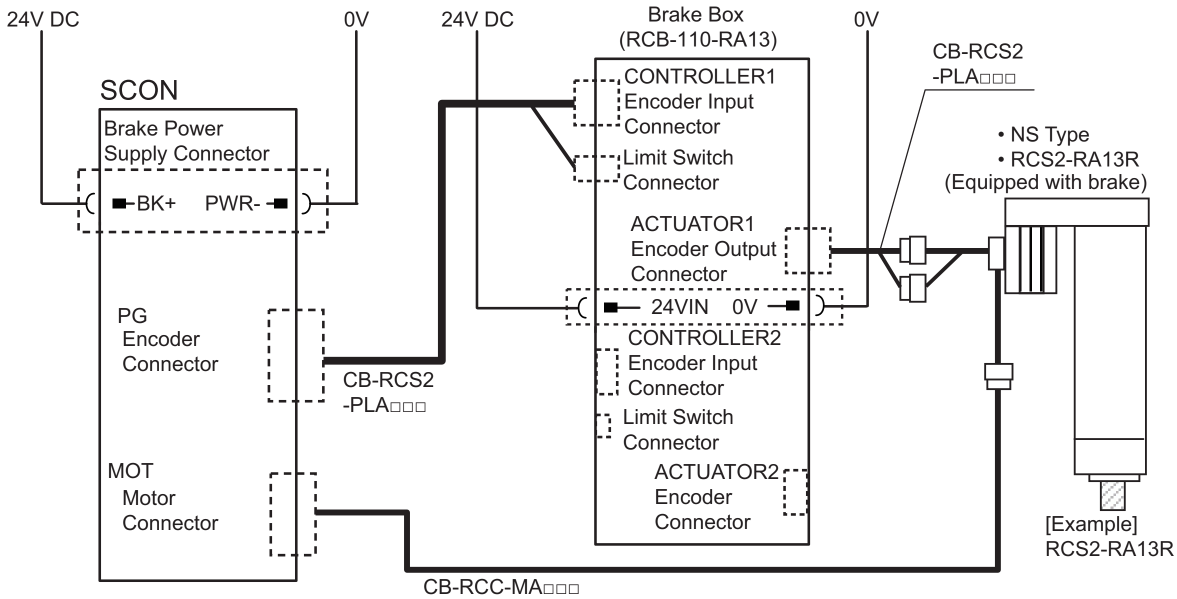
Note 1 Applicable Encoder Cable types □□□ : cable length Example) 030 = 3m

Actuator Type	Cable
For Single Axis Robot Connection	CB-X1-PA□□□
For connection of Short-Axis Robot with LS type	CB-X1-PLA□□□
For ISWA Connection	CB-X1-PA□□□-WC
For connection of NS/Linear Servo/RCS2	CB-X3-PA□□□
For connection of NS/Linear Servo/RCS2 equipped with LS	CB-X2-PLA□□□
For RCS2	CB-RCS2-PA□□□
For RCS2-RT/RA13R	CB-RCS2-PLA□□□
For RCS2-RA13R equipped with loadcell	CB-RCS2-PLLA□□□

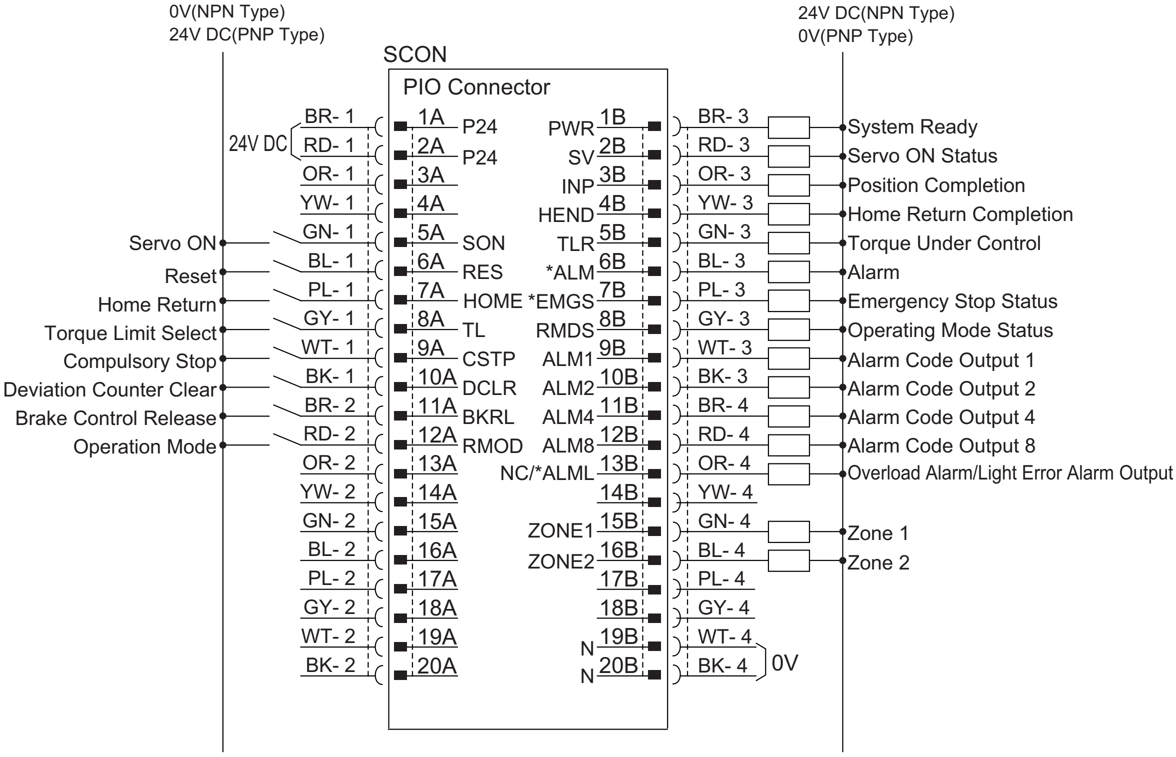
Note 2 Applicable Moter Cable types □□□ : cable length Example) 030 = 3m

Actuator Type	Cable
For Linear (except for Large Type)	CB-X-MA□□□
For Large Type Linear	CB-XMC-MA□□□
For Single Axis Robot Connection	CB-RCC-MA□□□
For Single Axis Robot Connection	CB-RCC-MA□□□-RB
For ISWA	CB-X-PA□□□-WC

2) Connection of RCS2-RA13R actuator equipped with brake or NS-type equipped with brake

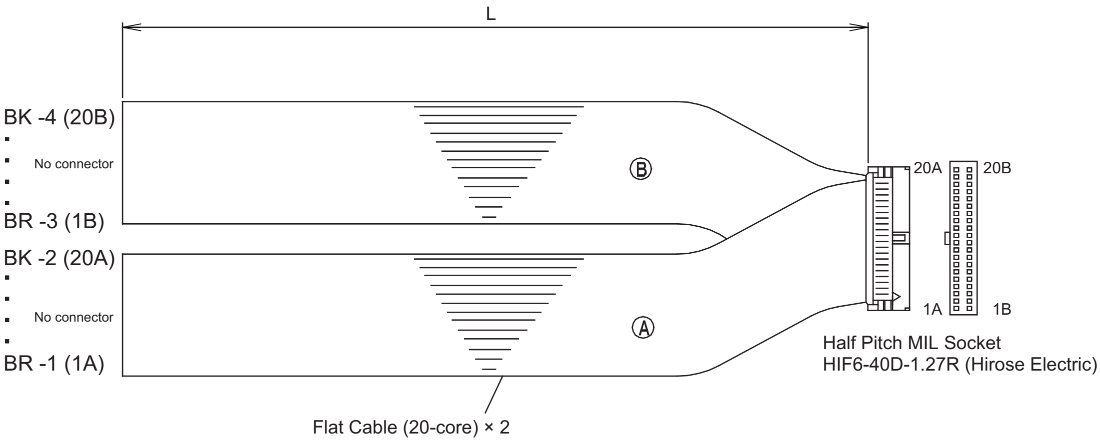


[5] PIO Circuit



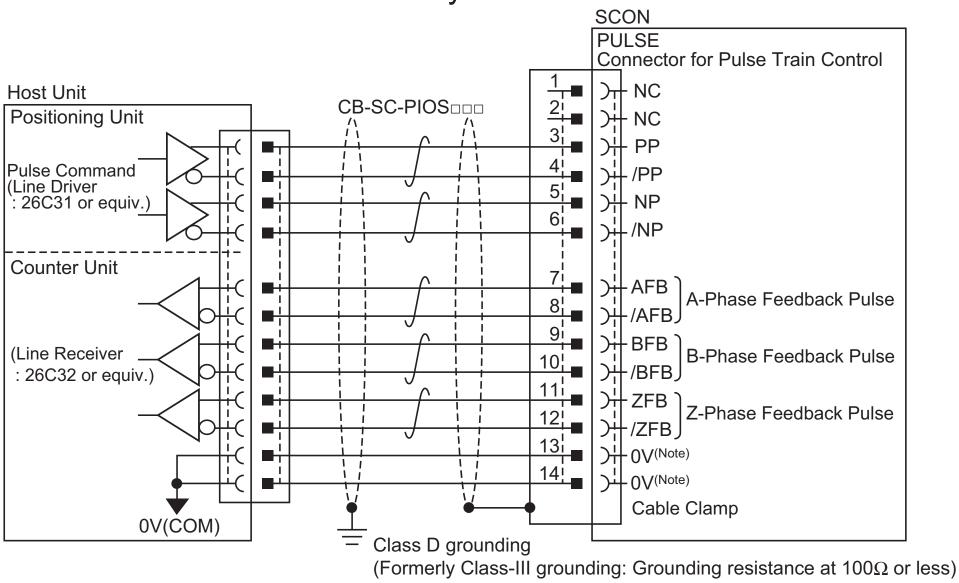
"*" in codes above shows the signal of the active low. Processing occurs when an input signal of the type is turned OFF. An output signal of the type is normally ON in the power-on status and turned OFF at signal output.

- Use the attached cable for the I/O connection.
  Model : CB-PAC-PIO□□□ (□□□ indicates the cable length L. Example. 020 = 2m)



[6] Circuits for Pulse Train Control

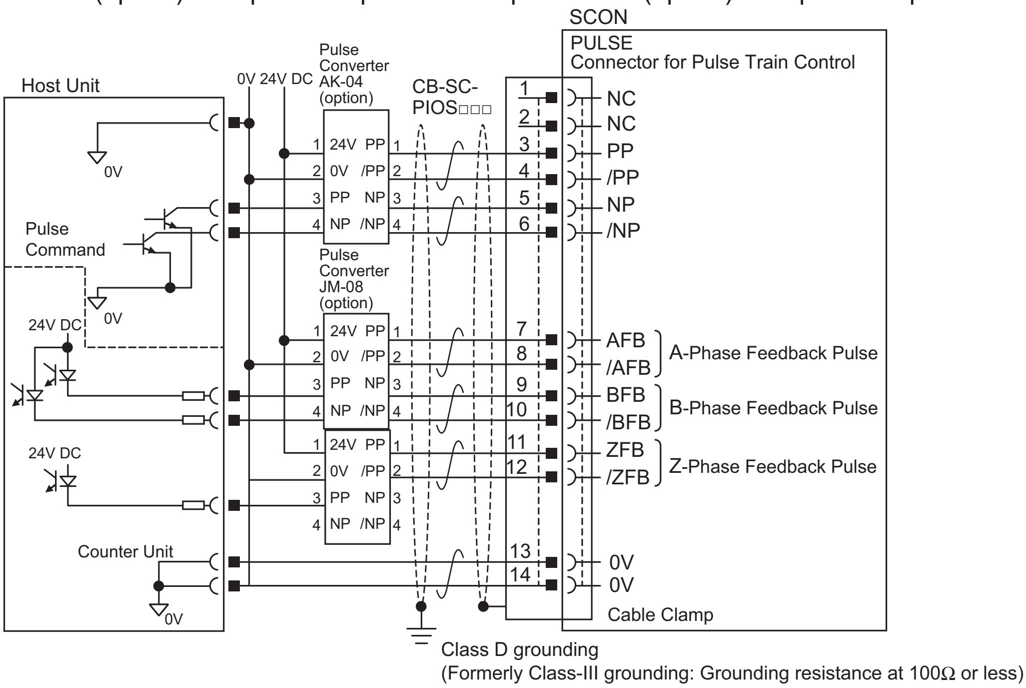
• When Host Unit is Differential System



(Note) Lay out also 0V (COM) if it exists on the host unit.

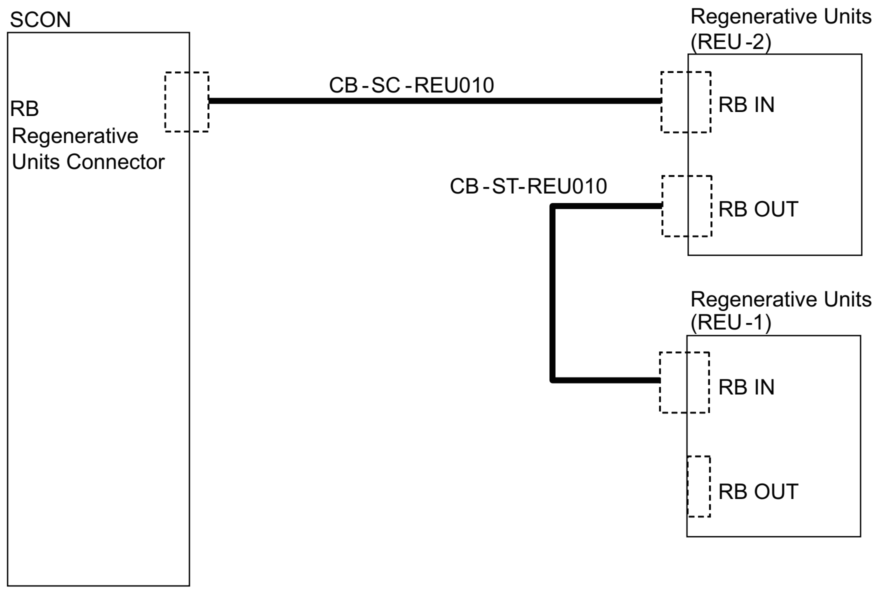
• When Host Unit is Open Collector System

AK-04 (option) is required for pulse train input. JM-08 (option) is required for pulse train output.



⚠ Caution : Use the same power source for the host open collector input and output, AK-04 and JM-08.

[7] Regenerative Units Circuit



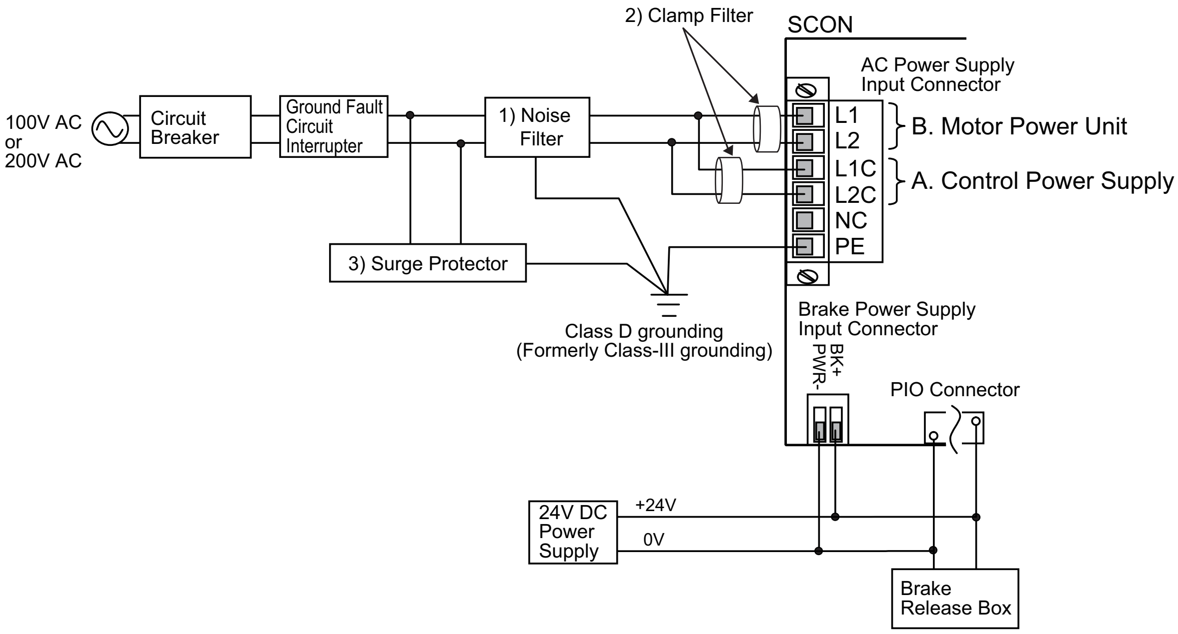
2.3 Wiring Method

2.3.1 Wiring of Power Circuit

Supply the appropriate power from the following considering the controller type.

Power Supply Type	Specifications	Reference
Motor Power Supply	100V Specification : 100 to 115V AC ±10% 50/60Hz	
Control Power Supply	200V Specification : 200 to 230V AC ±10% 50/60Hz	
I/O Power Supply	24V DC ±10%	When the PIO is used
Brake Power Supply	24V DC ±10% 1A	For brake equipped type

The figure below shows a sample wiring of the power circuit.



⚠ Caution : Attaching noise filter 1) is a mandatory thing to do. Not doing so may cause error or unexpected operation to the controller because of noise.
Also, the peripheral devices may receive an influence of this controller noise.
Attach 2) and 3) if necessary considering the noise environment and the power supply condition. It is recommended to attach them even though it is not mandatory.

Load current of SCON-CA varies depending on the connected actuator, etc. Select the circuit breaker that suits to the specification.
[Refer to 1.3]

Parts Name		Model	Supplier	Position to attach
1)	Noise Filter	NF2010A-UP	SOSHIN ELECTRIC CO.,LTD	Attach in range of 300mm or less from controller
		MC1210	DENSEI-LAMBDA	
2)	Clamp Filter	ZCAT3035-1330	TDK	Attach as close as possible to controller
3)	Surge Protector	R • A • V-781BWZ-2A	Okaya ELECTRIC CO.,LTD	Attach at the input terminal of noise filter

● AC Power Supply Input Connector

Connector Name	AC Power Supply Input Connector	
Cable Side	MSTB2-5/6-STF-5.08	Enclosed in standard package
Controller Side	MSTB2-5/6-GF-5.08	

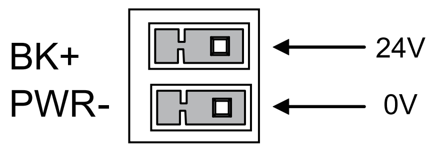
Note 1 The input power voltage cannot be changed after the delivery. Supply the power voltage that meets the specification.

Pin No.	Signal Name	Contents	Applicable cable diameter
1	L1	Motor AC power input	KIV 2mm^2 (AWG14)
2	L2	Motor AC power input	
3	L1C	Control AC power input	KIV 0.75mm^2 (AWG18)
4	L2C	Control AC power input	
5	NC	Unconnected	
6	PE	Protective ground line	KIV 2mm^2 (AWG14)

● Brake Power Supply Connector

Connector Name	Brake Power Supply Connector	
Cable Side	MC1.5/2-ST-3.5	Enclosed in standard package
Controller Side	MC1.5/2-G-3.5	

Pin No.	Signal Name	Contents	Applicable cable diameter
	BK+	24V DC power supply input	KIV 0.5mm^2 (AWG20)
	PWR-	24V DC ground	



2.3.2 Wiring for Emergency Stop Circuit (System I/O)

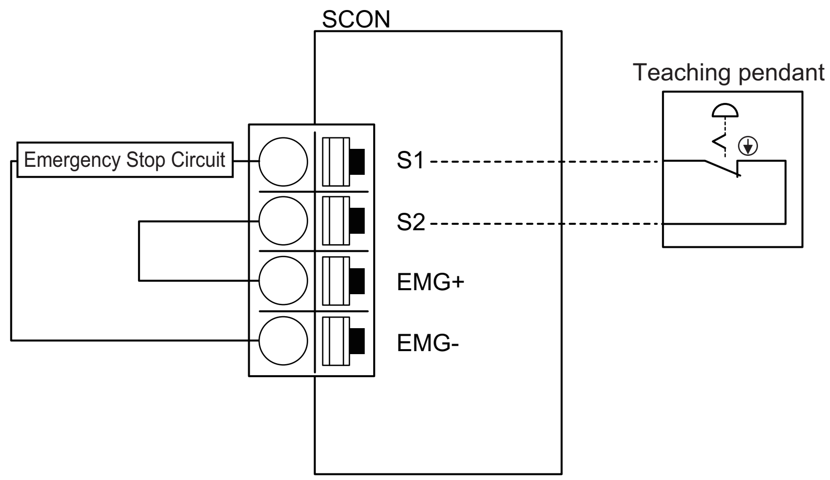
Make sure to construct the wiring of the emergency stop circuit considering the suitability to the Safety Category of the whole system.

● System I/O Connector

Connector Name	System I/O Connector	
Cable Side	FMC1.5/4-ST-3.5	Enclosed in standard package
Controller Side	MC1.5/4-G-3.5	

Pin No.	Signal Name	Contents	Applicable cable diameter
1	S1	Emergency-stop switch contact output	KIV 0.5mm² (AWG20)
2	S2	Emergency-stop switch contact output	
3	EMG+	Power output for emergency stop	
4	EMG-	Emergency-stop input	

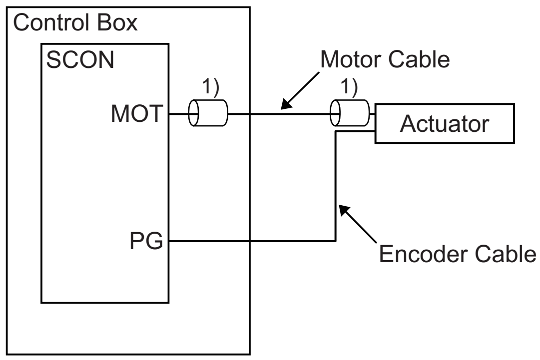
• Basic Circuit Configuration [Refer to 2.1.3 [3], 2.2.3 [3]]



[Refer to Chapter 10 for conformance to Safety Category.]

2.3.3 Connection to Actuator

Connect the motor cable to the MOT connector
Connect the encoder cable to the PG connector.
Connect the brake release box if using RCS2-RA13R or NS Type equipped with brake.



Attach a clamp filter to the motor cable if necessary considering the noise environment.

	Parts Name	Model	Supplier	Position to attach
1)	Clamp Filter	ZCAT3035-1330	TDK	• Near SCON • Near Actuator

⚠ Caution : For Absolute Type, remove the absolute battery connector from the controller before connecting the encoder cable.

● Specification of connector for Motor Cable

Connector Name	Motor Connector (MOT)	
Cable Side	GIC2.5/4-STF-7.62	
Controller Side	GIC2.5/4-GF-7.62	

Pin No.	Signal Name	Contents	Applicable cable diameter
1	PE	Protective ground line	Cable dedicated for IAI actuators
2	U	Motor drive phase U	
3	V	Motor drive phase V	
4	W	Motor drive phase W	

● Specification of Encoder Connector

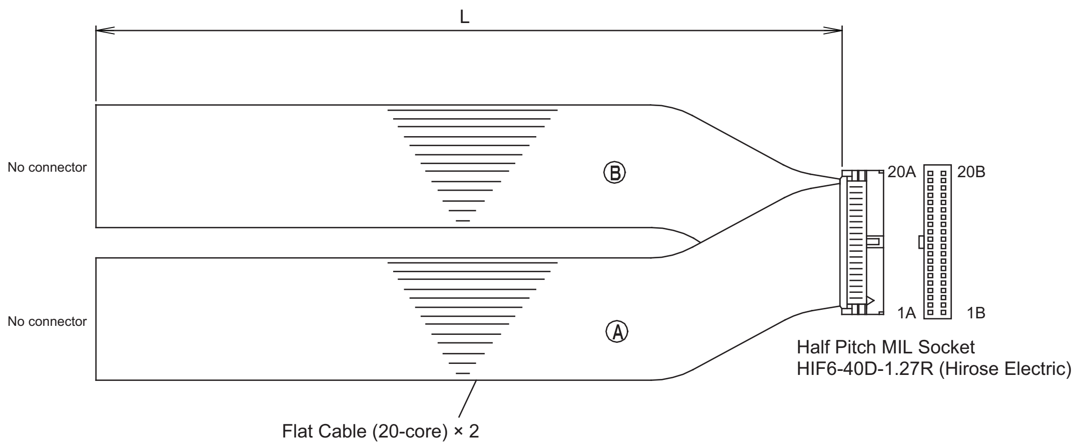
Connector Name	Encoder Connector (PG)	
Cable Side	10126-3000VE	
Controller Side	10226-6202JL	

Pin No.	Signal Name	Contents	Applicable cable diameter
1	A+	Phase A Difference + Input (Phase U+)	Cable dedicated for IAI encoders
2	A-	Phase A Difference - Input (Phase U-)	
3	B+	Phase B Difference + Input (Phase V+)	
4	B-	Phase B Difference - Input (Phase V-)	
5	Z+	Phase Z Difference + Input (Phase W+)	
6	Z-	Phase Z Difference - Input (Phase W-)	
7	SRD+	Send/Receive Difference + (Pulse/Magnetic Pole Changeover +)	
8	SRD-	Send/Receive Difference - (Pulse/Magnetic Pole Changeover -)	
9	LC_SRD+	Loadcell Communication +	
10	LC_SRD-	Loadcell Communication -	
11	NC	Unconnected	
12	E24V	Sensor Power Output	
13	0V	24V Power Supply GND	
14	BAT+	Backup Battery Power Supply	
15	BAT-	Battery Ground	
16	VCC	Encoder Power	
17	GND	GND	
18	LC_VCC	Loadcell Power +	
19	LC_GND	Loadcell Power -	
20	BKR-	Brake Release Output Signal - (COM : Common to All Axes)	
21	BKR+	Brake Release Output Signal +	
22	NC	Unconnected	
23	RSV	Sensor Input RSV	
24	OT	Sensor Input OT	
25	CLEEP	Sensor Input CLEEP	
26	LS	Sensor Input LS	

2.3.4 Connection of PIO

Conduct the connection of I/O to the controller is to be carried out using the dedicated I/O cable. Cable length is to be indicated in the controller model code. Please check the controller model code. A desired I/O cable can be selected from 2m (standard), 3m, and 5m cables. Up to 10m I/O cables are sold separately.
Also regarding the cable for connection to the host controller (PLC, etc.), the terminal end is just cut and no connector is attached nor any treatment is applied so the user can make a free wiring layout.

Model : CB-PAC-PIO□□□
(□□□ indicates the cable length L. Example. 020 = 2m)



No.	Cable Color	Wiring	No.	Cable Color	Wiring
1A	BR-1	Flat Cable Ⓐ (Press Welding) AWG28	1B	BR-3	Flat Cable Ⓑ (Press Welding) AWG28
2A	RD-1		2B	RD-3	
3A	OR-1		3B	OR-3	
4A	YW-1		4B	YW-3	
5A	GN-1		5B	GN-3	
6A	BL-1		6B	BL-3	
7A	PL-1		7B	PL-3	
8A	GY-1		8B	GY-3	
9A	WT-1		9B	WT-3	
10A	BK-1		10B	BK-3	
11A	BR-2		11B	BR-4	
12A	RD-2		12B	RD-4	
13A	OR-2		13B	OR-4	
14A	YW-2		14B	YW-4	
15A	GN-2		15B	GN-4	
16A	BL-2		16B	BL-4	
17A	PL-2		17B	PL-4	
18A	GY-2		18B	GY-4	
19A	WT-2		19B	WT-4	
20A	BK-2		20B	BK-4	

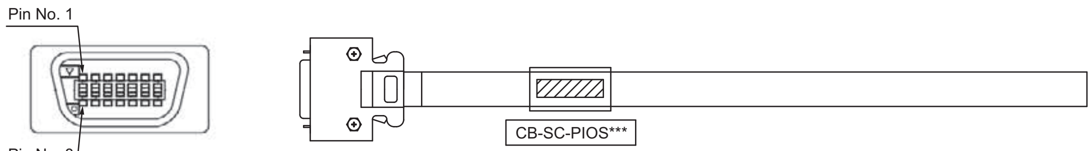
For the signal assignment of each wire, refer to the following considering the operation mode.
1) Positioner Mode·······························2.1.3 [5] PIO Circuit
2) Pulse Train Control Mode···············2.2.3 [5] PIO Circuit

2.3.5 Connection of Pulse Train Signal

Only the plug and the shell are equipped for the standard type.
Perform the same cable layout as the optional connector cable for the pulse train control.

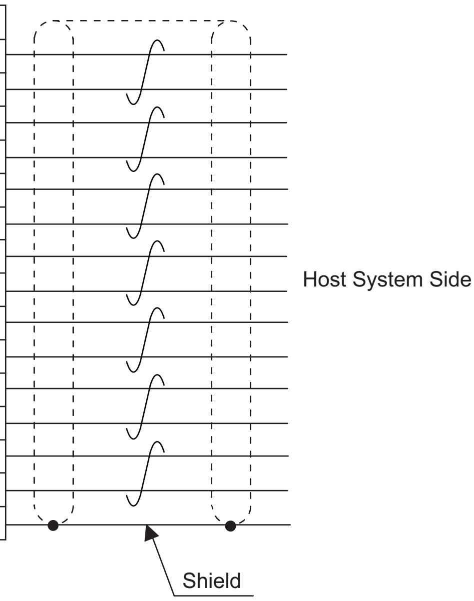
[1] Standard Type (Plug + Shell)
The plug and shell are standard accessory.
Plug : 10114-3000PE (Supplier : 3M)
Shell : 10314-52F0-008 (Supplier : 3M)
The assignment of the signal is the same as [2] Cable for Pulse Control in Option. Refer to that to perform the connection.
Use the multiple twisted pair shielded cable with AWG24 (0.2mm^2). When using the cables of the host controller (PLC, etc.), solder it directly to the connector.
Also, to prevent the noise influence as much as possible, make the cable as short as possible.

[2] Cable with Connectors for Pulse Train Control (Option)
Model : CB-SC-PIOS□□□ □□□ indicates the cable length Example) 020 = 2m
Cable length : 10m MAX. in differential mode
2m MAX. in open collector mode
Note : There is no connector equipped on the host controller (PLC, etc.) side. Make an appropriate treatment that suits the host controller (PLC, etc.). Also, to prevent the noise influence as much as possible, make the cable as short as possible.

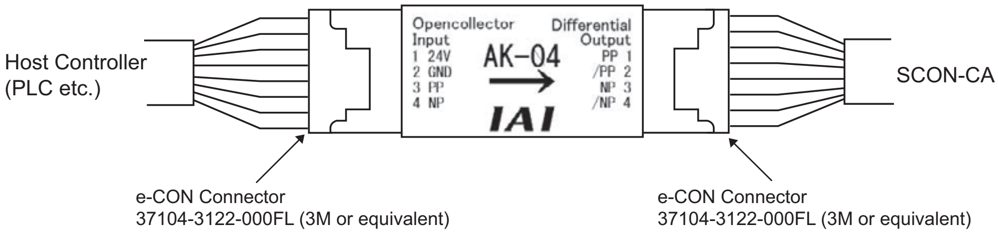


Plug : 10114-3000PE (Sumitomo 3M)
Shell : 10314-52F0-008 (Sumitomo 3M)

Wiring	Color	Symbol	Signal Name	No.
AWG24 (0.2mm^2) Soldered	BK	–	–	1
	WT/BK	–		2
	RD	PP	Pulse Train Input	3
	WT/RD	/PP		4
	GN	NP		5
	WT/GN	/NP		6
	YW	AFB	+A	7
	WT/YW	/AFB	−A	8
	BR	BFB	+B	9
	WT/BR	/BFB	−B	10
	BL	ZFB	+Z	11
	WT/BL	/ZFB	−Z	12
	GY	GND	Line Driver Output Line for Feedback Pulse Output	13
	WT/GY	GND		14
Shield is connected to the cable clamp				



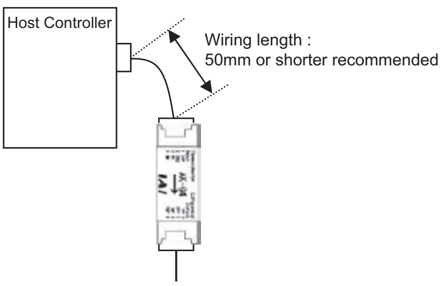
[3] Pulse converter : AK-04
The pulse converter converts command pulses in the open collector mode to those in the differential mode.
Use this converter if the host controller sends output pulses in the open collector mode.



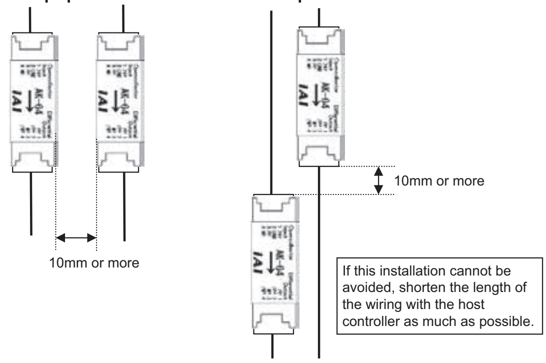
> ⚠ Caution
>
> 1) Pay attention not to insert wrongly because it is the same e-CON connector as input and output. Putting the power on with the insertion being wrong will burn AK-04.
> 2) Use the pulse converter in the ambient temperature range between 0ºC and 40ºC.
> 3) The temperature increase of about 30ºC occurs during operation. Accordingly, neither install several pulse converters in close contact nor install them within a duct. Do not install the pulse converter near other heating devices.
> 4) If more than one pulse converters are installed, set a pulse converter apart from another by 10mm or more.
> 5) Make the wiring between the host controller (PLC, etc.) and AK-04 as short as possible. Long one is easy to pick the noise. Also make the wiring between AK-04 to SCON-CA as short as possible.
> Place AK-04 close to the host controller.

A recommended installation sample is shown in the figure below.

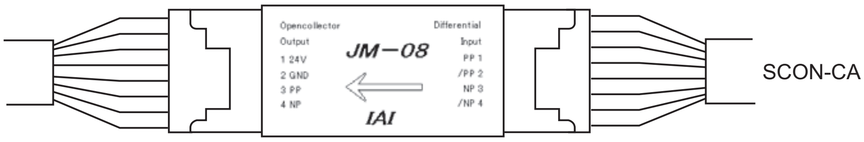
- Make the cable length between the host controller and pulse converter as short as possible.



- Keep pulse converters separated for 10mm or more from each other.



[4] Pulse converter : JM-08
The pulse converter converts feedback pulses in the differential mode into those in the open collector mode.
Use this converter in the case the pulse input of the host controller is open collector (24V) type.

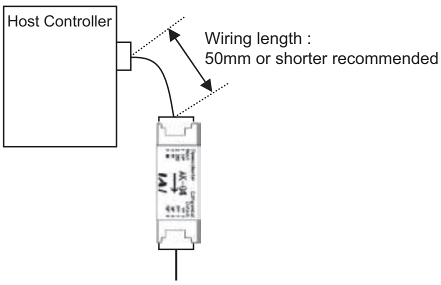


Caution

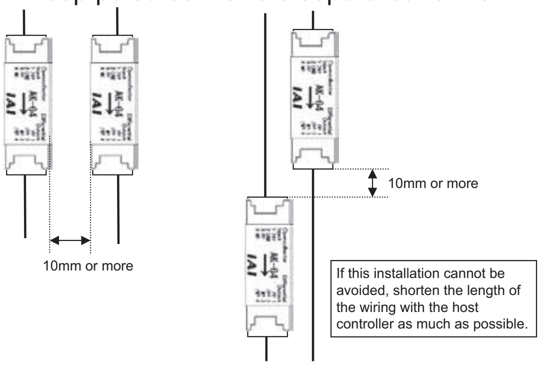
1) Pay attention not to insert wrongly because it is the same e-CON connector as input and output. Putting the power on with the insertion being wrong will burn JM-08.
2) Use the pulse converter in the ambient temperature range between 0ºC and 40ºC.
3) The temperature increase of about 30ºC occurs during operation. Accordingly, neither install several pulse converters in close contact nor install them within a duct. Do not install the pulse converter near other heating devices.
4) If more than one pulse converters are installed, set a pulse converter apart from another by 10mm or more.
5) Make the wiring between the host controller (PLC, etc.) and JM-08 as short as possible. Long one is easy to pick the noise. Also make the wiring between JM-08 to SCON-CA as short as possible.
Place JM-08 close to the host controller.

A recommended installation sample is shown in the figure below.

- Make the cable length between the host controller and pulse converter as short as possible.

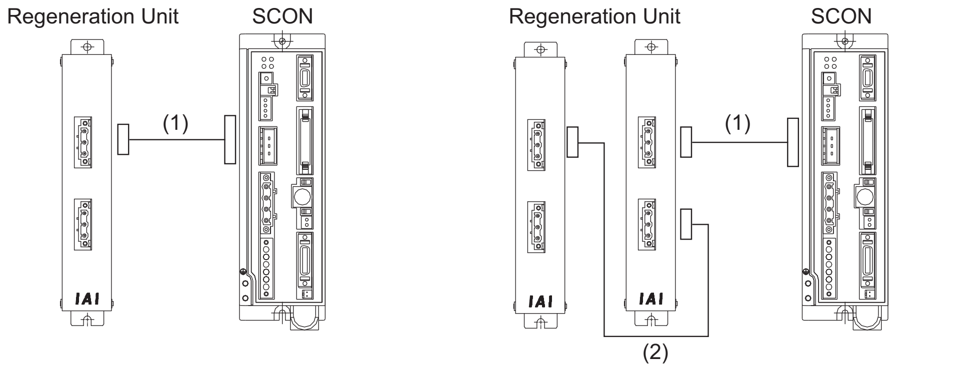


- Keep pulse converters separated for 10mm or more from each other.



2.3.6 Connectable Regenerative Units

Connect regenerative unit (s) with attached cables as shown in the figure below.
1) When connecting 1 unit : Connect with enclosed cable (CB-SC-REU)
2) When connecting 2 or more units : Connect with enclosed cable (CB-ST-REU)



● Specification of connector for connecting external regenerative unit

Connector Name	External Regenerative Unit Connector (RB)	
Cable Side	1-178128-3	
Controller Side	1-178138-5	

Pin No.	Signal Name	Contents	Applicable cable diameter
	RB+	Regeneration Resistor + (Motor drive DC voltage)	Dedicated cable is enclosed to regenerative unit
	RB-	Regeneration Resistor -	
	PE	Ground Terminal	

[1] Controller link cable

1) Regenerative resistance connection cable for SCON (CB-SC-REU□□□)

□□□ indicates the cable length (Example) 010 = 1m

Wiring	Color	Signal	No.		No.	Signal	Color	Wiring
KIV 1.0mm² (AWG17)	Light Blue	RB+	1		1	RB+	Light Blue	KIV 1.0mm² (AWG17)
	Brown	RB-	2		2	RB-	Brown	
	Green/Yellow	PE	3		3	PE	Green/Yellow	

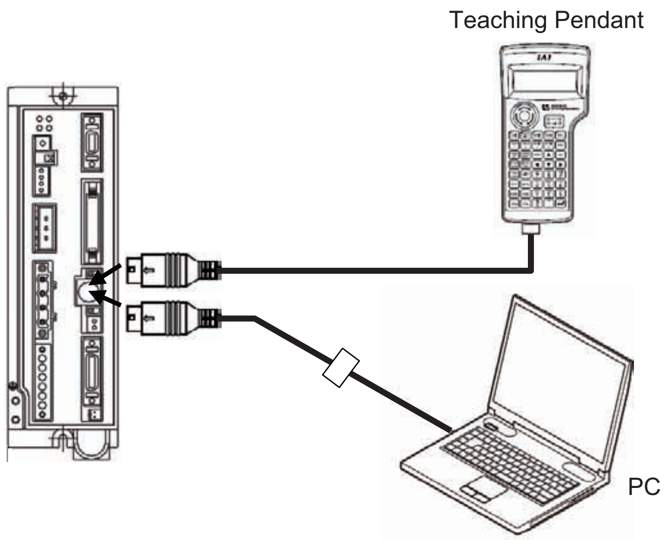
2) Regenerative resistance connection cable for XSEL (CB-ST-REU□□□)

□□□ indicates the cable length (Example) 010 = 1m

Wiring	Color	Signal	No.		No.	Signal	Color	Wiring
KIV 1.0mm² (AWG17)	Light Blue	RB+	1		1	RB+	Light Blue	KIV 1.0mm² (AWG17)
	Brown	RB-	2		2	RB-	Brown	
	Green/Yellow	PE	3		3	PE	Green/Yellow	

2.3.7 SIO Connector Connection

SIO connector can be used not only for the connection of the teaching tools, but also for the connections of ROBONET, Gateway Unit and the host controller (PLC, touch panel and PC). For the operation, refer to the instruction manual of each module.
[Refer to 1.1.3 Instruction manuals related to this product, which are contained in the instruction manual (CD/DVD).]



> ⚠ Caution : If the controller is connected with a teaching tool, set the operation mode setting switch to MANU.
>
> Removing the teaching pendant while the power is ON causes a transient emergency stop. Thus, the devices such as the actuator which are in operation will stop.
> Do not disconnect the teaching pendant during the operation.

Chapter 3 Operation

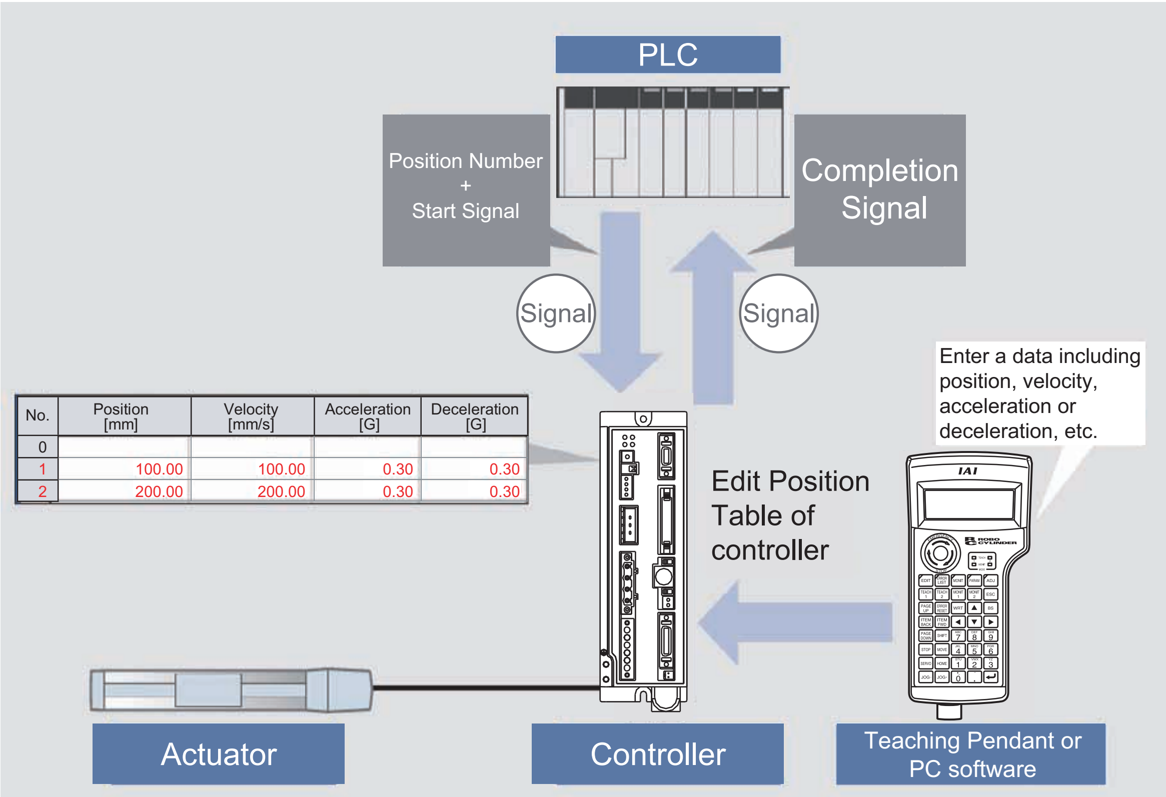
3.1 Basic Operation

3.1.1 Basic Operation Methods

There are two types, Positioner Mode and Pulse Train Control Mode, for the operation. Select the suitable one considering the system function.

There are various types of actuators including slider, rod, rotary and gripper types. The same operation control method is applicable unless particular descriptions are contained in this manual.

(1) Positioner Mode



1) Set target positions (coordinate values), velocities, accelerations, and decelerations by the required number of positioning points in the position table by using a teaching tool such as PC software.

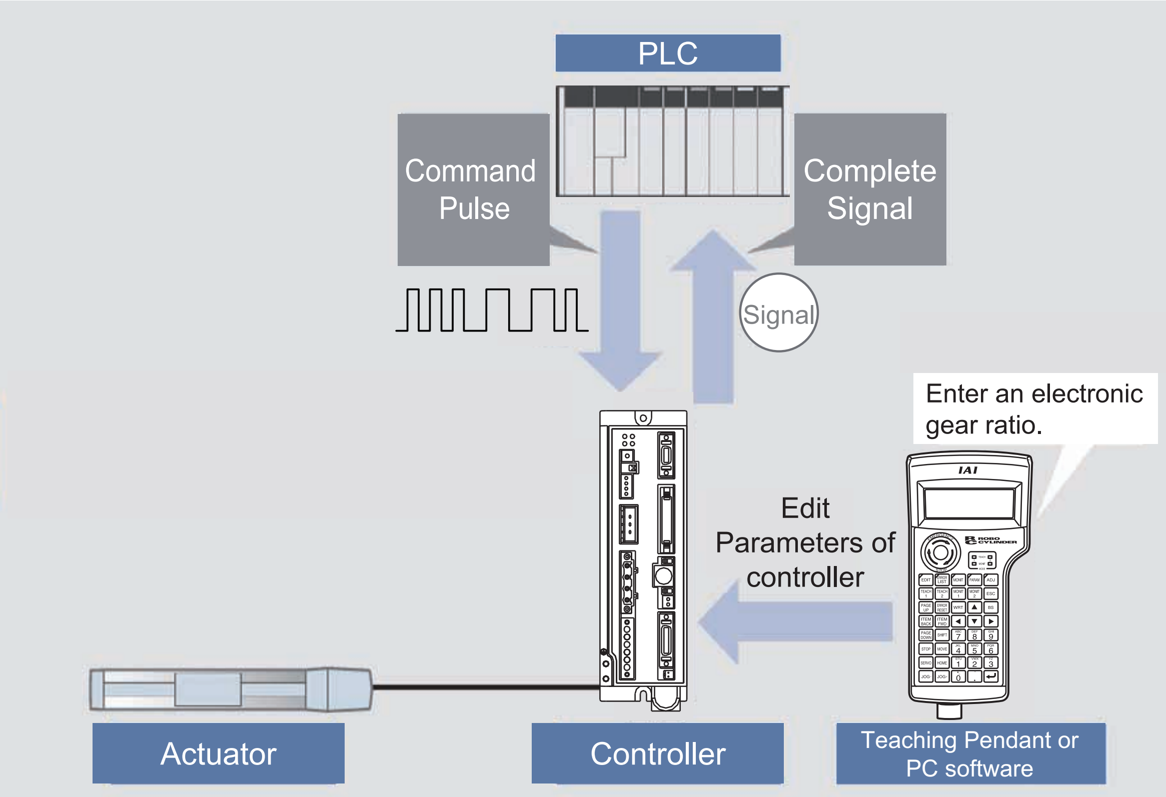
2) Enter the binary data of position numbers subject to positioning on the PLC and turn ON the start signal.

3) The actuator is placed at the proper coordinate value according to the positioning information in the specified position number.

4) If the positioning is completed, the binary data of the position number is output. The completion signal is also output.

The above procedure describes the basic operation method in the positioner mode.

(2) Pulse Train Control Mode



1) Set the pulse train format and the electric gear ratio (the distance of actuator movement in mm against 1 pulse) to the parameters in the controller with using a teaching tool such as PC software.

2) Send pulses based on the moving distance of the actuator to the controller from the PLC (positioning unit).

3) The controller multiplies the entered number of pulses by the electrical gar ratio to get the moving distance. The actuator is moved by the moving distance from the current position. The velocity varies depending on the entered pulse rate (frequency).

4) After the positioning is completed, the completion signal is output.

The above procedure describes the basic operation method in the pulse train control mode.

3.1.2 Parameter Settings

Parameter data should be set to be suit to the system or application. Parameters are variables to be set to meet the use of the controller in the similar way as settings of the ringtone and silent mode of a cell phone and settings of clocks and calendars.

(Example)

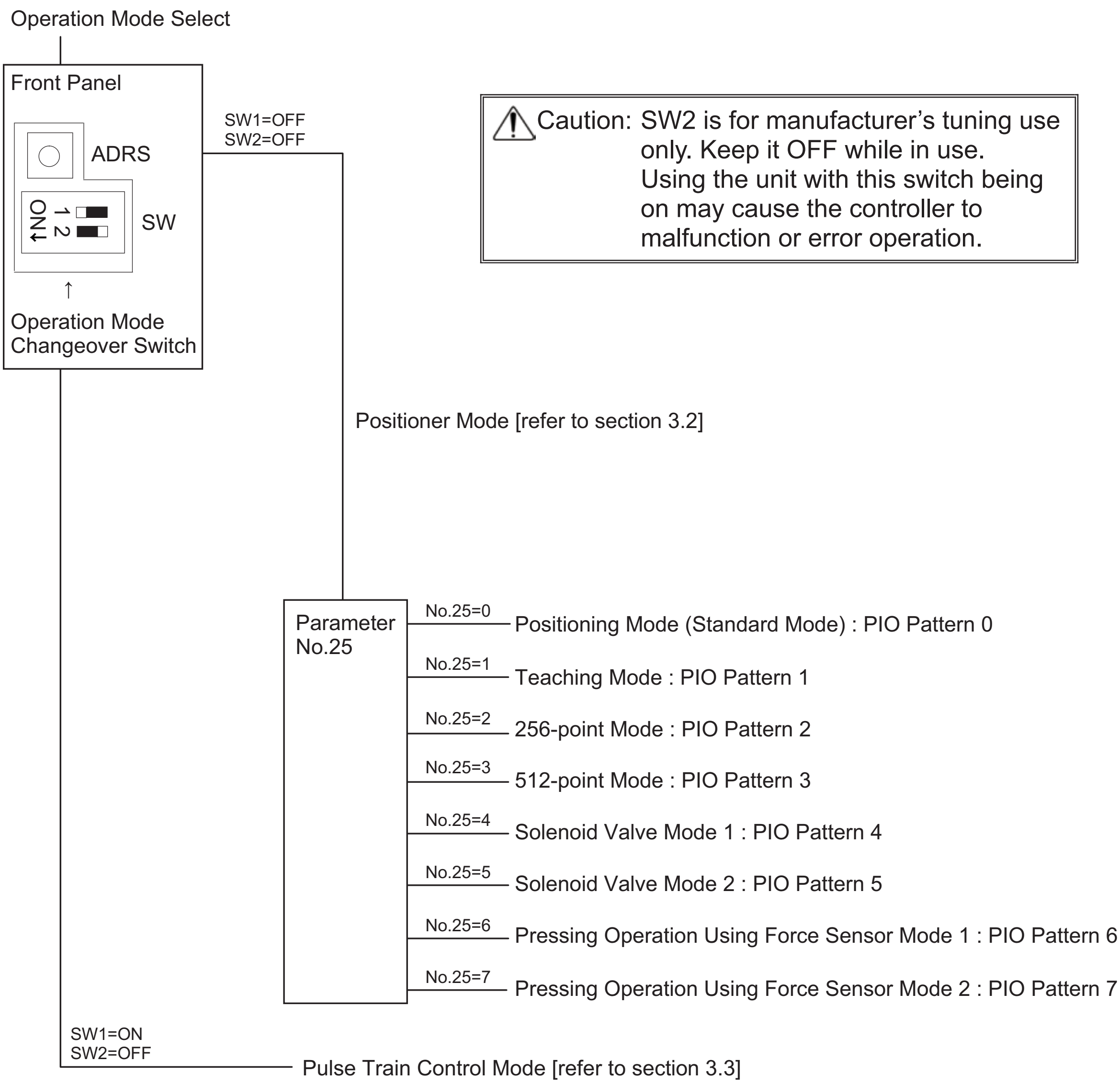
Soft Stroke Limit	:	Set a proper operation range for definition of the stroke end, prevention of interferences with peripherals and safety.
Zone Output	:	Set to require signal outputs in an arbitral position zone within the operation zone.

Parameters should be set to meet the use of the controller prior to operation. Once set, they may not set every operation.
Refer to Chapter 8 for the parameter types and the details.

3.2 Operation in Positioner Mode

This controller has a function to switch over the mode between Positioner Mode and Pulse Train Control Mode with the switch on the front of the controller. In the positioner mode, the following 8 types of PIO pattern can be selected with a proper parameter.
This Operational PIO Pattern cannot be switched over after the system is finished to be established or during the actuator operation. Choose the optimum pattern beforehand considering the system operation specifications and prepare the cables and sequence design.

> ⚠ Caution: SW2 is for manufacturer's tuning use only. Keep it OFF while in use. Using the unit with this switch being on may cause the controller to malfunction or error operation.



[1] PIO Pattern Selection and Main Functions ○: Valid function

PIO Pattern (Parameter No.25)		0	1	2	3	4	5	6	7
Mode		Positioning mode	Teaching mode	256-point mode	512-point mode	Solenoid valve mode 1	Solenoid valve mode 2	Pressing operation using force sensor mode 1	Pressing operation using force sensor mode 2
Major functions	Number of positioning points	64	64	256	512	7	3	32	5
	Operation with the Position No. Input	○	○	○	○	×	×	○	×
	Position No. direct command operation	×	×	×	×	○	○	×	○
	Positioning	○	○	○	○	○	○	○	○
	Velocity change during the movement	○	○	○	○	×	×	○	×
	Pressing (tension)	○	○	○	○	○	×	Δ*2	Δ*2
	Pressing in use of force sensor	×	×	×	×	×	×	○	○
	Pitch Feeding (relative moving feed)	○	○	○	○	○	×	○	○
	Home return signal input	○	○	○	○	○	×	○	○
	Pause	○	○	○	○	○	Δ*1	○	○
	Jog moving signal	×	○	×	×	×	×	×	×
	Teaching signal input (Current Position Writing)	×	○	×	×	×	×	×	×
	Brake release signal input	○	×	○	○	○	○	○	○
	Moving Signal Output	○	○	×	×	×	×	×	×
	Zone signal output	○	×	×	×	○	○	×	×
	Position zone signal output	○	○	○	×	○	○	○	○
	Position detection feedback pulse output	○	○	○	○	○	○	○	○
	Vibration Control	○	○	○	○	○	○	○	○

*1 The pause signal is not provided. Refer to 3.2.4 [8].
*2 Tensile operation is not allowed.

(Reference)

Zone signal output signal : Set the zone range in parameter No.1 and 2. The signal is always effective after home return is completed.

Position zone signal : This feature is associated with the specified position number. The zone range is set in the position table. The zone range is enabled only when the position is specified but disabled if another position is specified.

[2] Overview of major Functions

Function	Description
Number of positioning points	Number of positioning points which can be set in the position table.
Operation with the Position No. Input	Normal operation started by turning the start signal ON after position No. is entered with binary data.
Position No. direct command operation	Operation enabled by turning the signal directly corresponding to a position No. ON
Positioning	Positioning enabled at an arbitrary position by the data set in the position table
Velocity change during the movement	Velocity change enabled by activating another position No. during movement
Pressing (tension)	Operation by an arbitrary pressing (tensile) force set in the position table enabled
Pressing in use of force sensor	Highly precise pressing enabled by measuring the current pressing force by using a force sensor (loadcell) to control it
Pitch Feeding (relative moving feed)	Pitch feed by an arbitrary moving distance set in the position table enabled
Home return signal input	Input signal exclusively used for home return. Set to ON to start home return
Pause	The operation can be interrupted or continued by setting this signal to ON or OFF, respectively.
Jog moving signal	The actuator can only be moved while the input is set to ON.
Teaching signal input (Current Position Writing)	Setting the input signal to ON allows the coordinate value in the stop state to be written to the position table.
Brake release signal input	The brake (option) can only be released while the input is set to ON.
Moving Signal Output	The output signal is set to ON while the actuator is moved.
Zone signal output	The output signal is set to ON while the actuator is entered within the zone defined by the coordinate values set as parameters.
Position zone signal output	The output signal is set to ON while the actuator is entered within the zone defined by the coordinate values set in the position table.
Position detection feedback pulse output	Feedback pulses sent out from the encoder can be subject to differential output. [Refer to Section 3.3 Operation in Pulse Train Control Mode for details.]
Vibration Control	Vibrations of the load installed on the actuator can be suppressed. However, this is invalid in the home return and pressing operations.

[3] Operation modes of rotary actuator in multiple rotation mode and command limitations

An actuator of multi-rotation specification includes two operation modes, or the normal mode enabling only a limited number of rotations and the index mode [Note 1] enabling a number of rotations. A specific operation mode can be selected by parameter No.79 “Rotational axis mode selection”. Parameter No.80 “Rotational axis shortcut selection” allows the shortcut to be made valid or invalid.
The table below lists the settings of parameters and the operation specification in each mode.

Rotary axis mode Parameter No.79	Rotational axis shortcut selection Parameter No.80	Current position indication	Absolute position command zone	Relative position command zone	Soft Limit Enabling/ Disabling
0 (Normal Mode)	0 (Disabled)	-9999.99 to 9999.99 [Note 2]	-0.15 to 9999.15 [Note 2]	-9999.30 to 9999.30 [Note 2]	Enabled
1 (Index Mode)	0 (Disabled)	0 to 359.99	0 to 359.99	-360.00 to 360.00	Disabled
	1 (Enabled)				

Note 1: The index mode is unavailable for absolute actuators.
Note 2: It is limited within the range of the software limit.

3.2.1 Set of Position Table (This section is not required in selection of pulse train control mode.)

The values in the position table can be set as shown below. For only positioning, only the position data may be written if specifying the speed, acceleration, and deceleration is not required. The speed, acceleration, and deceleration are automatically set to the data defined by the relevant parameters. Therefore, setting the speed, acceleration, and deceleration data often used to the relevant parameters makes input easy.

1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	11)	12)	13)	14)	15)	
No.	Position [mm]	Velocity [mm/s]	Acceleration [G]	Deceleration [G]	Pressing [%]	Threshold [%]	Positioning width [mm]	Zone+ [mm]	Zone- [mm]	Acceleration/ Deceleration mode	Incremental	Gain set	Stop mode	Vibration suppress No.	Comment
0	0.00	100.00	0.30	0.30	0.00	0.00	0.10	0.00	0.00	0	0	0	0	0	
1	100.00	100.00	0.30	0.30	0.00	0.00	0.10	0.00	0.00	0	0	0	0	0	
2	150.00	200.00	0.30	0.30	50.00	0.00	30.00	0.00	0.00	0	0	0	0	0	
3	200.00	400.00	1.00	1.00	0.00	0.00	0.10	0.00	0.00	0	0	0	0	1	
4	200.00	200.00	0.30	0.30	0.00	0.00	0.10	250.00	230.00	0	0	0	0	2	
5	500.00	50.00	0.10	0.10	0.00	0.00	0.10	0.00	0.00	0	0	0	0	0	
6															
7															

> ⚠ Caution: The input value is treated as the angle for the rotary actuator.
> Therefore;
> [mm] → [deg]:················ 1.2 = 1.2deg
> [mm/s] → [deg/s]: ·········· 100 = 100deg/s
> Note that the notation is [mm] on the screen of the teaching tool such as PC software.

1) Position No.············· It is the number commanded by PLC in operation command.

> ⚠ Caution: Do not use position No.0 if available positions remains enough.
> At the first servo ON after power ON, the completed position No. output is 0 even if the actuator is not located at position No.0. The actuator enters into the same state as that at positioning to position No.0. The completed position No. output is 0 during movement of the actuator. To use position No.0, get the command history by using the sequence program to check completed position No.0 based on the history.

2) Position [mm] ·········· Positioning coordinate value. Enter it as the distance from the home position.
For pitch feed (relative movement = incremental feed), enter the pitch width.
A value with – indicates that the actuator moves toward the home position. A value without – indicates that the actuator moves to be away from the home position.

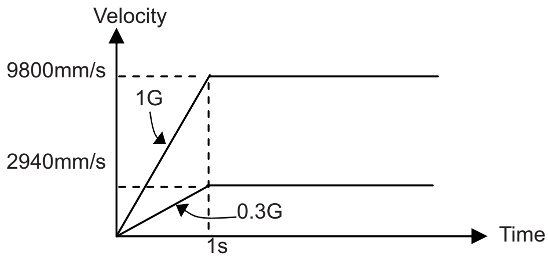
> ⚠ Caution: (1) In the case of a Gripper Type:
> Set the coordinate value on the single finger basis. Set the moving distance of a single finger from the home. In the specification, the stroke indicates the total moving distance of both fingers.
> Thus the actual stroke is a half of the value in the specification.
> (2) In the case of a Rotary Type
> Set the coordinate value by an angle from the home.

3) Velocity [mm/s] ········· Set the velocity in the operation.
Do not attempt to input a value more than the maximum velocity.

4) Acceleration [G] ······· Set the acceleration at start.

5) Deceleration [G] ······· Set the deceleration at stop.

(Reference) How to set the acceleration is described below. The same idea can be applied to the deceleration.
1G=9800mm/s^2: Accelerated to 9800mm/s per second
0.3G: Accelerated to 9800mm/s × 0.3 = 2940mm/s per second



Caution: (1) Set the velocity, acceleration and deceleration so that they do not exceed the rating values described in the brochure or the instruction manual of the actuator. Failure to follow this may cause the life of the actuator to be shortened extremely.
(2) If shocks and/or vibrations appear on the actuator and/or the work, lower the acceleration and/or the deceleration. In such cases, do not continue the use of the actuator, otherwise the product life may be shortened extremely fast.
(3) If the carriage weight is extremely lighter than the rating carriage weight, acceleration/deceleration larger than their rating values to shorten the tact time. Please contact IAI for the settings in such situation. Inform us of the weight, shape and mounting method of the work and the installation conditions of the actuator.
(4) For the actuator of gripper type, set the velocity, acceleration and deceleration on the single finger basis. Note that the relative velocity, acceleration and deceleration between both the fingers are as twice as the setting values.

6) Pressing [%] ············ Setting proper data here allows pressing to be done. Set a pressing torque (limit current value) in %. If the value is set to 0, the normal positioning operation is performed.
The speed for the pressing operation is set in Parameter No.34.
If the setting done in 3) is less than the pressing speed setting value, the pressing operation is performed at this setting value.
For pressing operation using force sensor, set the pressing force by percent of the base thrust in pressing operation using force sensor.

* Base thrust in pressing operation using force sensor: Converted thrust at rating motor output in pressing operation using force sensor

Actuator		Base thrust in pressing operation using force sensor [N]
RCS2-RA13R	1t Type	4900
	2t Type	9800

Example: 7350N for setting of 150% of 1t type

7) Threshold [%] ·········· Set the threshold value of the pressing torque in %.
If the torque (load current) becomes larger than this setting value during pressing, the detection signal is output. This feature is used to monitor the load current and judge whether the operation is good or not in such an operation as press fitting in pressing.

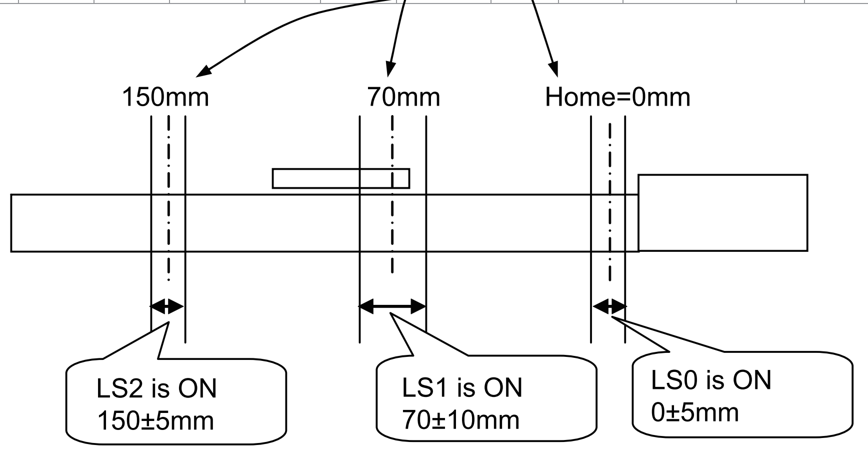
Chapter 3 Operation

8) Positioning width [mm] ······For positioning in PIO patterns[*1] 0 to 4, 6 or 7, the positioning complete signal is output if the remaining moving distance is entered within the zone set here.
For pressing, the actuator is moved at the setup velocity and acceleration/deceleration in the same way as normal positioning to the position of the coordinate value set in 2) and then performs pressing movement by the data set here.
For PIO pattern 5, the positioning band is not the complete signal output range against positioning command. Despite the specified position number, the relevant output signal (LS*) is turned ON when the actuator reaches the setting range. The operation is accomplished as if a sensor were installed to detect the actuator. PIO pattern 5 does not correspond to the pressing operation.
*1 PIO pattern : This is the operation pattern of Positioner mode.
[Refer to 3.2 Operation in Positioner Mode]

[Example of PIO pattern 5]

The figure below shows the position table and the position at which each of the LS signals is turned ON. If the actuator passes any of the positioning bands in the operation by another position number or manual operation in the servo-off state, the relevant LS signal is always turned ON.

No.	Position [mm]	Velocity [mm/s]	Accele-ration [G]	Decele-ration [G]	Pressing [%]	Thresh-old [%]	Positioning width [mm]	Zone+ [mm]	Zone- [mm]	Acceleration/ Deceleration mode	Incre-mental	Gain set	Stop mode
0	0.00	250.00	0.20	0.20	0	0	5.00	0.00	0.00	0	0	0	0
1	70.00	250.00	0.20	0.20	0	0	10.00	0.00	0.00	0	0	0	0
2	150.00	250.00	0.20	0.20	0	0	5.00	0.00	0.00	0	0	0	0

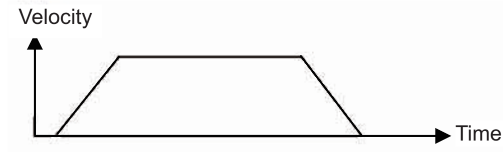
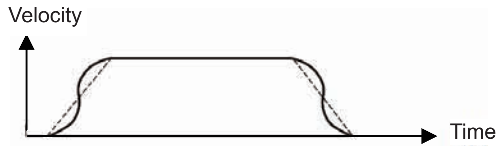
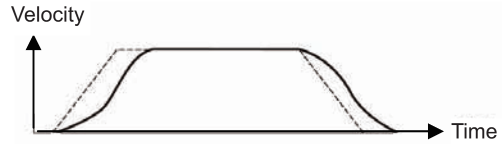


9) Zone + [mm] (Note) ·····Set the coordinate value on the positive side at which position zone output signal PZONE is turned ON. PZONE is set to ON in the zone between this value and the coordinate value on the negative side set in 10).
The feature follows the specified position number. It is valid only when the position is specified but invalid in another position operation.

10) Zone - [mm] (Note) ······Set the coordinate value on the negative side at which position zone output signal PZONE is turned ON.

(Note) If set to Zone + < Zone -, PZONE Signal turns ON out of the ranges of Zone + and Zone -.

11) Acceleration / deceleration mode ······ Select a proper acceleration/deceleration pattern depending on the load.

Set Value	Acceleration/ Deceleration Pattern	Operation
0	Trapezoid	
1	S-motion (Refer to Caution at S-shaped Motion)	 Set the S-motion rate with parameter No.56.
2	First-Order Delay Filter (Refer to Caution at First-order Delay Filter)	 Set the delay time constant with parameter No.55.

⚠ Caution at S-shaped Motion:

1) Since it requires a speed change during the operation, even if having the position command or direct command that S-shaped motion is set while the actuator is moving, S-shaped motion control cannot be performed and will be the trapezoid control.
   Make sure to make a command while the actuator is stopped.
2) S-shaped motion control is invalid in the index mode of the rotary actuator.
   It will be the trapezoid control even if S-shaped acceleration/deceleration control is indicated
3) Do not use S-shaped acceleration/deceleration control if the setting of the acceleration time or the deceleration time exceeds 2 seconds. It will be the trapezoid control.
4) Do not pause on the move during acceleration or deceleration. It will change the speed (acceleration) and may cause a danger.

⚠ Caution at First-order Delay Filter:

1) Since it requires a speed change during the operation, even if having the position command or direct command that first-order delay filter is set while the actuator is moving, first-order delay filter control cannot be performed and will be the trapezoid control.
   Make sure to make a command while the actuator is stopped.
2) First-order delay filter control is invalid in the index mode of the rotary actuator.
   It will be the trapezoid control even if first-order delay filter control is indicated

12) Incremental··············Set to 1 for pitch feed (relative movement = incremental feed).
The value set for the position in 1) indicates the pitch feed distance.
With the value set to 0, positioning is defined to the position in 1) based on the absolute coordinate system.

> ⚠ Caution: In the pitch feed, do not perform a command with a pitch smaller than the minimum encoder resolution (lead/encoder pulse number) or that less than positioning accuracy repeatability.
> There would be no deviation to occur even with the command because it is an operation command to the same position as the positioning complete condition, but the positioning control cannot be performed properly.
> When solenoid valve mode 2 is selected, set this to 0. Setting this to 1 causes the position data error to occur.

13) Gain set····················Six parameters required for servo gain adjustment are collected to be a single set. Up to four sets can be registered to change the servo gain in positioning.
By utilizing Off Board Tuning Function (Note) in the PC software, the setting close to the optimum can be obtained.
(Note) Refer to Section 10 Appendix Connectable Actuators for the applicable models.
It may require the setting of the gain set dedicated for the home-return operation in the case this function is used to have the high-speed setting or the setting to apply a transported weight more than the ratings.
For how to set up and the caution items, refer to the instruction manual for RC PC Software.
[Parameters included in a set:]
- Servo gain number (Position Gain)
- Position feed forward gain
- Speed Loop Proportional Gain
- Speed Loop Integral Gain
- Torque Filter Time Constant
- Current control band number

It is able to establish the gain set that corresponds to the position number to be operated to the indicated gain set.

[Refer to "Servo Adjustment" in Section 8.3 for each gain parameter details.]

Setting	Selected parameter set	Parameter No.
0	Gain set 0	7, 71, 31 to 33, 54
1	Gain set 1	120 to 125
2	Gain set 2	126 to 131
3	Gain set 3	132 to 137

14) Stop mode ················Automatic servo OFF is enabled after a certain period from the completion of positioning for power saving.
A proper period can be selected from three parameters.

Setting	Operation after completion of operation	parameter No.
0	Servo ON not changed	–
1	Automatic servo OFF after certain period	36
2	Automatic servo OFF after certain period	37
3	Automatic servo OFF after certain period	38

⚠ Caution:
- No retaining torque is provided in automatic servo OFF. Pay sufficient attention to the setting because the actuator may be moved by external force applied to it.
- Do not use the automatic servo OFF if the next moving command is relative distance specification (pitch feed). Failure to follow it may cause position shift to occur.
- Do not use the automatic servo OFF in pressing. If used, the pressing force is lost.
- Automatic Servo OFF would not function in the operation with teaching mode of PC software.

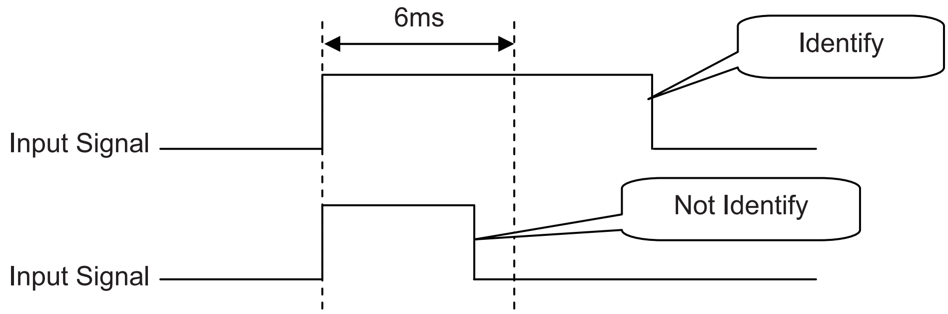
15) Vibration suppress No.····· Suppresses vibration (sympathetic vibration) of the load installed on the actuator.
The vibration suppress No. can accept three types of vibrations.
Four parameters are defined for a single vibration to form a single set.
In the position table, parameter sets are defined to correspond to position numbers for which vibrations must be suppressed.
[Refer to Chapter 5 Vibration Suppress Control Function (Option) for details.]

Setting	Vibration suppress frequency (Natural frequency)	Parameter No.
0	Vibration suppress frequency (Natural frequency)	–
1	Normal position control (no vibration suppress)	97 to 100
2	Vibration suppress control parameter set 1	101 to 104
3	Vibration suppress control parameter set 2	105 to 108

⚠ Caution:
(1) The natural frequency range between 0.5Hz and 30Hz can be suppressed.
(2) The target vibrations are those of the load induced by the actuator connected to the controller.
Any other vibrations cannot be suppressed.
(3) Vibrations to be suppressed should be in the same direction as that in which the actuator is moved. Vibrations in any other directions cannot be suppressed.
(4) The function is not applied to the home return and pressing operations.
(5) The function is not available in the pulse train control mode.
(6) One or more setting vibration frequencies are rather low, the tact time may be long. With a vibration frequency being 6Hz or less, the positioning convergence time is 150ms or longer.

3.2.2 Control of Input Signal

The input signal of this controller has the input time constant of 6ms considering the prevention of wrong operation by chattering and noise.
Therefore, input each input signal for 6ms or more (Note) continuously. The signal cannot be identified if it is less than 6ms.



(Note) It is necessary to input 26ms or more for PWRT Signal of PIO Pattern 1.
[Refer to 3.2.4 Operation with Position No. Input = Operations of PIO Patterns 0 to 3 and 6.]

3.2.3 Operation Ready and Auxiliary Signals = Common to Patterns 0 to 7

[1] Emergency stop status (EMGS)

PIO signal	Output
	*EMGS
Common to Patterns 0 to 7	○

○ : Available, ×: Unavailable

1) Emergency Stop Status EMGS is usually turned on and is turned off when "2.1.3 [3] Power and Emergency Stop Circuit" is open between EMG+ and EMG- (emergency stop condition or not connected).
2) It turns back ON if the emergency stop condition is released and the circuit is closed between EMG+ and EMG-.

Have an appropriate safety treatment such as interlock with this signal for the host controller (PLC, etc.).
[Caution] EMGS is different from the emergency stop output caused by a controller alarm.

[2] Operation Mode (RMOD, RMDS)

PIO signal	Input	Output
	RMOD	RMDS
Common to Patterns 0 to 7	○	○

○ : Available, ×: Unavailable

Two operation modes are provided so that the operation by PIO signals does not overlap with the operation by a teaching tool such as PC software through SIO (serial) communication.
The mode change is normally done by the operation mode setting switch ON the front panel of the controller.

AUTO·········Operation by PIO signals is valid.
MANU·········Operation through SIO (serial) communication is valid.

However, when having the controller in link connection (Note 1) and the teaching tool such as PC software being connected using SIO converter, there is a case the controller and the teaching tool are placed far from each other. In such a case, the controller can be entered into the MANU mode by setting PIO signal RMOD to ON.
Because the RMDS signal is set to ON with the MANU mode selected by using the signal, make the operation sequence interlocked.
The table below lists the switches ON the front panel, the modes selected by the RMOD signal and the corresponding output states of the RMDS signal.

Note 1: For the details of the link connection, refer to “10.2 Way to Set Multiple Controllers with 1 Teaching Tool”.

○: Selected or set to ON

Condition		Status							
Teaching tool such as PC software	PIO Operation Invalid (Note 2)	○	○	○	○	×	×	×	×
	PIO Operation Allowed (Note 2)	×	×	×	×	○	○	○	○
Switches ON front panel	AUTO	○	○	×	×	○	○	×	×
	MANU	×	×	○	○	×	×	○	○
PIO Input	RMOD	×	○	×	○	×	○	×	○
PIO Output	RMDS	×	○	○	○	×	○	○	○
PIO valid: ◎, PIO invalid:●		◎	●	●	●	◎	◎	◎	◎

Operation by normal PIO

Note 2: “PIO Operation Allowed” or “PIO Operation Invalid” is the function to select a restriction while the teaching tool such as PC software is connected.

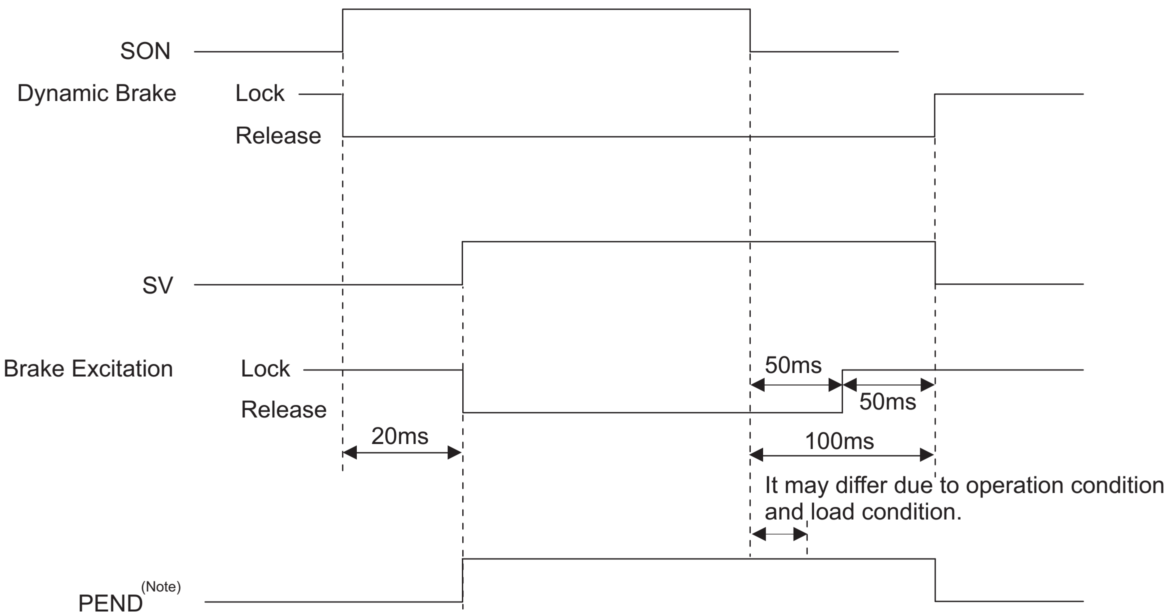
⚠Caution: (1) Note that selecting “PIO Operation Allowed” by using the teaching tool such as PC software makes all PIO signals valid to enable operation however the states of the switches and RMOD signal input may be. In this status, the actuator may be started depending on the signals from PLC.
(2) If the teaching tool such as PC software is disconnected from the controller, “PIO Operation Allowed” or “PIO Operation Invalid” holds the state selected before. After teaching operation or debugging is terminated, select “PIO Operation Allowed” and disconnect the teaching tool such as PC software from the controller.

[3] Servo ON (SON, SV, PEND)

PIO signal	Input	Output	
	SON	SV	PEND
Other than pattern 5	○	○	○
Pattern 5	○	○	×

○ : Available, ×: Unavailable

1) Servo ON signal SON is the input signal making the servo motor of the actuator operable.
2) If the servo-on is performed to enable operation, the SV output signal is turned ON. Concurrently positioning completion signal PEND is turned ON.
3) With the power being supplied, then controller cannot be operated while the SV signal remains OFF. If the SON signal is turned OFF under operation of the actuator, the actuator is decelerated and stopped with the forced stop torque. After the stop, the servo OFF occurs to enter the motor into the free running state.
   The brake (option) is of release-in-excitation type. Therefore, making the excitation on will release the brake while making it off will lock the brake.



(Note) PEND would not turn ON in the pause condition.

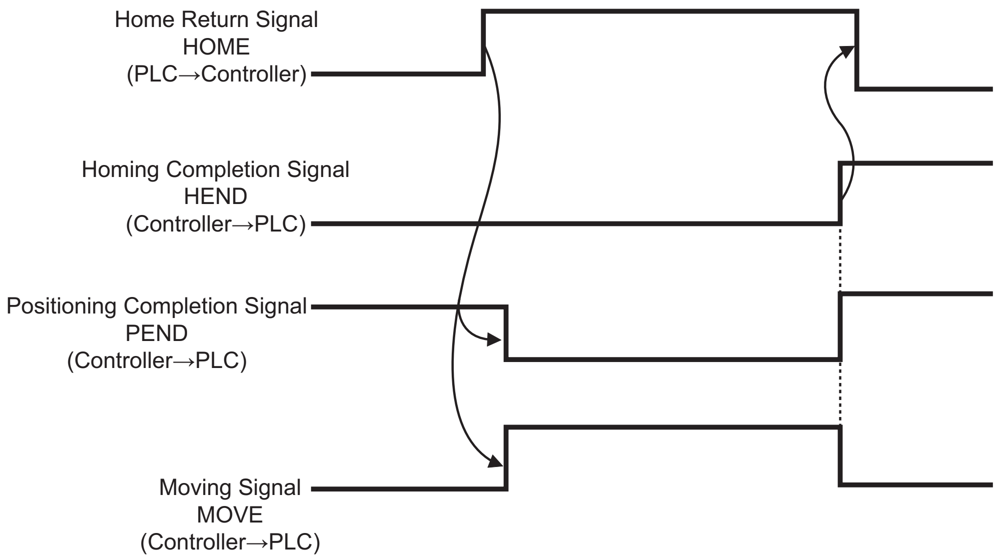
[4] Home Return (HOME, HEND, PEND, MOVE)

PIO signal	Input	Output		
	HOME	HEND	PEND	MOVE
Patterns 0 and 1	○	○	○	○
Patterns 2 to 4	○	○	○	×
Pattern 5	× Note1	○	×	×
Patterns 6 and 7	○	○	○	×

○ : Available, ×: Unavailable

Note 1: For pattern 5, the home return by the HOME signal is not allowed. Refer to 3.2.6 [1] Home Return (ST0, HEND) for how to perform a home-return operation.

The HOME signal is intended for automatic home return. The HOME signal is caught at the rising edge (ON edge) to start the home return. At completion of the home return, home return completion signal HEND is turned ON. The home-return complete signal HEND is kept on unless the memory of origin point is lost for a reason. During the home return operation, positioning completion signal PEND and moving signal MOVE are set to OFF and ON, respectively.



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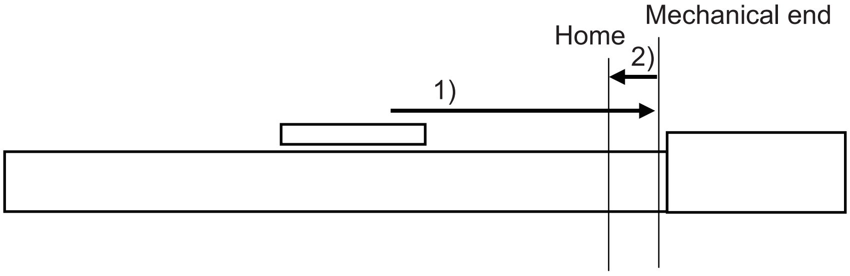
[Operation of Slider Type/Rod Type Actuator]

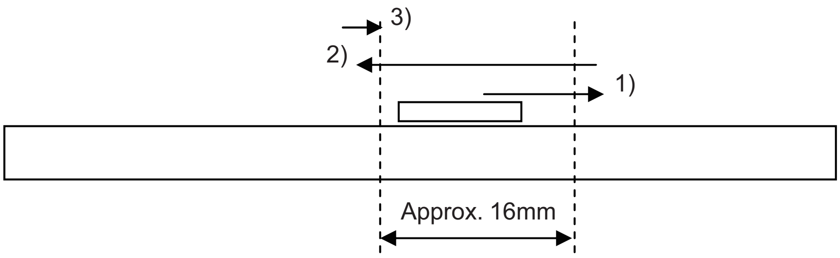


1) With the HOME signal being ON, the actuator moves toward the mechanical end at the home return speed.
   The moving speed is 20mm/s for most actuators but less than 20mm/s for some actuators. Refer to the instruction manual of each actuator.
2) The actuator is turned at the mechanical end and stopped at the home position. The moving distance is the value set by Parameter No.22 "Home return offset level".(Note 1)

> ⚠ Caution: In the home reverse specification, the actuator moves in the reverse direction. Make sure to refer to Section 8.2 [18] when a change to Parameter No.22 "Home Return Offset Level" is required.

Note 1: It moves for the offset amount after the encoder Z-phase is detected.

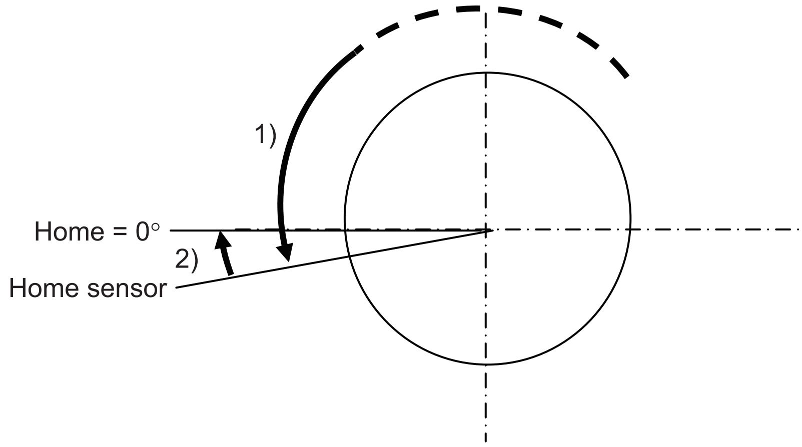
[Actuator Movement for Spurious Absolute Type]



1) With HOME Signal ON, the actuator moves towards the home-return direction set in Parameter No.5 at 3mm/s (fixed).
2) Move back and forth in approximately 16mm (to confirm the current position).
3) Home return operation is completed after the actuator confirms the current position.

> ⚠ Caution: For Spurious Absolute Type, make sure to have a home return operation after the power is turned ON or the software is reset.
> B3 Error would be generated if there was an interrupting object in the procedure of 2) and the current position could not be detected properly.

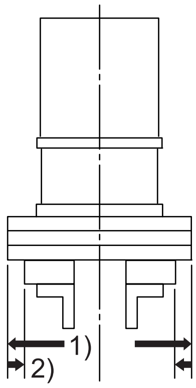
[Operation of Rotary Actuator]



1) The actuator rotates in CCW (counterclockwise) direction from the view point of the load side. The velocity is either 20deg/s or 5deg/s. (It depends on the setting of each actuator.)
2) At the home sensor input, the actuator is turned in the reverse direction and stopped at the home position. The rotation angle is the value set by Parameter No.22 “Home return offset level” after the detection of phase Z.

> ⚠ Caution: Make sure to refer to Section 8.2 [18] when a change to Parameter No.22 “Home Return Offset Level” is required.

[Operation of Actuator of Gripper Type]



1) If the HOME signal is turned ON, the actuator moves toward the mechanical end at the home return speed (20mm/s).
2) The actuator is turned at the mechanical end and stopped at the home position. The rotation angle is the value set by parameter No.22 “Home return offset level” after the detection of phase Z.

> ⚠ Caution: Make sure to refer to Section 8.2 [18] when a change to Parameter No.22 “Home Return Offset Level” is required.

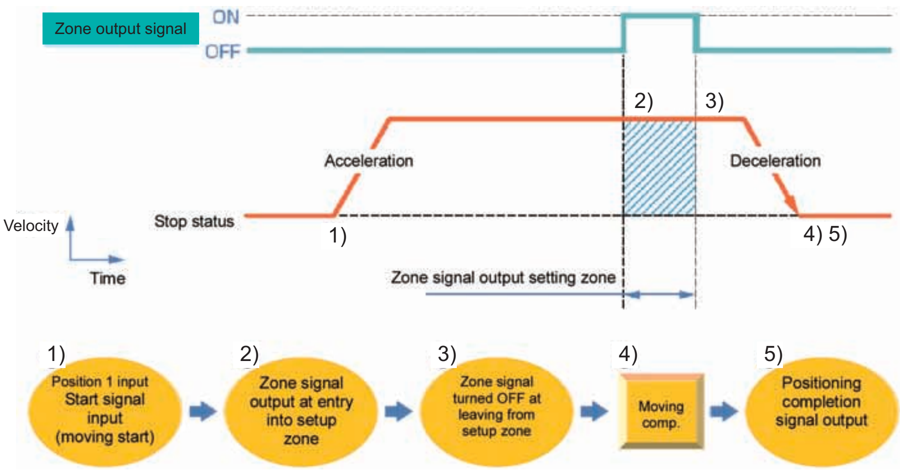
[5] Zone Signal and Position Zone Signal (ZONE1, PZONE)

PIO signal	Output	
	ZONE1(Note 2)	PZONE(Note 2)
Pattern 0	○	○
Pattern 1	×	○
Pattern 2	×	○
Pattern 3(Note 1)	×	×
Pattern 4	○	○
Pattern 5	○	○
Pattern 6	×	○
Pattern 7	×	○

○ : Available, ×: Unavailable

Note 1 Pattern 3 does not have the zone signal output feature.

Note 2 PZONE Signal can be changed to ZONE1 and ZONE2 Signals by the setting in Parameter No.149.



The relevant signal can be turned ON while the actuator passes or stops in the zone range in either of the following 2 types:

1) Zone signal (ZONE1)·················· The output signal is turned ON at the position set by the proper parameter.
2) Position zone signal (PZONE)····· The output signal is turned ON at the position set in the position table.

The feature can play a role as the sensor for judging whether the completion position is good or not at completion of pressing, setting the continuous operation zone in pitch feed or interlocking operations of other units in the setting zone.

(1) Zone signal (ZONE)

Set the zone range to the relevant parameter.

1) Parameter No.1 : Zone boundary 1+
2) Parameter No.2 : Zone boundary 1-

The zone signal ZONE is kept effective also during the emergency stop unless the memory of the origin is lost due to alarm.

(2) Position zone signal (PZONE)

No.	Position [mm]	Velocity [mm/s]	Accele-ration [G]	Decele-ration [G]	Pressing [%]	Thresh-old [%]	Positioning width [mm]	Zone+ [mm]	Zone- [mm]	Acceleration/ Deceleration mode	Incre-mental	Gain set	Stop mode
0													
1	0.00	250.00	0.20	0.20	0	0	0.10	50.00	30.00	0	0	0	0
2	100.00	250.00	0.20	0.20	0	0	0.10	70.00	60.00	0	0	0	0
3	50.00	250.00	0.20	0.20	50	0	20.00	60.00	65.00	0	0	0	0

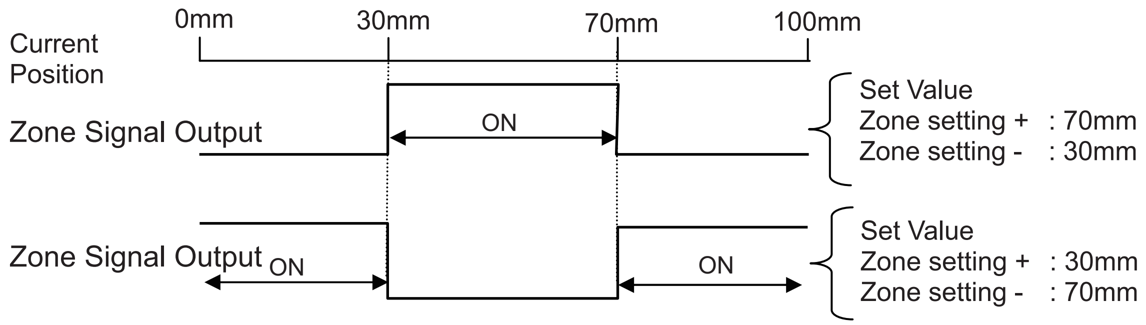
Setting of zone range

Zone ranges should be set in the position table.
While the operation corresponding to a position number is executed, the zone range set for the position number is valid. It is kept effective also during the emergency stop unless the actuator is operated or the memory of the origin is lost due to alarm.

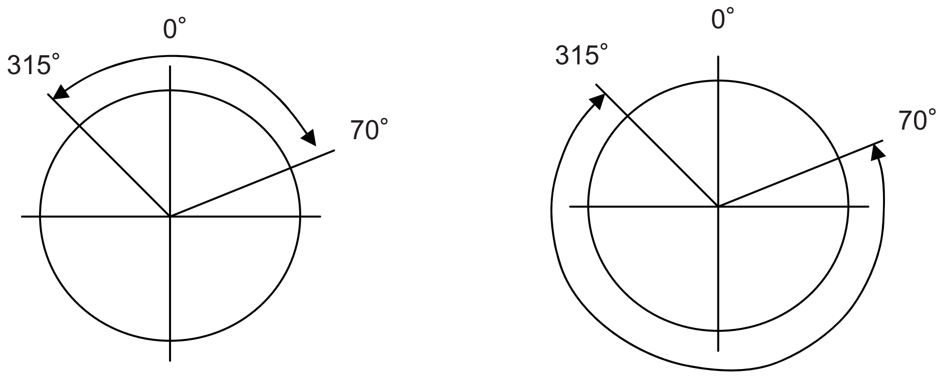
(3) Setting values and signal output range
The zone output range varies depending on the difference between the value set for the positive side of the zone and that for the negative side.

1) Value set for positive side > value set for negative side: Output signal turn ON in the range from the value on negative side to that on positive side, and turns OFF out of the range
2) Value set for positive side < value set for negative side: Output signal turn OFF in the range from the value on positive side to that on negative side, and turns ON out of the range

[Example of Line Axis]



[Example of rotary actuator of multi-rotation specification in index mode]



Set Value
Zone setting + : 70°
Zone setting - : 315°

Set Value
Zone setting + : 315°
Zone setting - : 70°

⚠Caution: Since this signal becomes effective after the coordinate system is established after the home return is completed, it would not be output just with the power turned ON.

[6] Alarm, Alarm Reset (*ALM, RES)

PIO signal	Input	Output
	RES	*ALM
Common to Patterns 0 to 7	○	○

○ : Available, ×: Unavailable

1) Alarm signal *ALM is set to ON in the normal status but turned OFF at the occurrence of an alarm at a level equal to or higher than the operation release level.
2) Turning reset signal RES ON under occurrence of an alarm at the operation release level allows the alarm(Note 1) to be released. The action is taken at the rising edge (ON edge).
3) The alarm reset should be done after the cause of the alarm is confirmed and removed. If alarm reset and restart are repeated many times without removal of the cause, a severe failure such as motor burnout may occur.

Note 1 Check the 9.4 Alarm List for details of alarms.

> ⚠ Caution: Reset signal RES has two features, or alarm reset under occurrence of an alarm and operation interruption (cancellation of remaining moving distance) under temporary stop.
> For the operation interruption under temporary stop, refer to the description of the operation in each pattern.

[7] Binary Output of Alarm Data Output (*ALM, PM1 to 8)

PIO signal	Output	
	*ALM	PM1 to 8
Common to Patterns 0 to 3	○	○
Pattern 4 (Note 1)	○	×
Pattern 5 (Note 1)	○	×
Pattern 6	○	○
Pattern 7 (Note 1)	○	×

○ : Available, ×: Unavailable

Note 1 Patterns 4, 5, and 7 do not have this function.

1) If an alarm at a level equal to or higher than the operation release level occurs, completed position number output signals PM1 to PM8 output the alarm information in the binary code format.
2) The PLC can read the binary code of alarm signal *ALM as the strobe signal to refer to alarm information.

○: ON ●: OFF

*ALM	ALM8 (PM8)	ALM4 (PM4)	ALM2 (PM2)	ALM1 (PM1)	Binary Code	Description: Alarm code is shown in ( ).
○	●	●	●	●	–	Normal
●	●	●	○	●	2	Software reset during servo ON (090) Position number error during teaching (091) PWRT signal detected during movement (092) PWRT signal detected before completion of home return (093)
●	●	●	●	○	3	Move command during servo OFF (080) Position Command in Incomplete Home Return (082) Absolute position move command when home return is not yet completed (083) Movement Command during Home Return Operation (084) Position No. error during movement (085) Move command while pulse train input is effective (086) Move command during loadcell calibration (087) Position Command Data Error (0A3) Command Deceleration Error (0A7)
●	●	○	●	●	4	Drive mode error (0DD) Field bus module not detected (0F3) Mismatched PCB (0F4)
●	●	○	●	○	5	Loadcell data error (0A9) Loadcell calibration error (0E1) Loadcell communication error (0E2) Loadcell error (0E3) Field bus link error (0F1) Field bus module error (0F2)
●	●	○	○	●	6	Parameter data error (0A1) Position data error (0A2) Unsupported motor/encoder type (0A8)
●	●	○	○	○	7	Z-Phase Position Error (0B5) Magnetic Pole Indeterminacy (0B7) Home sensor non-detection (0BA) Home return timeout (0BE) Creep sensor not detected (0BF)

(Note) *ALM Signal is an active low signal. It is ON when the power is applied to the controller, and turns OFF when the signal is output.

Chapter 3 Operation

○ :ON ● :OFF

*ALM	ALM8 (PM8)	ALM4 (PM4)	ALM2 (PM2)	ALM1 (PM1)	Binary Code	Description: Alarm code is shown in ( ).
●	○	●	●	●	8	Actual Speed Excessive (0C0) Overrun detected (0C2)
●	○	●	●	○	9	Electromagnetic Brake Unrelease Error (0A5) Dynamic brake not released (0A6) Overcurrent (0C8) Overheat (0CA) Current Sensor Offset Adjustment Error (0CB) Emergency stop relay fused (0CD) Drop in control supply voltage (0CE) I/O 24V Power Supply Error (0CF)
●	○	●	○	○	11	Electric Angling Mismatching (0B4) Deviation Overflow (0D8) Software stroke limit exceeded (0D9) Feed Back Pulse Error (0DA) Pressing Motion Range Over Error (0DC)
●	○	○	●	●	12	Exceeded allowable time of exceeding torque allowing continuous pressing (0C4) Illegal control system transition command (0C5) Mismatching torque current/force feedback (0C6) Motor Power Source Voltage Excessive (0D2) Motor power-supply voltage low (0D3) Belt-breaking sensor detected (0D7) Overload (0E0) Driver logic error (0F0)
●	○	○	●	○	13	Spurious absolute error (0B3) Encoder send error (0E4) Encoder Receipt Error (0E5) Encoder count error (0E6) A-, B- and Z-phase Wire Breaking (0E7) Absolute Encoder Error Detection 2 (0EE) Absolute Encoder Error Detection 3 (0EF)
●	○	○	○	●	14	CPU Error (0FA) FPGA Error(0FB) Logic Error (0FC)
●	○	○	○	○	15	Nonvolatile memory write verify error (0F5) Nonvolatile memory write timeout (0F6) Nonvolatile memory data destroyed (0F8)

(Note) *ALM Signal is an active low signal. It is ON when the power is applied to the controller, and turns OFF when the signal is output.

[8] Brake release (BKRL)

PIO signal	Input
	BKRL
Pattern 0	○
Pattern 1(Note 1)	×
Pattern 2 to 7	○

○ : Available, ×: Unavailable

Note 1 Pattern 1 does not have this feature

The brake can be released while BKRL signal is set to ON. If a brake is installed in the actuator, the brake is automatically controlled by servo ON/OFF. Releasing the brake may be required to move the slider and/or the rod by hand in case of installation of the actuator in the machine or direct teach*1.
This operation can be done by break release signal BKRL as well as the brake release switch ON the front panel of the controller.

*1 Direct teaching : This operation is intended to get coordinate values to the position by moving the slider and/or the rod by hand.

> ⚠ Warning:(1) Take sufficient care to release the brake. Inappropriate brake release may cause people to be injured and/or the actuator, the work and/or the machine to be damaged.
> (2) After the brake is released, always make the brake applied again. Any operation with the brake remaining released is extremely dangerous. The slider or rod may drop to cause people to be injured and/or the actuator, the work and/or the machine to be damaged.

[9] Battery Alarm (*BALM)

PIO signal	Input
	*BALM
Common to Patterns 0 to 7	○

1) Battery alarm *BALM is set to ON in the normal absolute battery voltage or for an actuator of incremental encoder specification.
2) *BALM is turned OFF if the absolute battery voltage drops to be less than 3.1V.
3) An alarm code 0EE “absolute encode error detection 2” occurs if the absolute battery voltage drops to be less than 2.5V. The backup data cannot be held any more.
4) If Overload Warning Level Ratio is set to a value other than 100% in Parameter No.143, the power turns OFF once the motor temperature exceeds the value in this parameter. Lower the load level (by decreasing the acceleration speed, etc.).

> ⚠ Warning: If the machine is operated with the backup data erased, unintended motion may occur to cause people to be injured and/or the actuator, the work and/or the unit to be damaged.
> If *BALM is turned OFF, replace the battery as soon as possible. [Refer to Chapter 7 Absolute Reset and Absolute Battery.]
> Use dedicated batteries.

3.2.4 Operation with the Position No. Input = Operations of PIO Patterns 0 to 3 and 6

This section describes the methods of operations of PIO patterns 0 to 3 and 6. These patterns provide normal controller operation methods in which the controller is operated by turning the start signal ON after a position No. is entered.
PIO pattern 6 is dedicatedly used for pressing operation using force sensor. The pattern is intended to operate the actuator equipped with loadcell (RCS2-RA13R) to enable highly precise pressing control. Before the actuator can be operated, proper calibration and initialization of parameters are required. [Refer to 3.2.7 Pressing Operation Using Force Sensor Operation Ready]
The control methods of positioning, pitch feed, and pressing are the same as those described before.

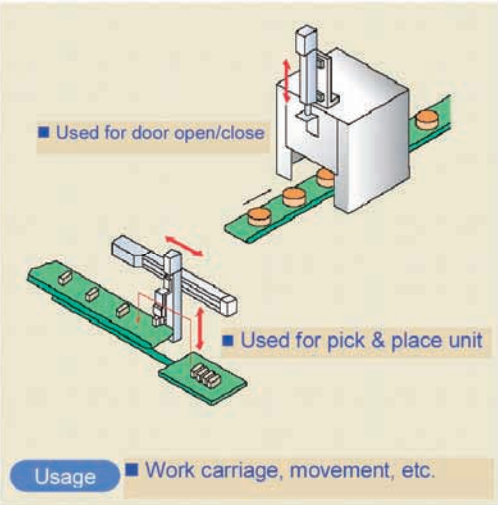
[1] Positioning [Basic] (PC1 to PC**, CSTR, PM1 to PM**, PEND, MOVE, LOAD, TRQS)

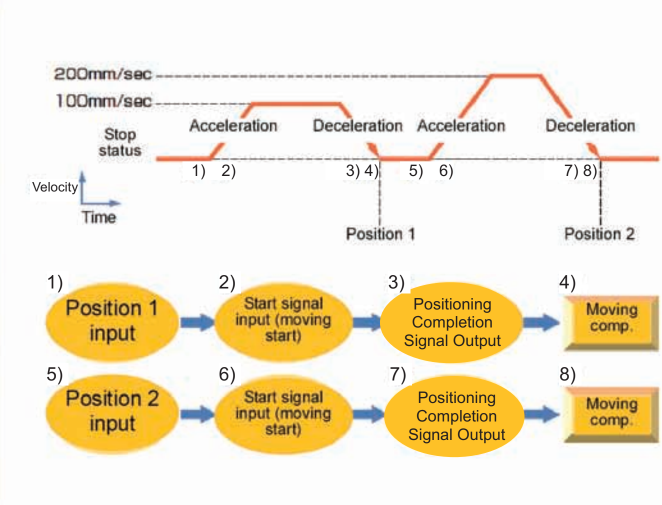
PIO signal	Input		Output				
	PC1 to PC**	CSTR	PM1 to PM**	PEND	MOVE	LOAD	TRQS
PIO pattern 0	PC1 to 32	○	PM1 to 32	○	○	×	×
PIO pattern 1	PC1 to 32	○	PM1 to 32	○	○	×	×
PIO pattern 2	PC1 to 128	○	PM1 to 128	○	×	×	×
PIO pattern 3	PC1 to 256	○	PM1 to 256	○	×	×	×
PIO pattern 6	PC1 to 16	○	PM1 to 16	○	×	○	○

○ : Available, ×: Unavailable

(Note) Operation without home return leads the operation based on the data of the specified position No. after automatichome return. If one or more problems are found, interlock by home return complete signal HEND is required.

■ Sample use

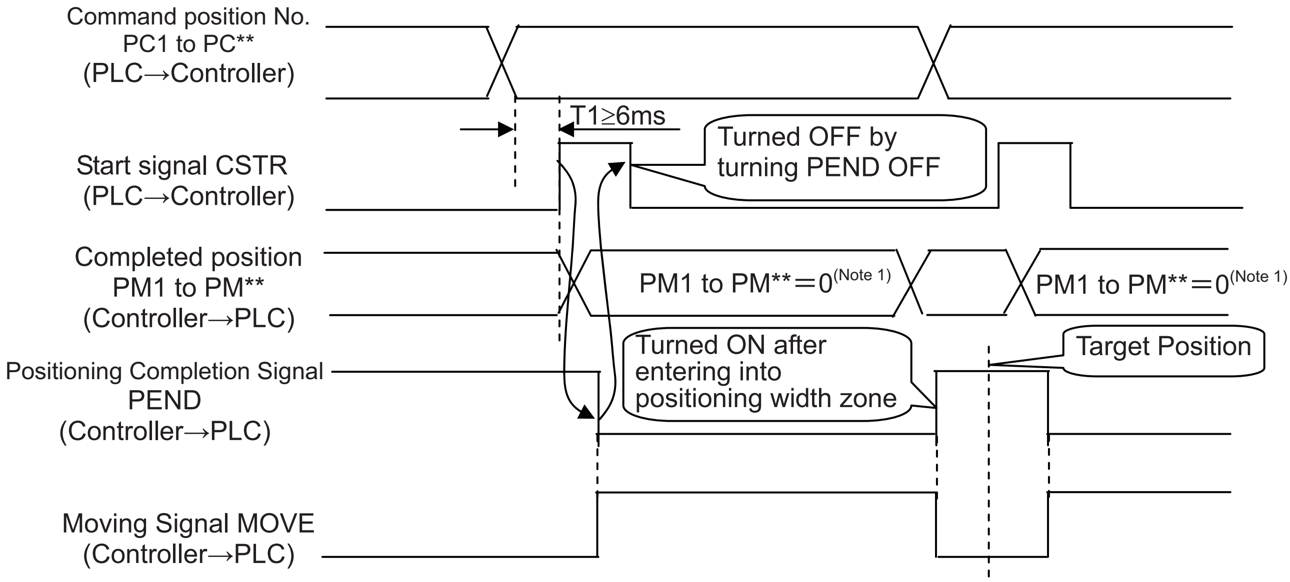




No.	Position [mm]	Velocity [mm/s]	Accele-ration [G]	Decele-ration [G]	Pressing [%]	Thresh-old [%]	Positioning width [mm]	Zone+ [mm]	Zone- [mm]	Acceleration/ Deceleration mode	Incre-mental	Gain set	Stop mode
0													
1	70.00	100.00	0.20	0.20	0	0	0.10	0.00	0.00	0	0	0	0
2	150.00	200.00	0.20	0.20	0	0	0.10	0.00	0.00	0	0	0	0

■ Control method

1) First enter command position No. PC1 to PC** with binary data. Next turn start signal CSTR ON. Then the actuator starts acceleration depending on the data in the specified position table for positioning to the target position.
2) At operation start, positioning complete signal PEND is turned OFF. Always turn the CSTR signal OFF. Without it, the completed position number is not output and the positioning complete signal is not turned ON at the completion of positioning.
3) When the positioning is completed, the positioning complete position numbers are output from complete position No.PM1 to PM** with binary data and also positioning complete signal PEND is turned ON.
4) The moving signal MOVE turns ON at the same time as the operation starts, and turns OFF once the positioning complete signal PEND turns ON or the movement command output completes.
5) Positioning complete signal PEND is turned ON if the remaining moving distance enters into the positioning width. PEND Signal will be kept ON once it is turned ON unless the start signal CSTR is turned back ON, servo is turned OFF (Note) or the actuator is out of the positioning band width range (Note).
   (Note) It can be switched over with Parameter No.39.



Note 1: The completion position No. output is set to 0 during movement of the actuator.

⚠ Caution:

(1) Set the period taken from entering position No. to turning CSTR ON to 6ms or larger. In spite of 6ms timer process in the PLC, commands may be input to the controller concurrently to cause positioning to another position. Take the scanning time in the PLC into account to set a period as 2 to 4 times as the scanning time. Set the value similarly if the PLC reads the complete position.

(2) At the completion of positioning, positioning complete signal PEND is not turned ON if start signal SCTR remains ON. If this occurs, turn CSTR OFF then PEND is turned ON immediately. Therefore, create the sequence program so that turning PEND ON makes CSTR turned OFF and the PLC waits for the state in which PEND is turned ON.

(3) At the positioning to the position same as that specified in the stop (complete) position number, PEND is turned OFF once but moving signal MOVE is not turned ON.
Therefore, use PEND to turn CSTR OFF.

(4) MOVE is turned ON as soon as PEND is turned OFF and turned ON as soon as PEND is turned ON. Accordingly, with a large positioning width being set, MOVE may be turned OFF while the actuator is moved.

■ Binary data ○ : ON ● : OFF

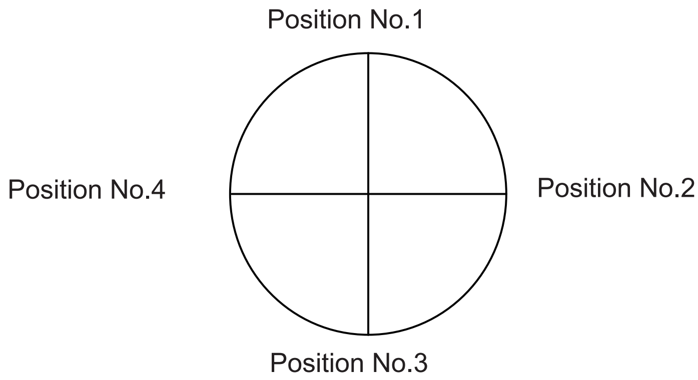
Command position No. / Completed position No.	PC256 / PM256	PC128 / PM128	PC64 / PM64	PC32 / PM32	PC16 / PM16	PC8 / PM8	PC4 / PM4	PC2 / PM2	PC1 / PM1
0	●	●	●	●	●	●	●	●	●
1	●	●	●	●	●	●	●	●	○
2	●	●	●	●	●	●	●	○	●
3	●	●	●	●	●	●	●	○	○
4	●	●	●	●	●	●	○	●	●
5	●	●	●	●	●	●	○	●	○
6	●	●	●	●	●	●	○	○	●
7	●	●	●	●	●	●	○	○	○
8	●	●	●	●	●	○	●	●	●
9	●	●	●	●	●	○	●	●	○
10	●	●	●	●	●	○	●	○	●
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
509	○	○	○	○	○	○	○	●	○
510	○	○	○	○	○	○	○	○	●
511	○	○	○	○	○	○	○	○	○

[Shortcut control of rotary actuator of multi-rotation specification]

(1) Set of shortcut selection

The shortcut selection can be made valid/invalid by Parameter No.80 “shortcut selection during rotation”. If the shortcut selection is made valid, the actuator can be moved only in a single direction.

[Operation Examples]

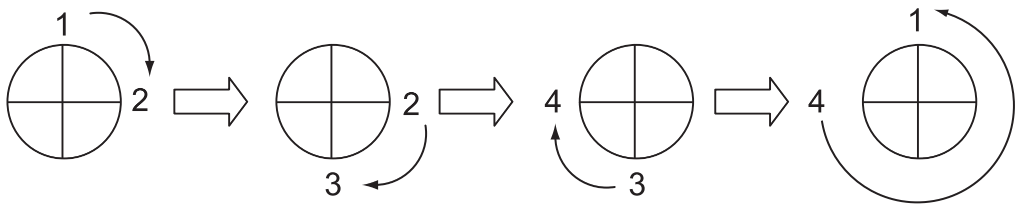


Position No.	Position
1	0
2	90
3	180
4	270

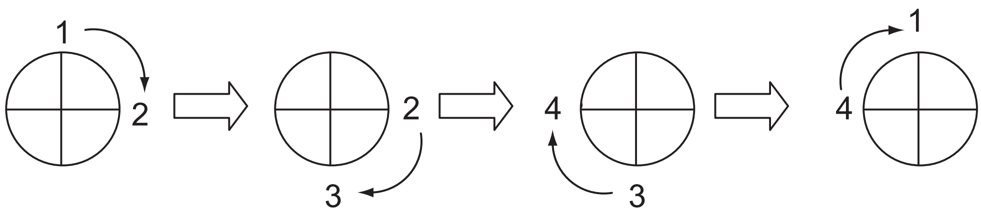
Enter position data assuming 1° = 1mm.
(Example) 1.2 is assumed as 1.2°.

For operation in the order of positions 1→2→3→4, the actuator is moved differently whether the shortcut selection is valid or invalid.

- When shortcut selection is invalid:

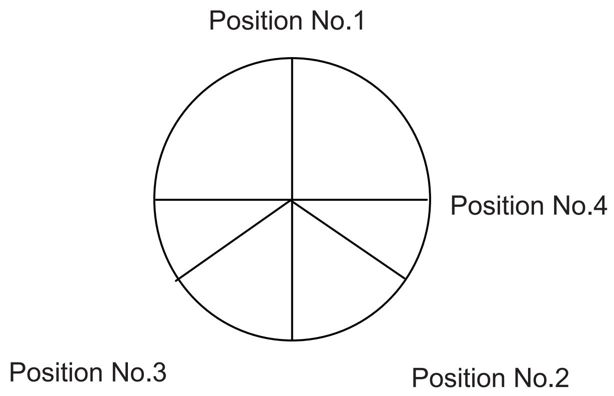


- When shortcut selection is valid:



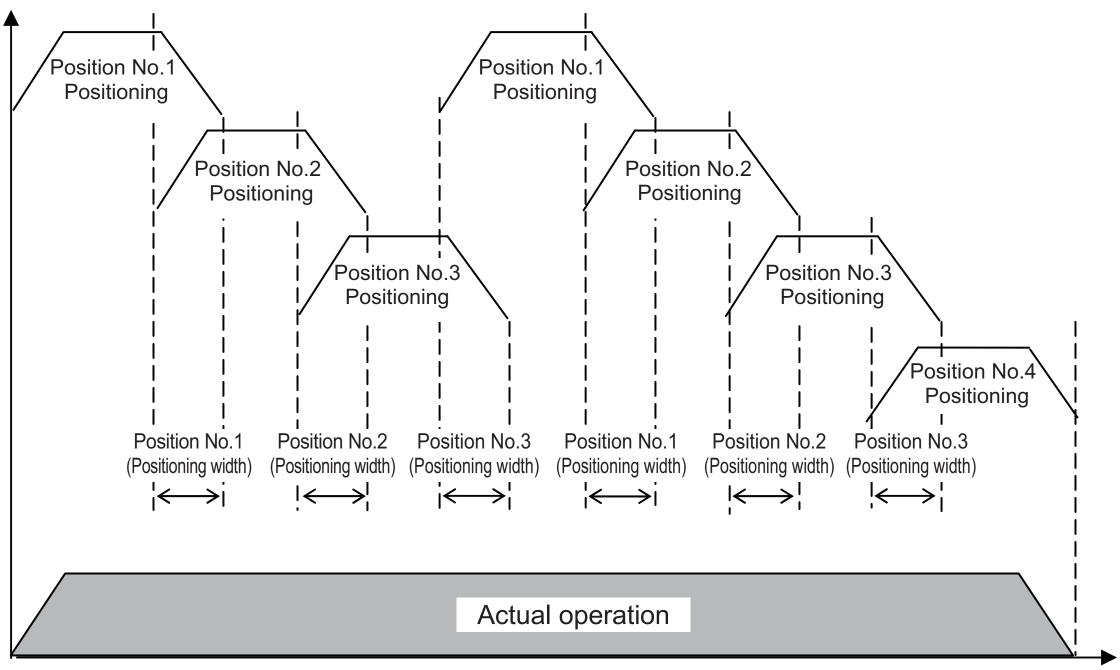
(2) Infinite Rotation Control
Making the shortcut selection valid and moving the actuator in a specific direction continuously allows the actuator to be rotated continuously as a motor. The continuous operation can be done as described below.

[Operation Examples]
This example rotates the actuator by 2 turns and finally stops it at position No.4.



Position No.	Position
1	0
2	120
3	240
4	90

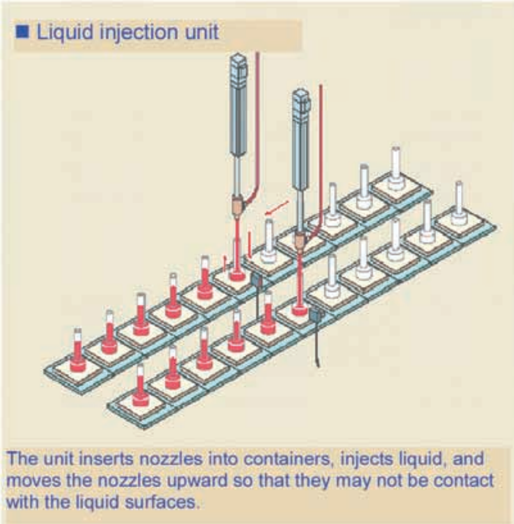
Enter position data assuming 1° = 1mm.
(Example) 1.2 is assumed as 1.2°.

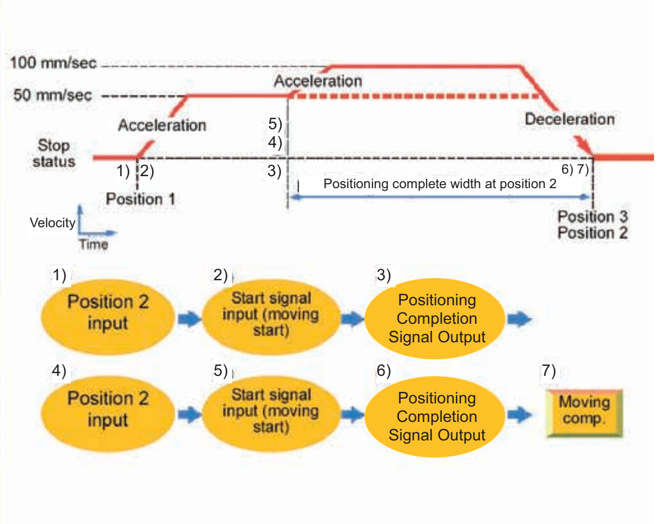


1) Widen the positioning widths of position No.1 to 3 so that they are located before the position at which deceleration is started.
2) Positioning of position No.1 makes positioning complete signal PEND turned ON before deceleration is started.
If PEND is turned ON, positioning of position No.2 is executed. Similarly, positioning is repeated in the order of position No.3 → 1 → 2 → 3 → 4. Because the normal positioning always gives position data specified last the highest priority, the actuator can be rotated continuously.
3) If the speeds in position No.1 to 4 are set to be the same, the actuator can be rotated at the same speed. Then the actuator is stopped at the positioning set in position No.4. The number of rotations is defined by the number of repeats of position No.1 to 3.

[2] Speed change during the movement

■ Sample use





No.	Position [mm]	Velocity [mm/s]	Accele-ration [G]	Decele-ration [G]	Pressing [%]	Thresh-old [%]	Positioning width [mm]	Zone+ [mm]	Zone- [mm]	Acceleration/ Deceleration mode	Incre-mental	Gain set	Stop mode
0													
1	150.00	250.00	0.20	0.20	0	0	0.10	0.00	0.00	0	0	0	0
2	0.00	50.00	0.20	0.20	0	0	100.00	0.00	0.00	0	0	0	0
3	0.00	100.00	0.20	0.20	0	0	0.10	0.00	5.00	0	0	0	0

■ Control method

The speed of the actuator can be changed while it moves. Positions are used by the number of speeds. The method of controlling the operation to each position is the same as that described in [1] Positioning.

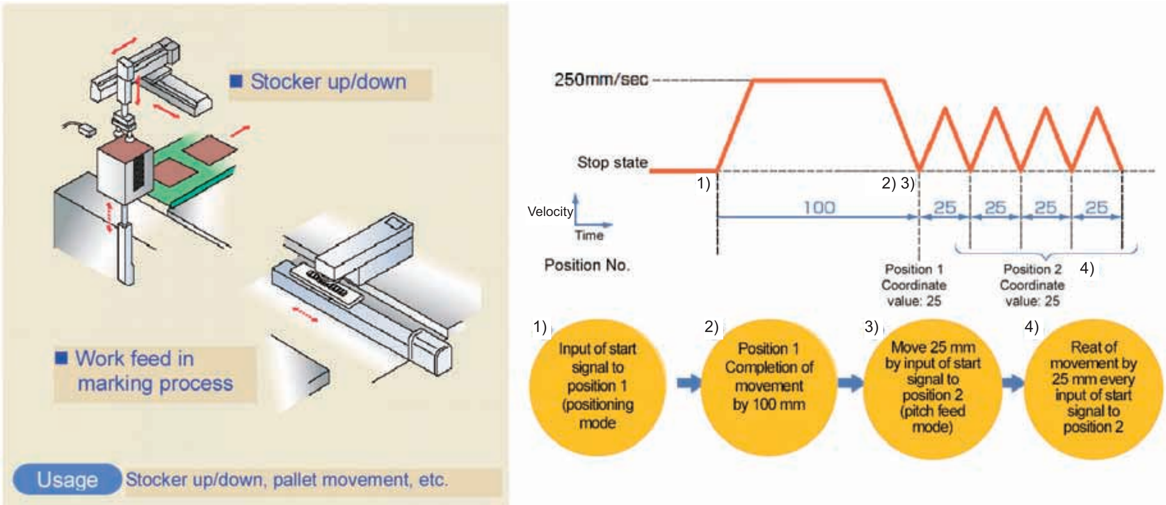
The example below describes the case of 2 speeds:

1) In this example, the speed is changed while the actuator moves from the position of 150mm to the position of 0mm. At first, set the positioning to the target position at the first speed in position No.2. In the positioning width, set the distance from the speed change position to the target position. The value is set to 100mm in the example. Thus, for position No.2, positioning complete signal PEND is turned ON at the position before the target position by 100mm.
2) Set the positioning to the target position at the second speed in position No.3.
3) Start position No.2. Then start position No.3 successively when PEND in position No.2 is turned ON. In normal positioning, position data specified later has always a priority over position data specified earlier. Thus, the operation in position No.3 is started on the way of the operation in position No.2.

In this example, the target positions No.2 and 3 are equal with each other. They may not be the same. However, setting the target positions to be equal with each other allows the distance from the speed change position to the target position to be known easily.
To increase in the number of speed change steps, add a position number and operation sequence, set the speed change position in the positioning width and operate the actuator continuously.

[3] Pitch Feeding (relative movement = incremental feed)

■ Sample use



No.	Position [mm]	Velocity [mm/s]	Accele-ration [G]	Decele-ration [G]	Pressing [%]	Thresh-old [%]	Positioning width [mm]	Zone+ [mm]	Zone- [mm]	Acceleration/ Deceleration mode	Incre-mental	Gain set	Stop mode
0													
1	100.00	250.00	0.20	0.20	0	0	0.10	0.00	0.00	0	0	0	0
2	25.00	250.00	0.20	0.20	0	0	0.10	0.00	0.00	0	1	0	0

(Position No.2 sets pitch feed.)

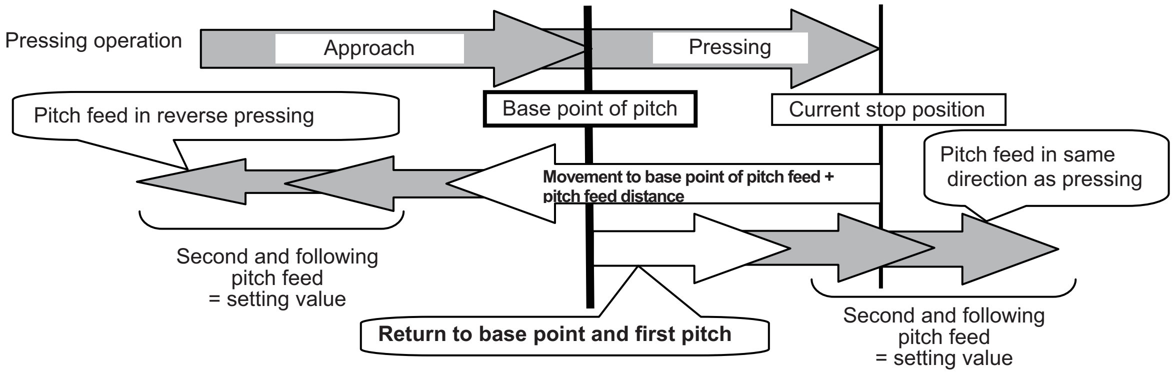
■ Control method

1) The method of controlling pitch feed is the same as that described in [1] Positioning except the setting of the position table. Repeat the positioning of a specific position No.
2) For pitch feed, the position set in the position table indicates the pitch. Set the pitch (relative moving distance = incremental moving distance) in column “Position”.
3) If the operation command is issued, the actuator moves from the current stop position by “Position” in the position table. To perform continuous movement, repeat the operation. The relative movement amount is calculated in ‘mm’. Therefore, there will be no cumulative tolerable error in repeated operations.

> ⚠ Caution: In the pitch feed, do not perform a command with a pitch smaller than the minimum encoder resolution (lead/encoder pulse number) or that less than positioning accuracy repeatability.
> There would be no deviation to occur even with the command because it is an operation command to the same position as the positioning complete condition, but the positioning control cannot be performed properly.

⚠ Caution: (1) If the actuator reaches the software limit corresponding to the stroke end in the pitch feed operation, the actuator stops at the position and positioning complete signal PEND is turned ON.

(2) Note that, in pitch feed just after pressing operation (to be in the pressing state), the start position is not the stop position at the completion of pressing but the coordinate value entered in “Position” of the pressing position data. The movement to the base point is added to the first pitch feed.



(3) If the position number for pitch feed is started (CSTR ON) during normal positioning, the actuator moves to the position of the coordinate resulting from adding the pitch feed distance to the target coordinate of the positioning. Repeating the start of pitch feed several times allows the pitch feed distance to be added to the target position by the number of repeats. Do not use the pitch feed function in such a way, because the PLC cannot confirm the complete position.

(4) Note that, if pitch feed is started (CSTR ON) repeatedly during pause, the actuator moves continuously by the distance based on the number of starts. In such a case, cancel the remaining moving distance by turning reset signal RES to ON in the pause state or take interlock so that the start signal is not turned ON during pause.

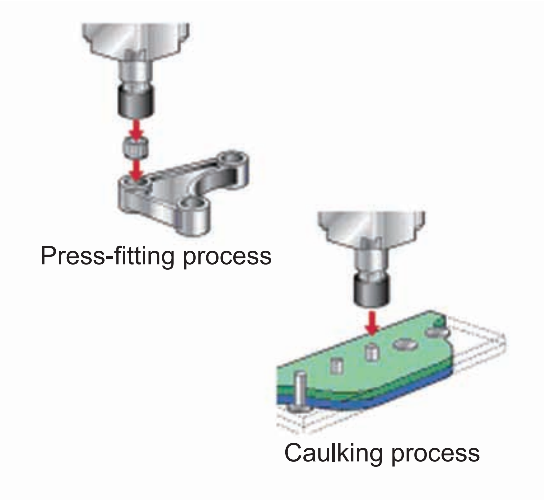
(5) At software limit (stroke end) in pitch feed, the actuator is decelerated to be stopped and positioning complete output PEND is output.

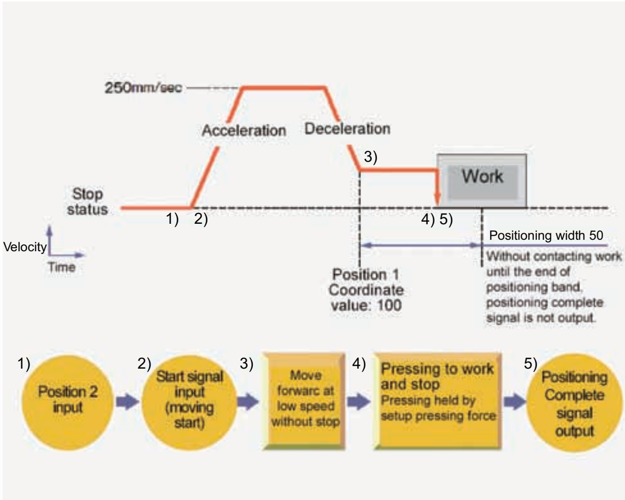
(6) MOVE turns ON at the same time as PEND turns OFF, and turns OFF once PEND turns ON or the movement command output completes. Accordingly, with a large positioning width being set, MOVE may be turned OFF while the actuator is moved.

(7) Pressing is enabled by using the pitch feed function. However, do not make control of changing to pitch feed on the way of normal positioning (before PEND turning ON). Pressing is interrupted by using the pitch feed function as soon as start signal CSTR is turned ON. The PLC cannot manage the position of the actuator any more.

[4] Pressing operation

■ Sample use





No.	Position [mm]	Velocity [mm/s]	Acceleration [G]	Deceleration [G]	Pressing [%]	Threshold [%]	Positioning width [mm]	Zone+ [mm]	Zone- [mm]	Acceleration/ Deceleration mode	Incremental	Gain set	Stop mode
0													
1	0.00	250.00	0.20	0.20	0	0	0.10	0.00	0.00	0	0	0	0
2	100.00	250.00	0.20	0.20	50	0	50.00	0.00	0.00	0	0	0	0

(Position No.2 sets pressing operation.)

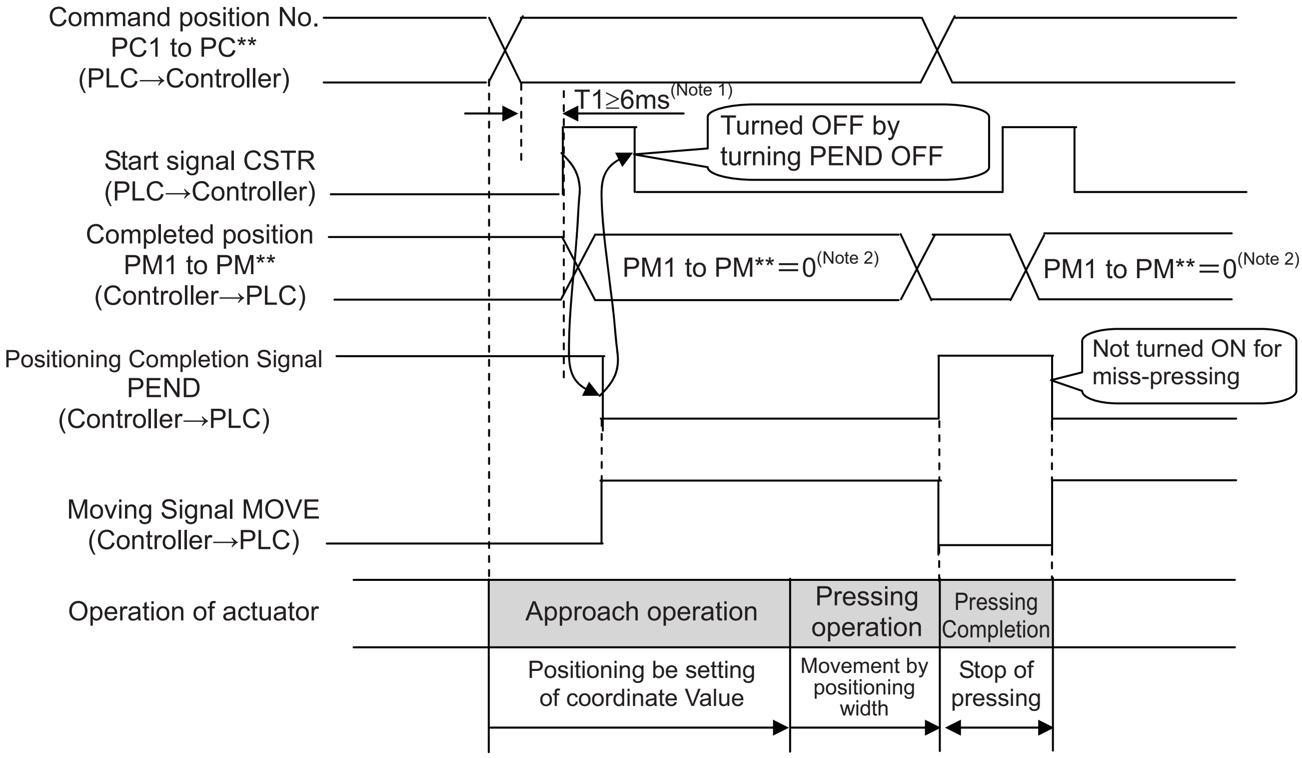
■ Control method

1) The method of controlling the pressing operation is the same as that described in [1] Positioning except the setting of the position table. Any setting of “Pressing” in the position table allows the pressing operation to be done. “Positioning width” is assumed as pressing operation distance.
2) The actuator moves at the setting speed and rating torque to the position of the coordinate set in “Position” in the similar way as normal positioning. Then the operation changes to pressing. The moving distance in pressing is the value set in “Positioning width”. The pressing is performed with the torque (current limit value) set in percent in “Pressing” of PIO patterns 0 to 3 being the upper limit.
   Pressing operation using force sensor of PIO pattern 6 performs pressing by the pressing force set in percent of the base thrust in pressing operation using force sensor*.
   * Base thrust in pressing operation using force sensor:
   Converted thrust at rating motor output in pressing operation using force sensor

Actuator		Base thrust in pressing operation using force sensor [N]
RSC2-RA13R	1t type	4900
	2t type	9800

3) The control method is the same as that in [1] Positioning. However, the processing of positioning complete signal PEND is different from that in [1] Positioning.
   PEND is output when the shaft is stopped by pressing (pressing complete). If the work is not subject to pressing (miss-pressing), the actuator moves by the value set in “Positioning width” to stop but PEND is not turned ON.

⚠ Caution: When having a pressing operation using force sensor, it is necessary to calibrate the loadcell.
[Refer to 3.2.7 Pressing Operation Using Force Sensor Operation Ready (Calibration of Loadcell)]

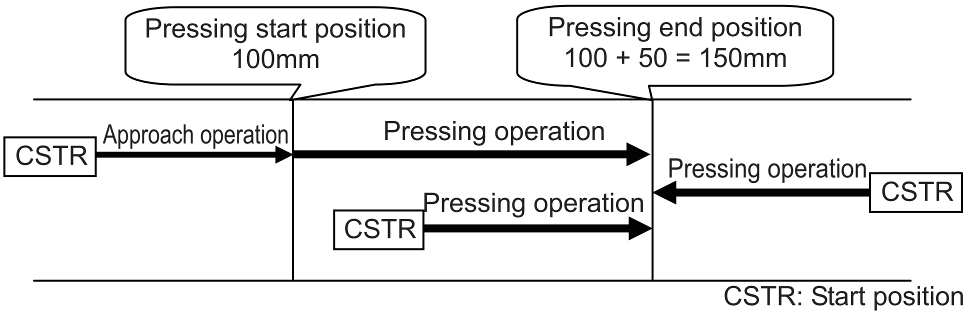


Note 1: Set the period taken from entering the position number to turning CSTR ON to 6ms or longer. Because 6ms timer process on the PLC is also entered to the controller, positioning at another position may occur. Take the PLC scan time into account.

Note 2: The completion position No. output is set to 0 during movement of the actuator.

⚠Caution: (1) The speed during pressing operation is set in Parameter No.34. Check the 10.4 List of Specifications of Connectable Actuators for the pressing operation speed.
Do not set any value larger than the value in the list. If the speed set in the position table is equal to or less than the pressing speed, the pressing is performed at the setup speed.

(2) The approach start position of pressing should be located at or before the pressing start position (coordinate 100mm or less in the above example) If not, the moving direction varies depending on the start position to be dangerous.
For example, pressing at coordinate larger than the pressing end position (larger than 150mm) is performed in the direction from the current position to the pressing end position. Note that pressing after positioning to the position of coordinate 100mm does not take place.



(3) The work is pressed after the pressing is completed. The work may moves backward or forward. If the actuator is moved backward before the approach position, alarm code 0DC “Pressing Motion Range Over Error” occurs to stop the actuator. In movement of the work in the pressing direction, PEND is turned OFF if the load current becomes lower than the current limit (pressing (%)). Miss-pressing occurs when the actuator moves by the pressing moving distance set in “Positioning width”.

(4) Do not make control of changing to pressing on the way of normal positioning (before PEND turning ON). Depending on the position at which start signal CSTR is turned ON, the pressing is performed improperly. Then the PLC cannot manage the position of the actuator.

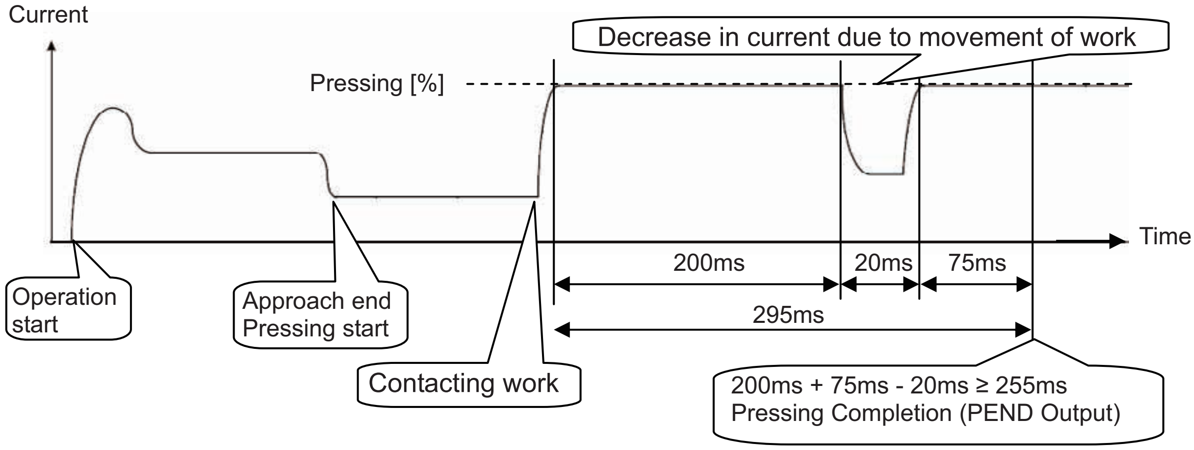
(5) Pressing control cannot be performed with the rotary actuator. If the index mode is selected for the rotary actuator of multi-rotation specification, pressing operation cannot be set. The positioning complete signal PEND is turned ON when the actuator reaches the positioning width.

(6) If the actuator gets pressed to the work during the approach operation, 0DC “Pressing Motion Range Over Error” would be issued.

(7) If the actuator is RCS2-RA13R (Ultra-High Thrust Type), there is a limit in the duration and duty of continuous pressing. Use of the product above this limit may cause a failure occurred due to the motor heat generation.
[Refer to 10.4.2 Specifications and Limitations in Pressing Operation of RCS2-RA13R]

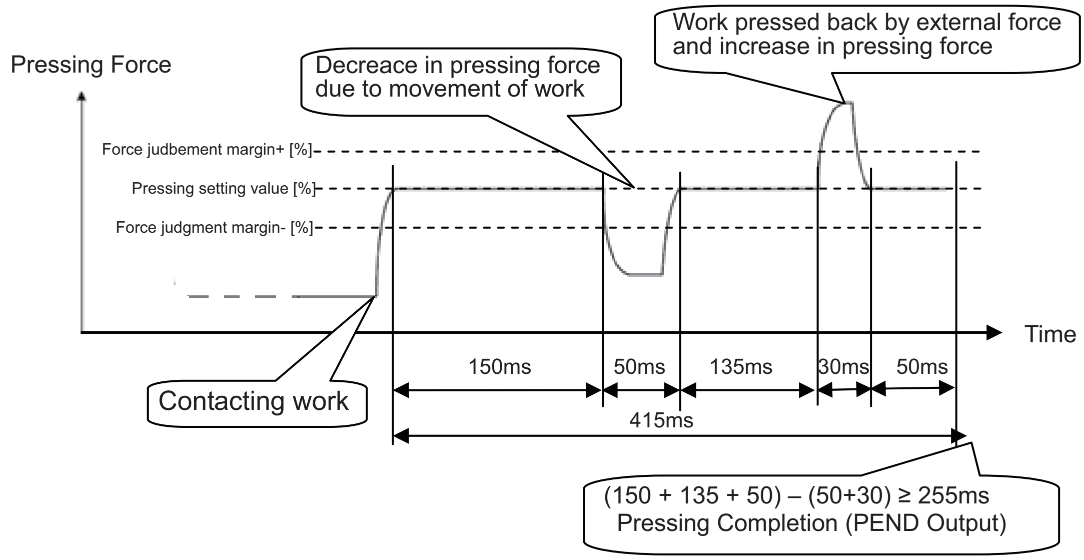
Judging completion of pressing operation

(1) Normal case (PIO patterns 0 to 3):
The operation monitors the torque (current limit value) in percent in “Pressing” of the position table and turns pressing complete signal PEND ON when the load current satisfies the condition shown below during pressing. PEND is turned ON at satisfaction of the condition if the work is not stopped.
(Accumulated time in which current reaches pressing value [%]) – (accumulated time in which current is less than pressing value [%]) ≥ 255ms (Parameter No.6)



(2) Pressing operation using force sensor (PIO pattern 6):
If the pressing force during pressing operation satisfies the following condition against the pressing force set in percent by “Pressing” in the position table, pressing complete signal PEND is turned ON. This occurs even if the actuator does not stop.

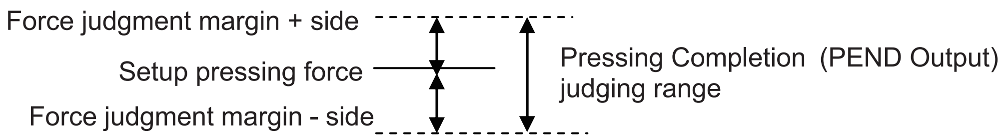
- Condition:
(Accumulated time in which pressing force enters within the range between force judgment margin+ and force judgment margin–) ≥ 255ms (Parameter No.6)



Force judgment margins are described by percent of the base thrust in pressing operation using force sensor *1 provided by the actuator. They should be set in Parameter No.95 and 96.
The pressing complete judging range is,

Pressing setting value [%] + Force judgment margin+ [%]

to Pressing setting value [%] – Force judgment margin [%]



*1 Base thrust in pressing operation using force sensor:
Converted thrust at rating motor output in pressing operation using force sensor

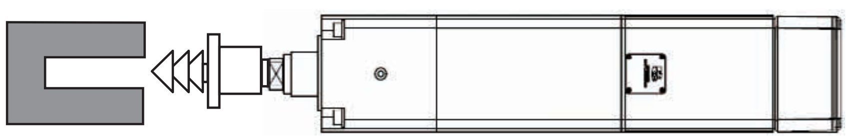
Actuator		Base thrust in pressing operation using force sensor [N]
RCS2-RA13R	1t type	4900
	2t type	9800

[Setting sample]
In case where the actuator is of 1-ton type and the pressing value, force judgment margin + side, and force judgment margin – side are set to 150%, 4%, and 4%, respectively:
Setup pressing value: 4900 [N] × 150% = 7350 [N] and
Force judgment margin + and –: 4900 [N] × 4% = 196 [N].
Hence, the pressing complete judging range is between 7154 to 7546 [N].

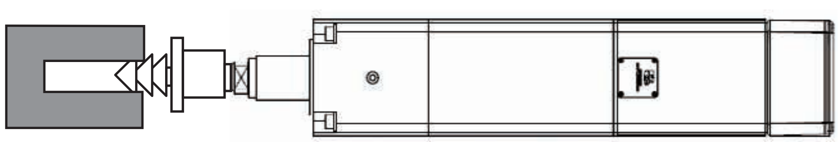
(3) Torque Level Detection during Pressing Operation (Valid in PIO pattern 6)

■ Image diagram

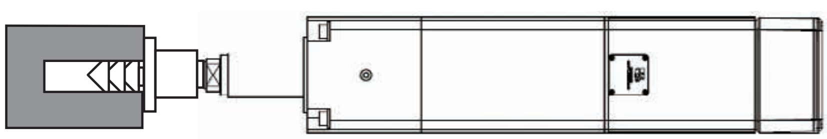
Operation start



Detect torque level while in pressing operation



Pressing Complete

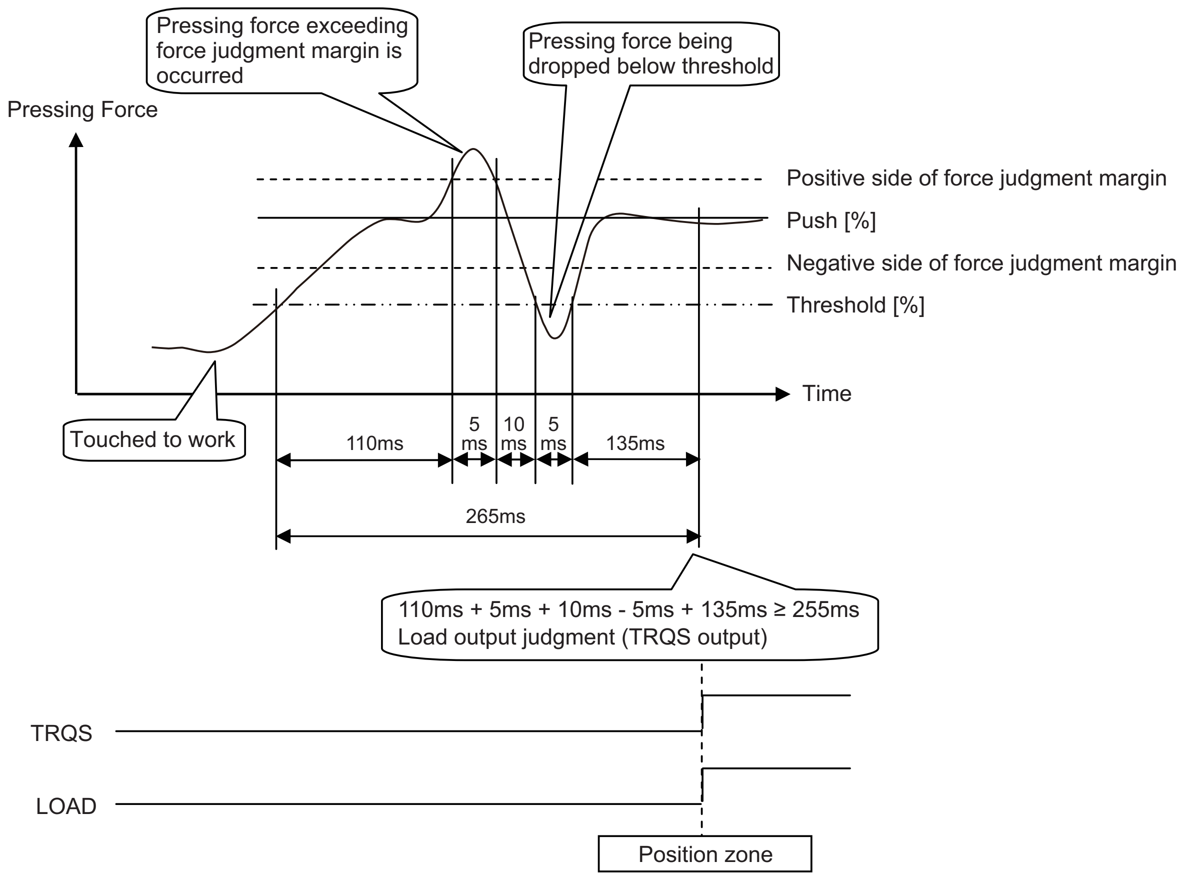


■ Control method

This is a function to detect whether the specified load is applied to the actuator by checking the torque while in press-fitting operation when having a press-fitting process with the pressing operation. If there is no resistance in press-fitting, the specified load would not be applied, thus it is defined as the normal pressing is not conducted and an alarm can be issued from PLC.

It monitors the pressing force set in % in “Threshold” in the position data, and turns the torque level status (TRQS) signal ON when the pressing force reaches the following condition. At the same time, load output judge (LOAD) signal also turns ON if it is in the position zone.
This signal turns OFF either when a movement command to another position is issued or the servo is turned OFF. This signal is kept ON once it is turned ON until the next movement command.

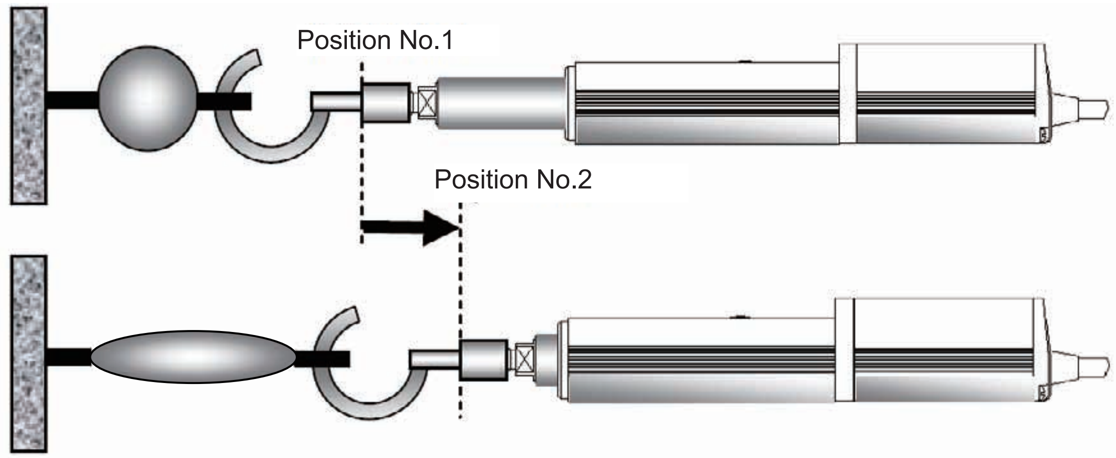
● Condition:
(Total time of pressing force to reach above threshold) – (total time of pressing force to get below threshold) ≥ 255ms (Parameter No.6)



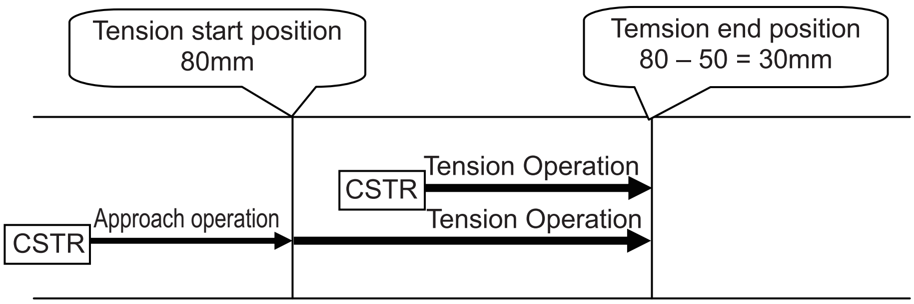
[5] Tension Operation

> Warning: Do not perform tension operation by pressing operation using force sensor.
> The pressing operation using force sensor requires an actuator applicable for dedicated loadcell and pressing operation using force sensor.
> The tension operation by using an actuation equipped with loadcell causes the loadcell to be damaged.

■ Image diagram



No.	Position [mm]	Velocity [mm/s]	Acceleration [G]	Deceleration [G]	Pressing [%]	Threshold [%]	Positioning width [mm]	Zone+ [mm]	Zone- [mm]	Acceleration/ Deceleration mode	Incremental	Gain set	Stop mode
0													
1	100.00	250.00	0.20	0.20	0	0	0.10	0.00	0.00	0	0	0	0
2	80.00	250.00	0.20	0.20	50	0	–50.00	0.00	0.00	0	0	0	0
3													



CSTR: Start position

■ Control method

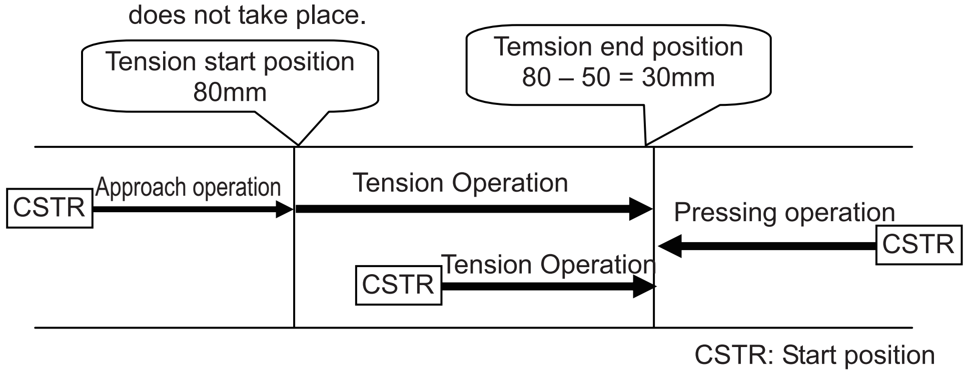
The method of controlling the tension operation is the same as that described in [4] Pressing operation. The control method is explained below by using the sample position table shown above.

1) Position No.2 indicates the settings of tension operation. The settings of “Position” and “Positioning width” show the tension start position and the tension quantity, respectively. Attach – (minus sign) to the tension quantity. Specify the upper limit of the torque required for tension in percent (limited current value) in “Pressing”. The speed, acceleration, and deceleration are the conditions of positioning to the coordinate value (80mm) set in “Position”.
2) Position No.1 indicates the tension start preparation position. Specify a value larger than the coordinate value at which the tension provided by position No.2 ends (80 – 50 = 30mm) in “Position”.

3) First define the positioning in position No.1. Next, the operation in position No.2 moves the actuator to the position of 80mm at the setting speed and rating torque and change to the tension operation. The actuator moves by 50mm in the negative direction in the tension operation. The upper limit of the tensile force is the torque set in percent.
4) In the similar way as pressing, the positioning complete signal is output when the shaft is stopped by tension (pressing complete). If the actuator cannot be stopped during movement within the setting positioning width (miss-pressing), it moves by the setting distance to stop but PEND is not turned ON.

Caution: (1) The speed during tension operation is set in Parameter No.34. Check the 10.4 List of Specifications of Connectable Actuators for the pressing speed. The speed for pulling operation is same as that for pressing operation. Do not set any value larger than the value in the list. If the speed set in the position table is equal to or less than the tension speed, the tension operation is performed at the setup speed.

(2) The tension ready position should be the tension start position or forward. If not, the moving direction varies depending on the start position to be dangerous.
The tension operation from a coordinate (less than 30mm = 80 – 50 in the above example) located before the end position (30mm) changes to the pressing operation from the current position to the tension end position. Note that the tension operation after positioning to the position of 80mm does not take place.



(3) The work is pulled also after completion of the tension. The work is drawn back or pulled further if the work is moved. When the work is drawn back before the approach position, alarm code 0DC “pressing operation range error” occurs to stop the work. When the work is moved in the tension direction and the load current becomes less than the current limit value (pressing in percent), PEND is turned OFF. Naturally, the work reaches the tension moving distance set in “Positioning width” to cause miss-pressing.

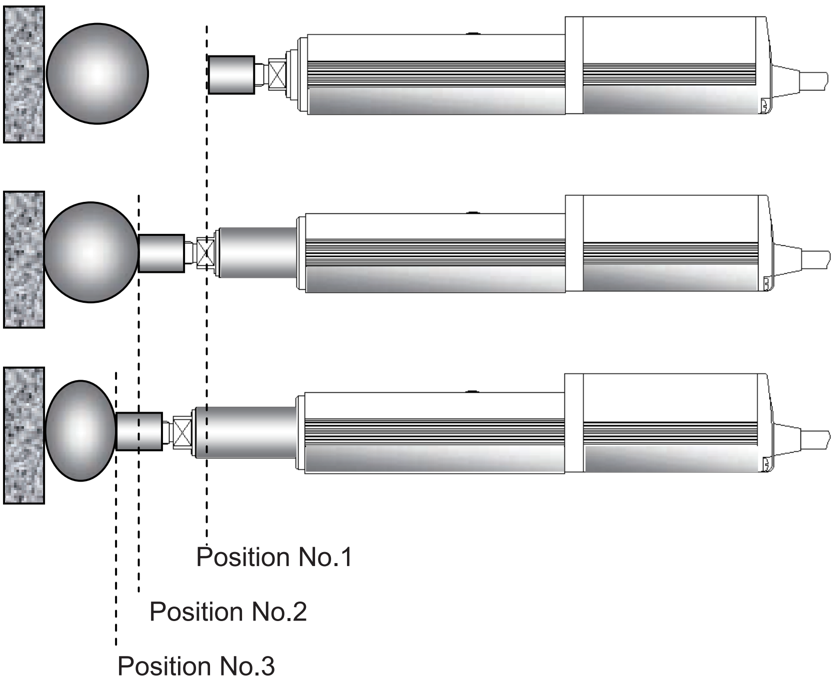
(4) Do not make control of changing to tension operation on the way of normal positioning (before PEND turning ON). Depending on the position at which start signal is turned ON, the tension operation is performed improperly. Then the PLC cannot manage the position of the actuator.

(5) Pulling operation cannot be performed with the rotary actuator.

(6) If the actuator is RCS2-RA13R (Ultra-High Thrust Type), there is a limit in the duration of pulling (= continuous pulling time) and duty of continuous pressing. Use of the product above this limit may cause a failure occurred due to the motor heat generation.
[Refer to 10.4.2 Specifications and Limitations in Pressing Operation of RCS2-RA13R]

[6] Multi-step pressing

■ Image diagram



No.	Position [mm]	Velocity [mm/s]	Accele-ration [G]	Decele-ration [G]	Pressing [%]	Thresh-old [%]	Positioning width [mm]	Zone+ [mm]	Zone- [mm]	Acceleration/ Deceleration mode	Incre-mental	Gain set	Stop mode
0													
1	0.00	250.00	0.20	0.20	0	0	0.10	0.00	0.00	0	0	0	0
2	50.00	250.00	0.20	0.20	30	0	20.00	0.00	0.00	0	0	0	0
3	50.00	250.00	0.20	0.20	50	0	20.00	0.00	0.00	0	0	0	0
4													

■ Control method

After pressing, the pressing pressure can only be changed in the pressing state.
The method of controlling multi-step pressing is the same as that described in [4] Pressing operation.

1) Set the weak pressing (30%) in position No.2 and perform the pressing operation.
2) If pressing complete signal PEND is turned ON, start the pressing operation with pressing pressure (50%) greater than the first pressure set in position No.3.
   The position data in position No.3 should be the same as that in position No.2 except the setting in “Pressing”.
3) To add a pressing step with another pressing pressure, add a sequence consisting of a position number and a pressing operation.

[7] Teaching by PIO (MODE, MODES, PWRT, WEND, JISL, JOG+, JOG-)

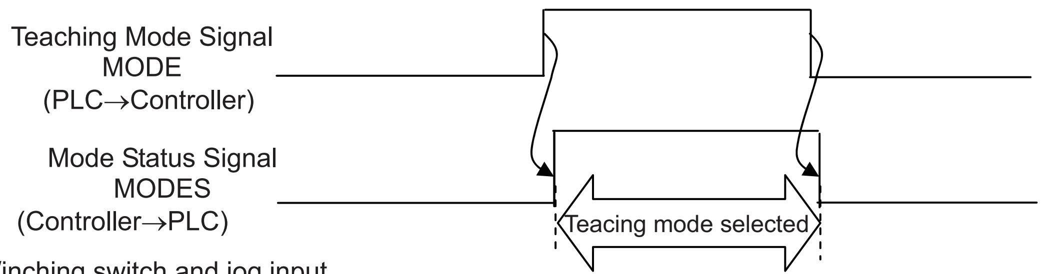
PIO signal	Input					Output	
	MODE	JISL	JOG+	JOG-	PWRT	MODES	WEND
Other than pattern 1	×	×	×	×	×	×	×
Pattern 1	○	○	○	○	○	○	○

○: Existence of signal, ×: No signal

(Note) The feature is available only in pattern 1.
Teaching by PIO is enabled.
It is possible to select the teaching mode, move the actuator to the target position with jog or inching operation, and write the coordinate value into any position number.

(1) Teaching Mode Selecting
1) To select the teaching mode, set teaching mode signal MODE to ON. If the teaching mode is selected, mode status signal MODES is turned ON.
- While the actuator is operating, MODE signal input is invalid. Therefore, after the operation is completed, the MODES signal is turned ON.
- With the MODES signal being ON, the CSTR signal is changed to teaching signal PWRT. Therefore, it is not possible to operate the actuator by specifying a position No.

2) To cancel the teaching mode to return to the normal operation mode, set the MODE signal to OFF. If the MODE signal is turned OFF, the MODES signal is turned OFF to return to the normal operation mode.



(2) Jog/inching switch and jog input
1) Jog/inching switching signal JISL indicates whether the jog operation*1 or inching operation*2 is performed by the jog input signal.
JISL signal OFF: ············ Jog operation
JISL signal ON: ··············· Inching operation
2) There are two jog input signals, or JOG+ for operation in the positive direction and JOG- for operation in the negative direction.

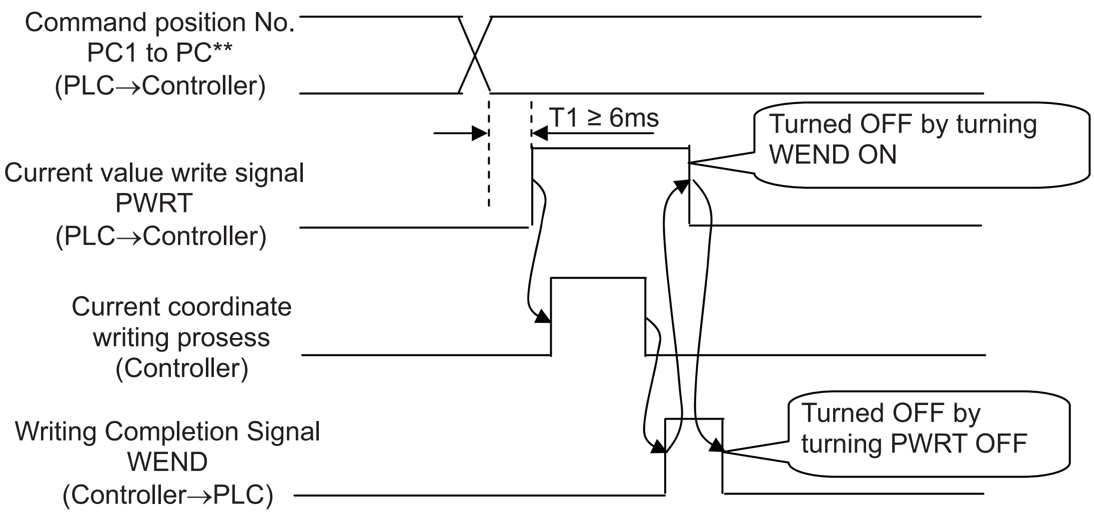
*1 Jog operation: The actuator is moved while the jog input signal is set to ON.
- JOG+ ·····While JOG+ is set to ON, the actuator is moved in the positive direction. If JOG+ is turned OFF, the actuator is decelerated and then stopped.
- JOG- ······While JOG- is set to ON, the actuator is moved in the negative direction. If JOG- is turned OFF, the actuator is decelerated and then stopped.
- Velocity ································· Value set in Parameter No.26 “PIO jog speed”.
- Acceleration/Deceleration ······ Rating acceleration/deceleration of actuator
- Pause Signal *STP················· Enabled

*2 Inching operation: Once the jog input signal is turned ON, the actuator is moved by a certain distance.
- JOG+ ·····Once JOG+ is turned ON, the actuator is moved by a certain distance in the positive direction.
- JOG- ······Once JOG- is turned ON, the actuator is moved by a certain distance in the negative direction.
- Moving distance ···················· Value set in Parameter No.48 “PIO inching distance”.
- Velocity ································· Value set in Parameter No.26 “PIO jog speed”.
- Acceleration/Deceleration ······ Rating acceleration/deceleration of actuator
- Pause Signal *STP················· Enabled

> ⚠ Warning: (1) In home return incomplete state, software limit cannot stop the actuator. Take interlock and prohibit the operation or perform the operation carefully.
> (2) If the JISL signal is changed during inching operation, the inching being operated is continued. If JISL is changed during job operation, the jog is stopped.

(3) Writing current data to position table

1) The feature is valid only when the teaching mode is selected (with the MODES signal being ON).
2) Specify the position number to which the current data is written in the binary data format in command position No.PC1 – PC32. Turn current value writing signal PWRT ON.
3) The coordinate value of the current position is written into the position table for the controller.
   If position data is written previously, only the coordinate value in "Position" is only rewritten. If nothing is written, the values set in the parameters below are written as the speed, acceleration/deceleration, positioning width, acceleration/deceleration mode, stop mode and vibration control No.. Other data is set to "0".
   - Velocity ············ Parameter No.8 "Default speed"
   - Acceleration ············ Parameter No.9 "Default acceleration/deceleration"
   - Deceleration ············ Parameter No.9 "Default acceleration/deceleration"
   - Positioning width ············ Parameter No.10 "Default positioning width (in-position)"
   - Acceleration/deceleration mode ··· Parameter No.52 "Default acceleration/deceleration mode"
   - Stop mode ············ Parameter No.53 "Default stop mode"
   - Vibration control No. ············ Parameter No.109 "Default vibration control No."
4) At the completion of writing, controller write complete signal WEND is output. Then turn the PWRT signal OFF.
5) When the PWRT signal is turned "OFF" the WEND signal is also turned "OFF".
   Turn OFF PWRT after confirming WEND is turned ON.
   Turning it OFF before turning ON disturbs the proper data writing.



⚠Caution:

(1) Set the period taken from entering position No. to turning the PWRT ON to 6ms or longer. In spite of 6ms timer process in the PLC, commands may be input to the controller concurrently to cause writing to another position. Take the scanning time in the PLC into account, set a period as 2 to 4 times as the scanning time.

(2) Turning the PWRT signal ON in the state in which home return is not completed (the HEND signal is set to ON) causes alarm 093 “PWRT signal detected before completion of home return” to occur.

(3) Turning PWRT signal OFF before turning WEND signal ON disturbs the proper data writing.

(4) Writing processing with position table screen remaining open on a teaching tool such as PC cannot lead the data on the screen to be updated. To update and confirm writing data, take the following actions:

1) PC software……Left-click the button.

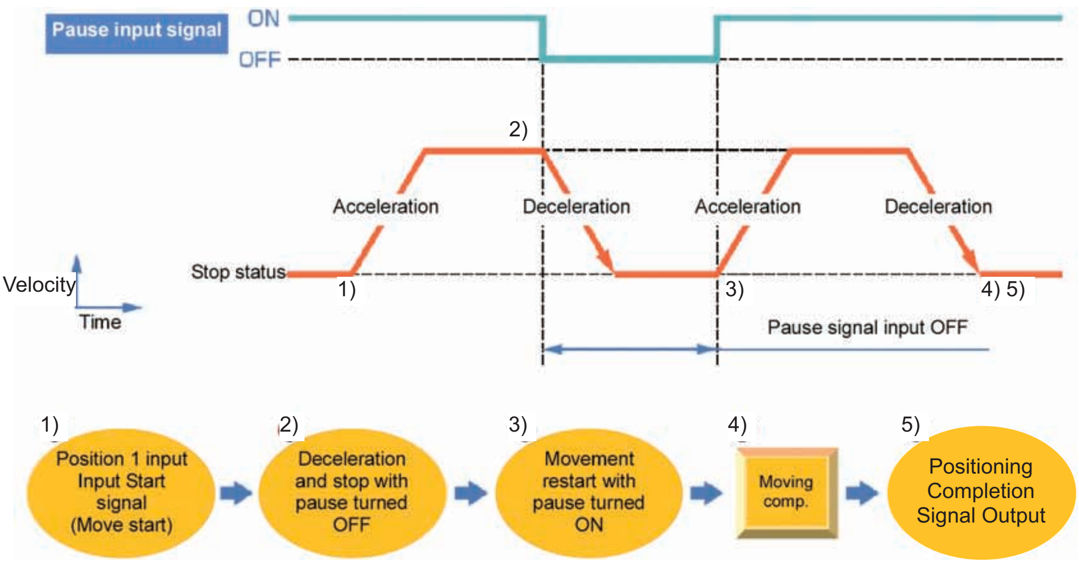
2) Teaching Pendant or Touch Panel Teaching …Change to user adjustment screen, input “4” in adjustment N O and return to the position table screen after software reset.

Check the relevant Instruction Manual for details of operation.

[8] Pause and Operation Interruption (*STP, RES, PEND, MOVE)

PIO signal	Input		Output	
	*STP	RES	PEND	MOVE
Pattern 0 to 1	○	○	○	○
Pattern 2 to 3	○	○	○	×

○: Existence of signal, ×: No signal

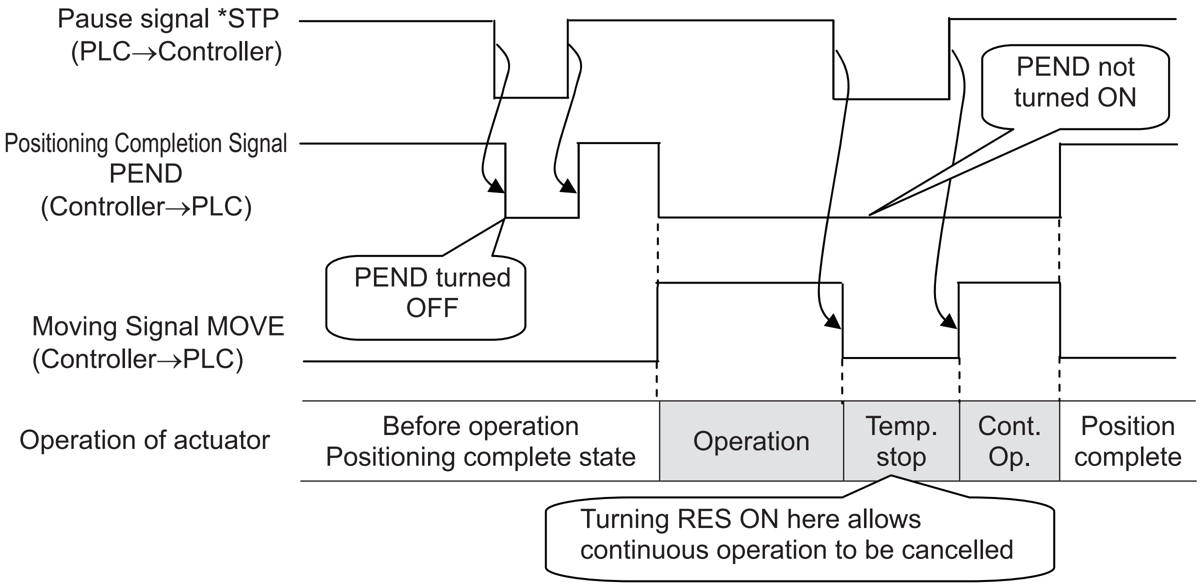


■ Control method

Pause is possible during movement. In addition, the remaining moving distance can be cancelled to interrupt the operation.

The pause signal is an input signal always set to ON. So, it is normally used to remain ON. Use this function for interlock in case where an object is invaded into the moving direction of the actuator being moved.

1) If pause signal *STP is turned off during operation of the actuator, the actuator is decelerated to a stop. The deceleration is defined by the value set in the position table.
2) During pause, moving signal MOVE is set to OFF but positioning complete signal PEND is not turned ON.
3) If pause signal *STP is returned to ON, the actuator continues the remaining movement. The acceleration is the value set in the position table.
4) Turning reset signal RES ON during pause (*STP being ON) allows the remaining movement to be canceled to interrupt the operation.



⚠Caution:	(1) At occurrence of an alarm in the release level(Note 1), RES can reset the alarm. Cancel the remaining moving distance after confirmation that alarm signal *ALM (being ON in normal state and OFF at occurrence of an alarm) is set to ON. Note 1: Check the 9.4 Alarm List for details of alarms. (2) Turning *STP OFF with the actuator being in the positioning complete state causes PEND to be turned OFF. Note that this situation may not occur when a sequence program is created. (3) If *STP is turned ON during pressing operation, the actuator is stopped with the pressing force remaining unchanged. If *STP is turned ON, the pressing operation is restarted.

3.2.5 Direct Position Specification (Solenoid Valve Mode 1) = Operation of PIO Pattern 4 or 7

The start signal is provided for every position number. Only turning ON the relevant input signal according to the table shown below allows the operation based on the data in the target position number to be performed. The operation mode is called the solenoid valve mode because solenoid valves can directly drive air cylinders.

At the completion of positioning, every completed position number is output as well as the positioning complete signal.

PIO pattern 7 is exclusively used for pressing operation using force sensor. It is intended for the actuator equipped with loadcell (RCS2-RA13R) to enable highly precise pressing control. Before the actuator can be operated, proper calibration and initialization of parameters are required. [Refer to 3.2.7 Pressing Operation Using Force Sensor Operation Ready (Calibration of Loadcell).]

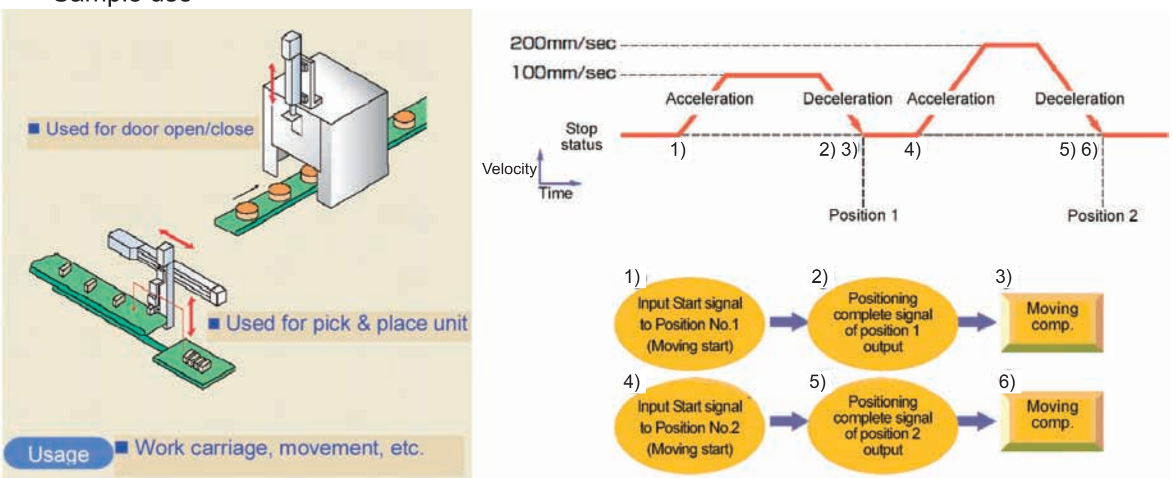
<u>Positioning, pressing, and pitch feed are possible. Their control methods are the same as those of other patterns.</u>

[1] Positioning [Basic] (ST1 to ST6, PE1 to PE6, PEND)

Position No.	Input	Output	
0	ST0	PE0	PEND
1	ST1	PE1	PEND
2	ST2	PE2	PEND
3	ST3	PE3	PEND
4	ST4	PE4	PEND
5	ST5	PE5	PEND
6	ST6	PE6	PEND

[Caution]
- Speed change is not allowed during movement.
- If start signal ST* is issued without home return, the home return operation is automatically done before the operation based on the data of the specified position number. When this specification is not desired, interlock by home return complete signal HEND is required.

■ Sample use

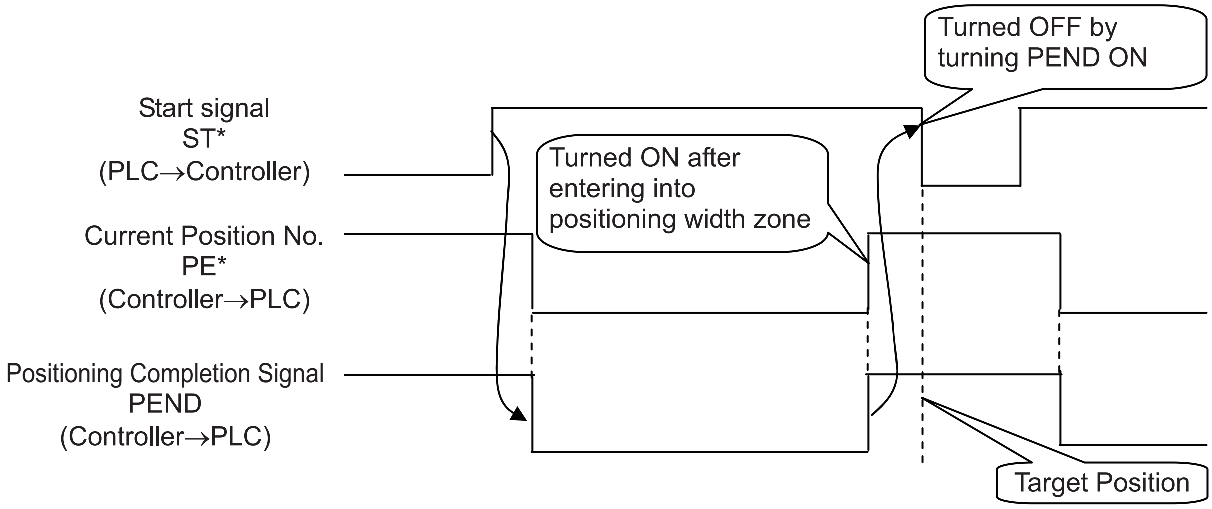


No.	Position [mm]	Velocity [mm/s]	Acceleration [G]	Deceleration [G]	Pressing [%]	Threshold [%]	Positioning width [mm]	Zone+ [mm]	Zone- [mm]	Acceleration/ Deceleration mode	Incremental	Gain set	Stop mode
0	0.00	100.00	0.20	0.20	0	0	0.10	0.00	0.00	0	0	0	0
1	70.00	100.00	0.20	0.20	0	0	0.10	0.00	0.00	0	0	0	0
2	150.00	200.00	0.20	0.20	0	0	0.10	0.00	0.00	0	0	0	0

Chapter 3 Operation

■ Control method

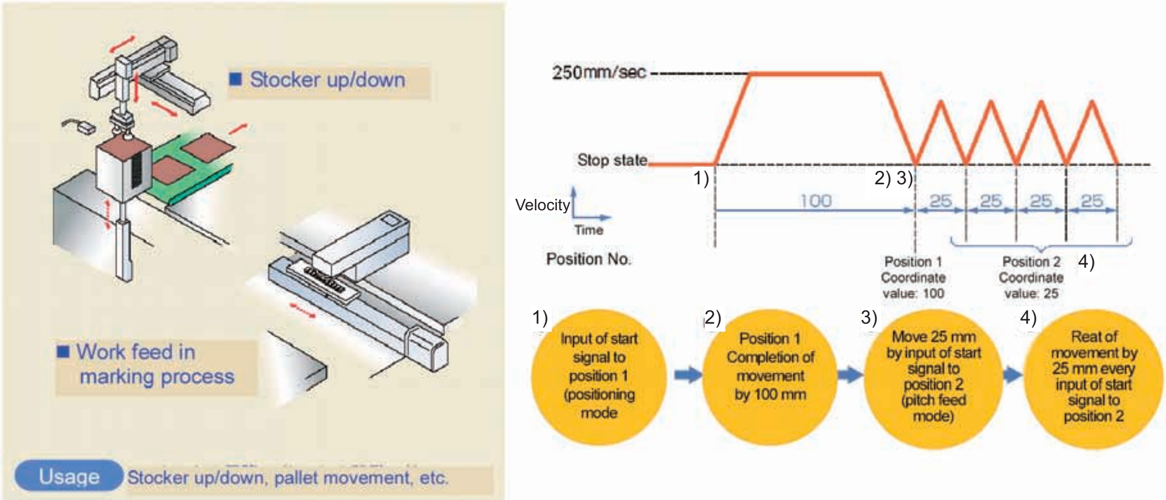
1) When start signal ST* is turned ON, the actuator starts acceleration based on the data in the specified position table for positioning to the target position.
2) At the completion of positioning, positioning complete signal PEND is turned ON as well as current position No. PE* of the specified position.
3) After PEND is turned ON, turn the ST* signal OFF.
4) Current position No. PE* and positioning completion signal PEND are turned ON if the remaining moving distance is entered into the positioning width zone. PE* and PEND turned ON once remain ON unless start signal ST* is turned ON again or the servo is turned OFF. They are also turned OFF when pause signal *STP is turned OFF.



⚠ Caution: (1) If the ST* signal is turned ON for the position after completion of positioning, both the PE* and PEND signals remain ON (except the pitch feed operation).
(2) Both the PE* and PEND signals are set to ON in the positioning width zone. Accordingly, they may be turned ON under operation of the actuator if a large positioning width is set.
(3) Interlock should be taken so that two or more ST* signals are set to ON simultaneously.
   1) Entering the ST* signal of another position during positioning is invalid. If the ST* signal of another position is turned ON during positioning, the operation is terminated after the completion of the positioning being operated.
   2) Entering the ST* signal of another position with the ST* signal of the current position remaining ON after the completion of positioning allows the positioning to the other position to be executed.
(4) If Parameter No.27 “Move command type” is set to “0” (factory setting), turning ST* OFF during positioning caused the operation to be interrupted.

[2] Pitch Feeding (relative movement = incremental feed)

■ Sample use



No.	Position [mm]	Velocity [mm/s]	Accele-ration [G]	Decele-ration [G]	Pressing [%]	Thresh-old [%]	Positioning width [mm]	Zone+ [mm]	Zone- [mm]	Acceleration/ Deceleration mode	Incre-mental	Gain set	Stop mode
0													
1	100.00	250.00	0.20	0.20	0	0	0.10	0.00	0.00	0	0	0	0
2	25.00	250.00	0.20	0.20	0	0	0.10	0.00	0.00	0	1	0	0

(Position No.2 sets pitch feed.)

■ Control method

1) The method of controlling pitch feed is the same as that described in [1] Positioning except the setting of the position table. Repeat the positioning of a specific position No.
2) For pitch feed, the position set in the position table indicates the pitch. Set the pitch (relative moving distance = incremental moving distance) in column “Position”.
3) If the operation command is issued, the actuator moves from the current stop position by “Position” in the position table. To perform continuous movement, repeat the operation. Any accumulation error does not occur because the home position (coordinate value 0) is specified as the base point.

⚠ Caution:

(1) Because pitch feed is repeated, turning ON the ST* signal of the same position after completion of positioning causes both the PE* and PEND signals to be turned OFF at operation start and turned ON again at completion of positioning in the same way as [1] Positioning.

(2) If the actuator reaches the software limit (stroke end) in pitch feed, the actuator is decelerated to be stopped and current position No. PE* and positioning complete signal PEND are turned ON at the stop position.

(3) Both the PE* and PEND signals are set to ON in the positioning width zone. Accordingly, they may be turned ON under operation of the actuator if a large positioning width is set.

(4) Interlock should be taken so that two or more ST* signals are set to ON simultaneously.
   1) Entering the ST* signal of another position during positioning is invalid. If the ST* signal of another position is turned ON during positioning, the operation is terminated after the completion of the positioning being operated.
   2) Entering the ST* signal of another position with the ST* signal of the current position remaining ON after the completion of positioning allows the positioning to the other position to be executed.

(5) If Parameter No.27 “Move command type” is set to “0” (factory setting), turning ST* OFF during positioning caused the operation to be interrupted.

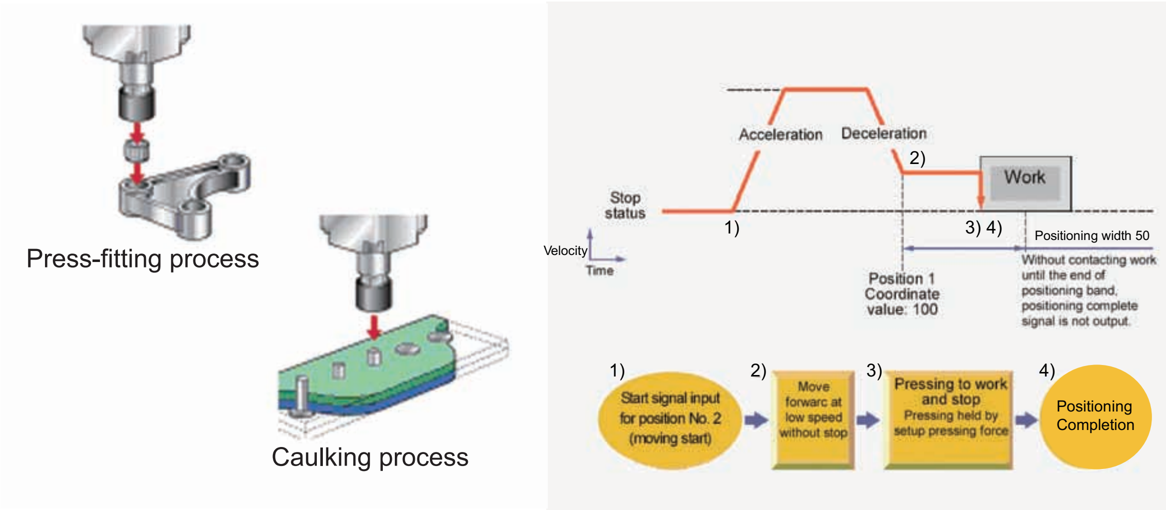
(6) Note that, when Parameter No.27 “Move command type” is set to “1”, starting (ST* ON) pitch feed repeatedly during pause causes the actuator to be moved successively by the number of starts. If this situation is supposed, cancel the remaining moving distance by turning reset signal RES ON in the pause state or take interlock so that start signals are not turned on during pause.

(7) The pressing operation is enabled by using the pitch feed function.

(8) In the pitch feed, do not perform a command with a pitch smaller than the minimum encoder resolution (lead/encoder pulse number) or that less than positioning accuracy repeatability.
   There would be no deviation to occur even with the command because it is an operation command to the same position as the positioning complete condition, but the positioning control cannot be performed properly.

[3] Pressing operation

■ Sample use



No.	Position [mm]	Velocity [mm/s]	Acceleration [G]	Deceleration [G]	Pressing [%]	Threshold [%]	Positioning width [mm]	Zone+ [mm]	Zone- [mm]	Acceleration/ Deceleration mode	Incremental	Gain set	Stop mode
0													
1	0.00	250.00	0.20	0.20	0	0	0.10	0.00	0.00	0	0	0	0
2	100.00	250.00	0.20	0.20	50	0	50.00	0.00	0.00	0	0	0	0

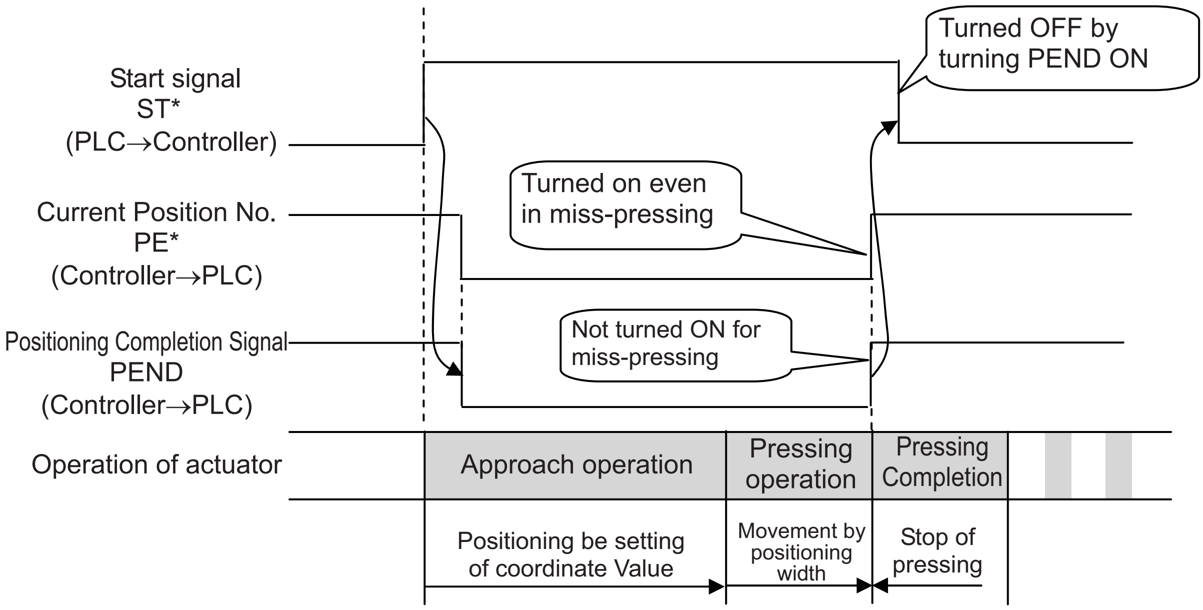
(Position No.2 sets pressing operation.)

■ Control method

1) The method of controlling the pressing operation is the same as that described in [1] Positioning except the setting of the position table. Any setting of “Pressing” in the position table allows the pressing operation to be done. “Positioning width” is assumed as pressing operation distance.
2) The actuator moves at the setting speed and rating torque to the position of the coordinate set in “Position” in the similar way as normal positioning. Then the operation changes to pressing. The moving distance in pressing is the value set in “Positioning width”. The pressing is performed with the torque (current limit value) set in percent in “Pressing” of PIO patterns 4 being the upper limit.
   Pressing operation using force sensor of PIO pattern 7 performs pressing by the pressing force set in percent of the base thrust in pressing operation using force sensor*1.
   *1 Base thrust in pressing operation using force sensor:
   Converted thrust at rating motor output in pressing operation using force sensor

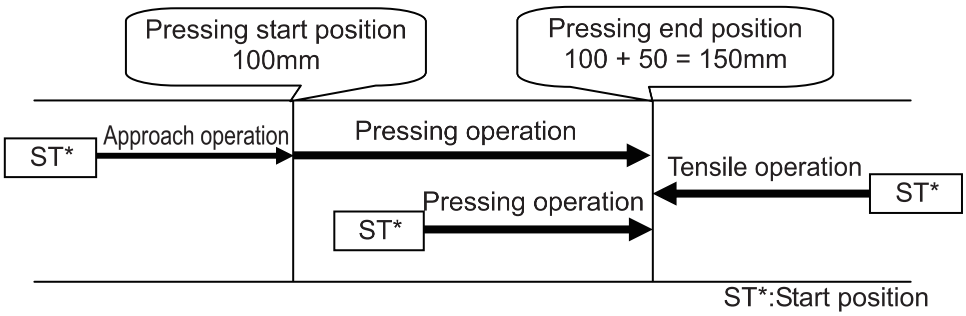
Actuator		Base thrust in pressing operation using force sensor [N]
RSC2-RA13R	1t type	4900
	2t type	9800

3) The control method is the same as that in [1] Positioning. However, the processing of positioning complete signal PEND is different from that in [1] Positioning.
   PEND is output when the shaft is stopped by pressing (pressing complete). If the work is not subject to pressing (miss-pressing), the actuator moves by the value set in “Positioning width” to stop but PEND is not turned ON. The current position No. PE* is turned ON at the completion of pressing and even in miss-pressing.



Caution: (1) The speed during pressing operation is set in Parameter No.34. Check the 10.4 List of Specifications of Connectable Actuators for the pressing operation speed.
Do not set any value larger than the value in the list. If the speed set in the position table is equal to or less than the pressing speed, the pressing is performed at the setup speed.

(2) The approach start position of pressing should be located at or before the pressing start position (coordinate 100mm or less in the above example) If not, the moving direction varies depending on the start position to be dangerous.
For example, pressing at coordinate larger than the pressing end position (larger than 150mm) is performed in the direction from the current position to the pressing end position. It would not proceed to the pressing operation at 150mm point after positioning at 100mm point.



(3) The work is pressed after the pressing is completed. The work may moves backward or forward. If the actuator is moved backward before the approach position, alarm code 0DC "pressing zone error" occurs to stop the actuator. In movement of the work in the pressing direction, PEND is turned OFF if the load current becomes lower than the current limit (pressing (%)). Miss-pressing occurs when the actuator moves by the pressing moving distance set in "Positioning width".

(4) Pressing control cannot be performed with the rotary actuator.

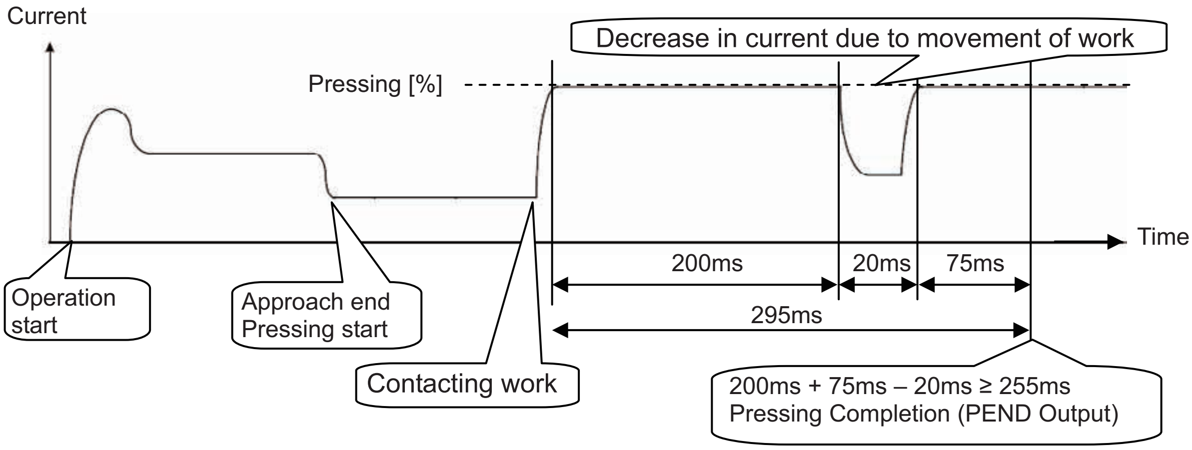
(5) If the actuator is RCS2-RA13R (Ultra-High Thrust Type), there is a limit in the duration and duty of continuous pressing. Use of the product above this limit may cause a failure occurred due to the motor heat generation.
[Refer to 10.4.2 Specifications and Limitations in Pressing Operation of RCS2-RA13R]

Judging completion of pressing operation

(1) Normal case (PIO pattern 4):

The operation monitors the torque (current limit value) in percent in “Pressing” of the position table and turns pressing complete signal PEND ON when the load current satisfies the condition shown below during pressing. PEND is turned ON at satisfaction of the condition if the work is not stopped.

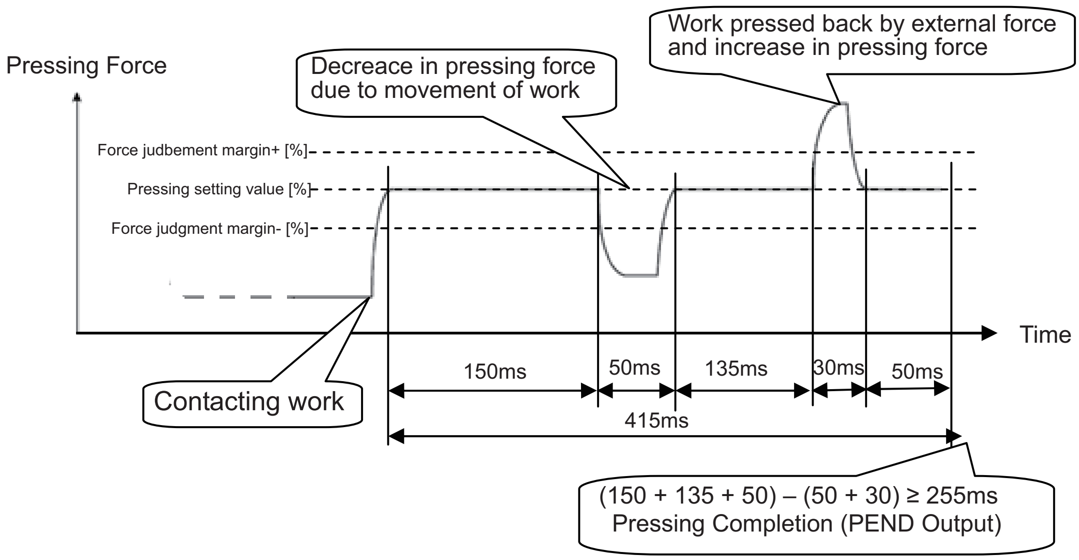
(Accumulated time in which current reaches pressing value [%]) – (accumulated time in which current is less than pressing value [%]) ≥ 255ms (Parameter No.6)



(2) Pressing operation using force sensor (PIO pattern 7):

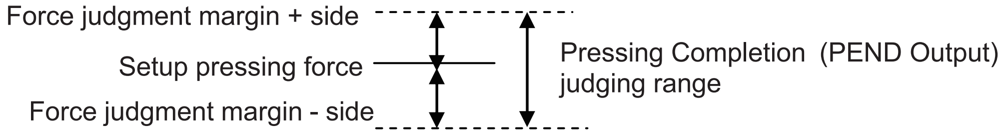
If the pressing force during pressing operation satisfies the following condition against the pressing force set in percent by “Pressing” in the position table, pressing complete signal PEND is turned ON. This occurs even if the actuator does not stop.

- Condition:
  (Accumulated time in which pressing force enters within the range between force judgment margin+ and force judgment margin–) ≥ 255ms (Parameter No.6)



Force judgment margins are described by percent of the base thrust in pressing operation using force sensor [*1] provided by the actuator. They should be set in Parameter No.95 and 96.
The pressing complete judging range is,

Pressing setting value [%] + Force judgment margin+ [%]
to Pressing setting value [%] – Force judgment margin [%]



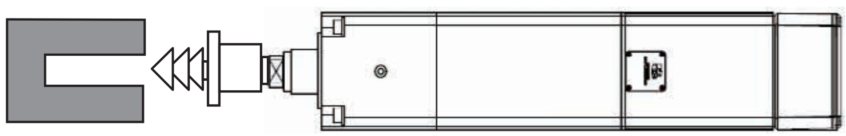
*1 Base thrust in pressing operation using force sensor:
Converted thrust at rating motor output in pressing operation using force sensor

Actuator		Base thrust in pressing operation using force sensor [N]
RCS2-RA13R	1t type	4900
	2t type	9800

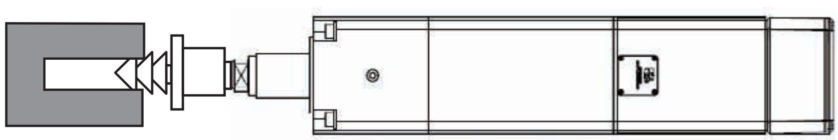
[Setting sample]
In case where the actuator is of 1-ton type and the pressing value, force judgment margin + side, and force judgment margin - side are set to 150%, 4%, and 4%, respectively:
Setup pressing value: 4900 [N] × 150% = 7350 [N] and
Force judgment margin + and - : 4900 [N] × 4% = 196 [N].
Hence, the pressing complete judging range is between 7154 to 7546 [N].

(3) Torque Level Detection during Pressing Operation (Valid in PIO pattern 6)
■ Image diagram

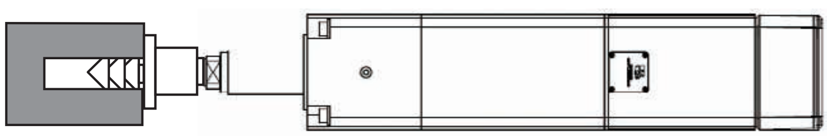
Operation start



Detect torque level while in pressing operation



Pressing Complete

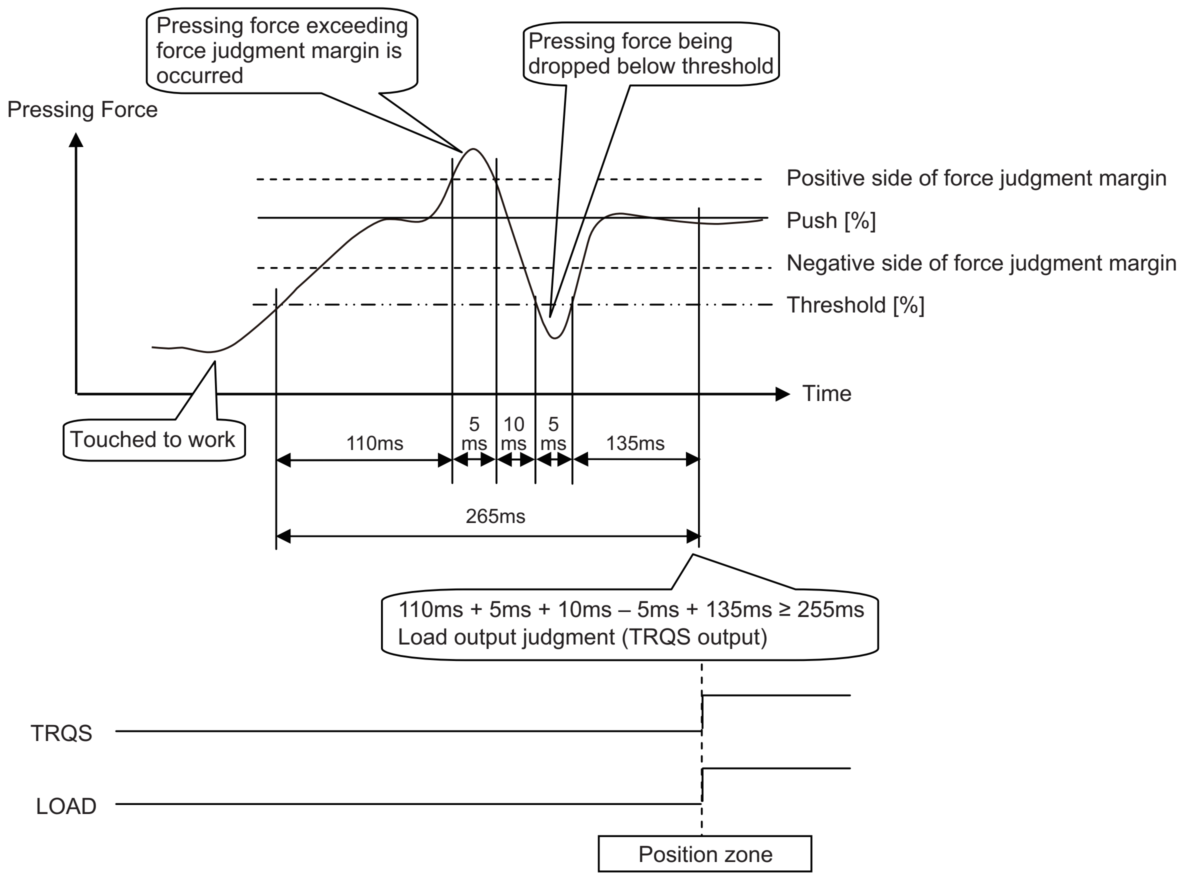


■ Control method

This is a function to detect whether the specified load is applied to the actuator by checking the torque while in press-fitting operation when having a press-fitting process with the pressing operation. If there is no resistance in press-fitting, the specified load would not be applied, thus it is defined as the normal pressing is not conducted and an alarm can be issued from PLC.

It monitors the pressing force set in % in “Threshold” in the position data, and turns the torque level status (TRQS) signal ON when the pressing force reaches the following condition. At the same time, load output judge (LOAD) signal also turns ON if it is in the position zone.
This signal turns OFF either when a movement command to another position is issued or the servo is turned OFF. This signal is kept ON once it is turned ON until the next movement command.

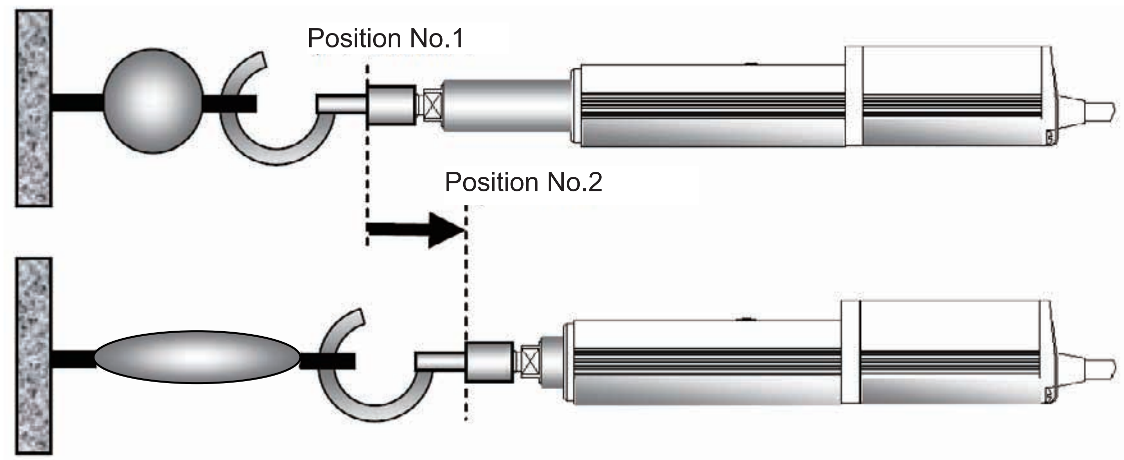
● Condition:
(Total time of pressing force to reach above threshold) – (total time of pressing force to get below threshold) ≥ 255ms (parameter No.6)



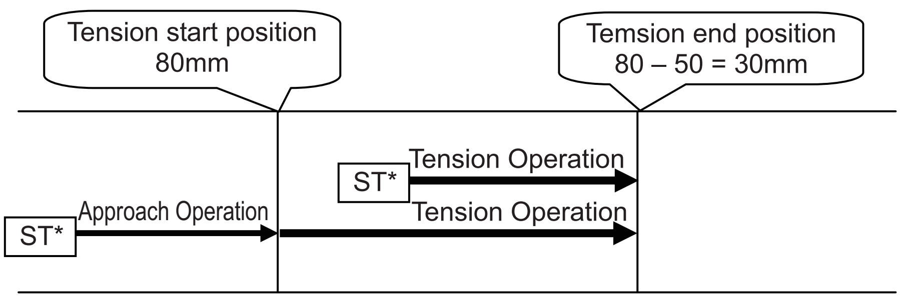
[4] Tension Operation

> Warning: Do not perform tension operation by pressing operation using force sensor.
> The pressing operation using force sensor requires an actuator applicable for dedicated loadcell and pressing operation using force sensor.
> The tension operation by using an actuation equipped with loadcell causes the loadcell to be damaged.

■ Image diagram



No.	Position [mm]	Velocity [mm/s]	Accele-ration [G]	Decele-ration [G]	Pressing [%]	Thresh-old [%]	Positioning width [mm]	Zone+ [mm]	Zone- [mm]	Acceleration/ Deceleration mode	Incre-mental	Gain set	Stop mode
0													
1	100.00	250.00	0.20	0.20	0	0	0.10	0.00	0.00	0	0	0	0
2	80.00	250.00	0.20	0.20	50	0	–50.00	0.00	0.00	0	0	0	0
3													



ST*: Start position

■ Control method

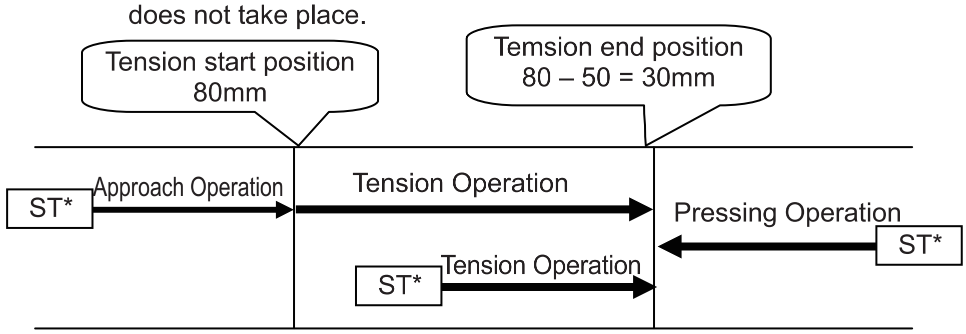
The method of controlling the tension operation is the same as that described in [3] Pressing operation. The control method is explained below by using the sample position table shown above.

1) Position No.2 indicates the settings of tension operation. The settings of "Position" and "Positioning width" show the tension start position and the tension quantity, respectively. Attach – (negative sign) to the tension quantity. Specify the upper limit of the torque required for tension in percent (limited current value) in "Pressing". The speed, acceleration, and deceleration are the conditions of positioning to the coordinate value (80mm) set in "Position".
2) Position No.1 indicates the tension start preparation position. Specify a value larger than the coordinate value at which the tension provided by position No.2 ends (80 – 50 = 30mm) in "Position".

3) First define the positioning in position No.1. Next, the operation in position No.2 moves the actuator to the position of 80mm at the setting speed and rating torque and change to the tension operation. The actuator moves by 50mm in the negative direction in the tension operation. The upper limit of the tensile force is the torque set in percent.
4) In the similar way as pressing, the positioning complete signal is output when the shaft is stopped by tension (pressing complete). If the actuator cannot be stopped during movement within the setting positioning width (miss-pressing), it moves by the setting distance to stop but PEND is not turned ON. The current position No. PE* is turned on at the completion of pressing and even in miss-pressing.

⚠Caution: (1) The speed during tension operation is set in Parameter No.34. [Refer to 10.4 List of Specifications of Connectable Actuators for the pressing speed.]
Do not set any value larger than the value in the list. If the speed set in the position table is equal to or less than the tension speed, the tension operation is performed at the setup speed.

(2) The tension ready position should be the tension start position or forward. If not, the moving direction varies depending on the start position to be dangerous.
The tension operation from a coordinate (less than 30mm = 80 – 50 in the above example) located before the end position (30mm) changes to the pressing operation from the current position to the tension end position. Note that the tension operation after positioning to the position of 80mm does not take place.



ST*: Start position

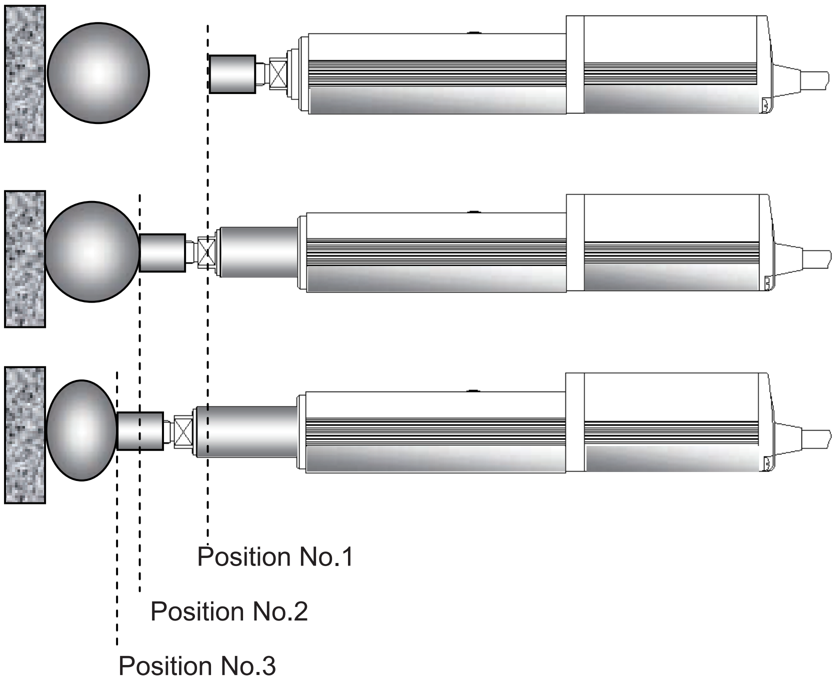
(3) The work is pulled also after completion of the tension. The work is drawn back or pulled further if the work is moved. When the work is drawn back before the approach position, alarm code 0DC “pressing operation range error” occurs to stop the work. When the work is moved in the tension direction and the load current becomes less than the current limit value (pressing in percent), PEND is turned OFF. Naturally, the work reaches the tension moving distance set in “Positioning width” to cause miss-pressing.

(4) Pulling operation cannot be performed with the rotary actuator.

(5) If the actuator is RCS2-RA13R (Ultra-High Thrust Type), there is a limit in the duration of pulling (= continuous pulling time) and duty of continuous pressing. Use of the product above this limit may cause a failure occurred due to the motor heat generation.
[Refer to 10.4.2 Specifications and Limitations in Pressing Operation of RCS2-RA13R]

[5] Multi-step pressing

■ Image diagram



No.	Position [mm]	Velocity [mm/s]	Acceleration [G]	Deceleration [G]	Pressing [%]	Threshold [%]	Positioning width [mm]	Zone+ [mm]	Zone- [mm]	Acceleration/ Deceleration mode	Incremental	Gain set	Stop mode
0													
1	0.00	250.00	0.20	0.20	0	0	0.10	0.00	0.00	0	0	0	0
2	50.00	250.00	0.20	0.20	30	0	20.00	0.00	0.00	0	0	0	0
3	50.00	250.00	0.20	0.20	50	0	20.00	0.00	0.00	0	0	0	0
4													

■ Control method

After pressing, the pressing pressure can only be changed in the pressing state.
The method of controlling multi-step pressing is the same as that described in [3] Pressing operation.

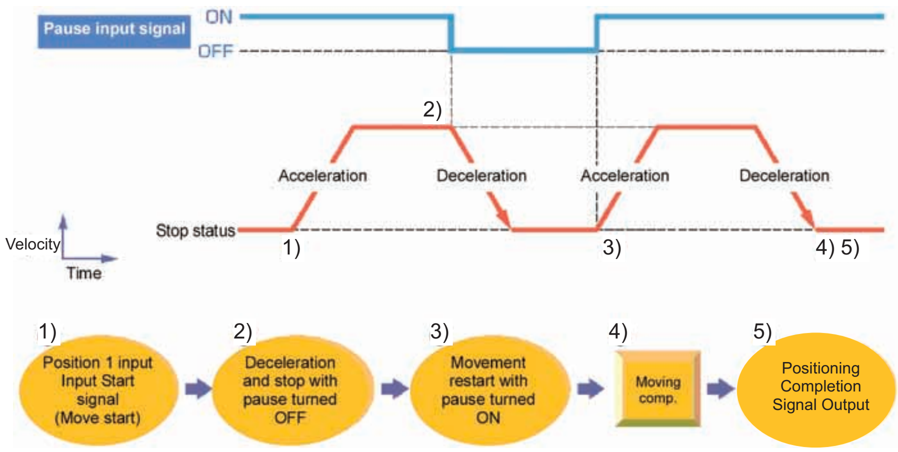
1) Set the weak pressing (30%) in position No.2 and perform the pressing operation.
2) If pressing complete signal PEND is turned ON, start the pressing operation with pressing pressure (50%) greater than the first pressure set in position No.3.
   In this particular operation, turn ON ST3 after completion of ST2, and turn OFF ST2 when PEND is turned OFF. In usual case, do not turn ON two or more ST* signals simultaneously.
   The position data in position No.3 should be the same as that in position No.2 except the setting in "Pressing".
3) To add a pressing step with another pressure, add a sequence consisting of a position number and a pressing operation.

[6] Pause and Operation Interruption (ST*, *STP, RES, PE*, PEND)

Pause is possible during movement. In this mode, the following two methods are possible for pause.

1) Use of pause signal *STP
   Turning reset signal RES ON during the pause allows the remaining moving distance to be cancelled to interrupt the operation.
2) Use of start signal ST*
   This method is valid when Parameter No.27 "Move command type" is set to "0" (factory setting). The actuator can only be moved while the ST* signal is set to ON and stopped if ST* is turned OFF. Since setting the ST* signal to OFF is assumed as interrupt of operation, the remaining moving distance may not be cancelled.

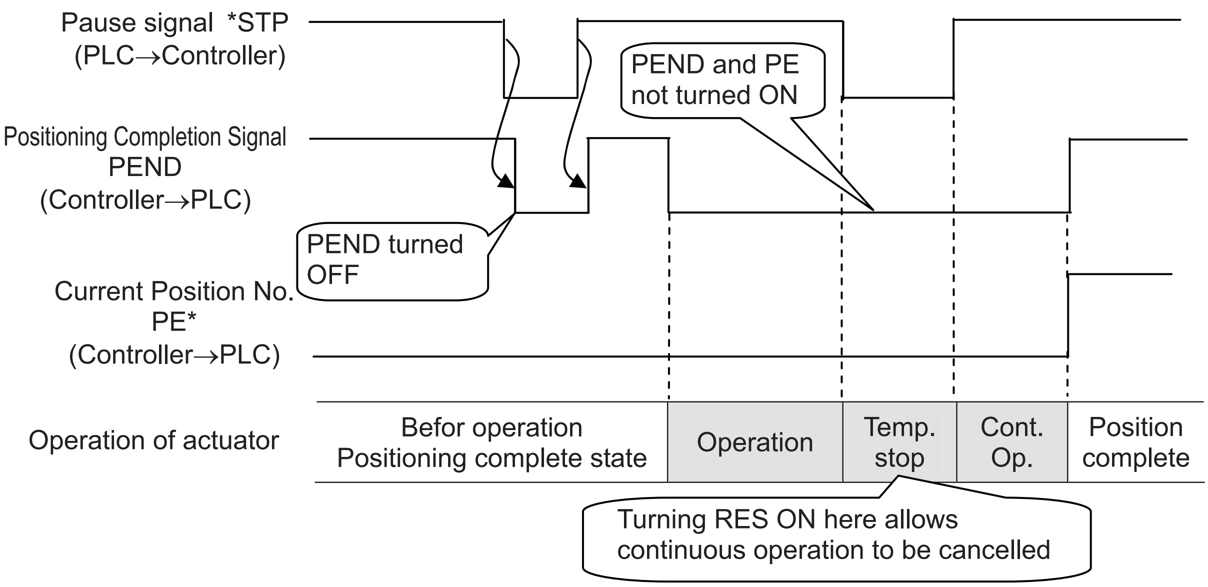
(1) Use of pause signal *STP



■ Control method

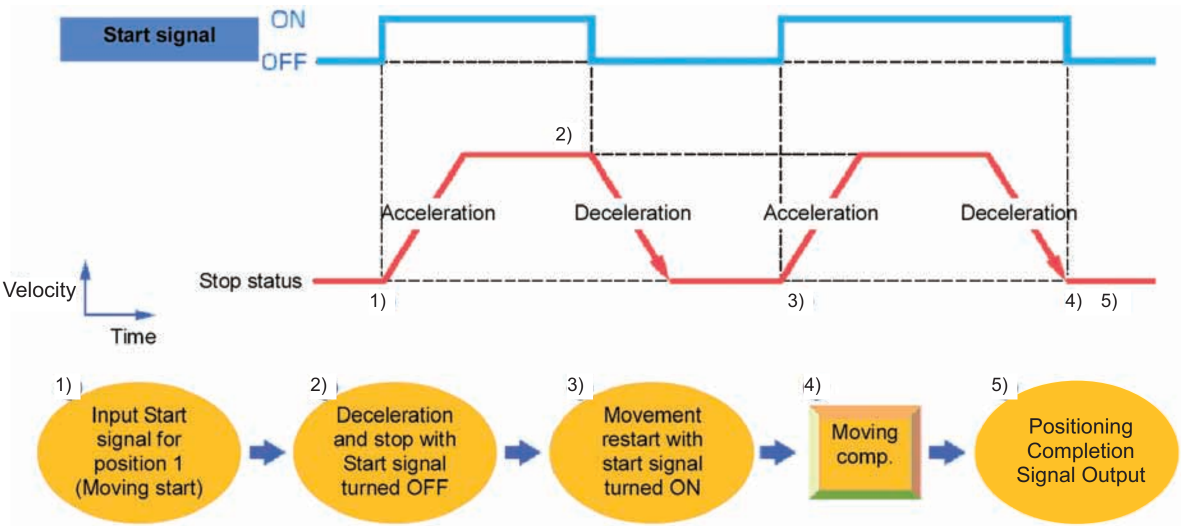
The pause signal is an input signal always set to ON. So, it is normally used to remain ON. Use this function for interlock in case where an object is invaded into the moving direction of the actuator being moved.

1) If pause signal *STP is turned off during operation of the actuator, the actuator is decelerated to a stop. The deceleration is defined by the value set in the position table.
2) During pause, current position No. PE* and positioning complete signal PEND are not turned ON.
3) If pause signal *STP is returned to ON, the actuator continues the remaining movement. The acceleration is the value set in the position table.
4) Turning reset signal RES ON during pause (*STP being ON) allows the remaining movement to be canceled to interrupt the operation.



> ⚠Caution: (1) At occurrence of an alarm in the release level[Note 1], RES can reset the alarm. Cancel the remaining moving distance after confirmation that alarm signal *ALM (being ON in normal state and OFF at occurrence of an alarm) is set to ON.
> Note 1: [Refer to 9.4 Alarm List for details of alarms.]
> (2) Turning *STP OFF with the actuator being in the positioning complete state causes PEND to be turned OFF. Note that this situation may not occur when a sequence program is created.

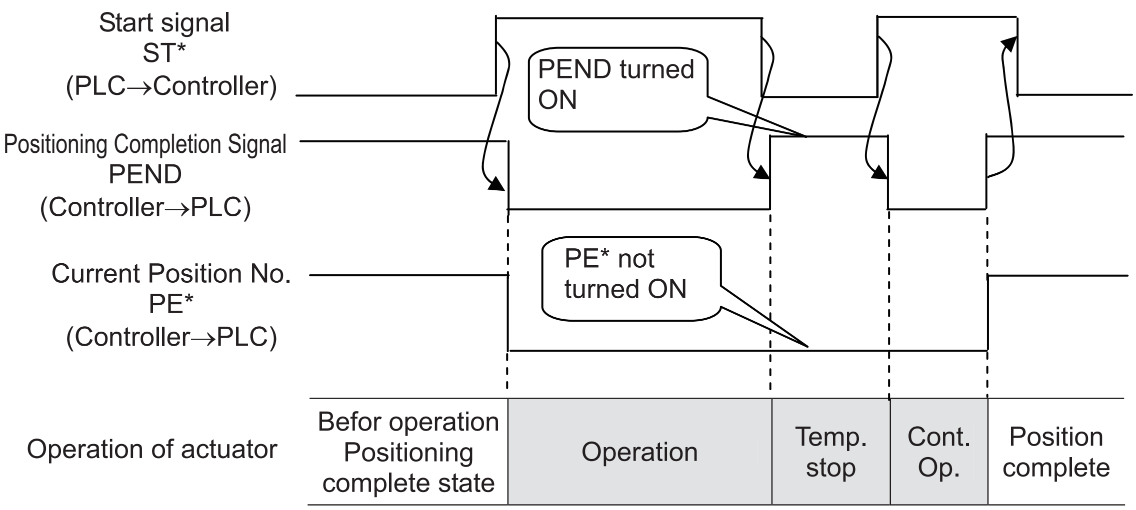
(2) Use of start signal ST*



■ Control method

If start signal ST* is turned OFF during movement, the actuator can be paused.
Use the control method for interlock in case where an object is invaded into the moving direction of the actuator being moved.

1) If the ST* signal is turned OFF during movement, the actuator is paused. The deceleration is the value set in the position table.
2) Turning the ST* signal OFF causes the positioning to be interrupted and deemed complete signal PEND to be turned ON.
3) If the ST* signal is turned ON again, the remaining movement is continued. The acceleration is the value set in the position table.



3.2.6 Direct Position Specification (Solenoid Valve Mode 2) = Operation of PIO Pattern 5

The start signal is provided for every position number. Only turning ON the relevant input signal according to the table shown below allows the operation based on the data in the target position number to be performed. The operation mode is called the solenoid valve mode because solenoid valves can directly drive air cylinders. At invasion of the actuator into the positioning width set for each position, the output signal is turned ON in the operation of any position number or manual operation of the actuator in servo OFF status as if a sensor were installed.

Positioning and speed change during operation are possible. Their control methods are the same as those of other patterns.

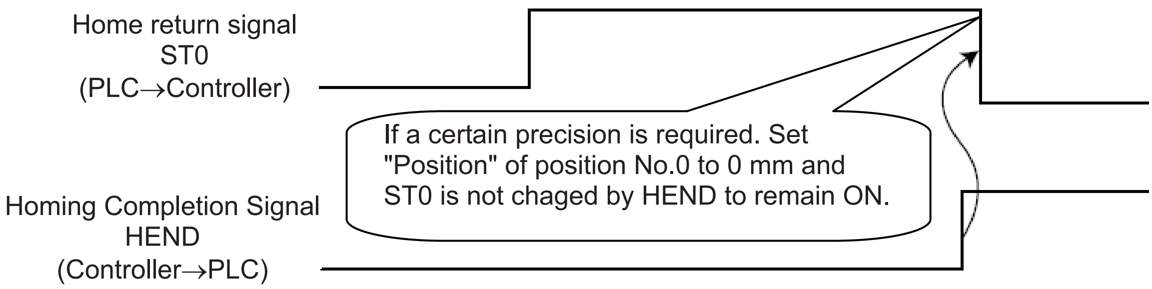
> ⚠ Caution: This pattern does not allow pressing and pitch feed.

[1] Home return (ST0, HEND)

The I/O of PIO varies as shown in the table below depending on the position number before home return.

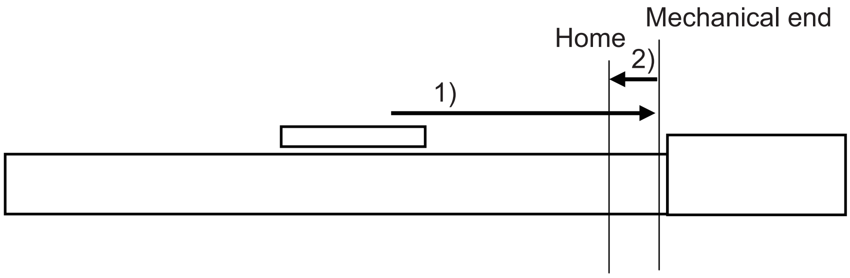
Position No.	Input	Output
0	ST0	LS0
1	ST1 ⇒ JOG+	LS1
2	ST2 ⇒ Invalid	LS2 ⇒ Invalid

Before home return, start signal ST0 works as JOG- moving to the home return direction while it is set to ON and ST1 works as JOG+ while it is set to ON. By using this function, move the actuator to a position at which home return can be done safely. The speed of ST1 is the home return speed.
After the home return is fully prepared, turn the ST0 signal ON to start the home return. At the completion of the home return, home return complete signal HEND is turned ON. Turn the ST0 signal OFF if HEND is turned ON. HEND remains ON unless the home is lose due to occurrence.
If a certain home positioning precision is required, Set “Position” of position No.0 to 0 mm and the ST0 signal is not changed by the HEND signal to remain ON. After the home return is completed, positioning is provided for position No.0. [Refer to 3.2.6 [3] Positioning.]



> ⚠ Warning: (1) Use this pattern with Parameter No.27 “Move command type” set to “0” (factory setting). When Parameter No.27 is set to “1”, the home return is started as soon as the ST0 signal is turned ON and the operation cannot be stopped even if ST0 is turned OFF.
> (2) If “Position” in position No.0 is set to other than 0mm, the operation is continued without change to provide positioning after home return.

[Operation of Slider Type/Rod Type Actuator]

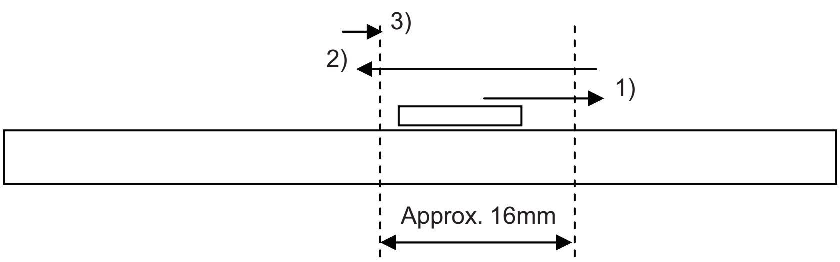


1) With the ST0 signal being ON, the actuator moves toward the mechanical end at the home return speed.
   The moving speed is 20mm/s for most actuators but less than 20mm/s for some actuators. Check the instruction manual of actuator.
2) The actuator is turned at the mechanical end and stopped at the home position. The moving distance is the value set by Parameter No.22 “Home return offset level”.(Note 1)

⚠Caution:	In the home reverse specification, the actuator moves in the reverse direction. Make sure to refer to Section 8.2 [18] when a change to Parameter No.22 “Home Return Offset Level” is required.

Note 1: It moves for the offset amount after the encoder Z-phase is detected.

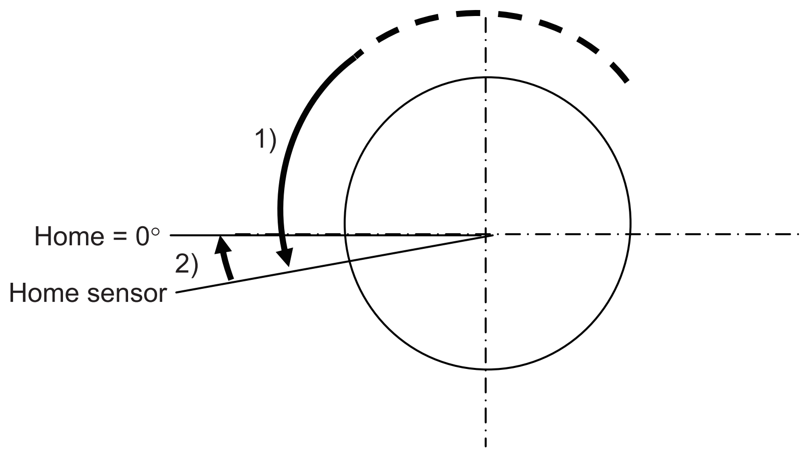
[Actuator Movement for Spurious Absolute Type]



1) With HOME Signal ON, the actuator moves towards the home-return direction set in Parameter No.5 at 3mm/s (fixed).
2) Move back and forth in approximately 16mm (to confirm the current position).
3) Home return operation is completed after the actuator confirms the current position.

⚠Caution:	For Spurious Absolute Type, make sure to have a home return operation after the power is turned ON or the software is reset. B3 Error would be generated if there was an interrupting object in the procedure of 2) and the current position could not be detected properly.

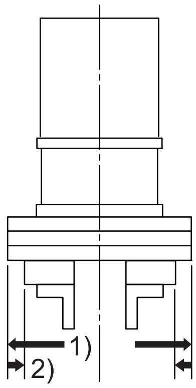
[Operation of Rotary Actuator]



1) The actuator rotates in CCW (counterclockwise) direction from the view point of the load side. The velocity is either 20deg/s or 5deg/s. (It depends on the setting of each actuator.)
2) At the home sensor input, the actuator is turned in the reverse direction and stopped at the home position. The rotation angle is the value set by Parameter No.22 "Home return offset level" after the detection of phase Z.

⚠ Caution: Make sure to refer to Section 8.2 [18] when a change to Parameter No.22 "Home Return Offset Level" is required.

[Operation of actuator of gripper type]



1) If the HOME signal is turned ON, the actuator moves toward the mechanical end at the home return speed (20mm/s).
2) The actuator is turned at the mechanical end and stopped at the home position. The rotation angle is the value set by Parameter No.22 "Home return offset level" after the detection of phase Z.

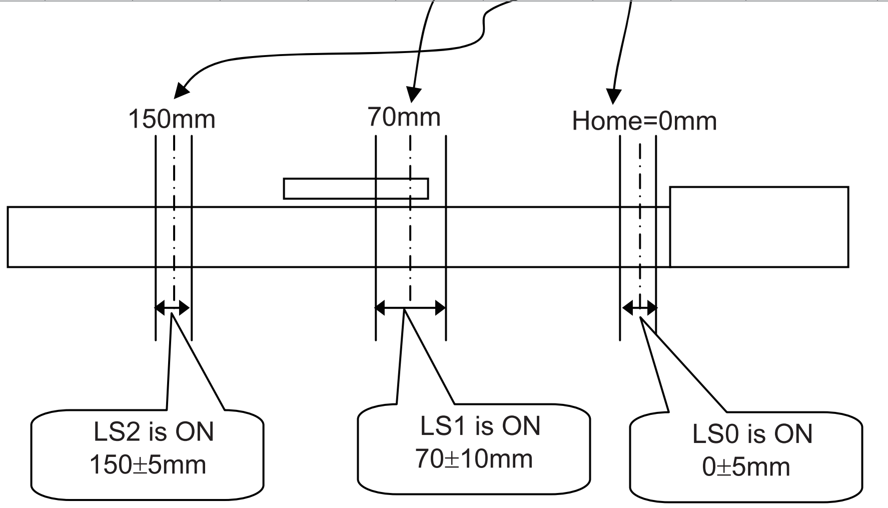
⚠ Caution: Make sure to refer to Section 8.2 [18] when a change to Parameter No.22 "Home Return Offset Level" is required.

[2] Features of LS signals (LS0 to 2)

The LS* signals are not complete signals for positioning commands such as those for other PIO patterns. Despite the specified position No., the corresponding LS* signal is turned ON when the actuator is entered into the setup value range as if the actuator were detected by a sensor installed.

(Example) The figure below shows the position table and the position at which each of the LS signals is turned ON. If the actuator passes any of the positioning widths in the operation by another position number or manual operation in the servo OFF state, the relevant LS signal is always turned ON.

No.	Position [mm]	Velocity [mm/s]	Accele-ration [G]	Decele-ration [G]	Pressing [%]	Thresh-old [%]	Positioning width [mm]	Zone+ [mm]	Zone- [mm]	Acceleration/ Deceleration mode	Incre-mental	Gain set	Stop mode
0	0.00	250.00	0.20	0.20	0	0	5.00	0.00	0.00	0	0	0	0
1	70.00	250.00	0.20	0.20	0	0	10.00	0.00	0.00	0	0	0	0
2	150.00	250.00	0.20	0.20	0	0	5.00	0.00	0.00	0	0	0	0



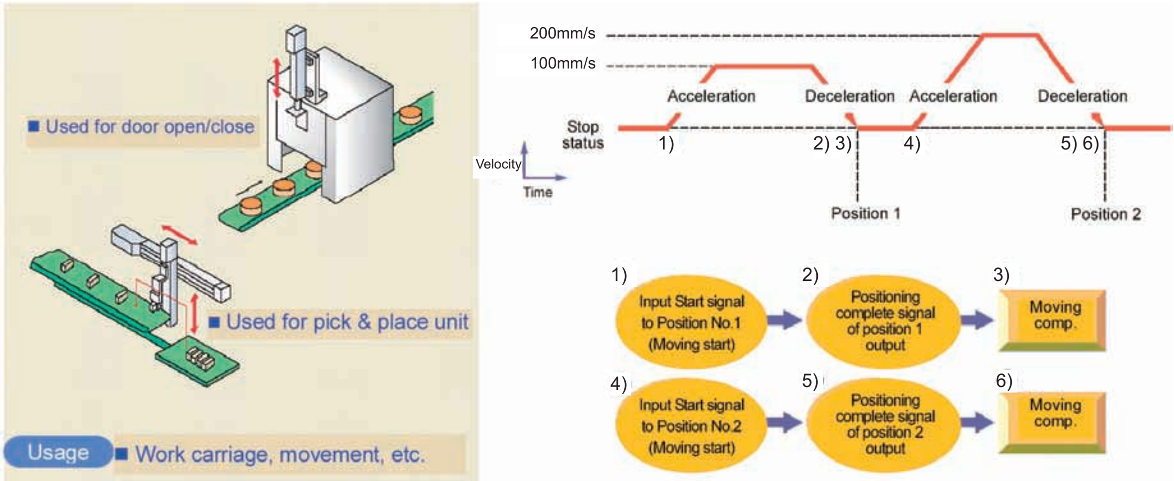
Caution: Even though a cold start error is generated, LS Signal would not turn OFF.

[3] Positioning [Basic] (ST0 to ST2, LS0 to LS1)

Position No.	Input	Output
0	ST0	LS0
1	ST1	LS1
2	ST2	LS2

[Caution] Pressing and pitch feed are unavailable.

■ Sample use

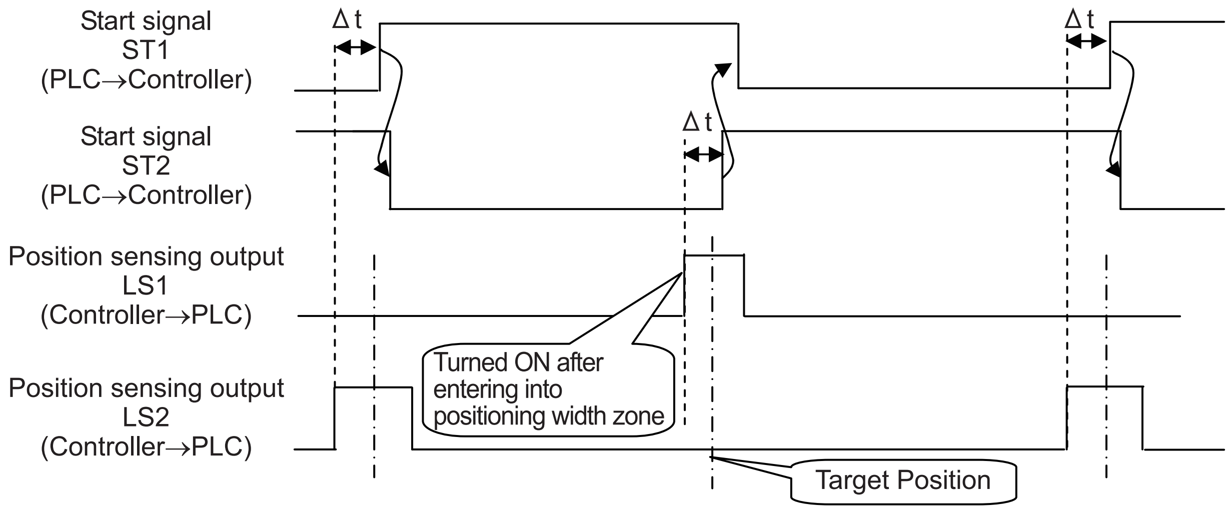


No.	Position [mm]	Velocity [mm/s]	Accele-ration [G]	Decele-ration [G]	Pressing [%]	Thresh-old [%]	Positioning width [mm]	Zone+ [mm]	Zone- [mm]	Acceleration/ Deceleration mode	Incre-mental	Gain set	Stop mode
0	0.00	100.00	0.20	0.20	0	0	0.10	0.00	0.00	0	0	0	0
1	70.00	100.00	0.20	0.20	0	0	0.10	0.00	0.00	0	0	0	0
2	150.00	200.00	0.20	0.20	0	0	0.10	0.00	0.00	0	0	0	0

■ Control method

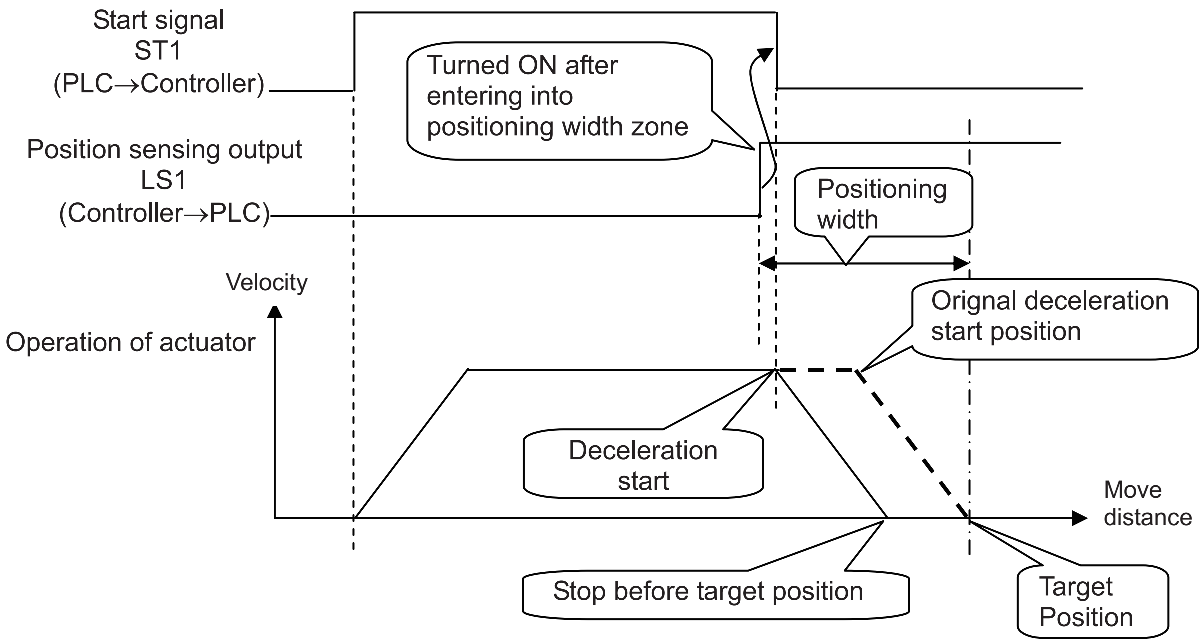
1) When start signal ST* is turned ON, the actuator starts acceleration based on the data in the specified position table for positioning to the target position. Turning the ST* signal OFF on the way causes the actuator to be decelerated and stopped. So, make the ST* signal remain ON until the actuator reaches the target position.
2) At the completion of positioning, position detection output LS* of the specified position is turned ON.
3) Position detection output LS* is turned ON if the remaining moving distance enters into the positioning width. LS* is set to ON if the current position is located within the positioning width zone or OFF if the current position is located out of the positioning width zone (the same situation occurs in the servo OFF status).
4) Leave the ST* signal to be ON until the actuator is moved to another position and turn off it at the next ST* signal. If the ST* signal is turned OFF at the LS* signal, the actuator is decelerated to a stop in the positioning width and thus the actuator may not reach the target position. In continuous operation, turn on the next ST* signal by setting the positioning width within the required precision range or setting the period taken from detection of the LS* signal to reaching the target position.

(Example) Repetition of ST1 → ST2 → ST1 →
Insert timer Δt if necessary.



Δt : Time required to certainly reach the target position after the position sensing output LS1 or 2 is turned on.

[Example of stop position when the ST* signal is turned OFF by the LS* signal]
If the positioning width is set at a position before the original deceleration start position, the actuator cannot reach the target position.

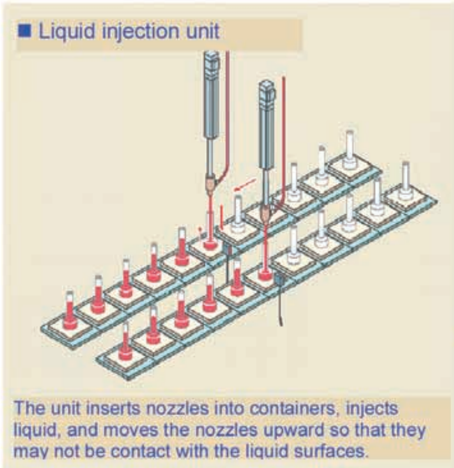


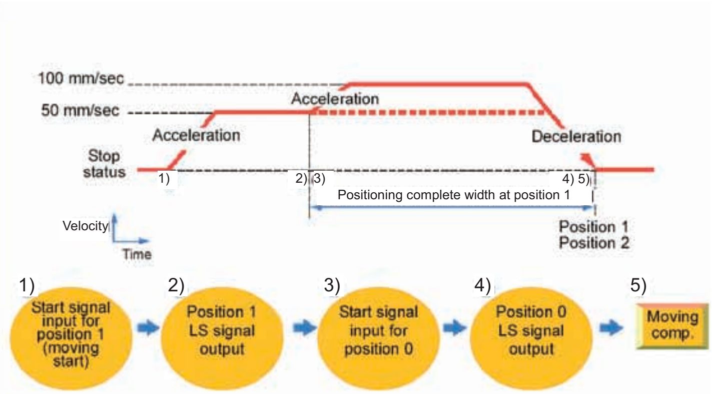
⚠ Caution: (1) If the ST* signal for the position is turned ON after the completion of positioning, the LS* signal remains ON. (2) Both the LS* and PEND signals are set to ON in the positioning width zone. Accordingly, they may be turned ON under operation of the actuator if a large positioning width is set. (3) Interlock should be taken so that two or more ST* signals are set to ON simultaneously. If two or more ST* signals are input simultaneously, they will be executed according to the following priorities: ST0→ST1→ST2

Chapter 3 Operation

[4] Speed change during the movement

■ Sample use





No.	Position [mm]	Velicoty [mm/s]	Accele-ration [G]	Decele-ration [G]	Pressing [%]	Thresh-old [%]	Positioning width [mm]	Zone+ [mm]	Zone- [mm]	Acceleration/ Deceleration mode	Incre-mental	Gain set	Stop mode
0	0.00	100.00	0.20	0.20	0	0	0.10	0.00	0.00	0	0	0	0
1	0.00	50.00	0.20	0.20	0	0	100.00	0.00	0.00	0	0	0	0
2	150.00	200.00	0.20	0.20	0	0	0.10	0.00	0.00	0	0	0	0

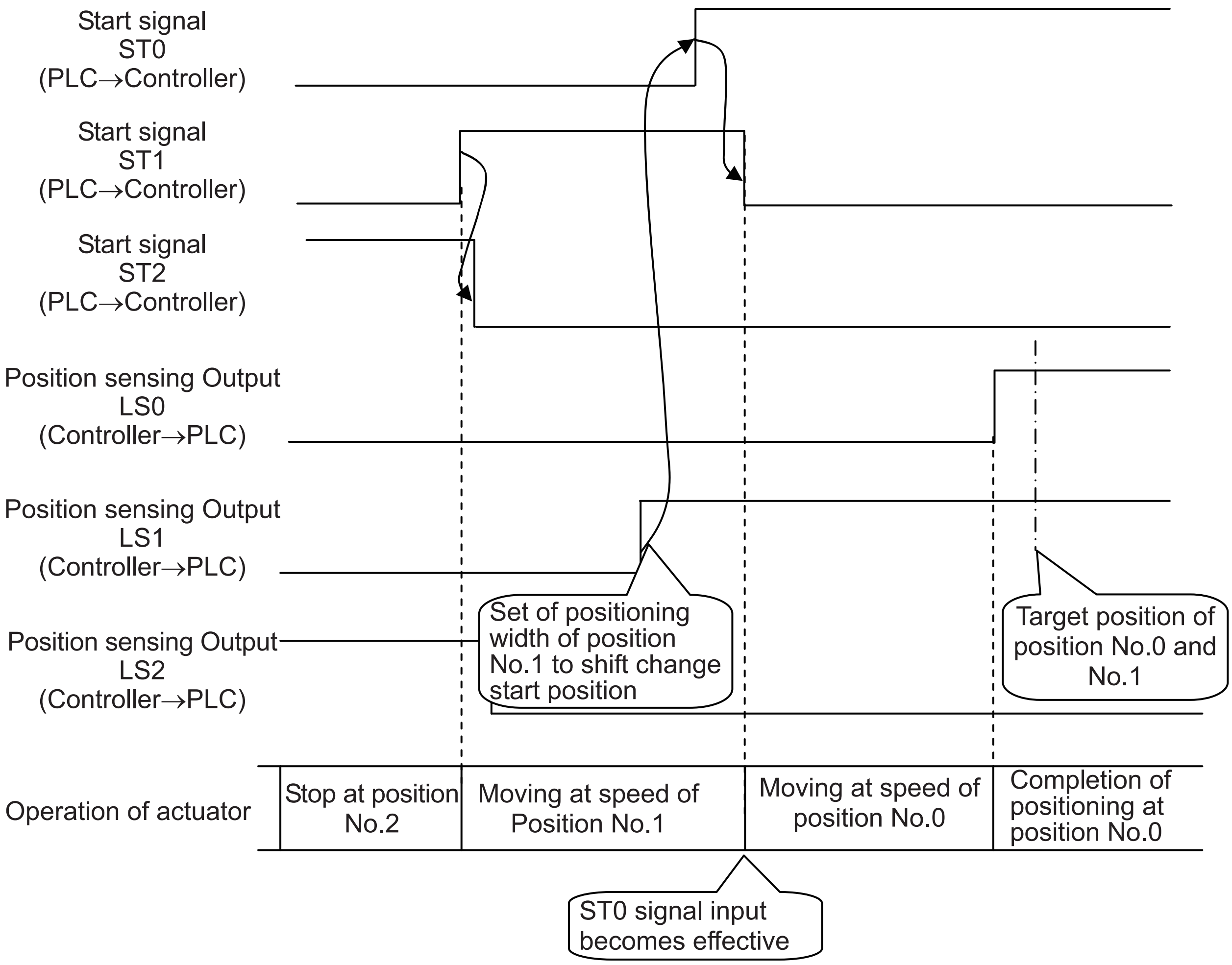
■ Control method

The speed of the actuator can be changed while it moves. The operation control method is the same as that in [3] Positioning. This pattern prioritizes the start signal specified later over the previous signal. Accordingly if another position No. is started during operation, then the new operation begins. This can be used to change the speed.

1) In this example, the speed is changed while the actuator moves from the position of 150mm to the position of 0mm. At first, set the positioning to the target position at the first speed in position No.1. In the positioning width, set the distance from the speed change position to the target position. The value is set to 100mm in the example. Thus, for position No.1, position sensing signal LS1 is turned ON at the position before the target position by 100mm.
2) Set the positioning to the target position at the second speed in position No.0.
3) Then start position No.1 (ST1 signal) and use position sensing output signal LS1 of position No.1 to start position No.0 (ST0 signal). Since this pattern prioritizes the signal specified later over the previous signal, the operation of No.1 is changed to the operation of No.0 during the operation of No.1.
   (Note) If there is a signal commanded afterwards, the commanded signal will start activating once the previously commanded signal is turned OFF.
4) Use position sensing signal LS0 of position No.0 to turn the ST1 signal OFF.

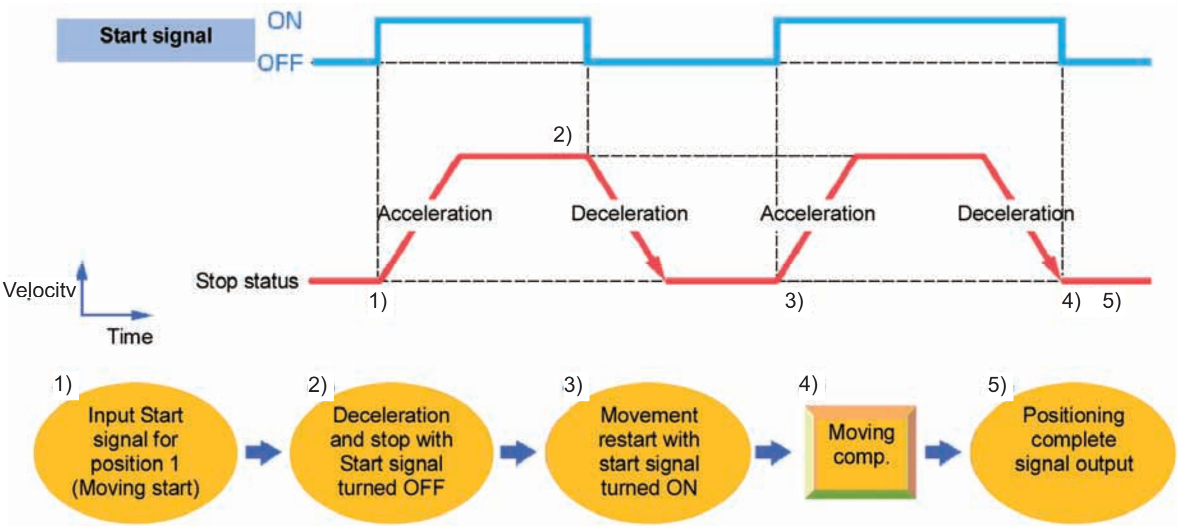
In this example, the target positions No.2 and 3 are equal with each other. They may not be the same. However, setting the target positions to be equal with each other allows the distance from the speed change position to the target position to be known easily.
Depending on the timing when the actuator accepts the input signal, the speed change may be delayed a little. Changing the positioning width can adjust the timing.

The timing chart shown below indicates that the actuator changes its speed while it moves to position No.1 after the completion of positioning at position No.2 and moves to position No.0.



[5] Pause and Operation Interruption (ST*, *STP, RES, PE*, PEND)

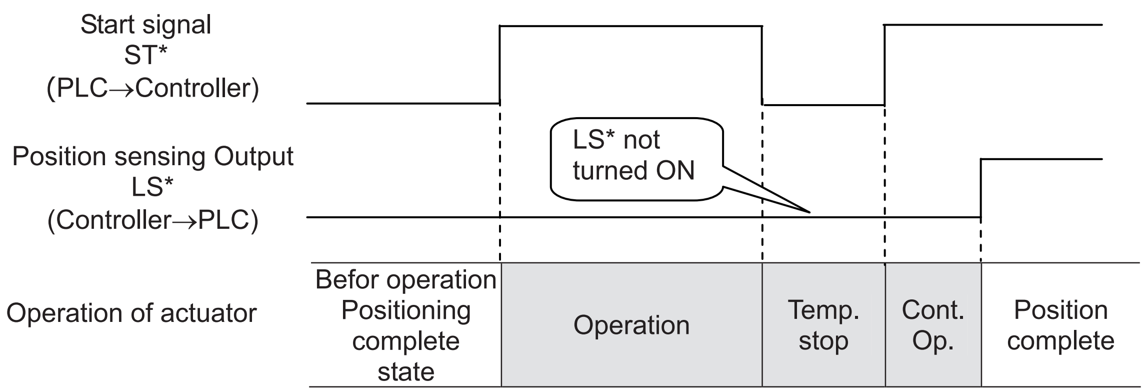
Turning start signal ST* OFF allows the actuator to be paused while it is moved. To restart it, turn the same ST* signal ON.



■ Control method

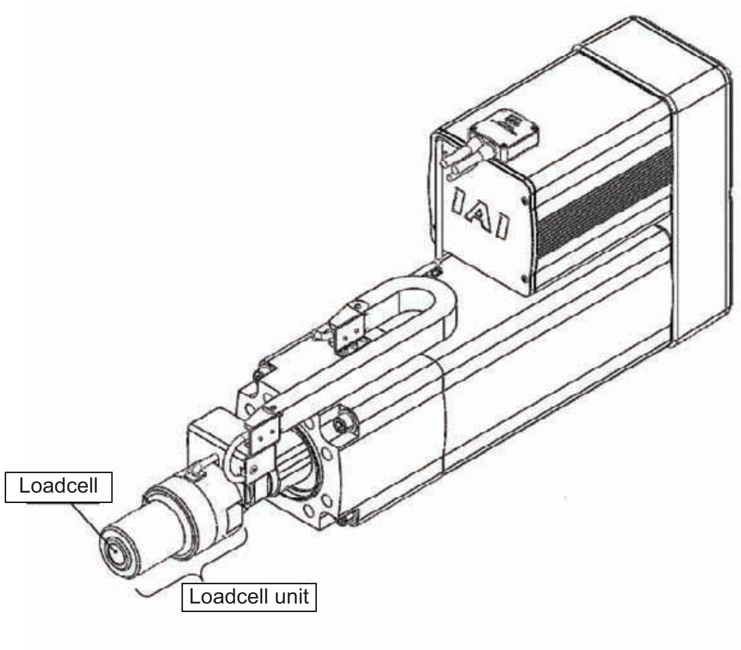
If start signal ST* is turned OFF during movement, the actuator can be paused.
Use the control method for interlock in case where an object is invaded into the moving direction of the actuator being moved.

1) If the ST* signal is turned OFF during movement, the actuator is decelerated to a stop. The deceleration is the value set in the position table.
2) If the ST* signal is turned ON again, the remaining movement is continued. The acceleration is the value set in the position table.



3.2.7 Operation Ready for Pressing Operation Using Force Sensor (Calibration of Loadcell)

The operation by pressing operation using force sensor (PIO patterns 6 and 7) provides feedback control for pressing force by the loadcell to allow highly precise pressing operation using force sensor.
Before pressing by pressing operation using force sensor is carried out, perform the setting and processing described below.

> ⚠ Caution: The pressing operation using force sensor requires a dedicated loadcell and an actuator fit to the pressing operation using force sensor. The actuator equipped with the loadcell cannot make tensile operation. The tensile operation causes the loadcell to be damaged.
>
> 
>

[1] Initial Setting

Pressing by pressing operation using force sensor uses a loadcell. Before the operation can be started, parameters must be initialized. Set the four parameters listed in the table below as shown in the area enclosed by the thick frame.

No.	Name	Set value for actuator with loadcell	Set value for pressing operation using force sensor	Reference
92	Use of loadcell [0: No use / 1: Use]	1	1	0: No use of loadcell 1: Use of loadcell
93	Selection of pressing control [0: Current limit / 1: Force sensor]	1	1	0: Control by current limit (normal control) 1: Control by force sensor
117	Automatic loadcell calibration at start [0: Yes / 1: No]	1	1 (Recommended) or 0	0: No automatic calibration of loadcell 1: Automatic calibration of loadcell
118	Pressing operation without completion of loadcell calibration [0: Disable / 1: Enable]	0	0	0: Pressing disabled in no completion of calibration 1: Pressing enabled in no completion of calibration

(1) Set of pressing control by loadcell

1) Set Parameter No.92 “Use of loadcell” to “1” “use”. If Parameter No.92 is set to “0” (Does not use), the loadcell is invalid.
2) Set Parameter No.93 “Selection of pressing control” to “1” “pressing by pressing operation using force sensor”. If Parameter No.93 is set to “0”, pressing by current limit is selected.

[Settings of Parameter No.92 and 93 and pressing control]

Parameter No.92 Use of loadcell	Parameter No.93 Selection of pressing control	Pressing control
1: Use of loadcell	1: Control by force sensor	Pressing by pressing operation using force sensor
	0: Control by current limit	Pressing by current limit
0: No use of loadcell	1: Control by force sensor	Alarm 0A1 Parameter data error
	0: Control by current limit	Pressing by current limit

(2) Set of calibration of loadcell

Perform the settings to set when to have the calibration and to protect from the operation without the calibration.

1) To measure precise force, proper loadcell calibration is required. Set Parameter No.117 “Automatic calibration at start” to “1” to perform calibration automatically or “0” to perform calibration arbitrarily.
   If it is set to automatic setting, the calibration is conducted once after the power is supplied to the controller or software reset is held from the teaching tool such as PC software. The calibration time is 10ms. The calibration does not lead the actuator to be operated.
2) Parameter No.118 can provide protection so that pressing may not be performed without calibration. Set the parameter to “0”. Pressing without any calibration after power-on causes alarm 0E1 “calibration error” to occur.
   Setting the parameter to “1” allows pressing without calibration to be performed.

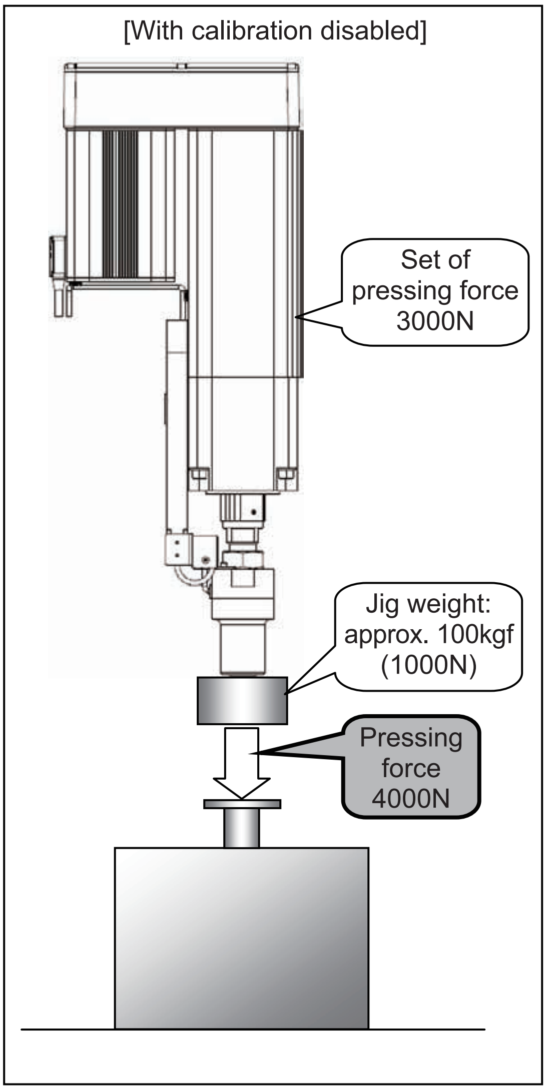
[2] Calibration of Loadcell (CLBR, CEND)

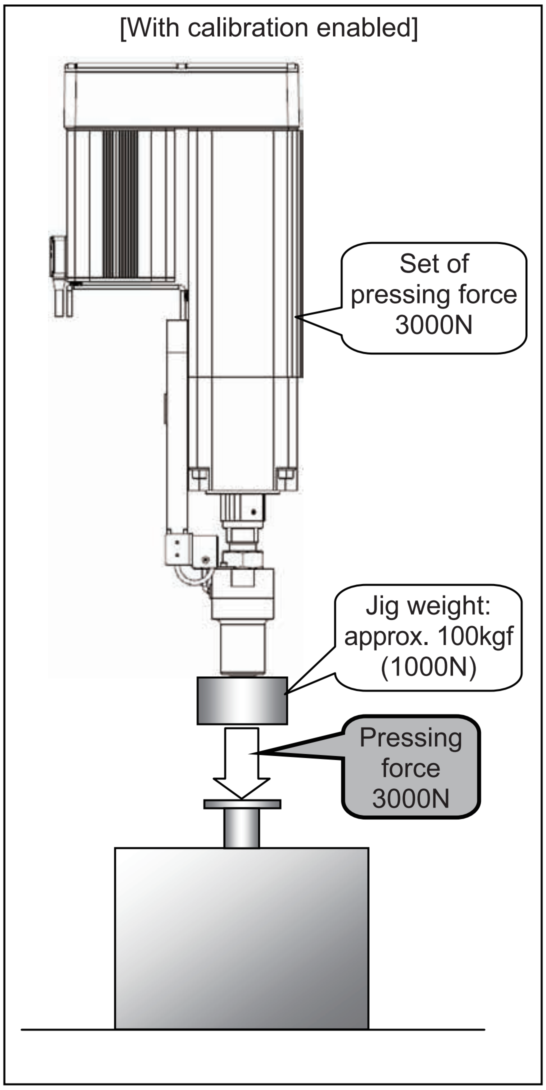
A loadcell with no load is set to 0 [N] at shipment.
Do not fail to conduct a calibration when the condition that a pressing tool such as a pusher is attached is set to the origin (0 [N]).
Just before highly precise pressing, provide readjustment and inspection depending on the condition.
Calibration can be performed from a teaching tool such as PC software. [Refer to the Instruction Manual of each teaching tool for details.]

PIOsignal	Input	Output
	CLBR	CEND

■ Example of calibration

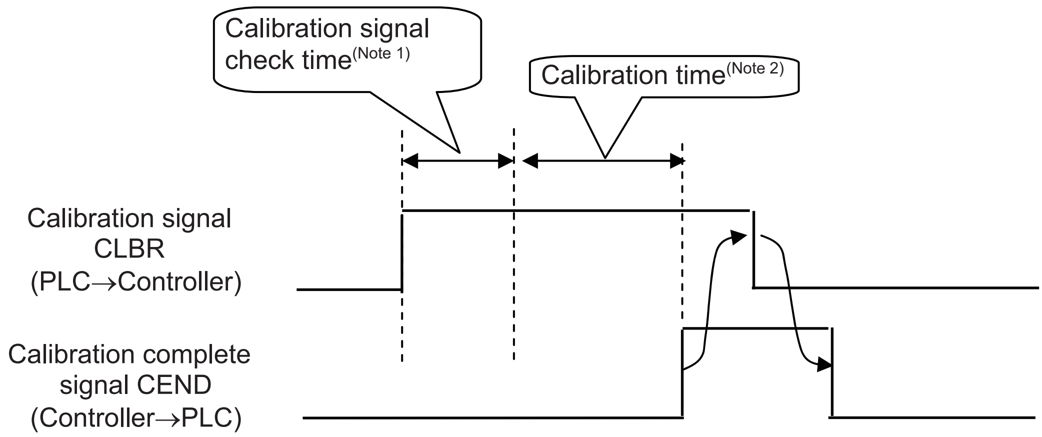
As shown in the figures below, when a pressing operation with 3000N is desired with a pressing jig of 1000N (approx. 100kgf) being attached, and the calibration is not conducted or the loadcell is not used, the pressing force set in the position table mush be set as it becomes 3000N – 1000N = 2000N. Setting 3000N in the position table causes pressing force of 4000N to be added to the work.
Calibration enables pressing [%] equivalent to desired pressing force 3000N to be set in the position table to realize highly precise pressing force. If the weight of the pressing jig changes, the value set in the position table may not be changed.





1) Stop the operation. (Calibration is disabled during axis motion, pressing or pause. If calibration signal CLBR is set to ON, alarm 0E1 "Loadcell calibration error" occurs.)
2) Turn loadcell calibration signal CLBR ON.
3) At the completion of calibration, calibration complete signal CEND is turned ON. Set the CLBR signal to OFF.
   Unless calibration ends normally, alarm 0E1 "Loadcell calibration error" occurs. Try the calibration again.

⚠Caution: Operation commands are not accepted normally if the CLBR signal is set to ON.



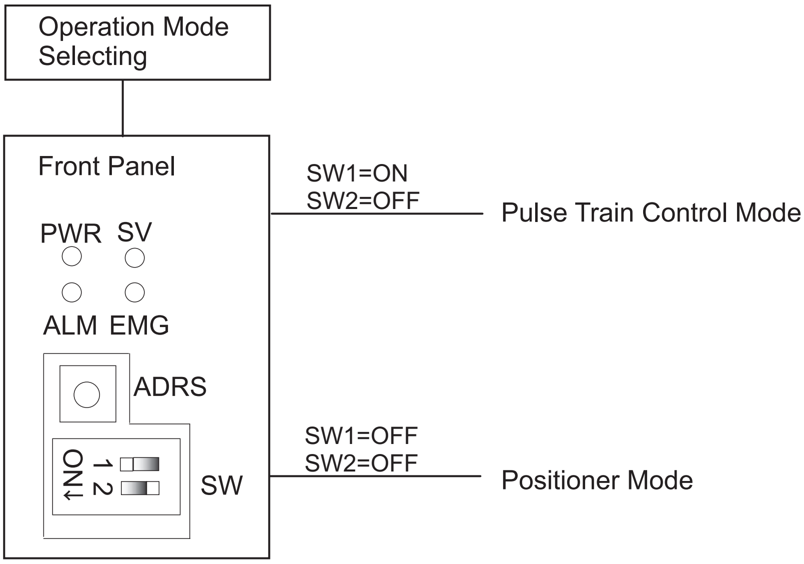
Note 1 The time zone indicates the calibration signal check time (20ms). If CLBR is turned OFF within the period, the calibration signal is ignored to cancel the calibration.

Note 2 The calibration time depends on Parameter No.119 "Loadcell calibration time" (factory setting: 10ms). However, if it is set to the automatic calibration at startup, the time should be fixed to 10ms no matter what the parameter setting is.
If CLBR is turned OFF during the period before CEND is turned ON, alarm 0E1 "Loadcell calibration error" occurs.

[Reference]	Loadcell is a delicate measurement tool. To maintain its accuracy, it is suggested to have a calibration at regular intervals (conducted by the supplier). Please contact us for the details related to the calibration such as the calibration frequency.

3.3 Operation in Pulse Train Control Mode

This controller can switch over the setting between Pulse Train Control Mode and Positioner Mode with the switch on the controller front side. In Pulse Train Mode, the actuator can be operated by the pulse train output of the host controller (PLC) positioning control function. This operation mode is not to be changed after the system is complete to be established or during an operation.



⚠Caution:
- SW2 is for manufacturer's tuning use only. Keep it OFF while in use. Using the unit with this switch on may cause the controller to malfunction or perform an unexpected operation.
- In Pulse Train Control Mode, the operation is performed corresponding to the input pulse.

Input Pulse Value	⇒ Moving distance
Input pulse frequency	⇒ Velocity
Change in Input Pulse Frequency	⇒ Velocity change and acceleration/deceleration

Do not use the actuator above the specifications for the commands of the movement amount, acceleration and deceleration from the host controller (PLC). Doing so may cause an abnormal noise or malfunction.
- In Pulse Train Control Mode, the anti-vibration control or pressing operation using force sensor cannot be performed.
- Pulse train control cannot be performed with Fieldbus type controller. Selecting Pulse Train Control Mode will issue Alarm 0DD "Drive Mode Error".
- The actuator equipped with the linear spurious absolute encoder cannot be controlled with the pulse train. It will generate Alarm 0DD "Drive Mode Error".

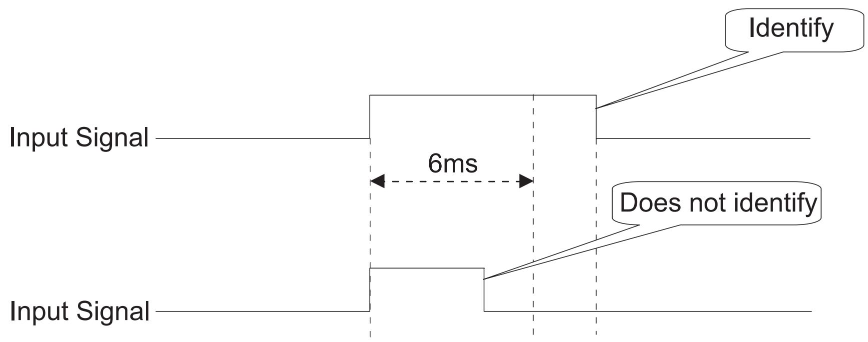
■ Main Functions

	Function Name	Name
1	Dedicated home return signal	When this function (signal) is used, home return(Note 1) can be performed without using a complex sequence or an external sensor, etc.
2	Brake control function	Since the controller controls the brake, there is no need to program a separate sequence. The electromagnetic brake power is supplied to the controller from a power supply different from the main power. Accordingly, the electromagnetic brake can be released freely after the main power has been cut OFF.
3	Torque limiting function	The torque can be limited (a desired limit can be set by a parameter) using an external signal. When the torque reaches the specified level, a signal will be output. This function (signal) permits pressing and press fitting operations.
4	Position-command primary filter function	Soft start and stop can be achieved even when the actuator is operated in the command-pulse input mode where acceleration and deceleration are not considered.
5	Position detection feedback function	Position detection data is output using differential pulse trains. The current position can be read in real time(Note 2) from the host controller.

Note 1 In the pulse train control mode, even the actuator of absolute specification needs home return because it operates as that of incremental specification.
Note 2 Up to 2.5Mpps can be output in real time.

3.3.1 I/O Signal Controls

The input signals of this controller incorporate an input time constant to prevent malfunction due to chattering, noise, etc. Make sure to input the signals continuously for 6ms or more.
(Note) Command pulse train inputs (PP•/PP, NP•/NP) do not have input time constants. Also, it is necessary to input 16ms or more for CSTP Signal.



⚠Caution: To use I/O signals, be sure to tilt the operation mode setting switch on the front panel of the controller to the “AUTO” position.

3.3.2 Operation Ready and Auxiliary Signals

[1] System Ready (PWR)

PIO signal	Output
	PWR

The signal is turned ON if the controller can be controlled after main power-on.
It is turned ON once the initialization terminates normally after main power-on and SCON can be controlled regardless of alarm and servo status.
Even in the alarm condition, when the SCON can control the system, it is turned "ON".
The signal is synchronized with the illumination of the PWR LED (GN) on the front face of the controller.

[2] Emergency stop status (*EMGS)

PIO signal	Output
	*EMGS

1) Emergency Stop Status EMGS is usually turned on and is turned off when "2.2.3 [3] Power and Emergency Stop Circuit" is open between EMG+ and EMG- (emergency stop condition or not connected).
2) It turns back on if the emergency stop condition is cancelled and the circuit is closed between EMG+ and EMG-. Have an appropriate safety treatment such as interlock with this signal for the host controller (PLC, etc.).

⚠Caution: It is not an emergency stop output due to an alarm generation of the controller.

[3] Operation Mode (RMOD, RMDS)

PIO signal	Input	Output
	RMOD	RMDS

○ : Available, ×: Unavailable

Two operation modes are provided so that the operation by PIO signals does not overlap with the operation by a teaching tool such as PC software through SIO (serial) communication. The mode change is normally done by the operation mode setting switch on the front panel of the controller.

AUTO·········· Operation by PIO signals is valid.
MANU········· Operation through SIO (serial) communication is valid.

However, the controller is subject to link connection(Note 1) to connect with a teaching tool such as PC software by using a SIO converter, the controller may be far apart from the teaching tool. In such a case, the controller can be entered into the MANU mode by setting PIO signal RMOD to ON.
Because the RMDS signal is set to ON with the MANU mode selected by using the signal, make the operation sequence interlocked.
The table below lists the switches on the front panel, the modes selected by the RMOD signal and the corresponding output states of the RMDS signal.

Note 1 For the details of the link connection, refer to "10.2 Way to Set Multiple Controllers with 1 TeachingS Tool".

○: Selected or set to ON

Condition		Status							
Teaching tool such as PC software	PIO Operation Invalid (Note 2)	○	○	○	○	×	×	×	×
	PIO Operation Allowed (Note 2)	×	×	×	×	○	○	○	○
Switches on front panel	AUTO	○	○	×	×	○	○	×	×
	MANU	×	×	○	○	×	×	○	○
PIO Input	RMOD	×	○	×	○	×	○	×	○
PIO Output	RMDS	×	○	○	○	×	○	○	○
PIO valid: ◎, PIO invalid:●		◎	●	●	●	◎	◎	◎	◎

Operation by normal PIO

Note 2 "PIO Operation Allowed" or "PIO Operation Invalid" is the function to select a restriction while the teaching tool such as PC software is connected.

> ⚠ Caution: (1) Note that selecting "PIO Operation Allowed" by using the teaching tool such as PC software makes all PIO signals valid to enable operation however the states of the switches and RMOD signal input may be. In this status, the actuator may be started depending on the signals from PLC.
> (2) If the teaching tool such as PC software is disconnected from the controller, "PIO Operation Allowed" or "PIO Operation Invalid" holds the state selected before. After teaching operation or debugging is terminated, select "PIO Operation Allowed" and disconnect the teaching tool such as PC software from the controller.

[4] Compulsory Stop (CSTP)

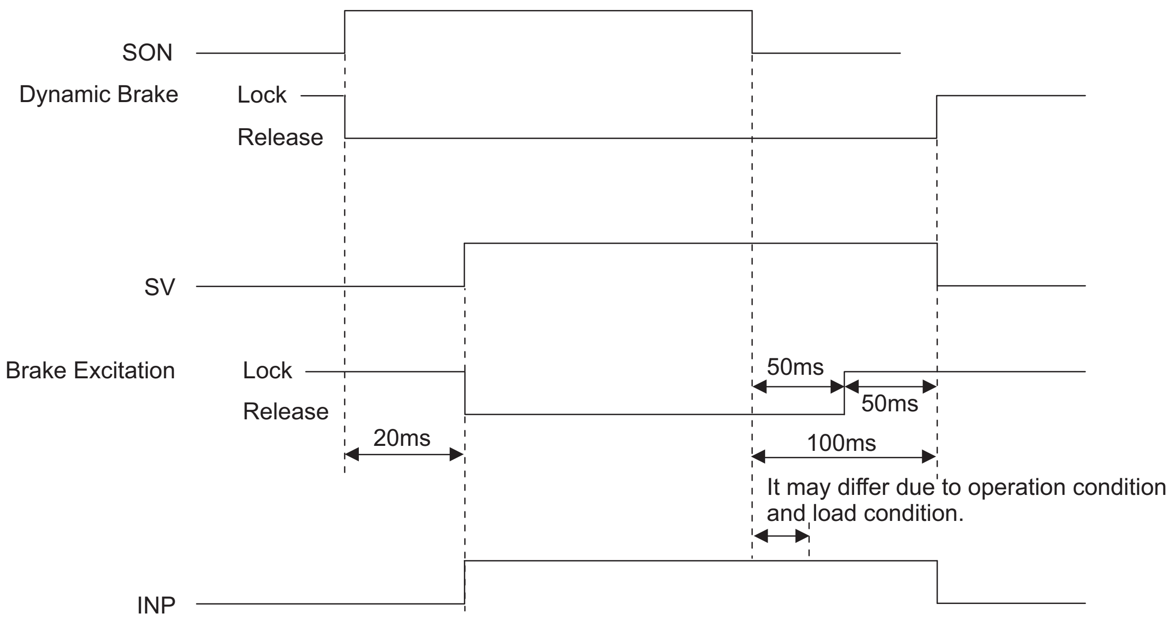
PIO signal	Input
	CSTP

This signal is used to forcibly stop the actuator.
Input the CSTP signal continuously for 16ms continuous or longer. Once CSTP Signal is received, the actuator decelerates and stops with the emergency stop torque, turns the servo OFF and cut the drive source. At this time, the deviation counter is cleared.

[5] Servo ON (SON, SV)

PIO signal	Input	Output
	SON	SV

1) Servo ON signal SON is the input signal making the servo motor of the actuator operable.
2) If the servo-on is performed to enable operation, the SV output signal is turned ON. Concurrently positioning completion signal PEND is turned ON.
3) With the power being supplied, then controller cannot be operated while the SV signal remains OFF. If the SON signal is turned OFF under operation of the actuator, the actuator is decelerated and stopped with the forced stop torque. After the stop, the servo OFF occurs to enter the motor into the free running state.
The brake (option) is of release-in-excitation type. Therefore, making the excitation on will release the brake while making it off will lock the brake.
At this time, the function selected by the applicable parameter (dynamic brake, electromagnetic brake or deviation counter clearing) is implemented.



- Servo OFF status

1. Once the actuator stops, no retaining torque will be supplied.
2. The pulse train input, HOME (home return signal), TL (torque-limiting selection signal) and CSTP (external forced stop signal) are all ignored.
3. Output signals SV (ready signal), HEND (home return complete signal) and TLR (torque limiting signal) are all cleared (turned OFF).
4. INP (Positioning Completion Signal)
   The INP (Positioning Completion Signal) is OFF when the servo is OFF.

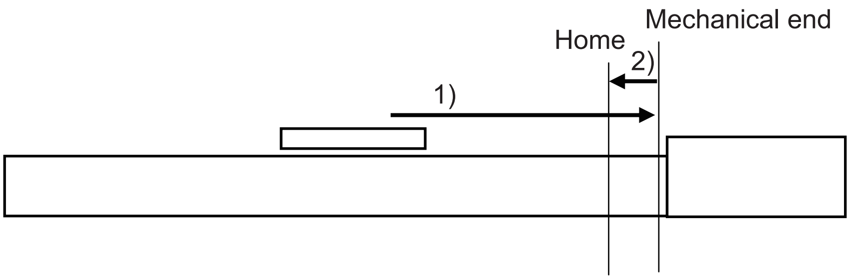
[6] Home Return (HOME, HEND)

PIO signal	Input	Output
	HOME	HEND

The HOME signal is intended for automatic home return.
When the HOME signal is turned ON, the command will be processed at the leading edge (ON edge) of the signal and the actuator will perform home return operation automatically.
Once the home return is completed, the HEND (home return completion) signal will turn ON.
Set the home (enter "0") in the current value register of the host controller (PLC) using the current value preset function, etc., when the HOME signal turns ON.

> ⚠ Caution:
> (1) The HOME signal is given priority over any pulse train command. Even when the actuator is moving with a pulse train command, it will start home return once the HOME signal is turned ON.
> (2) The HOME signal is processed only at the leading edge (ON edge) of the signal.
> (3) If the SON signal is turned OFF or an alarm is detected during home return, the home return operation will stop. If the servo is turned OFF, the home return command will be cancelled even when the HOME signal remains ON. To perform home return again, therefore, turn the HOME signal OFF and then turn it ON again.
> (4) The actuator can be operated without using this function. If this function is not used, however, management of position data will solely be dependent on the host controller (monitoring soft stroke limit is effective in the home return complete status). Therefore, take the necessary measures to prevent an over-stroke, such as not sending pulse commands with travel distances exceeding the effective stroke or providing external limit switches for stroke end detection, etc., to forcibly stop the actuator.
> (5) Servo-off or deviation counter clearing causes HEND to be turned OFF. Perform home return again.

[Operation of Slider Type/Rod Type Actuator]



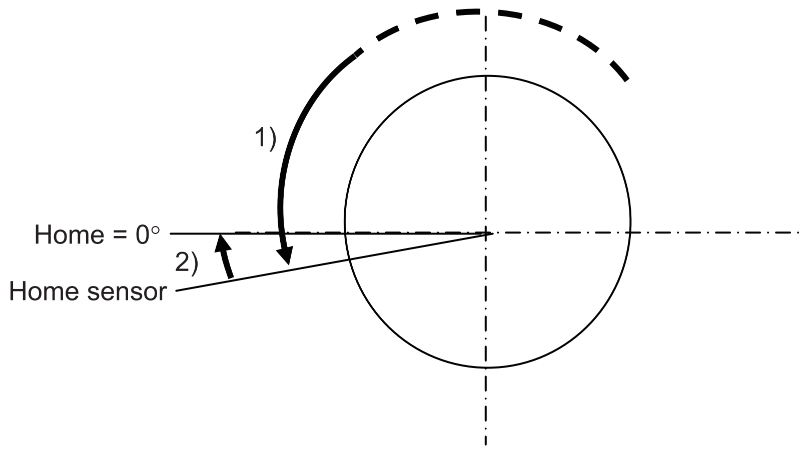
1) With the HOME signal being ON, the actuator moves toward the mechanical end at the home return speed.
   The moving speed is 20mm/s for most actuators but less than 20mm/s for some actuators. Check the instruction manual of each actuator.
2) The actuator is turned at the mechanical end and stopped at the home position. The moving distance is the value set by Parameter No.22 "Home return offset level".(Note 1)

> ⚠ Caution: In the home reverse specification, the actuator moves in the reverse direction. Make sure to refer to Section 8.2 [18] when a change to Parameter No.22 "Home Return Offset Level" is required.

Note 1: It moves for the offset amount after the encoder Z-phase is detected.

[Operation of Rotary Actuator]

(1) 300° Rotation Specification

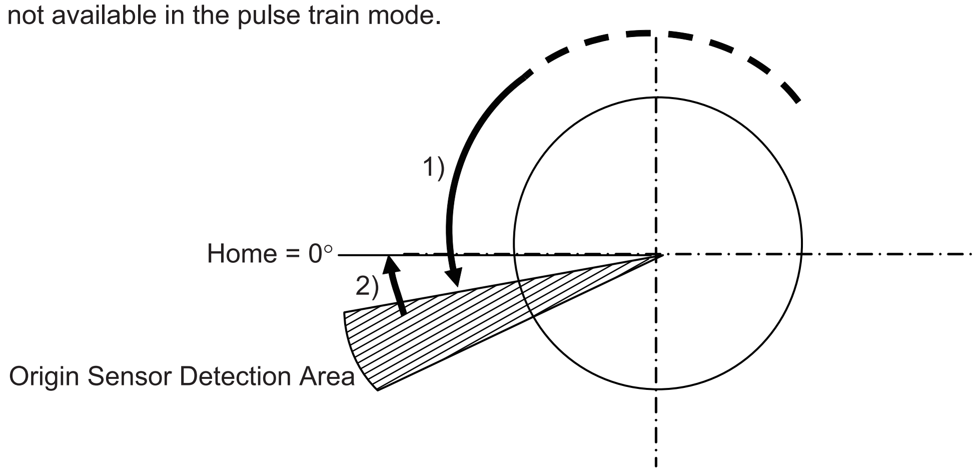


1) The actuator rotates in CCW (counterclockwise) direction from the view point of the load side. The velocity is either 20deg/s or 5deg/s. (It depends on the setting of each actuator.)
2) At the home sensor input, the actuator is turned in the reverse direction and stopped at the home position. The rotation angle is the value set by Parameter No.22 "Home return offset level" after the detection of phase Z.

⚠ Caution: Make sure to refer to Section 8.2 [18] when a change to Parameter No.22 "Home Return Offset Level" is required.

(2) Multi-Rotation Specification

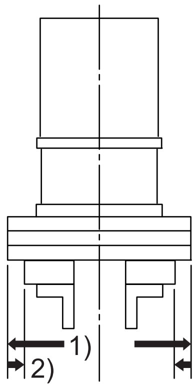
It is not available in the pulse train mode.



1) Once the home-return command is issued, the actuator rotates in CCW (counterclockwise) direction from the view point of the load side. The velocity is either 20deg/s or 5deg/s. (It depends on the setting of each actuator.)
2) Once the origin sensor turns ON, the actuator starts to move in the reversed direction with 1deg/s speed again. The amount of the movement at this time is that set in Parameter No.22 "Home return offset level" after the origin sensor is turned OFF.

⚠ Caution: The operation of the reversed rotation type should be in the reversed way.

[Operation of actuator of gripper type]



1) If the HOME signal is turned ON, the actuator moves toward the mechanical end at the home return speed (20mm/s).
2) The actuator is turned at the mechanical end and stopped at the home position. The rotation angle is the value set by Parameter No.22 “Home return offset level” after the detection of phase Z.

⚠ Caution: Make sure to refer to Section 8.2 [18] when a change to Parameter No.22 “Home Return Offset Level” is required.

[7] Zone (ZONE1, ZONE2)

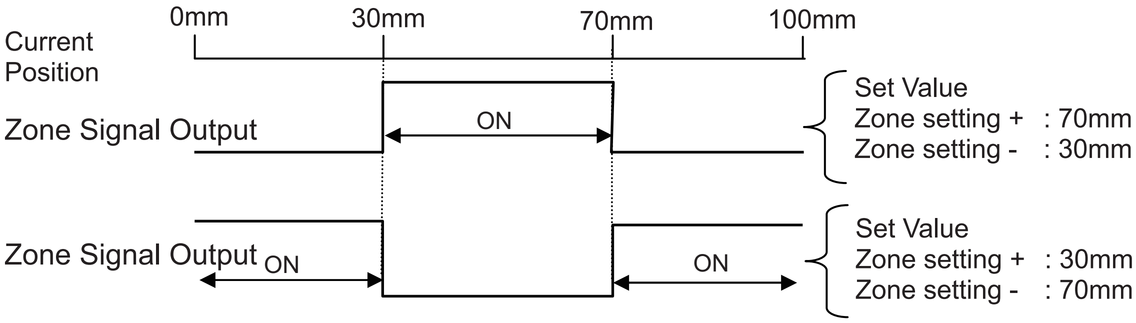
PIO signal	Output	
	ZONE1	ZONE2

Each of the signals turns ON when the current actuator position is inside the range specified by the relevant parameter.
Two zones, ZONE1 and ZONE2, can be set.
When the current position of the actuator is in ZONE1, it is turned ON if it is in the range of Parameter No.1 “Zone 1 Positive Side” and Parameter No.2 “Zone 1 Negative Side”, while is OFF when out of the range. These signals are always enabled in the home return complete state and not affected by the servo status or alarm status. (The ZONE2 signal turns ON/OFF according to Parameter No.23 “Zone 2+” and Parameter No.24 “Zone 2-”.

● Setting values and signal output range
The zone output range varies depending on the difference between the value set for the plus side of the zone and that for the minus side.

1) Value set for plus side > value set for minus side: Output signal turn ON in the range from the value on negative side to that on positive side, and turns OFF out of the range
2) Value set for plus side < value set for minus side: Output signal turn OFF in the range from the value on positive side to that on negative side, and turns ON out of the range

[For Straight Slide Actuators]



[Operation of rotary actuator of multi-rotation specification in index mode]
It does not corresponds to pulse train mode.

[8] Alarm, Alarm Reset (*ALM, RES)

PIO signal	Input	Output
	RES	*ALM

1) Alarm signal *ALM is set to ON in the normal status but turned OFF at the occurrence of an alarm at a level equal to or higher than the operation release level.
2) Turning reset signal RES ON under occurrence of an alarm at the operation release level allows the alarm(Note 1) to be released. The action is taken at the rising edge (ON edge).
3) The alarm reset should be done after the cause of the alarm is confirmed and removed. If alarm reset and restart are repeated many times without removal of the cause, a severe failure such as motor burnout may occur.

Note 1 Check the 9.4 Alarm List for details of alarms.

[9] Binary Output of Alarm Data Output (*ALM, ALM1 to 8)

PIO signal	Output	
	*ALM	ALM1 to ALM8

1) If an alarm at a level equal to or higher than the operation release level occurs, alarm output signals ALM 1 to 8 output the alarm information in the binary code format.
2) The PLC can read the binary code of alarm signal *ALM as the strobe signal to check the alarm information.

○: ON ●: OFF

*ALM	ALM8	ALM4	ALM2	ALM1	Binary Code	Description: Alarm code is shown in ( ).
○	●	●	●	●	–	Normal
●	●	●	○	●	2	Software reset during servo ON (090)
●	●	●	○	○	3	Move command during servo OFF (080) Movement Command during Home Return Operation (084) Move command while pulse train input is effective (086)
●	●	○	●	●	4	Drive mode error (0DD) Mismatched PCB (0F4)
●	●	○	○	●	6	Parameter data error (0A1) Unsupported motor/encoder type (0A8)
●	●	○	○	○	7	Z-Phase Position Error (0B5) Magnetic Pole Indeterminacy (0B7) Home sensor non-detection (0BA) Home return timeout (0BE) Creep sensor not detected (0BF)
●	○	●	●	●	8	Actual Velocity Excessive (0C0) Overrun detected (0C2)

(Note) *ALM Signal is an active low signal. It is ON when the power is applied to the controller, and turns OFF when the signal is output.

○: ON ●: OFF

*ALM	ALM8	ALM4	ALM2	ALM1	Binary Code	Description: Alarm code is shown in ( ).
●	○	●	●	○	9	Electromagnetic Brake Unrelease Error (0A5) Dynamic brake not released (0A6) Overcurrent (0C8) Overheat (0CA) Current Sensor Offset Adjustment Error (0CB) Emergency stop relay fused (0CD) Drop in control supply voltage (0CE) I/O 24V Power Supply Error (0CF)
●	○	●	○	○	11	Command counter overflow (0A4) Electric Angling Mismatching (0B4) Deviation Overflow (0D8) Software stroke limit exceeded (0D9) Feed Back Pulse Error (0DA)
●	○	○	●	●	12	Motor Power Source Voltage Excessive (0D2) Motor power-supply voltage low (0D3) Belt-breaking sensor detected (0D7) Overload (0E0) Driver logic error (0F0)
●	○	○	●	○	13	Encoder send error (0E4) Encoder Receipt Error (0E5) Encoder count error (0E6) A-, B- and Z-phase Wire Breaking (0E7)
●	○	○	○	●	14	CPU Error (0FA) FPGA Error(0FB) Logic Error (0FC)
●	○	○	○	○	15	Nonvolatile memory write verify error (0F5) Nonvolatile memory write timeout (0F6) Nonvolatile memory data destroyed (0F8)

(Note) *ALM Signal is an active low signal. It is ON when the power is applied to the controller, and turns OFF when the signal is output.

[10] Brake Forcible Release (BKRL)

PIO signal	Output
	BKRL

The brake can be released while BKRL signal is turned ON.
For the actuator equipped with a brake, the brake can be controlled by turning the servo ON/OFF, however, a release of the brake may be necessary in the case of installing the unit to a system so the slider or rod can be moved by hand.
This operation can be performed not only by the brake release switch on the front panel of the controller, but also by the brake release signal BKRL.

⚠ Warning: (1) Take sufficient care to release the brake. Inappropriate brake release may cause people to be injured and/or the actuator, the work and/or the machine to be damaged.
(2) After the brake is released, always make the brake applied again. Any operation with the brake remaining released is extremely dangerous. The slider or rod may drop to cause people to be injured and/or the actuator, the work and/or the machine to be damaged.

[11] Overload Alarm/Light Error Alarm (*OVLW/*ALML)

PIO signal	Output
	*OVLW/*ALML

Use this with changing the setting in Parameter No.151.
Setting Parameter No.151 to “0” changes to the overload warning output, and it turns OFF when the motor temperature exceeds the rate set in Parameter No.143 “Overload Level Ratio”. This signal will be ON as long as the motor temperature does not exceed the warning level.
Setting Parameter No.151 to “1” changes to the light failure alarm output, and it turns OFF when a message level alarm is generated. This signal will be ON as long as the message level alarm is not issued.

3.3.3 Pulse Train Input Operation

[1] Command Pulse Input (PP•/PP, NP•/NP)

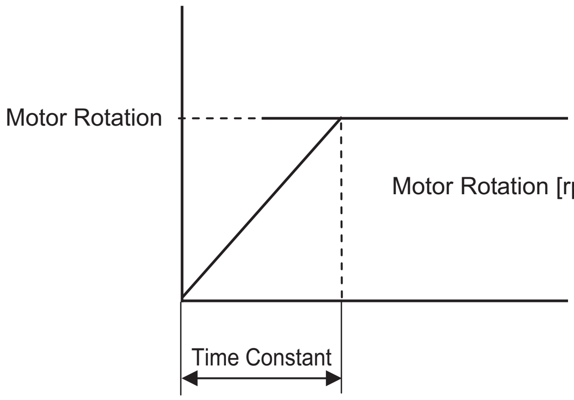
Pulses of up to 200kpps in the open-collector mode or up to 2.5Mpps in the differential mode can be input.
6 types of command pulse train can be selected. Set the pulse train format in Parameter No.63 and active high/low in Parameter No.64.
[Refer to 3.3.4 Settings of Basic Parameters Required for Operation]

> ⚠Caution:
> (1) The directions in which the actuator moves upon receiving forward and reverse pulses conform to the pulse count direction set in Parameter No.62.
> (2) As for the forward/reverse directions, pay attention to the host controller setting or PP･/PP and NP･/NP connections.
> (3) Set the actuator acceleration/deceleration on the host controller side.
> (4) The actuator acceleration/deceleration should not exceed the rated acceleration/deceleration of the applicable actuator. [Refer to the actuator's catalog or the appendix in this Instruction Manual for the rated acceleration/deceleration of each actuator.]
> * The rotating direction of the motor is defined so that the counterclockwise direction as viewed from the end of the load shaft represents the forward direction.

Command Pulse String Mode		Input Terminal	In Normal Rotation	In Reverse Rotation
Negative Logic	Normal Rotation Pulse String	PP•/PP		
	Reverse Rotation Pulse String	NP•/NP		
	The normal rotation pulse string shows the motor rotation amount in normal direction, and reverse rotation pulse string shows the motor rotation amount in reverse direction.			
	Pulse Train	PP•/PP		
	Symbol	NP•/NP	Low	High
	The command pulse shows the motor rotation amount and the command symbol shows the rotation direction.			
	A/B Phase Pulse String	PP•/PP		
		NP•/NP		
	The A/B Phase 4-fold Pulse with the phase difference of 90° shows the commands for the rotation amount and direction.			
Positive Logic	Normal Rotation Pulse String	PP•/PP		
	Reverse Rotation Pulse String	NP•/NP		
	Pulse Train	PP•/PP		
	Symbol	NP•/NP	High	Low
	A/B Phase Pulse String	PP•/PP		
		NP•/NP		

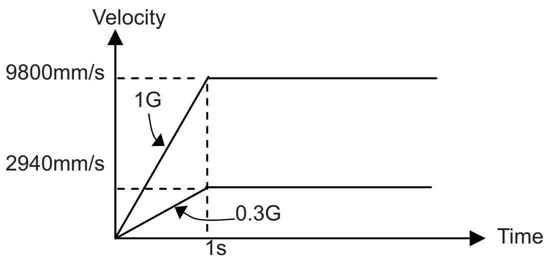
⚠ Caution: Consider the electric gear ratio of the host side and that on this controller side when having a calculation.

(Reference) Acceleration/deceleration settings of general positioning device



$$\text{Motor Rotation [rpm]} = \frac{\text{Velocity [mm/s]}}{\text{Ball Screw • Lead Length [mm/rev]}} \times 60$$

1G=9800mm/s^2 : Acceleration capable to accelerate up to 9800mm/s per second
0.3G:Acceleration capable to accelerate up to 9800mm/s × 0.3 = 2940mm/s per second



⚠ Caution: Caution: Set the acceleration/deceleration speed not to exceed the maximum acceleration/deceleration speed of the actuator. An operation with exceeding condition may cause a malfunction.

[2] Position complete (INP)

PIO signal	Output
	INP

This signal will turn ON when the remaining travel pulses (accumulated pulses) on the deviation counter enters the positioning width.
When the servo is ON, this signal turns ON when the accumulated pulses on the deviation counter are within the number of pulses set in Parameter No.10 “Default positioning width”.
This signal is OFF while the servo is OFF.

⚠ Caution:
(1) This signal will turn ON when the servo turns ON (because positioning is executed at the current position where the servo is ON).
(2) The conditions of the output of this signal are the deviation (servo lag pulses) and the variance in the command pulses in 1ms.
Even if the deviation is within the positioning width, the signal would not turn ON if there is a variance to the command pulse in 1ms.

[3] Torque Limit Select (TL, TLR)

PIO signal	Input	Output
	TL	TLR

This signal is used to limit the torque of the motor.
While the TL signal is ON, the actuator thrust (motor torque) can be limited to the torque set in Parameter No.57 “Torque limit”.
With the TL signal being ON, the TLR signal (torque limiting) will turn ON when the actuator thrust reaches the torque limit.
The TL signal is disabled during home return.

Caution:
- Do not turn the TL signal OFF while the TRL signal is ON.
- An excessive deviation (accumulated pulses) may generate while torque is being limited (TL signal is ON) (for example, the actuator may receive a load just like it receive a pressing force in pressing operation and therefore become no longer operable). If the TL signal is turned OFF in this condition, actuator control will start at the maximum torque the moment the signal changes, thus causing the actuator to move suddenly or run uncontrollably. After turning TLR signal ON, perform an operation in the reversed way to confirm TLR signal turns OFF. After turning TLR signal ON, perform an operation in the reversed way to confirm TLR signal turns OFF. If the condition is difficult for the reversed movement, turn the servo OFF or clear the deviation counter (by turning DCLR ON).

[4] Deviation Counter Clear (DCLR)

PIO signal	Input
	DCLR

This is the signal to clear the deviation counter that stores the specified pulse until its process is completely finished (positioning is completed) once a command pulse is input.
It is used when the deviation is desired to be cleared after the pressing by TL signal is complete (TLR signal ON). Once the deviation is cleared, TLR signal turns OFF and the condition can be made as it is positioned at the point where the pressing is complete.

Caution: DCLR signal is a signal that is processed at the level. Input the pulse train while DCLR signal is on and the actuator will operate. Turn this signal ON only when the deviation counter is cleared.

[5] Feedback Pulse Output (AFB•/AFB, BFB•/BFB, ZFB•/ZFB)

Data of detected positions are output using differential pulses (phases A, B and Z of up to 2.5Mpps). The host controller can read the current actuator position in real time using a counter function, etc. This function is also available in Positioner Mode.
6 types of feedback pulse train can be selected. Set the pulse train format in Parameter No.69 and active high/low in Parameter No.70. The output also can be done with a different electric gear ratio from the input pulse by the settings of Parameters No.114 to 116.

> ⚠ Caution:
> (1) These pulse signals can be disabled using user Parameter No.68 “Enable or disable (default) feedback pulses”. Set this parameter to “Disable” if the feedback pulses are not used.
> (2) If these signals are to be read by the host controller to set a closed loop, set a logically consistent sequence to implement the applicable processing.
> (3) If the actuator encoder is not a serial encoder, the phase-Z signal is output directly. If the actuator uses a serial encoder, the phase-Z pulse is output within a mechanical angle range of ±0.5° from the zero (home) position. Based on the communication cycle with the encoder, this precision can be assured when the motor velocity is 100rpm or below.

Command Pulse String Mode		Input Terminal	In Normal Rotation	In Reverse Rotation
Negative Logic	Normal Rotation Pulse String	AFB•/AFB		
	Reverse Rotation Pulse String	BFB•/BFB		
	The normal rotation pulse string shows the motor rotation amount in normal direction, and reverse rotation pulse string shows the motor rotation amount in reverse direction.			
	Pulse Train	AFB•/AFB		
	Symbol	BFB•/BFB	Low	High
	The command pulse shows the motor rotation amount and the command symbol shows the rotation direction.			
	A/B Phase Pulse String	AFB•/AFB		
		BFB•/BFB		
	The A/B Phase 4-fold Pulse with the phase difference of 90º shows the commands for the rotation amount and direction.			
Positive Logic	Normal Rotation Pulse String	AFB•/AFB		
	Reverse Rotation Pulse String	BFB•/BFB		
	Pulse Train	AFB•/AFB		
	Symbol	BFB•/BFB	High	Low
	A/B Phase Pulse String	AFB•/AFB		
		BFB•/BFB		
ZFB•/ZFB			When the actuator encoder is other than the serial encoder, the Z-phase signal is output as it is. In the case of serial encoder, the range of ±0.5º of mechanical angle from the point 0 position (origin), is output as the Z-phase signal. Only when the motor rpm is 100rpm or less, this accuracy can be guaranteed for the communication frequency with the encoder.	

3.3.4 Settings of Basic Parameters Required for Operation

It is a mandatory parameter to perform an operation.
(The parameters listed in the table below may only be set if the actuator performs only positioning operation.)

Parameter No.	Parameter Name	Details
65	Electronic Gear Numerator	This parameter determines the unit travel distance of the actuator per command pulse train input 1 pulse.
66	Electronic Gear Denominator	
63	Command Pulse Mode	Specifies the command pulse train input mode.
64	Command Pulse Mode Input Polarity	Sets the type of active high/low of the specified pulse train

[1] Electrical Gear Setting

This parameter determines the unit travel distance of the actuator per command pulse train input 1 pulse.

User Parameter No.65/No.66 Electronic Gear Numerator/Denominator

Name	Symbol	Unit	Input Range	Initial Value (For reference)
Electronic Gear Numerator	CNUM	–	1 to 4096	2048
Electronic Gear Denominator	CDEN	–	1 to 4096	125

Determine the movement amount and calculate value for the electric gear setting by following the formula below:
Line Axis Unit Travel Distance: Min. Travel Distance Unit (1, 0.1, 0.01mm etc.)/pulse
Rotary Axis Unit Travel Distance: Min. Travel Distance Unit (1, 0.1, 0.01deg. etc.)/pulse

■ Electronic Gear Formula:

In the case of Line Axis

$$\frac{\text{Electronic Gear Numerator (CNUM)}}{\text{Electronic Gear Denominator (CDEN)}} = \frac{\text{No. of Encoder Pulses}^{(\text{Note 1})}\ \text{[pulse/rev]}}{\text{Actuator Lead Length [mm/rev]}} \times \text{Unit Travel Distance [mm/pulse]}$$

In the case of Rotary Axis

$$\frac{\text{Electronic Gear Numerator (CNUM)}}{\text{Electronic Gear Denominator (CDEN)}} = \frac{\text{No. of Encoder Pules}^{(\text{Note 1})}\ \text{[pulse/rev]}}{\text{360 [deg/rev]} \times \text{Rotary Axis Reduction Ratio}} \times \text{Unit Travel Distance [deg/pulse]}$$

Note 1 : Refer to 10.4 List of Specifications of Connectable Actuator for the encoder pulse of each actuator.

■ Formula for velocity:
The velocity of the actuator can be figured out with the following formula.
Velocity = Unit Travel Distance × Input Pulse Frequency [Hz]

■ Examples of electronic gear calculations:
To set the unit travel distance to 0.01 (1/100) mm for an actuator a ball screw lead of 10mm, equipped with an encoder of 16384pulses/rev.

$$\frac{\text{Electronic Gear Numerator (CNUM)}}{\text{Electronic Gear Denominator (CDEN)}} = \frac{\text{No. of Encoder Pluses [pulse/rev]}}{\text{Ball Screw Lead Length [mm/rev]}} \times \text{Unit Travel Distance [deg/pulse]}$$

$$= \frac{16384}{10} \times \frac{1}{100} = \frac{2048}{125}$$

The electronic gear numerator (CNUM) is calculated as 2048, while the electronic gear denominator (CDEN) is calculated as 125. Based on these settings, the travel distance per command pulse train input pulse becomes 0.01mm.

⚠ Caution:

- The fraction has to be completely reduced so both the electric gear numerator (CNUM) and electric gear denominator (CDEN) can be 4096 or less and make them to be integral numbers. (Do not stop reducing the fraction on the way.)
- CNUM and CDEN on the line axis have to satisfy the following relative formulas.

$$2^{31} \geq \frac{\text{Stroke Length [mm]}}{\text{Ball Screw Lead Length [mm/rev]}} \times \text{No. of Encoder Pluses [pulse]} \times \text{CNUM}$$

$$2^{31} \geq \frac{\text{Stroke Length [mm]}}{\text{Ball Screw Lead Length [mm/rev]}} \times \text{No. of Encoder Pluses [pulse]} \times \text{CDEM}$$

- Use rotary actuators of multi-rotation specification within the range where the following formula is satisfied. Moreover, the maximum rotation angle is ±9999 deg (maximum software stroke limit).

$$\pm 2^{31} \geq \frac{\text{Maximum rotation angle [deg]}}{\text{Unit Travel Distance [deg/pulse]}}$$

Maximum rotation angle : Set the usage conditions (MAX. -9999 to 9999deg)
Unit Travel Distance : Travel distance per command pulse

- Do not set the minimum movement unit out of the encoder resolution ability. If this setting is conducted, the actuator would not start moving until enough command pulse is stored in the encoder resolution error.

$$\text{Encoder resolution for line axis [mm/pulse]} = \frac{\text{Ball Screw Lead Length [mm/rev]}}{\text{No. of Encoder Pluses [pulse/rev]}}$$

$$\text{Encoder resolution for rotational axis [deg/pulse]} = \frac{360\,[\text{deg/rev}] \times \text{Rotary Axis Reduction Ratio}}{\text{No. of Encoder Pluses [pulse/rev]}}$$

- Pay attention not to exceed the specification limit when setting the velocity, acceleration and deceleration.

[2] Format Settings of Command Pulse Train

Set the format of command pulse train in Parameter No.63 and active high/low in No.64.

(1) Command Pulse Mode

User Parameter No.63 Command PulseInput Mode

Name	Symbol	Unit	Input Range	Initial Value
Command Pulse Input Mode	CPMD	–	0 to 2	1

	Command Pulse String Mode	Input Terminal	In Normal Rotation	In Reverse Rotation	Setting Value of Parameter No. 63
Negative Logic	Normal Rotation Pulse String	PP•/PP			2
	Reverse Rotation Pulse String	NP•/NP			
	The normal rotation pulse string shows the motor rotation amount in normal direction, and reverse rotation pulse string shows the motor rotation amount in reverse direction.				
	Pulse Train	PP•/PP			1
	Symbol	NP•/NP	Low	High	
	The command pulse shows the motor rotation amount and the command symbol shows the rotation direction.				
	A/B Phase Pulse String	PP•/PP			0
		NP•/NP			
	The A/B Phase 4-fold Pulse with the phase difference of 90° shows the commands for the rotation amount and direction.				
Positive Logic	Normal Rotation Pulse String	PP•/PP			2
	Reverse Rotation Pulse String	NP•/NP			
	Pulse Train	PP•/PP			1
	Symbol	NP•/NP	High	Low	
	A/B Phase Pulse String	PP•/PP			0
		NP•/NP			

(2) Command Pulse Mode Input Polarity

User Parameter No.64 Command Pulse Input Mode Polarity

Name	Symbol	Unit	Input Range	Initial Value
Command Pulse Input Mode Polarity	CPMD	–	0 to 1	0

Set Value
Positive logic : 0
Negative logic : 1

3.3.5 Output Settings of Feedback Pulse

This is a parameter to set when outputting the feedback pulse to the host controller (PLC, etc.). This function is also available in Positioner Mode.

[1] Setting Feedback Pulse Output Effective

Set it if the feedback pulse is to be used.

No.	Name	Symbol	Unit	Input Range	Initial Value
68	Feedback Pulse Output	FPIO	–	0 to 1	1

You can select whether to enable or disable the feedback pulse output.
0: Disable
1: Enable

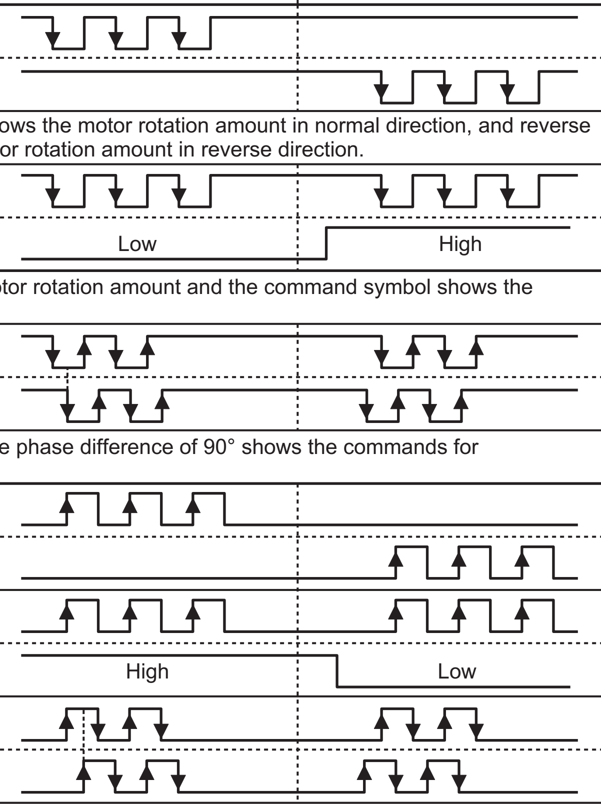
⚠Caution: Make this setting invalid if the feedback pulse is not to be used.

[2] Format Settings for Feedback Pulse

Set the format of output pulse in Parameter No.69 and active high/low in No.70.

(1) Feedback Pulse Train

No.	Name	Symbol	Unit	Input Range	Initial Value
69	Feedback Pulse Train	FBPT	–	0 to 2	0



	Command Pulse String Mode	Input Terminal	In Normal Rotation	In Reverse Rotation	Setting Value of Parameter No. 69
Negative Logic	Normal Rotation Pulse String	AFB•/AFB			2
	Reverse Rotation Pulse String	BFB•/BFB			
	The normal rotation pulse string shows the motor rotation amount in normal direction, and reverse rotation pulse string shows the motor rotation amount in reverse direction.				
	Pulse Train	AFB•/AFB			1
	Symbol	BFB•/BFB	Low	High	
	The command pulse shows the motor rotation amount and the command symbol shows the rotation direction.				
	A/B Phase Pulse String	AFB•/AFB			0
		BFB•/BFB			
	The A/B Phase 4-fold Pulse with the phase difference of 90° shows the commands for the rotation amount and direction.				
Positive Logic	Normal Rotation Pulse String	AFB•/AFB			2
	Reverse Rotation Pulse String	BFB•/BFB			
	Pulse Train	AFB•/AFB			1
	Symbol	BFB•/BFB	High	Low	
	A/B Phase Pulse String	AFB•/AFB			0
		BFB•/BFB			
ZFB•/ZFB			When the actuator encoder is other than the serial encoder, the Z-phase signal is output as it is. In the case of serial encoder, the range of ±0.5° of mechanical angle from the point 0 position (origin), is output as the Z-phase signal. Only when the motor rpm is 100rpm or less, this accuracy can be guaranteed for the communication frequency with the encoder. * When the encoder pulse count is 16384 (Pulse/rev), it shows the serial encoder.		

(2) Feedback Pulse Form Polarity

No.	Name	Symbol	Unit	Input Range	Initial Value
70	Feedback Pulse Form Polarity	FBPT	–	0 to 1	0

0: Disable
1: Enable

[3] Electric Gear Settings for Feedback Pulse

This is the parameter to determine the output pulse corresponding to the actuator movement amount. Determine the movement amount per pulse to define how many millimeters you would like the actuator to move with the output of 1 pulse.

Movement in line axis per pulse = Minimum output unit (1, 0.1, 0.01mm etc.)/pulse
Movement in rotary axis per pulse = Minimum output unit (1, 0.1, 0.01deg etc.)/pulse

(1) Selecting used feedback pulse gear ratio (Parameter No.114)

No.	Name	Symbol	Unit	Input Range	Initial Value
114	Selecting used feedback pulse gear ratio	FPIO	–	0 to 1	0

0: It outputs the pulse equivalent to the input pulse.
If the movement amount of input pulse is 0.01mm, 1 pulse is output when moved for 0.01mm. Thus, 1 pulse is output in response to 1 pulse of input.
Output pulse is determined by the electric gear for input (Parameters No.65 and 66).

1: The relation of the output pulse and the actuator movement can be set freely. Set the electric gear in Parameters No.115 and 116.

(2) Electrical Gear (Feedback Pulse) (Parameter No.115, No.116)

Set these parameters when the relation of the output pulse and the actuator movement are to be set freely.
These parameters are enabled when Parameter No.114 is set to 1.

User Parameter No.115/116 Electronic Gear (Feedback Pulse) Numerator/Denominator

Name	Symbol	Unit	Input Range	Initial Value (For reference)
Electronic Gear Numerator	FNUM	–	1 to 4096	2048
Electronic Gear Denominator	FDEN	–	1 to 4096	125

■ Electronic Gear Formula:

In the case of Line Axis

$$\frac{\text{Electronic Gear Numerator (FNUM)}}{\text{Electronic Gear Denominator (FDEN)}} = \frac{\text{No. of Encoder Pulses [pulse/rev]}}{\text{Ball Screw Lead Length [mm/rev]}} \times \text{Movement amount per pulse [mm]}$$

In the case of Rotary Axis

$$\frac{\text{Electronic Gear Numerator (FNUM)}}{\text{Electronic Gear Denominator (FDEN)}} = \frac{\text{No. of Encoder Pules [pulse/rev]}}{\text{360 [deg/rev]} \times \text{Rotary Axis Reduction Ratio}} \times \text{Movement amount per pulse [mm]}$$

Note 1 : Refer to 10.4 List of Specifications of Connectable Actuator for the encoder pulse of each actuator.

■ Formula for velocity:

The velocity of the actuator is in proportion to the frequency of the output pulse.
Velocity = Movement amount per pulse × Output Pulse Frequency [Hz]

■ Examples of electronic gear calculations:
When outputting the feedback pulse of the actuator equipped with an encoder with 10mm ball screw lead and 16384pulse/rev in 0.02mm movement per pulse:

$$\frac{\text{Electronic Gear Numerator (FNUM)}}{\text{Electronic Gear Denominator (FDEN)}} = \frac{\text{No. of Encoder Pluses [pulse/rev]}}{\text{Ball Screw Lead Length [mm/rev]}} \times \text{Movement amount per pulse [mm]}$$

$$= \frac{16384}{10} \times \frac{2}{100} = \frac{4096}{125}$$

The electric gear numerator (FNUM) = 4096, electric gear denominator (FDEN) = 125 will give the output of 1 pulse in 0.02mm of the actuator move.

Caution:

- The fraction has to be completely reduced so both the electric gear numerator (FNUM) and electric gear denominator (FDEN) can be 4096 or less and make them to be integral numbers. (Do not stop reducing the fraction on the way.)
- FNUM and FDEN on the line axis have to satisfy the following relative formulas.

$$2^{31} \geq \frac{\text{Stroke Length [mm]}}{\text{Ball Screw Lead Length [mm/rev]}} \times \text{No. of Encoder Pluses [pulse]} \times \text{FNUM}$$

$$2^{31} \geq \frac{\text{Stroke Length [mm]}}{\text{Ball Screw Lead Length [mm/rev]}} \times \text{No. of Encoder Pluses [pulse]} \times \text{FDEM}$$

- Use rotary actuators of multi-rotation specification within the range where the following formula is satisfied. Moreover, the maximum rotation angle is ±9999 deg (maximum software stroke limit).

$$\pm 2^{31} \geq \frac{\text{Maximum rotation angle [deg]}}{\text{Unit Travel Distance [deg/pulse]}}$$

Maximum rotation angle : Set the usage conditions (MAX. -9999 to 9999deg)
Unit Travel Distance : Travel distance per command pulse

$$\text{Encoder resolution for line axis [mm/pulse]} = \frac{\text{Ball Screw Lead Length [mm/rev]}}{\text{No. of Encoder Pluses [pulse/rev]}}$$

$$\text{Encoder resolution for rotational axis [deg/pulse]} = \frac{360\ \text{[deg/rev]} \times \text{Rotary Axis Reduction Ratio}}{\text{No. of Encoder Pluses [pulse/rev]}}$$

- Do not have the setting that gives the movement per pulse less than the encoder resolution.

$$\text{Output pulse} = \frac{\text{Encoder resolution [mm/pulse]}}{\text{Movement amount per pulse [mm/pulse]}}$$

The formula is as shown above and the pulse output is based on the encoder pulse, therefore evenly allocated feedback pulse responding to the velocity cannot be output.

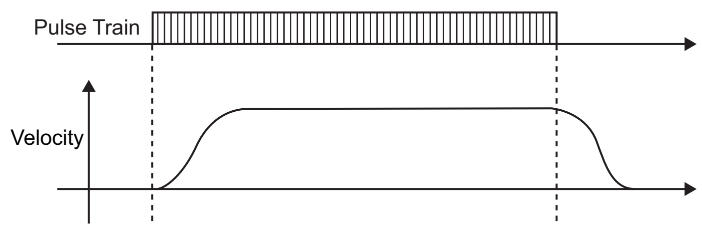
3.3.6 Parameter Settings Required for Advanced Operations

Depending on systems and/or loads, set the following parameters if necessary.

[1] Position command primary filter time constant

No.	Name	Symbol	Unit	Input Range	Initial Value
55	Position command primary filter time constant	PLPF	msec	0.0 to 100.0	0.0

The acceleration/deceleration of the actuator can be set in S-shaped curve with this parameter setting. (It is not the S-shaped acceleration/deceleration function.)
If command pulse train is input at a certain frequency, the actuator is accelerated/decelerated slowly depending on the time constant.
The actuator moves by the number of command pulses.
Even if the host controller (PLC etc.) has no acceleration/deceleration function or the frequency of command pulses varies rapidly, the actuator can be accelerated/decelerated smoothly.
The delay in positioning stabilizing time requires approximately 3 times longer than the set value after the command pulse input stop. If the set value is 100msec, the stabilizing time would be approximately 300msec.



[2] Torque Limit

No.	Name	Symbol	Unit	Input Range	Initial Value
57	Torque Limit	TQLM	%	0 to 70	70

Set a desired torque limit used in the torque limit input signal (TL), which is an external input signal.
Set a desired torque as a percentage of the rated thrust representing 100% (the rated thrust is specified in the catalog).
When the external torque-limit input signal (TL) turns ON, the torque will be limited according to the setting.
Once the torque current reaches a level corresponding to the specified torque limit, the torque limiting signal (TLR) will be output as an external output signal.

[3] Clearing deviation during servo OFF or alarm stop

No.	Name	Symbol	Unit	Input Range	Initial Value
58	Clearing deviation during servo OFF or alarm stop	FSTP	–	0 to 1	1

In this parameter, can select whether to activate or inactivate the function to clear the differential at the servo OFF and alarm stop.
It is recommended not to change this setting from the initial setting.
0: Disable
1: Enable

[4] Error monitor during torque limiting

No.	Name	Symbol	Unit	Input Range	Initial Value
59	Error monitor during torque limiting	FSTP	–	0 to 1	0

You can select whether to enable or disable the function to monitor deviation while torque is being limited (the TL signal is ON).
By enabling this function, you can have the controller output an error while torque is being limited, if a deviation equal to or exceeding the value set by the applicable parameter.
0: Disable
1: Enable

[5] Deviation Counter Clear Input

No.	Name	Symbol	Unit	Input Range	Initial Value
60	Deviation Counter Clear Input	FPIO	–	0 to 1	0

You can select whether to enable or disable the function to clear the generated deviation while torque is being limited (the TL signal is ON).
Disable this function in conditions where torque must be limited (pressing is not performed).
0: Disable
1: Enable

[6] Torque limit command input

No.	Name	Symbol	Unit	Input Range	Initial Value
61	Torque limit command input	FPIO	–	0 to 1	0

Torque control of the motor with the value set in Parameter No.57 “Torque Control Value” can be performed with PIO (TL Signal ON) from the host system. In this parameter, a choice can be made from using (disable) TL Signal (Torque Limiting Signal) and not using (enable) the signal.
0: Disable
1: Enable

[7] Pulse count direction

No.	Name	Symbol	Unit	Input Range	Initial Value
62	Pulse count direction	FPIO	–	0 to 1	Set individually

You can set the direction in which the motor turns according to command pulses.
Set the same value as that set in Parameter No.5 “Home-Return Direction” and the actuator moves in positive direction if the command pulse is input in positive direction.
0: Forward rotation
1: Reverse rotation

[8] Compulsory Stop Input

No.	Name	Symbol	Unit	Input Range	Initial Value
67	Compulsory Stop Input	FPIO	–	0 to 1	0

Compulsory stop of the actuator can be performed with PIO (CSTP Signal ON) from the host system. In this parameter, a choice can be made from using (disable) CSTP Signal (Compulsory Stop Input Signal) and not using (enable) the signal.
0: Disable
1: Enable

Chapter 4 Field Network

SCON-CA is applicable for the field networks shown in the list below.
Except for RS485, it is the option which can be selected when purchasing. It cannot be changed after the product is delivered.
Also, for the field networks other than RS485, PIO cannot be equipped. And Pulse Train Control Mode cannot be operated.

■ Type of Field Network

Name of Field Network	Description	Detail
DeviceNet	Allows actuator to be controlled through I/O communication using control signals similar to PIO or numerical data communication.	Refer to ME0256 of separate volume. (Note 1)
CC-Link		Refer to ME0254 of separate volume. (Note 1)
PROFIBUS-DP		Refer to ME0258 of separate volume. (Note 1)
CompoNet		Refer to ME0221 of separate volume. (Note 1)
MECHATROLINK		Refer to ME0222 of separate volume. (Note 1)
EtherCAT		Refer to ME0273 of separate volume. (Note 1)
EtherNet/IP		Refer to ME0278 of separate volume. (Note 1)
RS485	Controls actuator through general-purpose protocol “MODBUS”.	Refer to ME0156 of separate volume. (Note 1)

(Note 1)
- SCON-CA is handled as a slave unit. For details of each network, check the Instruction Manuals of the master unit provided by the manufacturer and that of the installed PLC.
- The Instruction Manuals describing how to use SCON-CA field networks are provided separately. Read them together with this manual.

Chapter 5 Vibration Suppress Control Function

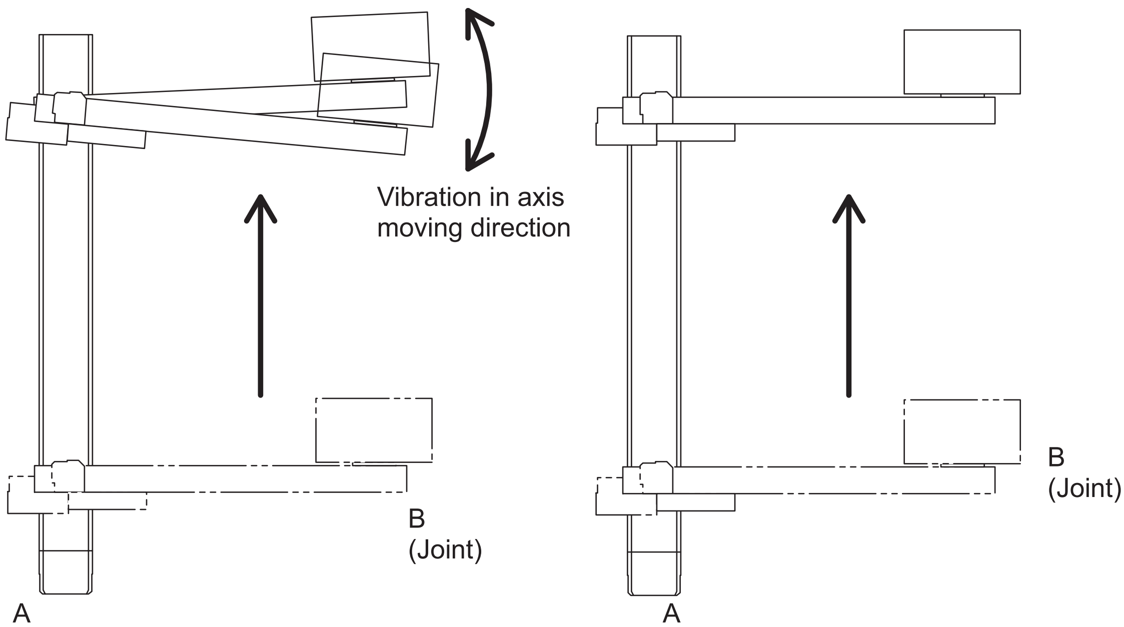
The vibration suppress control function suppresses vibrations of loads induced by our actuators.
The function can suppress vibrations in the same direction as the movement of the actuator in the frequency range from 0.5Hz to 30Hz.
Measure the frequency of the generated vibration and set it to the parameter. Three frequencies can be defined as parameters. Specify the parameters in the position table to reflect them on suppression of vibrations generated by the operation. For a single moving command (position data), only a single parameter can be set.

(Note) Before this function can be used, you must read the cautions described on the next page.

[Functional Operation]

The figure below shows an example in which two actuators are subject to 2-axis combination. Actuator A is moved to cause actuator B corresponding to a joint to be vibrated. Measure the vibrations of B in the direction in which A is moved and make proper vibration suppress control in the direction to suppress the vibrations of B. Vibrations of actuator B caused by the movement of B cannot be suppressed.

★No setting of vibration suppress control ☆Setting of vibration suppress control



⚠ Caution:

- Use of vibration suppress control
  It is necessary to obtain a key file if you wish to use the frequency analysis tool for anti-vibration control included in the PC software.
  Please contact IAI for the key file.
- Vibrations subject to vibration suppress control
  It is the vibration of the load generated by IAI actuator, and is in the same directions as the actuator movement.
- Vibrations not subject to vibration suppress control
  1) Vibration whose source is not the operation of the actuator
  2) Vibration in a direction different from the direction in which the actuator, or the vibration source, is moved.
  3) Vibration of vibrating object itself (This function moves objects easily vibrated without vibrations and cannot suppress vibrations already generated.)
- Conditions in which vibration suppress effect can hardly be obtained
  1) When the frequency to control is the same value as the mechanical angle of the motor (motor rotation) or the electrical angle of the motor
     Frequency of motor's mechanical angle (motor revolution):
       operation speed [mm/s]/lead length [mm]
     Frequency of motor's electric angle:
       4 times of frequency of mechanical angle for servo motor installation axis
       Same as frequency of linear actuator's mechanical angle
     Example 1: Servo motor installation axis
       For lead length 20mm and operation speed 100mm/s:
         Frequency of mechanical angle (motor revolution) : 5Hz
         Frequency of electric angle (four times of frequency of mechanical angle) : 20Hz
     Example 2: Linear Actuator
       For lead length 50mm and operation speed 100mm/s:
         Frequency of mechanical angle : 20Hz
         Frequency of electric angle (same as frequency of mechanical angle) : 20Hz
  2) When a higher speed response is required for the vibration control than the set speed control response, the speed response is not able to catch up with the vibration control.
- Vibration suppress control unavailable in home return and pressing operations
  Home return and pressing operations cannot suppress vibrations. Operating the vibration suppress control function in pressing causes 0A2 "position data error" to occur.
- Prohibition of simultaneous use of vibration suppress control with feed forward gain
  The vibration suppress control function cannot be used with feed forward gain simultaneously.
- Prohibition of switch to use vibration suppress control during moving operation.
  Switching between vibration suppress control and normal positioning is disabled during movement of the actuator. Any switching command causes 0C5 "Illegal control system transition command error" to occur.
- Response of vibration suppress control
  Vibration suppress control has time lag from speed command in the operation plan. This makes tact time longer.
  Lower the setting frequency is, longer the time lag is.
- Prohibition of use of vibration suppress control in pulse-train control mode
  The vibration suppress control function cannot be used in the pulse-train control mode.
- Consideration of servo gain
  If the servo gain setting is not conducted properly, the effect of the anti-vibration control may get dropped. First adjust the servo gain prior to setting of vibration suppress control.

5.1 Setting Procedure

To use the vibration suppress control function, make proper measurements and settings depending on the procedure described below.

Before setting vibration suppress control
1) Are steps up to trial adjustment 2 in Starting Procedure/Positioner Mode completed?
2) Is the key file stored in the folder that the PC Software startup file is stored if the specific frequency is to be measured using the vibration control frequency analysis tool stored in the PC Software?

→No

1) Provide start setting according to Starting Procedure/Positioner Mode.
2) It is necessary to obtain a key file aside from the software if you wish to use the frequency analysis tool for anti-vibration control included in the PC software. Please contact us for the details.

↓ Yes

Confirmation of vibration to be suppressed
Is vibration source our actuator? Is vibration direction the same as moving direction?

→No

This function cannot suppress the vibration.
Take other measures.

↓ Yes

Measurement of Natural frequency
Measure the Natural frequency by any of the following methods:
- Use of PC software installation tool
  [Refer to the Instruction Manual of the PC software.]
- Use of measuring instrument such as vibration meter or acceleration pickup
- Calculation from video image data

↓

Setting of vibration suppress control [See next page.]
- Set the measured natural frequency in the parameter.
  (Note) The value can be written to the parameter on PC software installation tool if used.
- Set related parameters.

↓

Setting of vibration suppress control parameter set No.
Set the anti-vibration control parameter set number to be used to the position number that anti-vibration of the position table is required.

↓

Trial operation (check of vibration suppress effect)
Operate the actuator.
Is sufficient vibration suppress effect obtained?

→No

↓ Yes

Now the settings are completed.

Chapter 5 Vibration Suppress Control Function

5.2 Settings of Parameters for Vibration Suppress Control

Set the parameters associated with vibration suppress control, which are listed in the table below.

Parameter No.	Parameter Set No.	Parameter Name	Unit	Factory Setting	Input Range
97	1	Damping characteristic coefficient 1	Rate	10	0 to 1000
98		Damping characteristic coefficient 2	Rate	1000	0 to 1000
99		Natural frequency	1/1000Hz	10000	500 to 30000
100		Notch filter gain	Rate	9990	1 to 20000
101	2	Damping characteristic coefficient 1	Rate	10	0 to 1000
102		Damping characteristic coefficient 2	Rate	1000	0 to 1000
103		Natural frequency	1/1000Hz	10000	500 to 30000
104		Notch filter gain	Rate	9990	1 to 20000
105	3	Damping characteristic coefficient 1	Rate	10	0 to 1000
106		Damping characteristic coefficient 2	Rate	1000	0 to 1000
107		Natural frequency	1/1000Hz	10000	500 to 30000
108		Notch filter gain	Rate	9990	1 to 20000
109		Default vibration suppress No.		0	0 to 3
110		Stop method at servo OFF		0	0, 1

[1] Damping characteristic coefficient 1,2 (Parameter No.97, 98, 101, 102, 105, and 106)
Do not change.

[2] Natural frequency [1/1000Hz] (Parameter No.99, 103 and 107)
Set the natural frequency of the load measured. It can be input directly to the parameter from the frequency analysis tool for anti-vibration control included in the PC software if the tool is already used. [Refer to the Instruction Manual of the PC software.]
Set the specific frequency of the loaded object close to the setting so a higher anti-vibration performance can be obtained.

[Reference] Other vibration measuring methods
- Use of measuring instrument such as vibration meter and acceleration pickup
- Calculation from video image data

[3] Notch filter gain (Parameter No.100, 104 and 108)
Set the notch filter gain following the table below in response to the measured specific frequency of the loaded object. See the table below for reference. Provide fine adjustment if overshooting occurs.
If the notch filter gain setting is too high, overshooting would occur during the settling time.
If the notch filter gain setting is too low, undershooting would occur during the settling time.

Measured Natural Frequency [Hz]	Setting Value of Notch Filter Gain	
	Other than linear actuator	Linear actuator
0.5	9900	9880
1	9980	9970
2 to 30	9990	9990

[4] Default vibration suppress No. (Parameter No.109)
When a position is written into a position table not registered yet, the value set to this parameter is automatically entered in the “Vibration suppress No.” field. To change the setting, edit the position table later.
0: Normal position control (default)
1: Vibration suppress control parameter set 1
2: Vibration suppress control parameter set 2
3: Vibration suppress control parameter set 3

[5] Stop method at servo OFF (Parameter No.110)
The table below shows the relationship between the values of Parameter No.110 and stop commands.

<table>
<tr><th rowspan="3">Stop Command</th><th colspan="4">Stop Process</th></tr>
<tr><th colspan="2">0</th><th colspan="2">1</th></tr>
<tr><th>Vibration suppress control</th><th>Normal positioning control</th><th>Vibration suppress control</th><th>Normal positioning control</th></tr>
<tr><td>Pause</td><td>Deceleration by vibration suppress and stop</td><td>Normal deceleration and stop</td><td rowspan="4">Deceleration by vibration suppress and stop</td><td rowspan="4">Normal deceleration and stop</td></tr>
<tr><td>Servo OFF</td><td colspan="2" rowspan="3">Sudden stop by emergency stop torque</td></tr>
<tr><td>Emergency Stop</td></tr>
<tr><td>Error
(Operation-cancellation level alarms)</td></tr>
<tr><td>Error
(Cold start)</td><td colspan="4">Sudden stop due to emergency stop torque</td></tr>
</table>

5.3 Setting of Position Data

To make the anti-vibration control effective, set the parameter set number to be used in Anti-Vibration Number Column in Position Data.
(Note) The vibration suppress control function cannot be used in pressing operation.

No.	Position [mm]	Velocity [mm/s]	Accele-ration [G]	Decele-ration [G]	Pressing [%]	Thresh-old [%]	Positioning width [mm]	Zone+ [mm]	Zone- [mm]	Acceleration/ Deceleration mode	Incre-mental	Gain set	Stop mode	Vibration suppress No.
0														
1	0.00	50.00	0.01	0.01	0	0	0.10	0.00	0.00	0	0	0	0	0
2	50.00	50.00	0.01	0.01	0	0	0.10	0.00	0.00	0	0	0	0	1
3	50.00	50.00	0.01	0.01	50	0	0.10	0.00	0.00	0	0	0	0	3
4														

Set natural frequency 1 (valid)
Set natural frequency 3 (It cannot be in common with Error: 0A2 Position Data Error Pressing Operation.)

Chapter 6 Power-saving Function (Auto Servo-motor OFF Function)

The controller has the automatic servo OFF function to save power consumption while the actuator is stopped. Read the description in this chapter carefully to save power so that the controller can be operated safely.
The servo is automatically turned OFF after a certain period from completion of positioning. The next positioning command is issued to turn the servo ON automatically and achieve the positioning. No holding current flows in the stop state to allow the power consumption to be saved.
Three periods from completion of positioning to servo OFF can be set as parameters. The period used for the automatic servo OFF is specified in the position table.

⚠Warning: Do not use this function if the automatic servo OFF is followed by pitch feed (relative movement).
Servo ON/OFF may cause slight position shift to occur. If position shift occurs due to external force during servo OFF, positioning to the correct position is disabled. It is because pitch feed is operated based on the position at start used as the base point.

⚠Caution: This function is ineffective for pressing. Do not use. It becomes effective at completion of positioning. In pressing, the function becomes effective only when miss-pressing occurs (the status at the completion of operation without pressing is the same as that at the completion of positioning).
No retaining torque is provided in automatic servo-off. The actuator can move with an external force. Pay attention to the interference to the peripherals and the safety in the installation.
This function cannot be utilized in Pulse Train Mode.

(1) Setting of periods taken until automatic servo OFF
Three periods from completion of positioning to automatic servo OFF can be set in the following parameters in seconds [sec].

Parameter No.	Description
36	Auto Servo Motor OFF Delay Time 1 (Unit: sec)
37	Auto Servo Motor OFF Delay Time 2 (Unit: sec)
38	Auto Servo Motor OFF Delay Time 3 (Unit: sec)

(2) Set of power-saving mode
Select a proper power-saving mode from the conditions below. Set the corresponding value in the stop mode of the position table.
[Refer to 14) Stop mode in 3.2.1 Set of Position Table.]

Set Value	Operation after completion of positioning	Parameter No.
0	Servo ON not changed	–
1	Automatic servo OFF after certain period	36
2	Automatic servo OFF after certain period	37
3	Automatic servo OFF after certain period	38

(3) Status of positioning complete signal in selection of automatic servo OFF
Automatic servo OFF causes the actuator to be in other than the positioning complete state due to the servo OFF. Positioning complete signal (PEND) is turned OFF. Changing the PEND signal to the in-position signal judging whether the actuator is stopped within the positioning width zone instead of the positioning complete signal allows PEND not to be turned OFF during servo OFF.
This setting is reflected on complete position numbers PM1 to PM** in PIO patterns 0 to 3 and 6 confirming the positioning complete position No. or current position numbers PE* in PIO patterns 4 and 7.
Define the setting in Parameter No.39.

Value set in Parameter No.39	Content of PEND signal	Signal outputs during automatic servo OFF		
		PEND	PM1 to M**	PE**
0	Positioning Completion Signal	OFF	OFF	OFF
1	In-position Signal	ON	ON	ON

(Note) The SV on the front panel blinks green during the automatic servo OFF.

[For Parameter No.39 = 0]

Operation of actuator	Positioning operation	Automatic servo OFF standby	Servo OFF	Positioning operation
Servo Condition	ON	ON	OFF	ON
Completed Position No. Input (Current position number output)	PM1 to ** =0 (PE** = OFF)	PM1 to ** = Output (PE** = ON)	PM1 to ** = 0 (PE** = OFF)	PM1 to ** = 0 (PE** = OFF)
Positioning Completion Signal PEND	OFF	ON	OFF	OFF

Servo OFF Delay Time
(Parameter No.36 to 37)

[For Parameter No.39 = 1]

Operation of actuator	Positioning operation	Automatic servo OFF standby	Servo OFF	Positioning operation
Servo Condition	ON	ON	OFF	ON
Completed Position No. Input (Current position number output)	PM1 to ** = 0 (PE** = OFF)	PM1 to ** = Output (PE** = ON)	PM1 to ** = 0 Output (PE** = ON)	PM1 to ** = 0 (PE** = OFF)
Positioning Completion Signal PEND	OFF	ON	ON	OFF

Servo OFF Delay Time
(Parameter No.36 to 37)

Chapter 7 Absolute Reset and Absolute Battery

7.1 Absolute Reset

The controller of absolute specification holds encoder position information by battery backup. It is not necessary to perform the home-return operation every time the power is turned ON.
In order to hold the encoder position information, absolute reset is required.
Provide absolute reset in the following cases:

(1) Initial activation
(2) Replacement of absolute battery
(3) Disconnection of encoder cable from controller

The absolute reset is performed by using a teaching tool such as PC software or PIO. Each of the absolute reset procedures is described below.

⚠ Caution: If it is Pulse Train Control Mode, it would not comply with absolute type. Take the greatest care.

[1] Absolute reset procedure from teaching tool

1) Connect the controller with the actuator. [Refer to Chapters 1 and 2.]
2) Connect the absolute battery (Enclosed battery if starting up for the first time, new battery if replacing) to the absolute battery connecting connector on the front panel of the controller. [Refer to 7.2.]
3) Connect the teaching tool, set the operation mode setting switch on the front panel of the controller to MANU side, and then turn the controller ON.
4) The absolute encoder error appears on the teaching tool. Perform alarm reset.
5) Perform home-return operation. Once the home return is complete, the point of origin is memorized at the same time the origin point is established.

In below explains the procedure using each teaching tool:

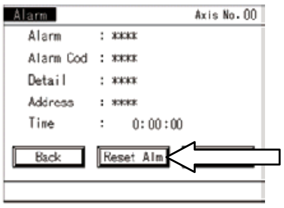
(1) For PC software

1) Select position data on the main screen and click the Alarm button.

2) Select the position data in the main window and press Servo → Home.

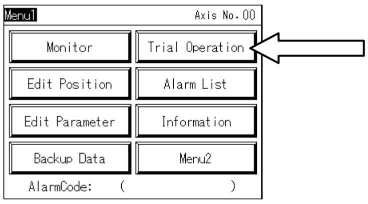
(2) For CON-PT

1)



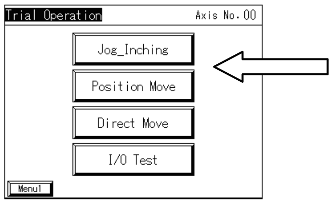
For CON-PT, press Reset Alm.

2)



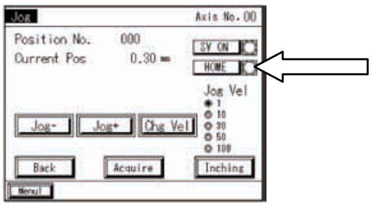
Press Trial Operation on the Menu 1 screen.

3)



Press Jog_Inching on Trial screen.

4)

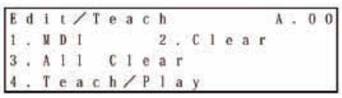


Touch SV ON → HOME in Jog/Inching Window.

(3) For CON-T

For CON-T, press the ERROR RESET key.

1)



Press the EDIT key on the Edit/Teach screen.

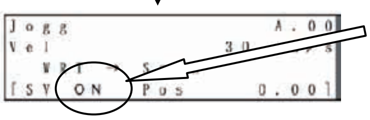
2)

Press the STU 1 key on the Mode Select screen.

3)

Press the STU 1 key on the Teach/Play screen.

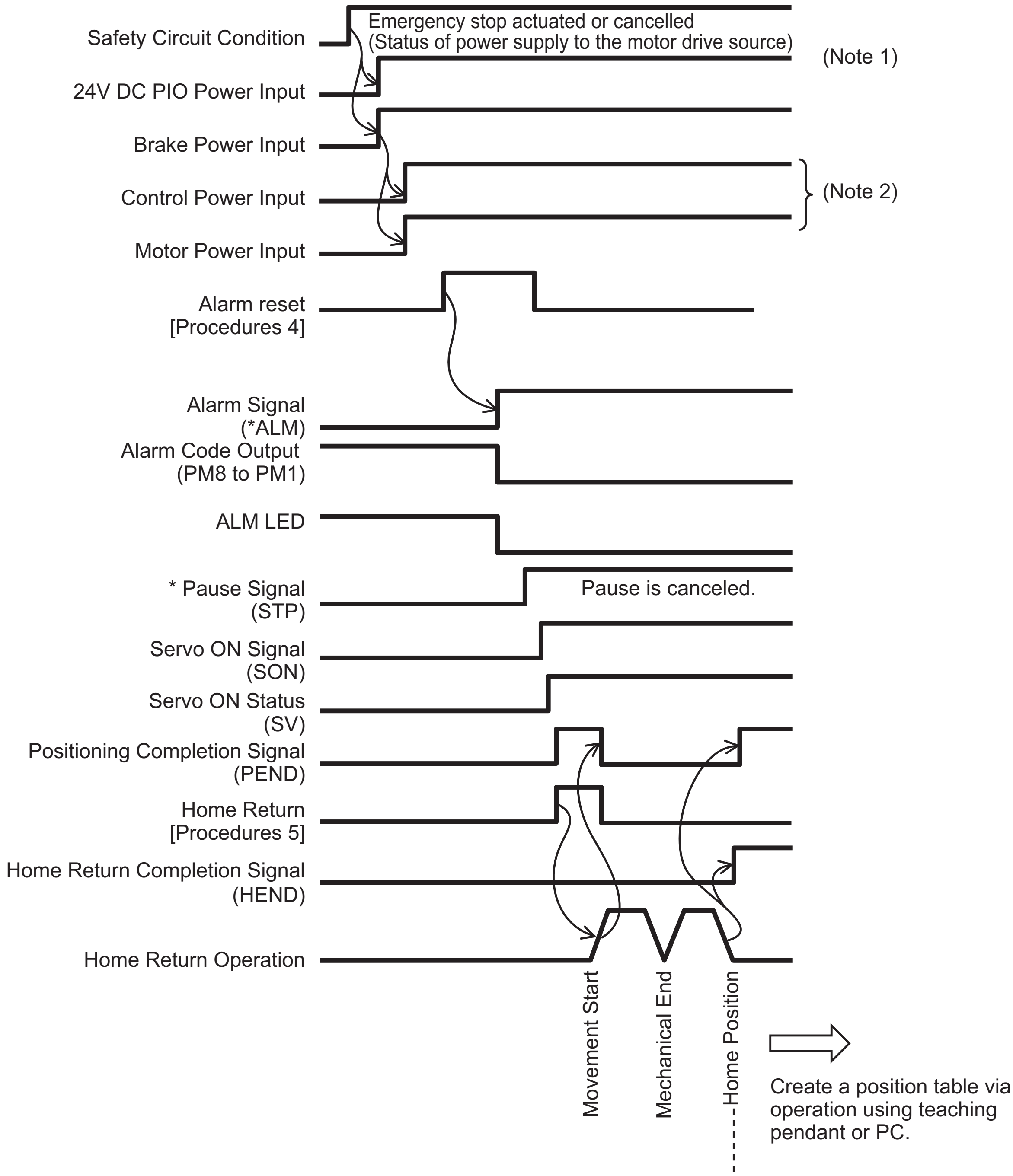
4)



If [SV OFF] is displayed, press the SERVO key.

Confirm [SV ON] and press the HOME key.

[Absolute Reset Process]



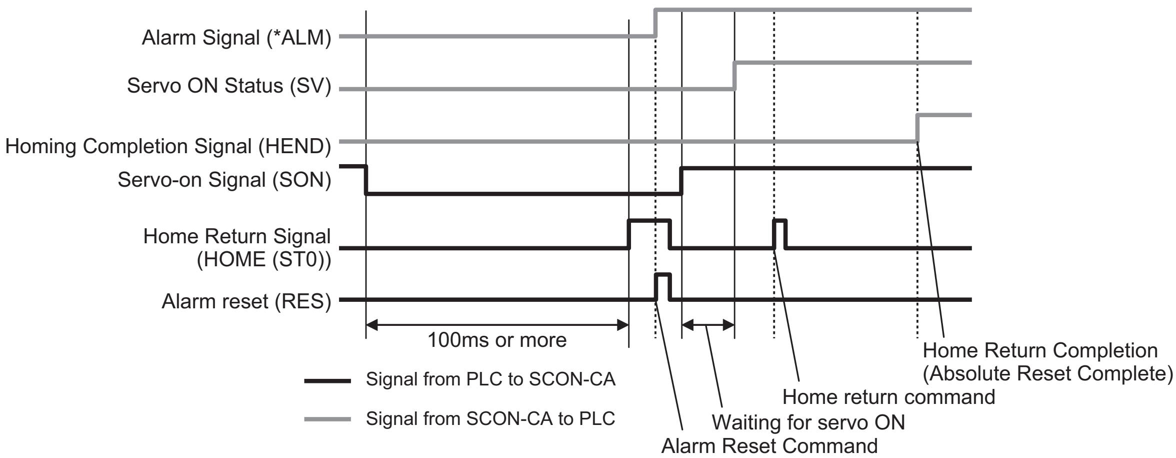
Note 1 Turn ON 24V power supply for PIO (and 24V power supply for brake if the actuator is equipped with a brake) prior to turn ON the control power supply or motor power supply.

Note 2 Have the control power supply and motor power supply in common, and have them turned ON that the same time.

[2] Absolute reset using PIO

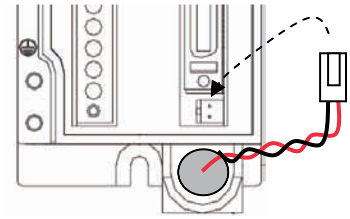
1) Check the servo-on status SV is OFF.
2) Turn the servo-on Input SON OFF for 100ms or longer.
   (Turn the SV and SON signals OFF and continue this status for 100ms or longer.)
3) Turn the home return signal HOME (ST0 signal in case of PIO pattern 5) from OFF to ON. (Processed with ON edge.)
4) Turn the reset signal RES from OFF to ON. (Processed with ON edge.)
5) Check that the alarm signal *ALM is ON (controller's alarm(Note 1) is cancelled).
   (Note 1) If the cause of the alarm is not removed, an alarm will be present again (*ALM signal OFF). Check the condition including other alarm causes.
6) Turn the home return signal HOME (ST0 signal in case of PIO pattern 5) and reset signals RES OFF.
7) Turn the servo-on signal SON ON.
8) Wait until the servo-on status SV turns ON.
9) Turn the home return signal HOME (ST0 signal in case of PIO pattern 5) ON (with ON edge). The home return operation is started.
10) When the homing completion signal HEND is turned ON (completion of home return), absolute reset is completed.

[Timing]



7.2 Absolute Battery

An absolute battery is enclosed with the absolute type controller.
The absolute battery is used to back up the absolute data.
Connect the battery to the absolute battery connector on the front panel of the controller.



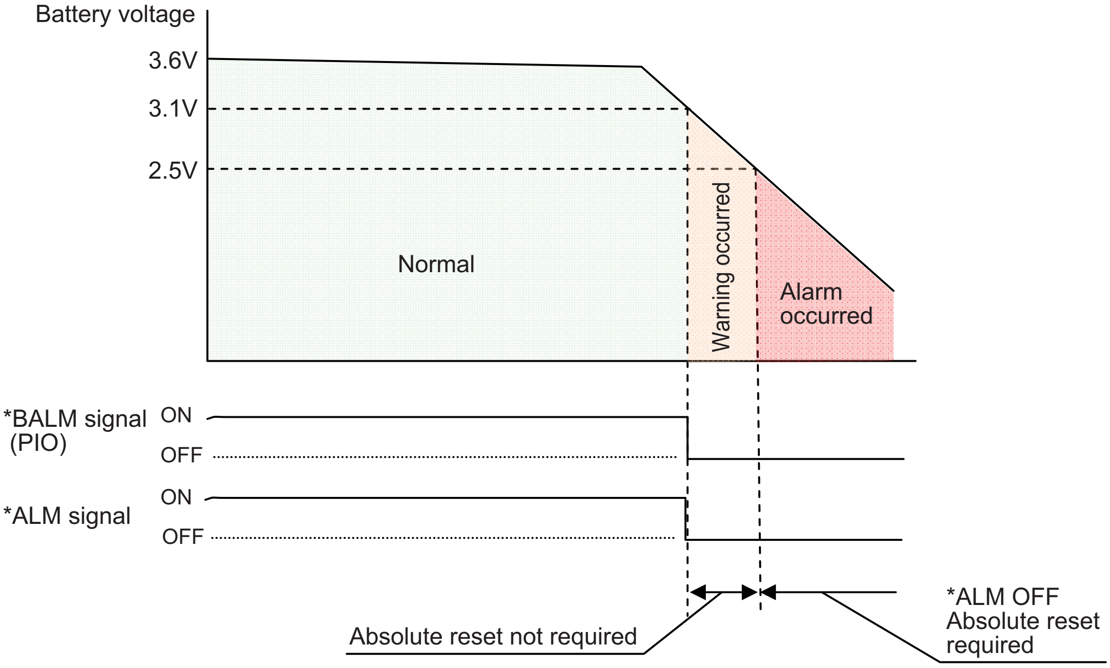
7.2.1 Absolute encoder backup specifications

Item		Specifications
Battery model		AB-5
Battery voltage		3.6V
Current capacity		2000mAH
Reference for battery replacing timing(Note 1) (Ambient temperature 40°C)		2 years after use (if left unused without power supply to controller)
		4 years after use (if 50% of time with power supply to controller)
Error detection(*1)	Output of voltage drop alert signal *BALM	3.1V ±3% or less
	Output of Alarm output *ALM	2.5V ±8% or less
	Warning → Reference for time suspended after alert till alarm	7 days if the controller is operated continuously at 20°C.
		2.5 days if the controller is operated continuously at 40°C.
Absolute data retaining duration at battery replacement		15 minutes (Have the replacing work done within this time.)

(Note 1) Replace the battery regularly.
*1 Error detection : If the voltage of the absolute battery is dropped, the error detection responding to the voltage is held.

Voltage	PIO Signals	Alarm
3.1V ±3% or less	Voltage drop alert signal *BALM(Note 2) OFF	–
2.5V ±8% or less	Alarm signal *ALM(Note 2) OFF	OEE Absolute Encoder Error Detection 2 or OEF Absolute Encoder Error Detection 3

(Note 2) *BALM and *ALM are the signals of active low.
After the power is supplied to the controller, they are usually on and turned OFF when an error is detected.
Replace the battery before alarm is generated due to the lamp display by *BALM signal of PLC.
If the alarm is generated, it will be necessary to absolute reset after the battery replacement.



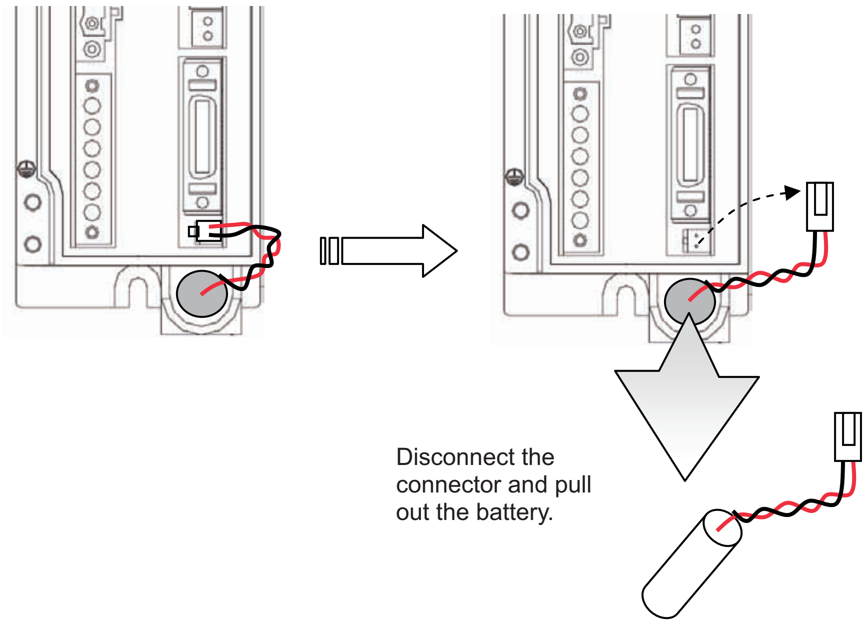
Battery voltage
3.6V
3.1V
2.5V
Normal
Warning occurred
Alarm occurred
*BALM signal (PIO)
ON
OFF
*ALM signal
ON
OFF
Absolute reset not required
*ALM OFF
Absolute reset required

7.2.2 Replacement of absolute battery

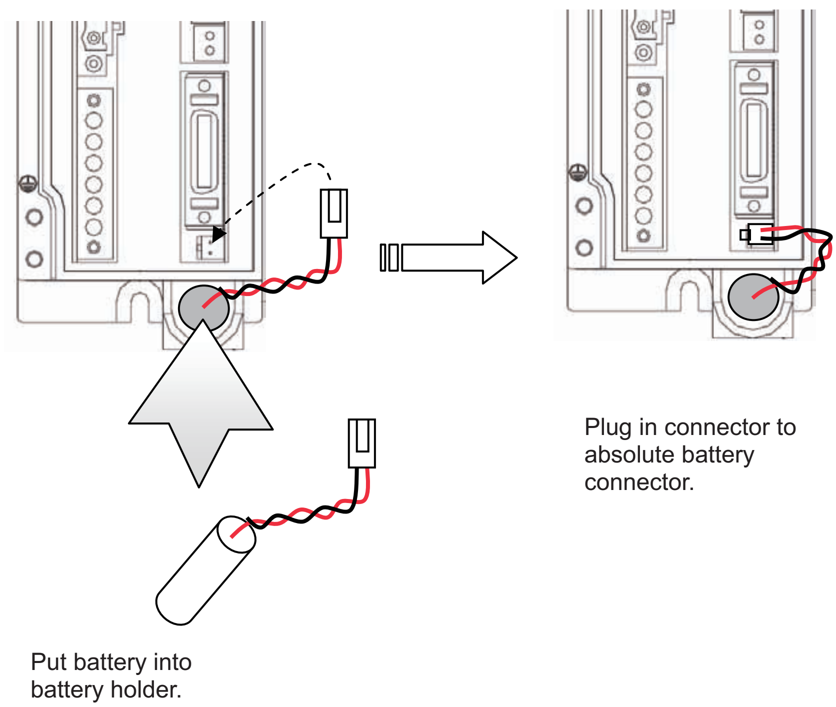
For the battery replacement, remove the battery connector while keeping the power to the controller ON, and change the battery installed in the battery holder.

> ⚠ Caution: To replace the old absolute battery with a new one with the controller power being OFF, complete the replacement within 15 minutes from the removal of the old battery. The absolute data may get lost if it exceeds 15 minutes.

[Removal]



[Attachment]



Chapter 8 I/O Parameter

Parameters are the data to set up considering the system and application.
When a change is required to the parameters, make sure to back up the data before the change so the settings can be returned anytime.
With using PC software, it is able to store the backup to the PC. Leave a memo if using the teaching pendant.
Also, for the purpose of rapid recovery after the investigation of failure unit or replacing the controller, keep data backup or memo also after the parameter change.
The change to the parameters will be activated after they are edited, written to the flash FeRAM, then either software reset or reboot of the power. It will not be active only with writing on the teaching tool.

⚠ Warning: Parameter setting has great influences on operations of the controller.
Incorrect parameter setting may not only cause malfunction or failure of the controller to occur but also people and assets to be exposed to risk.
The controller is configured to be applicable to normal operation at shipment.
Before providing certain change or setting for the controller to be fit to your system, understand the control methods of the controller sufficiently. Please contact us if you have anything unclear.
Do not turn OFF the power to the controller during the parameter writing.

8.1 I/O Parameter List

The categories in the table below indicate whether parameters should be set or not. There are five categories as follows:

A : Check the settings before use.
B : Use parameters of this category depending on their uses.
C : Use parameters of this category with the settings at shipments leaving unchanged as a rule. Normally they may not be set.
D : Parameters of the category are set at shipment in accordance with the specification of the actuator. Normally they may not be set.
E : Parameters of the category are exclusively used by us for convenience of production. Changing their settings may not only cause the actuator to operate improperly but also to be damaged. So, never change the setting of the parameters.

Category do not appear on the teaching tool.
Also, the unused parameter numbers are not mentioned in the list.

No.	Category	Name	Symbol	Unit (Note1)	Input Range	Default factory setting	for Positioner Mode	for Pulse Train Mode	Relevant sections
1	B	Zone 1+	ZNM1	mm (deg)	-9999.99 to 9999.99	Actual stroke on + side (Note2)	○	○	8.2 [1]
2	B	Zone 1-	ZNL1	mm (deg)	-9999.99 to 9999.99	Actual stroke on - side (Note2)	○	○	8.2 [1]
3	A	Soft limit+	LIMM	mm (deg)	-9999.99 to 9999.99	Actual stroke on + side (Note2)	○	○	8.2 [2]
4	A	Soft limit+	LIML	mm (deg)	-9999.99 to 9999.99	Actual stroke on - side (Note2)	○	○	8.2 [2]
5	D	Home Return Direction	ORG	–	0: Reverse, 1: Normal	In accordance with actuator (Note2)	○	○	8.2 [3]
6	C	Press & hold stop judgment period	PSWT	msec	0 to 9999	255	○		8.2 [4]
7	C	Servo gain number	PLGO	–	0 to 31	In accordance with actuator (Note2)	○	○	8.2 [5] 8.3
8	B	Default speed	VCMD	mm/s (deg/s)	1 to Actuator's max. speed	Rated actuator speed (Note2)	○		8.2 [6]
9	B	Default acceleration/deceleration	ACMD	G	0.01 to actuator's max. acceleration/ deceleration	Rated actuator's acceleration/ deceleration (Note2)	○		8.2 [7]
10	B	Default positioning width	INP	mm (deg)	0.01 to 999.99	0.10	○	○	8.2 [8]
13	C	Current-limiting value during home return	ODPW	%	1 to 300	In accordance with actuator (Note2)	○	○	8.2 [9]
14	E	Dynamic brake	FSTP	–	0: Disabled, 1: Enabled	1	○	○	8.2 [10]
15	B	Pause input disable	FPIO	–	0: Enabled, 1: Disabled	0	○		8.2 [11]
16	B	SIO communication speed	BRSL	bps	9600 to 230400	38400	○	○	8.2 [12]
17	B	Minimum delay time for slave transmitter activation	RTIM	msec	0 to 255	5	○	○	8.2 [13]
18	E	Home position check sensor input polarity	AIOF	–	0 to 2	In accordance with actuator (Note2)	○	○	8.2 [14]
19	E	Overrun sensor input polarity	AIOF	–	0 to 2	In accordance with actuator (Note2)	○	○	8.2 [15]
20	E	Creep sensor input polarity	AIOF	–	0 to 2	In accordance with actuator (Note2)	○	○	8.2 [16]
21	B	Servo ON input disable	FPIO	–	0: Enabled, 1: Disabled	0	○	○	8.2 [17]
22	C	Home Return Offset Level	OFST	mm (deg)	0.00 to 9999.99	In accordance with actuator (Note2)	○	○	8.2 [18]
23	B	Zone 2+	ZNM2	mm (deg)	-9999.99 to 9999.99	Actual stroke on + side (Note2)	○	○	8.2 [1]
24	B	Zone 2-	ZNL2	mm (deg)	-9999.99 to 9999.99	Actual stroke on - side (Note2)	○	○	8.2 [1]
25	A	PIO pattern selection	IOPN	–	0 to 7	0 (Standard Type)	○		8.2 [20]

Note 1 The unit (deg) is for rotary actuator. It is displayed in mm in the teaching tools.
Note 2 The setting values vary in accordance with the specification of the actuator. At shipment, the parameters are set in accordance with the specification.

I/O Parameter List (Continued)

No.	Category	Name	Symbol	Unit(Note1)	Input Range	Default factory setting	for Positioner Mode	for Pulse Train Mode	Relevant sections
26	B	PIO jog velocity	IOJV	mm/s (deg/s)	1 to Actuator's max. speed	100	○		8.2 [21]
27	B	Movement Command Type	FPIO	–	0: Level 1: Edge	0	○		8.2 [22]
31	C	Velocity Loop Proportional Gain	VLPG	–	1 to 27661	In accordance with actuator (Note2)	○	○	8.2 [23] 8.3
32	C	Velocity Loop Integral Gain	VLPT	–	1 to 217270	In accordance with actuator (Note2)	○	○	8.2 [24] 8.3
33	C	Torque Filter Time Constant	TRQF	–	0 to 2500	In accordance with actuator (Note2)	○	○	8.2 [25] 8.3
34	C	Press Velocity	PSHV	mm/s (deg/s)	1 to actuator's max. pressing speed	In accordance with actuator (Note2)	○		8.2 [26]
35	C	Safety Velocity	SAFV	mm/s (deg/s)	1 to 250 (max. for actuator of 250 or less)	100	○	○	8.2 [27]
36	B	Auto Servo-motor OFF Delay Time 1	ASO1	sec	0 to 9999	0	○		8.2 [28]
37	B	Auto Servo-motor OFF Delay Time 2	ASO2	sec	0 to 9999	0	○		8.2 [28]
38	B	Auto Servo-motor OFF Delay Time 3	ASO3	sec	0 to 9999	0	○		8.2 [28]
39	B	Position complete signal output method (Note3)	FPIO	–	0: PEND, 1: INP	0	○		8.2 [29]
40	C	Home-return input disable	FPIO	–	0: Enabled, 1: Disabled	0	○	○	8.2 [30]
41	C	Operating-mode input disable	FPIO	–	0: Enabled, 1: Disabled	0	○	○	8.2 [31]
42	C	Enable function	FPIO	–	0: Enabled, 1: Disabled	1	○	○	8.2 [32]
45	B	Silent interval magnification	SIVM	time	0 to 10	0	○	○	8.2 [33]
46	B	Velocity override	OVRD	%	1 to 100	100	○		8.2 [34]
47	B	PIO jog velocity 2	IOV2	mm/s (deg/s)	1 to Actuator's max. speed	100	○		8.2 [21]
48	B	PIO inch distance	IOID	mm (deg)	0.01 to 1.00	0.1	○		8.2 [36]
49	B	PIO inch distance 2	IOD2	mm (deg)	0.01 to 1.00	0.1	○		8.2 [36]
50	C	Load Output Judgment Time Period	LDWT	msec	0 to 9999	255	○		8.2 [37]
52	B	Default acceleration/deceleration mode	CTLF	–	0 to 2	0 (Trapezoid)	○	○	8.2 [38]
53	B	Default stop mode	CTLF	–	0 to 3	0 (Not Applicable)	○		8.2 [39]
54	C	Current-control width number	CLPF	–	0 to 4	In accordance with actuator (Note2)	○	○	8.2 [40]
55	B	Position-command primary filter time constant	PLPF	msec	0.0 to 100.0	0.0	○	○	8.2 [41]
56	B	S-motion rate	SCRV	%	0 to 100	0	○		8.2 [42]
57	B	Torque limit	TQLM	%	0 to 70	70		○	3.3.6
58	E	Deviation clear at servo OFF & alarm stop	FSTP	–	0: Disabled, 1: Enabled	1		○	3.3.6
59	C	Deviation error monitor during torque limiting	FSTP	–	0: Disabled, 1: Enabled	0		○	3.3.6
60	B	Deviation Counter Clear Input	FPIO	–	0: Enabled, 1: Disabled	0		○	3.3.6
61	B	Torque limit command input	FPIO	–	0: Enabled, 1: Disabled	0		○	3.3.6
62	B	Pulse count direction	FPIO	–	0: Forward motor rotation 1: Reverse motor rotation	In accordance with actuator (Note2)	○	○	3.3.6
63	B	Command Pulse Input Mode (Pulse String Mode)	CPMD	–	0 to 2	1 (pulse-train and moving direction angle)		○	3.3.4
64	B	Command Pulse Input Mode Polarity	CPMD	–	0: Positive Logic 1: Negative Logic	0		○	3.3.4
65	B	Electronic Gear Numerator	CNUM	–	1 to 4096	2048	○	○	3.3.4

Note 1 The unit (deg) is for rotary actuator. It is displayed in mm in the teaching tools.
Note 2 The setting values vary in accordance with the specification of the actuator. At shipment, the parameters are set in accordance with the specification.
Note 3 In the pulse-train mode, INP is automatically selected. (Cannot be selected)

I/O Parameter List (Continued)

No.	Category	Name	Symbol	Unit (Note1)	Input Range	Default factory setting	for Positioner Mode	for Pulse Train Mode	Relevant sections
66	B	Electronic Gear Denominator	CDEN	–	1 to 4096	125	○	○	3.3.4
67	B	Compulsory Stop Input	FPIO	–	0: Enabled, 1: Disabled	0		○	3.3.6
68	B	Feedback Pulse Output	FPIO	–	0: Enabled, 1: Disabled	1	○	○	3.3.5
69	B	Feedback Pulse Train	FBPT	–	0 to 2	0 (A/B Phase Pulse String)	○	○	3.3.5
70	B	Feedback Pulse Form Polarity	FBPT	–	0: Positive Logic 1: Negative Logic	0	○	○	3.3.5
71	B	Feed forward gain	PLFG	–	0 to 100	0	○	○	8.2 [57] 8.3
72	E	Timer period for emergency stop relay fusing monitor	EMWT	msec	0 to 60000	3000	○	○	8.2 [58]
73	D	Encoder voltage level	EVLV	–	0 to 3	Depending on encoder cable length (Note2)	○	○	8.2 [59]
74	C	PIO Power Supply Supervision	FPIO	–	0: Enabled, 1: Disabled	0	○	○	8.2 [60]
75	D	Electromagnetic brake power monitor	FSTP	–	0: Disabled, 1: Enabled	In accordance with actuator (Note2)	○	○	8.2 [61]
76	D	Belt breaking sensor input polarity	AIOF	–	0 to 2	In accordance with actuator (Note2)	○	○	8.2 [62]
77	D	Ball Screw Lead Length	LEAD	mm	0.01 to 999.99	In accordance with actuator (Note2)	○	○	8.2 [63]
78	D	Axis operation type	ATYP	–	0: Line Axis 1: Rotary Axis	In accordance with actuator (Note2)	○		8.2 [64]
79	B	Rotary axis mode selection	ATYP	–	0: Normal Mode 1: Index Mode	In accordance with actuator (Note2)	○		8.2 [65]
80	B	Rotational axis shortcut selection	ATYP	–	0: Disabled, 1: Enabled	In accordance with actuator (Note2)	○		8.2 [66]
84	A	Field bus operation mode (Note4)	FMOD	–	0 to 8	Separate volume	○		Separate volume
85	A	Field Bus Node Address (Note4)	NADR	–	0 to 127	Separate volume	○		Separate volume
86	A	Field bus baud rate (Note4)	FBRS	–	0 to 4	Separate volume	○		Separate volume
87	E	Network Type (Note4)	NTYP	–	0 to 7	Separate volume	○		Separate volume
88	D	Software limit margin	SLMA	mm (deg)	0 to 9999.99	In accordance with actuator (Note2)	○	○	8.2 [71]
89	D	Allowable time of exceeding torque allowing continuous pressing	PSCT	sec	0 to 300	In accordance with actuator (Note2)	○		8.2 [72]
90	C	Field I/O format (Note4)	FPIO	–	0 to 3	Separate volume	○		Separate volume
91	C	Current limit value at stopping due to miss-pressing	FSTP	–	0: Current limit value during movement 1: Current limit value during pressing	0	○		8.2 [74]
92	C	Use of loadcell	FFRC	–	0: Not Applicable 1: Use	In accordance with actuator (Note2)	○		8.2 [75]
93	C	Selection of pressing control	FFRC	–	0: Current limit 1: Force sensor	In accordance with actuator (Note2)	○		8.2 [76]
94	C	Pressing operation using force sensor gain	FRCG	–	100 to 30000	1500	○		8.2 [77]
95	C	Force judgment margin +	FJMM	%	1 to Maximum Pressing Force	In accordance with actuator (Note2)	○		8.2 [78]
96	C	Force judgment margin -	FJML	%	1 to Maximum Pressing Force	In accordance with actuator (Note2)	○		8.2 [78]

Note 1 The unit (deg) is for rotary actuator. It is displayed in mm in the teaching tools.
Note 2 The setting values vary in accordance with the specification of the actuator. At shipment, the parameters are set in accordance with the specification.
Note 4 These parameters are exclusively used for the field network. Set the parameters according to the Instruction Manual of each field network, a separate volume.

I/O Parameter List (Continued)

No.	Category		Name	Symbol	Unit	Input Range	Default factory setting	for Positioner Mode	for Pulse Train Mode	Relevant sections
97	C	Vibration suppress parameter set 1	Damping characteristic coefficient 1	DC11	–	0 to 1000	10	○		5.2
98	C		Damping characteristic coefficient 2	DC21	–	0 to 1000	1000	○		5.2
99	B		Natural frequency	NP01	1/1000Hz	500 to 30000	10000	○		5.2
100	C		Notch filter gain	NFG1	–	1 to 20000	9990	○		5.2
101	C	Vibration suppress parameter set 2	Damping characteristic coefficient 1	DC12	–	0 to 1000	10	○		5.2
102	C		Damping characteristic coefficient 2	DC22	–	0 to 1000	1000	○		5.2
103	B		Natural frequency	NP02	1/1000Hz	500 to 30000	10000	○		5.2
104	C		Notch filter gain	NFG2	–	1 to 20000	9990	○		5.2
105	C	Vibration suppress parameter set 3	Damping characteristic coefficient 1	DC11	–	0 to 1000	10	○		5.2
106	C		Damping characteristic coefficient 2	DC21	–	0 to 1000	1000	○		5.2
107	B		Natural frequency	NP01	1/1000Hz	500 to 30000	10000	○		5.2
108	C		Notch filter gain	NFG2	–	1 to 20000	9990	○		5.2
109	B		Default vibration suppress No.	CTLF	–	0 to 3	0	○		5.2
110	B		Stop method at servo OFF	FSTP	–	0: Rapid stop 1: Deceleration to stop	0	○		5.2
111	B		Calendar function	FRTC	–	0: Does not use the calendar timer 1: Use the calendar timer	1	○	○	8.2 [82]
112	B		Monitoring mode	FMNT	–	0: Does not use 1: Monitor function 1 2: Monitor function 2	1	○	○	8.2 [83]
113	B		Monitoring period	FMNT	msec	1 to 100	1	○	○	8.2 [84]
114	B		Selecting used feedback pulse gear ratio	FPIO	–	0: Not Applicable 1: Use	0	○	○	8.2 [85]
115	B		Electrical Gear (Feedback Pulse)	FNUM	–	1 to 4096	125	○	○	8.2 [86]
116	B		Electronic Gear Denominator (Feedback Pulse)	FDEN	–	1 to 4096	2048	○	○	8.2 [86]
117	B		Automatic loadcell calibration at start	FFRC	–	0: Does not perform 1: Perform	1	○		8.2 [87]
118	B		Pressing operation without completion of loadcell calibration	FFRC	–	0: Disabled, 1: Enabled	0	○		8.2 [88]
119	B		Loadcell calibration time	CLBT	msec	1 to 9999	10	○		8.2 [89]
120	C		Servo gain number 1	PLG1	–	0 to 31	In accordance with actuator (Note2)	○	○	8.2 [5] 8.3

Note 2: The setting values vary in accordance with the specification of the actuator. At shipment, the parameters are set in accordance with the specification.

I/O Parameter List (Continued)

No.	Category	Name	Symbol	Unit	Input Range	Default factory setting	for Positioner Mode	for Pulse Train Mode	Relevant sections
121	C	Feed forward gain 1	PLF1	–	0 to 100	In accordance with actuator (Note2)	○	○	8.2 [57]
122	C	Velocity Loop Proportional Gain 1	VLG1	–	1 to 27661	In accordance with actuator (Note2)	○	○	8.2 [23] 8.3
123	C	Velocity Loop Integral Gain 1	VLT1	–	1 to 217270	In accordance with actuator (Note2)	○	○	8.2 [24] 8.3
124	C	Torque Filter Time Constant 1	TRF1	–	0 to 2500	In accordance with actuator (Note2)	○	○	8.2 [25] 8.3
125	C	Current control width number 1	CLP1	–	0 to 4	In accordance with actuator (Note2)	○	○	8.2 [40] 8.3
126	C	Servo gain number 2	PLG2	–	0 to 31	In accordance with actuator (Note2)	○	○	8.2 [5] 8.3
127	C	Feed forward gain 2	PLF2	–	0 to 100	In accordance with actuator (Note2)	○	○	8.2 [57]
128	C	Velocity Loop Proportional Gain 2	VLG2	–	1 to 27661	In accordance with actuator (Note2)	○	○	8.2 [23] 8.3
129	C	Velocity Loop Integral Gain 2	VLT2	–	1 to 217270	In accordance with actuator (Note2)	○	○	8.2 [24] 8.3
130	C	Torque Filter Time Constant 2	TRF2	–	0 to 2500	In accordance with actuator (Note2)	○	○	8.2 [25] 8.3
131	C	Current control width number 2	CLP2	–	0 to 4	In accordance with actuator (Note2)	○	○	8.2 [40] 8.3
132	C	Servo gain number 3	PLG3	–	0 to 31	In accordance with actuator (Note2)	○	○	8.2 [5] 8.3
133	C	Feed forward gain 3	PLF3	–	0 to 100	In accordance with actuator (Note2)	○	○	8.2 [57]
134	C	Velocity Loop Proportional Gain 3	VLG3	–	1 to 27661	In accordance with actuator (Note2)	○	○	8.2 [23] 8.3
135	C	Velocity Loop Integral Gain 3	VLT3	–	1 to 217270	In accordance with actuator (Note2)	○	○	8.2 [24] 8.3
136	C	Torque Filter Time Constant 3	TRF3	–	0 to 2500	In accordance with actuator (Note2)	○	○	8.2 [25] 8.3
137	C	Current control width number 3	CLP3	–	0 to 4	In accordance with actuator (Note2)	○	○	8.2 [40] 8.3
138	C	Servo gain switchover time constant	GCFT	ms	10 to 2000	10	○	○	8.2 [108]
139	A	Home preset value	PRST	mm	-9999.99 to 9999.99	In accordance with actuator (Note2)	○	○	8.2 [109]
140	B	IP Address	IPAD	–	0.0.0.0 to 255.255.255.255	192.168.0.1		–	Separate volume
141	B	Subnet Mask	SNMK	–	0.0.0.0 to 255.255.255.255	255.255.255.0		–	Separate volume
142	B	Default Gateway	DFGW	–	0.0.0.0 to 255.255.255.255	0.0.0.0		–	Separate volume
143	B	Overload Level Ratio	OLWL	%	50 to 100	100	○	○	8.2 [113]
147	B	Total Movement Count Threshold	TMCT	Times	0 to 999999999	0 (Disabled)	○	–	8.2 [114]
148	B	Total Operated Distance Threshold	ODOT	m	0 to 999999999	0 (Disabled)	○	○	8.2 [115]
149	B	Zone Output Changeover	FPIO	–	0: Not to change 1: To change	0	○	–	8.2 [116]
150	A	Linear Absolute Home Preset Value	LAPS	mm	-9999.99 to 9999.99	In accordance with actuator	○	○	8.2 [117]
151	B	Light Error Alarm Output Select	FSTP	–	0:	0: Battery Voltage Drop Warning Output 1: Output of battery voltage drop warning or message-level alarm	○	○	8.2 [118]

Note 2: The setting values vary in accordance with the specification of the actuator. At shipment, the parameters are set in accordance with the specification.

⚠ Caution: When the controller is operated via serial communication, always set the controller in the "positioner mode" (piano switch 1: OFF).
If it happens to be in the "pulse train mode" by mistake, the controller may operate erratically because it is operated according to the "pulse train mode" parameters.

8.2 Detail Explanation of Parameters

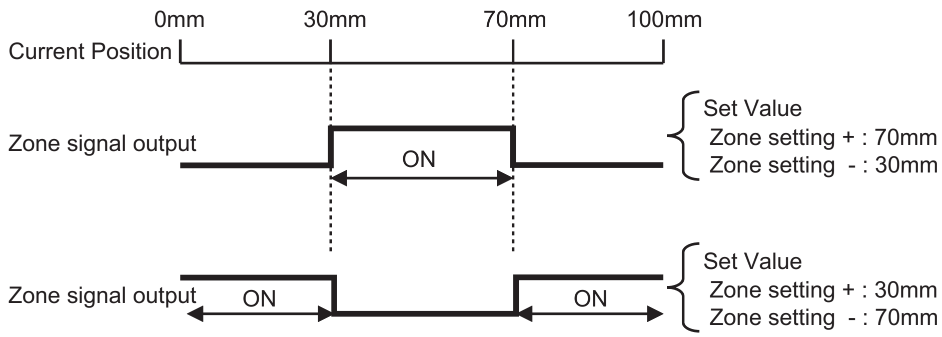
> ⚠ Caution: • If parameters are changed, provide software reset or reconnect the power to reflect the setting values.
> • The unit (deg) is for rotary actuator and lever type gripper. Pay attention that it is displayed in mm in the teaching tools.

[1] Zone 1+, Zone 1- (Parameter No.1, No.2)
Zone 2+, Zone 2- (Parameter No.23, No.24)

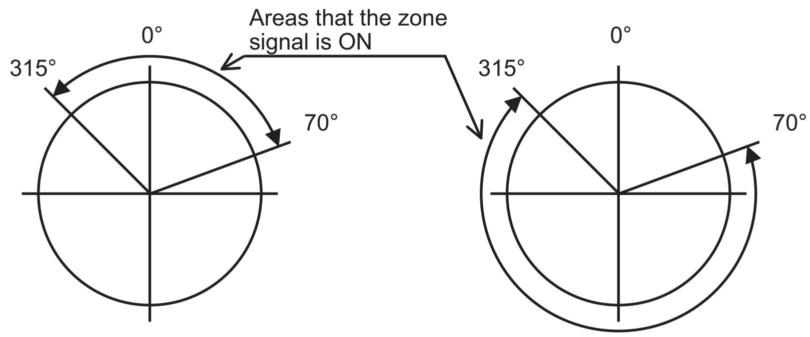
No.	Name	Symbol	Unit	Input Range	Default factory setting
1	Zone 1+	ZNM1	mm (deg)	-9999.99 to 9999.99	Actual stroke on + side
2	Zone 1-	ZNL1	mm (deg)	-9999.99 to 9999.99	Actual stroke on - side
23	Zone 2+	ZNM2	mm (deg)	-9999.99 to 9999.99	Actual stroke on + side
24	Zone 2-	ZNL2	mm (deg)	-9999.99 to 9999.99	Actual stroke on - side

These parameters are used set the zone in which zone signal (ZONE1 or ZONE2) turns ON in a mode other than PIO patterns 1 to 3 (ZONE2 is valid only in the pulse-train control mode).
The minimum setting unit is 0.01mm (deg).
If a specific value is set to both zone setting + and zone setting -, the zone signal is not output.
A setting sample is shown below.

[Example of when line axis]



[Example of Rotary Actuator Index Mode]

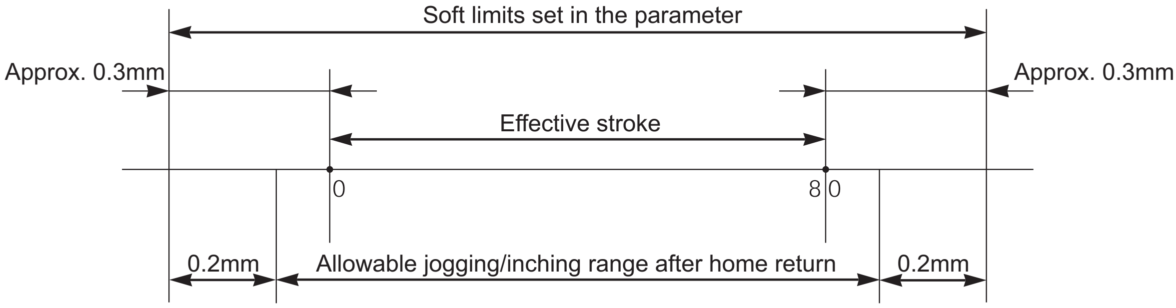


> ⚠ Caution: The zone detection range would not output unless the value exceeds that of the minimum resolution (actuator lead length / No. of Encoder Pluses).

[2] Soft limit +, Soft limit – (Parameter No.3, No.4)

No.	Name	Symbol	Unit	Input Range	Default factory setting
3	Soft limit +	LIMM	mm (deg)	-9999.99 to 9999.99	Actual stroke on + side
4	Soft limit –	LIML	mm (deg)	-9999.99 to 9999.99	Actual stroke on - side

0.3mm (deg) is added to the outside of the effective actuator stroke for the setting at the delivery (since there would be an error at the end of effective stroke if set to 0). Change the setting if required for the cases such as when there is interference or to prevent a crash, or when using the actuator with slightly exceeding effective stroke in the operational range.
An incorrect soft limit setting will cause the actuator to collide into the mechanical end, so exercise sufficient caution.
The minimum setting unit is 0.01mm.
(Note) To change a soft limit, set a value corresponding to 0.3mm outside of the effective stroke.
Example) Set the effective stroke to between 0mm and 80mm
Parameter No.3 (positive side) 80.3
Parameter No.4 (negative side) -0.3



The operational range for jog and inching after the home return is 0.2mm less than the set value.
Alarm Code 0D9 "Soft Limit Over Error" will be generated when the set value exceeded the value (0 when shipped out) set in Parameter No.88 "Software Limit Margin". If the setting is not done in Parameter No.88, the value set in this parameter become the detection value for Alarm Code 0D9 "Soft Limit Over Error".

[3] Home Return Direction (Parameter No.5)

No.	Name	Symbol	Unit	Input Range	Default factory setting
5	Home Return Direction	ORG	–	0: Reverse 1: Forward	In accordance with actuator

Unless there is a request of Home Reversed Type (option), the home-return direction is on the motor side for the line axis, counterclockwise side for the rotary axis and outer (open) side for the gripper. [Refer to the coordinate system of the actuator.]
If it becomes necessary to reverse the home direction after the actuator is installed on the machine, change the setting.

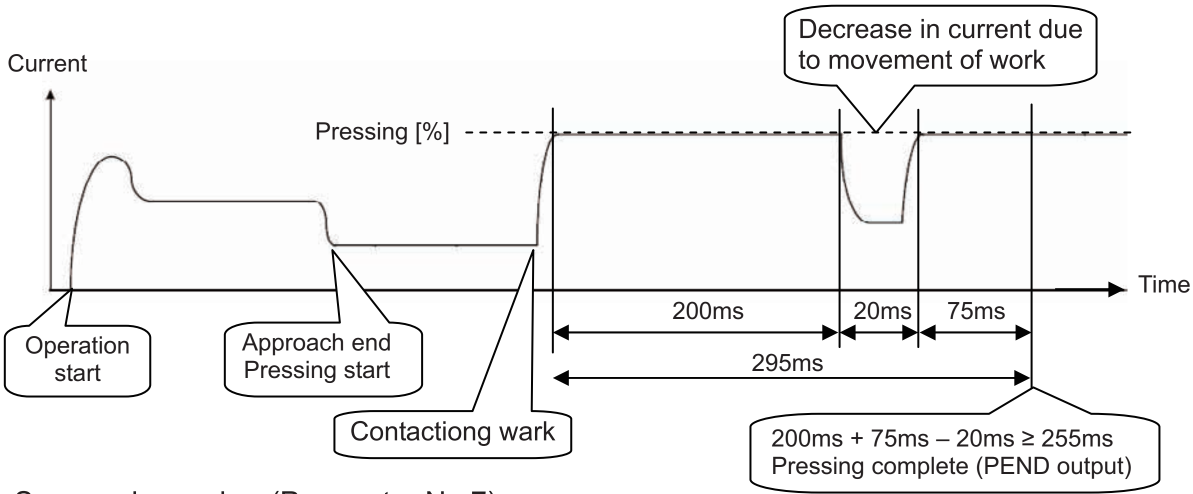
⚠ Caution: For the actuator of rod or rotary type, the home direction cannot be changed.

[4] Press & hold stop judgment period (Parameter No.6)

No.	Name	Symbol	Unit	Input Range	Default factory setting
6	Press & hold stop judgment period	PSWT	msec	0 to 9999	255

Judging completion of pressing operation

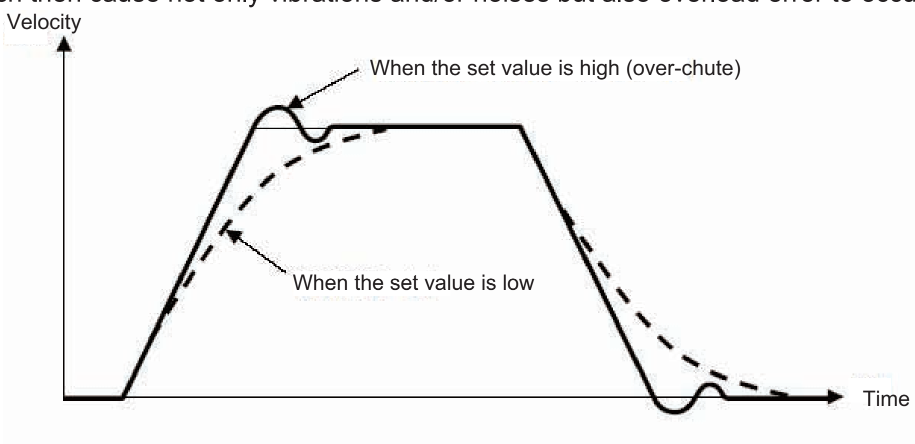
(1) For Standard type (PIO pattern 0 to 3)
The operation monitors the torque (current limit value) in percent in "Pressing" of the position table and turns pressing complete signal PEND ON when the load current satisfies the condition shown below during pressing. PEND is turned ON at satisfaction of the condition if the work is not stopped.
(Accumulated time in which current reaches pressing value [%])
– (accumulated time in which current is less than pressing value [%])
≥ 255 ms (Parameter No.6)



[5] Servo gain number (Parameter No.7)

No.	Name	Symbol	Unit	Input Range	Default factory setting
7	Servo gain number	PLGO	–	0 to 31	In accordance with actuator

The servo gain is also called position loop gain or position control system proportion gain. The parameter defines the response when a position control loop is used. Increasing the set value improves the tracking performance with respect to the position command. However, increasing the parameter value excessively increases the changes of overshooting.
When the set value is too low, the follow-up ability to the position command is degraded and it takes longer time to complete the positioning.
For a system of low mechanical rigidity or low natural frequency (every object has its own natural frequency), setting a large servo gain number may generate mechanical resonance, which then cause not only vibrations and/or noises but also overload error to occur.



[6] Default velocity (Parameter No.8)

No.	Name	Symbol	Unit	Input Range	Default factory setting
8	Default velocity	VCMD	mm/s (deg/s)	1 to Actuator's max. verocity	Rated actuator speed

The factory setting is the rated velocity of the actuator.
When a target position is set in an unregistered position table, the setting in this parameter is automatically written in the applicable position number.
It is convenient to set the velocity often used.

[7] Default acceleration/deceleration (Parameter No.9)

No.	Name	Symbol	Unit	Input Range	Default factory setting
9	Default acceleration/deceleration	ACMD	G	0.01 to actuator's max. acceleration/ deceleration	Rated actuator's acceleration/ deceleration

The factory setting is the rated acceleration/deceleration of the actuator.
When a target position is set in an unregistered position table, the setting in this parameter is automatically written in the applicable position number.
It is convenient to set the acceleration/deceleration often used.

[8] Default positioning width (in-position) (Parameter No.10)

No.	Name	Symbol	Unit	Input Range	Default factory setting
10	Default positioning width	INP	mm (deg)	0.01 to 999.99	0.10

When a target position is set in an unregistered position table, the setting in this parameter is automatically written in the applicable position number. When the remaining moving distance enters into this width, the positioning complete signal is output.
It is convenient to set the positioning width often used.

[9] Current-limiting value during home return (Parameter No.13)

No.	Name	Symbol	Unit	Input Range	Default factory setting
13	Current-limiting value during home return	ODPW	%	1 to 300	In accordance with actuator

The factory setting conforms to the standard specification of the actuator.
Increasing this setting will increase the home return torque.
Normally this parameter need not be changed. If the home return should be completed before the correct position depending on the affixing method, load condition or other factors when the actuator is used in a vertical application, the setting value must be increased. Please contact IAI.

[10] Dynamic brake (Parameter No.14)

No.	Name	Symbol	Unit	Input Range	Default factory setting
14	Dynamic brake	FSTP	–	0 : Disabled, 1 : Enabled	1

This parameter defines whether the dynamic brake is enabled or disabled while the actuator is at standstill.
Normally it need not be changed.

[11] Pause input disable (Parameter No.15)

No.	Name	Symbol	Unit	Input Range	Default factory setting
15	Pause input disable	FPIO	–	0 : Enabled, 1 : Disabled	0

This parameter defines whether the pause input signal is disabled or enabled.
If pause from PIO is not required, setting the parameter to “1” allows the actuator to be operated without wiring of the pause signal input.

Set Value	Description
0	Enabled (Use the input signal)
1	Disabled (Does not use the input signal)

[12] SIO communication speed (Parameter No.16)

No.	Name	Symbol	Unit	Input Range	Default factory setting
16	SIO communication speed	BRSL	bps	9600 to 230400	38400

Set the SIO baud rate for the startup.
Set an appropriate value in accordance with the communication speed of the host.
One of 9600, 14400, 19200, 28800, 38400, 76800, 115200 and 230400 bps can be selected as the communication speed.

> ⚠ Caution: The baud rate after the PC software is connected will be the rate of PC software. To make effective the value set in the parameter, turn off the power once and on it again.

[13] Minimum delay time for slave transmitter activation (Parameter No.17)

No.	Name	Symbol	Unit	Input Range	Default factory setting
17	Minimum delay time for slave transmitter activation	RTIM	msec	0 to 255	5

In this setting, set the time from receiving the command (received data) during the SIO communication till the response (sent data) is returned to the host side.

[14] Home position check sensor input polarity (Parameter No.18)

No.	Name	Symbol	Unit	Input Range	Default factory setting
18	Home position check sensor input polarity	AIOF	–	0 to 2	In accordance with actuator

The home sensor is an option.

Set Value	Description
0	Standard specification (sensor not used)
1	Input is a contact
2	Input is b contact

[15] Overrun sensor input polarity (Parameter No.19)

No.	Name	Symbol	Unit	Input Range	Default factory setting
19	Overrun sensor input polarity	AIOF	–	0 to 2	In accordance with actuator

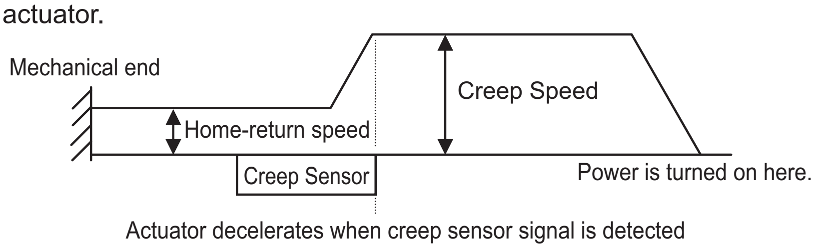
This parameter is set properly prior to the shipment according to the specification of the actuator.

Set Value	Description
0	Standard specification without sensor
1	Over travel detection sensor input is a contact
2	Over travel detection sensor input is b contact

[16] Creep sensor input polarity (Parameter No.20)

No.	Name	Symbol	Unit	Input Range	Default factory setting
20	Creep sensor input polarity	AIOF	–	0 to 2	In accordance with actuator

Even though the movement speed for most of the actuators at the home return is 20mm/s, there are some actuators with other settings. Refer to the instruction manual of each actuator.
Even though the actuator with long stroke requires time to home-return if the power is shut at a point far from the home position, the required time can be improved with using the creep sensor.
The actuator moves at the creep speed (100mm/s or less) until a creep sensor signal is detected, upon which the actuator will decelerate to the home return speed.
Creep sensor is an option for the line axis type.
This parameter is set properly prior to the shipment according to the specification of the actuator.



Set Value	Description
0	Not to use
1	Input is a contact
2	Input is b contact

[17] Servo ON input disable (Parameter No.21)

No.	Name	Symbol	Unit	Input Range	Default factory setting
21	Servo ON input disable	FPIO	–	0: Enabled 1: Disabled	0

This parameter defines whether the servo ON input signal is disabled or enabled.
When the servo ON input signal is disabled, the servo is turned ON as soon as the controller power is turned ON.
Set this parameter to “1” if servo ON/OFF is not provided by PIO signals.

Set Value	Description
0	Enabled (Use the input signal)
1	Disabled (Does not use the input signal)

[18] Home Return Offset Level (Parameter No.22)

No.	Name	Symbol	Unit	Input Range	Default factory setting
22	Home Return Offset Level	OFST	mm (deg)	0.00 to 9999.99	In accordance with actuator

In this setting can set the distance from the mechanical end to the home position.
An adjustment is available for the following cases.

1) Want to match the actuator home position and the mechanical origin of the system.
2) Want to set a new home after reversing the factory-set home direction.
3) Want to eliminate a slight deviation from the previous home position generated after replacing the actuator.

[Adjustment Process]

1) Homing execution
2) Offset check
3) Parameter setting change
4) If setting a number close to a multiple of the lead length (including home-return offset value = 0) to the home offset value, there is a possibility to servo lock on Z-phase at absolute reset, thus the coordinates may get shifted for the lead length.
   For Absolute Type, do not attempt to set a value near a number that the lead length is multiplied by an integral number.
   Have enough margin.
   After the setting, repeat home return several times to confirm that the actuator always returns to the same home position.

⚠ Caution : If the home return offset has been changed, the soft limit parameters must also be adjusted accordingly.
In case the there is a necessity of setting a value more than the initial setting, contact IAI.

[19] Zone 2+, Zone 2– (Parameter No.23, No.24)

[Refer to 8.2 [1].]

[20] PIO pattern selection (Parameter No.25)

No.	Name	Symbol	Unit	Input Range	Default factory setting
25	PIO pattern selection	IOPN	–	0 to 7	0 (Standard Type)

Select the PIO operation pattern in Parameter No.25.
Check the 3.2 Operation in Positioner Mode for details of PIO patterns.

Pattern type	Value set in Parameter No.25	Mode	Feature of PIO pattern
PIO pattern 0	0 (factory setting)	Positioning mode (Standard type)	• Number of positioning points: 64 • Position command: Binary code • Zone signal output: 1 point • Position zone signal output: 1 point
PIO pattern 1	1	Teaching mode (Teaching type)	• Number of positioning points: 64 • Position command: Binary code • Position zone signal output: 1 point • Jog operation enabled by PIO signal • Writing current position data to position table enabled by PIO signal
PIO pattern 2	2	256-point mode (256-point type)	• Number of positioning points: 256 • Position command: Binary code • Position zone signal output: 1 point
PIO pattern 3	3	512-point mode (512-point type)	• Number of positioning points: 512 • Position command: Binary code • Zone signal output: None
PIO pattern 4	4	Solenoid valve mode 1 (7-point type)	• Number of positioning points: 7 • Position command: Individual No. signal ON • Zone signal output: 1 point • Position zone signal output: 1 point
PIO pattern 5	5	Solenoid valve mode 2 (3-point type)	• Number of positioning points: 3 • Position command: Individual No. signal ON • Signal equivalent to LS (limit switch) enabled • Zone signal output: 1 point • Position zone signal output: 1 point
PIO pattern 6	6	Pressing Operation Using Force Sensor Mode 1	• Number of positioning points: 32 • Position command: Binary code • Position zone signal output: 1 point • Judgment of pressing force enabled
PIO pattern 7	7	Pressing Operation Using Force Sensor Mode 2 (Solenoid valve Type)	• Number of positioning points: 5 • Position command: Individual No. signal ON • Position zone signal output: 1 point • Judgment of pressing force enabled

[21] PIO jog velocity (Parameter No.26), PIO jog velocity 2 (Parameter No.47)

No.	Name	Symbol	Unit	Input Range	Default factory setting
26	PIO jog velocity	IOJV	mm/s (deg/s)	1 to Actuator's max. speed(note1)	100

This is the jog operation velocity setting with PIO signal (jog input command) when PIO pattern = 1 (Teaching Mode) is selected.
Set an appropriate value in Parameter No.26 in accordance with the purpose of use.
Note 1 The maximum speed is limited to 250mm/s.

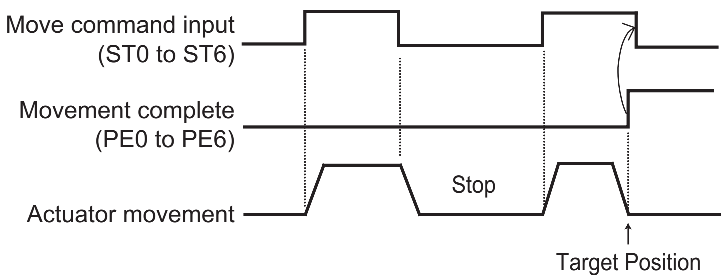
[22] Movement Command Type (Parameter No.27)

No.	Name	Symbol	Unit	Input Range	Default factory setting
27	Movement Command Type	FPIO	–	0 : Level 1 : Edge	0

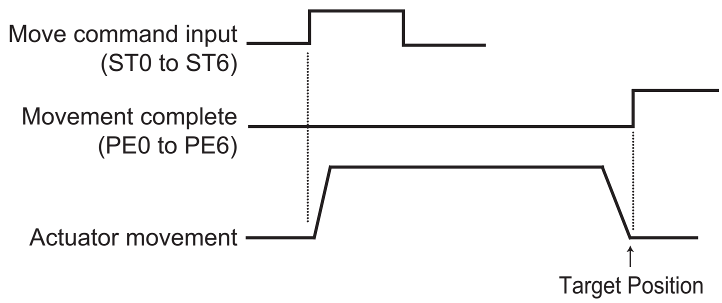
Set the input methods for the start signal (ST0 to ST6, or ST0 to ST2 if PIO Pattern = 5) when PIO Pattern 4 = Electromagnetic Valve Mode 1 (7-point type), PIO Pattern 5 = Electromagnetic Valve Mode 2 (3-point type) and PIO Pattern 7 = Pressing Operation Using Force Sensor Mode 2 (Electromagnetic Valve Mode).

Set Value	Input method	Description
0	Level	The actuator starts moving when the input signal turns ON. When the signal turns OFF during movement, the actuator will decelerate to a stop and complete its operation.
1	Edge	The actuator starts moving when the rising edge of the input signal is detected. The actuator will not stop when the signal turns OFF during the movement, until the target position is reached.

[Level System]



[Edge System]

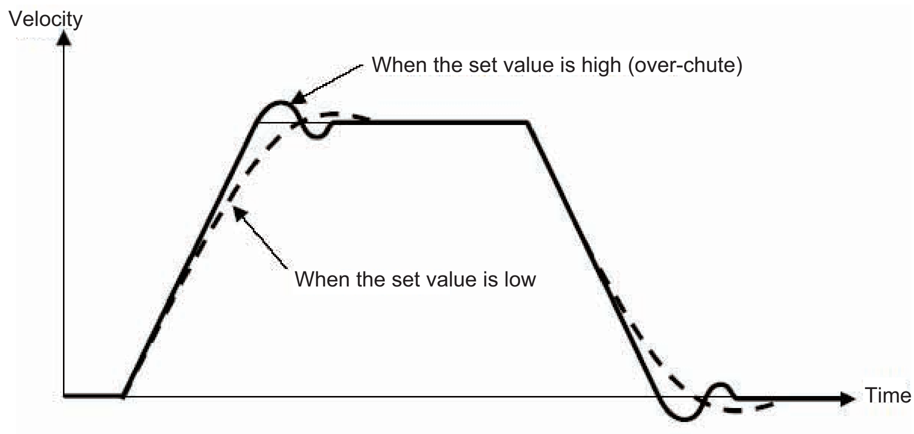


Chapter 8 I/O Parameter

[23] Velocity Loop Proportional Gain (Parameter No.31)

No.	Name	Symbol	Unit	Input Range	Default factory setting
31	Velocity Loop Proportional Gain	VLPG	–	1 to 27661	In accordance with actuator

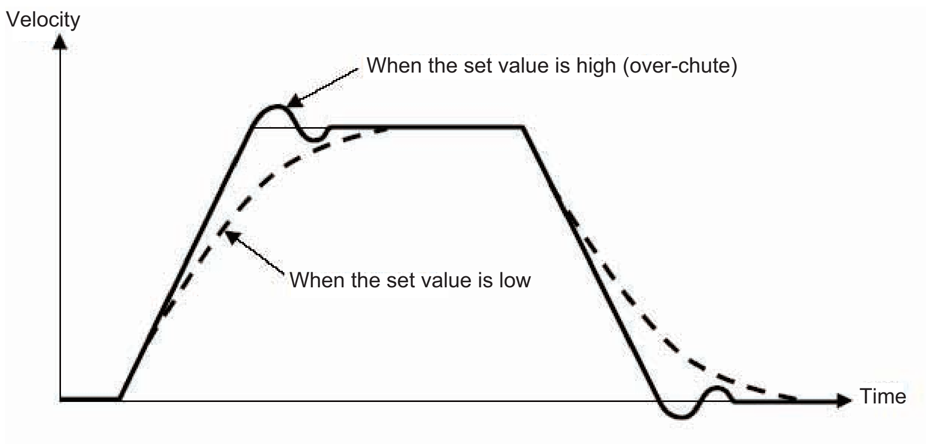
This parameter determines the response of the speed control loop. When the set value is increased, the follow-up ability to the velocity command becomes better (the servo-motor rigidity is enhanced). The higher the load inertia becomes, the larger the value should be set. However, excessively increasing the setting will cause overshooting or oscillation, which facilitates producing the vibrations of the mechanical system.



[24] Velocity Loop Integral Gain (Parameter No.32)

No.	Name	Symbol	Unit	Input Range	Default factory setting
32	Velocity Loop Integral Gain	VLPT	–	1 to 217270	In accordance with actuator

Any machine produces frictions. This parameter is intended to cope with deviation generated by external causes including frictions. Increasing the setting value improves the reactive force against load change. That is, the servo rigidity increases. However, increasing the parameter value excessively may make the gain too high, which then cause the machine system to be vibrated due to overshoot or shaking.
Tune it to obtain the optimum setting by watching the velocity response.



[25] Torque Filter Time Constant (Parameter No.33)

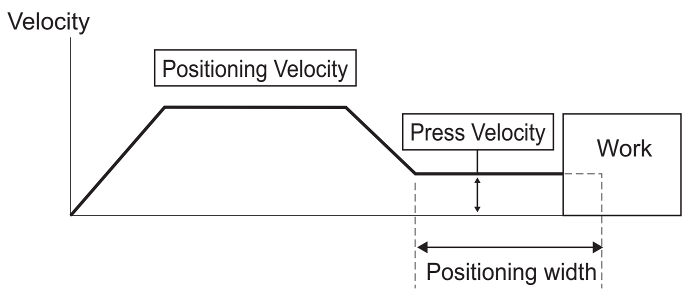
No.	Name	Symbol	Unit	Input Range	Default factory setting
33	Torque Filter Time Constant	TRQF	–	0 to 2500	In accordance with actuator

This parameter decides the filter time constant for the torque command. When vibrations and/or noises occur due to mechanical resonance during operation, this parameter may be able to suppress the mechanical resonance. This function is effective for torsion resonance of ball screws (several hundreds Hz).

[26] Press Velocity (Parameter No.34)

No.	Name	Symbol	Unit	Input Range	Default factory setting
34	Press Velocity	PSHV	mm/s (deg/s)	1 to actuator's max. pressing speed	In accordance with actuator

This is the parameter to set the velocity in pressing operation.
The setting is done considering the actuator type when the product is delivered. [Refer to 10.4.1 List of Specifications of Connectable Actuators]
If a change to the setting is required, make sure to have the setting below the maximum pressing velocity of the actuator. Setting it fast may disable to obtain the specified pressing force. Also when setting at a low velocity, take 5mm/s as the minimum.



⚠Caution:	If the velocity of the positioning of the position table is set below this parameter, the pressing speed will become the same as the positioning speed.

[27] Safety Velocity (Parameter No.35)

No.	Name	Symbol	Unit	Input Range	Default factory setting
35	Safety Velocity	SAFV	mm/s (deg/s)	1 to 250 (maximum speed for the actuators with 250 or less)	100

This is the parameter to set the maximum speed of manual operation while the safety velocity selected in the teaching tool. Do not have the setting more than necessary.

[28] Auto Servo Motor OFF Delay Time 1, 2, 3 (Parameter No.36, No.37, No.38)

No.	Name	Symbol	Unit	Input Range	Default factory setting
36	Auto Servo Motor OFF Delay Time 1	ASO1	sec	0 to 9999	0
37	Auto Servo Motor OFF Delay Time 2	ASO2	sec	0 to 9999	0
38	Auto Servo Motor OFF Delay Time 3	ASO3	sec	0 to 9999	0

Set the duration before the servo turns OFF after positioning process is complete when the power saving function is used.
[Refer to Chapter 6 Power-saving Function.]

[29] Position complete signal output method (Parameter No.39)

No.	Name	Symbol	Unit	Input Range	Default factory setting
39	Position complete signal output method	FPIO	–	0: PEND, 1: INP	0

This is the parameter to select the type of the positioning complete signals to be used.
It is available except for when PIO Pattern = 5 (Electromagnetic Valve Type 2 [3-point type]) is selected.
There are 2 types of positioning complete signals and the output condition would differ depending on whether the servo is ON after the positioning is complete or the servo is OFF.

<table>
<tr><th>Setting</th><th colspan="2">Signal Type</th><th>During Servo ON (positioning complete)</th><th>During Servo OFF</th></tr>
<tr><td>0</td><td colspan="2">PEND</td><td>It will not turn OFF even if the current position is out of the range of the positioning width.</td><td>Turns OFF in any case</td></tr>
<tr><td>1</td><td colspan="2">INP(Note1)</td><td colspan="2">Turns ON when the current position is in the positioning width, and OFF when out of it.</td></tr>
<tr><td rowspan="2">Pulse train control mode(Note1)</td><td rowspan="2">INP</td><td>AUTO</td><td>Turns ON when the current position is in the positioning width (Parameter No.10), and OFF when out of it.</td><td>Turns OFF in any case</td></tr>
<tr><td>MANU</td><td colspan="2">Turns ON when the current position is in the positioning width (Parameter No.10), and OFF when out of it.</td></tr>
</table>

Complete position No. outputs PM1 to PM** and current position No. outputs PE0 to PE6 are issued in the similar way.

Note 1 In Pulse Train Mode, the signal becomes INP compulsorily when the setting is AUTO, and turns OFF during the servo-off condition.

[30] Home return input disable (Parameter No.40)

No.	Name	Symbol	Unit	Input Range	Default factory setting
40	Home return input disable	FPIO	–	0: Enabled 1: Disabled	0

This parameter defines whether the home return input signal is disabled or enabled.
Normally this parameter need not be changed.

Set Value	Description
0	Enabled (Use the input signal)
1	Disabled (Does not use the input signal)

[31] Operating mode input disable (Parameter No.41)

No.	Name	Symbol	Unit	Input Range	Default factory setting
41	Operating mode input disable	FPIO	–	0: Enabled 1: Disabled	0

This parameter defines whether the operation mode input signal is disabled or enabled.
Normally this parameter need not be changed.

Set Value	Description
0	Enabled (Use the input signal)
1	Disabled (Does not use the input signal)

[32] Enable function (Parameter No.42)

No.	Name	Symbol	Unit	Input Range	Default factory setting
42	Enable function	FPIO	–	0: Enabled 1: Disabled	1

Set valid/invalid the deadman switch function if the teaching pendant is equipped with a deadman switch.

Set Value	Description
0	Enabled (Use the function)
1	Disabled (Does not use the function)

[33] Silent interval magnification (Parameter No.45)

No.	Name	Symbol	Unit	Input Range	Default factory setting
45	Silent interval magnification	SIVM	times	0 to 10	0

Use this parameter to set the silent interval (no communication) time by the time taken for communication of 3.5 characters or longer before command data transmission when the controller is operated via serial communication.
This parameter need not be changed when a teaching tool such as PC software is used.
If "0" is set, no multiplier is applied.

[34] Velocity override (Parameter No.46)

No.	Name	Symbol	Unit	Input Range	Default factory setting
46	Velocity override	OVRD	%	1 to 100	100

When move commands are issued from the PLC, the moving speed set in the "Velocity" field of the position table can be overridden by the value set by this parameter.
Actual movement velocity = [Velocity set in the position table] × [setting value in Parameter No.46]

Example) Value in the "Velocity" field of the position table: 500mm/s
Setting in Parameter No.46 20%
In this case, the actual movement speed becomes 100mm/s.

The minimum setting unit is 1% and the input range is 1 to 100%.

(Note) This parameter is ignored for move commands from a teaching tool such as PC software.

[35] PIO jog velocity 2 (Parameter No.47)

Refer to Section 8.2 [21] for details.

[36] PIO inch distance, PIO inch distance 2 (Parameter No.48, No.49)

No.	Name	Symbol	Unit	Input Range	Default factory setting
48	PIO inch distance	IOID	mm	0.01 to 1.00	0.1
49(Note1)	PIO inch distance 2	IOD2	mm	0.01 to 1.00	0.1

When the selected PIO pattern is “1” (teaching mode), this parameter defines the inching distance to be applied when inching input commands are received from the PLC.
The maximum allowable value is 1 mm.
Note 1 Parameter No.49 “PIO inching distance 2” is not used for the controller.

[37] Load Output Judgment Time Period (Parameter No.50)

No.	Name	Symbol	Unit	Input Range	Default factory setting
50	Load Output Judgment Time Period	LDWT	msec	0 to 9999	255

This parameter defines the time taken to judging whether torque level status signal (TRQS) is ON.
If the command torque exceeds the value set in “Threshold” of position data for the time set by this parameter during pressing operation, torque level status signal (TRQS) is turned ON.
Refer to 3.2.4 [4] or 3.2.5 [3] Pressing Operation for the details of the pressing operation.

[38] Default acceleration/deceleration mode (Parameter No.52)

No.	Name	Symbol	Unit	Input Range	Default factory setting
52	Default acceleration/deceleration mode	CTLF	–	0 to 2	0 (Trapezoid)

When a target position is written to an unregistered position table, this value is automatically set as the “Acceleration/deceleration mode” of the applicable position number.

Set Value	Description
0	Trapezoid
1	S-motion
2	Primary delay filter

[39] Default stop mode (Parameter No.53)

No.	Name	Symbol	Unit	Input Range	Default factory setting
53	Default stop mode	CTLF	–	0 to 3	0 (Does not use)

This parameter defines the power-saving function.
[Refer to Chapter 6 Power-saving Function.]

[40] Current control width number (Parameter No.54)

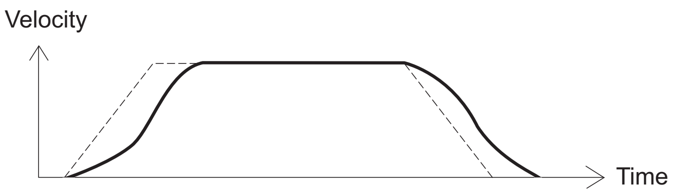
No.	Name	Symbol	Unit	Input Range	Default factory setting
54	Current control width number	CLPF	–	0 to 4	In accordance with actuator

This parameter is for the manufacturer's use only to determine the response capability of the current loop control. Therefore, do not change the settings in this parameter. If the parameter is changed carelessly, control safety may be adversely affected and a very dangerous situation may result.

[41] Position-command primary filter time constant (Parameter No.55)

No.	Name	Symbol	Unit	Input Range	Default factory setting
55	Position-command primary filter time constant	PLPF	msec	0.0 to 100.0	0.0

Use this in the case to set the value in "Acceleration/Deceleration" box in the position table to 2 "1-step delay filter", or in the case that there is no acceleration/deceleration function the host controller in Pulse Train Control Mode.
The primary delay filter is disabled if "0" is set.
The greater the setting value is, the longer the delay is and the slower the acceleration/deceleration is. The impact at the acceleration and deceleration will be eased, but the takt time will become longer.
Refer to 3.3.6 [1] Position command primary filter time Constant for the details of Pulse Train Control Mode.

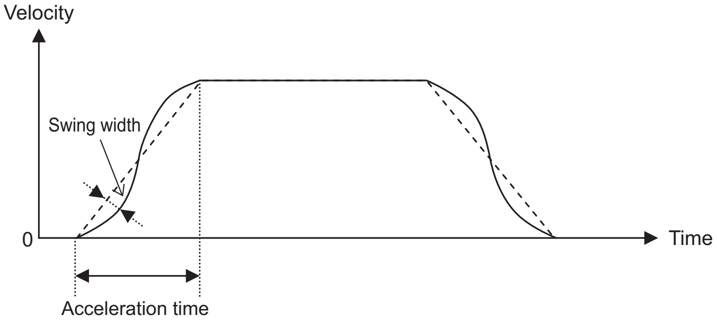


Chapter 8 I/O Parameter

[42] S-motion rate (Parameter No.56)

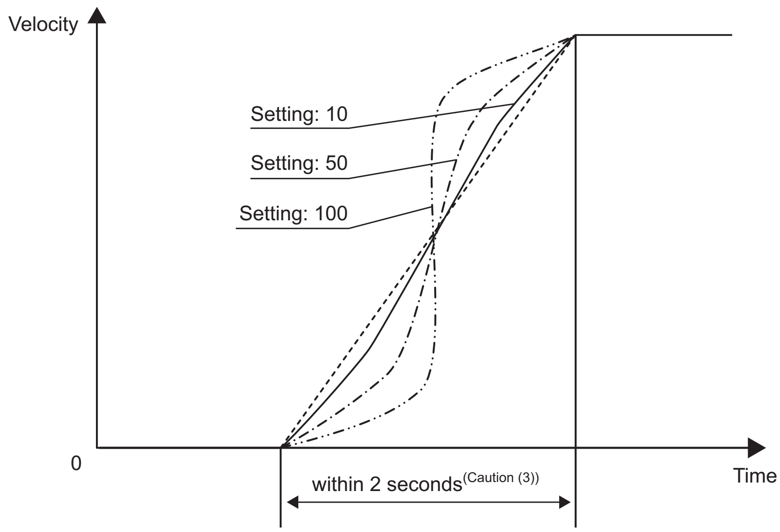
No.	Name	Symbol	Unit	Input Range	Default factory setting
56	S-motion rate	SCRV	%	0 to 100	0

This parameter is used when the value in the "Acceleration/deceleration mode" field of the position table is set to "1 [S-motion]".
This enables to ease the impact at acceleration and deceleration without making the takt time longer.



The S-motion is a sine curve that has the acceleration time as 1 cycle.
The level of its swing width can be set by this parameter.

Setting of Parameter No.56 [%]	Level of swing width
0 [Set in delivery]	No S-motion (Dotted line shown in the image below)
100	Sine curve swing width × 1 (Double-dashed line shown in the image below)
50	Sine curve swing width × 0.5 (Dashed line shown in the image below)
10	Sine curve swing width × 0.1 (Solid line shown in the image below)



Caution: (1) If the S-motion is specified in acceleration/deceleration mode, executing position command or direct value command while the actuator is moving causes an actuator to move along the trapezoid pattern. To change a speed during operation, be sure to specify such a position command while the actuator is in pause state.
(2) In the index mode of rotary actuator, the S-motion control is disabled. If S-motion acceleration/deceleration is specified, the trapezoid pattern is used in acceleration/deceleration mode.
(3) If acceleration time or deceleration time exceeds 2 seconds, do not specify S-motion control. The actuator will be the trapezoid operation.
(4) Do not perform temporary stop during acceleration or deceleration. The speed change (acceleration) may cause the dangerous situation.

[43] Torque limit (Parameter No.57)
This parameter is exclusively used for the pulse-train control mode.
[Refer to 3.3.6 Parameter Settings Required for Advanced Operations.]

[44] Deviation clear at servo OFF & alarm stop (Parameter No.58)
This parameter is exclusively used for the pulse-train control mode.
[Refer to 3.3.6 Parameter Settings Required for Advanced Operations.]

[45] Deviation error monitor during torque limiting (Parameter No.59)
This parameter is exclusively used for the pulse-train control mode.
[Refer to 3.3.6 Parameter Settings Required for Advanced Operations.]

[46] Deviation Counter Clear Input (Parameter No.60)
This parameter is exclusively used for the pulse-train control mode.
[Refer to 3.3.6 Parameter Settings Required for Advanced Operations.]

[47] Torque limit command input (Parameter No.61)
This parameter is exclusively used for the pulse-train control mode.
[Refer to 3.3.6 Parameter Settings Required for Advanced Operations.]

[48] Pulse count direction (Parameter No.62)
This parameter is exclusively used for the pulse-train control mode.
[Refer to 3.3.6 Parameter Settings Required for Advanced Operations.]

[49] Command Pulse Input Mode (Parameter No.63)
This parameter is exclusively used for the pulse-train control mode.
[Refer to 3.3.4 Settings of Basic Parameters Required for Operation.]

[50] Command Pulse Input Mode Polarity (Parameter No.64)
This parameter is exclusively used for the pulse-train control mode.
[Refer to 3.3.4 Settings of Basic Parameters Required for Operation.]

[51] Electronic Gear Numerator (Parameter No.65)
This parameter is exclusively used for the pulse-train control mode.
[Refer to 3.3.4 Settings of Basic Parameters Required for Operation.]

[52] Electronic Gear Denominator (Parameter No.66)
This parameter is exclusively used for the pulse-train control mode.
[Refer to 3.3.4 Settings of Basic Parameters Required for Operation.]

[53] Compulsory Stop Input (Parameter No.67)
This parameter is exclusively used for the pulse-train control mode.
[Refer to 3.3.6 Parameter Settings Required for Advanced Operations.]

[54] Feedback Pulse Output (Parameter No.68)
This parameter defines whether feedback pulse output is enabled or disabled.
[Refer to 3.3.6 Settings of Parameters Required for Applicable Operations.]

[55] Feedback Pulse Train (Parameter No.69)
This parameter defines the output pattern of feedback pulses.
[Refer to 3.3.6 Settings of Parameters Required for Applicable Operations.]

[56] Feedback Pulse Form Polarity (Parameter No.70)
Refer to 3.3.5 Output Settings of Feedback Pulse for the details. The setting is the same for the cases other than Pulse Train Control Mode.

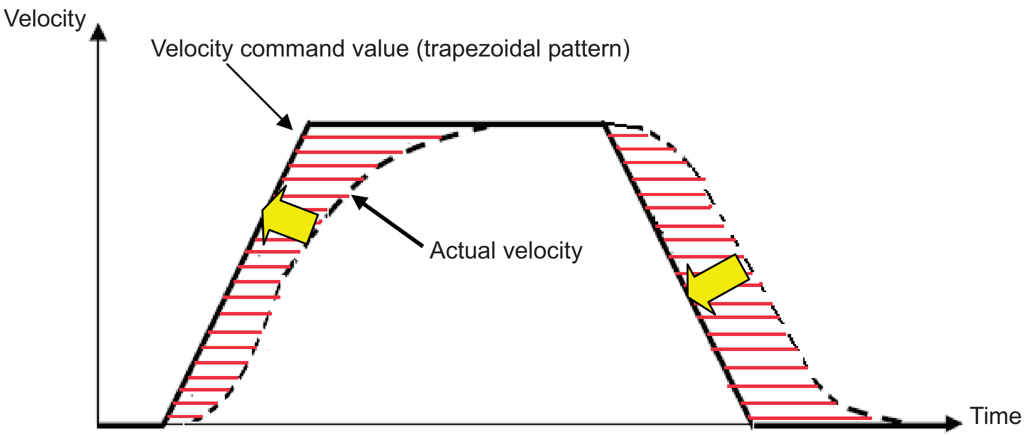
[57] Feed forward gain (Parameter No.71)

No.	Name	Symbol	Unit	Input Range	Default factory setting
71	Feed forward gain	PLFG	–	0 to 100	0

This parameter defines the level of feed forward gain to be applied to position control. Setting this parameter allows the servo gain to be increased and the response of the position control loop to be improved. This is the parameter to improve the takt time and traceability even more after fine-tuning the settings for “Servo Gain Number (Parameter No.7)”, “Velocity Loop Proportional Gain (Parameter No.31)”, etc. This can result in shorter positioning time. The gain adjustment of position, speed and current loop in feedback control can directly change the response of the servo control system. Thus, improper adjustment may cause the control system to be unstable and further vibrations and/or noises to occur. On the other hand, since this parameter only changes the speed command value and does not relate with the servo loop, it neither makes the control system unstable nor generate continuous vibrations and/or noises. However, excessive setting may generate vibrations and/or noises until the machine can follow command values in every operation.

In the trapezoidal pattern, adding the value resulting from multiplying the speed command by the feed forward gain to the speed command can reduce the delay of speed follow-up and the position deviation.

The feedback control providing control in accordance with the result causes control delay to occur. This conducts the supportive control independent from the control delay.



⚠Caution: Anti-vibration control function is unavailable when the feed-forward gain is used (with the settings except for 0).

Chapter 8 I/O Parameter

[58] Timer period for emergency stop relay fusing monitor (Parameter No.72)

No.	Name	Symbol	Unit	Input Range	Default factory setting
72	Timer period for emergency stop relay fusing monitor	EMWT	msec	0 to 60000	3000

This parameter defines the timer period in which fusing of the emergency stop relay for cutting off the motor drive power is detected.
If the motor AC power is not cut off after elapse of the timer period set by this parameter following the cutoff of the driver power, the control will recognize that the relay has been fused and generate an alarm.
Normally this parameter need not be changed. When a value between 0 and 9 is set, no fusing is detected.

[59] Encoder voltage level (Parameter No.73)

No.	Name	Symbol	Unit	Input Range	Default factory setting
73	Encoder voltage level	EVLV	–	0 to 3	Depending on encoder cable length

To stabilize encoder detection signals, this parameter defines the voltage supplied to the encoder circuit to one of four levels in accordance with the encoder type and the length of the encoder relay cable.
Normally this parameter need not be changed. If you have changed the length of the encoder relay cable after the shipment, the value of the parameter may be changed.
If you wish to change this parameter, always consult us in advance. If the setting is not optimum, it may cause an operation error of the actuator or malfunction of the encoder.

[60] PIO Power Supply Supervision (Parameter No.74)

No.	Name	Symbol	Unit	Input Range	Default factory setting
74	PIO Power Supply Supervision(Note1)	FPIO	–	0: Enabled 1: Disabled	0

A power monitor function is provided to prevent incorrect operations, burning of the I/O board and/or breakdown of parts caused by an abnormal voltage of the 24V DC for PIO power supply. This parameter can be disabled in certain situations such as when the controller is operated by a teaching tool without connection of PIO during trail operation for adjustments. Do not forget put it back to “0” (Valid) before starting the system operation after the test run for the adjustment is finished.

Set Value	Description
0	Enabled
1	Disabled

Note 1 The power monitoring will not be conducted no matter the settings for the Fieldbus types (CC-Link/DeviceNet, etc.).

[61] Electromagnetic brake power monitor (Parameter No.75)

No.	Name	Symbol	Unit	Input Range	Default factory setting
75	Electromagnetic brake power monitor	FSTP	–	0: Disabled 1: Enabled	In accordance with actuator

A power monitor function is provided to prevent actuator malfunction or breakdown of parts caused by an abnormal voltage of the 24V DC brake power supply when an actuator with brake is used.
Normally this parameter need not be changed because it has been set properly prior to the shipment in accordance with the actuator, i.e. whether or not the actuator is equipped with brake.

Set Value	Description
0	Disabled (no brake)
1	Enabled (with brake)

⚠Caution: If this parameter is set to "Disabled", no brake control is provided.

[62] Belt breaking sensor input polarity (Parameter No.76)

No.	Name	Symbol	Unit	Input Range	Default factory setting
76	Belt breaking sensor input polarity	AIOF	–	0 to 2	In accordance with actuator

Set the sensor input polarity for Alarm Code 0D7 "Belt Break Detection" for Ultra-High Thrust Type RCS2-RA13R.

Parameter No.		Set Value
76	not used	0
	Input is a contact	1
	Input is b contact	2

⚠Caution: Changing the setting of this parameter disables the alarm to be detected.

[63] Ball Screw Lead Length (Parameter No.77)

No.	Name	Symbol	Unit	Input Range	Default factory setting
77	Ball Screw Lead Length	LEAD	mm	0.01 to 999.99	In accordance with actuator

This parameter set the ball screw lead length.
The factory setting is the value in accordance with the actuator characteristics.

⚠Caution: If the setting is changed, not only the normal operation with indicated speed, acceleration or amount to move is disabled, but also it may cause a generation of alarm, or malfunction of the unit.

[64] Axis operation type (Parameter No.78)

No.	Name	Symbol	Unit	Input Range	Default factory setting
78	Axis operation type	ATYP	–	0: Line Axis 1: Rotary Axis	In accordance with actuator

This parameter defines the type of the actuator used.

Connected Actuator	Set Value	Reference
Line Axis	0	Actuator other than rotational axis
Rotary Axis	1	Rotary Axis (RS-30/60, RCS2-RT6/RT6R/RT7/RT7R/ RTC8L/RTC8HL/RTC10L/RTC12L)

⚠Caution: Do not change the setting of this parameter. Failure to follow this may cause an alarm or fault to occur.

[65] Rotary axis mode selection (Parameter No.79)

No.	Name	Symbol	Unit	Input Range	Default factory setting
79	Rotary axis mode selection	ATYP	–	0: Normal Mode 1: Index Mode	In accordance with actuator

This parameter defines the mode of the rotational axis.
When the axis operation type (Parameter No.78) is set to “Rotary Axis” and the index mode is selected, the current value indication is fixed to “0 to 359.99”. When the index mode is selected, the short course control is enabled.

Set Value	Description
0	Normal Mode
1	Index Mode

• The index mode cannot be specified for actuators of absolute specification.

(Note) With the rotational axes RS-30/60 and RCS2-RTC8L/RTC8HL/RTC10//RTC12L, the factory setting is “1” (index mode).
With the rotational axes RCS2-RT6/RT6R/RT7/RT7R, the factory setting is “0” (normal mode).

⚠Caution: When it is set to “Index Mode”, the push & hold operation is not available. Even when data is entered in the “Push & Hold” data box in the Position Data, it becomes invalid and normal operation is performed. The positioning width becomes the parameter’s default value for the positioning width.

[66] Rotational axis shortcut selection (Parameter No.80)

No.	Name	Symbol	Unit	Input Range	Default factory setting
80	Rotational axis shortcut selection	ATYP	–	0: Disabled 1: Enabled	In accordance with actuator

Select whether valid/invalid the shortcut when positioning is performed except for when having the relative position movement in the multiple rotation type rotary actuator.
The shortcut means that the actuator is rotated to the next position in the rotational direction of the smaller travel distance.

Set Value	Description
0	Disabled
1	Enabled

Refer to [Nearer Direction Control of Multi-Rotation Type Rotary Actuator] in 3.2.4 Operation with the Position No. Input = Operations of PIO Patterns 0 to 3 and 6.

[67] Fieldbus operation mode (Parameter No.84)

This parameter is exclusively used for the controller of field bus specification.
Check the relevant Instruction Manual of each field bus.

[68] Fieldbus Node Address (Parameter No.85)

This parameter is exclusively used for the controller of field bus specification.
Check the relevant Instruction Manual of each field bus.

[69] Fieldbus baud rate (Parameter No.86)

This parameter is exclusively used for the controller of field bus specification.
Check the relevant Instruction Manual of each field bus.

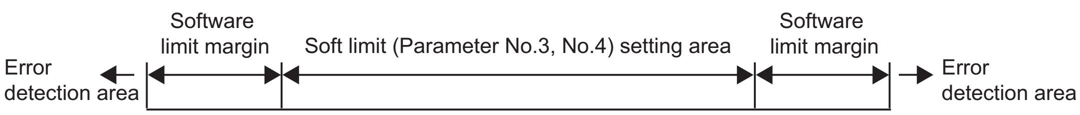
[70] Network Type (Parameter No.87)

This parameter is exclusively used for the controller of field bus specification.
Check the relevant Instruction Manual of each field bus.

[71] Software limit margin (Parameter No.88)

No.	Name	Symbol	Unit	Input Range	Default factory setting
88	Software limit margin	SLMA	mm (deg)	0 to 9999.99	0

This is the parameter to set the amount of over error detection against the soft limit errors set in Parameters No.3 and No.4.
It is not necessary to change the setting in normal use.



[72] Allowable time of exceeding torque allowing continuous pressing (Parameter No.89)

No.	Name	Symbol	Unit	Input Range	Default factory setting
89	Allowable time of exceeding torque allowing continuous pressing	PSCT	sec	0 to 300	In accordance with actuator

This is the parameter to limit the continuous pressing time when using RCS2-RA13R with the pressing setting of 71% or more.
When the unit is used beyond this limit, Alarm Code 0C4 “continuous pressing capable torque time over” will be generated to prevent the temperature rise on the motor due to the continuous pressing operation. [Refer to 10.4.2 Specifications and Limitations in Pressing Operation of RCS2-RA13R.]

Parameter No.89	Description
0	Do not judge
1 to 300sec	Allowable time of continuous pressing (when pressing setting of 71% or more is used in RCS2-RA13R)

[73] Fieldbus I/O format (Parameter No.90)

This parameter is exclusively used for the controller of field bus specification.
Check the relevant Instruction Manual of each field bus.

[74] Current limit value at stopping due to miss-pressing (Parameter No.91)

No.	Name	Symbol	Unit	Input Range	Default factory setting
91	Current limit value at stopping due to miss-pressing	FSTP	–	0: Current limit value during movement 1: Current limit value during pressing	0

This parameter defines the restricted current value at stopping due to miss-pressing.
This restricted current value locks the servo till the next moving command.

Parameter No.91	Description
0	Current limit value during movement (2.8 to 4 times of rating value depending on actuator characteristics)
1	Press-motion current-limiting value

[75] Use of loadcell (Parameter No.92)

No.	Name	Symbol	Unit	Input Range	Default factory setting
92	Use of loadcell	FFRC	–	0: Not Applicable 1: Use	0

This parameter defines whether the loadcell (option) is used or not.

Set Value	Description
0	Does not use the loadcell (when standard actuator)
1	Use the loadcell (For the actuator with the loadcell)

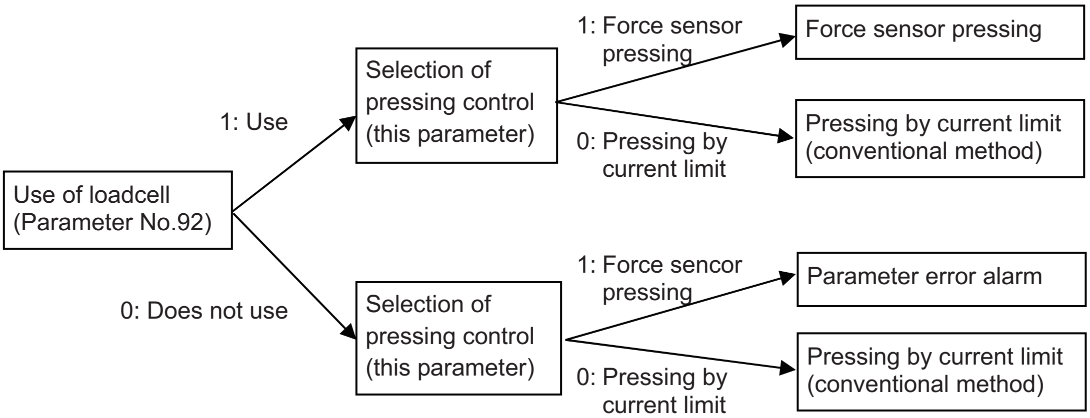
[Refer to 3.2.7 Pressing Operation Using Force Sensor Operation Ready.]

[76] Selection of pressing control (Parameter No.93)

No.	Name	Symbol	Unit	Input Range	Default factory setting
93	Selection of pressing control	FFRC	–	0: Current limit 1: Force sensor	0

This parameter defines the pressing method.

Set Value	Description
0	Pressing by current limit (when standard actuator)
1	Force sensor pressing (For the actuator with the loadcell)



[Refer to 3.2.7 Pressing Operation Using Force Sensor Operation Ready.]

[77] Pressing operation using force sensor gain (Parameter No.94)

No.	Name	Symbol	Unit	Input Range	Default factory setting
94	Pressing operation using force sensor gain	FRCG	–	100 to 30000	1500

This parameter defines the gain for pressing operation using force sensor. Normally this parameter need not be changed. The gain may be adjusted when the rigidity of the pressing target is extremely large or small.
The factory-set value is 1500.
The table below shows the relationship among the rigidity of pressing target, the response of pressing operation using force sensor system and pressing operation using force sensor gain.
Please contact IAI in case there is a necessity of changing this setting.

Reference setting value of pressing operation using force sensor gain

		Rigidity of pressing target Hard ← Rigidity → Soft					
Response of pressing operation using force sensor system	High ← Response → Low	500	…	750	…	1500	…
		⋮		⋮		⋮	
		1000	…	1500	…	3000	…
		⋮		⋮		⋮	
		1500	…	2250	…	4500	…
		⋮		⋮		⋮	

[78] Force judgment margin + / - (Parameter No.95, No.96)

No.	Name	Symbol	Unit	Input Range	Default factory setting
95	Force judgment margin +	FJMM	%	1 to Maximum Pressing Force	In accordance with actuator
96	Force judgment margin -	FJML	%	1 to Maximum Pressing Force	In accordance with actuator

This parameter defines the pressing force range in which the completion of pressing by pressing operation using force sensor is assumed (to output PEND).
[Refer to 3.2.4 [4] 2) or 3.2.5 [3] 2) Pressing operation using force sensor.]

[79] Damping characteristic coefficient 1, 2 / Natural frequency / Notch filter gain (Parameter No.97 to No.108)

This parameter is exclusively used for vibration suppress control.

	Name	Parameter No.
Parameter set 1	Damping characteristic coefficient 1	97
	Damping characteristic coefficient 2	98
	Natural frequency	99
	Notch filter gain	100
Parameter set 2	Damping characteristic coefficient 1	101
	Damping characteristic coefficient 2	102
	Natural frequency	103
	Notch filter gain	104
Parameter set 3	Damping characteristic coefficient 1	105
	Damping characteristic coefficient 2	106
	Natural frequency	107
	Notch filter gain	108

[Refer to Chapter 5 Vibration Suppress Control Function (Option) for details.]

[80] Default vibration suppress No. (Parameter No.109)

This parameter is exclusively used for vibration suppress control.
[Refer to Chapter 5 Vibration Suppress Control Function (Option).]

[81] Stop method at servo OFF (Parameter No.110)

This parameter defines how to stop the actuator at issue of servo OFF command, emergency stop or occurrence of an error (operation release level).

<table>
<tr><td rowspan="3">Stop Command</td><td colspan="4">Set Value</td></tr>
<tr><td colspan="2">0</td><td colspan="2">1</td></tr>
<tr><td>In Anti-Vibration Control Process(Note 1)</td><td>In Normal Position Control Process</td><td>In Anti-Vibration Control Process(Note 1)</td><td>In Normal Position Control Process</td></tr>
<tr><td>Pause</td><td>Vibration Control Deceleration and Stop(Note 1)</td><td>Normal Deceleration and Stop</td><td rowspan="4">Vibration Control Deceleration and Stop(Note 1)</td><td rowspan="4">Normal Deceleration and Stop</td></tr>
<tr><td>Servo OFF</td><td colspan="2" rowspan="3">Sudden stop due to emergency stop torque</td></tr>
<tr><td>Emergency Stop</td></tr>
<tr><td>Error (Operation Cancellation Level)</td></tr>
<tr><td>Error (Cold Start)</td><td colspan="4">Sudden stop due to emergency stop torque</td></tr>
</table>

Note 1 Anti-vibration control function is an optional item.

[82] Calendar function (Parameter No.111)

No.	Name	Symbol	Unit	Input Range	Default factory setting
111	Calendar function	FRTC	–	0: Does not use the calendar timer 1: Use the calendar timer	1

This parameter defines whether the calendar function (RTC) is used or not.
Set the current time with using a teaching tool when the calendar function is used.
[Refer to the instruction manual of the teaching tool for the details.]
In use of RTC, the alarm occurrence time in the alarm list is the time at which an alarm has occurred.
If RTC is not used, the time of alarm issuance shown in the alarm list counts the time passed since the power is supplied to the controller counted as 0 second.
The time data retainable duration with no power supply to the controller is approximately 10 days.

Set Value	Description
0	Unused
1	Use

[83] Monitoring mode (Parameter No.112)

No.	Name	Symbol	Unit	Input Range	Default factory setting
112	Monitoring mode	FMNT	–	0: Does not use 1: Monitor function 1 2: Monitor function 2	1

The controller can be connected with PC software to monitor the servo.
This parameter allows you to select a monitoring mode function (servo monitor).
Check the Instruction Manual of the RC PC software for details.

Set Value	Description
0	Unused
1	Sets the 4CH-30000 record mode.
2	Sets the 8CH-15000 record mode.

[84] Monitoring period (Parameter No.113)

No.	Name	Symbol	Unit	Input Range	Default factory setting
113	Monitoring period	FMNT	msec	1 to 100	1

This is the parameter to set up the frequency of time to obtain data (Sampling Frequency) when the monitoring mode is selected.
By setting the value in this parameter bigger, the frequency of data obtaining can be made longer.
It is set to 1ms in the initial setting. Up to 100ms can be set.

1ms frequency setting	100ms frequency setting
Up to 30 seconds in 4CH-30000 record mode	Up to 3000 seconds (50 minutes) in 4CH-30000 record mode
Up to 15 seconds in 8CH-15000 record mode	Up to 1500 seconds (25 minutes) in 8CH-15000 record mode

[85] Selecting used feedback pulse gear ratio (Parameter No.114)

No.	Name	Symbol	Unit	Input Range	Default factory setting
114	Selecting used feedback pulse gear ratio	FPIO	–	0: Not Applicable 1: Use	0

Refer to 3.3.5 Output Settings of Feedback Pulse when using the product with Pulse Train Control Mode.
Feedback pulse is available for the output also other than Pulse Train Control Mode. In this case, select “1”.

Set Value	Description
0	Outputs feedback pulses using the electronic gear ratio defined by parameter No.65 and 66 (command pulse-train) (initial value)
1	Outputs feedback pulses using the electronic gear ratio defined by parameter No.115 and 116.

[86] Electrical Gear (Feedback Pulse) (Parameter No.115, No.116)

No.	Name	Symbol	Unit	Input Range	Default factory setting
115	Electronic Gear Denominator	CDEN	–	1 to 4096	125
116	Electronic Gear Numerator	CNUM	–	1 to 4096	2048

Refer to 3.3.5 Output Settings of Feedback Pulse for the details.
The setting is the same for the cases other than Pulse Train Control Mode.

[87] Automatic loadcell calibration at start (Parameter No.117)

No.	Name	Symbol	Unit	Input Range	Default factory setting
117	Automatic loadcell calibration at start	FFRC	–	0: Does not perform 1: Perform	1

This parameter is exclusively used for pressing operation using force sensor.

Set Value	Description
0	Does not provide loadcell calibration automatically.
1	Provides loadcell calibration automatically. (initial value)

[Refer to 3.2.7 Pressing Operation Using Force Sensor Operation Ready.]

[88] Pressing operation without completion of loadcell calibration (Parameter No.118)

No.	Name	Symbol	Unit	Input Range	Default factory setting
118	Pressing operation without completion of loadcell calibration	FFRC	–	0: Disabled 1: Enabled	0

This parameter is exclusively used for pressing operation using force sensor.

Set Value	Description
0	Disables pressing operation if loadcell calibration is not completed yet. (initial value)
1	Enables pressing operation if loadcell calibration is not completed yet.

[Refer to 3.2.7 Pressing Operation Using Force Sensor Operation Ready.]

[89] Loadcell calibration time (Parameter No.119)

No.	Name	Symbol	Unit	Input Range	Default factory setting
119	Loadcell calibration time	CLBT	msec	1 to 9999	10

This parameter is exclusively used for pressing operation using force sensor. This parameter defines the adjustment data acquisition time in loadcell calibration. Normally, setting change is not necessary.
[Refer to 3.2.7 Pressing Operation Using Force Sensor Operation Ready.]

[90] Servo gain number 1 (Parameter No.120)

This parameter determines the response of the position control loop.
[Refer to description of Parameter No.7.]

[91] Feed forward gain 1 (Parameter No.121)

This parameter defines the feed forward gain of the position control system.
[Refer to description of Parameter No.71.]

[92] Velocity Loop Proportional Gain 1 (Parameter No.122)
This parameter determines the response of the speed control loop.
[Refer to description of Parameter No.31.]

[93] Velosity Loop Integral Gain 1 (Parameter No.123)
This parameter determines the response of the speed control loop.
[Refer to description of Parameter No.32.]

[94] Torque Filter Time Constant 1 (Parameter No.124)
This parameter decides the filter time constant for the torque command.
[Refer to description of Parameter No.33.]

[95] Current control width number 1 (Parameter No.125)
This parameter defines the control width of the current control system.
[Refer to description of Parameter No.54.]

[96] Servo gain number 2 (Parameter No.126)
This parameter determines the response of the position control loop.
[Refer to description of Parameter No.7.]

[97] Feed forward gain 2 (Parameter No.127)
This parameter defines the feed forward gain of the position control system.
[Refer to description of Parameter No.71.]

[98] Speed Loop Proportional Gain 2 (Parameter No.128)
This parameter determines the response of the speed control loop.
[Refer to description of Parameter No.31.]

[99] Speed Loop Integral Gain 2 (Parameter No.129)
This parameter determines the response of the speed control loop.
[Refer to description of Parameter No.32.]

[100] Torque Filter Time Constant 2 (Parameter No.130)
This parameter decides the filter time constant for the torque command.
[Refer to description of Parameter No.33.]

[101] Current control width number 2 (Parameter No.131)
This parameter defines the control width of the current control system.
[Refer to description of Parameter No.54.]

[102] Servo gain number 3 (Parameter No.132)
This parameter determines the response of the position control loop.
[Refer to description of Parameter No.7.]

[103] Feed forward gain 3 (Parameter No.133)
This parameter defines the feed forward gain of the position control system.
[Refer to description of Parameter No.71.]

[104] Velocity Loop Proportional Gain 3 (Parameter No.134)
This parameter determines the response of the speed control loop.
[Refer to description of Parameter No.31.]

[105] Velocity Loop Integral Gain 3 (Parameter No.135)
This parameter determines the response of the speed control loop.
[Refer to description of Parameter No.32.]

[106] Torque Filter Time Constant 3 (Parameter No.136)
This parameter decides the filter time constant for the torque command.
[Refer to description of Parameter No.33.]

[107] Current control width number 3 (Parameter No.137)
This parameter defines the control width of the current control system.
[Refer to description of Parameter No.54.]

[108] Servo gain switchover time constant (Parameter No.138)

No.	Name	Symbol	Unit	Input Range	Default factory setting
138	Servo gain switchover time constant	GCFT	ms	10 to 2000	10

When a switchover of the servo gain set is commanded in the position table, the switchover process is completed after time more than 3 times of the time spent in the setting of this parameter is passed since the operation of the commanded position number has started.

⚠Caution: A time constant being rather short may cause the servo gain to change rapidly to have the operation of the actuator unstable.

[109] Home preset value (Parameter No.139)

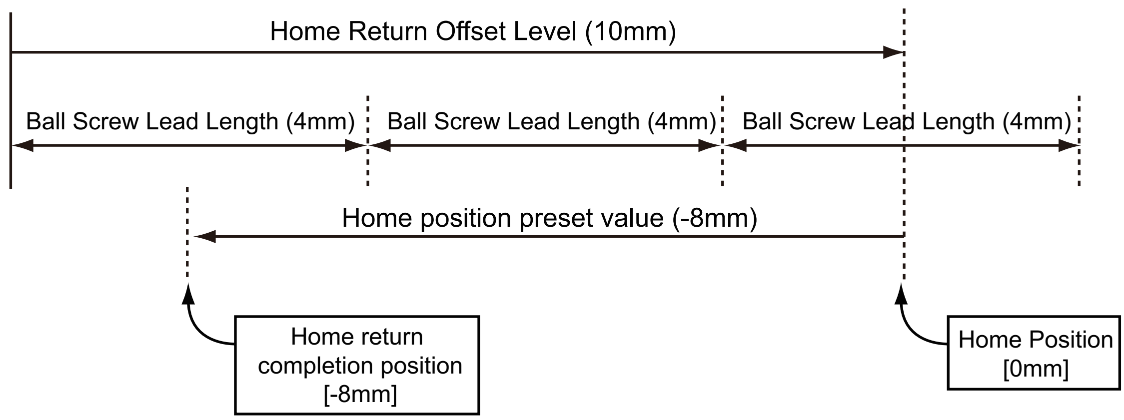
No.	Name	Symbol	Unit	Input Range	Default factory setting
139	Home preset value	PRST	mm	-9999.99 to 9999.99	In accordance with actuator

For the actuator of absolute specification, set this parameter so that (home return offset + value of this parameter) is within the range between 0 and the ball screw lead.
The value should be an integer multiple of ±(ball screw lead length) including 0.00.
(If the home return offset is within the range between 0 and ball screw lead length, the value of this parameter is 0.00.)
When this parameter is set to a value other than 0.00, the home return complete position is determined by calculating (home position + position set by this parameter)

> ⚠ Caution: If the above condition is not satisfied, the home position at restart after home return may shift by an integer multiple of the ball screw lead.

For the actuator of incremental specification, always set this parameter to 0.00.

<Setting example 1>
With ball screw lead length 4mm and home return offset level 10mm, set this parameter to -8mm.



[110] IP Address (Parameter No.140)

No.	Name	Symbol	Unit	Input Range	Default factory setting
140	IP Address	IPAD	–	0.0.0.0 to 255.255.255.255	192.168.0.1

It is the parameter dedicated for Fieldbus (EtherNet/IP).
[For details, refer to Fieldbus Instruction Manual.]

[111] Subnet Mask (Parameter No.141)

No.	Name	Symbol	Unit	Input Range	Default factory setting
141	Subnet Mask	SNMK	–	0.0.0.0 to 255.255.255.255	255.255.255.0

It is the parameter dedicated for Fieldbus (EtherNet/IP).
[For details, refer to Fieldbus Instruction Manual.]

[112] Default Gateway (Parameter No.142)

No.	Name	Symbol	Unit	Input Range	Default factory setting
142	Default Gateway	DFGW	–	0.0.0.0 to 255.255.255.255	0.0.0.0

It is the parameter dedicated for Fieldbus (EtherNet/IP).
[For details, refer to Fieldbus Instruction Manual.]

[113] Overload Level Ratio (Parameter No. 143)

No.	Name	Symbol	Unit	Input Range	Default factory setting
143	Overload Level Ratio	OLWL	%	50 to 100	100

With the motor temperature of when an operation is held at the rating being set as 100%, the overload warning (message level) is output when the motor temperature exceeds the rate set in this parameter.
The judgment would not be made if the value is set to 100%.

[114] Total Movement Count Threshold (Parameter No.147)

No.	Name	Symbol	Unit	Input Range	Default factory setting
147	Total Movement Count Threshold	TMCT	Times	0 to 999999999	0(Disabled)

An alarm is generated when the total movement count exceeds the value set to this parameter.
The judgment would not be made if the value is set to 0.

[115] Total Operated Distance Threshold (Parameter No.148)

No.	Name	Symbol	Unit	Input Range	Default factory setting
148	Total Operated Distance Threshold	ODOT	m	0 to 999999999	0(Disabled)

An alarm is generated when the total operation distance exceeds the value set to this parameter.
The judgment would not be made if the value is set to 0.

[116] Zone Output Changeover (Parameter No.149)

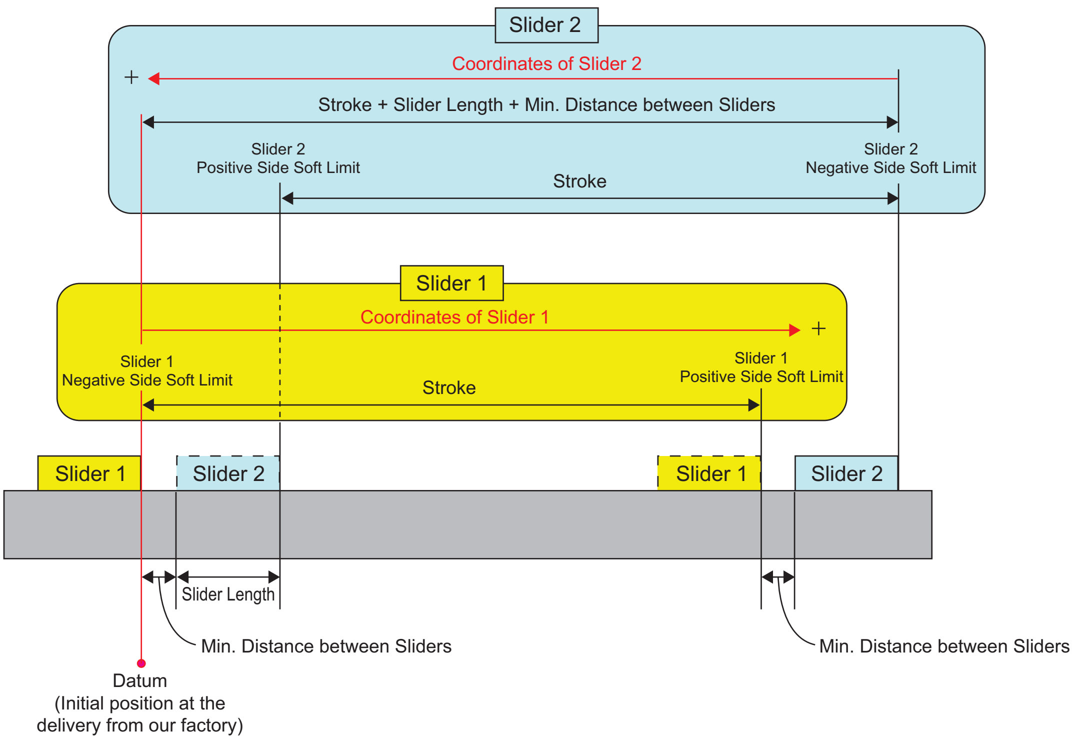
No.	Name	Symbol	Unit	Input Range	Default factory setting
149	Zone Output Changeover	FPIO		0: Not to change 1: To change	0

When there is PZONE signal to the current PIO pattern or the Fieldbus Operation Mode and no ZONE1 or ZONE2 signal, it is available to change the PZONE signal to either ZONE1 or ZONE2 signal.
(Note 1) ZONE1 signal is assigned prior to ZONE2 signal.
(Note 2) It would not function in the pulse train mode.
(Note 3) In the case there is no PZONE signal in PIO patterns, or both ZONE1 and ZONE2 signals exist, the setting would be invalid.

[117] Linear Absolute Home Preset Value (Parameter No.150)

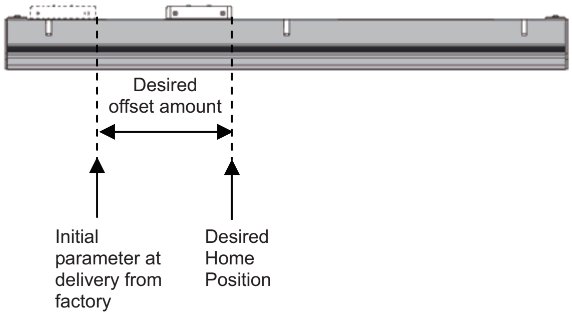
No.	Name	Symbol	Unit	Input Range	Default factory setting
150	Linear Absolute Home Preset Value	LAPS	mm	-9999.99 to 9999.99	In accordance with actuator

This can set the home position of the actuator for Spurious Absolute Type.
The diagram below shows the position of each part related to the datum (the initial position at the delivery from our factory):

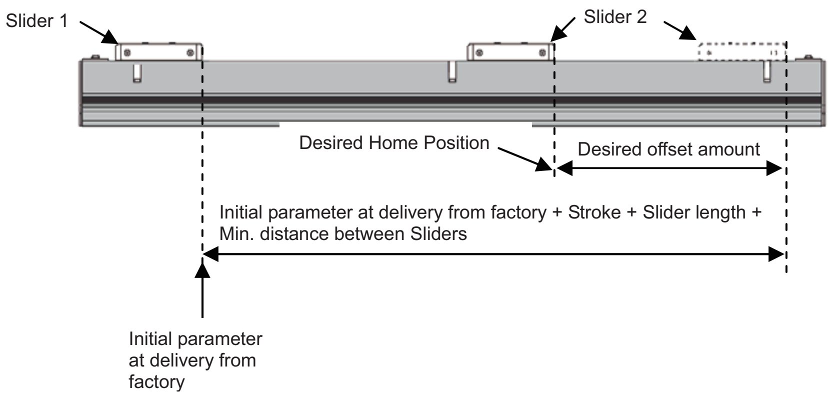


(Note 1) Note the initial parameter at the delivery from our factory in a memo before changing the settings.
(Note 2) Take the initial parameter at the delivery from our factory as the datum when giving a change to the settings.
(Note 3) After having a change to the settings, make sure to have an operation check with low speed.

When a change is required to the home position, do a calculation following the formula below and input the calculated value to the parameter.
1) Setting for Single Slider Type:
Parameter setting value = Initial parameter at delivery from factory (Parameter No.150) + Desired offset amount



2) Setting on Slider 2 for Double Slider Type (Refer to 1) for Slider 1):
Parameter setting value = [Initial parameter at delivery from factory (Parameter No.150) + Stroke (value indicated when purchased) + Slider length (value shown in catalog) + Min. distance between Sliders (value shown in catalog)] – Desired offset amount



(Note 4) For the spurious absolute type actuator, No.22: Home-return Offset Value and No.139: Home Preset Value are invalid.
For the actuators other than the spurious absolute type, this parameter is invalid.

[118] Light Error Alarm Output Select (Parameter No.151)

No.	Name	Symbol	Unit	Input Range	Default factory setting
151	Light Error Alarm Output Select	FSTP		0: Battery Voltage Drop Warning Output 1: Output of battery voltage drop warning or message-level alarm	0

It can be selected if an output is to be made when a message-level alarm is generated as well as when the battery voltage drop error is occurred for the output condition of BALM signal.
(Note) For Pulse Train Mode, by setting this parameter to "1", OUT12 becomes the ALML (Light Error Alarm) signal and outputs when a message-level alarm is generated.

8.3 Servo Adjustment

The parameters are preset at the factory before shipment so that the actuator operates stably within the rated (maximum) transportable weight.
However, the preset setting cannot always be the optimum load condition in the actual use. In such cases, servo adjustment may be required.
This section describes the basic servo adjustment method.

⚠ Caution:	Rapid and excessive settings are dangerous. They may devices including the actuator to be damaged and/or people to be injured. Take sufficient note on the setting. Record settings during servo adjustment so that prior settings can always be recovered. When a problem arises and the solution cannot be found, please contact IAI.

No.	Situation that requires adjustment	How to Adjust
1	Takes time to finish positioning Positioning accuracy is not appropriate Shorter takt time is desired	• Set Parameter No.55 “Position command primary filter time constant” to “0” if it is set. • Increase the value of Parameter No.7 “Servo gain number”. By setting a larger value, the follow-up ability to the position command becomes better. Set the value to any of 3 to 10 roughly or up to 15 at the maximum. If the value is too large, an overshoot is caused easily and may cause noise or vibration. If the value of Parameter No.7 “Servo gain number” is increased, also adjust the Parameter No.31 “Speed loop proportional gain” in increasing direction to ensure the stability in the control system. To increase the value of Parameter No.31 “Speed loop proportional gain” by about 20% of the default. Prior to the setting, adjust Parameter No.7 “Servo gain number”.
2	Vibration is generated at acceleration/deceleration	• The cause of the problem is excessive "acceleration/deceleration setting" or vulnerable structure of the unit on which the actuator is installed. If possible, reinforce the unit itself, first. • Decrease the values of “acceleration/deceleration setting”. • Decrease the number of Parameter No.7 “Servo gain number”. If the Parameter No.7 “Servo gain number” is too low, it takes long time to finish the positioning.
3	Speed is uneven during the movement Speed accuracy is not appropriate	• Increase the value of Parameter No.31 “Speed loop proportional gain”. By setting a larger value, the follow-up ability to the speed command becomes better. Setting too large value makes the mechanical components easy to vibrate. As a reference for the setting, increase the value little by little by 20% from the initial setting.
4	Abnormal noise is generated. Especially, when stopped state and operation in low speed (less than 50mm/sec), comparatively high noise is generated.	• Input the “Torque Filter Time Constant”. Try to increase by 50 as a reference for the setting. If the setting is too large, it may cause a loss of control system stability and lead the generation of vibration. [Important] Prior to Adjustment: This phenomenon is likely to occur when the stiffness of the mechanical components is not sufficient. The actuator itself may also resonate if its stroke is over 600mm or it is belt-driven type. Before having an adjustment, check if: 1) The value for Parameter No.7 “Servo gain number”, Parameter No.31 “Speed loop proportional gain”, or Parameter No.32 “Speed loop integral gain” are excessive. 2) The stiffness of the load is sufficient as much as possible, or the attachments are not loosened. 3) The actuator unit is mounted securely with a proper torque. 4) There is no waviness on the actuator mounting surface.

No.	Situation that requires adjustment	How to Adjust
5	Trace precision is desired to be improved. Equi-speed performance is desired to be improved. Response is desired to be improved.	• Make the condition optimized with Parameter No.7 "Servo gain number" and Parameter No.31 "Velocity loop proportional gain" adjusted by referring to the way to adjust stated in No. 1 to 3 in the previous page. [Reference] The most important factor is to select the actuator (motor). The servo is extremely sensitive to the inertia of the load. If the inertia moment of the load is too large in comparison with the inertia moment of the servo motor itself, the motor is highly affected by the load. This may cause the actuator to be controlled unstably. Therefore, to improve the precisions of the trace, position, speed and response of the actuator, the load inertia ratio must be made small. For high trace precision, equi-speed performance, and response of the actuator in such a use as application, it is better to use ball screws with small leads in the actuator as much as possible and an actuator of motor capacity higher by at least one level. The best method is to calculate the load inertia to select the proper actuator.
6	Large static friction of load makes actuator start slowly. Large load inertia makes response of actuator low at start and stop. Takt time is desired to be shortened.	• Set parameter No.71 "Feed forward gain". Select a value in the range from 10 to 50 roughly. The larger the setting value is, the smaller the deviation is. Then the response is improved. Setting a large value may cause vibrations and/or noises to occur. Set the feed forward gain in order to improve the response of the actuator further after adjusting Parameter No.7 "Servo gain number" and Parameter No.31 "Speed loop proportional gain".
7	(Pulse train control) An abnormal noise is generated in acceleration/deceleration and Alarm Code 0D8 "Deviation Overflow" is issued and stopped. There is an impact at the start or stop.	• Change the setting in Parameter No.55 "Position command primary filter time constant" to approximately 50ms. If there is no improvement in situation, try to increase the setting gradually. If there is an improvement, try to decrease the setting gradually to the boundary. Making a change to this setting will make the settling time longer thus the takt time also becomes longer. The accuracy for the positioning also becomes worse. It is recommended, to solve the problem from the root cause, to replace the host positioning unit with one that is equipped with acceleration/deceleration function. [Important] • There is a case that the acceleration/deceleration setting of the host controller (PLC) to output the pulse train is not appropriate, or the host controller is not equipped with this type of function. Tune the setting to the appropriate one (in the range it does not exceed the actuator acceleration/deceleration capability) if there is the acceleration/deceleration function. If there is not, tune the setting by using Parameter No.55.

Chapter 9 Troubleshooting

9.1 Action to Be Taken upon Occurrence of Problem

Upon occurrence of a problem, take an appropriate action according to the procedure below in order to ensure quick recovery and prevent recurrence of the problem.

1) Check the status indicator LEDs on the controller.

LED	Indication	Status
PWR	Green Light is turned ON.	System ready (normal CPU operation)
	OFF	Power OFF
SV	Green Light is turned ON.	Servo ON (Operation Available)
	Flashing in green	Automatic servo is OFF
	OFF	Servo OFF
ALM	Orange Light is turned ON.	Occurrence of alarm (operation release or cold start level alarm)
EMG	Red Light is turned ON.	Emergency stop condition (regardless of alarms)

2) Check whether an alarm occurs on the host controller (PLC, etc.).
3) Check the voltage of the main power supply.
4) Check the voltage of power supply for the PIO.
5) Check the voltage of the power supply for brake (For the actuator with the brake).
6) Alarm Check(Note1)
Check the alarm code on the teaching tool such as PC software.
7) Check the connectors for disconnection or connection error.
8) Check the cables for connection error, disconnection or pinching.
Before performing a continuity check, turn off the power (to prevent electric shocks) and disconnect the cables of measuring instruments (to prevent accidental power connection due to sneak current path).
9) Check the I/O signals.
Using the host controller (PLC, etc.) or a teaching tool such as PC software, check the presence of inconsistency in I/O signal conditions.
10) Check the noise elimination measures (grounding, installation of surge killer, etc.).
11) Check the events leading to the occurrence of problem(Note 1), as well as the operating condition at the time of occurrence.
12) Analyze the cause.
13) Treatment

Note1: If parameter No. 111 (Selection of using calendar function) is set to “1” (use), it is possible to know the date and time at which the alarm occurred.
Set the date and time from the teaching tool such as PC software at the first power-on of the controller.
The date and time data set once is retained for about 10 days if the power supply of the controller is OFF. Unless the setting is conducted or the clock data is lost, the clock shows 00/01/01 00:00:00 when the power is turned ON. Even if the date and time data is lost, the generated error code is retained.
Alarms subject to this function only include those in 9.4 Alarm but do not include errors in the teaching tool such as PC software.

> ! Request:
> In troubleshooting, exclude normal portions from suspicious targets to narrow down the causes. Check 1) to 11) described above before contacting us.

9.2 Fault Diagnosis

This section describes faults largely divided into three types as follows:
(1) Impossible operation of controller
(2) Positioning and speed of poor precision (incorrect operation)
(3) Generation of noise and/or vibration

9.2.1 Impossible operation of controller

Situation	Possible cause	Check/Treatment
At power-on, PWR on the status indicator LEDs does not go ON.	Proper power is not supplied.	Check the voltage. If the PWR LED does not go on despite normal power voltage and correct wiring, Please contact IAI. [Refer to 2.3.1 Wiring of Power Circuit.]
EMG on the status indicator LEDs lights.	During emergency-stop. 1) Was the emergency-stop switch. 2) The emergency stop release circuit is OFF to make the connection between EMG+ and EMG- of the system I/O connector open. 3) EMG+/- of the system I/O connector are not connected.	1) Release the emergency stop switch. 2) Check the emergency stop circuit. 3) Check the wiring of system I/O. [Refer to 2.3.2 Wiring for Emergency Stop Circuit.]
ALM in the status display LEDs turns on when the power is supplied.	Occurrence of alarm	Check the error code with the teaching tool being connected and remove the cause by referring the alarm list. [Refer to 9.4 Alarm List.]
The host controller (PLC) sends servo ON signal to the controller, but SV LED does not go ON. - - - - - - - - The host controller (PLC) cannot control PIO (24V DC I/O).	PIO signal communication is disabled. 1) 24V DC power for PIO is not supplied. 2) Poor contact of flat cable 3) The operation mode setting switch on the front panel is on “MANU” side. 4) The +/- pins of 24V DC power for PIO are connected inversely.	1) Check the PIO power voltage. If a single power supply is connected with large load, the power supply voltage may drop or the output may be shut down depending on power units. 2) Are the PIO cable connectors inserted to the mating connectors securely? Check the input signals on the I/O monitor of the teaching tool such as PC software. ⚠Caution In I/O cable conduction check, do not widen female pins of the connectors. Failure to follow this may cause poor contact. 3) Can such operation as jogging be performed from the teaching tool such as PC software? Set the operation mode setting switch on the front panel and restart the controller. [Refer to Name for Each Parts and Their Functions.] 4) Reverse connection of the PIO power supply does not affect the input circuit but makes the output circuit faulty. Check if the I/O of the host controller (PLC) operates normally.

[In the case of Positioner Mode]

Situation	Possible cause	Check/Treatment
Both position No. and start signal are input to the controller, but the actuator does not move.	There is a problem either in PIO signal treatment, position table setting or operation mode selection. 1) Servo OFF condition 2) The pause signal is OFF. 3) Positioning command is issued to a stop position. 4) There is no positioning data set to the commanded position number.	1) Is the status display LED SV turned ON? [Refer to Name for Each Parts and Their Functions] Turn ON the servo-on signal SON of PIO. 2) Operation is available when PIO pause signal *STP is ON and pause when it is OFF. Turn it ON. 3) Check the sequence or the settings of the position table. 4) It will generate Alarm Code 0A2 “Position Data Error”. Conduct the position table setting.

(Note) Refer to 2.1.3 [5] PIO Circuit for PIO signal.

[In the case of Pulse String Control Mode]

Situation	Possible cause	Check/Treatment
In spite of inputting pulse-train to the controller, the actuator does not move.	PIO signal processing or parameter setting is incorrect. 1) Servo OFF state 2) The pause signal is OFF. 3) The pulse-train type, a parameter, is selected incorrectly. 4) The positive/negative logic of pulse-train, a parameter, is selected inversely. 5) The unit moving distance per pulse, which is a setting condition of electronic gear ratio, a parameter, is too small.	1) Is the status display LED SV turned ON? [Refer to Name for Each Parts and Their Functions] Turn ON the servo-on signal SON of PIO. 2) Operation is available when PIO pause signal *STP is ON and pause when it is OFF. Turn it ON. 3) Check the pulse train type. [Refer to 3.3.4 [2] Format Settings of Command Pulse Train.] 4) Check the positive/negative logic of pulse-train. (Host units supplied by some manufacturers have positive/negative logic opposite to our logic. Reserve the logic setting and try the operation.) [Refer to 3.3.4 [2] Format Settings of Command Pulse Train.] 5) Do not make the unit moving distance less than the resolution of the encoder. The actuator does not move unless pulses by the resolution of the encoder are input. [Refer to Caution in 3.3.4 [1] Electrical Gear Setting] (Note) In case of 3) or 4), the actuator may not sometimes operate smoothly. You may not find case 5) when the actuator is moved for a long distance at a high frequency.

(Note) Refer to 2.2.3 [5] PIO Circuit for PIO signal.

[Startup Adjustment with Teaching Tool when Control Circuit Incomplete]

Situation	Possible cause	Check/Treatment
Operation is not performed even though the teaching tool is connected, and power to the controller motor and control circuit is supplied. (the emergency stop switch is released on the teaching pendant)	Cable treatment or mode selection 1) Emergency stop condition The status display LED EMG is ON. It is not connected between EMG + and -. 2) Servo OFF condition 3) In pause	1) Make a short circuit between EMG + and -. ⚠ Warning If the process of 1) is conducted, put back the setting as soon as the adjustment work is finished. Starting the operation without putting it back may cause a serious accident since the emergency stop is set invalid. 2) 3) Put the operation mode switch on the front panel of the controller to “MANU” side, and select the teach mode on the teaching tool.

9.2.2 Positioning and speed of poor precision (incorrect operation)

Situation	Possible cause	Check/Treatment
Completion of operation on the way to home return	In the home return of our standard specification, the actuator is first pressed to the mechanical end, moved oppositely, and subject to positioning stop at the home position. Therefore, the product may judge as the mechanical end even though it is still on the way when the load is large and interfere with surrounding object. 1) A load exceeding its rating weight is installed on the actuator. 2) It is touched to interference in the way of the run. 3) Torsion stress is applied to guide due to improper fixing method of the actuator or uneven fastening of bolts. 4) The sliding resistance of the actuator itself is large.	1) Reduce the load. 2) Remove the interference. 3) Loosen the fixing bolts once and check whether the slider can move smoothly. If the slider can move smoothly, check if there is a deformation on the attached surface, and install the actuator again following the instructions stated in Instruction Manual. 4) Please contact IAI.
Shocks at start and/or stop.	Acceleration/deceleration is set too high.	Decrease the settings of acceleration/deceleration.
Overshoot during deceleration to stop.	The load inertia is large.	Decrease the setting of deceleration. [Refer to 9.3.]
Positioning of poor precision	[Refer to 8.3 Servo Adjustment.]	
Uneven speed during movement		
Acceleration/deceleration not smooth (bad speed response)		
Trace of poop precision	(Note) When the pulse-train operation mode is selected, first adjust pulse-train commands.	

[In the case of Positioner Mode]

Situation	Possible cause	Check/Treatment
Positioning at a position different from that of commanded position No.	PIO signal processing is incorrect. 1) Start signal CSTR is input too early after position No. command. Or position No. command and start signal are input concurrently. 2) The correct position No. is not specified due to PIO signal disconnection or poor connector contact.	1) The stop position may be set for another purpose. Input the start signal after the controller fully reads the position number. [Refer to 3.2.4 Operation with the Position No. Input = Operations of PIO Patterns 0 to 3. Creating Sequence Program.] 2) Check the input signal on I/O monitor on the teaching tool.
Complete signal PEND is not output even though positioning process is completed.	PIO signal processing is incorrect. 1) Start signal CSTR is not turned OFF.	1) Make the start signal CSTR turned OFF before completing the positioning process by the turn-off of positioning complete signal PEND after starting operation, and so on.

[In the case of Pulse String Control Mode]

Situation	Possible cause	Check/Treatment
The actuator does not stop at the command position.	PIO signal processing or parameter setting is incorrect. 1) Incorrect electronic gear ratio 2) Acceleration/deceleration is set incorrectly in the host controller. 3) Noise 4) The pulse-train type, a parameter, is selected incorrectly. 5) The unit moving distance per pulse, which is a setting condition of electronic gear ratio, a parameter, is too small.	1) Check the setting of electronic gear ratio. The host controller also has the electronic gear ratio parameter. Set the electronic gear ratio not to be inconsistent with that of the host controller. In addition, reduce the electronic gear ratio as much as possible. If not, data overflow may occur in arithmetic processing to disable correct positioning. [Refer to 3.3.4 [1] Electrical Gear Setting.] 2) The actuator operates at the speed and acceleration/deceleration based on the frequency of input pulses. Check if the acceleration/deceleration set in the host controller exceed the rating acceleration/deceleration of the actuator. 3) Noise can be misread as the pulse if it jumps into the pulse train. Take proper measures against noise. [Refer to 1.7 Noise Elimination and Mounting Method.] Check the cable connection between the controller and AK-04 if AK-04 is used. • Cable length : 50mm or shorter recommended (as short as possible) • Shield treatment : Use the shield treatment wire. 4) Check the pulse-train type. [Refer to 3.3.4 [2] Format Settings of Command Pulse Train.] 5) Do not make the unit moving distance less than the resolution of the encoder. The actuator does not move unless pulses by the resolution of the encoder are input. [Refer to Caution in 3.3.4 [1] Electrical Gear Setting] (Note) In case of 2) or 3), the actuator may not sometimes operate. You may not find case 4) when the actuator is moved for a long distance at a high frequency.
There is an impact at start or stop	[Refer to 8.3 Servo Adjustment No.7]	

9.2.3 Generation of noise and/or vibration

Situation	Possible cause	Check/Treatment
Generation of noise and/or vibration from actuator itself	Noise and vibration are generated by many causes including the status of load, the installation of the actuator, and the rigidity of the unit on which the actuator is installed.	Servo adjustment may improve the situation. [Refer to 8.3 Servo Adjustment.]

[In the case of Positioner Mode]

Situation	Possible cause	Check/Treatment
Vibrations of load	1) Acceleration/deceleration is set too high. 2) The installation structure and/or the installed load are easily affected by acceleration/deceleration.	1) Decrease the settings of acceleration/deceleration. Set S-shape acceleration/deceleration. [Refer to 8.2 [42] S-motion rate.] 2) Use the vibration suppress control function. [Refer to Chapter 5.]

[In the case of Pulse String Control Mode]

Situation	Possible cause	Check/Treatment
Vibrations of actuator or load	Acceleration/deceleration is set too high.	Decrease the setting of acceleration/deceleration in the host controller or set S-shape acceleration/deceleration.
Generation of noise during acceleration	The host controller has no acceleration/deceleration function or does not have acceleration/deceleration function from speed 0. (Some positioning units have acceleration/deceleration function but cannot use the function from speed 0. Note this when you select a positioning unit.)	[Refer to 8.3 Servo Adjustment No.7]

9.2.4 Impossible Communication

Situation	Possible cause	Check/Treatment
• Not connectable with host machine • Not connectable with ROBONET	1) Communication rates do not match. 2) The machine number (station number) is set to be duplicate with that of another unit or out of the range. 3) Parameter No.17 "Minimum delay time for slave transmitter activation" is set incorrectly. 4) Poor wiring or disconnection of communication cable	1) Set the communication rate to match that of the host machine. [Refer to the Instruction Manual of the host unit.] 2) Correct the unit number (station number) setting. Machine numbers (station numbers) vary depending on communication modes. Refer to the Instruction Manual of each communication mode.(Note 1) 3) If the host device is that other than ROBONET and RS485 is used, and the host is in the response timeout error, adjust Parameter No.17 to a smaller value (2 as reference). In any other cases, increase or decrease the value at will to change the send/receive timing. (If the operation is performed properly, the transmission cycle of the host is too fast. Always check the response of SCON before next transmission.) If the controller is connected to ROBONET, set the value or parameter No.17 to "2". (Refer to the Instruction Manual of ROBONET [separate volume].) If the controller is connected to each of field buses (other than RS485), it is unnecessary to take the value of parameter No.17 into account. 4) Review the wiring again. Check if termination resistances are connected to network terminals with correct values.

(Note 1) Refer to the following Instruction Manual for communications:
- RS485 ······················ Section 10.1
- DeviceNet ················· DeviceNet Instruction Manual (separate volume)
- CC-Link ···················· CC-Link Instruction Manual (separate volume)
- PROFIBUS················ PROFIBUS Instruction Manual (separate volume)
- CompoNet················· CompoNet Instruction Manual (separate volume)
- MECHATROLINK······· MECHATROLINK Instruction Manual (separate volume)
- EtherCAT ·················· EtherCAT Instruction Manual (separate volume)
- EtherNet/IP ··············· EtherNet/IP Instruction Manual (separate volume)
- ROBONET ················· ROBONET Instruction Manual (separate volume)

9.3 Alarm Level

The alarms are classified to 3 types of levels by the content of the error.

Alarm level	ALM lamp	*ALM signal	Status when an error occurred	Cancellation method
Message	OFF	No output	No stop	Alarm from teaching tool such as PC software [Refer to Instruction Manual of each tool for details.]
Operation release	ON	Output	Servo OFF after deceleration to stop	Reset the alarm by the PIO or teaching tool.
Cold start	ON	Output	Servo OFF after deceleration to stop	Software reset or power reconnection by teaching tool. Home return is required for any actuators of other than absolute specification.

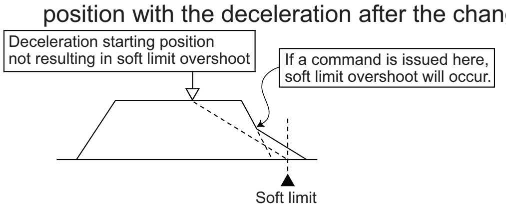
⚠ Caution: Reset each alarm after identifying and removing the cause.
If the cause of the alarm cannot be removed or when the alarm cannot be reset after removing the cause, please contact IAI.
If the same error occurs again after resetting the alarm, it means that the cause of the alarm has not been removed.

9.4 Alarm List

Alarm Code	Alarm Level	Alarm Name	Cause/Treatment
02E	Message	Calendar function related command in calendar function invalid status	Cause : An attempt was made to use the calendar in the state where the RTC (calendar) function was made ineffective. Treatment : Set parameter No.111 (Selection of use of calendar function) to "1" ("0": no use).
048		Driver Overload Alarm	Cause : The load current exceeded the value set in Parameter No.143 "Overload Level Ratio". This alarm is kept alarm condition until reset is made. This alarm turns ON when the load current exceeds the setting from a value below the setting. Treatment : Lower the setting of acceleration/deceleration. Also, increase the frequency of pause.
04E		Exceeded movement count threshold	Cause : The total number of the operation times exceeded the value set in Parameter No.147 "Total Movement Count Threshold".
04F		Exceeded operated distance threshold	Cause : The total number of the operation distance exceeded the value set in Parameter No.148 "Total Operated Distance Threshold".
068		SRAM access error	Cause : Servo monitor is not operated in the normal condition because of noise or malfunction of consisting parts. Treatment : 1) Take proper measures against noise. 2) When the servo monitoring function is not used, set parameter No.112 "Monitoring mode" to "0". 3) If the operation is not improved in use of the servo monitoring function in spite of measures against noise, Please contact IAI.
069		Detection of realtime clock oscillation stop	Cause : The calendar function is stopped and the current time data is lost. Treatment : Set the time again. [Refer to the Instruction Manual of RC PC software.] (Note) This error is not registered in the alarm list.
06A		Realtime clock access error	Cause : The calendar function is not working properly because of noise or malfunction of consisting parts. Treatment : 1) Take proper measures against noise. 2) When the calendar function is not used, set parameter No.111 "Calendar function" to "0". 3) If the operation is not improved in use of the calendar function in spite of measures against noise, Please contact IAI.
06B		Maintenance information data error	Cause : The maintenance information (total movement count, total operated distance) is lost. Treatment : Please contact IAI.

Alarm Code	Alarm Level	Alarm Name	Cause/Treatment
080	Operation release	Move command in servo OFF	Cause : A move command was issued when the servo is OFF. Treatment : Issue a movement command after confirming the servo is ON (servo ON signal (SV) or position complete signal (PEND) is ON).
082		Position command in incomplete home return	Cause : A position move command was issued before home return was completed. Treatment : Issue a command after confirming that home return has been completed (HEND) is ON.
083		Numerical command in incomplete home return	Cause : An absolute position command was issued by numerical specification before home return was completed (direct command from Field Network). Treatment : Issue a numeric specification after performing home return operation and confirming the complete signal (HEND).
084		Absolute position move command when home return is not yet completed	Cause : A move command was issued when home return was still in progress. Treatment : Issue a movement command after performing home return operation and confirming the complete signal (HEND).
085		Position No. error during movement	Cause : A non-existing (invalid) position number was specified in the positioner mode. Treatment : Check the position table again and indicate an effective position number.
086		Move command while pulse train input is effective	Cause : Actuator operation was commanded via serial communication in pulse train mode. Treatment : Stop the actuator operation command via serial communication in pulse train mode.
087		Moving command during loadcell calibration	Cause : A move command was issued during loadcell calibration. Treatment : After confirming the loadcell calibration is completed with the calibration complete (CEND) signal, and confirming CLBR Signal is turned OFF, perform the movement command.
090		Software reset during servo ON	Cause : A software reset command was issued when the servo was ON. Treatment : Issue a software reset command after confirming that the servo is OFF (SV signal is 0).
091		Position No. error in teaching	Cause : The position number out of the available range was selected in the teaching. Treatment : Select the position number from 63 or smaller.
092		PWRT signal detection during movement	Cause : The current position write signal (PWRT) was input in the teaching mode of PIO pattern 1 while the actuator was jogging. Treatment : Input the PWRT signal after confirming that the job button is not pressed and the actuator is stopped (MOVE output signal is OFF).
093		PWRT signal detection in incomplete home return	Cause : The current position write signal (PWRT) was input in the teaching mode of PIO pattern 1 when home return was not yet completed. Treatment : Input the HOME signal first to perform home return, and then input the PWRT signal after confirming that the home return has completed (HEND output signal is ON).

Alarm Code	Alarm Level	Alarm Name	Cause/Treatment
0A1	Cold start	Parameter data error	Cause : The data input range in the parameter area is not appropriate. This error occurs when the magnitude relationship is apparently inappropriate such as when 300mm was incorrectly input as the value of the soft limit negative side while the value of the soft limit positive side was 200.3mm. Treatment : Change the value to the appropriate one.
0A2	Operation release	Position data error	Cause : 1) A move command was input when no target position was set in the "Position" field of a position No. in the position table. 2) The value of the target value in the "Position" field exceeded the Parameter No.3 and 4 "Soft limit set value". 3) A target position was specified in the "Position" field by relative coordinate in the solenoid valve mode 2 of PIO pattern 5. 4) Pressing operation was specified while the vibration suppress control function remained effective. Treatment : 1) Set the target position. 2) Change the target position value to the one within the soft limit set value. 3) The target position cannot be set by relative coordinate (incremental feed). 4) The vibration suppress control function and pressing operation cannot be used concurrently. Provide setting so that either of the functions is effective.
0A3		Position command data error	Cause : 1) The speed or acceleration/deceleration value during direct numeric specification exceeded the maximum set value. 2) Pressing operation was specified in the field bus specification while the vibration suppress function remained effective. Treatment : 1) Table to input a proper value. 2) The vibration suppress control function and pressing operation cannot be used concurrently. Provide setting so that either of the functions is effective.
0A4		Command counter overflow	Cause : The number of input command pulses exceeded the range of -134217728 to +134217728 (H'F8000000 to '07FFFFFF). Treatment : Attempt to make the value of the electrical gear ratio smaller (make the movement against the unit bigger).
0A5		Electromagnetic brake unreleased error	Cause : The brake cannot be released. Treatment : Supplied the 24V power unit for the electromagnetic brake.
0A6	Cold start	Dynamic brake not released	Cause : The dynamic brake cannot be released when the servo is ON due to noise and electrostatic, etc. Treatment : Implement measures to eliminate noise or electrostatic. There is a concern of circuit breakdown. Please contact IAI.

Alarm Code	Alarm Level	Alarm Name	Cause/Treatment
0A7	Operation release	Command deceleration error	Cause : Because there is not enough deceleration distance when the deceleration is changed to a lower setting during the operation, the actuator exceeded the soft limit when deceleration was made from the current position with the deceleration after the change.  The cause is that the timing to make the next movement command when the speed was changed during the operation was late. Treatment : Make the timing earlier for the movement command for the deceleration speed change.
0A8	Cold start	Unsupported motor/encoder types	Cause : The motor connected to the controller is not applicable or the type of the encoder that the motor is connected is not applicable. Treatment : Please contact us if the alarm is issued even with the applicable actuator and the same problem happens again even after rebooting the power.
0A9		Loadcell data error	Cause : The data acquired from loadcell at power-on or software reset is incorrect. Treatment : 1) Effect of noise is suspected. Check if there is a device radiating the noise and have a treatment to prevent receiving the noise. 2) The loadcell may be faulty. If the error keeps occurring even with the power reboot for several times, it is considered the loadcell is malfunctioned. Please contact IAI.
0B3		Spurious absolute error	Cause : Home-return operation was not performed properly. 1) Work is interfering with peripheral equipment in the middle of home return. 2) Encoder Error Treatment : 1) Remove the interference. 2) Please contact IAI.
0B4		Electric angling mismatching	Cause : This alarm indicates that the position deviation counter has overflowed. Treatment : The alarm occurs when the actuator cannot be operated. Confirm about the load conditions, that the work does not interfere with any object nearby or the brake has been released, etc. If the error occurs even when the servo is ON, the cable breakage or disconnection is considered. Check the cable connection. Please contact IAI if there is no failure in the cable and connector connections.
0B5	Operation release	Z-Phase position error	The position where the Z-phase is detected before the home return operation, is out of the specified range. Cause : Encoder Error Treatment : Please contact IAI.

Alarm Code	Alarm Level	Alarm Name	Cause/Treatment
0B7	Cold start	Magnetic pole indeterminacy	Cause : The controller detects the magnetic pole phase when the servo is tuned ON for the first time after turning ON the power. This error indicates that the magnetic pole phase cannot be detected after the specified period. 1) Contact error or breakage at the connector of the motor relay cable. 2) Brake cannot be released on a controller equipped with a brake. 3) Detection of the motor is not performed properly because an external force is applied. 4) Large slide resistance of the actuator itself Treatment : 1) Check the wiring condition of the motor relay cable. 2) Check the wiring condition of the brake cable, and also turn on/off the brake release switch to see if the brake makes a "clicking" sound. If the brake is not making any noise, check if the power is supplied to the brake properly. 3) Check for abnormality in the assembly condition. 4) It the transportation weight is in the acceptable range, cut off the power to check the slide resistance manually by moving with hand. If the actuator itself is suspected to be the cause, please contact IAI.
0BA	Operation release	Home sensor non-detection	Cause : This indicates that the home-return operation of the actuator equipped with origin sensor (option except rotary actuator) is not completed in normal condition. 1) Work is interfering with peripheral equipment in the middle of home return. 2) Large slide resistance of the actuator itself 3) Installation failure, breakdown or disconnection of the home sensor Treatment : In the case that the work does not interfere with anything, the cause 2) or 3) is supposed. In such case, please contact IAI.
0BE		Home return timeout	Cause : Home return does not complete after elapse of a certain period after the start of home return. Treatment : This error does not occur in normal operation. The combination of the controller and actuator may be incorrect. Please contact IAI.
0BF		Creep sensor not detected	Cause : This indicates the actuator detected the creep sensor (option) before detecting the origin sensor (option except for rotary actuator), or the actuator reached the mechanical end (or the actuator cannot move anymore because the load is too large). 1) The position to apply the creep sensor is not appropriate. 2) The creep sensor is faulty. 3) The cable is disconnected or the connector is not plugged in properly. 4) The actuator cannot move due to heavy load caused by interference. Treatment : 1) Readjust the sensor installation position. 2) Replace the creep sensor. 3) Perform continuity check to see if the connector is plugged in properly. 4) Check the interference and the transportable weight and make sure there is no external force applied.

Alarm Code	Alarm Level	Alarm Name	Cause/Treatment
0C0	Operation release	Actual speed excessive	Cause : This indicates the number of motor rotation exceeded the number of allowable rotation. 1) The slide resistance of the actuator is locally high. 2) The load is increased too much due to a external force. With the reasons above, it can be considered a sudden speed increase has occurred before detecting the servo error. Treatment : Even though this would not occur in normal operation, check if there is any abnormality in the parts assembly condition. Also check if there is a possibility that an external force may be applied in the direction of the actuator movement.
0C2		Overrun sensor detected	Cause : This indicates that a signal from the OT sensor (option) installed at the mechanical end is detected. 1) The actuator was moved by hand or received external force while the servo was OFF (normal detection). 2) The actuator was jogged or operated by pulse-train in a condition where the home coordinates were not yet established and thus the soft stroke limit did not function correctly (normal detection). 3) The home position achieved by home return is not correct, or in the case of an absolute type controller the coordinates have shifted due to an inappropriate absolute reset position. 4) There is a mismatch between the sensor characteristics and the setting in Parameter No.19 “Overrun sensor input polarity”, or the wiring layout is wrong. 5) There is a mistake in the mating of the controller and actuator, or the settings in Parameters No.3 and 4 “Soft limit value” and Parameter No.77 “Ball screw limit length” are not appropriate. Treatment : If 1) or 2) is suspected, move the actuator in the opposite direction by hand. If this error occurred inside the effective stroke range, 3), 4), or 5) is a likely cause. If 3) is suspected, check the home position. Conduct the absolute reset again if it is the absolute type. If 4) or 5) is suspected, please contact IAI.
0C4	Cold start	Exceeded allowable time of exceeding torque allowing continuous pressing	Cause : The continuous pressing time exceeds the time set for parameter No.89 “Allowable time of exceeding torque allowing continuous pressing”. Treatment : Check the sequence again. Set the pressing time to be within the setting time.
0C5	Operation release	Illegal transition command in control system	Cause : 1) Change the operation from the vibration suppress control operation to the normal position control operation. 2) Change the operation from the normal position control operation to the vibration suppress control operation. Treatment : Change the sequence so the next action is conducted after confirming the positioning complete signal (PEND) is turned ON for both cases 1) and 2).

Alarm Code	Alarm Level	Alarm Name	Cause/Treatment
0C6	Cold start	Torque current • Mismatching force feed back	Cause : The feedback from the loadcell has continuously been larger than the rating motor output for 256 ms or longer. Treatment : 1) Check that there is no external force applied in the direction to push back from the load side. 2) Review wiring of actuator and loadcell cables. 3) The actuator, controller or loadcell may be faulty. Please contact IAI.
0C8		Overcurrent	Cause : The output current in the power circuit section is increased abnormally. Treatment : This alarm will not be generated in normal operation. If it occurs, insulation of the motor coil may have deteriorated. Check if there is deterioration in the insulation by measuring the phase resistance between the monitor connection lines U, V and W. The values for the phase resistance should be almost the same. There is a concern the insulation is deteriorated if the values are different in large amount. Please contact IAI.
0CA		Overheat	Cause : This indicates overheat (95°C or more) of the components inside the controller. 1) Operation is performed with the load condition exceeding the specified range. 2) High temperature around the controller. 3) Load to the motor is high due to external force. 4) A faulty part inside the controller. Treatment : 1) Revise the operation condition such as decreasing the acceleration/deceleration speed. 2) Lower the ambient temperature of the controller. 3) Confirm that there is no error in the mechanical part assembly condition. (Note) This error would not normally occur. If it occurs, confirm there is not (1) or (2) above. If the same error is issued again even after confirming (1) or (2) is not in the condition, it is considered to be a malfunction. Please contact IAI.
0CB		Current sensor offset adjustment error	Cause : An error was found to the sensor in the status check of the current detection sensor conducted at the initializing process in the startup. 1) The current detection sensor or any of its surrounding parts is faulty. 2) Inappropriate offset adjustment Treatment : A work (PC board) change or offset adjustment is required. Please contact IAI.
0CD		Emergency-stop relay	Cause : A melt-down of the emergency stop relay inside the controller. Treatment : The relay or controller must be replaced. Please contact IAI.
0CE		Drop in control supply voltage	Cause : 1) The AC power supply voltage is low. 2) Faulty part inside the controller Treatment : Check the voltage of the input power supply. In the case that the voltage is normal, please contact IAI.

Alarm Code	Alarm Level	Alarm Name	Cause/Treatment
0CF	Operation release	I/O 24V power supply error	Cause : 24V power supply for PIO is not connected. The voltage is extremely low. Treatment : Check the connection and voltage.
0D2	Cold start	Motor power source voltage excessive	Cause : A breakdown of the part inside the controller is considered. Treatment : If this error occurs frequently, the controller may be faulty at high probability. Please contact IAI.
0D3		Motor power supply voltage low	Cause : 1) If the power source is shut off out of the controller, servo-on command was made during the power is shut. 2) There is a concern of a malfunction of the controller internal components. Treatment : 1) Check the controller external circuit. 2) If this error occurs often, there is a concern of a controller malfunction. Please contact us.
0D7		Belt breaking sensor detected	Cause : The belt of the ultra-high thrust RCS2-RA13R is broken. Treatment : Belt must be replaced. Please contact IAI.
0D8	Operation release	Deviation overflow	Cause : This alarm indicates that the position deviation counter has overflowed. 1) The speed dropped or the actuator stopped due to the effect of external force or overload. 2) The excited-phase detection operation following the power-on is unstable. 3) The power supply voltage dropped. 4) Servo gain number is too small Treatment : 1) This error occurs when the actuator cannot be operated as it is commanded. Check the load conditions such as if the work is touching to the surrounding object, or brake is properly released, and remove the cause. 2) Overload can be concerned. Revise the transportable weight and redo the home-return operation. 3) Check for the source voltage.
0D9		Software stroke limit exceeded	Cause : The current position of the actuator exceeds the software stroke limit. Treatment : Return the actuator to be within the range of the software stroke limit.
0DA		Feed back pulse error	Cause : Feedback pulse data cannot be output within the cycle. Treatment : Take proper measures against noise.
0DC		Pressing motion range over error	Cause : 1) After the pressing operation has complete, the force to push back is too large and the pushed back to the pressing start position (“Position” in the position table). 2) The actuator touched the work during the approach movement before the pressing movement. Treatment : 1) Revise the setting and adjust it so the force to push back gets smaller. 2) Set the “Position” setting in front in the position table to shorten the approach distance.

Alarm Code	Alarm Level	Alarm Name	Cause/Treatment
0DD	Cold start	Drive mode error	Cause : 1) Linear ABS Actuator was used in Pulse Train Control Mode. 2) The actuator of field bus specification is started after it is set to the pulse-train control mode. Treatment : 1) Linear ABS Actuator cannot be used in Pulse Train Control Mode. 2) The actuator of field bus specification cannot be set to the pulse-train control mode. Set the pulse-train mode change switch on the front panel to OFF.
0E0	Cold start	Overload	Cause : 1) The work weight exceeds the rated weight, or an external force is applied and the load increased. 2) If the actuator is equipped with a brake, the brake is not released. 3) The slide resistance of the actuator is locally high. Treatment : 1) Check the work and its surrounding area to remove the cause. 2) Turn on the brake release switch to see if the brake is released. If the brake is not released, the brake itself may be faulty, cable may be disconnected, or the controller may be faulty. Please contact IAI. 3) In the case that the work can be moved by hand, move it. Then, check that there is no location where a sliding resistant is too large. Check if the installation face is distorted. When the error occurs in operation of the actuator only, Please contact IAI. ⚠ Caution Restart the operation after making sure to remove the cause. If you cannot determine that the cause is removed completely, wait for at least 30 minutes before turning on the power to prevent the motor coil from burning.
0E1	Operation release	Loadcell calibration error	Cause : 1) Calibration command is issued during actuator operation, temporary stop or pressing operation. 2) A calibration error occurs when calibration command is issued. 3) The calibration command signal CLBR is set to OFF before the completion of calibration. 4) Pressing command is issued without calibration. Treatment : 1) Conduct the calibration in the actuator stop condition. 2) Check whether a large load is applied to the loadcell due to biting. Effect of noise is suspected. Check the presence of noise source around the loadcell. 3) In either of 3) and 4), check the sequence again. Malfunction of the loadcell is considered. Replace the loadcell. Please contact IAI.
0E2	Cold start	Loadcell communication error	Cause : There was a communication error during the communication with the loadcell. Treatment : 1) Review wiring of loadcell cables and others. 2) Effect of noise is suspected. Check the presence of noise source around the loadcell. 3) Replace the loadcell if it may be faulty. 4) Replace the controller if it may be faulty. In cases 3) and 4), please contact IAI.

Alarm Code	Alarm Level	Alarm Name	Cause/Treatment
0E3		Loadcell error	Cause : Loadcell power error, hardware error such as board overheat or EEPROM error occurs. Treatment : 1) The effect of noise may be possible. Check the presence of noise source around the loadcell. 2) Replace the loadcell if it may be faulty. Please contact IAI.
0E4	Cold start	Encoder send error	Cause : The data sending and receiving between the controller and encoder is conducted by the serial communication. This error indicates that the data sent from the controller was not received properly at the encoder side. 1) Effect of noise 2) One or more communication ICs installed on the encoder board are faulty. 3) One or more communication ICs installed on the controller board are faulty. Treatment : 1) Interrupt the power to the peripheral equipment and activate only the actuator. If any error does not occur, it might be caused by noise. Take proper measures against noise. If 2) or 3) is the case, the encoder or controller must be replaced. If the cause cannot be specified, please contact IAI.
0E5		Encoder receipt error	Cause : This shows the data was not received in normal condition from the encoder side to the controller. 1) Cable breakage of encoder cable or connector connection failure. (If the detail code in the error list of the teaching tool is 0002H.) 2) Effect of noise. (If the detail code in the error list of the teaching tool is 0001H.) 3) Malfunction of component (communication part) inside the actuator. 4) A faulty part inside the controller (communication part). Treatment : 1) Check if any wire breakage on a connector and the condition of wire connections. 2) Interrupt the power to the peripheral equipment and activate only the actuator. If any error does not occur, it might be caused by noise. Take proper measures against noise. If 3) or 4) is the case, it is necessary to replace the actuator (motor part) or controller. If the cause cannot be specified, please contact IAI.
0E6		Encoder count error	Cause : This error code appears when the encoder cannot detect the position information properly. 1) The encoder relay cable or supplied actuator cable is disconnected or its connector is not plugged in correctly. 2) Foreign matter is deposited on the code wheel. 3) The position relationship between the code wheel and photo sensor changed due to shaft center shift caused by application of excessive external force, etc. 4) Faulty encoder board component Treatment : 1) Check if any wire breakage on a connector and the condition of wire connections. For the case of 2), 3) or 4), it is necessary either to clean the code wheel, adjust the installation position, replace the motor unit or replace the actuator. In any case, please contact IAI.

Alarm Code	Alarm Level	Alarm Name	Cause/Treatment
0E7	Cold start	A-, B- and Z-phase wire breaking	Cause : Encoder signals cannot be detected correctly. 1) The encoder relay cable or supplied actuator cable is disconnected or its connector is not plugged in correctly. 2) The encoder itself is faulty. Treatment : 1) Check if any wire breakage on a connector and the condition of wire connections. If the cables are normal, faulty encoder is suspected. Please contact IAI.
0EE		Absolute encoder error detection 2	Cause : This is the condition where the position information can not be detected in the absolute encoder. 1) Voltage drop of absolute battery. 2) The encoder relay cable or supplied actuator cable is disconnected or its connector is not plugged in correctly. Treatment : 1) Check the PIO battery alarm output (*BALM) and when it is turned OFF, replace the absolute battery with new one. 2) Check if any wire breakage on a connector and the condition of wire connections. Whichever action is taken under 1) or 2), an absolute reset must be performed. If the cables are normal, faulty encoder is suspected. Please contact IAI.
0EF		Absolute encoder error detection 3	Absolute encoder is not detecting the position information properly. (ABS encoder overspeed error) Cause : This error occurs in such cases as the speed exceeded the tracing acceleration speed limit in the drop by the brake release at the power cutoff of the absolute type vertical axis. (This condition should not occur in normal conditions of use. Take sufficient note on forced brake release.) Treatment : If the error is occurred, it is necessary to absolute reset.
0F0		Driver logic error	Cause : Exceeded load, parameter (motor type) mismatched, noise, malfunction of controller, etc. Treatment : Please contact IAI.
0F2		Field bus module error	Cause : A Field bus Module error was detected. Treatment : Check the Field bus related parameters.
0F3		Field bus module not detected	Cause : Field bus module not detected. Treatment : If the error cannot be resolved even after putting the power on again, please contact us.
0F4		Mismatched PCB	This controller uses a different print circuit board depending on the motor capacity. The PCB is not applicable for the connected motor in the startup check. Cause : The actuator may not match the controller. Check the model. Treatment : Should this error occur, please contact IAI.
0F5		Nonvolatile memory write verify error	It is verified at the data writing process to the non-volatile memory that the data inside the memory and the data to be written are matched. There was a mismatch detected in this process. Cause : Faulty nonvolatile memory. Treatment : When the error is caused even when the power is re-input, please contact IAI.
0F6		Nonvolatile memory write timeout	There is no response in the specified time duration during the data writing to the non-volatile memory. Cause : Faulty nonvolatile memory. Treatment : When the error is caused even when the power is re-input, please contact IAI.

Alarm Code	Alarm Level	Alarm Name	Cause/Treatment
0F8	Cold start	Nonvolatile memory data destroyed	Abnormal data was detected during the nonvolatile memory check after starting. Cause : Faulty nonvolatile memory. Treatment : When the error is caused even when the power is re-input, please contact IAI.
0FA	Cold start	CPU error	The CPU operation is not normal. Cause : 1) Faulty CPU 2) Malfunction due to noise Treatment : When the error is caused even when the power is re-input, please contact IAI.
0FB	Cold start	FPGA error (Faulty component)	The FPGA is not operating properly. Cause : 1) Malfunction due to the effect of noise, etc. 2) Faulty FPGA 3) Faulty circuit component around the FPGA. 4) Inappropriate board installation in the controller. Treatment : Turn the power off and reboot. If the error occurs again, check for presence of noise. If a spare controller is available, replace the problem controller with the spare controller. A recurring error with the spare controller suggests presence of noise. If the cause cannot be identified, please contact IAI.
100 to 1FF	Message	Alarm on teaching tool	[Refer to the Instruction Manual of teaching tool.]
200 to 2FF	Operation release	Alarm on teaching tool	[Refer to the Instruction Manual of teaching tool.]
300 to 3FF	Cold start	Alarm on teaching tool	[Refer to the Instruction Manual of teaching tool.]

Chapter 10 Appendix

10.1 Conformity to Safety Category

[1] System Configuration

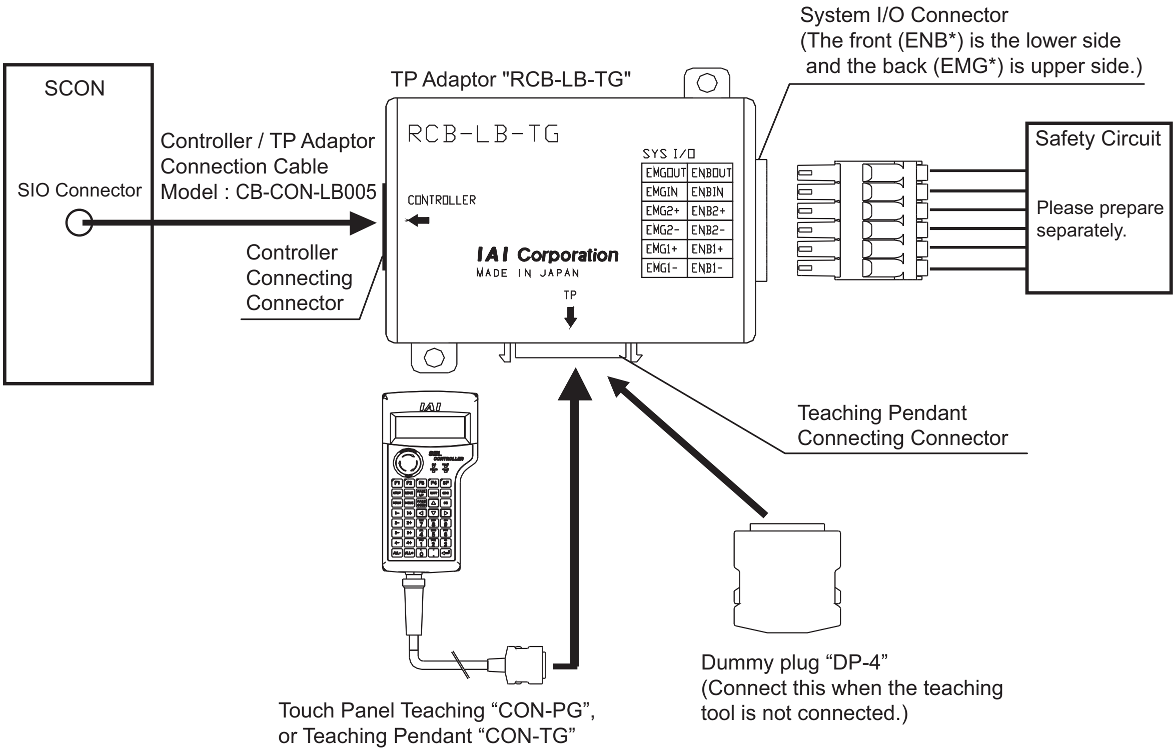
Use either of the following teaching pendants when it is necessary to construct a system conformed to the safety category (ISO12100-1).

(1) CON-TG

(2) CON-PG (Touch Panel Teaching)

Also, TP adapter (Model : RCB-LB-TG) is required.

The system can conform to up to safety category B to 4 (ISO13849-1) by changing connections of system I/O connectors.



[2] Wiring and setting of safety circuit

(1) Power supply

To use safety relays and/or contactors of 24V DC specification in the safety circuit, the control power supply should be used only for the circuit as much as possible. For example, to supply power to the safety circuit, do not use the power supply driving our robo-cylinder controller ACON or PCON.
It is the risk prevention treatment preparing for the cases such as the operation error of the safety circuit caused by not enough power capacity.

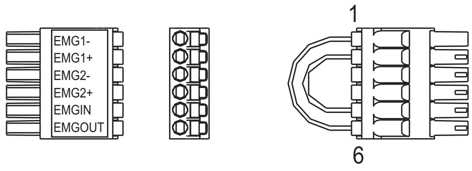
(2) Specification of system I/O connector for TP adapter

Connector Name		System I/O Connector		Applicable Wire
Upper side (EMG side)	Cable side	FMC1.5/6-ST-3.5(Note 1)	Phoenix Contact	AWG24 to 16 (0.2 to 1.25m^2)
	TP adapter side	MCDN1.5/6-G1-3.5P26THR		
Lower side (ENB side)	Cable side	FMC1.5/6-ST-3.5(Note 1)		
	TP adapter side	MCDN1.5/6-G1-3.5P26THR		

	Pin No.	Signal name	Description
Upper side (EMG side)	1	EMG1-	Emergency stop contact 1 (30V DC or less, 100mA or less)
	2	EMG1+	
	3	EMG2-	Emergency stop contact 2 (30V DC or less, 100mA or less)
	4	EMG2+	
	5	EMGIN	Emergency stop detection input
	6	EMGOUT	24V power supply output for emergency stop detection input
Lower side (ENB side)	7	ENB1-	Enable contact 1 (30V DC or less, 100mA or less)
	8	ENB1+	
	9	ENB2-	Enable contact 2 (30V DC or less, 100mA or less)
	10	ENB2+	
	11	ENBIN	Enable detection input
	12	ENBOUT	24V power supply output for enable detection input

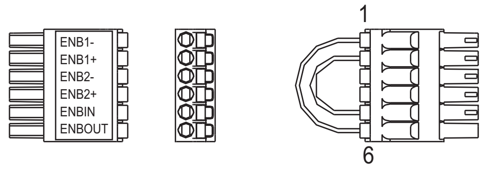
Note 1 Connectors on the cable side are attached under conditions where initial wiring has been conducted.
In order to support each category, remove the initial wiring and wire your safety circuit.

● Upper side (EMG) connector

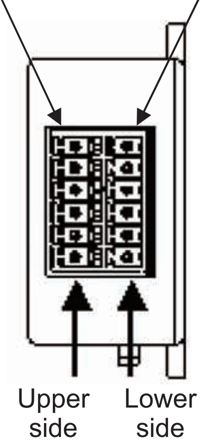


Wiring	Color	Signal	No.
AWG24	YW	EMG1-	1
	YW	EMG1+	2
	—	EMG2-	3
	—	EMG2+	4
	YW	EMGIN	5
	YW	EMGOUT	6

● Lower side (ENB) connector



Wiring	Color	Signal	No.
AWG24	YW	ENB1-	1
	YW	ENB1+	2
	—	ENB2-	3
	—	ENB2+	4
	YW	ENBIN	5
	YW	ENBOUT	6



TP Adapter Side View

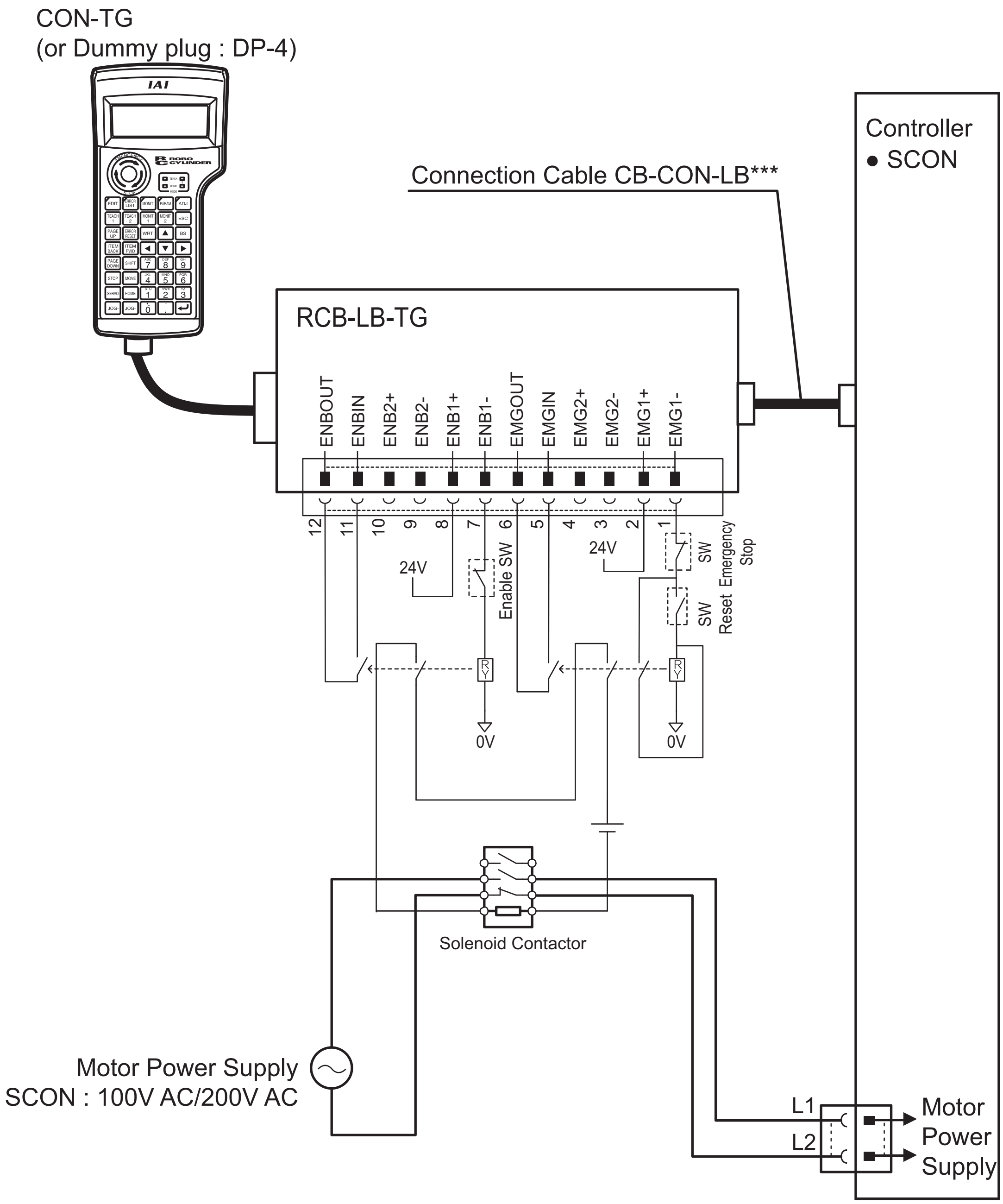
(3) Connection of dummy plug of TP adapter
When operating the controller with AUTO Mode, make sure to connect the enclosed dummy plug to TP Connector.

(4) Enable function*
If you are using the enable function, set it to Enable using the controller parameter.
Parameter No.42 Enable function
0 ··· Enable
1 ··· Disable [Default setting at shipment]

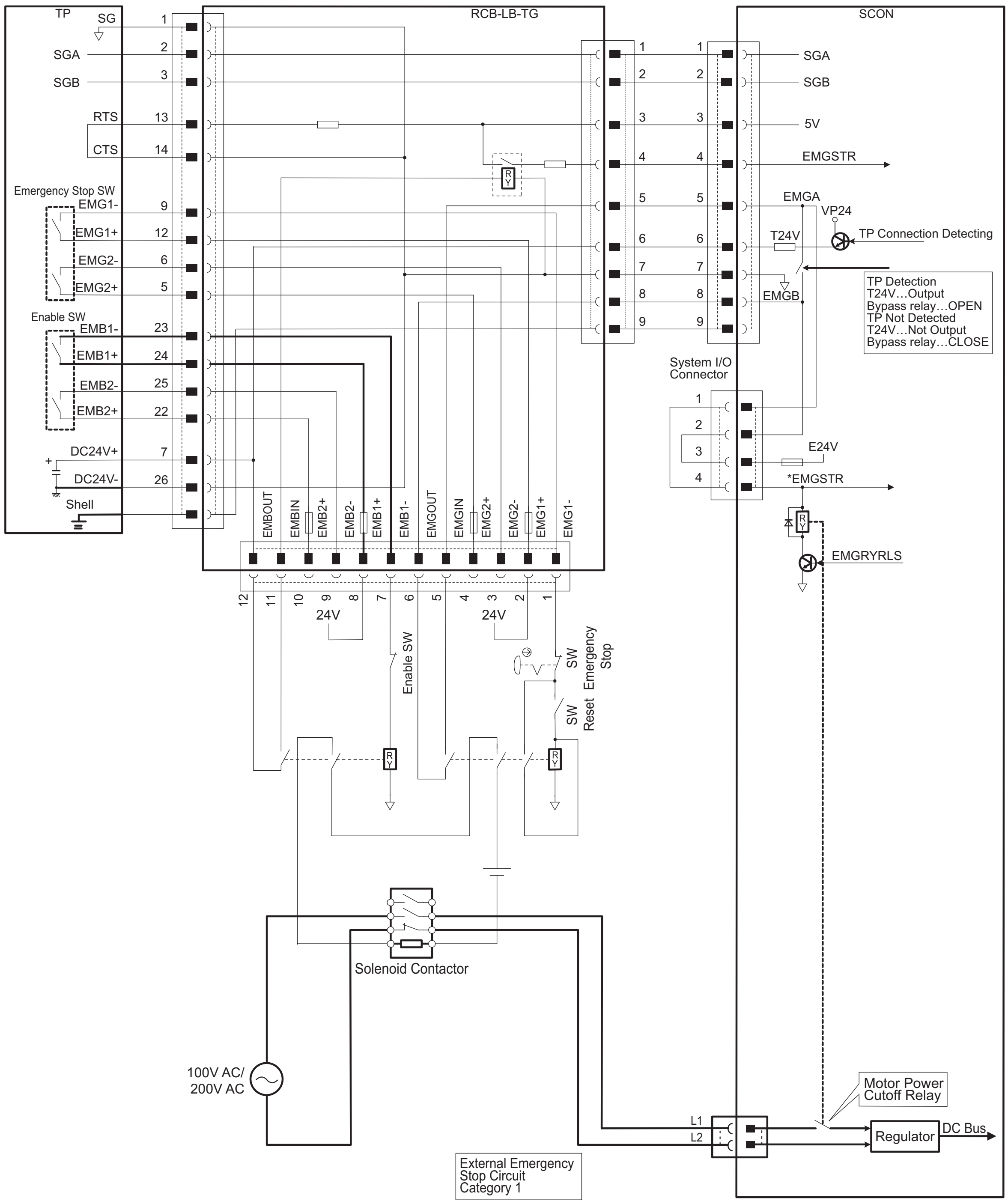
* Enable function : It is the function to monitor the status of the signal (safety switch, dead man's switch on teaching pendant, etc.) to permit the devices to operate.

[3] Examples of safety circuits

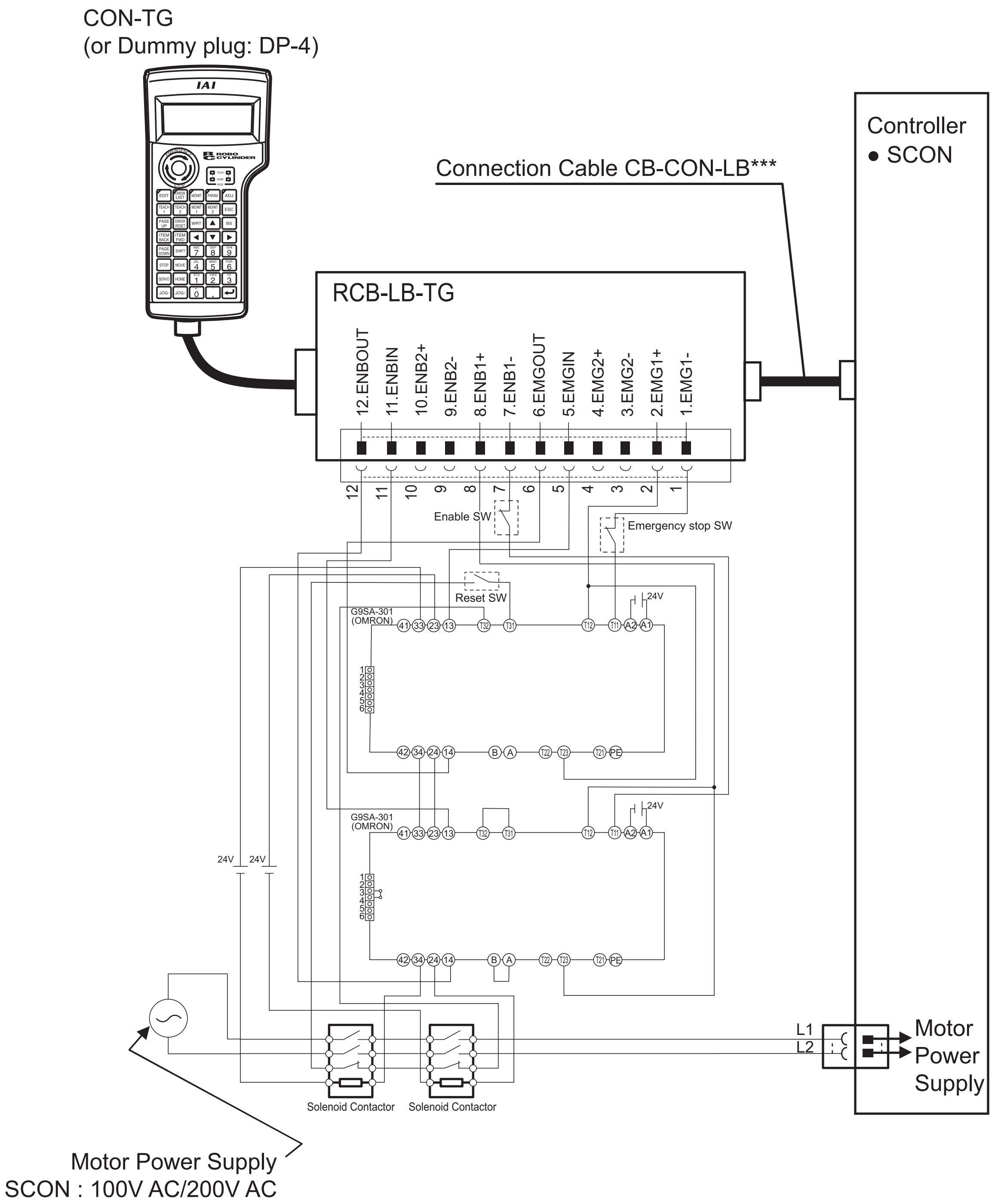
1) In case of category 1



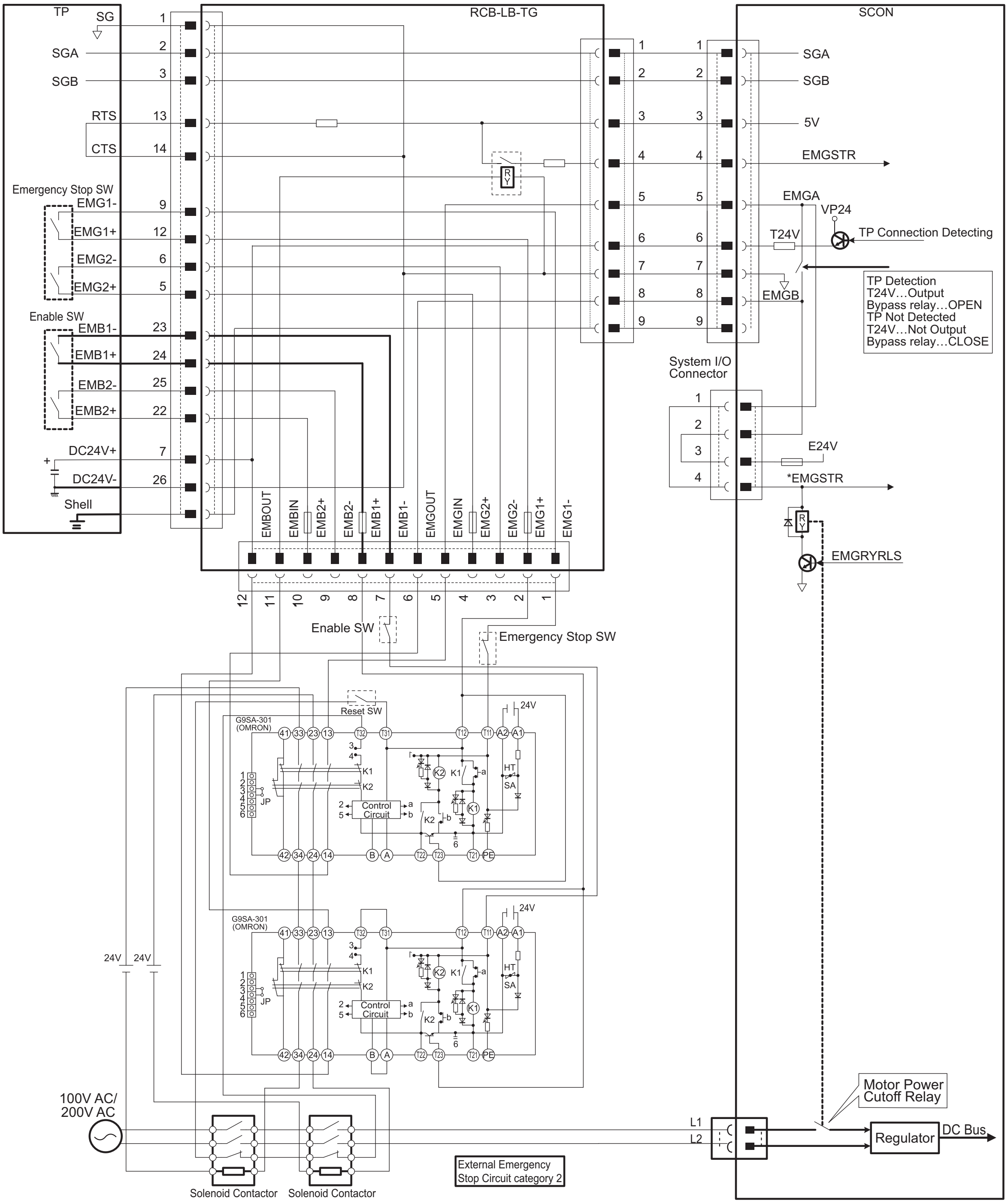
· Detailed category 1 circuit example



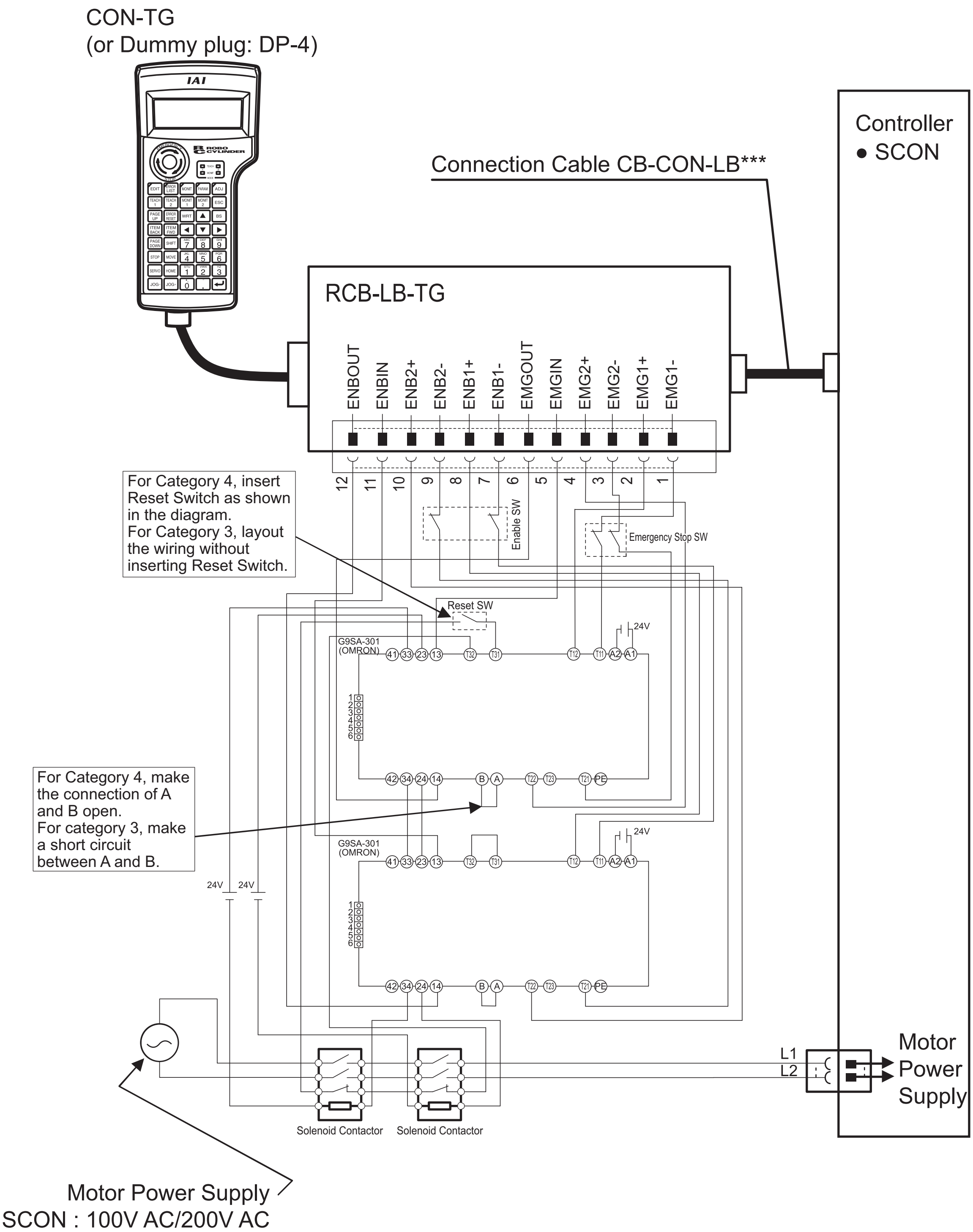
2) In case of category 2



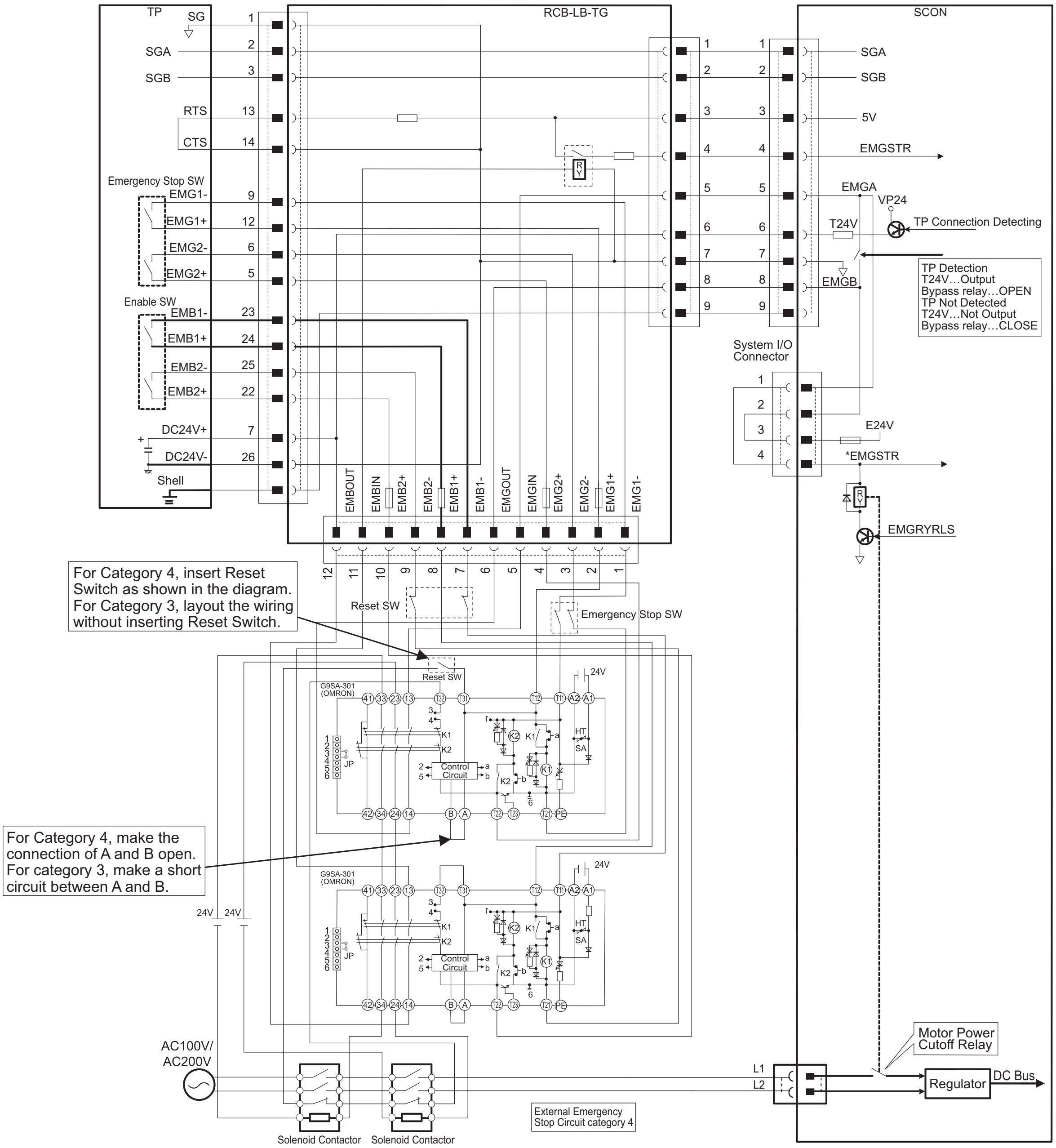
· Detailed category 2 circuit example



3) In case of category 3 or 4

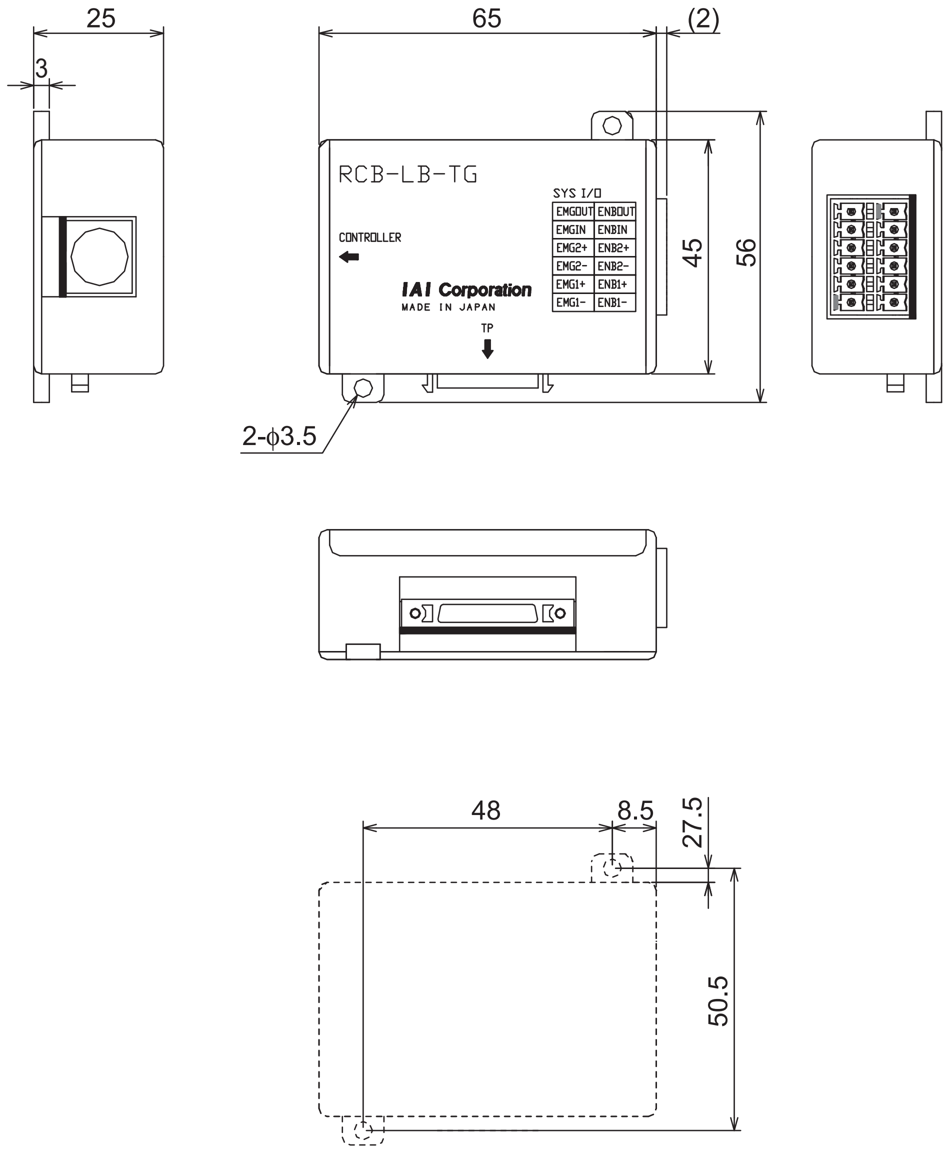


· Detailed category 3 or 4 circuit example



[4] TP adapter and accessories

1) TP adapter external dimensions

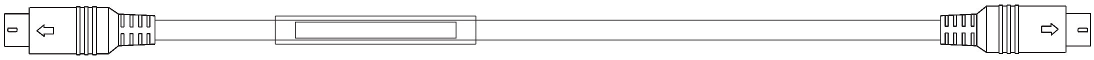


2) Connection Cable (Accessories)

- Controller/TP Adaptor Connection Cable

Use this cable to connect the controller and TP adapter (RCB-LB-TG).
Model : CB-CON-LB005（standard cable length : 0.5m）
Maximum cable length : 2.0m

CN1 CN2



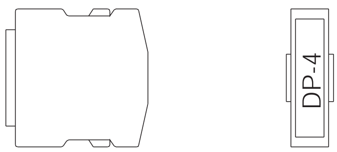
CB-CON-LB＊＊＊

CN1 Color	CN1 Signal	CN1 No.	CN2 No.	CN2 Signal	CN2 Color
BR	SGA	1	1	SGA	BR
YW	SGB	2	2	SGB	YW
RD	5V	3	3	5V	RD
OR	EMGS	4	4	EMGS	OR
BL	EMGA	5	5	EMGA	BL
GN	24V	6	6	24V	GN
PL	GND	7	7	GND	PL
GY	EMGB	8	8	EMGB	GY
Shield	FG			FG	Shield

CN1:
8PIN MIN DIN Connector (mold casting)
Contact : MD-SP2240 (J.S.T. Mfg.) ×8
Metal shell : MD-PS8T (J.S.T. Mfg.)
Housing A : MD-PI8A (J.S.T. Mfg.)
Housing B : MD-PI8B (J.S.T. Mfg.)
Cover : MD-PCC8T-S2 (J.S.T. Mfg.)

CN2:
8PIN MIN DIN Connector (mold casting)
Contact : MD-SP2240 (J.S.T. Mfg.) ×8
Metal shell : MD-PS8T (J.S.T. Mfg.)
Housing A : MD-PI8A (J.S.T. Mfg.)
Housing B : MD-PI8B (J.S.T. Mfg.)
Cover : MD-PCC8T-S2 (J.S.T. Mfg.)

3) Dummy plug (Accessories)
Connect a dummy plug to the teaching pendant connecting connector.
Make sure to connect a dummy plug if the AUTO mode is specified.
Without the connection, it will be the emergency stop condition.
Model : DP-4



Plug : TX20A-26PH1-D2P1-D1E (JAE)

Signal	No.
GND	1
EMGS	2
VCC	3
DTR	4
EMGOUT2	5
EMGIN2	6
NC	7
RSVCC	8
EMGIN1	9
NC	10
NC	11
EMGOUT1	12
RTS	13
CTS (GND)	14
TXD	15
RXD	16
DSR	17
NC	18
NC	19
RSVTBX1	20
RSVTBX2	21
ENBVCC2	22
ENBTBX1	23
ENBVCC1	24
ENBTBX2	25
GND	26

Short-circuit processing.

10.2 Way to Set Multiple Controllers with 1 Teaching Tool

It is usually necessary to connect the teaching tool to the controllers one by one when making a setup to multiple controllers with one unit of teaching tool. In this section, explains how to perform the settings without connecting and disconnecting the plug.

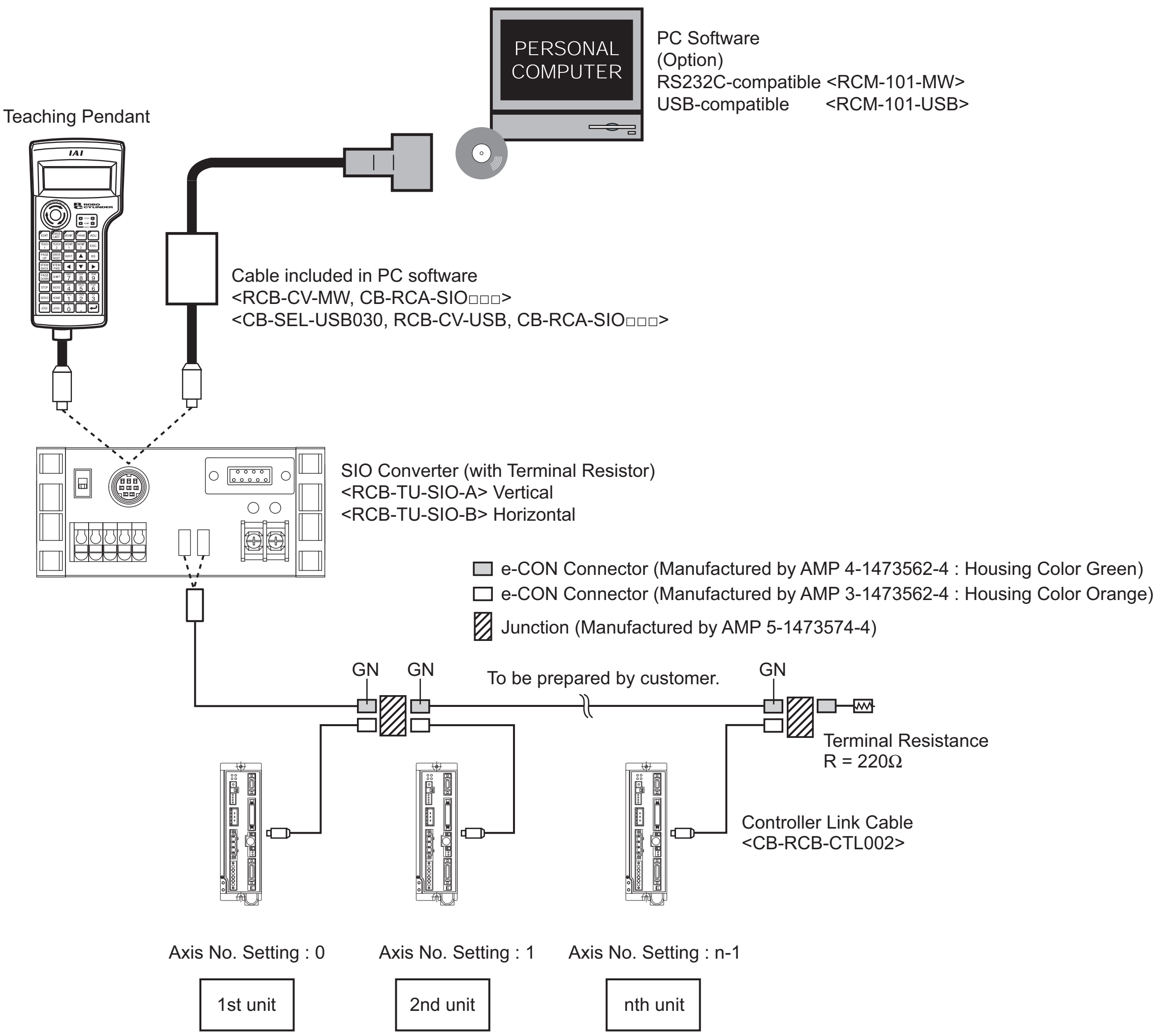
- Requisite devices :
  (1) SIO Converter (RCB-TU-SIO-A or RCB-TU-SIO-B) : 1 unit
  (2) Controller Link Cable (CB-RCB-CTL002) : Required by the number of controllers

  Accessories
  1) 4-way junction (Manufactured by AMP 5-1473574-4) : 1 unit
  2) e-CON Connector (Manufactured by AMP 4-1473574-4) : 1 unit
  3) Terminal Resistance (220Ω、with a e-CON connector) : 1 unit

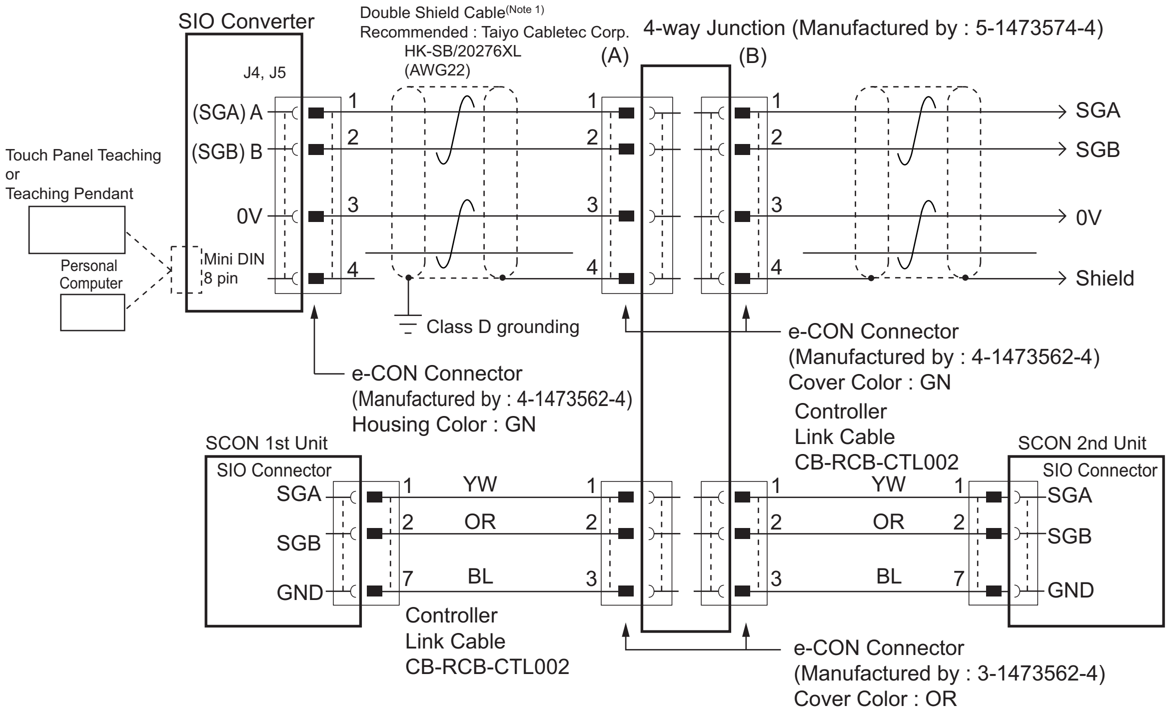
Instead of the e-CON cable attached to the controller link cable, a terminal block may be used. In this configuration, disconnect the e-CON connector from the controller link cable.

10.2.1 Connecting Example

Shown below is an example of connection.



10.2.2 Detailed Connection Diagram of Communication Lines



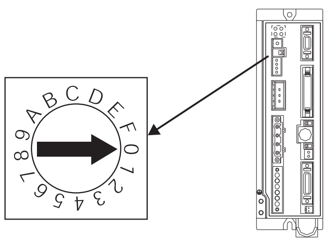
(Note 1) Apply a 2-pair shielded cable.
When connecting a cable other than recommended to (A) and (B), make sure to use a hard-cored cable equivalent to the vinyl cable (KIV) dedicated for control devices with the sheath outer diameter from 1.35 to 1.60mm. Using cables with outer diameter out of the specification may cause poor contact to occur.

⚠ Note : When cables with outer diameter out of the specification are used, use a terminal block instead of 4-direction junction. In this configuration, disconnect the e-CON connector of the link cable. If an error possibly caused by poor contact occurs frequently, replace the junction with the terminal block.

10.2.3 Axis No. Setting

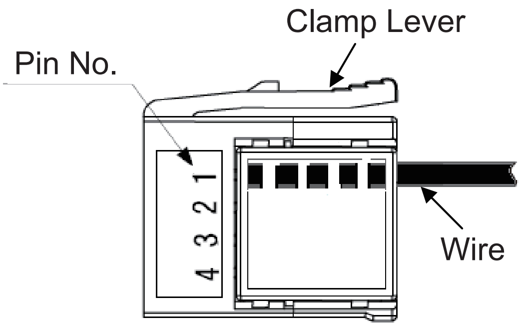
Set an axis number by using the axis number setting switch on the front panel of SCON.
Possible axis numbers range from 0 to F by 16 axes.
After the setting, turn off the power of SCON and then on it again.

Adjust the arrow to a desired position using a flathead screwdriver.

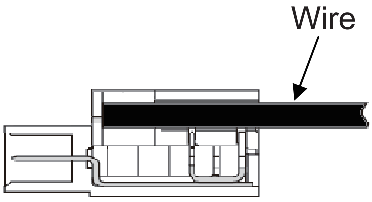


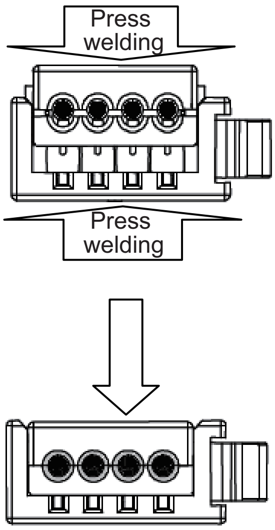
⚠ Note : The axis number must be unique.

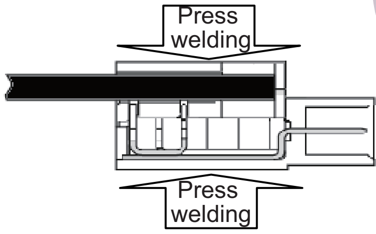
10.2.4 Handling of e-CON connector (how to connect)



1) Check the applicable cable size.
   Check the applicable cable. If it is not applicable, it may cause a connection failure or a breakage of the connector.
2) Check the pin numbers, do not reveal the sheath, and insert the cable till it reaches the end.
   Revealing the sheath may cause a failure such as short circuit or cable fall out.





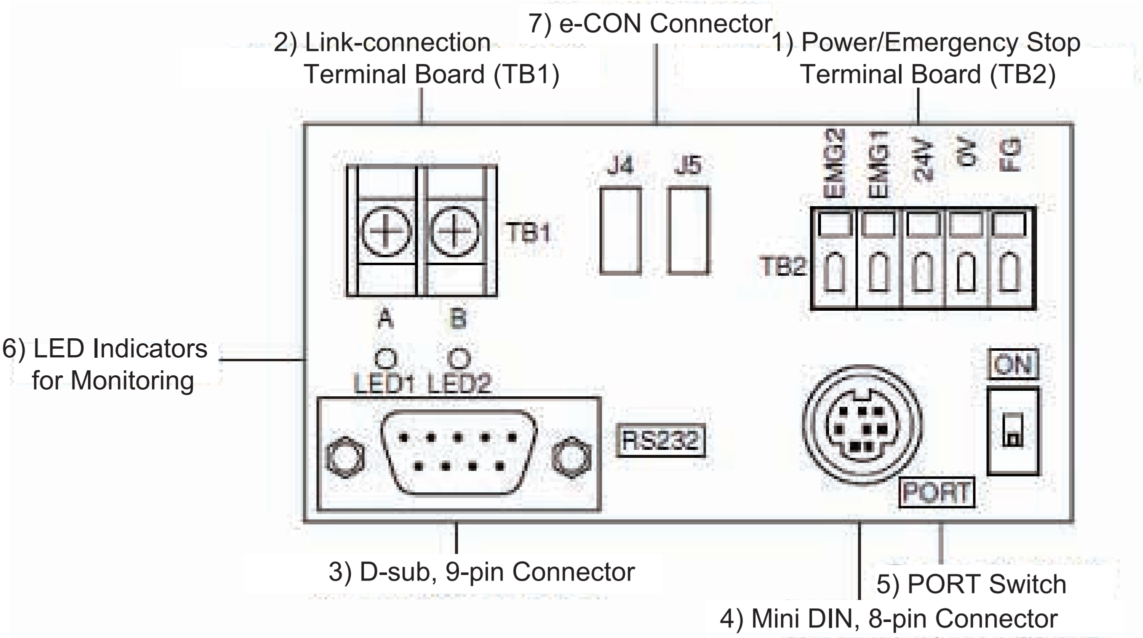


3) Use a (generally purposed) parallel plier with the width of 10mm or more to press-weld the cable from top and bottom.
   Use the parallel plier from the direction of , grip it while checking the condition of press-welding to make sure the press is in right angle and press it until it becomes completely flat to the housing.
   If the inserting is not enough, it may not be able to attach to the socket or may cause a contact failure.
4) After finishing the press-welding, pull the cable lightly to confirm that won't come out.

⚠ Note :
1) e-CON connector cannot be reused once the press-welding is failed. Use a new connector to retry the press-welding.
2) When connecting to the socket, hold the connector with care not to touch the clamp lever, insert the connector in parallel to the socket until the clamp lever makes a "click" sound.
3) After joining to the socket, do not pull the cables or pull the connector without releasing the lock of the clamp lever.

10.2.5 SIO Converter

The SIO converter converts the communication mode from RS232C to RS485 or vice versa.



1) Power/Emergency Stop Terminal Board (TB2)

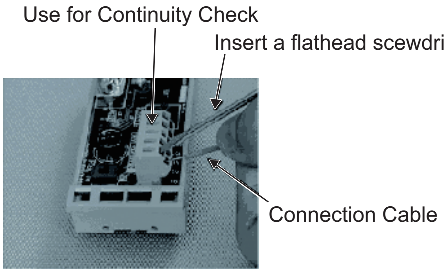
Symbol	Description
EMG1, EMG2	Turn the PORT switch ON to output the emergency stop switch signal, OFF to short-circuit EMG1 and EMG2. When applying the emergency stop switch of the teaching pendant to the emergency stop of the system, obtain the signal from here.
24V	Positive side of the 24V DC power supply (Power supply for the teaching pendant and conversion circuit.)
0V	Negative side of the 24V DC power supply
FG	Frame ground

(Note) 0V is connected to the pin No. 7 (GND) on the communication connector for the controller.

- Connection method

  Use a connection cable satisfying the following specifications :

Item	Specification
Applicable wire	Solid Wire : ϕ0.8 to 1.2mm/Stranded : AWG Size 20 to 18 (0.5 to 0.75mm^2)
Stripped wire length	10mm



2) Link-connection Terminal Board (TB1)
This is the connection port to obtain communication connection with the controller.
Connect terminal “A” on the left side to communication line SGA of the controller. (Terminal A is connected to pin 1 of (7) internally.)
Connect terminal “B” on the right side to communication line SGB of the controller. (Terminal B is connected to pin 2 of (7) internally.)
Use a twisted pair shielded cable for the connection of SGA and SGB to TB1.

3) D-sub, 9-pin connector
A connection port with the PC. (RS232C)
It is used when the operation is conducted with using SIO communication.

4) Mini DIN, 8-pin connector
This connector is connected to PC software, teaching pendant or touch panel teaching.

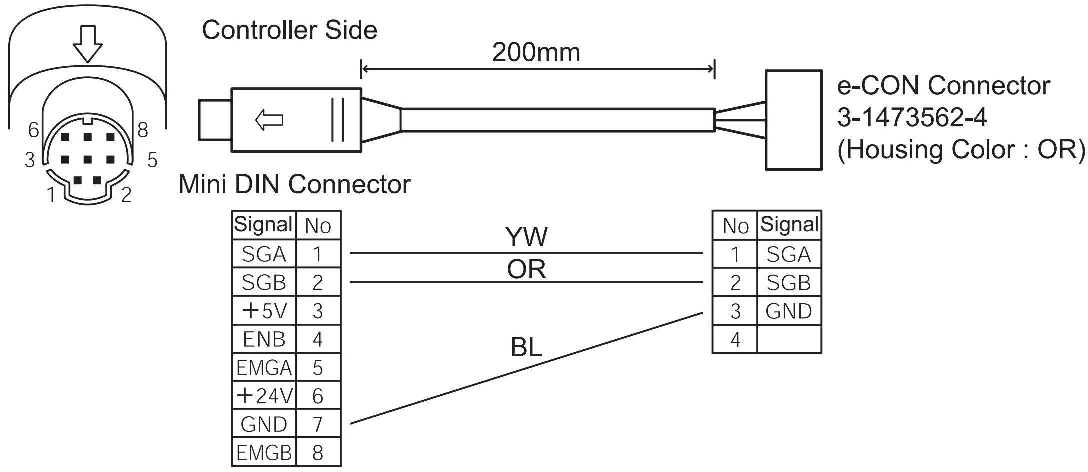
5) PORT Switch
The PORT switch is used to exchange enable/disable of connector (4).
Set the switch to ON if connector (4) is used or OFF if not used.
The switchover of valid/invalid on the teaching pendant is held at the same time as the emergency stop button switch signal output (between EMG1 and 2).

6) LED Indicators for Monitoring
LED1 : Lights/blinks while the controller sends signals.
LED2 : Lights/blinks while signals are sent from the RS232C connector.

7) e-CON Connector
It is used when connecting to the controller with e-CON connector without using 2).

10.2.6 Communications Cable

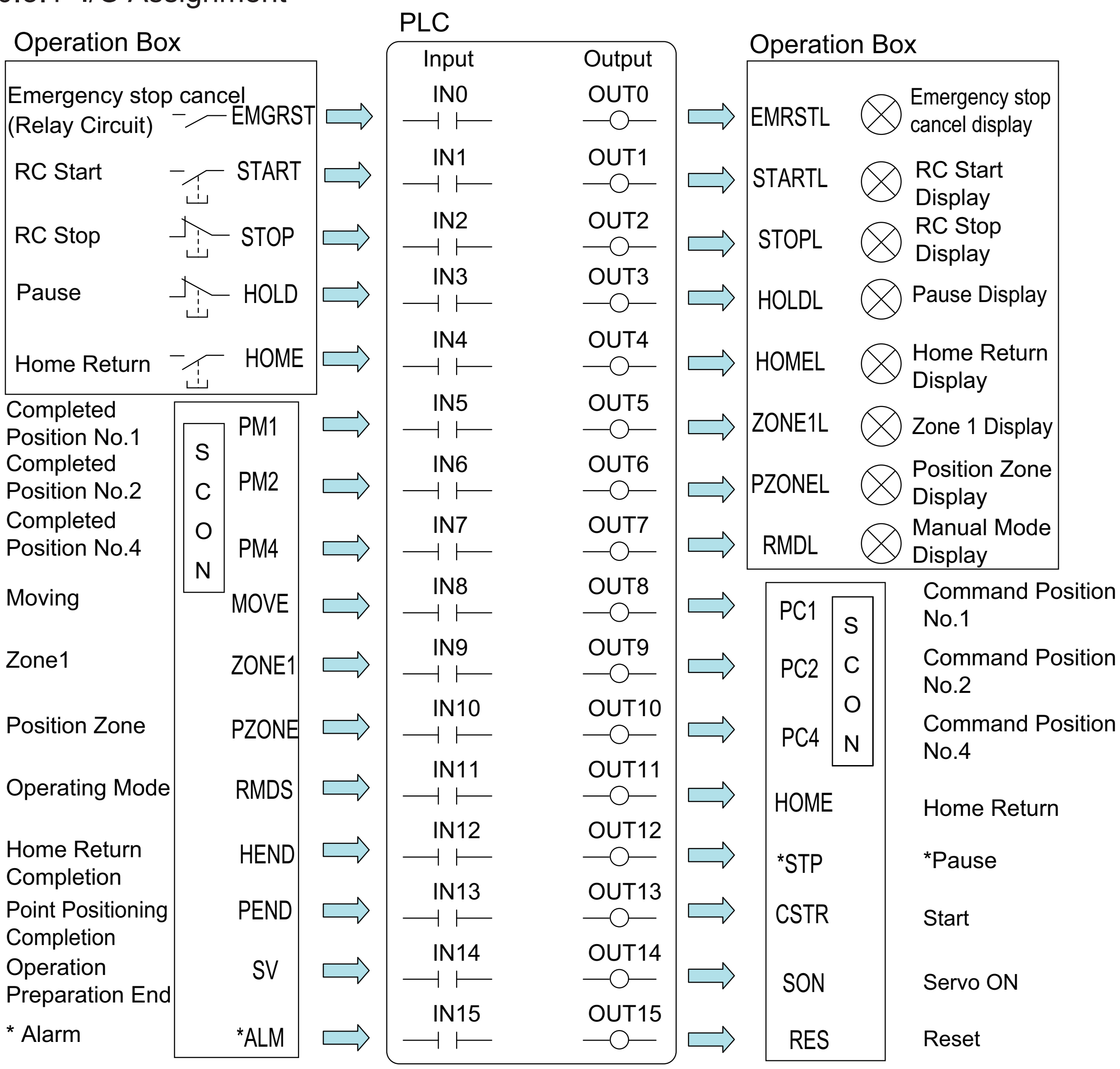
1) Controller Link Cable (CB-RCB-CTL002)



10.3 Example of Basic Positioning Sequence (PIO pattern 0 to 3)

This section shows an example in which a simple operation box directs SCON to move the actuator successively to three positions on an axis.

10.3.1 I/O Assignment

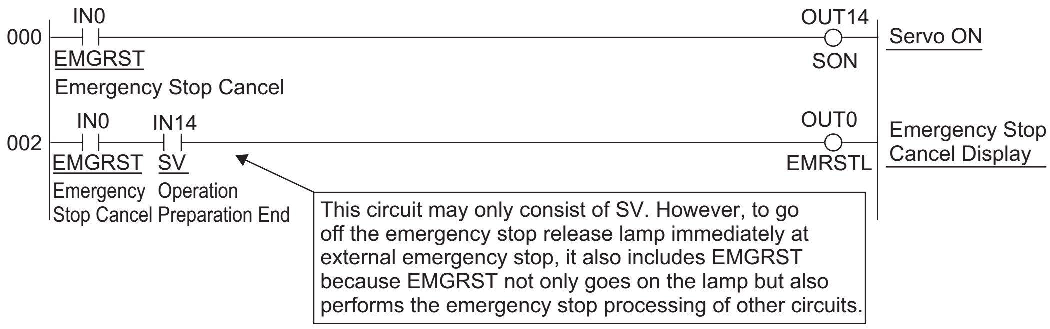


"*" in codes above shows the signal of the active low. Input signal is processed with it is turned OFF and output signal is usually ON when the power is supplied and is OFF when signal output.

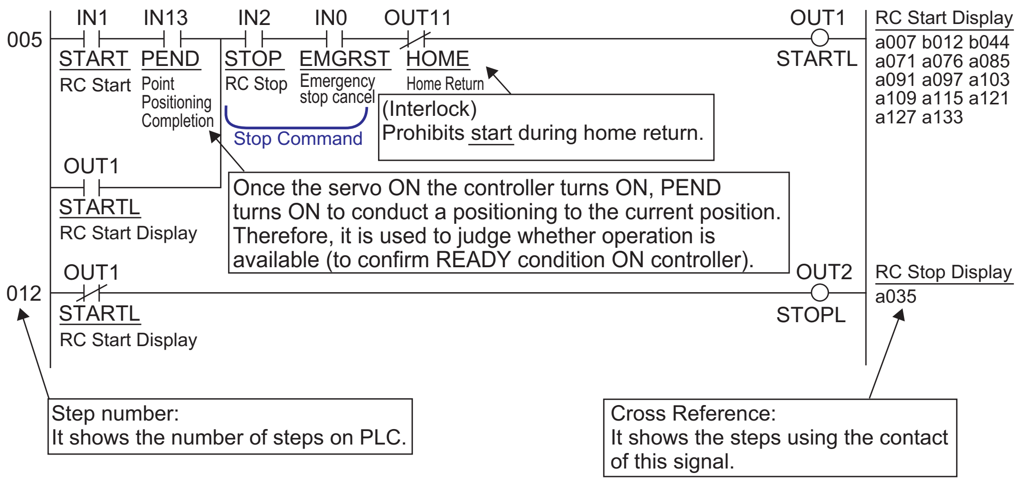
10.3.2 Ladder Sequence

[1] Servo ON (Emergency Stop) Circuit

1) It is presumed that the emergency stop release circuit installed in the operation box possesses the self-retaining circuit as shown in “2.1.3 [3] Emergency Stop Circuit”. When it comes to the emergency stop release condition, “Servo-on” signal from PLC to SCON turns ON.
2) Then if the emergency stop release state continues, the operation ready complete signal (sent from SCON to PLC) is turned on to go on the “Emergency stop release” lamp, which indicates that the actuator can be operated.



[2] Operation and Stop Circuit



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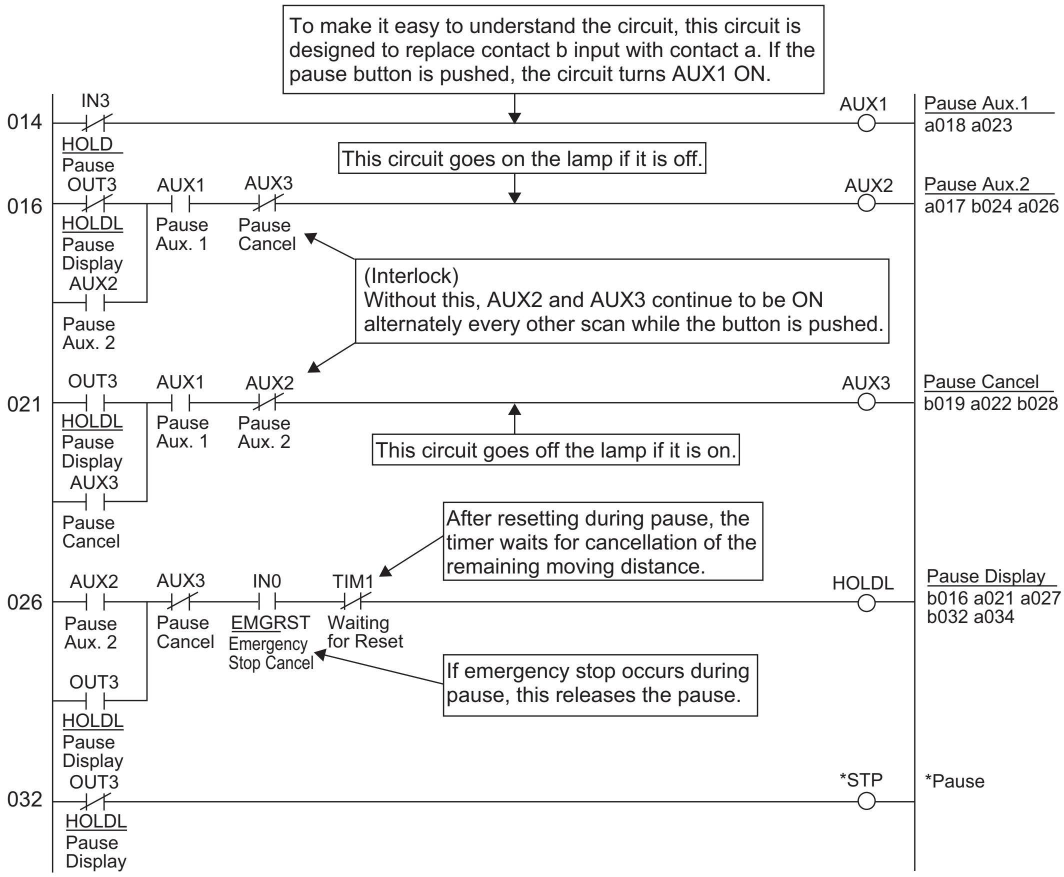
[3] Pause Circuit

Pause is provided by a single pushbutton. In a similar way as use of an alternate switch, push the button to make the actuator pause and push it again to release the pause of the actuator. Pushing the pushbutton leads the "pause command and pause lamp ON" state and pushing the pushbutton again brings "pause release command and pause lamp OFF".



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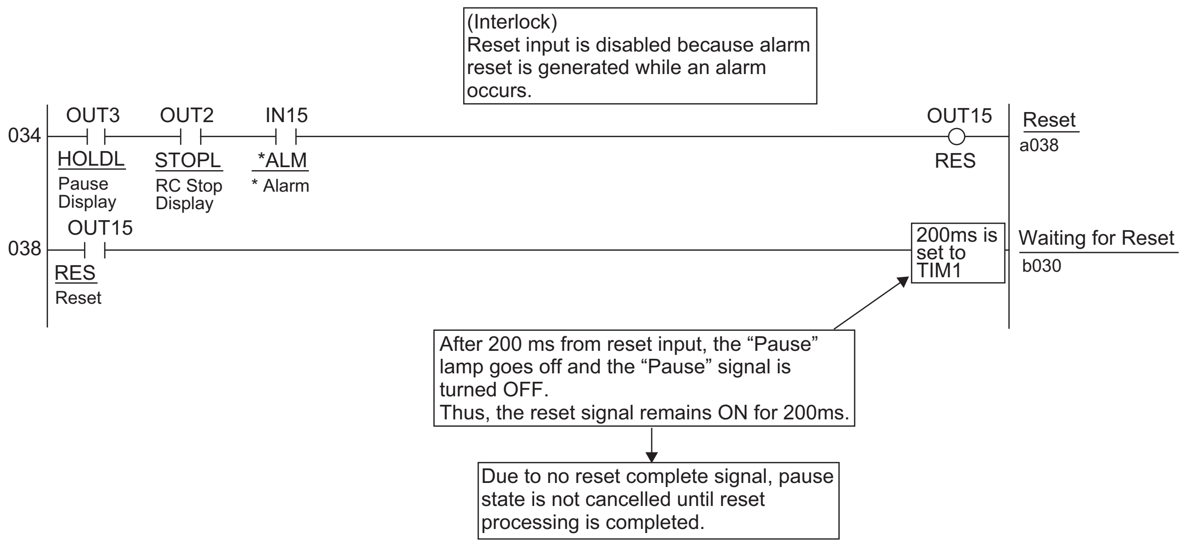
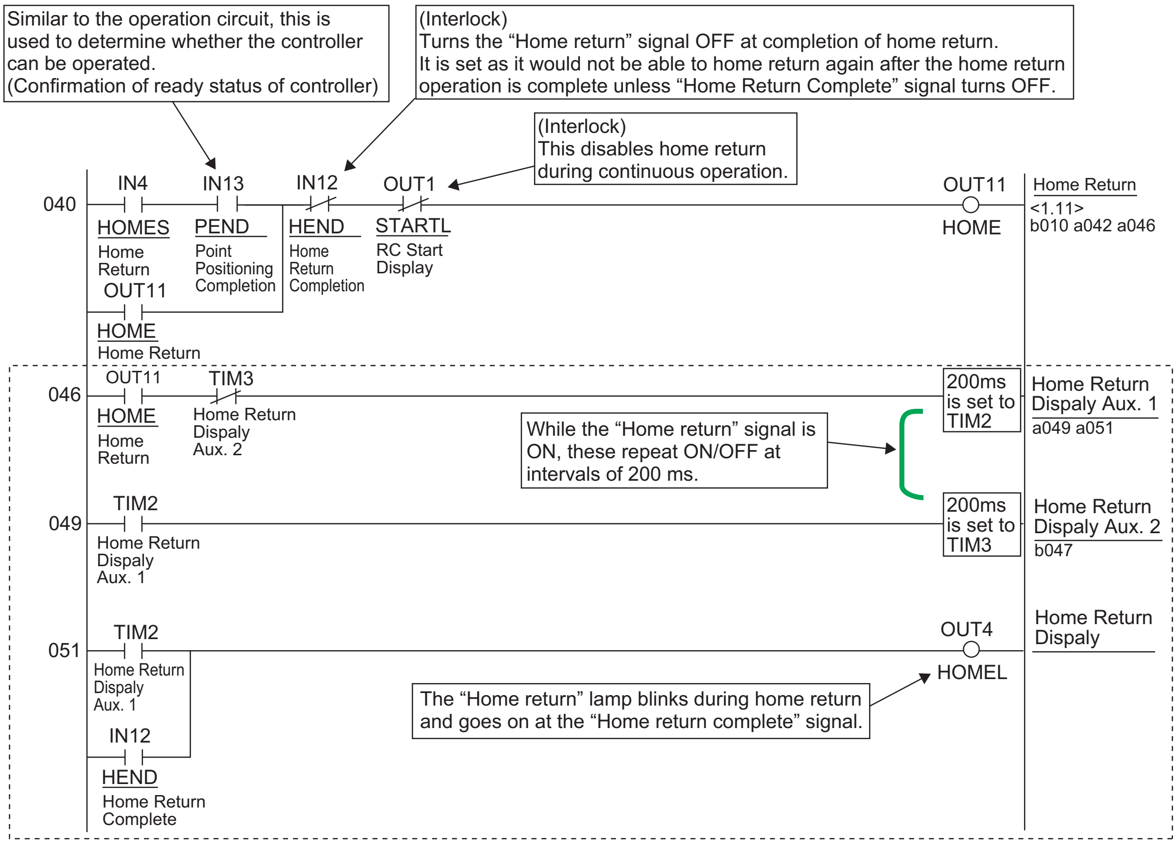
[4] Reset Circuit

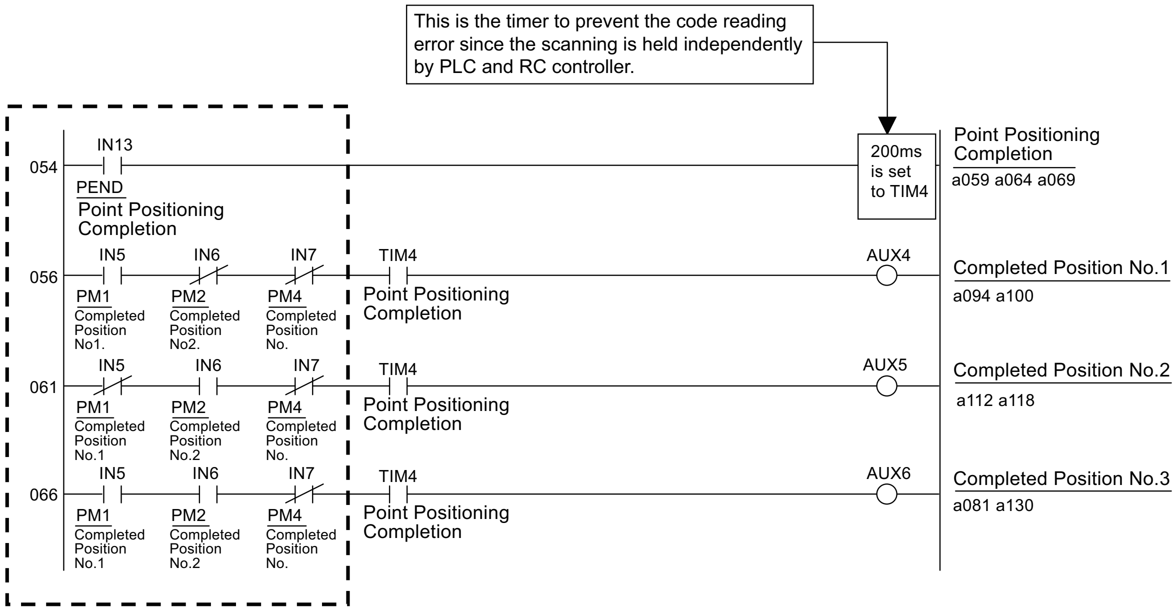
If the “Stop” button on the operation box is pushed during pause, the “Reset” signal sent from PLC to SCON is turned ON and the remaining moving distance is cancelled. In addition, this operation releases the pause. (It is because the pause is not required with no remaining moving distance.)



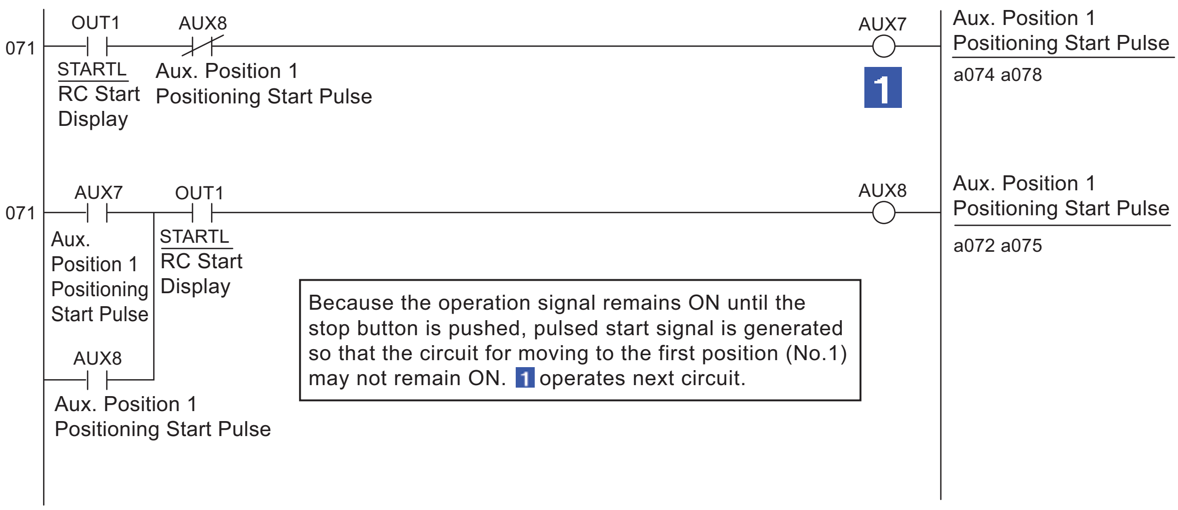
[5] Home Return Circuit



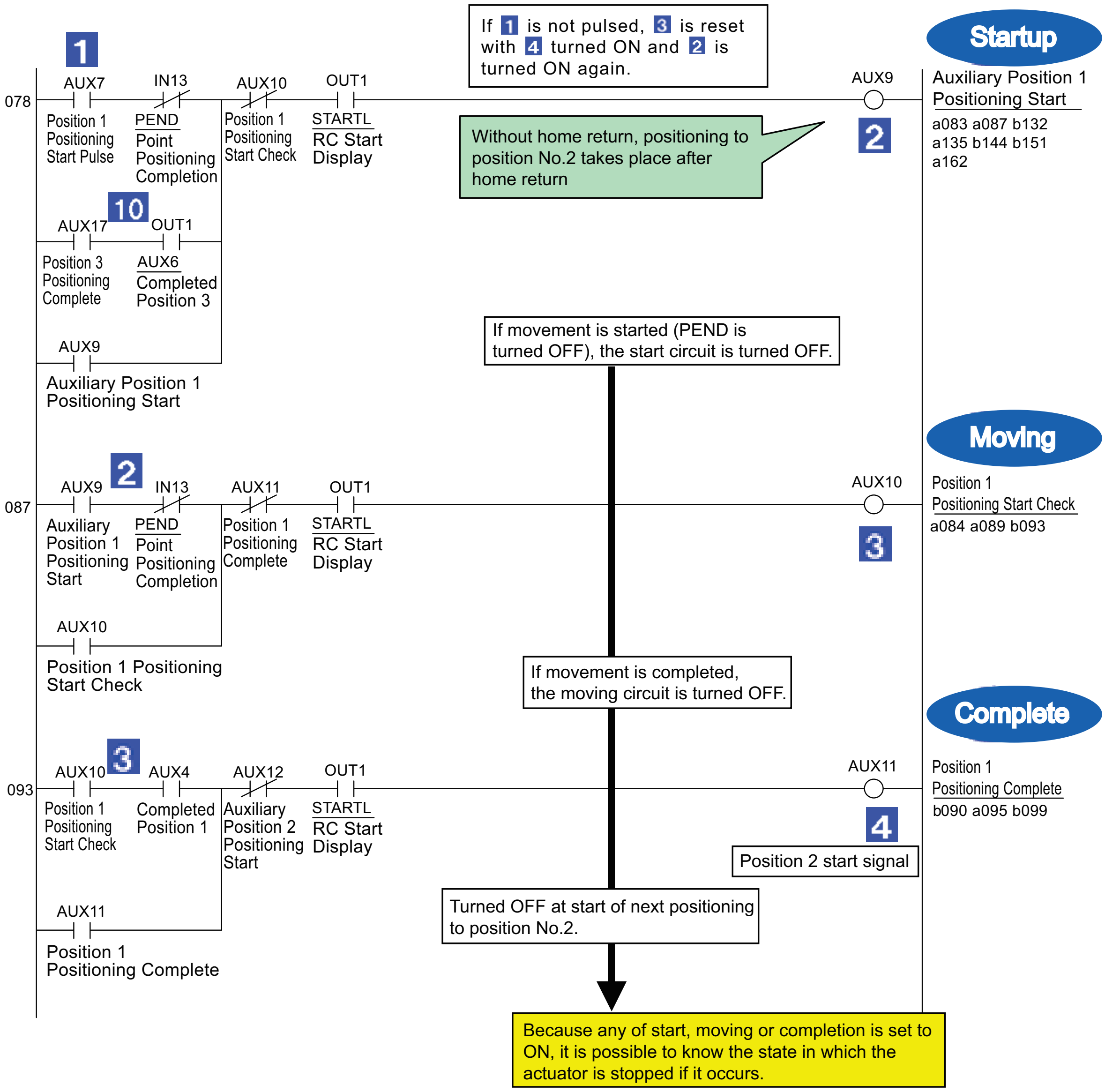
[6] Decode Circuit of Positioning Complete Position No.
The decode circuit converts the binary data of positioning complete position No. sent from SCON to PLC into the corresponding bit data.



[7] Actuator Start Circuit
If the "Operation" switch on the operation box is pushed, the lamp of the "Operation" pushbutton switch described in 11.3.3 Operation and Stop Circuit goes on and, at the same time, the actuator starts successive positioning of position No. 1→2→3→1→2•••. The circuit below is intended for the activation.

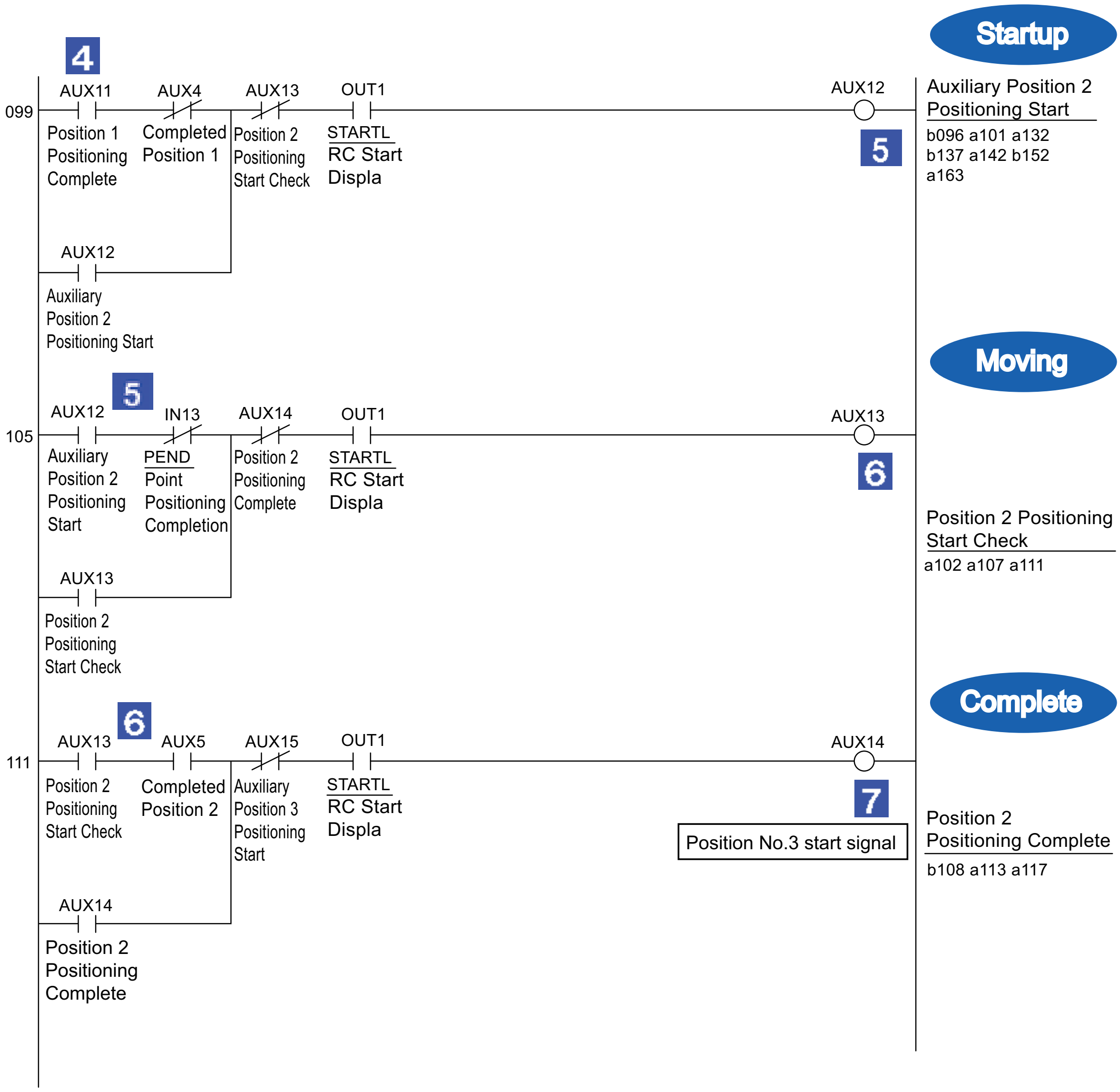


[8] Position 1 Operation Circuit
The main circuit is designed to process and manage signals “start” → “moving” → “positioning complete” to move the actuator to position No.1.



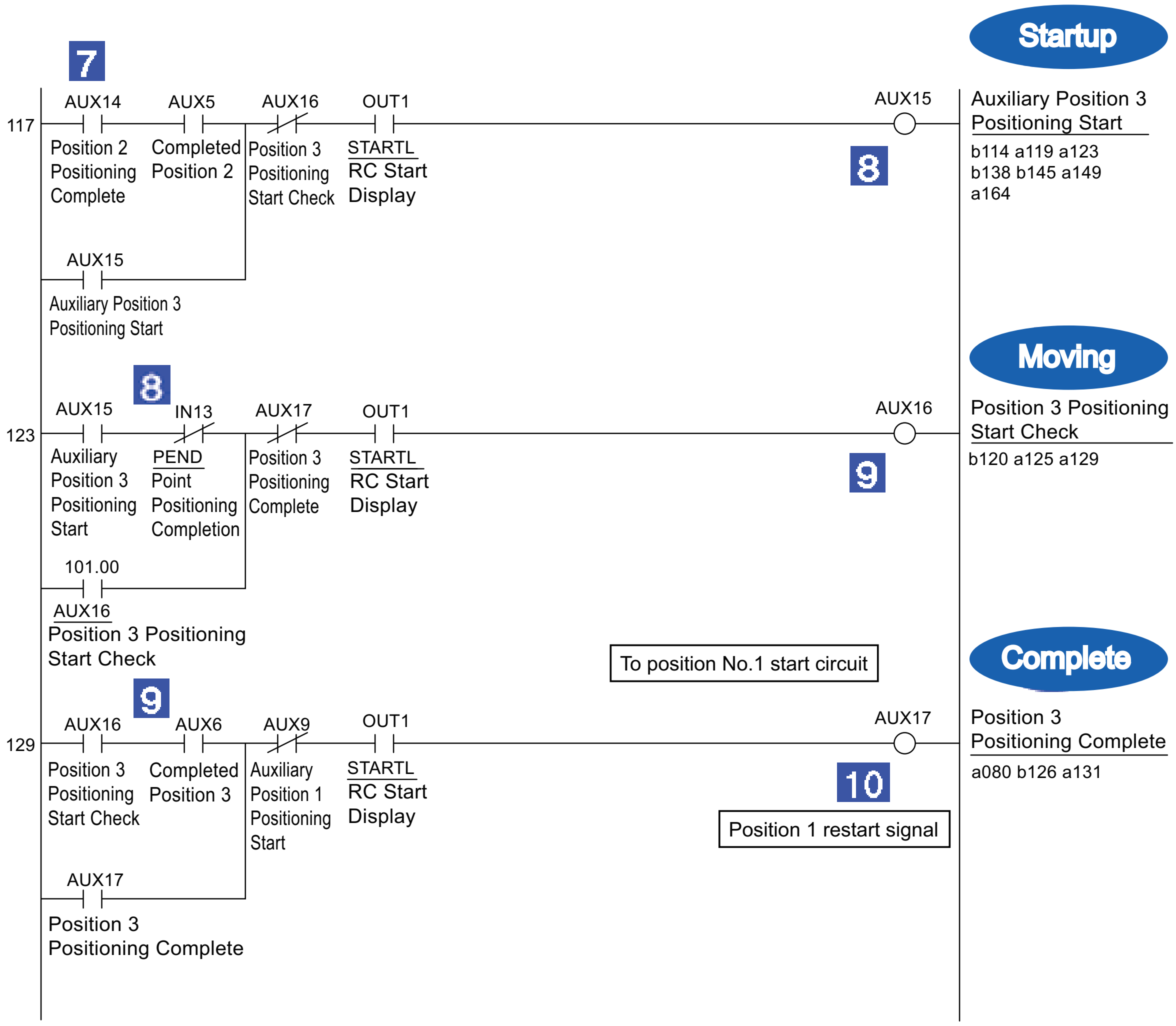
- Circuit **10** is designed to start positioning to position No.1 again after positioning to position No.3 is completed.
- If the “Operation” lamp goes off, the operation circuit is reset entirely. When the “Stop” button is pushed, the actuator will stop at completion of the operation being executed. At emergency stop, the actuator is stopped immediately (which is the function of SCON).

[9] Position 2 Operation Circuit
The main circuit is designed to process and manage signals “start” → “moving” → “positioning complete” to move the actuator to position No.2. This circuit indicates the same sequence as that of position No.1.



[10] Position 3 Operation Circuit

The main circuit is designed to process and manage signals "start" → "moving" → "positioning complete" to move the actuator to position No.3. This circuit indicates the same sequence as that of position No.1.



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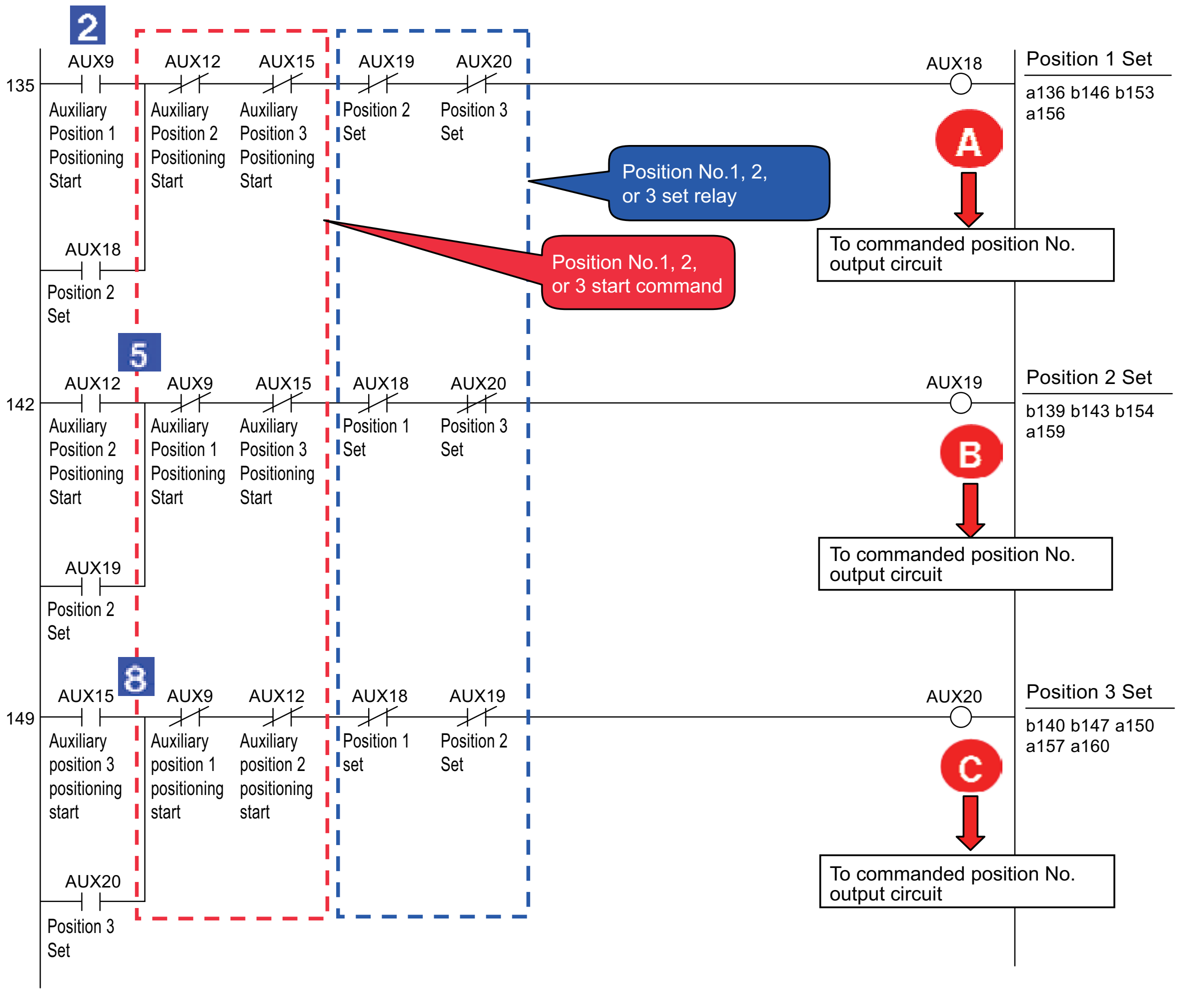
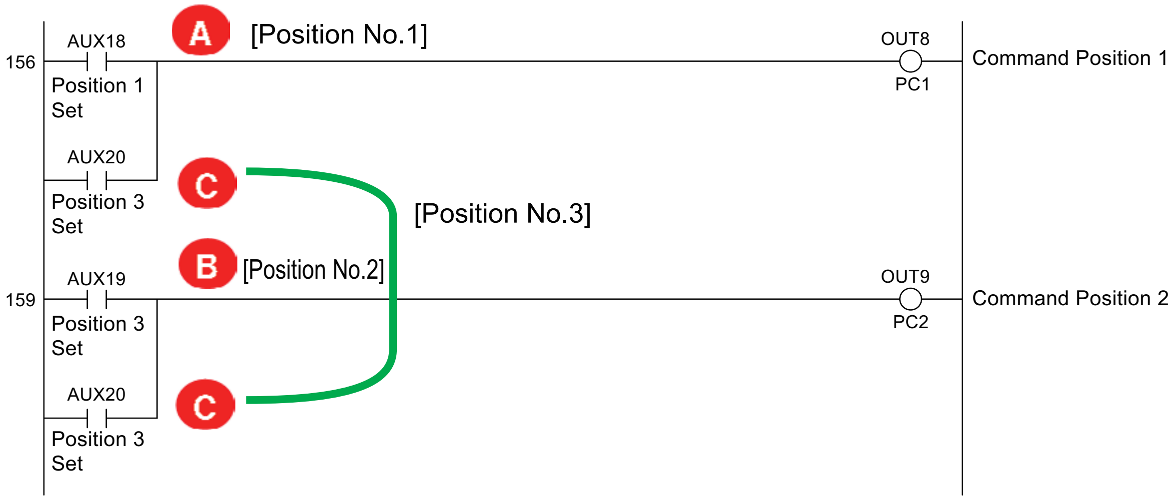
[11] Commanded Position No. Output Ready Circuit
The ready circuit is designed to hold start command and output commanded position No. in the binary code.
Interlock is taken so that position No. command may not be specified incorrectly.

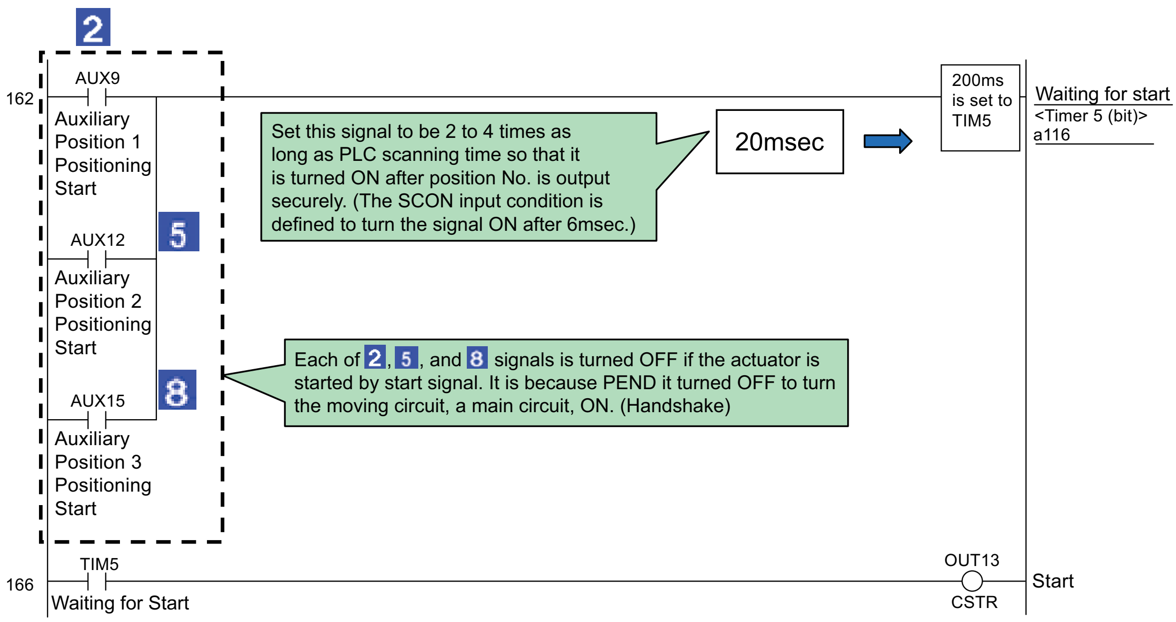


- Once a moving command to a position is issued, any of circuits A, B and C is turned ON to remember it unless a moving command to another position is issued. The operation circuit is cancelled by a stop command such as an emergency stop command. However, the circuit remembers the positions to which the actuator moved and the positions at which the actuator stopped until the cancellation. Such sequence design is also intended to cope with errors occurred and helpful to find the causes of the errors from circuit status, stop position inconsistency and other conditions.
- Taking interlock in both commands and results is usual means in circuit design to prevent results from being ON simultaneously. For example, if both SOLs in a solenoid valve of double SOL type are turned ON simultaneously, the coils are burned instantly. In another case, PLC executes a program in descending order but operations are not always done in the order. If you create a sequence program taking operation order into account, circuit change and/or addition due to debugging and specification change may cause the operation order to be modified without intention. Take interlock securely.

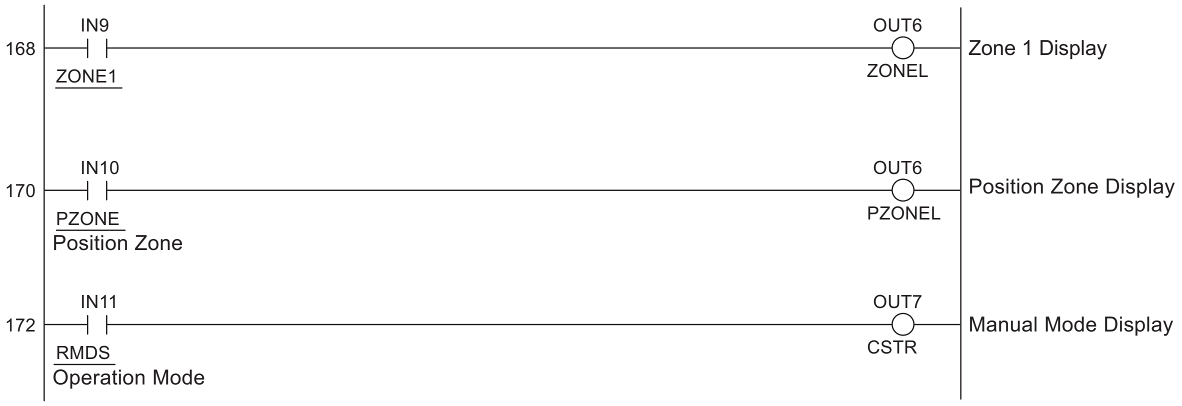
[12] Commanded Position No. Output Circuit
Depending on the result of the ready circuit, this circuit converts position No. to the binary code and outputs the data from PLC to SCON.



[13] Start Signal Output Circuit
After 20msec from the output of position No., this circuit outputs the start signal from PLC to SCON.



[14] Other Display Circuits (Zone 1, Position Zone, and Manual Mode)



[Reference]
Programs and functions of PLC are expressed differently depending on manufacturers. However, the contents of sequence designs do not vary fundamentally. Though arithmetic and data processing commands seem differently, any manufacturer defines command words executing the same functions as those of other manufacturers.

10.4 List of Specifications of Connectable Actuators

10.4.1 List of Specifications for Actuator Operation Conditions

Specifications described in the specification list are limited to the information required to set operation conditions and parameters. For other detailed specifications, refer to brochures and Instruction Manuals of actuators.

[Refer to 10.4.2 Specifications and Limitations in Pressing Operation of RCS2-RA13R.]

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
RCS2 (Rod Type)	RA4C (Note)	20	16384	12	Horizontal/ Vertical	600	0.3	–	–	–
				6		300	0.3	–	–	–
				3		150	0.2	–	–	–
		30		12		600	0.3	–	–	–
							High Accel/Decel Type : 1.0	–	–	–
				6		300	0.3	–	–	–
							High Accel/Decel Type : 1.0	–	–	–
				3		150	0.2	–	–	–
	RGS4C	20	16384	12	Horizontal/ Vertical	600	0.3	–	–	–
				6		300	0.3	–	–	–
				3		150	0.2	–	–	–
		30		12		600	0.3	–	–	–
							High Accel/Decel Type : 1.0	–	–	–
				6		300	0.3	–	–	–
							High Accel/Decel Type : 1.0	–	–	–
				3		150	0.2	–	–	–
	RGD4C	20	16384	12	Horizontal/ Vertical	600	0.3	–	–	–
				6		300	0.3	–	–	–
				3		150	0.2	–	–	–
		30		12		600	0.3	–	–	–
							High Accel/Decel Type : 1.0	–	–	–
				6		300	0.3	–	–	–
							High Accel/Decel Type : 1.0	–	–	–
				3		150	0.2	–	–	–
	RA4D	20	16384	12	Horizontal/ Vertical	600	0.3	–	–	–
				6		300	0.3	–	–	–
				3		150	0.2	–	–	–
		30		12		600	0.3	–	–	–
				6		300	0.3	–	–	–
				3		150	0.2	–	–	–
	RGS4D	20	16384	12	Horizontal/ Vertical	600	0.3	–	–	–
				6		300	0.3	–	–	–
				3		150	0.2	–	–	–
		30		12		600	0.3	–	–	–
				6		300	0.3	–	–	–
				3		150	0.2	–	–	–

(Note) The model type shown in the shaded box above is applicable for the off board tuning function. For the off board tuning function, refer to the instruction manual for RC PC Software.

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
RCS2 (Rod Type)	RGD4D	20	16384	12	Horizontal/ Vertical	600	0.3	–	–	–
				6		300	0.3	–	–	–
				3		150	0.2	–	–	–
		30		12		600	0.3	–	–	–
				6		300	0.3	–	–	–
				3		150	0.2	–	–	–
	RA4R	20	16384	12	Horizontal/ Vertical	600	0.3	–	–	–
				6		300	0.3	–	–	–
				3		150	0.2	–	–	–
		30		12		600	0.3	–	–	–
				6		300	0.3	–	–	–
				3		150	0.3	–	–	–
	RGD4R	20	16384	12	Horizontal/ Vertical	600	0.3	–	–	–
				6		300	0.3	–	–	–
				3		150	0.2	–	–	–
		30		12		600	0.3	–	–	–
				6		300	0.3	–	–	–
				3		150	0.2	–	–	–
	RA5C (Note)	60	16384	16	Horizontal/ Vertical	800 (at 50 to 250st) 755 (at 300st)	0.3	–	–	–
				8		400 (at 50 to 250st) 377 (at 300st)	0.3	–	–	–
				4		200 (at 50 to 250st) 188 (at 300st)	0.2	–	–	–
		100		16		800 (at 50 to 250st) 755 (at 300st)	0.3	–	–	–
							High Accel/Decel Type : 1.0	–	–	–
				8		400 (at 50 to 250st) 377 (at 300st)	0.3	–	–	–
							High Accel/Decel Type : 1.0	–	–	–
				4		200 (at 50 to 250st) 188 (at 300st)	0.2	–	–	–
	RGS5C	60	16384	12	Horizontal/ Vertical	800 (at 50 to 250st) 755 (at 300st)	0.3	–	–	–
				6		400 (at 50 to 250st) 377 (at 300st)	0.3	–	–	–
				3		200 (at 50 to 250st) 188 (at 300st)	0.2	–	–	–
		100		12		800 (at 50 to 250st) 755 (at 300st)	0.3	–	–	–
							High Accel/Decel Type : 1.0	–	–	–
				6		400 (at 50 to 250st) 377 (at 300st)	0.3	–	–	–
							High Accel/Decel Type : 1.0	–	–	–
				3		200 (at 50 to 250st) 188 (at 300st)	0.2	–	–	–

(Note) The model type shown in the shaded box above is applicable for the off board tuning function.
For the off board tuning function, refer to the instruction manual for RC PC Software.

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
RCS2 (Rod Type)	RGD5C	60	16384	16	Horizontal/ Vertical	800 (at 50 to 250st) 755 (at 300st)	0.3	–	–	–
				8		400 (at 50 to 250st) 377 (at 300st)	0.3	–	–	–
				4		200 (at 50 to 250st) 188 (at 300st)	0.2	–	–	–
		100		16		800 (at 50 to 250st) 755 (at 300st)	0.3	–	–	–
				8		400 (at 50 to 250st) 377 (at 300st)	0.3	–	–	–
				4		200 (at 50 to 250st) 188 (at 300st)	0.2	–	–	–
	RA5R	60	16384	16	Horizontal/ Vertical	800 (at 50 to 250st) 755 (at 300st)	0.3	–	–	–
				8		400 (at 50 to 250st) 377 (at 300st)	0.3	–	–	–
				4		200 (at 50 to 250st) 188 (at 300st)	0.2	–	–	–
	RA7AD	60	3072	12	Horizontal/ Vertical	600 (at 50 to 250st) 505 (at 300st)	0.15	–	–	–
				6		300 (at 50 to 250st) 250 (at 300st)	0.1	–	–	–
				3		150 (at 50 to 250st) 125 (at 300st)	0.05	–	–	–
		100		12		600 (at 50 to 250st) 505 (at 300st)	0.2	–	–	–
				6		300 (at 50 to 250st) 250 (at 300st)	0.1	–	–	–
	RGS7AD	60	3072	12	Horizontal/ Vertical	600 (at 50 to 250st) 505 (at 300st)	0.15	–	–	–
				6		300 (at 50 to 250st) 250 (at 300st)	0.1	–	–	–
				3		150 (at 50 to 250st) 125 (at 300st)	0.05	–	–	–
		100		12		600 (at 50 to 250st) 505 (at 300st)	0.2	–	–	–
				6		300 (at 50 to 250st) 250 (at 300st)	0.1	–	–	–

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
RCS2 (Rod Type)	RGD7AD	60	3072	12	Horizontal/ Vertical	600 (at 50 to 250st) 505 (at 300st)	0.15	–	–	–
				6		300 (at 50 to 250st) 250 (at 300st)	0.1	–	–	–
				3		150 (at 50 to 250st) 125 (at 300st)	0.05	–	–	–
		100		12		600 (at 50 to 250st) 505 (at 300st)	0.2	–	–	–
				6		300 (at 50 to 250st) 250 (at 300st)	0.1	–	–	–
	SRA7BD	60	3072	16	Horizontal/ Vertical	800	0.25	–	–	–
				8		400	0.15	–	–	–
				4		200	0.05	–	–	–
		100		16		800	0.3	–	–	–
				8		400	0.2	–	–	–
				4		200	0.1	–	–	–
		150		16		800	0.3	–	–	–
				8		400	0.2	–	–	–
				4		200	0.1	–	–	–
	SRGS7BD	60	3072	16	Horizontal/ Vertical	800	0.25	–	–	–
				8		400	0.15	–	–	–
				4		200	0.05	–	–	–
		100		16		800	0.3	–	–	–
				8		400	0.2	–	–	–
				4		200	0.1	–	–	–
		150		16		800	0.3	–	–	–
				8		400	0.2	–	–	–
				4		200	0.1	–	–	–
	SRGD7BD	60	3072	16	Horizontal/ Vertical	800	0.25	–	–	–
				8		400	0.15	–	–	–
				4		200	0.05	–	–	–
		100		16		800	0.3	–	–	–
				8		400	0.2	–	–	–
				4		200	0.1	–	–	–
		150		16		800	0.3	–	–	–
				8		400	0.2	–	–	–
				4		200	0.1	–	–	–
	RA13R	750	16384	2.5	Horizontal/ Vertical	85 (at 50st) 120 (at 100st) 125 (at 150/200st)	0.02	1000	9800	10
				1.25		62	0.01	2000	19600	10

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
RCS2 (Slider Type)	SA4C (Note)	20	16384	10	Horizontal/ Vertical	665	0.3	–	–	–
							High Accel/Decel Type : 1.0	–	–	–
				5		330	0.3	–	–	–
							High Accel/Decel Type : 1.0	–	–	–
				2.5		165	0.2	–	–	–
	SA4D (Note)	20	16384	10	Horizontal/ Vertical	665	0.3	–	–	–
				5		330	0.3	–	–	–
				2.5		165	0.2	–	–	–
	SA4R (Note)	20	16384	10	Horizontal/ Vertical	665	0.3	–	–	–
				5		330	0.3	–	–	–
				2.5		165	0.2	–	–	–
	SA5C (Note)	20	16384	20	Horizontal	1000 (at 50 to 550st) 980 (at 600st)	High Accel/Decel Type : 0.8	–	–	–
					Vertical	800	0.2	–	–	–
				12	Horizontal/ Vertical	800 (at 50 to 450st) 760 (at 500st)	0.3	–	–	–
							High Accel/Decel Type : 0.8	–	–	–
				6		400 (at 50 to 450st) 380 (at 500st)	0.3	–	–	–
							High Accel/Decel Type : 0.8	–	–	–
				3		200 (at 50 to 450st) 190 (at 500st)	0.2	–	–	–
	SA5D (Note)	20	16384	12	Horizontal/ Vertical	800 (at 50 to 450st) 760 (at 500st)	0.3	–	–	–
				6		400 (at 50 to 450st) 380 (at 500st)	0.3	–	–	–
				3		200 (at 50 to 450st) 190 (at 500st)	0.2	–	–	–
	SA5R (Note)	20	16384	12	Horizontal/ Vertical	800 (at 50 to 450st) 760 (at 500st)	0.3	–	–	–
				6		400 (at 50 to 450st) 380 (at 500st)	0.3	–	–	–
				3		200 (at 50 to 450st) 190 (at 500st)	0.2	–	–	–

(Note) The model type shown in the shaded box above is applicable for the off board tuning function.
For the off board tuning function, refer to the instruction manual for RC PC Software.

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
RCS2 (Slider Type)	SA6C (Note)	30	16384	20	Horizontal	1300 (at 50 to 500st) 1160 (at 550st) 990 (at 600st)	High Accel/Decel Type : 1.0	–	–	–
					Vertical	800	0.2	–	–	–
				12	Horizontal/ Vertical	800 (at 50 to 450st) 760 (at 500st) 640 (at 550st) 540 (at 600st)	0.3	–	–	–
							High Accel/Decel Type : 1.0	–	–	–
				6		400 (at 50 to 450st) 380 (at 500st) 320 (at 550st) 270 (at 600st)	0.3	–	–	–
							High Accel/Decel Type : 1.0	–	–	–
				3		200 (at 50 to 450st) 190 (at 500st) 160 (at 550st) 135 (at 600st)	0.2	–	–	–
	SA6D (Note)	30	16384	12	Horizontal/ Vertical	800 (at 50 to 450st) 760 (at 500st) 640 (at 550st) 540 (at 600st)	0.3	–	–	–
				6		400 (at 50 to 450st) 380 (at 500st) 320 (at 550st) 270 (at 600st)	0.3	–	–	–
				3		200 (at 50 to 450st) 190 (at 500st) 160 (at 550st) 135 (at 600st)	0.2	–	–	–
	SA6R (Note)	30	16384	12	Horizontal/ Vertical	800 (at 50 to 450st) 760 (at 500st) 640 (at 550st) 540 (at 600st)	0.3	–	–	–
				6		400 (at 50 to 450st) 380 (at 500st) 320 (at 550st) 270 (at 600st)	0.3	–	–	–
				3		200 (at 50 to 450st) 190 (at 500st) 160 (at 550st) 135 (at 600st)	0.2	–	–	–
	SA7C (Note)	60	16384	16	Horizontal/ Vertical	800 (at 50 to 600st) 640 (at 700st) 480 (at 800st)	0.3	–	–	–
							High Accel/Decel Type : 1.0	–	–	–
				8		400 (at 50 to 650st) 320 (at 700st) 240 (at 800st)	0.3	–	–	–
							High Accel/Decel Type : 0.8	–	–	–
				4		200 (at 50 to 650st) 160 (at to 700st) 120 (at to 800st)	0.2	–	–	–

(Note) The model type shown in the shaded box above is applicable for the off board tuning function.
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Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
RCS2 (Slider Type)	SA7R (Note)	60	16384	16	Horizontal/ Vertical	800 (at 50 to 600st) 640 (at 700st) 480 (at 800st)	0.3	–	–	–
				8		400 (at 50 to 650st) 320 (at 700st) 240 (at 800st)	0.3	–	–	–
				4		200 (at 50 to 650st) 160 (at to 700st) 120 (at to 800st)	0.2	–	–	–
	SS7C (Note)	60	16384	12	Horizontal/ Vertical	600 (at 50 to 500st) 470 (at to 600st)	0.3	–	–	–
				6		300 (at 50 to 500st) 230 (at to 600st)	0.3	–	–	–
	SS7R (Note)	60	16384	12	Horizontal/ Vertical	600 (at 50 to 500st) 470 (at to 600st)	0.3	–	–	–
				6		300 (at 50 to 500st) 230 (at to 600st)	0.3	–	–	–

(Note) The model type shown in the shaded box above is applicable for the off board tuning function.
For the off board tuning function, refer to the instruction manual for RC PC Software.

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
RCS2 (Slider Type)	SS8C	100	16384	20	Horizontal/ Vertical	1000 (at 50 to 600st) 960 (at to 700st) 765 (at to 800st) 625 (at to 900st) 515 (at to 1000st)	0.3	–	–	–
				10		500 (at 50 to 600st) 480 (at to 700st) 380 (at to 800st) 310 (at to 900st) 255 (at to 1000st)	0.3	–	–	–
		150		20		1000 (at 50 to 600st) 960 (at to 700st) 765 (at to 800st) 625 (at to 900st) 515 (at to 1000st)	0.3	–	–	–
				10		500 (at 50 to 600st) 480 (at to 700st) 380 (at to 800st) 310 (at to 900st) 255 (at to 1000st)	0.3	–	–	–
	SS8R	100	16384	20	Horizontal/ Vertical	1000 (at 50 to 600st) 960 (at to 700st) 765 (at to 800st) 625 (at to 900st) 515 (at to 1000st)	0.3	–	–	–
		150		10		500 (at 50 to 600st) 480 (at to 700st) 380 (at to 800st) 310 (at to 900st) 255 (at to 1000st)	0.3	–	–	–

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
RCS3 (Slider Type)	SA8 (Note)	100	16384	5	Horizontal/ Vertical	300 (at 50 to 650st) 260 (at to 700st) 230 (at to 750st) 200 (at to 800st) 180 (at to 850st) 170 (at to 900st) 150 (at to 950st) 135 (at to 1000st) 120 (at to 1050st) 110 (at to 1100st)	0.3	–	–	–
				10		600 (at 50 to 650st) 530 (at to 700st) 470 (at to 750st) 410 (at to 800st) 370 (at to 850st) 340 (at to 900st) 310 (at to 950st) 270 (at to 1000st) 250 (at to 1050st) 230 (at to 1100st)	0.5	–	–	–
				20	Horizontal/ Vertical	1200 (at 50 to 650st) 1070 (at to 700st) 940 (at to 750st) 840 (at to 800st) 750 (at to 850st) 670 (at to 900st) 610 (at to 950st) 550 (at to 1000st) 500 (at to 1050st) 460 (at to 1100st)	0.7	–	–	–

(Note) The model type shown in the shaded box above is applicable for the off board tuning function.
For the off board tuning function, refer to the instruction manual for RC PC Software.

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
RCS3 (Slider Type)	SA8 (Note)	100	16384	30	Horizontal	1800 (at 50 to 650st) 1610 (at to 700st) 1420 (at to 750st) 1260 (at to 800st) 1120 (at to 850st) 1010 (at to 900st) 910 (at to 950st) 830 (at to 1000st) 760 (at to 1050st) 690 (at to 1100st)	1.0	–	–	–
					Vertical		0.7	–	–	–
		150		10	Horizontal/ Vertical	600 (at 50 to 650st) 530 (at to 700st) 470 (at to 750st) 410 (at to 800st) 370 (at to 850st) 340 (at to 900st) 310 (at to 950st) 270 (at to 1000st) 250 (at to 1050st) 230 (at to 1100st)	0.5	–	–	–
				20	Horizontal/ Vertical	1200 (at 50 to 650st) 1070 (at to 700st) 940 (at to 750st) 840 (at to 800st) 750 (at to 850st) 670 (at to 900st) 610 (at to 950st) 550 (at to 1000st) 500 (at to 1050st) 460 (at to 1100st)	0.7	–	–	–

(Note) The model type shown in the shaded box above is applicable for the off board tuning function.
For the off board tuning function, refer to the instruction manual for RC PC Software.

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
RCS3 (Slider Type)	SA8 (Note)	150	16384	30	Horizontal	1800 (at 50 to 650st) 1610 (at to 700st) 1420 (at to 750st) 1260 (at to 800st) 1120 (at to 850st) 1010 (at to 900st) 910 (at to 950st) 830 (at to 1000st) 760 (at to 1050st) 690 (at to 1100st)	1.0	–	–	–
					Vertical		0.7	–	–	–
	SS8 (Note)	100	16384	5	Horizontal/ Vertical	300 (at 50 to 600st) 275 (at to 650st) 240 (at to 700st) 215 (at to 750st) 190 (at to 800st) 170 (at to 850st) 150 (at to 900st) 140 (at to 950st) 125 (at to 1000st)	0.3	–	–	–

(Note) The model type shown in the shaded box above is applicable for the off board tuning function.
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Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
RCS3 (Slider Type)	SS8 (Note)	100	16384	10	Horizontal/ Vertical	600 (at 50 to 600st) 550 (at to 650st) 485 (at to 700st) 430 (at to 750st) 385 (at to 800st) 345 (at to 850st) 310 (at to 900st) 280 (at to 950st) 255 (at to 1000st)	0.5	–	–	–
				20		1200 (at 50 to 600st) 1105 (at to 650st) 970 (at to 700st) 860 (at to 750st) 770 (at to 800st) 690 (at to 850st) 625 (at to 900st) 565 (at to 950st) 515 (at to 1000st)	0.7	–	–	–
				30	Horizontal	1800 (at 50 to 600st) 1660 (at to 650st) 1460 (at to 700st) 1295 (at to 750st) 1155 (at to 800st) 1035 (at to 850st) 935 (at to 900st) 850 (at to 950st) 775 (at to 1000st)	1.0	–	–	–
					Vertical		0.7	–	–	–

(Note) The model type shown in the shaded box above is applicable for the off board tuning function.
For the off board tuning function, refer to the instruction manual for RC PC Software.

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
RCS3 (Slider Type)	SS8 (Note)	150	16384	10	Horizontal/ Vertical	600 (at 50 to 600st) 550 (at to 650st) 485 (at to 700st) 430 (at to 750st) 385 (at to 800st) 345 (at to 850st) 310 (at to 900st) 280 (at to 950st) 255 (at to 1000st)	0.5	–	–	–
				20		1200 (at 50 to 600st) 1105 (at to 650st) 970 (at to 700st) 860 (at to 750st) 770 (at to 800st) 690 (at to 850st) 625 (at to 900st) 565 (at to 950st) 515 (at to 1000st)	0.7	–	–	–
				30	Horizontal	1800 (at 50 to 600st) 1660 (at to 650st) 1460 (at to 700st) 1295 (at to 750st) 1155 (at to 800st) 1035 (at to 850st) 935 (at to 900st) 850 (at to 950st) 775 (at to 1000st)	1.0	–	–	–
					Vertical		0.7	–	–	–

(Note) The model type shown in the shaded box above is applicable for the off board tuning function.
For the off board tuning function, refer to the instruction manual for RC PC Software.

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
RCS3CR (Slider Type)	SA8 (Note)	100	16384	5	Horizontal/ Vertical	300 (at 50 to 650st) 250 (at to 700st) 220 (at to 750st) 190 (at to 800st) 170 (at to 850st) 160 (at to 900st) 140 (at to 950st) 130 (at to 1000st) 120 (at to 1050st) 110 (at to 1100st)	0.3	–	–	–
				10		600 (at 50 to 650st) 500 (at to 700st) 440 (at to 750st) 390 (at to 800st) 350 (at to 850st) 320 (at to 900st) 290 (at to 950st) 260 (at to 1000st) 240 (at to 1050st) 220 (at to 1100st)	0.5	–	–	–
				20		1200 (at 50 to 650st) 1010 (at to 700st) 890 (at to 750st) 790 (at to 800st) 710 (at to 850st) 640 (at to 900st) 580 (at to 950st) 530 (at to 1000st) 480 (at to 1050st) 440 (at to 1100st)	0.7	–	–	–

(Note) The model type shown in the shaded box above is applicable for the off board tuning function.
For the off board tuning function, refer to the instruction manual for RC PC Software.

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
RCS3CR (Slider Type)	SA8 (Note)	100	16384	30	Horizontal	1800 (at 50 to 650st) 1510 (at to 700st) 1340 (at to 750st) 1190 (at to 800st) 1070 (at to 850st) 960 (at to 900st) 870 (at to 950st) 790 (at to 1000st) 720 (at to 1050st) 660 (at to 1100st)	1.0	–	–	–
					Vertical		0.7	–	–	–
		150	16384	10	Horizontal/ Vertical	600 (at 50 to 650st) 500 (at to 700st) 440 (at to 750st) 390 (at to 800st) 350 (at to 850st) 320 (at to 900st) 290 (at to 950st) 260 (at to 1000st) 240 (at to 1050st) 220 (at to 1100st)	0.5	–	–	–
				20		1200 (at 50 to 650st) 1010 (at to 700st) 890 (at to 750st) 790 (at to 800st) 710 (at to 850st) 640 (at to 900st) 580 (at to 950st) 530 (at to 1000st) 480 (at to 1050st) 440 (at to 1100st)	0.7	–	–	–

(Note) The model type shown in the shaded box above is applicable for the off board tuning function.
For the off board tuning function, refer to the instruction manual for RC PC Software.

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
RCS3CR (Slider Type)	SA8 (Note)	150	16384	30	Horizontal	1800 (at 50 to 650st) 1510 (at to 700st) 1340 (at to 750st) 1190 (at to 800st) 1070 (at to 850st) 960 (at to 900st) 870 (at to 950st) 790 (at to 1000st) 720 (at to 1050st) 660 (at to 1100st)	1.0	–	–	–
					Vertical		0.7	–	–	–
	SS8 (Note)	100	16384	5	Horizontal/ Vertical	300 (at 50 to 600st) 275 (at to 650st) 240 (at to 700st) 215 (at to 750st) 190 (at to 800st) 170 (at to 850st) 150 (at to 900st) 140 (at to 950st) 125 (at to 1000st)	0.3	–	–	–
				10		600 (at 50 to 600st) 550 (at to 650st) 485 (at to 700st) 430 (at to 750st) 385 (at to 800st) 345 (at to 850st) 310 (at to 900st) 280 (at to 950st) 255 (at to 1000st)	0.5	–	–	–

(Note) The model type shown in the shaded box above is applicable for the off board tuning function.
For the off board tuning function, refer to the instruction manual for RC PC Software.

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
RCS3CR (Slider Type)	SS8 (Note)	100	16384	20	Horizontal/ Vertical	1200 (at 50 to 600st) 1105 (at to 650st) 970 (at to 700st) 860 (at to 750st) 770 (at to 800st) 690 (at to 850st) 625 (at to 900st) 565 (at to 950st) 515 (at to 1000st)	0.7	–	–	–
RCS3CR (Slider Type)	SS8 (Note)	100	16384	30	Horizontal	1800 (at 50 to 600st) 1660 (at to 650st) 1460 (at to 700st) 1295 (at to 750st) 1155 (at to 800st) 1035 (at to 850st) 935 (at to 900st) 850 (at to 950st) 775 (at to 1000st)	1.0	–	–	–
RCS3CR (Slider Type)	SS8 (Note)	100	16384	30	Vertical		0.7	–	–	–
RCS3CR (Slider Type)	SS8 (Note)	150	16384	10	Horizontal/ Vertical	600 (at 50 to 600st) 550 (at to 650st) 485 (at to 700st) 430 (at to 750st) 385 (at to 800st) 345 (at to 850st) 310 (at to 900st) 280 (at to 950st) 255 (at to 1000st)	0.5	–	–	–

(Note) The model type shown in the shaded box above is applicable for the off board tuning function.
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Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
RCS3CR (Slider Type)	SS8 (Note)	150	16384	20	Horizontal/ Vertical	1200 (at 50 to 600st) 1105 (at to 650st) 970 (at to 700st) 860 (at to 750st) 770 (at to 800st) 690 (at to 850st) 625 (at to 900st) 565 (at to 950st) 515 (at to 1000st)	0.7	–	–	–
				30	Horizontal	1800 (at 50 to 600st) 1660 (at to 650st) 1460 (at to 700st) 1295 (at to 750st) 1155 (at to 800st) 1035 (at to 850st) 935 (at to 900st) 850 (at to 950st) 775 (at to 1000st)	1.0	–	–	–
					Vertical		0.7	–	–	–
RCS2 (Arm Type)	A4R	20	16384	10	Horizontal/ Vertical	330	0.2	–	–	–
				5		165	0.2	–	–	–
	A5R	20	16384	12	Horizontal/ Vertical	400	0.2	–	–	–
				6		200	0.2	–	–	–
	A6R	30	16384	12	Horizontal/ Vertical	400	0.2	–	–	–
				6		200	0.2	–	–	–
RCS2 (Gripper Type)	GR8	60	16384	Gear Ratio 1/5	-	400	0.3	–	–	–
RCS2 (Flat Type)	F5D	60	16384	16	Horizontal/ Vertical	800	0.3	–	–	–
				8		400	0.3	–	–	–
				4		200	0.2	–	–	–
		100		16		800	0.3	–	–	–
				8		400	0.3	–	–	–
				4		200	0.2	–	–	–

(Note) The model type shown in the shaded box above is applicable for the off board tuning function.
For the off board tuning function, refer to the instruction manual for RC PC Software.

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
RCS2 (Rotary Type)	RT6	60	16384	Gear Ratio 1/18	–	500 deg/s	–	–	–	–
	RT6R	60	16384	Gear Ratio 1/18	–	500 deg/s	–	–	–	–
	RT7R	60	16384	Gear Ratio 1/4	–	500 deg/s	–	–	–	–
	RTC8L	12	16384	Gear Ratio 1/24	–	750 deg/s	–	–	–	–
	RTC8HL	20	16384	Gear Ratio 1/15	–	1200 deg/s	–	–	–	–
				Gear Ratio 1/24	–	750 deg/s				
	RTC10L	60	16384	Gear Ratio 1/15	–	1200 deg/s	–	–	–	–
				Gear Ratio 1/24	–	750 deg/s				
	RTC12L	150	16384	Gear Ratio 1/18	–	800 deg/s	–	–	–	–
				Gear Ratio 1/30	–	600 deg/s				
ISA ISPA (Slider Type)	SXM SYM	60	16384	16	Horizontal	800	1.0	–	–	–
					Vertical		0.7	–	–	–
				8	Horizontal	400	0.6	–	–	–
					Vertical		0.5	–	–	–
				4	Horizontal	200	0.5	–	–	–
					Vertical		0.3	–	–	–
	SZM	60	16384	8	Vertical	400	0.3	–	–	–
				4	Vertical	200	0.3	–	–	–
	MXM MYM	100	16384	20	Horizontal	1000 (at 100 to 700st) 795 (at to 800st) 645 (at to 900st) 540 (at to 1000st)	1.0	–	–	–
					Vertical		0.8	–	–	–
				10	Horizontal	500 (at 100 to 600st) 480 (at to 700st) 380 (at to 800st) 310 (at to 900st) 255 (at to 1000st)	0.6	–	–	–
					Vertical		0.5	–	–	–
				5	Horizontal	250 (at 100 to 600st) 220 (at to 700st) 175 (at to 800st) 145 (at to 900st) 120 (at to 1000st)	0.5	–	–	–
					Vertical		0.3	–	–	–

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
ISA ISPA (Slider Type)	MZM	100	16384	10	Vertical	500 (at 100 to 600st) 480 (at to 700st) 380 (at 800st) 310 (at 900st) 255 (at 1000st)	0.5	–	–	–
				5	Vertical	250 (at 100 to 600st) 220 (at to 700st) 175 (at 800st) 145 (at 900st) 120 (at 1000st)	0.3	–	–	–
	MXM MYM	200	16384	30	Horizontal	1500 (at 100 to 700st) 1190 (at to 800st) 965 (at to 900st) 810 (at to 1000st)	1.0	–	–	–
					Vertical		1.0	–	–	–
				20	Horizontal	1000 (at 100 to 700st) 795 (at to 800st) 645 (at to 900st) 540 (at to 1000st)	1.0	–	–	–
					Vertical		0.8	–	–	–
				10	Horizontal	500 (at 100 to 600st) 480 (at to 700st) 380 (at to 800st) 310 (at to 900st) 255 (at to 1000st)	0.6	–	–	–
					Vertical		0.5	–	–	–
	MZM	200	16384	10	Vertical	500 (at 100 to 600st) 480 (at to 700st) 380 (at 800st) 310 (at 900st) 255 (at 1000st)	0.5	–	–	–

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
ISA ISPA (Slide Type)	MXMX	200	16384	30	Horizontal	1500 (at 800 to 1300st) 1425 (at 1400st) 1200 (at 1500st) 1050 (at 1600st) 900 (at 1700st) 825 (at 1800st) 750 (at 1900st) 675 (at 2000st)	0.3	–	–	–
				20	Horizontal	1000 (at 800 to 1300st) 950 (at 1400st) 800 (at 1500st) 700 (at 1600st) 600 (at 1700st) 550 (at 1800st) 500 (at 1900st) 450 (at 2000st)	0.3	–	–	–
	LXM LYM	200	16384	20	Horizontal	1000 (at 100 to 800st) 830 (at to 900st) 690 (at to 1000st) 585 (at to 1100st) 500 (at to 1200st)	1.0	–	–	–
					Vertical		0.8	–	–	–
				10	Horizontal	500 (at 100 to 700st) 470 (at to 800st) 385 (at to 900st) 320 (at to 1000st) 270 (at to 1100st) 235 (at to 1200st)	0.6	–	–	–
					Vertical		0.5	–	–	–
	LZM	200	16384	10	Vertical	500 (at 100 to 700st) 470 (at to 800st) 385 (at to 900st) 320 (at to 1000st) 270 (at to 1100st) 235 (at to 1200st)	0.5	–	–	–

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
ISA ISPA (Slider Type)	LXM LYM	400	16384	40	Horizontal	2000 (at 100 to 800st) 1660 (at to 900st) 1380 (at to 1000st) 1170 (at to 1100st) 1000 (at to 1200st)	1.0	–	–	–
					Vertical		1.0	–	–	–
				20	Horizontal	1000 (at 100 to 800st) 830 (at to 900st) 690 (at to 1000st) 585 (at to 1100st) 500 (at to 1200st)	1.0	–	–	–
					Vertical		0.8	–	–	–
	LZM	400	16384	10	Vertical	500 (at 100 to 700st) 470 (at to 800st) 385 (at to 900st) 320 (at to 1000st) 270 (at to 1100st) 235 (at to 1200st)	0.5	–	–	–

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
ISA ISPA (Slider Type)	LXMX	200	16384	20	Horizontal	1000 (at 1000 to 1400st) 950 (at 1500st) 830 (at 1600st) 740 (at 1700st) 650 (at 1800st) 590 (at 1900st) 540 (at 2000st) 490 (at 2100st) 440 (at 2200st) 410 (at 2300st) 370 (at 2400st) 340 (at 2500st)	0.3	–	–	–
		400		40	Horizontal	2000 (at 1000 to 1400st) 1900 (at 1500st) 1660 (at 1600st) 1480 (at 1700st) 1300 (at 1800st) 1180 (at 1900st) 1080 (at 2000st) 980 (at 2100st) 880 (at 2200st) 820 (at 2300st) 740 (at 2400st) 680 (at 2500st)	0.3	–	–	–
				20	Horizontal	1000 (at 1000 to 1400st) 950 (at 1500st) 830 (at 1600st) 740 (at 1700st) 650 (at 1800st) 590 (at 1900st) 540 (at 2000st) 490 (at 2100st) 440 (at 2200st) 410 (at 2300st) 370 (at 2400st) 340 (at 2500st)	0.3	–	–	–

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
ISA ISPA (Slider Type)	LXUWX	200	16384	20	Horizontal	1000 (at 1000 to 1400st) 950 (at 1500st) 830 (at 1600st) 740 (at 1700st) 650 (at 1800st) 590 (at 1900st) 540 (at 2000st) 490 (at 2100st) 440 (at 2200st) 410 (at 2300st) 370 (at 2400st) 340 (at 2500st)	0.3	–	–	–
		400		40	Horizontal	2000 (at 1000 to 1400st) 1900 (at 1500st) 1660 (at 1600st) 1480 (at 1700st) 1300 (at 1800st) 1180 (at 1900st) 1080 (at 2000st) 980 (at 2100st) 880 (at 2200st) 820 (at 2300st) 740 (at 2400st) 680 (at 2500st)	0.3	–	–	–
				20	Horizontal	1000 (at 1000 to 1400st) 950 (at 1500st) 830 (at 1600st) 740 (at 1700st) 650 (at 1800st) 590 (at 1900st) 540 (at 2000st) 490 (at 2100st) 440 (at 2200st) 410 (at 2300st) 370 (at 2400st) 340 (at 2500st)	0.3	–	–	–

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
ISA ISPA (Slider Type)	WXM	600	16384	40	Horizontal	2000 (at 100 to 800st) 1670 (at 900st) 1390 (at 1000st) 1170 (at 1100st) 1000 (at 1200st) 865 (at 1300st)	1.0	–	–	–
					Vertical		1.0	–	–	–
				20	Horizontal	1000 (at 100 to 800st) 835 (at 900st) 695 (at 1000st) 585 (at 1100st) 500 (at 1200st) 430 (at 1300st)	1.0	–	–	–
					Vertical		0.8	–	–	–
				10	Horizontal	500 (at 100 to 800st) 415 (at 900st) 345 (at 1000st) 290 (at 1100st) 250 (at 1200st) 215 (at 1300st)	0.6	–	–	–
					Vertical		0.5	–	–	–
		750		50	Horizontal	2000 (at 100 to 1000st) 1840 (at 1100st) 1570 (at 1200st) 1360 (at 1300st)	1.0	–	–	–
					Vertical		1.0	–	–	–
				25	Horizontal	1250 (at 100 to 900st) 1090 (at 1000st) 920 (at 1100st) 785 (at 1200st) 680 (at 1300st)	1.0	–	–	–
					Vertical		0.8	–	–	–

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
ISA ISPA (Slider Type)	WXMX	600	16384	40	Horizontal	2000 (at 900 to 1300st) 1965 (at 1400st) 1725 (at 1500st) 1530 (at 1600st) 1365 (at 1700st) 1225 (at 1800st) 1110 (at 1900st) 1005 (at 2000st) 915 (at 2100st) 840 (at 2200st) 770 (at 2300st) 710 (at 2400st) 655 (at 2500st)	0.3	–	–	–
				20	Horizontal	1000 (at 900 to 1300st) 980 (at 1400st) 860 (at 1500st) 765 (at 1600st) 680 (at 1700st) 610 (at 1800st) 555 (at 1900st) 500 (at 2000st) 455 (at 2100st) 420 (at 2200st) 385 (at 2300st) 355 (at 2400st) 325 (at 2500st)	0.3	–	–	–
		750		50	Horizontal	2000 (at 900 to 1700st) 1930 (at 1800st) 1740 (at 1900st) 1580 (at 2000st) 1440 (at 2100st) 1320 (at 2200st) 1210 (at 2300st) 1115 (at 2400st) 1035 (at 2500st)	0.3	–	–	–
				25	Horizontal	1250 (at 900 to 1500st) 1200 (at 1600st) 1075 (at 1700st) 965 (at 1800st) 870 (at 1900st) 790 (at 2000st) 720 (at 2100st) 660 (at 2200st) 605 (at 2300st) 555 (at 2400st) 515 (at 2500st)	0.3	–	–	–

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
ISDA ISPDA (Slider Type)	S	60	16384	16	Horizontal	800 (at 100 to 500st) 760 (at to 600st)	1.0	–	–	–
					Vertical		0.7	–	–	–
				8	Horizontal	400 (at 100 to 500st) 380 (at to 600st)	0.6	–	–	–
					Vertical		0.5	–	–	–
				4	Horizontal	200 (at 100 to 500st) 190 (at to 600st)	0.5	–	–	–
					Vertical		0.3	–	–	–
	M	100	16384	20	Horizontal	1000 (at 100 to 600st) 915 (at to 700st) 735 (at to 800st) 600 (at to 900st) 500 (at to 1000st)	1.0	–	–	–
					Vertical		0.8	–	–	–
				10	Horizontal	500 (at 100 to 600st) 455 (at to 700st) 365 (at to 800st) 300 (at to 900st) 250 (at to 1000st)	0.6	–	–	–
					Vertical		0.5	–	–	–
				5	Horizontal	250 (at 100 to 600st) 225 (at to 700st) 180 (at to 800st) 150 (at to 900st) 125 (at to 1000st)	0.5	–	–	–
					Vertical		0.3	–	–	–
		200		20	Horizontal	1000 (at 100 to 600st) 915 (at to 700st) 735 (at to 800st) 600 (at to 900st) 500 (at to 1000st)	1.0	–	–	–
					Vertical		0.8	–	–	–
				10	Horizontal	500 (at 100 to 600st) 455 (at to 700st) 365 (at to 800st) 300 (at to 900st) 250 (at to 1000st)	0.6	–	–	–
					Vertical		0.5	–	–	–

<table>
<tr><th>Actuator Series</th><th>Type</th><th>Motor Output
[W]</th><th>No. of Encoder Pluses</th><th>Lead
[mm]</th><th>Oriented Direction</th><th>Maximum Speed
[mm/s]</th><th>Maximum Acceleration/ Deceleration Speed
[G]</th><th>Minimum Pressing Force
[N]</th><th>Maximum Pressing Force
[N]</th><th>Rated Pressing Speed
[mm/s]</th></tr>
<tr><td rowspan="9">ISDA
ISPDA
(Slider Type)</td><td>MX</td><td>200</td><td>16384</td><td>20</td><td>Horizontal</td><td>1000
(at 800 to 1300st)
950 (at 1400st)
800 (at 1500st)
700 (at 1600st)</td><td>0.3</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td rowspan="6">L</td><td rowspan="4">200</td><td rowspan="6">16384</td><td rowspan="2">20</td><td>Horizontal</td><td rowspan="2">1000
(at 100 to 700st)
930
(at to 800st)
765
(at to 900st)
640
(at to 1000st)
545
(at to 1100st)
465
(at to 1200st)</td><td>1.0</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>Vertical</td><td>0.8</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td rowspan="2">10</td><td>Horizontal</td><td rowspan="2">500
(at 100 to 700st)
465
(at to 800st)
380
(at to 900st)
320
(at to 1000st)
270
(at to 1100st)
230
(at to 1200st)</td><td>0.6</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>Vertical</td><td>0.5</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td rowspan="2">400</td><td rowspan="2">20</td><td>Horizontal</td><td rowspan="2">1000
(at 100 to 700st)
930
(at to 800st)
765
(at to 900st)
640
(at to 1000st)
545
(at to 1100st)
465
(at to 1200st)</td><td>1.0</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>Vertical</td><td>0.8</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td rowspan="2">LX</td><td>200</td><td rowspan="2">16384</td><td rowspan="2">20</td><td rowspan="2">Horizontal</td><td rowspan="2">1000
(at 1000 to 1400st)
950 (at 1500st)
830 (at 1600st)</td><td rowspan="2">0.3</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>400</td><td>–</td><td>–</td><td>–</td></tr>
</table>

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
ISB ISPB (Slider Type)	SXM (Note)	50	16384	4	Horizontal	240 (at 100 to 600st) 165 (at to 700st) 130 (at to 800st) 100 (at to 900st)	0.5	–	–	–
					Vertical		0.4			
				8	Horizontal	480 (at 50 to 600st) 330 (at to 700st) 260 (at to 800st) 210 (at to 900st)	0.7	–	–	–
					Vertical		0.6			
				16	Horizontal	960 (at 50 to 600st) 655 (at to 700st) 515 (at to 800st) 415 (at to 900st)	1.2	–	–	–
					Vertical		0.8			
	SXL (Note)	50		4	Horizontal	240 (at 130 ot 580st) 165 (at to 680st) 130 (at to 780st) 100 (at to 880st)	0.5	–	–	–
					Vertical		0.4			
				8	Horizontal	480 (at 130 to 580st) 330 (at to 680st) 260 (at to 780st) 210 (at to 880st)	0.7	–	–	–
					Vertical		0.6			
				16	Horizontal	960 (at 130 to 580st) 655 (at to 680st) 515 (at to 780st) 415 (at to 880st)	1.2	–	–	–
					Vertical		0.8			

(Note) The model type shown in the shaded box above is applicable for the off board tuning function.
For the off board tuning function, refer to the instruction manual for RC PC Software.

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
ISB ISPB (Slider Type)	MXM (Note)	100 200	16384	5	Horizontal	300 (at 100 to 700st) 215 (at to 800st) 170 (at to 900st) 140 (at to 1000st) 115 (at to 1100st)	0.5	–	–	–
					Vertical		0.4			
				10	Horizontal	600 (at 100 to 700st) 430 (at to 800st) 345 (at to 900st) 280 (at to 1000st) 230 (at to 1100st)	0.7	–	–	–
					Vertical		0.6			
				20	Horizontal	1200 (at 100 to 700st) 860 (at to 800st) 695 (at to 900st) 570 (at to 1000st) 460 (at to 1100st)	1.2	–	–	–
					Vertical		1.0			
				30	Horizontal	1800 (at 100 to 700st) 1290 (at to 800st) 1045 (at to 900st) 860 (at to 1000st) 690 (at to 1100st)	1.2	–	–	–
					Vertical					

(Note) The model type shown in the shaded box above is applicable for the off board tuning function.
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Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
ISB ISPB (Slider Type)	MXL (Note)	100 200	16384	5	Horizontal	300 (at 120 to 670st) 215 (at to 770st) 170 (at to 870st) 140 (at to 970st) 115 (at to 1070st)	0.5	–	–	–
					Vertical		0.4			
				10	Horizontal	600 (at 120 to 670st) 430 (at to 770st) 345 (at to 870st) 280 (at to 970st) 230 (at to 1070st)	0.7	–	–	–
					Vertical		0.6			
				20	Horizontal	1200 (at 120 to 670st) 860 (at to 770st) 695 (at to 870st) 570 (at to 970st) 460 (at to 1070st)	1.2	–	–	–
					Vertical		1.0			
				30	Horizontal	1800 (at 120 to 670st) 1290 (at to 770st) 1045 (at to 870st) 860 (at to 970st) 690 (at to 1070st)	1.2	–	–	–
					Vertical					

(Note) The model type shown in the shaded box above is applicable for the off board tuning function.
For the off board tuning function, refer to the instruction manual for RC PC Software.

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
ISB ISPB (Slider Type)	MXMX	200	16384	20	Horizontal	1200 (at 800 to 1100st) 1100 (at to 1200st) 1000 (at to 1300st) 950 (at to 1400st) 800 (at to 1500st) 700 (at to 1600st) 600 (at to 1700st) 550 (at to 1800st) 500 (at to 1900st) 450 (at to 2000st)	0.4	–	–	–
				30	Horizontal	1800 (at 800 to 1100st) 1650 (at to 1200st) 1500 (at to 1300st) 1425 (at to 1400st) 1200 (at to 1500st) 1050 (at to 1600st) 900 (at to 1700st) 825 (at to 1800st) 750 (at to 1900st) 675 (at to 2000st)	0.4	–	–	–

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
ISB ISPB (Slider Type)	LXM (Note)	200 400	16384	10	Horizontal	600 (at 100 to 800st) 460 (at to 900st) 380 (at to 1000st) 320 (at to 1100st) 270 (at to 1200st) 220 (at to 1300st)	0.7	–	–	–
					Vertical		0.6			
				20	Horizontal	1200 (at 100 to 800st) 920 (at to 900st) 765 (at to 1000st) 645 (at to 1100st) 550 (at to 1200st) 440 (at to 1300st)	1.2	–	–	–
					Vertical		1.0			
				40	Horizontal	2400 (at 100 to 800st) 1840 (at to 900st) 1530 (at to 1000st) 1290 (at to 1100st) 1100 (at to 1200st) 880 (at to 1300st)	1.2	–	–	–
					Vertical					

(Note) The model type shown in the shaded box above is applicable for the off board tuning function.
For the off board tuning function, refer to the instruction manual for RC PC Software.

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
ISB ISPB (Slider Type)	LXL (Note)	200 400	16384	10	Horizontal	600 (at 120 to 770st) 460 (at to 870st) 380 (at to 970st) 320 (at to 1070st) 270 (at to 1170st) 220 (at to 1270st)	0.7	–	–	–
					Vertical		0.6			
				20	Horizontal	1200 (at 120 to 770st) 920 (at to 870st) 765 (at to 970st) 645 (at to 1070st) 550 (at to 1170st) 440 (at to 1270st)	1.2	–	–	–
					Vertical		1.0			
				40	Horizontal	2400 (at 120 to 770st) 1840 (at to 870st) 1530 (at to 970st) 1290 (at to 1070st) 1100 (at to 1170st) 880 (at to 1270st)	1.2	–	–	–
					Vertical					

(Note) The model type shown in the shaded box above is applicable for the off board tuning function.
For the off board tuning function, refer to the instruction manual for RC PC Software.

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
ISB ISPB (Slider Type)	LXMX LXUWX	200 400	16384	20	Horizontal	1200 (at 1000 to 1200st) 1150 (at to 1300st) 1000 (at to 1400st) 950 (at to 1500st) 830 (at to 1600st) 740 (at to 1700st) 650 (at to 1800st) 590 (at to 1900st) 540 (at to 2000st) 490 (at to 2100st) 440 (at to 2200st) 410 (at to 2300st) 370 (at to 2400st) 340 (at to 2500st)	0.4	–	–	–
		400		40	Horizontal	2400 (at 1000 to 1200st) 2300 (at to 1300st) 2000 (at to 1400st) 1900 (at to 1500st) 1660 (at to 1600st) 1480 (at to 1700st) 1300 (at to 1800st) 1180 (at to 1900st) 1080 (at to 2000st) 980 (at to 2100st) 880 (at to 2200st) 820 (at to 2300st) 740 (at to 2400st) 680 (at to 2500st)	0.4	–	–	–

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
SSPA (Slider Type)	LXM (Note)	750	16384	25	Horizontal Vertical	1080 (at 50 to 100st) 1250 (at to 900st) 1160 (at to 1000st) 970 (at to 1100st) 830 (at to 1200st) 720 (at to 1300st) 620 (at to 1400st) 550 (at to 1500st)	1.2	–	–	–
				50	Horizontal Vertical	1080 (at 50 to 100st) 1530 (at to 200st) 1870 (at to 300st) 2160 (at to 400st) 2420 (at to 500st) 2500 (at to 900st) 2320 (at to 1000st) 1950 (at to 1100st) 1660 (at to 1200st) 1440 (at to 1300st) 1250 (at to 1400st) 1100 (at to 1500st)	1.2	–	–	–

(Note) The model type shown in the shaded box above is applicable for the off board tuning function.
For the off board tuning function, refer to the instruction manual for RC PC Software.

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
ISDB ISPDB (Slider Type)	S (Note)	60	16384	4	Horizontal	240 (at to 500st)	0.5	–	–	–
						230 (at to 550st)		–	–	–
						200 (at to 600st)		–	–	–
					Vertical	170 (at to 170st)	0.4	–	–	–
						150 (at to 700st)		–	–	–
						135 (at to 750st)		–	–	–
						120 (at to 800st)		–	–	–
				8	Horizontal	480 (at to 500st)	0.7	–	–	–
						460 (at to 550st)		–	–	–
						400 (at to 600st)		–	–	–
					Vertical	345 (at to 650st)	0.6	–	–	–
						305 (at to 700st)		–	–	–
						270 (at to 750st)		–	–	–
						240 (at to 800st)		–	–	–
				16	Horizontal	960 (at to 500st)	1	–	–	–
						920 (at to 550st)		–	–	–
						795 (at to 600st)		–	–	–
					Vertical	690 (at to 650st)	0.8	–	–	–
						610 (at to 700st)		–	–	–
						540 (at to 750st)		–	–	–
						480 (at to 800st)		–	–	–

(Note) The model type shown in the shaded box above is applicable for the off board tuning function.
For the off board tuning function, refer to the instruction manual for RC PC Software.

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
ISDB ISPDB (Slider Type)	M (Note)	100 200	16384	5	Horizontal	300 (at to 600st)	0.5	–	–	–
						270 (at to 650st)		–	–	–
						240 (at to 700st)		–	–	–
						215 (at to 750st)		–	–	–
						190 (at to 800st)		–	–	–
					Vertical	170 (at to 850st)	0.4	–	–	–
						155 (at to 900st)		–	–	–
						140 (at to 950st)		–	–	–
						130 (at to 1000st)		–	–	–
						120 (at to 1050st)		–	–	–
						110 (at to 1100st)		–	–	–
				10	Horizontal	600 (at to 600st)	0.7	–	–	–
						545 (at to 650st)		–	–	–
						480 (at to 700st)		–	–	–
						430 (at to 750st)		–	–	–
						380 (at to 800st)		–	–	–
					Vertical	345 (at to 850st)	0.6	–	–	–
						310 (at to 900st)		–	–	–
						285 (at to 950st)		–	–	–
						260 (at to 1000st)		–	–	–
						240 (at to 1050st)		–	–	–
						220 (at to 1100st)		–	–	–

(Note) The model type shown in the shaded box above is applicable for the off board tuning function.
For the off board tuning function, refer to the instruction manual for RC PC Software.

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
ISDB ISPDB (Slider Type)	M (Note)	100 200	16384	20	Horizontal	1200 (at to 600st)	1	–	–	–
						1085 (at to 650st)		–	–	–
						960 (at to 700st)		–	–	–
						855 (at to 750st)		–	–	–
						765 (at to 800st)		–	–	–
					Vertical	690 (at to 850st)	1	–	–	–
						625 (at to 900st)		–	–	–
						570 (at to 950st)		–	–	–
						520 (at to 1000st)		–	–	–
						475 (at to 1050st)		–	–	–
						440 (at to 1100st)		–	–	–
				30	Horizontal	1800 (at to 600st)	1	–	–	–
						1630 (at to 650st)		–	–	–
						1440 (at to 700st)		–	–	–
						1280 (at to 750st)		–	–	–
						1150 (at to 800st)		–	–	–
					Vertical	1035 (at to 850st)	1	–	–	–
						935 (at to 900st)		–	–	–
						850 (at to 950st)		–	–	–
						780 (at to 1000st)		–	–	–
						715 (at to 1050st)		–	–	–
						660 (at to 1100st)		–	–	–

(Note) The model type shown in the shaded box above is applicable for the off board tuning function.
For the off board tuning function, refer to the instruction manual for RC PC Software.

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
ISDB ISPDB (Slider Type)	MX	200	16384	20	Horizontal	1200 (at to 1100st)	0.4	–	–	–
						1100 (at to 1200st)		–	–	–
						1000 (at to 1300st)		–	–	–
						950 (at to 1400st)		–	–	–
						800 (at to 1500st)		–	–	–
						700 (at to 1600st)		–	–	–
				30	Horizontal	1800 (at to 1100st)	0.4	–	–	–
						1650 (at to 1200st)		–	–	–
						1500 (at to 1300st)		–	–	–
						1425 (at to 1400st)		–	–	–
						1200 (at to 1500st)		–	–	–
						1050 (at to 1600st)		–	–	–

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
ISDB ISPDB (Slider Type)	L (Note)	200 400	16384	10	Horizontal	600 (at to 650st)	1	–	–	–
						585 (at to 700st)		–	–	–
						520 (at to 750st)		–	–	–
						470 (at to 800st)		–	–	–
						425 (at to 850st)		–	–	–
						385 (at to 900st)		–	–	–
						350 (at to 950st)		–	–	–
					Vertical	320 (at to 1000st)	1	–	–	–
						295 (at to 1050st)		–	–	–
						275 (at to 1100st)		–	–	–
						255 (at to 1150st)		–	–	–
						235 (at to 1200st)		–	–	–
						220 (at to 1250st)		–	–	–
						205 (at to 1300st)		–	–	–
				20	Horizontal	1200 (at to 650st)	1	–	–	–
						1165 (at to 700st)		–	–	–
						1045 (at to 750st)		–	–	–
						940 (at to 800st)		–	–	–
						850 (at to 850st)		–	–	–
						770 (at to 900st)		–	–	–
						705 (at to 950st)		–	–	–
					Vertical	645 (at to 1000st)	1	–	–	–
						595 (at to 1050st)		–	–	–
						545 (at to 1100st)		–	–	–
						505 (at to 1150st)		–	–	–
						470 (at to 1200st)		–	–	–
						440 (at to 1250st)		–	–	–
						410 (at to 1300st)		–	–	–

(Note) The model type shown in the shaded box above is applicable for the off board tuning function.
For the off board tuning function, refer to the instruction manual for RC PC Software.

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
ISDB ISPDB (Slider Type)	L (Note)	200 400	16384	40	Horizontal	1800 (at to 800st)	1	–	–	–
						1700 (at to 850st)		–	–	–
						1540 (at to 900st)		–	–	–
						1410 (at to 950st)		–	–	–
						1290 (at to 1000st)		–	–	–
					Vertical	1185 (at to 1050st)	1	–	–	–
						1095 (at to 1100st)		–	–	–
						1015 (at to 1150st)		–	–	–
						940 (at to 1200st)		–	–	–
						875 (at to 1250st)		–	–	–
						815 (at to 1300st)		–	–	–
	LX	200 400	16384	20	Horizontal	1200 (at to 1200st)	0.4	–	–	–
						1150 (at to 1300st)		–	–	–
						1000 (at to 1400st)		–	–	–
						950 (at to 1500st)		–	–	–
						830 (at to 1600st)		–	–	–
				40	Vertical	1800 (at to 1500st)	0.4	–	–	–
						1600 (at to 1660st)		–	–	–

(Note) The model type shown in the shaded box above is applicable for the off board tuning function.
For the off board tuning function, refer to the instruction manual for RC PC Software.

Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
NS	SXMS-A	60	16384	12	Horizontal	720	0.8	–	–	–
	SXMS-I		2400					–	–	–
	SXMM-A	60	16384	12	Horizontal	720	0.8	–	–	–
	SXMM-I		2400					–	–	–
	SZMS-A	60	16384	12	Vertical	600	0.7	–	–	–
	SZMS-I		2400					–	–	–
	SZMM-A	60	16384	12	Vertical	600	0.7	–	–	–
	SZMM-I		2400					–	–	–
	MXMS	200	16384	30	Horizontal	1800	1.0	–	–	–
				20		1200	0.8	–	–	–
	MXMM	200	16384	30	Horizontal	1800	1.0	–	–	–
				20		1200	0.8	–	–	–
	MXMXS	200	16384	30	Horizontal	1800	0.3	–	–	–
				20		1200	0.3	–	–	–
	MZMS	200	16384	20	Vertical	1000	0.5	–	–	–
	MZMM	200	16384	20	Vertical	1000	0.5	–	–	–
	LXMS	400	16384	40	Horizontal	2400	1.0	–	–	–
				20	Horizontal	1300	1.0	–	–	–
	LXMM	400	16384	40	Horizontal	2400	1.0	–	–	–
				20	Horizontal	1300	1.0	–	–	–
	LXMXS	400	16384	40	Horizontal	2400	0.3	–	–	–
				20	Horizontal	1300	0.3	–	–	–
	LZMS	400	16384	20	Vertical	1000	0.8	–	–	–
	LZMM	400	16384	20	Vertical	1000	0.8	–	–	–
IF	SA	60	16384	35	Horizontal	1750	0.3	–	–	–
		100			Horizontal		0.3	–	–	–
	MA	200	16384	35	Horizontal	1750	0.3	–	–	–
		400			Horizontal			–	–	–
FS	NM	60	16384	25	Horizontal	1250	0.3	–	–	–
		100			Horizontal		0.3	–	–	–
	WM	100	16384	25	Horizontal	1250	0.3	–	–	–
		200			Horizontal		0.3	–	–	–
	LM	400	16384	25	Horizontal	1250	0.3	–	–	–
	HM	400	16384	40	Horizontal	2000	0.3	–	–	–
RS	30	30	16384	Gear Ratio 1/50	–	360	–	–	–	–
				Gear Ratio 1/100		180		–	–	–
	60	60		Gear Ratio 1/50		360	–	–	–	–
				Gear Ratio 1/100		180		–	–	–

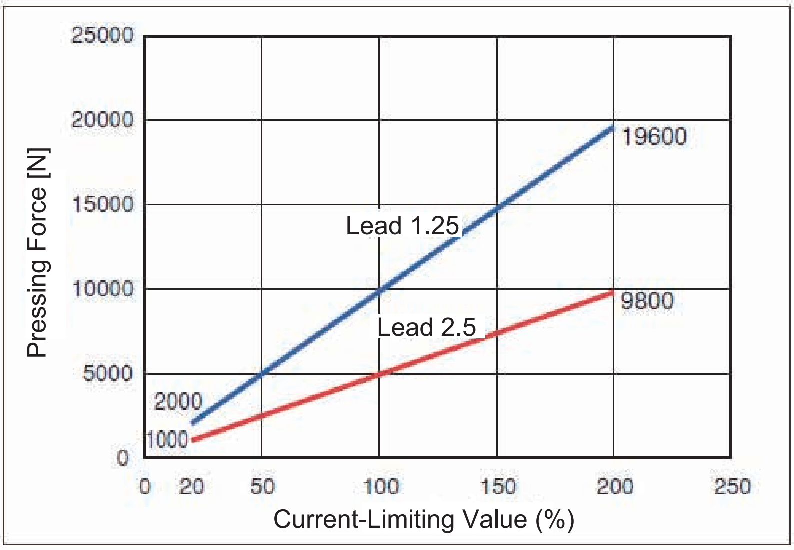
Actuator Series	Type	Motor Output [W]	No. of Encoder Pluses	Lead [mm]	Oriented Direction	Maximum Speed [mm/s]	Maximum Acceleration/ Deceleration Speed [G]	Minimum Pressing Force [N]	Maximum Pressing Force [N]	Rated Pressing Speed [mm/s]
LSA	S6SS	100	48000	48	Horizontal	2500	3.0	–	–	–
	S6SM						3.0	–	–	–
	S8SS	100	60000	60	Horizontal	2500	3.0	–	–	–
	S8SM						3.0	–	–	–
	S8HS						3.0	–	–	–
	S8HM						3.0	–	–	–
	S10SS	200	90000	90	Horizontal	2500	3.0	–	–	–
	S10SM						3.0	–	–	–
	S10HS	200S					3.0	–	–	–
	S10HM						3.0	–	–	–
	H8SS	200	50000	50	Horizontal	2500	3.0	–	–	–
	H8SM						3.0	–	–	–
	H8HS						3.0	–	–	–
	H8HM						3.0	–	–	–
	L15SS	200	50000	50	Horizontal	2500	3.0	–	–	–
	L15SM						3.0	–	–	–
	N10SS	100S	50000	50	Horizontal	2500	3.0	–	–	–
	N10SM						3.0	–	–	–
	N15SS	200	50000	50	Horizontal	2500	3.0	–	–	–
	N15SM						3.0	–	–	–
	N15HS						3.0	–	–	–
	N15HM						3.0	–	–	–
	N19SS	300S	72000	72	Horizontal	2500	3.0	–	–	–
	N19SM						3.0	–	–	–
	W21SS	400	45000	45	Horizontal	2500	3.0	–	–	–
	W21SM						3.0	–	–	–
LSAS	S10SS	100S	90000	90	Horizontal	2500	3.0	–	–	–
	S10SM						3.0	–	–	–
	S15SS	200S	50000	50	Horizontal	2500	3.0	–	–	–
	S15SM						3.0	–	–	–
	S15HS						3.0	–	–	–
	S15HM						3.0	–	–	–

10.4.2 Specifications and Limitations in Pressing Operation of RCS2-RA13R

[1] Pressing Force and Current-Limiting Value

Note :
- The relation between pressing force and current limit value is shown with reference values at the rating pressing speed (set at shipment).
- Apply a pressing force larger than the minimum pressing force to the actuator. If not, the pressing force can be unstable.
- If it becomes necessary to change the pressing speed, contact us.
  The positioning speed, a operation condition, should not be set to be less than the pressing speed. Failure to follow this causes the pressing speed to be the setting speed, which cannot bring proper pressing force.

■ Figure of mutual relation between pressing force and current limit value



[2] Limitation in Operation

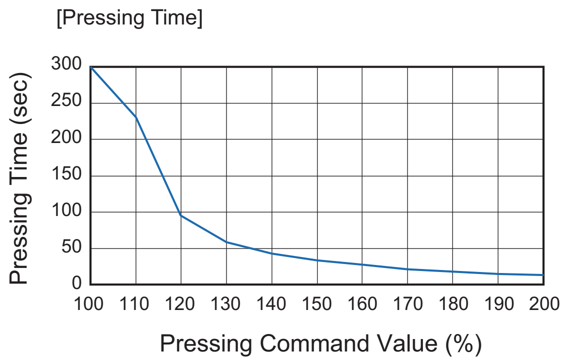
Make sure to follow the three conditions stated below for the operation of this product.

Condition 1. The pressing time is less than the specified time.
Condition 2. 1 cycle of the continuous operation thrust is less than the rated thrust of Ultra-High Thrust Actuator.
Condition 3. There should only be 1 time of pressing operation in 1 cycle of operation.

(1) Pressing Time

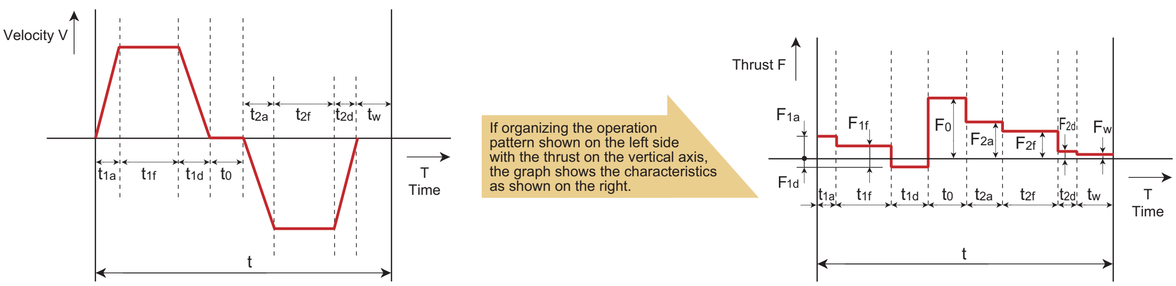
The maximum pressing time duration to the pressing command value should be less than the specified time. Not following this may cause a failure to the actuator.

Pressing Command Value [%]	Max. Pressing Time [sec]
70 or less	(Continuous pressing is available)
71 to 100	300
110	230
120	95
130	58
140	43
150	33
160	27
170	21
180	18
190	15
200	13



(2) Continuous Operation Thrust

Make the continuous operation thrust Ft in 1 cycle considering the load and duty smaller than the rated thrust. Also, make sure the pressing operation is only once in 1 cycle.



t : Operation time in 1 cycle (s)
t_{1a} : Acceleration time 1
t_{1f} : Rated speed movement time 1
t_{1d} : Deceleration time 1
t_u : Pressing time
t_{2a} : Acceleration time 2
t_{2f} : Rated speed movement time 2
t_{2d} : Deceleration time 2
t_w : Standby time

F_{1a} : Thrust necessary for acceleration 1
F_{1f} : Thrust necessary for rated speed movement 1
F_{1d} : Thrust necessary for deceleration 1
F_0 : Thrust necessary for pressing operation
F_{2a} : Thrust necessary for acceleration 2
F_{2f} : Thrust necessary for rated speed movement 2
F_{2d} : Thrust necessary for deceleration 2
F_w : Thrust necessary for standby

Figure out the continuous operation thrust F_t in 1 cycle using the following formula.
The thrust necessary for rated speed movement and standby are not needed if it is the horizontally oriented installation.

$$F_t = \sqrt{\frac{F_{1a}^2 \times t_{1a} + F_{1f}^2 \times t_{1f} + F_{1d}^2 \times t_{1d} + F_0^2 \times t_0 + F_{2a}^2 \times t_{2a} + F_{2f}^2 \times t_{2f} + F_{2d}^2 \times t_{2d} + F_w^2 \times t_w}{t}}$$

(1) $F_{1a}/F_{2a}/F_{1d}/F_{2d}$ vary depending on the operation direction. Calculate the following items.

If horizontally oriented (Common to acc/dec)	$F_{1a} = F_{1d} = F_{2a} = F_{2d} = (M + m) \times d$
If vertical and acceleration downwards	$F_{1a} = (M + m) \times 9.8 - (M + m) \times d$
If vertical and rated speed downwards	$F_{1f} = (M + m) \times 9.8 + \alpha$
If vertical and deceleration downwards	$F_{1d} = (M + m) \times 9.8 + (M + m) \times d$
If vertical and acceleration upwards	$F_{2a} = (M + m) \times 9.8 + (M + m) \times d$
If vertical and rated speed upwards	$F_{2f} = (M + m) \times 9.8 + \alpha$
If vertical and deceleration upwards	$F_{2d} = (M + m) \times 9.8 - (M + m) \times d$
If vertical and standby	$F_w = (M + m) \times 9.8$

M : Weight of moveable parts [kg](Note 1)
m : Load weight [kg]
d : Command acceleration/ deceleration speed [m/s^2]
α : Thrust considering resistance of running on external guide(Note 2)

Note 1 The weight of actuator moveable parts is 9kg. Add the weight of the fixtures attached to the rod.
Note 2 It is necessary to consider the resistance for the run on the external guide if it is attached.

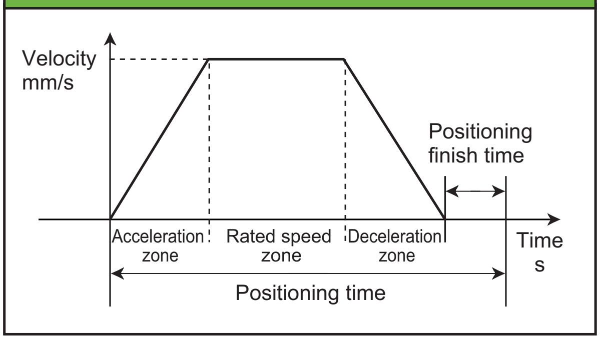
(2) $t_{\square a}$ is the acceleration time. The calculation differs depending whether its operation pattern is the trapezoid or triangle pattern.
The difference between the trapezoid and triangle patterns can be verified with the calculated arrival speed whether it is greater or smaller than the setting seed.

Arrival Speed (Vmax) = $\sqrt{\text{Movement distance (m)} \times \text{Set acceleration (m/s}^2)}$

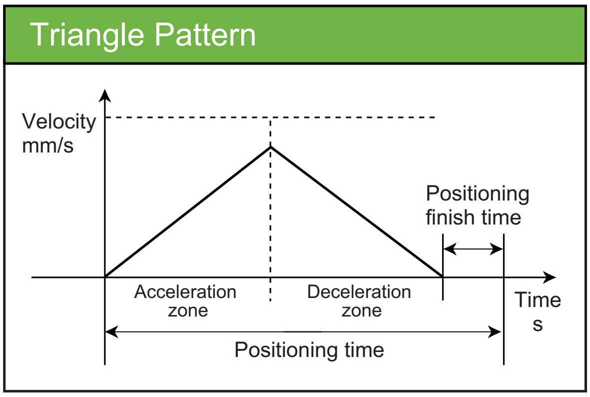
Set Speed < Arrival Speed → Trapezoid Pattern
Set Speed > Arrival Speed → Triangle Pattern

[When trapezoid pattern]
$t_{\square a} = Vs/a$ Vs : Set speed (m/s) a : Command acceleration (m/s^2)

Trapezoid Pattern



[When triangle pattern]
t□a = Vt/a Vt : Arrival speed (m/s) a : Command acceleration (m/s^2)



(3) t□f is the rated speed movement time. Figure out from the rated speed movement distance.
t□f = Lc/V Lc : Rated speed movement distance (m) V : Command speed (m/s)
Rated speed movement distance = Movement distance - Acceleration distance - Deceleration distance
Acceleration distance (Deceleration distance) = $V^2/2a$

(4) t□d is the deceleration time. If the acceleration and deceleration settings are the same, this should equal to the acceleration time.
t□d = V/a V : Set speed (trapezoid pattern) or arrival speed (triangle pattern) (m/s)
a : Command deceleration value (m/s^2)

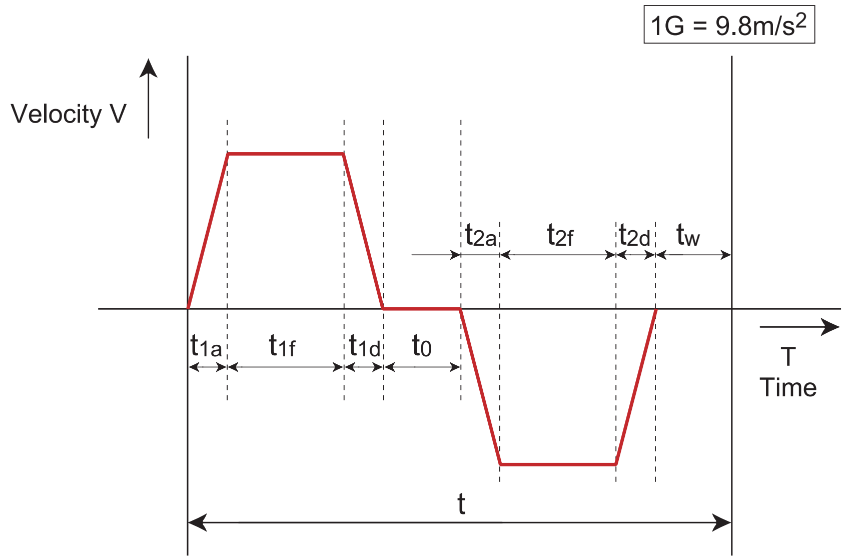
If the figured out continuous operation thrust Ft is smaller than the rated thrust, the operation is available.
Actuator rated thrust lead 2.5 type : 5100N
Lead 1.25 type : 10200N
If the value is too larger, it is necessary to have an action such as to shorten the pressing time, make the standby time longer, make the pressing force smaller, etc.

(Example)

Operational Conditions

- Used model : Ultra-High Thrust Actuator lead 1.25 type
- Installation posture : Vertical
- Velocity : 62mm/s
- Acceleration : 0.098m/s^2 (0.01G, deceleration value should be the same)
- Movement distance : 50mm
- Load weight : 100kg
- Pressing command value: 200% (2000kgf)
- Pressing time : 3sec
- Standby time : 2sec
- Pressing operation is conducted after going down for 50mm and standby for 2sec after going up for 50mm.
  And also, the operation condition for going up and down should be the same.

Looking at this operation pattern in a graph, the figure is as shown below.



1) Confirmation of Pressing Operation Time
   The pressing time is 3sec while the maximum pressing time is 13sec when the pressing command value is 200%, thus there should be no problem. It shows that there is no problem in the pressing time.

2) Calculation of Continuous Operation Thrust

Figure out the continuous operation thrust F_t by following the formula.

First, check the operation pattern of $t_{1a}/t_{1d}/t_{2a}/t_{2d}$ to find out that

Arrival speed (Vmax) = $\sqrt{0.05 \times 0.098} \rightarrow 0.07$m/s and,

therefore it is greater than the set speed 62mm/s (0.06m/s), thus the pattern is the trapezoid type.

Therefore, $t_{1a}/t_{1d}/t_{2a}/t_{2d} = 0.062/0.098 \rightarrow 0.63$s.

Secondary, if calculating t_{1f}/t_{2f};

Rated speed movement distance = 0.05 – {(0.062 × 0.062) / (2 × 0.098)} × 2 → 0.011m, thus $t_{1f}/t_{2f} = 0.011 / 0.062 \rightarrow 0.17$s

Also, if calculating $F_{1a}/F_{1f}/F_{1d}/F_{2a}/F_{2f}/F_{2d}$ from the formula;

$F_{1a} = F_{2d} = (9 + 100) \times 9.8 - (9 + 100) \times 0.098 \rightarrow 1058$N

$F_{1d} = F_{2a} = (9 + 100) \times 9.8 + (9 + 100) \times 0.098 \rightarrow 1079$N

$F_{1f} = F_{2f} = f_w = (9 + 100) \times 9.8 \rightarrow 1068$N

If substituting the values above to the continuous operation thrust formula;

$$F_t = \sqrt{\frac{F_{1a}^2 \times t_{1a} + F_{1f}^2 \times t_{1f} + F_{1d}^2 \times t_{1d} + F_0^2 \times t_0 + F_{2a}^2 \times t_{2a} + F_{2f}^2 \times t_{2f} + F_{2d}^2 \times t_{2d} + F_w^2 \times t_w}{t}}$$

$$= \sqrt{\begin{array}{l}\{(1058 \times 1058) \times 0.63 + (1068 \times 1068) \times 0.17 + (1079 \times 1079) \times 0.63 + (19600 \times 19600) \times \\ 3 + (1079 \times 1079) \times 0.63 + (1068 \times 1068) \times 0.17 + (1058 \times 1058) \times 0.63 + (1068 \times 1068) \times 2\} \\ / (0.63 + 0.17 + 0.63 + 3 + 0.63 + 0.17 + 0.63 + 2)\end{array}} \rightarrow 12113\text{N}$$

Since the answer exceeds 10200N, which is the rated thrust of Ultra-High Thrust Actuator 2 tone type, the operation is not allowed with this operation pattern.

Now, try to extend the standby time (to lower the duty).

In this case, $F_t = 9814$N assuming $t_w = 6.12$s ($t = 12$s), thus the operation is available.

Chapter 11 Warranty

11.1 Warranty Period

One of the following periods, whichever is shorter:
- 18 months after shipment from our factory
- 12 months after delivery to a specified location

11.2 Scope of Warranty

Our products are covered by warranty when all of the following conditions are met. Faulty products covered by warranty will be replaced or repaired free of charge:

(1) The breakdown or problem in question pertains to our product as delivered by us or our authorized dealer.
(2) The breakdown or problem in question occurred during the warranty period.
(3) The breakdown or problem in question occurred while the product was in use for an appropriate purpose under the conditions and environment of use specified in the instruction manual and catalog.
(4) The breakdown or problem in question was caused by a specification defect or problem, or by the poor quality of our product.

Note that breakdowns due to any of the following reasons are excluded from the scope of warranty:
[1] Anything other than our product
[2] Modification or repair performed by a party other than us (unless we have approved such modification or repair)
[3] Anything that could not be easily predicted with the level of science and technology available at the time of shipment from our company
[4] A natural disaster, man-made disaster, incident or accident for which we are not liable
[5] Natural fading of paint or other symptoms of aging
[6] Wear, depletion or other expected result of use
[7] Operation noise, vibration or other subjective sensation not affecting function or maintenance

Note that the warranty only covers our product as delivered and that any secondary loss arising from a breakdown of our product is excluded from the scope of warranty.

11.3 Honoring the Warranty

As a rule, the product must be brought to us for repair under warranty.

11.4 Limited Liability

(1) We shall assume no liability for any special damage, consequential loss or passive loss such as a loss of expected profit arising from or in connection with our product.
(2) We shall not be liable for any program or control method created by the customer to operate our product or for the result of such program or control method.

11.5 Conditions of Conformance with Applicable Standards/Regulations, Etc., and Applications

(1) If our product is combined with another product or any system, device, etc., used by the customer, the customer must first check the applicable standards, regulations and/or rules. The customer is also responsible for confirming that such combination with our product conforms to the applicable standards, etc. In such a case we will not be liable for the conformance of our product with the applicable standards, etc.

(2) Our product is for general industrial use. It is not intended or designed for the applications specified below, which require a high level of safety. Accordingly, as a rule our product cannot be used in these applications. Contact us if you must use our product for any of these applications:

[1] Medical equipment pertaining to maintenance or management of human life or health
[2] A mechanism or mechanical equipment intended to move or transport people (such as a vehicle, railway facility or aviation facility)
[3] Important safety parts of mechanical equipment (such as safety devices)
[4] Equipment used to handle cultural assets, art or other irreplaceable items

(3) Contact us at the earliest opportunity if our product is to be used in any condition or environment that differs from what is specified in the catalog or instruction manual.

11.6 Other Items Excluded from Warranty

The price of the product delivered to you does not include expenses associated with programming, the dispatch of engineers, etc. Accordingly, a separate fee will be charged in the following cases even during the warranty period:

[1] Guidance for installation/adjustment and witnessing of test operation
[2] Maintenance and inspection
[3] Technical guidance and education on operating/wiring methods, etc.
[4] Technical guidance and education on programming and other items related to programs

Change History

Revision Date	Revision Description
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