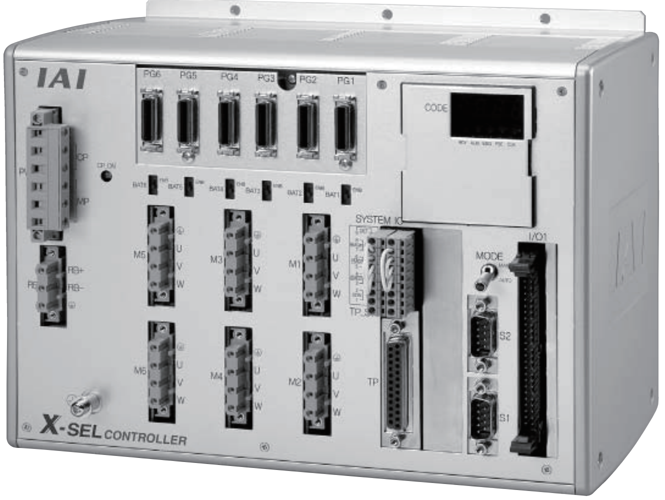
XSEL Controller P/Q/PCT/QCT Type

Operation Manual Nineteenth Edition



IAI America, Inc.

Please Read Before Use

Thank you for purchasing our product.

This Operation 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 Operation Manual for this product.
For the operation of this product, print out the necessary sections in the Operation Manual or display them using the personal computer.

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

[Important]

- This Operation Manual is original.
- The product cannot be operated in any way unless expressly specified in this Operation Manual. IAI shall assume no responsibility for the outcome of any operation not specified herein.
- Information contained in this Operation 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 Operation Manual without permission is prohibited.
- The company names, names of products and trademarks of each company shown in the sentences are registered trademarks.

INTELLIGENT ACTUATOR	CAUTION

Operator Alarm on Low Battery Voltage

This controller is equipped with the following backup batteries for retention of data in the event of power failure:

[1] System-memory backup battery
For retention of position data, global variables/flags, error list, strings, etc.

[2] Absolute-encoder backup battery (optional)
For retention of rotation data (when an absolute encoder is used)

Since these batteries are not rechargeable, they will be eventually consumed. Unless the batteries are replaced in a timely manner, the voltage will drop to a level where the data can no longer be retained. If a power failure occurs in this condition, the data will be lost. (The life of each battery varies depending on the operating time.)

Once the data is lost, the controller will not operate normally the next time the power is turned on, and recovery will take time.

(Reference)

System-memory backup battery --- An alarm occurs when the voltage drops to approx. 2.6 V and data backup becomes no longer possible at a battery voltage of approx. 2.3 V (rated voltage: 3.0 V).

Absolute-encoder backup battery --- An alarm occurs when the voltage drops to approx. 3.2 V and data backup becomes no longer possible at a battery voltage of approx. 2.7 V (rated voltage: 3.6 V).

To prevent this problem, this controller can output a low battery voltage alarm from its I/O port.
To output this alarm signal from an I/O port, you must set the applicable I/O parameter.

- Alarm output for the system-memory backup battery
  Set I/O parameter No. 59 to "1" --- Output port No. 313 (*) will be assigned as a dedicated port.
- Alarm output for the absolute-encoder backup battery
  Set I/O parameter No. 60 to "1" --- Output port No. 314 (*) will be assigned as a dedicated port.
  (*) Once set as an alarm output port, the applicable port can no longer be used as a general-purpose port.

It is recommended that this function be utilized to prevent unnecessary problems resulting from low battery voltage (consumption of battery life).
In particular, the person in charge of system design should utilize this function to provide a design means for issuing an operator alarm using an output signal from an I/O port, while the person in charge of electrical design should provide an electrical means for achieving the same effect.
For the battery replacement procedure, refer to the applicable section in the operating manual.

It is recommended that you always backup the latest data to a PC in case of voltage drop in the system-memory battery or unexpected controller failure.

About teaching pendant and PC software
Q/QCT type controllers only support the following teaching pendant and PC software:
Teaching pendant: IA-T-XA (ANSI type)
PC software: IA-101-XA-MW (Supplied with category 4 cable)

Drive-Source Cutoff Relay Error (Detection of Fused Relay: E6D)

As a condition limited to XSEL-P/PCT type controllers of standard single-phase specification, a “drive-source cutoff relay error (E6D)” may generate if the power is turned off and then turned on again (reconnected) too quickly.
This error indicates that the internal relay has fused, and its occurrence has to do with the specific circuit configuration of the above controller type.
Although the specific wait time varies depending on the input voltage and number of external regenerative resistors connected, as a general guide wait for at least 40 seconds before reconnecting the power.

Regarding Operation of High Speed Cartesian Robot CT4

It is necessary to declare specific functions in SEL language program for the operation.
[Refer to Appendix Operation of High Speed Cartesian Robot (CT4) for the details.]

Power Supply/Shutoff and Input of Emergency Stop

1) Do not turn on/off the power frequently.
2) Do not construct the system that allows frequent input of emergency stop or turning on/off of the drive power.

In the power source of the controller, there is a capacitor that allows large in-rush current (charge current) to flow transiently when the power is turned on.
Therefore, it may cause early degradation on the internal components if turning on/off of the power and turning on/off of the drive power due to emergency stop input are conducted frequently.
Contact IAI in case it is necessary to establish a system to allow frequent turning on/off of the power inevitably.

INTELLIGENT ACTUATOR	**CAUTION**

Note on Controller with Expanded CPU Unit Memory

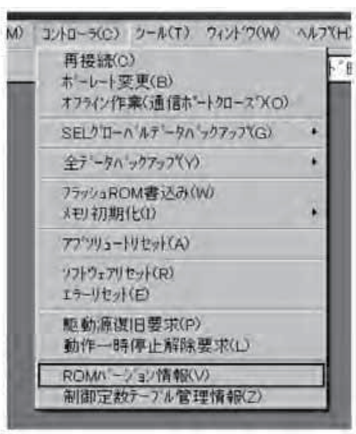
<u>* The controller with gateway function comes with an expanded memory in the CPU unit.</u>

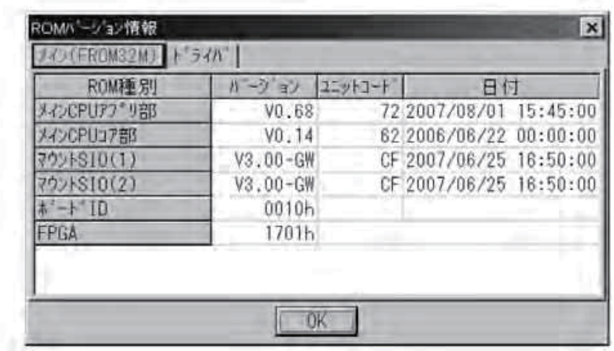
For a controller with expanded CPU unit memory, use the PC software or teaching pendant of an applicable version as specified below.

Teaching tool	Version
XSEL PC software	V7.2.0.0 or later
Teaching pendant SEL-T/TD	V1.01 or later

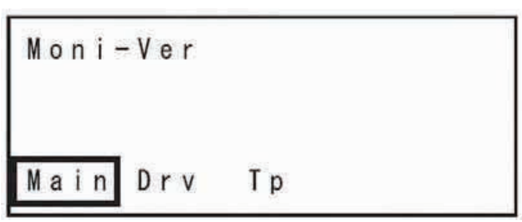
[How to check if the controller memory has been expanded]
Check in the PC software (Ver. 6.0.0.0 or later) by displaying the ROM version information (Controller (C) → ROM Version Information (V)), or on the teaching pendant (IA-T-X, IA-T-XD: Ver. 1.21 or later; SEL-T, SEL-TD: Ver. 1.00 or later) by displaying the main CPU firmware version information (Moni → Ver → Main).

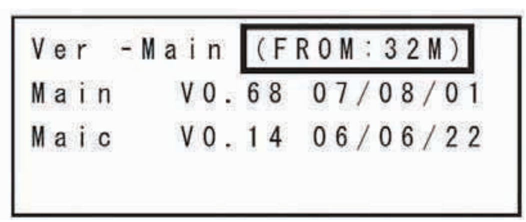
- Expanded memory: As shown below, “Main (FROM32M)” is shown in the PC software. On the teaching pendant screen, “Main (FROM32M)” is shown.





Checking in PC software





Checking in teaching pendant

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	Description
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 the product outside the specifications. Failure to do so may considerably shorten the life of the product. ● 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 ● For an actuator used in vertical orientation, select a model which is equipped with a brake. If selecting a model with no brake, the moving part may drop when the power is turned OFF and may cause an accident such as an injury or damage on the work piece.

No.	Operation Description	Description
2	Transportation	● When carrying a heavy object, do the work with two or more persons or utilize equipment such as crane. ● 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 in transportation, consider well about the positions to hold, weight and weight balance and pay special attention to the carried object so it would not get hit or dropped. ● Transport it using an appropriate transportation measure. The actuators available for transportation with a crane have eyebolts attached or there are tapped holes to attach bolts. Follow the instructions in the operation manual for each model. ● 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.
3	Storage and Preservation	● The storage and preservation environment conforms to the installation environment. However, especially give consideration to the prevention of condensation. ● Store the products with a consideration not to fall them over or drop due to an act of God such as earthquake.
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. Also, be equipped for a fall-over or drop due to an act of God such as earthquake. ● 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

No.	Operation Description	Description
4	Installation and Start	(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 ● 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. ● For the ground terminal on the AC power cable of the controller and the grounding plate in the control panel, make sure to use a twisted pair cable with wire thickness 0.5mm^2 (AWG20 or equivalent) or more for grounding work. For security grounding, it is necessary to select an appropriate wire thickness suitable for the load. Perform wiring that satisfies the specifications (electrical equipment technical standards). ● Perform Class D Grounding (former Class 3 Grounding with ground resistance 100Ω or below).

No.	Operation Description	Description
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	Description
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	● Check before starting the automatic operation or rebooting after operation stop that there is nobody in the safety protection fence. ● Before starting automatic operation, make sure that all peripheral equipment is in an automatic-operation-ready state and there is no alarm indication. ● Make sure to operate automatic operation start from outside 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.

No.	Operation Description	Description
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 Operation 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. ● The slider or rod may get misaligned OFF the stop position if the servo is turned OFF. Be careful not to get injured or damaged due to an unnecessary operation. ● Pay attention not to lose the cover or untightened screws, and make sure to put the product back to the original condition after maintenance and inspection works. Use in incomplete condition may cause damage to the product or an injury. * Safety protection Fence : In the case that there is no safety protection fence, the movable range should be indicated.
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. ● When removing the actuator for disposal, pay attention to drop of components when detaching screws. ● Do not put the product in a fire when disposing of it. The product may burst or generate toxic gases.
11	Other	● Do not come close to the product or the harnesses if you are a person who requires a support of medical devices such as a pacemaker. Doing so may affect the performance of your medical device. ● See Overseas Specifications Compliance Manual to check whether complies if necessary. ● For the handling of actuators and controllers, follow the dedicated operation manual of each unit to ensure the safety.

Alert Indication

The safety precautions are divided into “Danger”, “Warning”, “Caution” and “Notice” according to the warning level, as follows, and described in the Operation 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

CE Marking

If a compliance with the CE Marking is required, please follow Overseas Standards Compliance Manual (ME0287) that is provided separately.

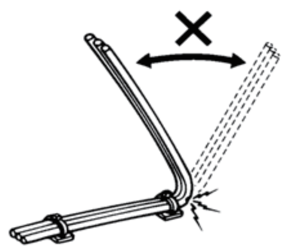
Prohibited Handling of Cables

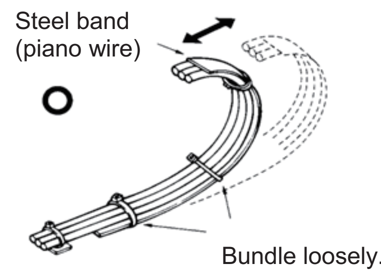
⚠ Caution

When designing an application system using actuators and controllers, incorrect wiring or connection of each cable may cause unexpected problems such as a disconnected cable or poor contact, or even a runaway system. This section explains prohibited handling of cables. Read the information carefully to connect the cables properly.

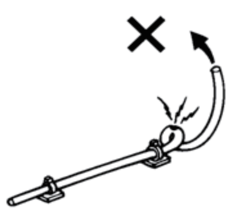
Ten Rules for Handling Cables (Must be Observed!)

1. Do not let the cable flex at a single point.

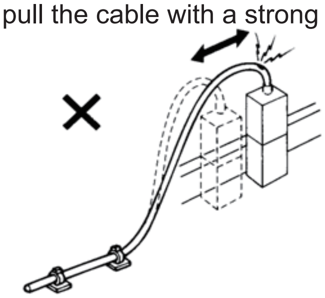




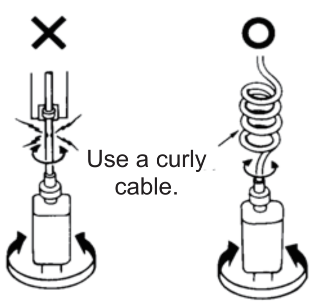
2. Do not let the cable bend, kink or twist.



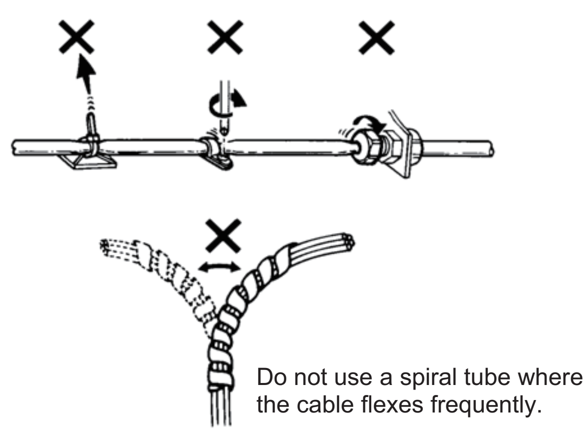
3. Do not pull the cable with a strong force.



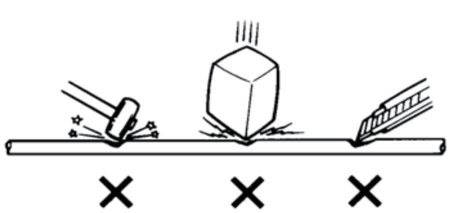
4. Do not let the cable receive a turning force at a single point.



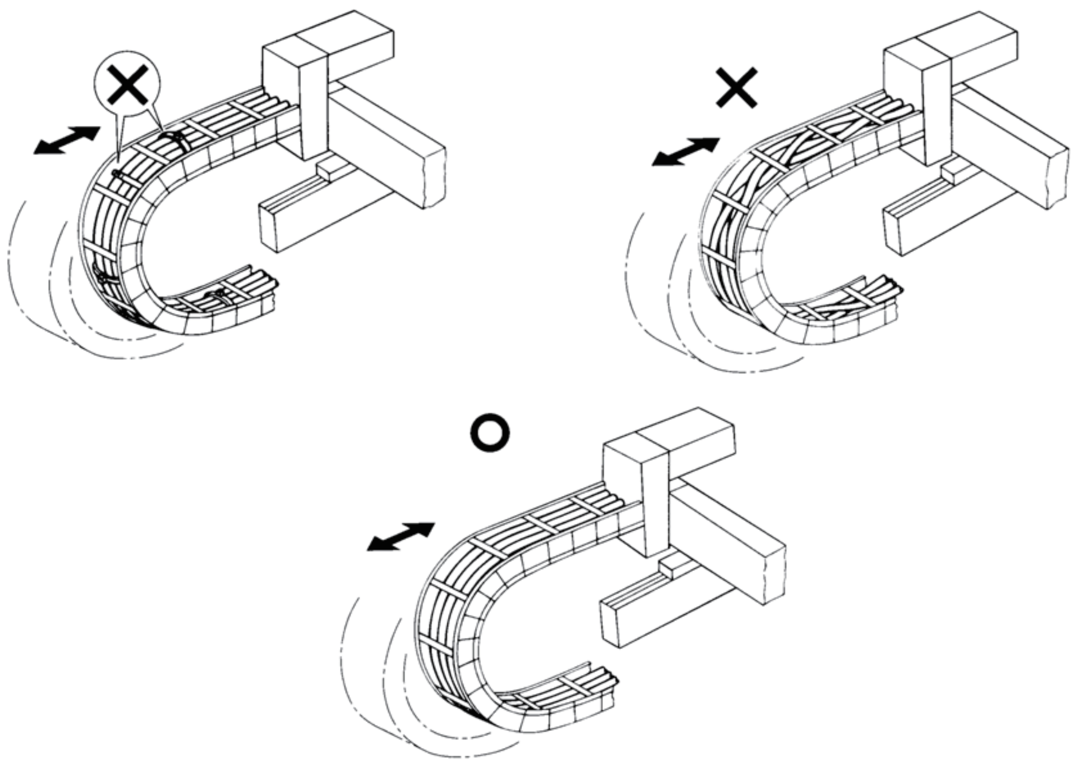
5. When fixing the cable, provide a moderate slack and do not tension it too tight.



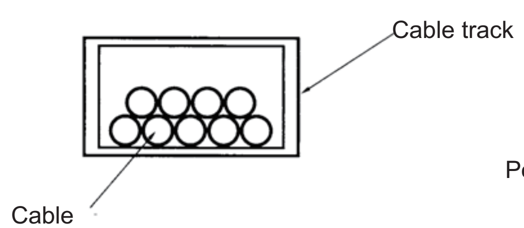
6. Do not pinch, drop a heavy object onto or cut the cable.



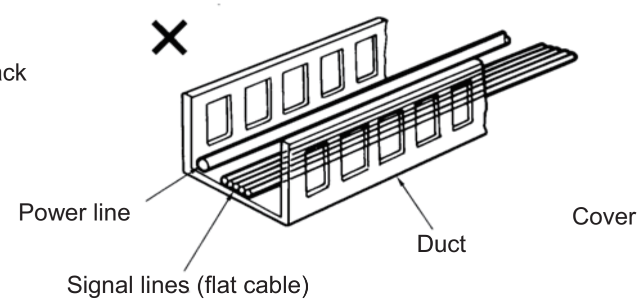
7. Do not let the cable get tangled or kinked in a cable track or flexible tube. When bundling the cable, keep a certain degree of flexibility (so that the cable will not become too taut when bent).



8. Do not cause the cables to occupy more than 60% of the space in the cable track.

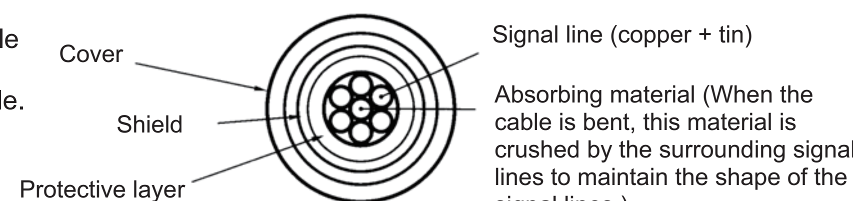


9. Do not lay signal lines together with circuit lines that create a strong electric field.



10. Always use a <u>robot cable</u> if the cable is likely to flex significantly.

[Standard structure of cable]
The standard structure of cable will vary depending on the manufacturer and type of cable.



★ Need for Robot Cables
A cable connected to a moving part of an actuator system will inevitably receive repeated bending loads at the base of the cable. As a result, the cores in the cable may break over time. To minimize the risk of cable breakage, we strongly recommend that a <u>robot cable</u> offering significantly higher flexibility be used in this type of application.

Important: Please Read Before Use

Caution

- Caution

[1] Be sure to read this Operation Manual to ensure the correct use of this product.
[2] This Operation Manual, in part or in whole, must not be used or reproduced without permission.
[3] Any handling, operation or other use not specified in this Operation Manual should be considered prohibited and must not be attempted. Also note that problems resulting from any handling, operation or other use not specified in this Operation Manual shall be excluded from the scope of warranty.
[4] Contents of this Operation Manual are subject to change without notice for the purpose of modification or improvement.
*If you have purchased the PC software:
At the initial setup of the product and after changing any of its parameters, be sure to back up the parameters.
[5] Certain specifications described in this manual may not apply to custom models.

Caution

- Emergency Action

If this product is found in a dangerous state, immediately turn off the power switch of the product as well as power switches of all equipment and devices connected to the product, or unplug all power cables from the electrical outlets. ("Dangerous state" refers to a situation where the product is generating an abnormal amount of heat or smoke, has ignited, or is otherwise feared to cause fire or bodily injury.)

Table of Contents

Introduction

Thank you for purchasing the XSEL Controller.

Inappropriate use or handling will prevent this product from demonstrating its full function and may even cause unexpected failure or result in a shortened service life. Please read this manual carefully, and handle the product with due care and operate it correctly. Keep this manual in a safe place and reference relevant items when needed.

The controller types covered by this manual are listed below.

Type	Specification
XSEL-P/PCT (Note)	Standard
XSEL-Q/QCT (Note)	Global

Note XSEL-PCT and XSEL-QCT are dedicated for CT4 Actuator.
For other actuators, use XSEL-P or XSEL-Q.

Refer to the following table for details on type specification.

Type

Example of type specification

XSEL - P - 3 - 400A - 200ACL - 60ABL - DV - N1 - EEE - 2 - 3
❶ ❷ ❸ ❹ (Axis 1) ❹ (Axis 2) ❹ (Axis 3) ❺ ❻ ❼ ❽ ❾

Type specification table

① Series	② Controller type	③ [*4] Number of axes	④ Details of axis 1 to axis 6 [*2, *3] Motor output (W)	Encoder type	Brake	Creep sensor	Home sensor (LS)	Synchro specification	⑤ Network (dedicated slot)	⑥ Standard I/O (slot 1)	⑦ Expanded-I/O slot Slot 2	Slot 2	Slot 2	⑧ I/O flat cable length	⑨ Power-source voltage
XSEL	P (Standard) Q[*1] (Safety-category compliant) PCT : Dedicated for CT4 (Standard) QCT[*1] : Dedicated for CT4 (Safety-category compliant)	1 (1 axis) 2 (2 axes) 3 (3 axes) 4 (4 axes) 5 (5 axes) 6 (6 axes)	12 (12W) 30D (30W for DS) 30R (30W for RS) 60 (60W) 100 (100W) 150 (150W) 200 (200W) 300 (300W) 400 (400W) 600 (600W) 750 (750W)	I (Incremental) A (Absolute) G (Quasi-absolute)	Blank (No brake) B (With brake)	Blank (No creep sensor) C (With creep sensor)	Blank (No home sensor) L (With home sensor)	Blank (No synchro) M (Master axis specification) S (Slave axis specification)	Blank (Network not available) DV (DeviceNet 256/256 board) CC (CC-Link 256/256 board) PR (ProfiBus 256/256 board) ET (Ethernet Data communica-tion board)	E (Not used) N1 (Input 32/ Output 16 NPN board) N2 (Input 16/ Output 32 NPN board) N3 (Input 48/ Output 48 NPN board) P1 (Input 32/ Output 18 PNP board) P2 (Expanded I/O PNP16/32) P3 (Input 48/ Output 48 PNP board)	E (Not used) N1 (Expanded I/O NPN32/16) N2 (Expanded I/O NPN16/32) N3 (Multi-point I/O NPN48/48) P1 (Expanded I/O PNP32/16) P2 (Expanded I/O PNP16/32) P3 (Multi-point I/O PNP48/48) S [*5] (Expanded I/O with base)	E (Not used) N1 (Expanded I/O NPN32/16) N2 (Expanded I/O NPN16/32) N3 (Multi-point I/O NPN48/48) P1 (Expanded I/O PNP32/16) P2 (Expanded I/O PNP16/32) P3 (Multi-point I/O PNP48/48) S [*5] (Expanded I/O with base)	E (Not used) N1 (Expanded I/O NPN32/16) N2 (Expanded I/O NPN16/32) N3 (Multi-point I/O NPN48/48) P1 (Expanded I/O PNP32/16) P2 (Expanded I/O PNP16/32) P3 (Multi-point I/O PNP48/48) S [*5] (Expanded I/O with base)	2: 2 m (Standard) 3: 3 m 5: 5 m 0: None [*1]	2: Single-phase, 200 V 3: Three-phase, 200 V

*1 With this type, a safety protection circuit can be configured by separating the motor drive source.
*2 RCS2-R**7 series, RCS-RB75 series, RCS-G20, RCS-R* and linear motor (LCA) actuators cannot be connected as axes 5 and 6.
*3 One large high-thrust linear actuator (W21H☐) occupies the space of two axes with one axis, so pay attention to the total number of axes.
*4 [3] indicates the number of connected axes regardless of whether or not the condition in *3 applies.
*5 S indicates that an expanded I/O board will be added later, instead of being installed from the beginning. In this case, the applicable expanded I/O base slot becomes empty.

This controller receives two types of power from external power sources: one for driving the motor (three-phase or single-phase, 200 to 220 V) and the other for control (single-phase, 200 to 220 V).

* A single-phase power source is required only for controllers of single-phase specification.

The motor-drive power supply is controlled independently of the control power supply, and the internal operations of the controller are different depending on whether it is of the global specification or standard specification.

With the standard controller, the main CPU in the system performs all self-diagnosis checks and supplies power to the drive part only when the system can operate properly.

With the global controller, the user must provide a separate circuit that cuts off the three-phase 200-VAC motor power supplied to the controller. If this drive-power cutoff circuit is not provided, safe operation of the controller cannot be guaranteed.

If your controller is of the global specification, be sure to provide a safety circuit (drive-power cutoff circuit).

This controller can be configured with one to six axes. Just like other conventional SEL controllers, this controller can be combined with various actuators. When connecting an actuator, be sure to use a dedicated cable.

- Turn on the controller power before or simultaneously with the motor power.
- Turn off the controller power after or simultaneously with the motor power.
- Before performing a check or inserting/removing a connector, turn off the power and wait for at least 10 minutes. Even after the power is turned off, the internal circuits will continue to carry high voltages for a short period.
- About actuator duty
  IAI recommends that our actuators be used at a duty of 50% or less as a guideline in view of the relationship of service life and precision:

$$\text{Duty (\%)} = \frac{\text{Acceleration / Deceleration Time}}{\text{Motion time} + \text{Inactivity}} \text{ X } 100$$

- After turning off the control power, be sure to wait for at least 5 seconds (40 seconds for single-phase P type controllers) before turning it back on.
  An “E6D, Drive-source cutoff relay error” may generate if the control power is turned off and then turned on again too quickly.
- Do not insert or remove connectors while the controller power is on. Doing so may cause malfunction.
- Items to note when introducing an absolute-specification controller
  Follow the steps below to initialize the absolute-data backup battery circuit and thereby prevent early consumption of the battery:
  (1) Set the absolute-data backup battery enable/disable switch to the botto position.

  (2) Connect the encoder cable.
  (3) Turn on the power.
  (4) Set the absolute-data backup battery enable/disable switch to the top (ENB) position.
  The above steps must be performed after the encoder cable has been removed due to relocation, etc.

Read the operation manual for each actuator. If you have purchased our optional PC software and/or teaching pendant, read the respective operation manuals, as well.

* Utmost effort has been made to ensure that the information contained in this manual is true and correct. However, should you find any error or if you have any comment regarding the content, please contact IAI.

Part 1 Installation

Caution

Chapter 1 Safety Precautions

The XSEL Controller can be combined with a maximum of six actuators of different types, and is able to provide integrated control over the entire system including peripherals. In other words, the XSEL Controller has the ability to control systems of all sizes ranging from a small system to a large factory automation system. In general, however, the occurrence rate of accidents due to wrong operation or carelessness will rise as the system becomes larger and more complex. Please give due consideration to safety measures.

This system product was developed as a drive unit for an automated machine, etc., and as such the maximum torque and speed are limited to levels acceptable for an automatically driven machine. However, strict observance of the following items is requested to prevent unforeseen danger. Also read the appendix entitled, "Safety Rules and Others."

1. Do not handle this product in manners not specified in this manual. If you have any question regarding the content of this manual, please contact IAI.
2. Always use the specified, genuine IAI cables for wiring between the controller and the actuator.
3. Do not enter the operation area of the machine while the machine is operating or ready to operate (the controller power is on). If the machine is used in a place accessible to other people, provide an appropriate safety measure such as enclosing the machine with a cage.
4. When assembling/adjusting or maintaining/inspecting the machine, always turn off the controller power at the source beforehand. The operator should display in a conspicuous place a plate or other sign saying that operation is in progress and that the power should not be turned on. The operator should keep the entire power cable beside him or her to prevent another person from inadvertently plugging in the cable.
5. When two or more operators are to work together, set call-out signals to ensure safety of all personnel during the work. In particular, a person turning on/off the power or moving an axis—either via a motor or manually—must always say what he or she is going to do out loud and confirm the responses from the others first before actually performing the operation.

Chapter 2 Warranty

1. Warranty Period

One of the following periods, whichever is shorter:
- 18 months after shipment from our company
- 12 months after delivery to the specified location

2. Scope of the 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 operation manual and catalog.

(4) The breakdown of problem in question was caused by a specification defect or problem, or by a quality issue with 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.

3. Honoring the Warranty

As a rule, the product must be brought to us for repair under warranty.

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.

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 operation manual.

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

Chapter 3 Installation Environment and Selection of Auxiliary Power Devices

1. Installation Environment

(1) When installing and wiring the controller, do not block the ventilation holes provided for cooling. (Insufficient ventilation will not only prevent the product from functioning fully, but it may also result in failure.)
(2) Prevent foreign matter from entering the controller through the ventilation holes. Since the controller is not designed as dustproof or waterproof (oilproof), avoid using it in a dusty place or place subject to oil mist or splashed cutting fluid.
(3) Do not expose the controller to direct sunlight or radiant heat from a high heat source such as a heat-treating furnace.
(4) Use the controller in a non-condensing environment free from corrosive or inflammable gases.
(5) Use the controller in an environment where it will not receive external vibration or impact.
(6) Prevent electrical noise from entering the controller or its cables.

Environmental Condition of Controller

Item	Specification and description
Ambient operating temperature range	0 to 40°C
Ambient operating humidity range	10% to 95% (Non-condensing; conforming to JIS C3502 RH-2)
Storage temperature range	-25°C to 70°C (Excluding the battery)
Maximum operating altitude	2000 m
Protection class	IP20
Vibration	$10 \leq f < 57$: 0.035 mm (continuous), 0.075 mm (intermittent) $57 \leq f \leq 150$: 4.9 m/s^2 (continuous), 9.8 m/s^2 (intermittent) X, Y and Z directions
Impact	147 mm/s^2, 11 ms, half-sine pulse, 3 times each in X, Y and Z directions

Electrical Specifications of Controller

Item	Specification	
Power-source voltage	Three-phase, 200 to 230 VAC ± 10%	Single-phase, 200 to 230 VAC ± 10%
Power-source frequency	50/60 Hz ± 5% (Conforming to JIS C3502 RH-2)	
Momentary power failure resistance	0.5 cycle (Phase-independent)	
Electric shock protection	Class I: Basic isolation, grounding by ground terminal	
Overvoltage class	Class II: Withstand voltage of 2500 V at voltage inputs below 300 VAC (rated input)	
Pollution degree	Pollution degree 2	
Rush current	120 A max. for motor power, 50 A max. for control power (at 40°C, 200-VAC input) The level of rush current will vary depending on the power-source environment. The above values are provided for reference purpose only.	
Leak current	2 mA max. (Controller only without any axes connected)	

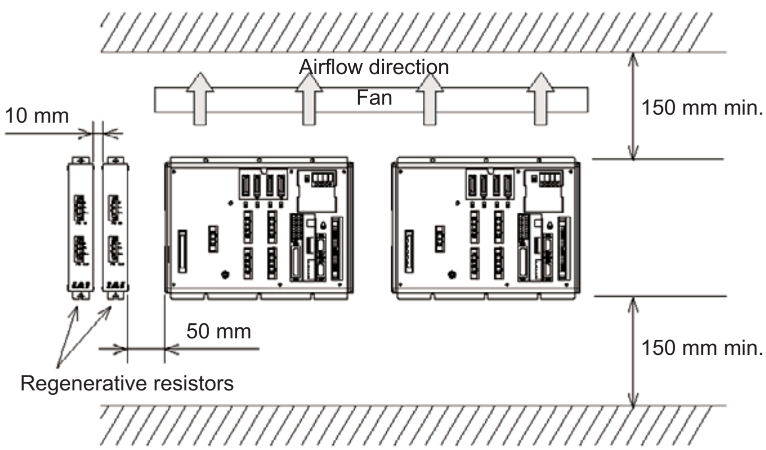
2. Heat Radiation and Installation

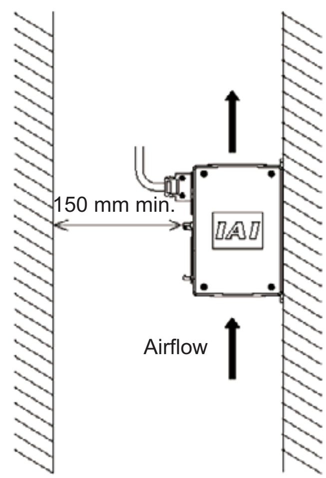
Design the control panel size, controller layout and cooling method so that the ambient temperature around the controller will be kept at or below 40°C.

Install the controller vertically on a wall, as illustrated below. The controller will be cooled by forced ventilation (exhaust air will be discharged from the top). Be sure to install the controller in the aforementioned direction and provide a minimum clearance of 150 mm above and 150 mm below the controller.

If multiple controllers are to be installed side by side, providing additional suction fans on top of the controllers will help maintain a uniform ambient temperature.

Provide a minimum clearance of 150 mm between the front side of the controller and a wall (enclosure).





If multiple controllers are to be connected on top of one another, prevent the controller above from taking in the exhaust air from the controller below.
Provide a clearance of approx. 50 mm between the regenerative resistor and the controller, and a clearance of approx., 10 mm between the regenerative resistors.

3. Selection of Auxiliary Power Devices

This section provides selection guidelines for breakers, earth leakage breakers, contactors, surge absorbers and noise filters that can be used with the AC power-supply line of the XSEL controller. These devices must be selected by taking into consideration the power consumption, rush current and maximum motor drive current of the controller.

(1) Power consumption
The table below lists the current capacities of the control power supply and motor power supply.
The power values of the control power supply are indicated by maximum loads. The power values of the motor power supply can vary in accordance with the connected axes and load condition. The table lists the power values of the motor power supply based on a load factor of 100%. Although a duty factor of 50% is recommended in this manual, these values assume the maximum allowable performance of the controller. A maximum motor current of three times the rated current may flow during high-acceleration operations. The table below indicates the momentary maximum currents calculated as three times the corresponding rated currents.

Guideline for AC Power-supply Operating Current

	Control power supply	Motor power supply					
		~ 400 W	~ 800 W	~ 1200 W	~ 1600 W	~ 2000 W	~2400 W
Rated power	181 VA	800 VA	1595 VA	2390 VA	3185 VA	3980 VA	4775 VA
Rated current	0.71 A	2.6 A	5.2 A	7.7 A	10.3 A	12.8 A	15.4 A
Momentary maximum power		2400 VA	4785 VA	7170 VA	9555 VA	11940 VA	14325 VA
Momentary maximum current		7.7 A	15.4 A	23 A	30.7 A	38.3 A	46.0 A

(2) Leak current
When installing the controller, always provide an inverter-type earth leakage breaker.
The table below lists the controller leak currents excluding the currents leaked from the servo system.

Model	Leak current (control power supply)	Leak current (motor power supply)
P/PCT type (Standard specification)	0.4 mA (200-VAC input)	2 mA max. (200-VAC input)
Q/QCT type (Global specification)	0.2 mA (200-VAC input)	2 mA max. (200-VAC input)

(3) Rush current
The table below lists reference rush currents that may generate in the control power supply and motor power supply. As for the motor power supply system, the capacitor volume will vary depending on the number of driver boards installed. However, the maximum current that can flow through the motor power supply remains the same.

	Control power supply	Motor power supply	
		Less than 1200 W	1200 W or above
Rush current	50 A	60 A max.*	120 A max.*
Rush current duration	3 ms		

* At 40°C, 200-VAC input

(4) Auxiliary power devices

[1] Circuit breaker

Install a circuit breaker or earth leakage breaker in the AC power-supply line (primary side) of the controller in order to prevent damage due to power switching and short current. One circuit breaker or earth leakage breaker can be used to protect both the motor power supply and control power supply.

- While the actuator is accelerating or decelerating, the controller current increases to three times the rated current. Select an appropriate circuit breaker that will not trip when this higher current flows. If the circuit breaker you have selected trips, change it to one with the next higher level of rated current.
- Select a circuit breaker that will not trip due to rush current. [Refer to the graph of operating characteristics in the manufacturer's catalog.]
- The rated cutoff current of the selected circuit breaker must be enough to cut off any short-circuit current, should it flow, without fail.
  Rated cutoff current > Short-circuit current = Power-supply capacity on primary side / Power-supply voltage
- The rated current of the selected circuit breaker should have an ample allowance.
  Rated current of circuit breaker > (Rated motor power-supply capacity [VA] + Control power-supply capacity [VA]) / AC input voltage x Safety factor (rough guide: 1.2 to 1.4)

Rated current of circuit breaker > (Rated motor power-supply capacity [VA] + Control power-supply capacity [VA]) / AC input voltage x Safety factor (rough guide: 1.2 to 1.4)

[2] Earth leakage breaker

Install an earth leakage breaker on the AC power-supply line side (primary side) of the controller to cut off earth leakage current. One earth leakage breaker may be used to serve both the motor power and plant power.

- You must select an appropriate earth leakage breaker that can meet your specific purpose, be it fire protection, protection of human life, or the like. Also measure the earth leakage current at the location where the earth leakage breaker is to be installed.
- The earth leakage current changes according to the capacity of the motor to be connected, lengths of cables, and surrounding environment. So that proper earth leakage protection can be provided, measure the earth leakage current at the location where the earth leakage breaker is to be installed.
- Use an earth leakage breaker of harmonic type.

[3] Electromagnetic contactor

If your controller is of the global specification, an electromagnetic contactor must be installed in front of the motor power input port on the controller so that the motor drive source can be cut off. Select a product that meets your requirement for safety category. Refer to Chapter 6, "Safety Circuit," for the configuration of the safety circuit.

[4] Noise filter, ring core and clamp filters
The global specification has no built-in noise filters in the motor power supply. If your controller is of the global specification, therefore, be sure to install noise filters and ring cores for the motor drive power supply externally to the controller. Even with the standard controller, noise filters and ring cores must be installed if noise-sensitive external equipment will be used.

With both the global specification and standard specification, use the same noise filters and ring cores to protect both the motor power supply and control power supply.

Install clamp filters to ensure compliance with the EC Directives or if necessary for other reasons.

- Clamp filter A
  Install this clamp filter to the control power cable and motor cable (if there are multiple axes, connect to the cables of all axes).
- Clamp filter B
  Install this clamp filter to the motor power cable.

Caution:	Be sure to use the following noise filter, ring core and clamp filters to ensure compliance with the EC Directives (IAI uses the following filters in the evaluation certification tests under the EMC Directives).

Recommended Noise Filter, Ring Core and Clamp Filters

	Supplier	Model number
Noise filter	NBH-20-432 (for single-phase power supply) TAC-20-683 (for three-phase power supply) NF3020C-SVA (for three-phase power supply) MXB-1220-33 (for single-phase power supply) MC1320 (for three-phase power supply)	COSEL COSEL SOSHIN ELECTRIC TDK-Lambda TDK-Lambda
Ring core	ESD-R-25	NEC Tokin
Clamp filter A	ZCAT3035-1330	TDK
Clamp filter B	RFC-H13	Kitagawa Industries

[5] Surge absorber
With both the global specification and standard specification, the motor drive part of the XSEL controller has no built-in surge absorber to protect the equipment against surge noises that may generate in the controller due to lightning, etc.

Therefore, a surge absorber must be installed externally to the controller if you want to increase the surge resistance of your equipment.

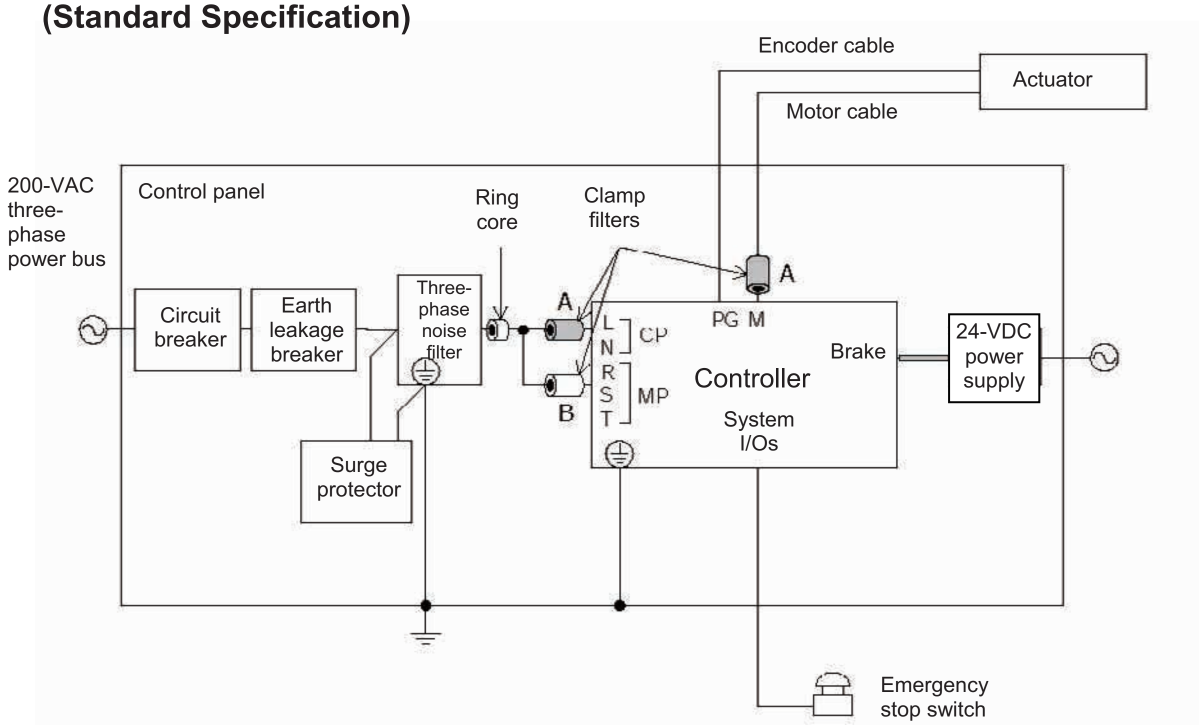
Caution:	Be sure to use the following surge absorber to ensure compliance with the EC Directives. Recommended surge absorber: R/A/V-781BXZ-4 by Okaya Electric Industries

specifications are shown on the following pages.

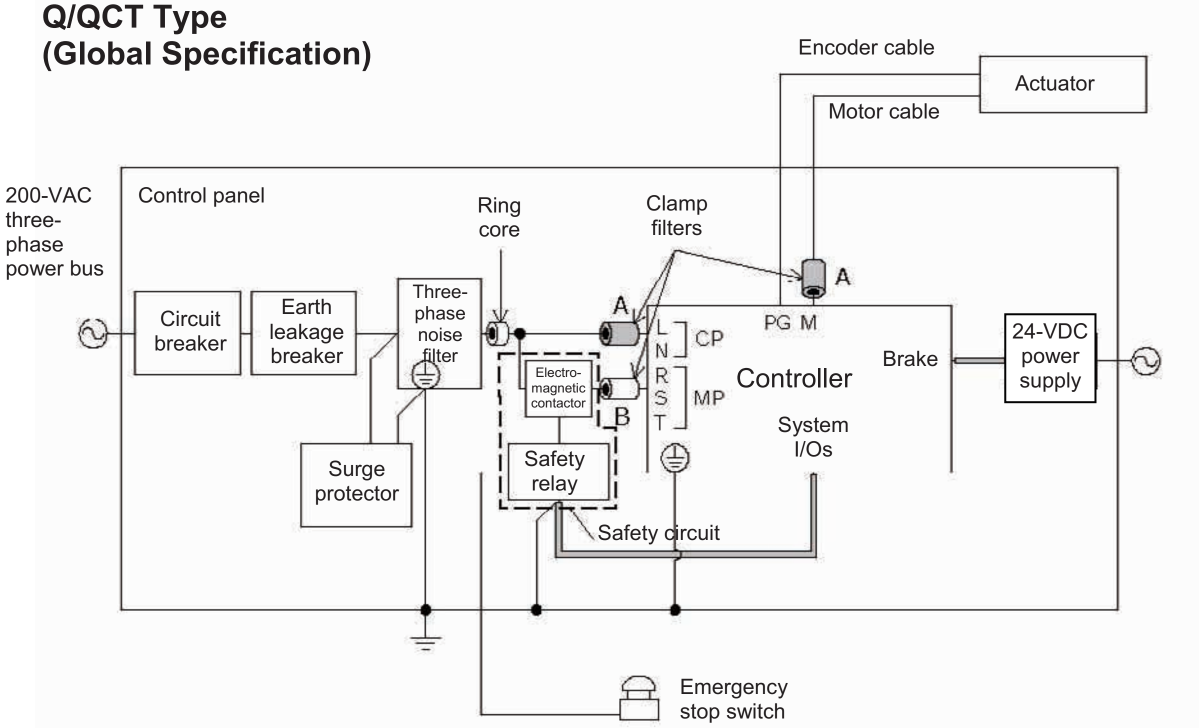
Peripheral Configurations

Three-phase power supply specification

P/PCT Type
(Standard Specification)



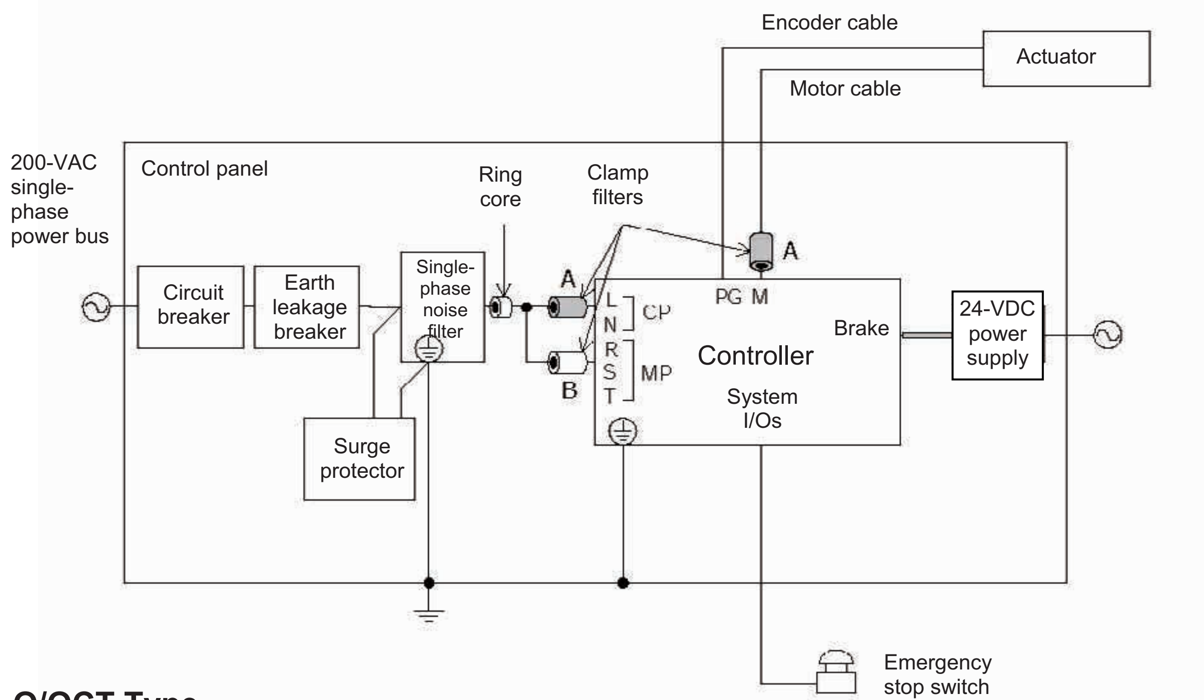
Q/QCT Type
(Global Specification)



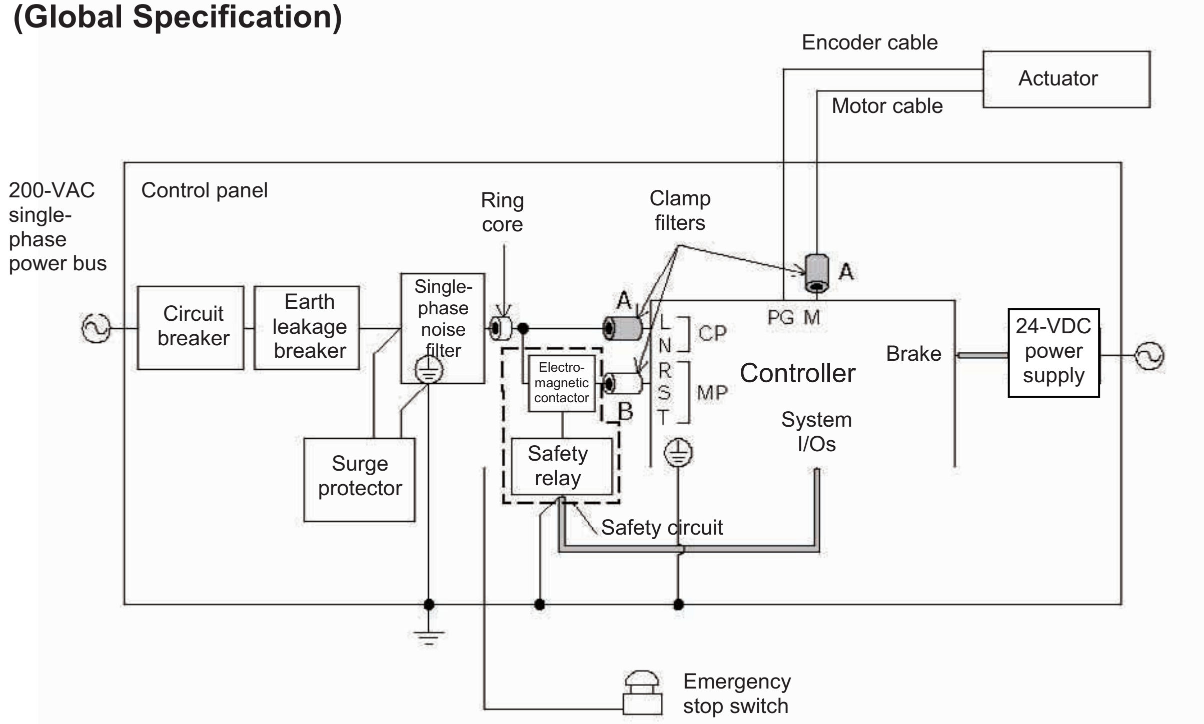
Peripheral Configurations

Single-phase power supply specification

P/PCT Type
(Standard Specification)

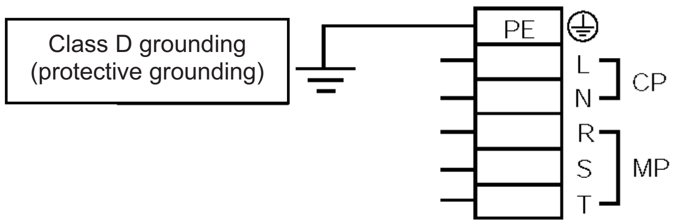


Q/QCT Type
(Global Specification)



4. Noise Control Measures and Grounding

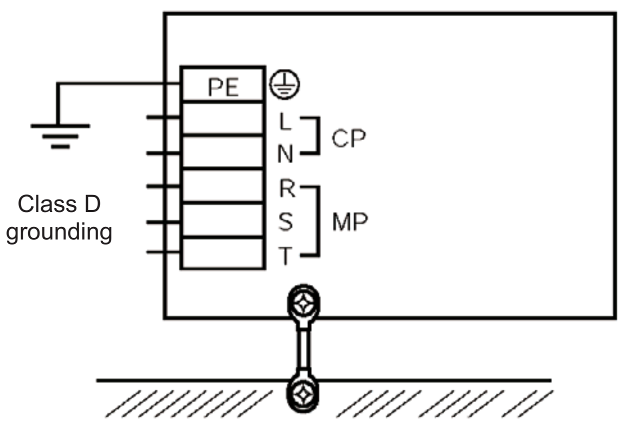
(1) Wiring and power source
PE on the power terminal block is used for protective grounding. Provide Class D grounding from this terminal.
Use a grounding cable with a wire size of 1.0 mm^2 (#AWG17) or more, which should not be smaller than the AC power cable.



a. Notes on wiring method
Use twisted cables for the AC power cable and 24-VDC external power cable. Wire the controller cables separately from lines creating a strong electric field such as power circuit lines (by not bundling them together or placing in the same cable duct).

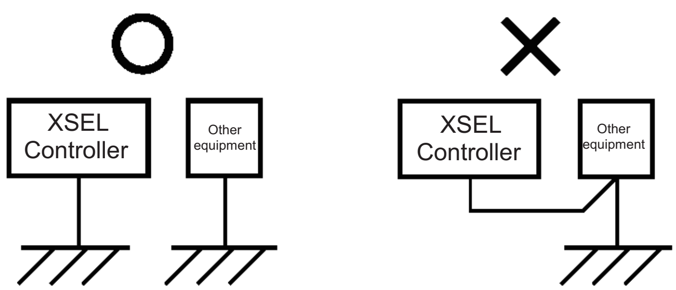
If you wish to extend the motor cable or encoder cable beyond the length of each supplied cable, please contact IAI's Technical Service Section or Sales Engineering Section.

(2) Noise-elimination grounding



Metal enclosure

Provide dedicated grounding for the FG and PE.



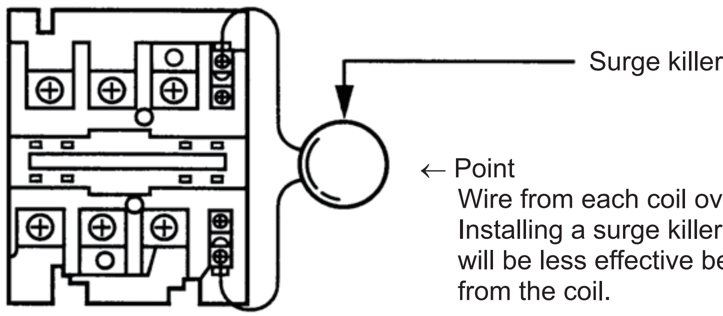
Do not connect as above.

(3) Noise sources and noise elimination

There are many noise sources, but solenoid valves, magnet switches and relays are of particular concern when building a system. Noise from these parts can be eliminated using the measures specified below:

a. AC solenoid valve, magnet switch, relay

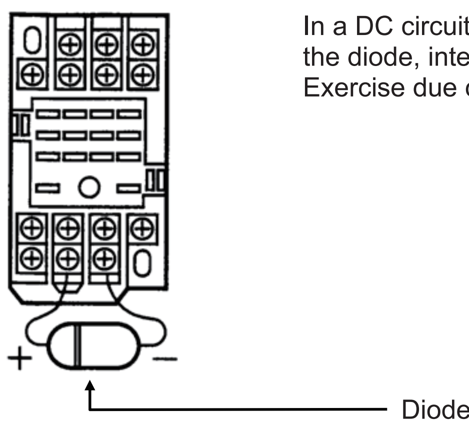
Measure --- Install a surge killer in parallel with the coil.



← Point
Wire from each coil over the shortest distance.
Installing a surge killer on the terminal block, etc., will be less effective because of a longer distance from the coil.

b. DC solenoid valve, magnet switch, relay

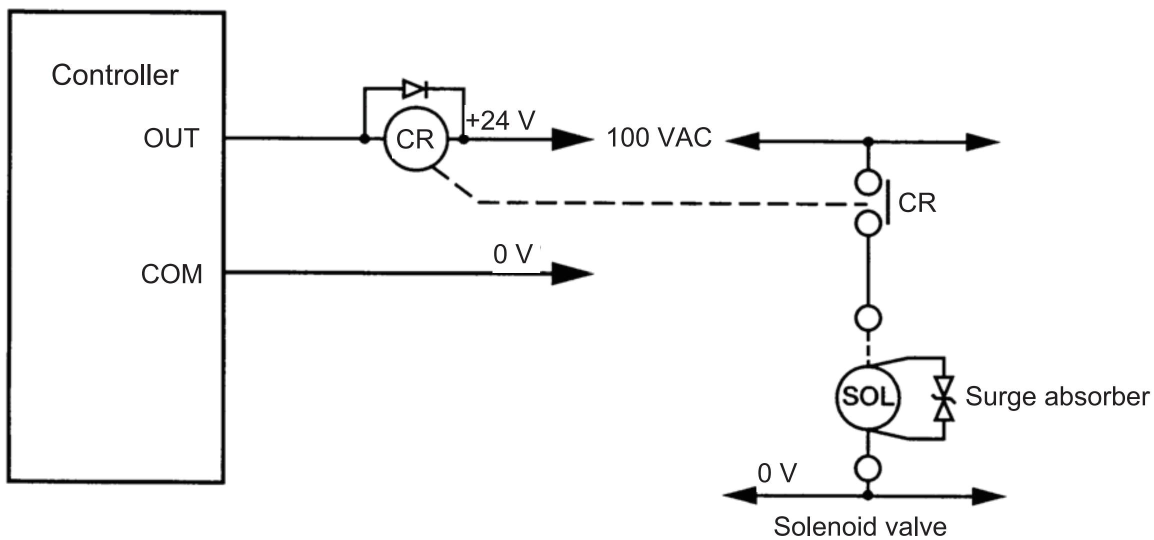
Measure --- Install a diode in parallel with the coil. Determine the diode capacity in accordance with the load capacity.



In a DC circuit, connecting a diode in reversed polarity will damage the diode, internal parts of the controller and DC power supply. Exercise due caution.

The above noise elimination measures are particularly important when a 24-VDC relay is driven directly by a controller output and there is also a 100-VAC solenoid valve, etc.

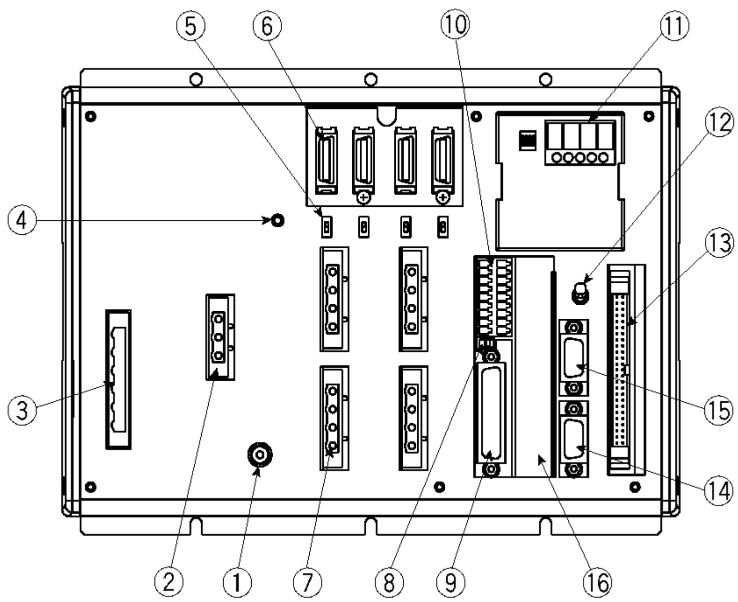
Reference Circuit Diagram



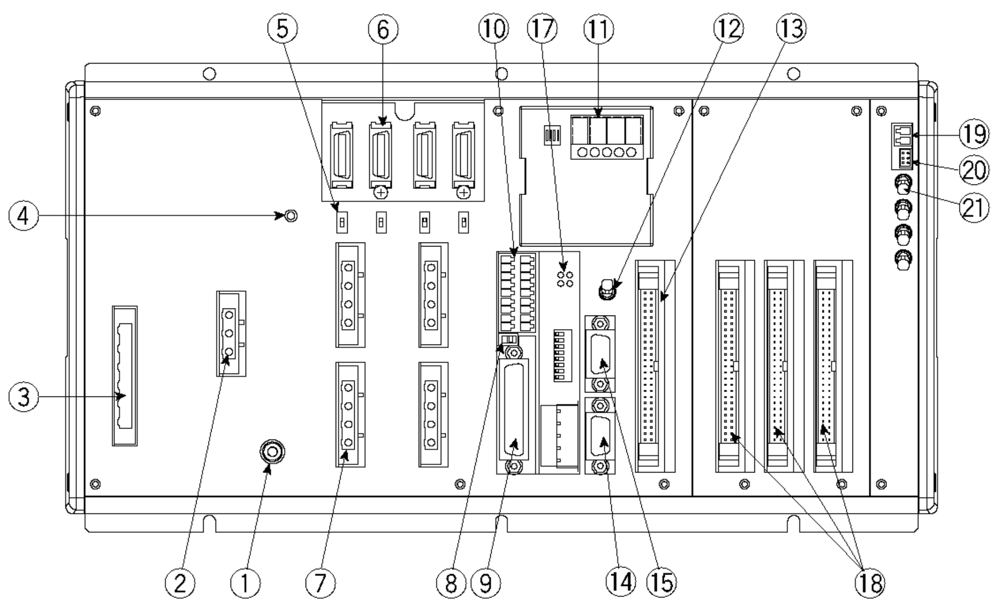
Chapter 4 Name and Function of Each Part

1. Front View of Controller

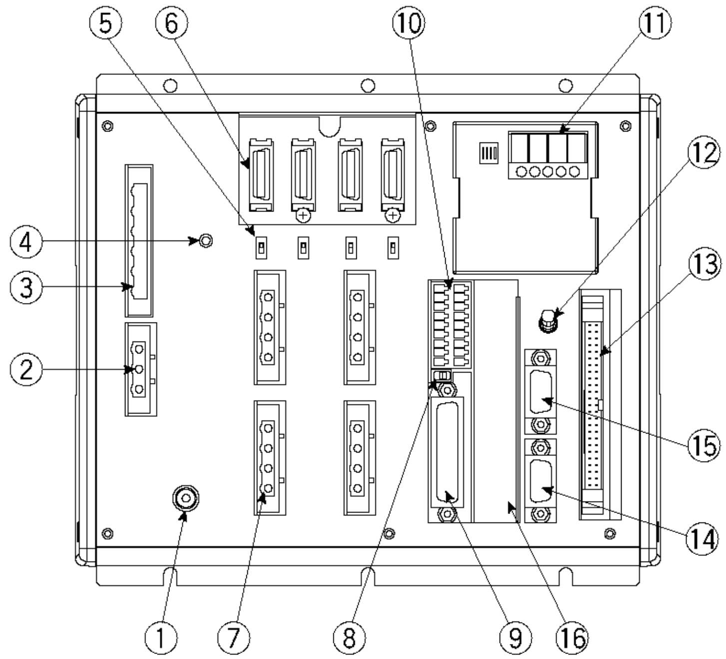
P/PCT Type (Standard Specification), 4 axes



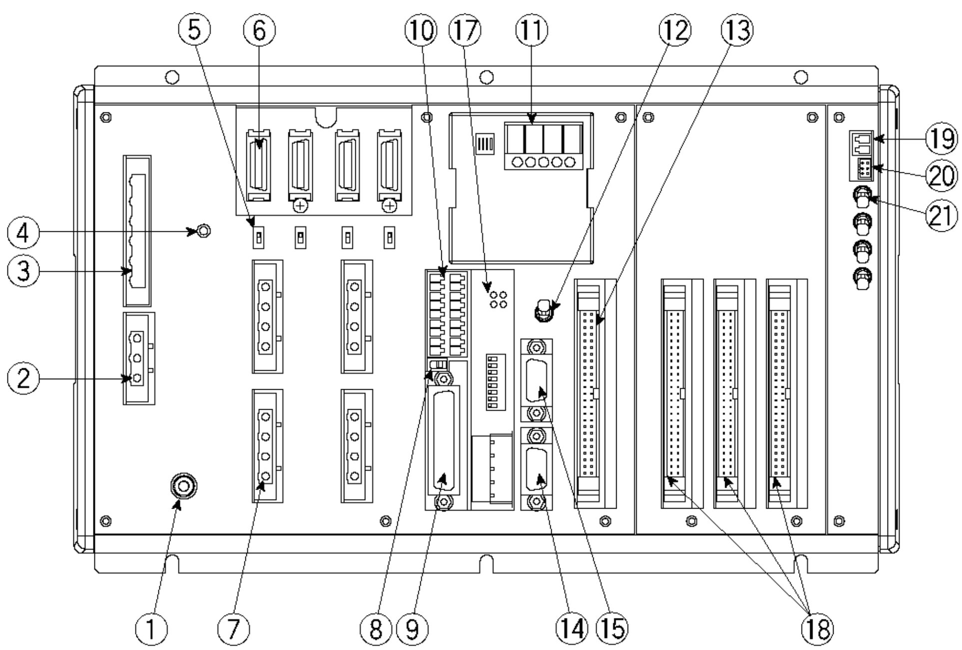
P/PCT Type (Standard Specification), 4 axes with expansion I/O board and brake unit



Q/QCT Type (Global Specification), 4 axes



Q/QCT Type (Global Specification), 4 axes with expansion I/O board and brake unit



(1) FG terminal........................ This terminal is used to ground FG on the enclosure. The enclosure is connected to PE in the AC input part inside the controller.

FG Terminal Specifications

Item	Description
	M4 3-point SEMS screw, 5 mm
Name	FG
Cable size	2.0 to 5.5 mm^2 min.
Grounding method	Class D grounding

(2) External regenerative unit connector........................ This connector is used to connect a regenerative resistance unit that may be required when the controller is used in a high-speed/high-load environment, etc., and the built-in regenerative resistance capacity is not sufficient. Whether or not an external regenerative resistance is necessary will be determined by the specific application such as axis configuration. Refer to “Number of Regenerative Resistors to Be Connected” in Appendix.

External Regenerative Unit Connector Specifications

Item	Overview	Details
Connector	3-pin 2-piece connector by Phoenix Contact	GIC2.5/3-STF-7.62
Connector name	RB	
Cable size	Applicable wire size: AWG12 to 24	The cable is supplied with the external regenerative unit.
Size of supplied cable	1.0 mm^2 (equivalent to AWG17)	
Connected unit	External regenerative box	
Terminal assignments	RB+	Regenerative resistance + (Motor-driving DC voltage)
	RB–	Regenerative resistance –
	⏚	Grounding terminal

(3) AC-power input connector .... A 200-VAC, single-phase or three-phase input connector consisting of six terminals including motor power terminals, control power terminals and a PE terminal.

Note) Take note that the single-phase input specification and three-phase input specification are available depending on the required motor-drive power source. The standard type only comes with a terminal block.

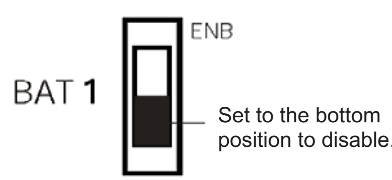
Caution To prevent electric shock, do not touch this connector when the controller is receiving power.

AC Power Connector Specifications

Item		Overview				Details
Connector		6-pin 2-piece connector by Phoenix Contact			GMSTB 2.5/6-7.62	
Connector name		PWR				
	Connected unit	Single-phase power source 200/230 VAC, 50/60 Hz				
Single-phase specification	Terminal assignments	6		PE	Protective grounding wire	
		5	IN	CP_L	200 VAC for control power, phase L	Cable size 0.75 mm^2 (AWG 18)
		4	IN	CP_N	200 VAC for control power, phase N	
		3		NC	Do not connect this terminal.	
		2	IN	MP_L	200 VAC for motor power, phase L	Cable size 2 mm^2 (AWG 14)
		1	IN	MP-N	200 VAC for motor power, phase N	
Three-phase specification	Terminal assignments	6		PE	Protective grounding wire	
		5	IN	CP_L	200 VAC for control power, phase L	Cable size 0.75 mm^2 (AWG 18)
		4	IN	CP_N	200 VAC for control power, phase N	
		3	IN	MP_R	200 VAC for motor power, phase R	Cable size 2 mm^2 (AWG 14)
		2	IN	MP_S	200 VAC for motor power, phase S	
		1	IN	MP_T	200 VAC for motor power, phase T	

(4) Control-power monitor LED .... A green light illuminates when the control power supply is generating the controller's internal power correctly.

(5) Absolute-data backup battery enable/disable switch................................ This switch is used to enable or disable encoder data backup using the absolute-data backup battery. The backup is disabled before shipment. Set the switch to the top position after connecting the encoder/axis-sensor cables and turning on the power.



(6) Encoder/axis-sensor connector .... This connector is used to connect the actuator encoder and axis sensors such as LS, CREEP and OT. * LS, CREEP and OT sensors are optional.

Encoder/Axis-sensor Connector Specifications

Item	Description	Details
Connector	Half-pitch, 26-pin I/O connector	10226-6202JL (by Sumitomo 3M)
	Cable-end connector	10126-3000VE (by Sumitomo 3M) (Hood: 10326-52F0-008)
Connector name	PG1 to 6	Encoder/axis-sensor connector
Maximum wiring distance	30 m	

	Pin No.	Signal name	Description
Signal table	**1**	A+	Phase-A differential + input (phase U+)
	2	A–	Phase-A differential - input (phase U-)
	3	B+	Phase-B differential + input (phase V+)
	4	B–	Phase-B differential - input (phase V-)
	5	Z+	Phase-Z differential + input (phase W+)
	6	Z–	Phase-Z differential - input (phase W-)
	7	SRD+	Send/receive differential + (pulse/magnetic pole switching +)
	8	SRD–	Send/receive differential - (pulse/magnetic pole switching -)
	9	NC	Not connected
	10	NC	Not connected
	11	NC	Not connected
	12	24VOUT	Sensor power output
	13	0V	24-V power ground
	14	BATT	Backup battery
	15	BATTGND	Battery ground
	16	VCC	Encoder power
	17	GND	GND
	18	NC	Not connected
	19	NC	Not connected
	20	BK–	Brake open output signal - (COM: Common to all axes)
	21	BK+	Brake open output signal +
	22	NC	Not connected
	23	*RSV	Sensor input RSV
	24	*OT	Sensor input OT
	25	*CLEEP	Sensor input CLEEP
	26	*LS	Sensor input LS

(7) Motor connector.................. This connector is used to drive the motor inside the actuator.

Motor Connector Specifications

Item	Description			Details
Connector	GIC2.5/4-STF-7.62			4-pin, 2-piece connector by Phoenix Contact
Connector name	M1 to 6			Motor connector
Cable size	0.75 mm^2 (equivalent to AWG18)			Supplied with the actuator.
Connected unit	Actuator			
Terminal assignments	**1**		PE	Protective grounding wire
	2	Out	U	Motor drive phase U
	3	Out	V	Motor drive phase V
	4	Out	W	Motor drive phase W

(8) Teaching-pendant type switch (P/PCT type only)..... This switch is used to change the type of the teaching pendant connected to the teaching connector (9). It switches between “IAI’s standard teaching pendant” and “ANSI teaching pendant.” The switch is located on the front side of the board. Select the applicable setting in accordance with the teaching pendant used.

Left: **PC cable (comforming to safety category 4)**
SEL-T, SEL-TD, SEL-TG teaching pendant
IA-T-XA teaching pendant

Right: **PC cable**
IA-T-X, IA-T-XD teaching pendant

Switch

Note 1: The safety gate switch will not function if this switch is not set correctly.
Note 2: Q/QCT type controllers connot be used with IAI’s standard teaching pendants and standard personal computer cable (black).
Note 3: The TP switch is not provided on Q/QCT type controllers.

(9) Teaching connector .... The teaching interface connects IAI's teaching pendant or a PC (PC software) to enable operation and setting of your equipment from the teaching pendant/PC. The physical interface consists of a RS232C system based on a 25-pin, D-sub connector. The signal level conforms to RS232C, and a desired baud rate (up to 115.2 kbps) can be selected depending on the program. RS232C communication is possible only when the mode switch (12) is set to the MANU position.
You can also use an ANSI teaching pendant equipped with an ANSI-compliant double-action enable switch. Whether the controller supports an ANSI teaching pendant or IAI's standard teaching pendant can be set using the selector switch (8) provided above the teaching connector. (P/PCT type only)

* With a Q/QCT type controller, connect the supplied dummy plug to the teaching connector in the AUTO mode.

* Q/QCT type controllers connot be used with IAI's standard teaching pendants and standard personal computer cable (black).

Interface Specifications of Teaching Serial Interface

Item	Description	Details
Connector	DSUB-25	XM3B-2542-502L (by Omron)
Connector name	T.P.	Teaching connector
Communication method	RS232C-compliant, start-stop synchronous half-duplex communication	Signal assignments conform to the RS232C DTE terminal layout. Assign dedicated control lines to undefined lines, etc.
Baud rate	Up to 115.2 kbps	Half-duplex communication speeds of up to 115.2 kbps are supported.
Maximum wiring distance	10M	At 38.4 kbps
Interface standard	RS232C	
Connected unit	Dedicated teaching pendant	IAI's standard teaching pendant for XSEL, or ANSI teaching pendant
Connection cable		Dedicated cable
Power supply	5 VDC or 24 VDC	A multi-fuse (MF-R090) is installed to protect each line against short current (the fuse will trip with currents of between 1.1 A and 2.2 A).
Protocol	XSEL teaching protocol	The connector supports the XSEL-J/K teaching pendant interface protocol.
Emergency-stop control	Series emergency-stop relay drive (24 V)	An emergency-stop relay drive line is provided in the interface connector. This line is connected in series with other emergency-stop contact. Two independent emergency-stop input circuits are provided as a redundant safety design.
Enabling control	Enable switch line (24 V)	A line for connecting an enable switch is provided as an operator interlock. Two independent enable input circuits are provided as a redundant safety design.
(12) Mode switch	AUTO/MANU switch	Whether or not the teaching pendant can be used is set by the AUTO/MANU mode switch. The controller establishes a handshake with the teaching pendant only when this switch is set to the MANU mode. Note, however, that the teaching pendant displays the monitor screen regardless of the AUTO/MANU setting.

Interface Specifications of Teaching Serial Interface

Item	No.	Direction	Signal name	Details
Terminal assignments	1		FG	Frame ground
	2	Out	TXD	Transmitted data
	3	In	RXD	Received data
	4	Out	RTS	Request to send
	5	In	CTS	Clear to send
	6	Out	DSR	Equipment ready
	7		SG	Signal ground
	8		NC	Not connected
	9	In	RSVTBX1	RSV signal line for generic teaching pendant
	10	In	RSVTBX2	RSV signal line for generic teaching pendant
	11		NC	Not connected
	12	Out	EMGOUT1	Emergency-stop contact 1
	13	In	EMGIN1	
	14		NC	Not connected
	15	Out	RSVVCC	24-V power supply for IA-T-XA/SEL-T (D) teaching pendant
	16	Out	EMGOUT2	Emergency-stop contact 2
	17	Out	ENBVCC1	Enable drive power 1
	18	Out	VCC	Power output (power supply for IA-T-X (D) teaching pendant)
	19	In	ENBTBX1	Enable input 1
	20	In	DTR	Terminal ready
	21	Out	ENBVCC2	Enable drive power 2
	22	In	ENBTBX2	Enable input 2
	23	Out	EMGS	Emergency-stop status
	24	In	EMGIN2	Emergency-stop contact 2
	25		SG	Signal ground

Shading indicates that the signal is used only with an ANSI teaching pendant.

(10) System I/O connector .... This I/O connector is used to control the safety actions of the controller. With the global specification, a safety circuit conforming to a desired safety category of up to level 4 can be configured using this connector and an external safety circuit.

System I/O Connector Specifications

Item	Overview	Details
Connector	2-piece COMBICON connector (18 pins)	MCD1.5/9-G1-3.5P26THR (by Phoenix Contact)
	Cable-end connector	FMC1.5/9-ST-3.5
	Applicable wire size	AWG24 to 16
Connector name	SYSTEM IO	
Connected unit	External safety circuit	Emergency stop, safety gate, ready out, external relay cutoff

Overview of Terminal Assignments

	Pin No.	Signal name	Description	
Left	**9**	DET	IN	External contact error input
	8	EMGin	IN	Emergency-stop detection input
	7		+24V	24-V power output for emergency-stop detection input
	6	EMG1	line+	Emergency-stop switch 1
	5		line-	8 mA (P/PCT type)
	4	EMG2	line+	Emergency-stop switch 2
	3		line-	8 mA (P/PCT type)
	2	SDN	Out+	External relay drive cutoff contact output
	1		Out-	
Right	18	DET	+24V	24-V power output for external contact error input
	17	ENBin	IN	Enable detection input
	16		+24V	24-V power output for enable detection input
	15	ENB1	line+	Enable switch (safety gate, etc.)
	14		line-	8 mA (P/PCT type)
	13	ENB2	line+	Safety gate switch 2
	12		line-	8 mA (P/PCT type)
	11	RDY	Out+	Ready signal contact output
	10		Out-	

Only a terminal block is supplied without cable (EMG and ENB are shorted by a cable). Do not supply power other than from a 24-VDC power supply to the RDY and SDN contacts.

(11) Panel window .... This window consists of a 4-digit, 7-segment LED display and five LED lamps that indicate the status of the equipment.
For the information shown on the display, refer to 2, “Explanation of Codes Displayed on the Panel Window” or the “Error Code Table.”

Meanings of Five LEDs

Name	Status when the LED is lit
RDY	CPU ready (program can be run)
ALM	CPU alarm (system-down level error), CPU hardware error
EMG	Emergency stop has been actuated, CPU hardware error, power-system hardware error
PSE	Power-system hardware error
CLK	System clock error

(12) Mode switch .... This alternate switch with lock is used to command a controller operation mode. To operate the switch, pull it toward you and tilt.
Tilting the switch upward will select MANU (manual mode), while tilting it downward will select AUTO (auto mode). Teaching can be performed only in the MANU mode, but auto program start is not enabled in the MANU mode.

* With Q/QCT type controllers, connect the supplied dummy plug to the teaching connector (9) while this switch is set to the AUTO mode.

(13) Standard I/O connector ...... This connector consists of a 50-pin flat connector and comprises 32-input/16-output DIOs.

Overview of Standard I/O Interface Specifications

Item	Description
Connector name	I/O
Connector	Flat connector, 50-pin
Power supply	Supplied from connector pin Nos. 1 and 50
Input	32 points (including general-purpose and dedicated inputs)
Output	16 points (including general-purpose and dedicated outputs)
Connected to	External PLC, sensor, etc.

The functions are at the time of shipment. The functions assigned to port Nos. 000 to 015, 300 to 310, 313 and 314 can be changed via I/O parameters. (Refer to Nos. 30 to 56, No. 59 and 60 in 1, “I/O Parameters,” of Appendix, “List of Parameters.”)

I/O Interface List

Pin No.	Category	Port No.	Function	Cable color
1		-	+24-V input	Brown-1
2	Input	000	Program start	Red-1
3		001	General-purpose input	Orange-1
4		002	General-purpose input	Yellow-1
5		003	General-purpose input	Green-1
6		004	General-purpose input	Blue-1
7		005	General-purpose input	Purple-1
8		006	General-purpose input	Gray-1
9		007	Program specification (PRG No. 1)	White-1
10		008	Program specification (PRG No. 2)	Black-1
11		009	Program specification (PRG No. 4)	Brown-2
12		010	Program specification (PRG No. 8)	Red-2
13		011	Program specification (PRG No. 10)	Orange-2
14		012	Program specification (PRG No. 20)	Yellow-2
15		013	Program specification (PRG No. 40)	Green-2
16		014	General-purpose input	Blue-2
17		015	General-purpose input	Purple-2
18		016	General-purpose input	Gray-2
19		017	General-purpose input	White-2
20		018	General-purpose input	Black-2
21		019	General-purpose input	Brown-3
22		020	General-purpose input	Red-3
23		021	General-purpose input	Orange-3
24		022	General-purpose input	Yellow-3
25		023	General-purpose input	Green-3
26		024	General-purpose input	Blue-3
27		025	General-purpose input	Purple-3
28		026	General-purpose input	Gray-3
29		027	General-purpose input	White-3
30		028	General-purpose input	Black-3
31		029	General-purpose input	Brown-4
32		030	General-purpose input	Red-4
33		031	General-purpose input	Orange-4
34	Output	300	Alarm output	Yellow-4
35		301	Ready output	Green-4
36		302	Emergency-stop output	Blue-4
37		303	General-purpose output	Purple-4
38		304	General-purpose output	Gray-4
39		305	General-purpose output	White-4
40		306	General-purpose output	Black-4
41		307	General-purpose output	Brown-5
42		308	General-purpose output	Red-5
43		309	General-purpose output	Orange-5
44		310	General-purpose output	Yellow-5
45		311	General-purpose output	Green-5
46		312	General-purpose output	Blue-5
47		313	General-purpose output	Purple-5
48		314	General-purpose output	Gray-5
49		315	General-purpose output	White-5
50		-	0 V	Black-5

(14) General RS232C port connector 1 .... Channel 1 of the two-channel RS232C port provided for connection of general RS232C equipment.
(Refer to I/O parameter Nos. 201 to 203.)

(15) General RS232C port connector 2 .... Channel 2 of the two-channel RS232C port provided for connection of general RS232C equipment.
(Refer to I/O parameter Nos. 213 to 215.)

General RS232C Connector Specifications

Item	Overview			Details
Connector	D-sub, 9-pin (DTE)			XM2C-0942-502L (OMRON)
Connector name	S1/S2			
Maximum wiring distance	10 M			At 38400 bps
Interface standard	RS232C			
Connected unit	AT-compatible PC, etc.			Half-duplex communication
Connection cable				PC-AT standard 232C cross-cable
Terminal assignments	**1**	In	(CD)	(Carrier detection: Not used)
	2	In	RD	Received data (RXD)
	3	Out	SD	Transmitted data (TXD)
	4	Out	ER	Equipment ready (DTR)
	5	In	SG	Signal ground
	6	In	DR	Data set ready (DSR)
	7	Out	(RS)	(Request to send (RTS): Not used)
	8	In	(CS)	(Clear to send (CTS): Not used)
	9		NC	Not used

Use a cross-cable to connect to the RS232C port of a PC.

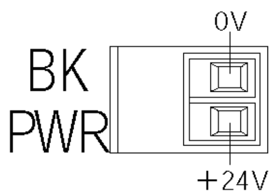
(16) Installation position of field network board .... This is where a Fieldbus interface module is installed. In this example, this position is left unoccupied (no module is installed).

(17) Optional board .... An optional field network board is installed.
A DeviceNet board is installed in this example.

(18) Expansion I/O board (optional) .... Optional expansion I/O boards are installed in the example.

(19) Supplementary Power Source (for brake, etc.) Input Connector................ It is a 24V DC input connector to for brake releasing and driving*.
When an actuator equipped with a brake or that necessary to supply power from this connector is to be connected, supply external 24V DC. For wiring, use shielded cables and connect the shield on the 24V power source side.
The connector consists of 0V on the top terminal and +24V input terminal on the bottom.

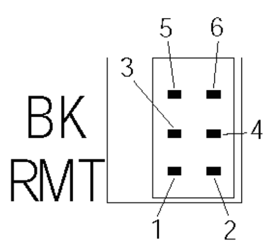
* (As of January, 2014) CT4 Pick & Rotary Axis



Supplemental Power Input Connector Specifications

Item	Overview	Details
Connector	Phoenix Contact	MC1.5/2-G-3.5
Cable-end connector	Phoenix Contact	MC1.5/2-ST-3.5 Applicable wire size: AWG28 to 14
Connector name	BK PWR	
Input voltage	24 VDC ± 10%	
Terminal assignments	0 V	24-V power ground
	+24 V	24-V power input

(20) Brake-release switch connector .... This connector accepts a switch that releases the actuator brake externally from the controller. Shorting the COM and BKRMT* terminals of this connector will release the brake. Use this connector if you want to operate the actuator manually in the event of a power failure or error in the controller.



Brake-release Switch Connector Specifications

Item	Item		Overview
Connector	Hirose		DF11-6DP-2DS (*)
Connector name	BK RMT		
Connected unit	Brake-release switch		
Terminal assignments	**1**	BKRMT1 (BKRMT5)	Brake-release switch input for axis 1 (5)
	2	BKRMT2 (BKRMT6)	Brake-release switch input for axis 2 (6)
	3	BKRMT3	Brake-release switch input for axis 3
	4	BKRMT4	Brake-release switch input for axis 4
	5	COM (COM)	Switch input common
	6	COM (COM)	Switch input common

*) Mating connector --- Hirose socket: DF11-6DS-2C, crimp terminal: DF11-2428SC
The items in ( ) are for the brake unit for 5/6-axis type.

(21) Brake switch .... This alternate switch with lock is used to release the axis brake. To operate the switch, pull it toward you and tilt.
Tilting the switch upward (RLS side) will release the brake forcibly, while tilting it downward (NOM) will enable an automatic brake control by the controller.

2. Explanation of Codes Displayed on the Panel Window

2.1 Application

Display	Priority (*1)	Description
ACF	1	AC power is cut off (including momentary power failure or drop in power-source voltage).
EFxx	1	System-down level error
Prd	2	Writing data to the flash ROM.
ErG	3	Emergency stop is being actuated (except during the update mode).
Enb	4	Enable switch (deadman switch/safety gate) OFF (except in the update mode)
EExx	5	Cold-start level error
Edxx	5	Cold-start level error
ECxx	5	Operation-cancellation level error
Ebxx	5	Operation-cancellation level error
- rP	6	Waiting for a drive-source cutoff reset input (except during the update mode).
- rS	6	Operation is in pause (waiting for restart) (except during the update mode).
- ILC	7	All servo axes are interlocked (except during the update mode).
EAxx	8	Message level error
E9xx	8	Message level error
rUdC	9	Core update mode
UdC	9	Core update is in progress.
FUdc	9	Core update has completed.
rUdS	9	Slave update mode
UdS	9	Slave update is in progress.
FUdS	9	Slave update has completed.
P***	9	Running a program (last started program). *** indicates the program number. (Controller with expanded memory (with gateway function))
P**	9	Running a program (last started program); “No.” indicates program number.
Inxx	9	Initialization sequence number
dbG	9	Debug mode
Ardy	9	Ready status (auto mode)
rdy	9	Ready status (manual mode)

(*1) The priority increases as the number decreases.

2.2 Core

Display	Priority (*1)	Description
ACF	1	AC power is cut off (including momentary power failure or drop in power-source voltage).
EEXX	1	Cold-start level error
EdXX	1	Cold-start level error
ECXX	1	Operation-cancellation level error
EbXX	1	Operation-cancellation level error
EAXX	2	Message level error
E9XX	2	Message level error
rUdA	2	Application update mode
UdA	2	Application update is in progress.
FUdA	2	Application update has completed.
P_ _ _	2	Hardware test mode process
ErA	2	Clearing the application flash ROM.
FErA	2	Application flash ROM has been cleared.
JPA	2	Jump to the application
CHFC	2	Core flash-ROM check process
CHFA	2	Application flash-ROM check process
CHSd	2	SDRAM check process

(*1) The priority increases as the number decreases.

2.3 Current Monitor and Variable Monitor

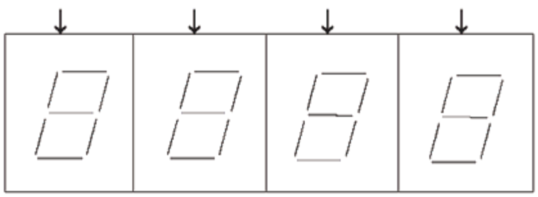
Other parameter Nos. 49 and 50 can be set up to monitor currents or variables on the panel window (main application version 0.09 or later).

(1) Current monitor

Currents of up to four axes having continuous axis numbers can be monitored.
Parameter settings
Other parameter No. 49 = 1
Other parameter No. 50 = Smallest axis number among the axes to be monitored

Example) If other parameter No. 49 is set to "1" and other parameter No. 50 to "3" for a 6-axis controller, the far-right segment digit will show the current for axis 3.

Axis 6 Axis 5 Axis 4 Axis 3



When data is written to the flash ROM or a software reset (restart) is executed after the parameter values have been input, the panel window will show the motor current to rating ratio (%) by a segment pattern, instead of "ready status" or "program run number."
The segment display patterns and corresponding motor current to rating ratios (%) are shown below.

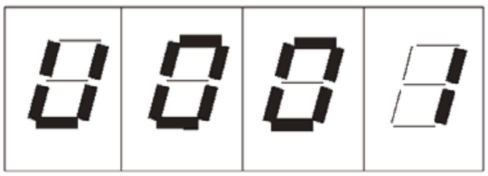
	0 < Motor current to rating ratio (%) ≤ 25		100 < Motor current to rating ratio (%) ≤ 150
	25 < Motor current to rating ratio (%) ≤ 50		150 < Motor current to rating ratio (%) ≤ 200
	50 < Motor current to rating ratio (%) ≤ 75		200 < Motor current to rating ratio (%)
	75 < Motor current to rating ratio (%) ≤ 100		

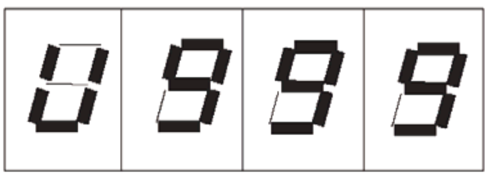
Thick lines indicate illuminated segments.

(2) Variable monitor

The contents of global integer variables can be displayed on the panel window.
Positive integers of 1 to 999 can be displayed.
Parameter settings
Other parameter No. 49 = 2
Other parameter No. 50 = Variable number of the global integer variable to be monitored

When data is written to the flash ROM or a software reset (restart) is executed after the parameter values have been input, the panel window will show the content of the global integer variable, instead of “ready status” or “program run number.” The far-left segment digit should read “U.”
Display example)





Chapter 5 Specifications

1. Controller Specifications

1.1. P/PCT Type (Standard Specification)

	Controller with 1 to 6 axes	
Total output when maximum number of axes are connected Note 3)	Single-phase specification: 1600W	Three-phase specification: 2400W
Control power input	Single-phase, 200 to 230 VAC ± 10%	
Motor power input	Single-phase specification, 200 to 230 VAC ± 10%	Three-phase specification, 200 to 230 VAC ± 10%
Power-source frequency	50/60 Hz	
Isolation resistance	10 MΩ min. (Measured at 500 VDC between the power terminal and I/O terminals and between the external terminals (together) and case)	
Withstand voltage	1500 VAC for 1 minute Note 1)	
Ambient operating temperature range	0 to 40°C	
Ambient operating humidity range	10% to 95% (Non-condensing; conforming to JIS C3502 RH-2)	
Storage temperature range	-25°C to 70°C (Excluding the battery)	
Protection class	IP20	
Drive-source cutoff method	Internal relay	
Emergency-stop input	Contact-B input (Internal power-supply type)	
Emergency-stop action	Deceleration stop + Regenerative brake by timer (failsafe)	
Enable input	Contact-B input (Internal power-supply type)	
System ready output	No-voltage contact (relay) output; for generation of equipment ready signal based on the wired-OR logic among multiple equipment. Max. 500 mA (24 VDC).	
Axis control method	AC full digital servo	
Position detection methods	15-bit incremental encoder (Wire-saving type) 15-bit rotation data backup absolute encoder Both have a control resolution of 14 bits (16384 pulses)	
Batteries	For backup of absolute data: AB-5 by IAI For backup of system memory: CR2032	
Speed setting	1 mm/sec to 3000 mm/sec (Varies depending on the model used.)	
Acceleration/deceleration setting	0.01 G to 3 G (Varies depending on the model used.)	
Programming language	Super SEL language	
Program steps	Controller with expanded memory (with gateway function)	9999 steps (total)
	Controller without expanded memory	6000 positions (total)
Number of positions	Controller with expanded memory (with gateway function)	20000 steps (total) Positions from Nos. 1 to 10000 can be saved in the battery backup memory. Positions from Nos. 10001 to 20000 can be saved in the flash memory.
	Controller without expanded memory	4000 steps (total) All position data can be saved in the battery backup memory.

Number of programs	Controller with expanded memory (with gateway function)	128 programs
	Controller without expanded memory	64 programs
Multi-tasking	16 programs	
Storage device	Flash ROM + SRAM battery backup	
Data input methods	Teaching pendant or PC software	
Absolute brake unit (brake-type or absolute-specification actuator only)	Built-in brake drive circuit Driven by over-excitation at 90 V, released at 45 V (steady state) No limitation on how many brake axes can be controlled (all 6 axes can be equipped with brake).	
Protective functions	Motor overcurrent, overload, motor-driver temperature check, overload check, encoder-open detection	
Regenerative resistance	Built-in (1 kΩ, 20 W); expandable by external unit	
Accessory	I/O flat cable	
Standard inputs	32 points or 16 points, NPN or PNP (set before shipment)	
Standard outputs	16 points or 32 points, NPN or PNP (set before shipment)	
RS232C port for teaching serial interface	Enabled only in the manual operation mode. IAI's dedicated teaching pendant or ANSI teaching pendant (selected by a switch)	
RS232C port for general PC connection	Dedicated 2-channel RS232C, 9-pin DTE specification Half-duplex at speeds up to 115.2 kbps (1 channel) or up to 76.8 kbps (simultaneous communication with 2 channels) Note 2)	
Expanded inputs/outputs (optional)	Expandable to 3 slots	
Fieldbus interface (optional)	Profibus-DP (IN: 32 bytes max. / OUT: 32 bytes max.) DeviceNet (IN: 32 bytes max. / OUT: 32 bytes max.) CC-Link (IN: 32 bytes max. / OUT: 32 bytes max.)	
Ethernet interface (optional)	Packet communication (client-server communication) by TCP/IP using SEL language XSEL PC software connection MODBUS/TCP remote I/O (IN: 32 bytes max. / OUT: 32 bytes max.)	

Note 1) The withstand voltage of the actuator motor is 1000 V for 1 minute.
When performing a withstand voltage test with the controller and actuator connected, make sure the test voltage and duration will not exceed 1000 V and 1 minute, respectively.

Note 2) If one RS232C channel is used at a communication speed of 115.2 kbps, use the other channel at 38.4 kbps or below. If these speeds are exceeded, an overrun error or other problems will occur and successful communication cannot be guaranteed.

* RCS2-R**7/LS/LSA series actuators cannot be connected as axis 5 or 6.

Note 3) For ROBO Cylinder High-Speed Type (RCS3-CT□), calculate with twice of the motor wattage described on the model.

1.2 Q/QCT Type (Global Specification)

	Controller with 1 to 6 axes	
Total output when maximum number of axes are connected Note 4)	Single-phase specification: 1600W	Three-phase specification: 2400W
Control power input	Single-phase, 200 to 230 VAC ± 10%	
Motor power input	Single-phase specification, 200 to 230 VAC ± 10%	Single-phase specification, 200 to 230 VAC ± 10%
Power-source frequency	50/60 Hz	
Isolation resistance	10 MΩ min. (Measured at 500 VDC between the power terminal and I/O terminals and between the external terminals (together) and case)	
Withstand voltage	1500 VAC for 1 minute (Caution)Note 1)	
Ambient operating temperature range	0 to 40°C	
Ambient operating humidity range	10% to 95% (Non-condensing; conforming to JIS C3502 RH-2)	
Storage temperature range	-25°C to 70°C (Excluding the battery)	
Protection class	IP20	
Drive-source cutoff method	External safety circuit	
Emergency-stop input	Contact-B input (External power-supply type, redundant)	
Emergency-stop action	Deceleration stop + Regenerative brake by timer (failsafe)	
Enable input	Contact-B input (External power-supply type, redundant)	
System ready output	No-voltage contact (relay) output; for generation of equipment ready signal based on the wired-OR logic among multiple equipment. Max. 500 mA (24 VDC).	
Axis control method	AC full digital servo	
Position detection methods	15-bit incremental encoder (Wire-saving type) 15-bit rotation data backup absolute encoder Both have a control resolution of 14 bits (16384 pulses)	
Batteries	For backup of absolute data: AB-5 by IAI For backup of system memory: CR2032	
Speed setting	1 mm/sec to 2500 mm/sec	
Acceleration/deceleration setting	0.01 G to 1 G	
Programming language	Super SEL language	
Program steps	Controller with expanded memory (with gateway function)	9999 steps (total)
	Controller without expanded memory	6000 steps (total)
Number of positions	Controller with expanded memory (with gateway function)	20000 steps (total) Positions from Nos. 1 to 10000 can be saved in the battery backup memory. Positions from Nos. 10001 to 20000 can be saved in the flash memory.
	Controller without expanded memory	4000 steps (total) All position data can be saved in the battery backup memory.
Number of programs	Controller with expanded memory (with gateway function)	128 programs
	Controller without expanded memory	64 programs

Multi-tasking	16 programs
Storage device	Flash ROM + SRAM battery backup
Data input methods	Teaching pendant or PC software
Brake unit (brake-type actuator only)	Built-in brake drive circuit Driven by over-excitation at 90 V, released at 45 V (steady state) No limitation on how many brake axes can be controlled (all 6 axes can be equipped with brake).
Protective functions	Motor overcurrent, overload, motor-driver temperature check, overload check, encoder-open detection
Regenerative resistance	Built-in (1 kΩ, 20 W); expandable by external unit
Accessory	I/O flat cable
Standard inputs	32 points or 16 points, NPN or PNP (set before shipment)
Standard outputs	16 points or 32 points, NPN or PNP (set before shipment)
RS232C port for teaching serial interface	Enabled only in the manual operation mode. ANSI teaching pendant (selected by a switch)
RS232C port for general PC connection	Dedicated 2-channel RS232C, 9-pin DTE specification Half-duplex at speeds up to 115.2 kbps (1 channel) or up to 76.8 kbps (simultaneous communication with 2 channels) Note 3)
Expanded inputs/outputs (optional)	Expandable to 3 slots
Fieldbus interface (optional)	Profibus-DP (IN: 32 bytes max. / OUT: 32 bytes max.) DeviceNet (IN: 32 bytes max. / OUT: 32 bytes max.) CC-Link (IN: 32 bytes max. / OUT: 32 bytes max.)
Ethernet interface (optional)	Packet communication (client-server communication) by TCP/IP using SEL language XSEL PC software connection MODBUS/TCP remote I/O (IN: 32 bytes max. / OUT: 32 bytes max.)

Note 1) The withstand voltage of the actuator motor is 1000 V for 1 minute.
When performing a withstand voltage test with the controller and actuator connected, make sure the test voltage and duration will not exceed 1000 V and 1 minute, respectively.
Note 2) The XSEL-J/K type supports 3000 positions.
Note 3) If one RS232C channel is used at a communication speed of 115.2 kbps, use the other channel at 38.4 kbps or below. If these speeds are exceeded, an overrun error or other problems will occur and successful communication cannot be guaranteed.
* RCS2-R**7/LS/LSA series actuators cannot be connected as axis 5 or 6.
Note 4) For ROBO Cylinder High-Speed Type (RCS3-CT□), calculate with twice of the motor wattage described on the model.

1.3 Differences between Q/QCT Type (Global Specification) and P/PCT Type (Standard Specification)

Users require different safety categories in accordance with the overall configuration of their equipment.
The Q/QCT type (global specification) controller has no built-in drive-source cutoff circuit so that the user can design their equipment to a desired safety category.
The P/PCT type (standard specification) controller has a built-in circuit for cutting off the drive source inside the controller using a relay.
The differences between these two specifications are summarized below. Items not specified in the table are basically the same between the two specifications.

Differences between Global Specification and Standard Specification

Item	Q/QCT type (global specification)	P/PCT type (standard specification)
Power input part	Motor power supply and control power supply are separated.	
Safety circuit configuration	Redundant circuits are supported.	Redundant circuits are not supported.
Drive-source cutoff circuit	Installed externally.	Built-in motor-power cutoff relay
Highest safety category supported	Safety category 4 (The user is responsible for demonstrating conformance.)	Safety category B
System I/O connector	18-pin, 2-row/2-piece connector by Phoenix Contact	
ANSI TP	Supported (redundant safety circuits).	Supported (redundant safety circuits are not supported).

TP: Teaching pendant

2. External I/O Specifications

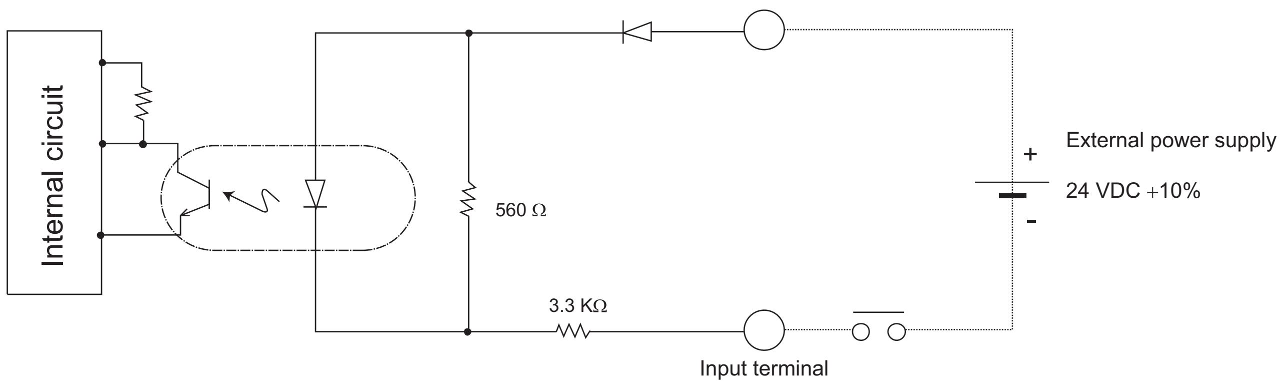
2.1. NPN Specification

(1) Input part

External Input Specifications (NPN Specification)

Item	Specification
Input voltage	24 VDC ±10%
Input current	7 mA per circuit
ON/OFF voltage	ON voltage --- 16.0 VDC min. OFF voltage --- 5.0 VDC max.
Isolation method	Photocoupler isolation
External devices	[1] No-voltage contact (minimum load of approx. 5 VDC/1 mA) [2] Photoelectric/proximity sensor (NPN type) [3] Sequencer transistor output (open-collector type) [4] Sequencer contact output (minimum load of approx. 5 VDC/1 mA)

[Input circuit]



* P24: I/O interface pin No. 1

Caution

If a non-contact circuit is connected externally, malfunction may result from leakage current. Use a circuit in which leakage current in a switch-off state does not exceed 1 mA.

⊙ XSEL controller's input signal

At the default settings, the system recognizes the ON/OFF durations of input signals if they are approx. 4 msec or longer. The ON/OFF duration settings can also be changed using I/O parameter No. 20 (input filtering frequency).

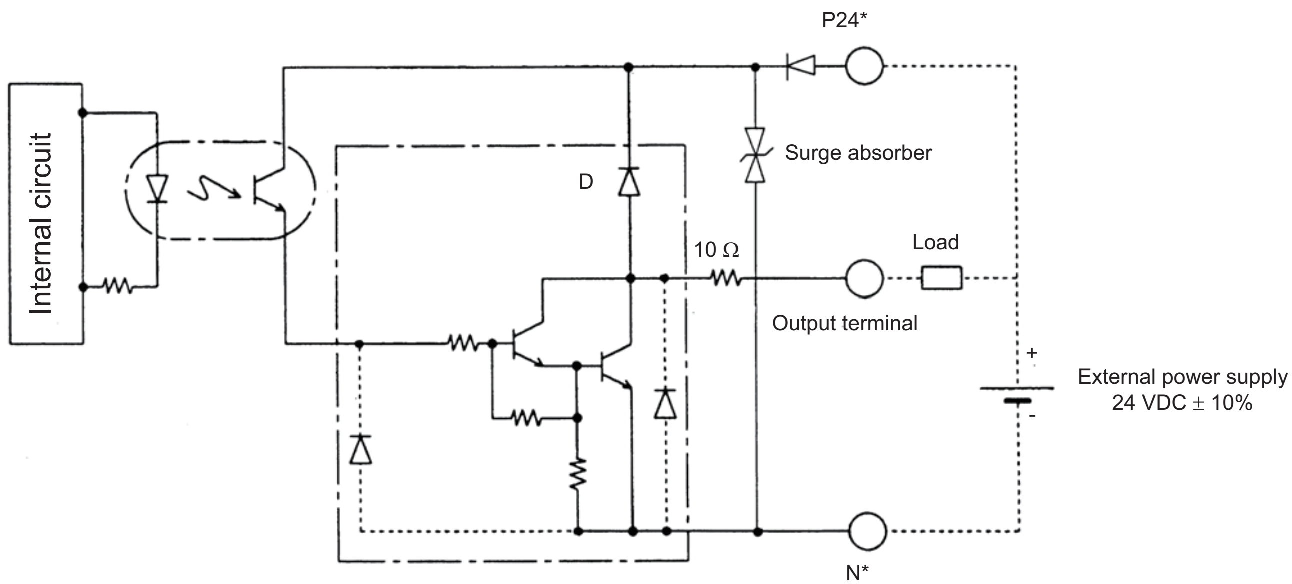
(2) Output part

External Output Specifications (NPN Specification)

Item	Specification	
Load voltage	24 VDC	TD62084 (or equivalent)
Maximum load current	100 mA per point, 400 mA per 8 ports Note)	
Leakage current	0.1 mA max. per point	
Isolation method	Photocoupler isolation	
External devices	[1] Miniature relay [2] Sequencer input unit	

Note) 400 mA is the maximum total load current of every eight ports from output port No. 300. (The maximum total load current of output port No. 300 + n to No. 300 + n + 7 is 400 mA, where n is 0 or a multiple of 8.)

[Output circuit]



* P24: I/O interface pin No. 1
* N: I/O interface pin No. 50

Caution

In the event that the load is short-circuited or current exceeding the maximum load current is input, the overcurrent protection circuit will be actuated to cut off the circuit. However, give due consideration to the circuit connection layout to prevent short-circuit or overcurrent.

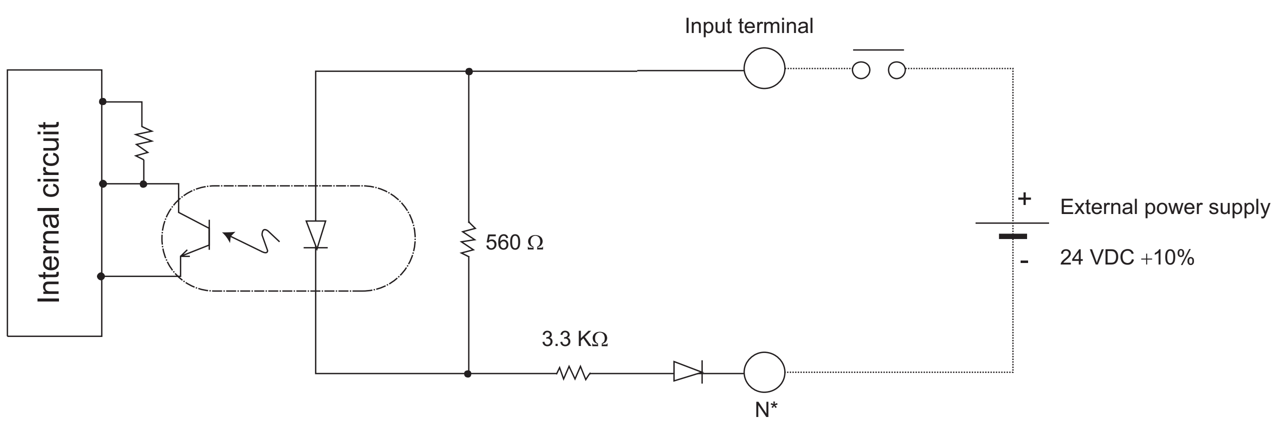
2.2. PNP Specification

(1) Input part

External Input Specifications (PNP Specification)

Item	Specification
Input voltage	24 VDC ±10%
Input current	7 mA per circuit
ON/OFF voltage	ON voltage --- 8 VDC max. OFF voltage --- 19 VDC min.
Isolation method	Photocoupler isolation
External devices	[1] No-voltage contact (minimum load of approx. 5 VDC/1 mA) [2] Photoelectric/proximity sensor (PNP type) [3] Sequencer transistor output (open-collector type) [4] Sequencer contact output (minimum load of approx. 5 VDC/1 mA)

[Input circuit]



* N: I/O interface pin No. 50

Caution

If a non-contact circuit is connected externally, malfunction may result from leakage current. Use a circuit in which leakage current in a switch-off state does not exceed 1 mA.

⊙ XSEL controller's input signal

At the default settings, the system recognizes the ON/OFF durations of input signals if they are approx. 4 msec or longer. The ON/OFF duration settings can also be changed using I/O parameter No. 20 (input filtering frequency).

Part 1 Installation

Chapter 5 Specifications.

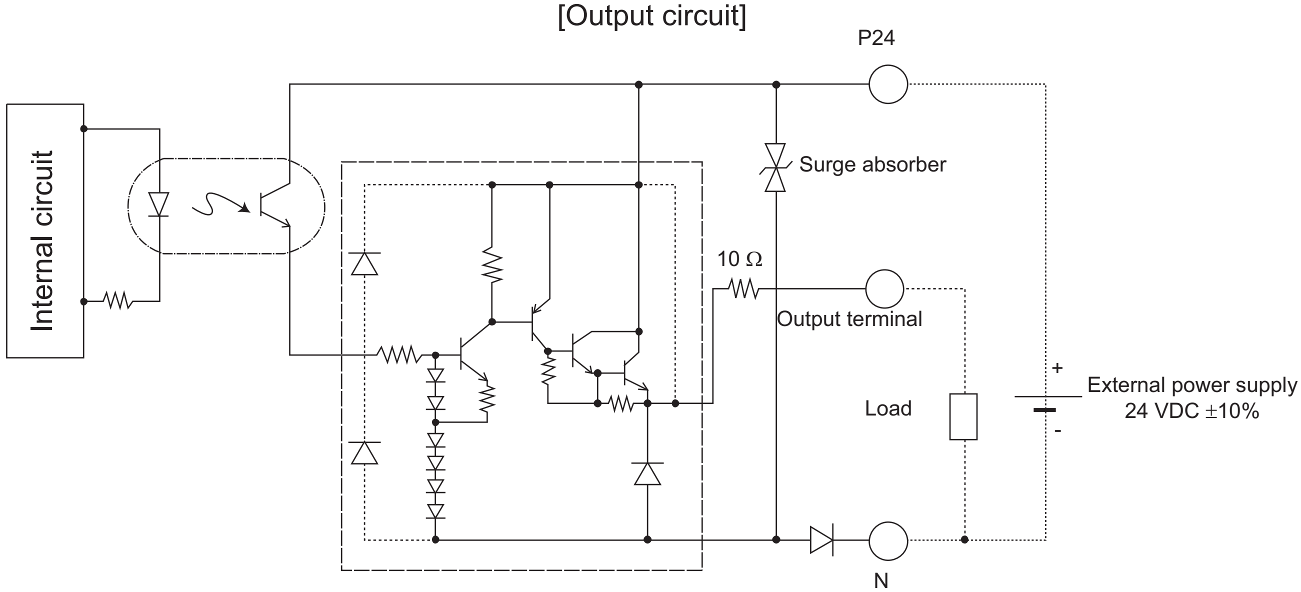
(2) Output part

External Output Specifications

Item	Specification	
Load voltage	24 VDC	TD62784 (or equivalent)
Maximum load current	100 mA per point, 400 mA per 8 ports Note)	
Leakage current	0.1 mA max. per point	
Isolation method	Photocoupler isolation	
External devices	[1] Miniature relay [2] Sequencer input unit	

Note) 400 mA is the maximum total load current of every eight ports from output port No. 300. (The maximum total load current of output port No. 300 + n to No. 300 + n + 7 is 400 mA, where n is 0 or a multiple of 8.)

[Output circuit]



* P24: I/O interface pin No. 1
* N: I/O interface pin No. 50

Caution

In the event that the load is short-circuited or a current exceeding the maximum load current is input, the overcurrent protection circuit will be actuated to cut off the circuit. However, give due consideration to the circuit connection layout to prevent short-circuit or overcurrent.

3. Power-Source Capacity and Heat Output

The power consumption and heat output of the XSEL controller will vary depending on the number of connected axes and I/O configuration. This section explains how to estimate the power-source capacity and heat output of your XSEL controller.

The XSEL controller requires the following power supplies:

A. Control power
   Power to the logic control part of the controller. Single-phase 200 VAC must be supplied.
B. Motor power
   Power for driving the actuator. Three-phase (single-phase) 200 VAC must be supplied.
   * A single-phase power source is required only for controllers of single-phase specification.
C. I/O power
   If a DIO card is installed in an I/O slot, 24 VDC must be supplied.
D. Supplemental power input (Power source to release brake and drive actuator)
   It is necessary to supply 24V DC when connecting an actuator equipped with a brake or that recommended by IAI.
   Recommended actuator (as of January, 2014): CT4 Pick & Rotary Actuator

(1) Power-source capacity and heat output

Rated power-source capacity [VA] = Motor drive power [VA]*1 + Control power-source capacity [VA]*2

Heat output [W] = Total sum of output losses [W]*3 + (Heat output from control power supply [VA]*4 x 0.7 (Efficiency) x 0.6 (Power factor))

*1 Select an appropriate motor drive power [VA] from Table 1. Note that during acceleration/deceleration, the motor drive power increases by up to three times (or by up to twice if the motor wattage is 600 W or 700 W).

*2 Calculate the control power-source capacity [VA] by selecting the installed parts and then adding up the power x quantity products of all installed parts according to the “Control power supply (Internal consumption, External consumption)” fields of Table 2.

*3 Calculate the total sum of output losses [W] by selecting from Table 1 the output losses for all actuators to be connected.

*4 Calculate the heat output from control power supply [VA] by selecting the installed parts and then adding up the power x quantity products of all installed parts according to the “Control power supply (Internal consumption)” and “External power supply (Internal consumption)” fields of Table 2.

Table 1. Motor Drive Powers and Output Losses (P/Q/PCT/QCT Types)

Actuator motor capacity [W]	Motor drive power [VA]	Output loss [W]
20	26	1.58
30D (other than RS)	46	2.07
30R (RS)	138	3.93
60	138	3.93
60(RCS3-CTZ5C-□-60)	197	3.6
100	234	6.12
150	328	8.30
200	421	9.12
400	796	19.76
400(RCS3-CT8C-□-400)	1230	18.0
600	1164	27.20
750	1521	29.77
100 (LSA-S6S)	101	3.74
100 (LSA-S8S)	159	4.07
100 (LSA-S8H)	216	3.84
100S (LSA-N10S)	284	4.48
200 (LSA-S10S)	343	5.35
200 (LSA- H8S,L15S)	189	5.38
200 (LSA-H8H)	379	5.38
200S (LSA-S10H)	417	5.01
200S (LSA-N15S)	486	4.37
200S (LSA-N15H)	773	6.42
300S (LSA-N19S)	662	11.58
400 (LSA-W21S)	920	16.68
1000 (LSA-W21H)	1843	37.77
DD Motor (LT18S, T18S)	503	7.5
DD Motor (LH18S, H18S)	1462	20.8

RS: Rotational axis / LSA: Linear actuator

Table 2. Motor Drive Powers and Output Losses (P/Q/PCT/QCT Types)

		Control power supply		External power source		Quantity
		Internal consumption [VA]	External consumption [VA]	Internal consumption [VA]	External consumption [VA]	
Base part		31.4				1
Driver	Per board	6.26				1 to 3 *5
Encoder	Per axis	2.38	3.57			1 to 6
Fan unit	Per fan	5.71				0 to 6
Axis sensor	Per axis	4.57				3 to 6*6
DIO card	DIO (48 points)	5.95		14.52		0 to 4
	DIO (96 points)	8.33		26.81		0 to 4
Network module	DeviceNet	2.38		1.71		0 to 1
	CC-Link	2.38		1.19		0 to 1
	Profibus-DP	4.17				0 to 1
	Ethernet	5.36				0 to 1
Teaching pendant	IA-T-X, XD		3.57			0 to 1
	SEL-T, TD		6.67			0 to 1
Brake	Per axis			5.95	13.81	0 to 1
Actuator Driving Source	CT4 Pick & Rotary Axis			5.95	max4	1

*5 One large high-thrust linear actuator (W21H□) occupies the space of two axes with one axis. One axis requires one driver board.

*6 The use quantities of fans are shown in the table below.

		Use quantity for P/PCT type	Use quantity for Q/QCT type
1 to 4 axes	Without expanded I/O	4	3
	With expanded I/O	5	4
5 to 6 axes	Without expanded I/O	5	4
	With expanded I/O	6	5

(2) Calculation example

Obtain the power-source capacities and heat outputs when a controller of the following specifications is used.

Actuator for axis 1: 200 W Actuator for axis 2: 200 W Actuator for axis 3: 100 W with brake
Actuator for axis 4: 60 W Standard controller with standard DIO
Options: DeviceNet, teaching pendant (IAI's standard type)

[1] Control power-supply capacity

$$\{\underbrace{31.14}_{\text{Base part}} + \underbrace{6.26 \times 2}_{\text{Drivers}} + \underbrace{(2.38 + 3.57) \times 4}_{\text{Encoders}} + \underbrace{4.57 \times 4}_{\text{Fan units}} + \underbrace{5.95 \times 1}_{\text{DIO}} + \underbrace{2.38}_{\text{DeviceNet}} + \underbrace{3.57}_{\text{Teaching pendant}}\} \cong 97.9\ [\text{VA}]$$

[2] Heat output from control system

$$\{(\underbrace{31.14}_{\text{Base part}} + \underbrace{6.26 \times 2}_{\text{Drivers}} + \underbrace{2.38 \times 4}_{\text{Encoders}} + \underbrace{4.57 \times 4}_{\text{Fan units}} + \underbrace{5.95}_{\text{DIO}} + \underbrace{2.38}_{\text{DeviceNet}}) + (\underbrace{14.52 \times 1}_{\text{DIO}} + \underbrace{1.71}_{\text{DeviceNet}} + \underbrace{5.95 \text{ x } 1}_{\text{Brake}})\} \times 0.7\ (\text{Efficiency}) \text{ x } 0.6\ (\text{Power factor}) \cong 43\ [\text{W}]$$

[3] I/O power-source capacity (24 VDC)
14.52 x 1 = 14.52 [VA]

[4] Brake power-source capacity (24 VDC)
(5.95 + 13.81) x 1 = 19.76 [VA]

[5] Motor power-source capacity
421 + 421 + 234 + 138 = 1214 [VA]

[6] Heat output from motor power supply
9.12 + 9.12 + 6.12 + 3.39 ≅ 27.8 [W]

[7] Power-source capacity = [1] Control power-source capacity + [5] Motor power-source capacity
= 97.9 + 1214 = 1311.9 [VA]

[8] Heat output = [2] Heat output from control system + [6] Heat output from motor power supply
= 43 + 27.8 = 70.8 [W]

(3) Calculating the wattage of each actuator that can be connected to a single-phase specification system
For LSA (Linear Actuator) and DD (Direct Drive Motor) to connect to the single phase type, calculate the wattage from “Output for controller wattage calculation” in the table below.
Also, make selection to have the total wattage of LSA, DD and other actuators at 1600W or less.

1600W ≥ LSA Total wattage of LSAs (Output for controller wattage calculation × Number of axes) + Wattage of DD (Output for controller wattage calculation) + Wattage of other actuators (Motor wattage × Number of axes)

Wattage Calculation Table for LSA and DD in Single Phase Type

Actuator model number	Corresponding driver output [W]	Number of sliders [unit]	Output for controller wattage calculation [W]	Remarks
S6SS	100	1	300	
S6SM	100	2	600	
S8SS	100	1	300	
S8SM	100	2	600	
S8HS	100	1	300	
S8HM	100	2	600	
S10SS	100	1	300	
S10SM	100	2	600	
S10HS	200	1	600	
S10HM	200	2	1200	
H8SS/L15SS	200	1	600	
H8SM/L15SM	200	2	1200	
H8HS	200	1	600	
H8HM	200	2	1200	
N15SS	200	1	600	
N15SM	200	2	1200	
N15HS	200	1	600	
N15HM	200	2	1200	
N19SS	300	1	600	
W21SS	400	1	800	
W21SM	400	2	1600	
W21HS	1000	1	1500	
W21HM	1000	2	3000	Cannot be used.
DD (LT18S, T18S)	200	—	600	
DD (LH18S, H18S)	600	—	1200	

4. External Dimensions

4.1 P/Q/PCT/QCT Type (Three-phase Standard Specification, Single-phase Global Specification, Single-phase Standard Specification) 4-axis Controller

External views of enclosures for various 4-axis controllers are shown below (the external enclosure dimensions are the same for 1-axis to 4-axis controllers).

Fig. 4-1 P/Q/PCT/QCT Type 4-axis Controller (Incremental Specification) (Three-phase Standard Specification, Single-phase Global Specification, Single-phase Standard Specification)

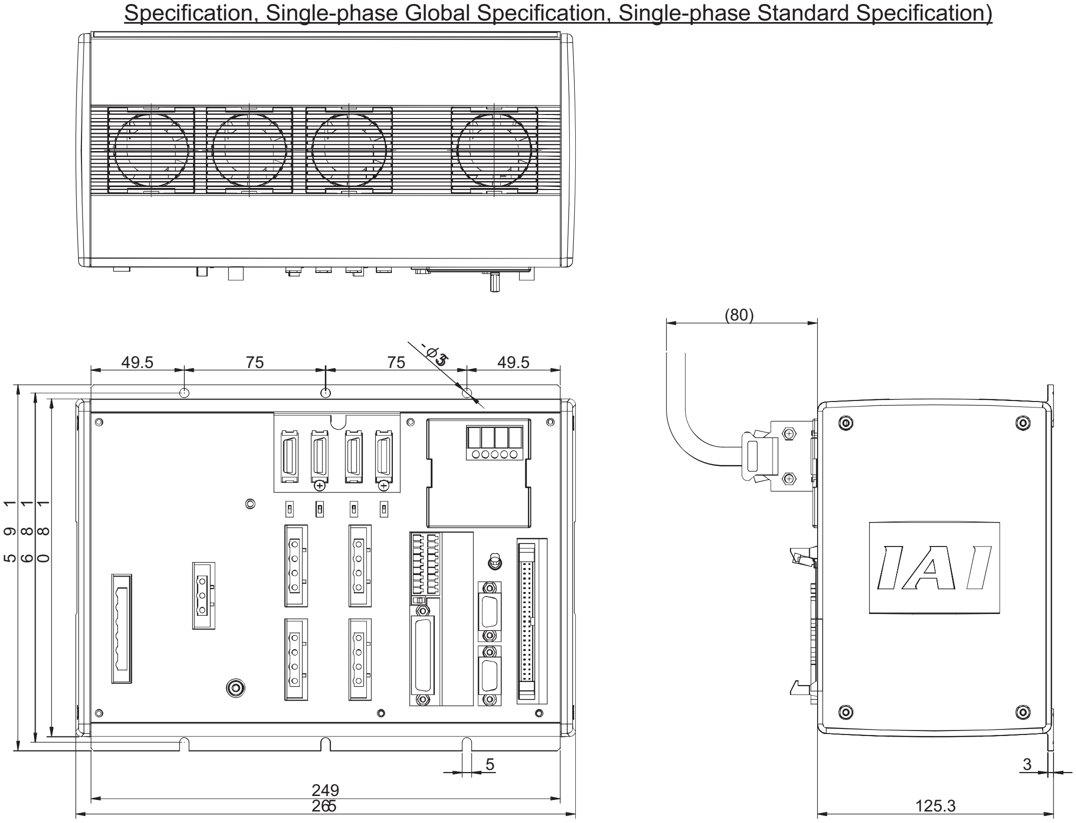


Fig. 4-2 P/Q/PCT/QCT Type 4-axis Controller with Absolute Brake Unit (Three-phase Standard Specification, Single-phase Global Specification, Single-phase Standard Specification)

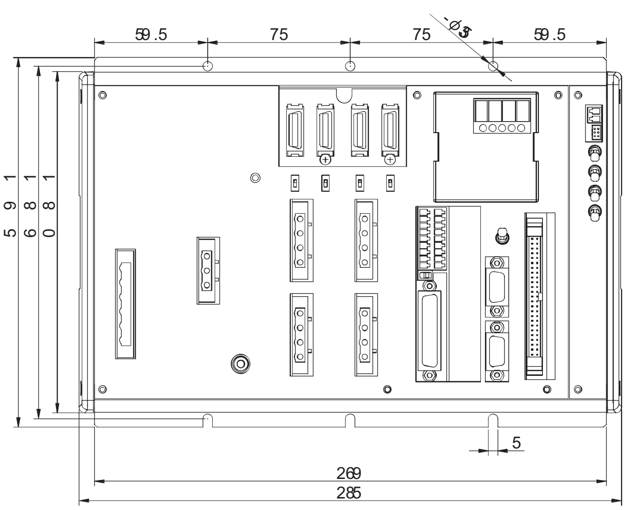


Fig. 4-3 P/Q/PCT/QCT Type 4-axis Controller with Expansion I/O Board (Incremental Specification) (Three-phase Standard Specification, Single-phase Global Specification, Single-phase Standard Specification)

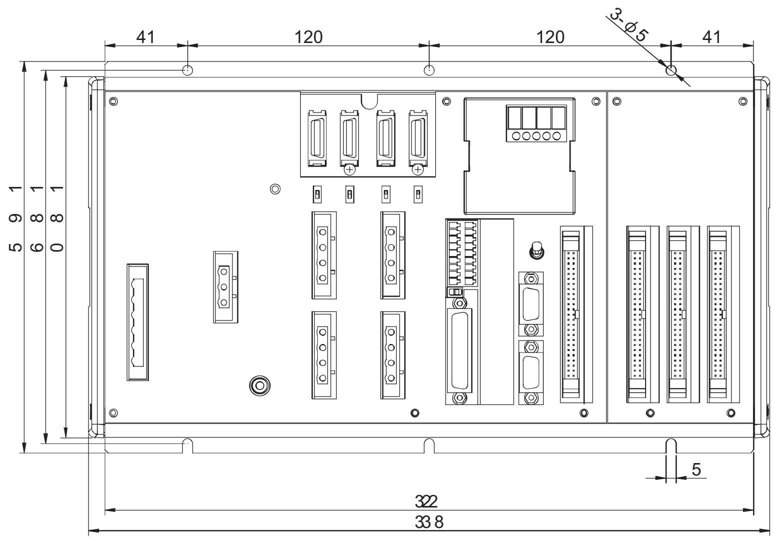
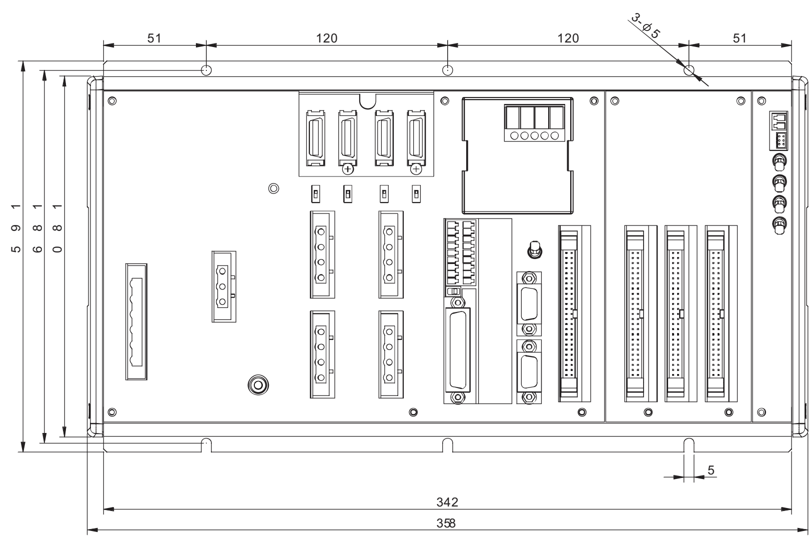


Fig. 4-4 P/Q/PCT/QCT Type 4-axis Controller with Expansion I/O Board + Absolute Brake Unit (Three-phase Standard Specification, Single-phase Global Specification, Single-phase Standard Specification)



4.2 P/Q/PCT/QCT Type (Standard Specification) 6-axis Controller (Three-phase Standard Specification, Single-phase Global Specification, Single-phase Standard Specification)

External views of enclosures for various 6-axis controllers are shown below (the external enclosure dimensions are the same for 5-axis and 6-axis controllers).

Fig. 4-5 P/Q/PCT/QCT Type 4-axis Controller (Incremental Specification) (Three-phase Standard Specification, Single-phase Global Specification, Single-phase Standard Specification)

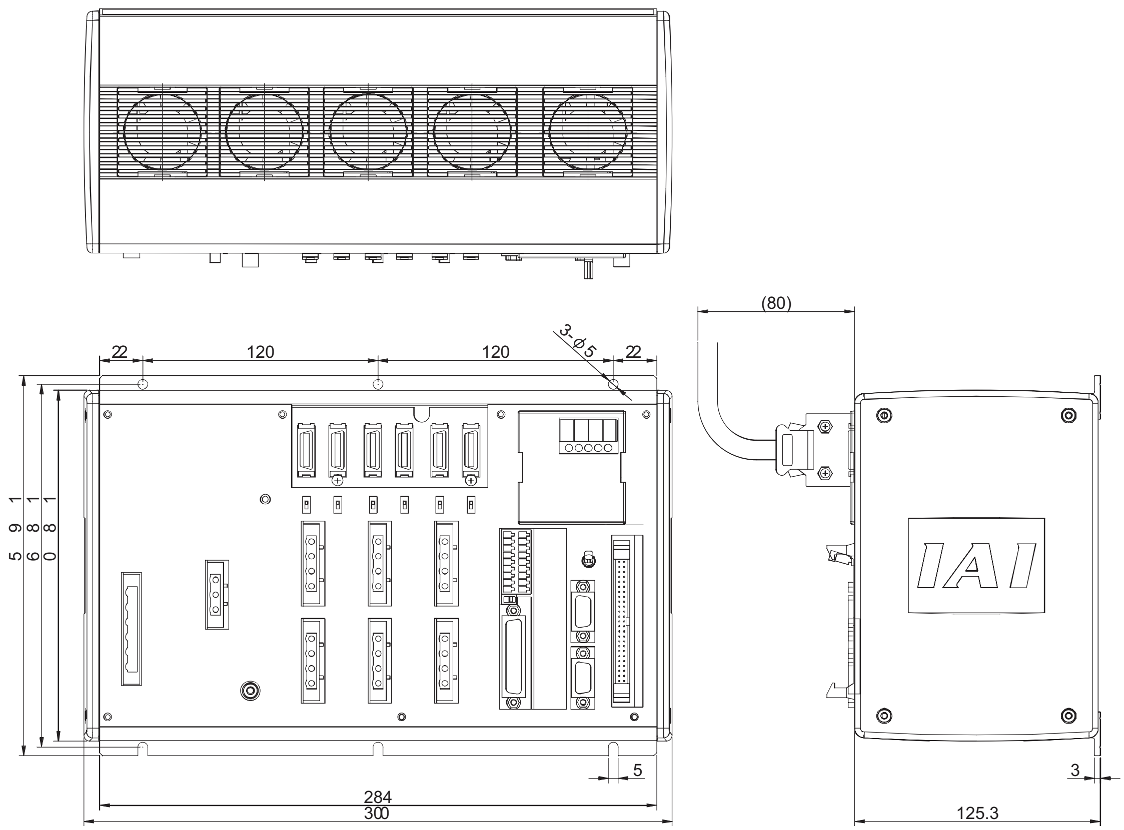


Fig. 4-6 P/Q/PCT/QCT Type 6-axis Controller with Absolute Brake Unit (Three-phase Standard Specification, Single-phase Global Specification, Single-phase Standard Specification)

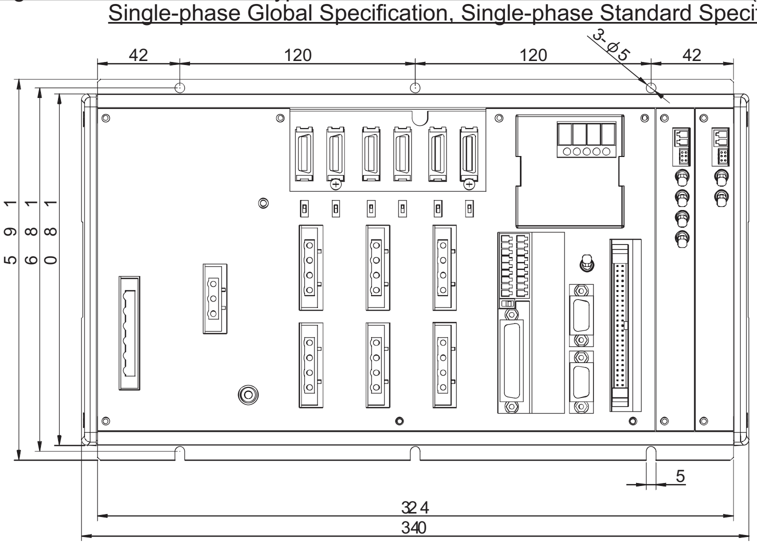


Fig. 4-7 P/Q/PCT/QCT Type 4-axis Controller with Expansion I/O Board (Incremental Specification) (Three-phase Standard Specification, Single-phase Global Specification, Single-phase Standard Specification)

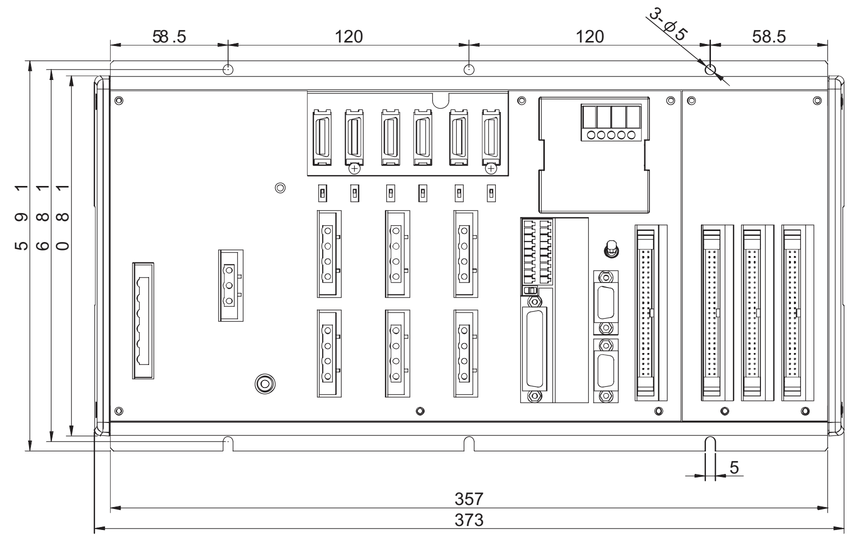
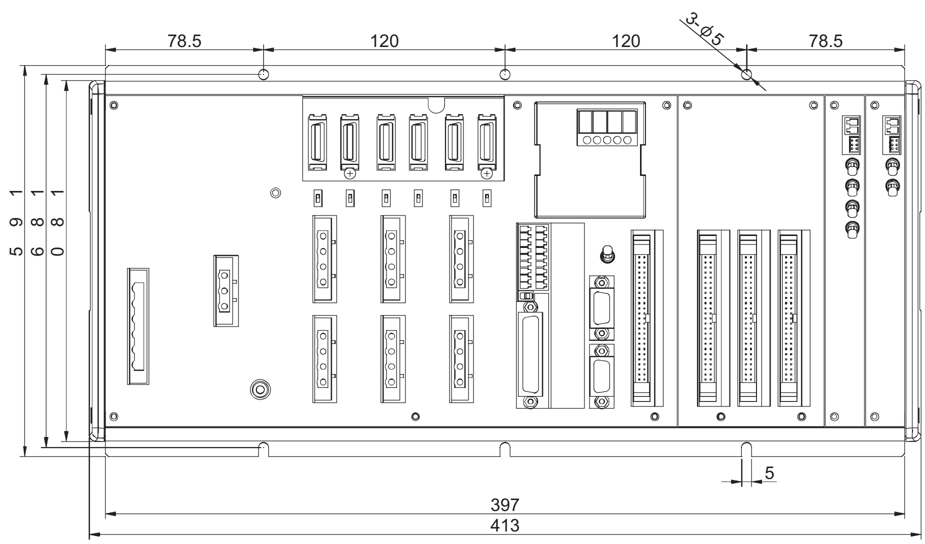


Fig. 4-8 P/Q/PCT/QCT Type 6-axis Controller with Expansion I/O Board + Absolute Brake Unit (Three-phase Standard Specification, Single-phase Global Specification, Single-phase Standard Specification)



4.3 Q/QCT Type (Three-phase Global Specification) 4-axis Controller

External views of enclosures for various 4-axis controllers are shown below (the external enclosure dimensions are the same for 1-axis to 4-axis controllers).

Fig. 4-9 Q/QCT Type 4-axis Controller (Incremental Specification) (Three-phase Global Specification)

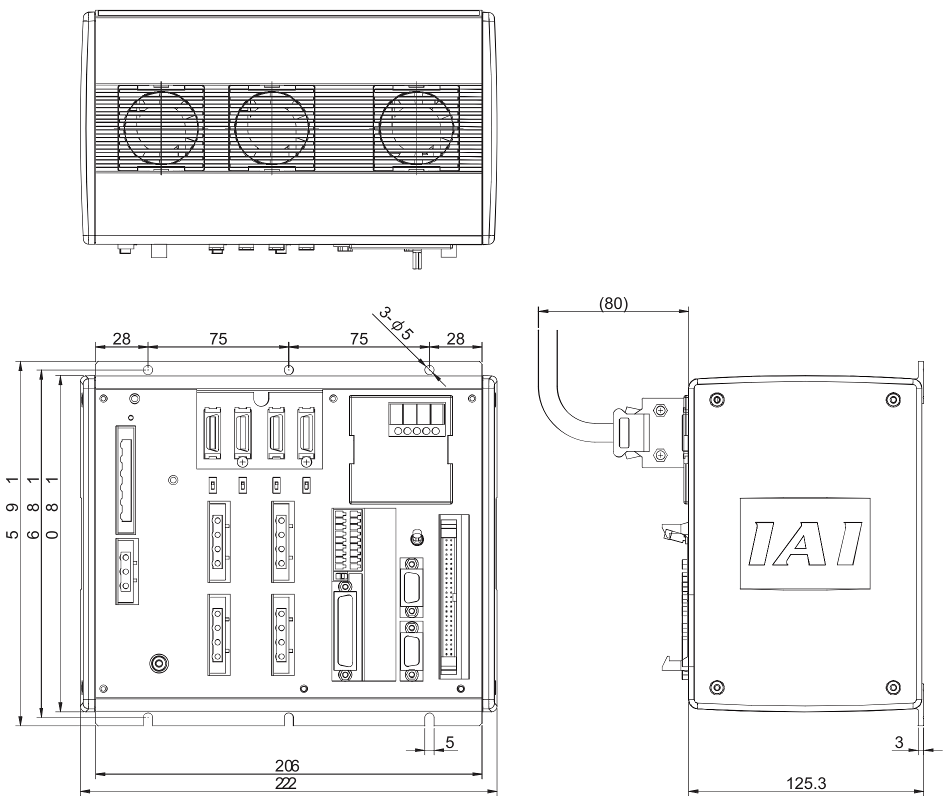


Fig. 4-10 Q/QCT Type 4-axis Controller with Absolute Brake Unit (Three-phase Global Specification)

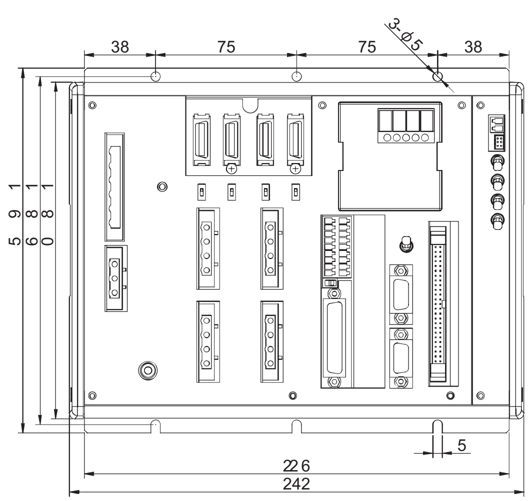


Fig. 4-11 Q/QCT Type 4-axis Controller with Expansion I/O Board (Incremental Specification)

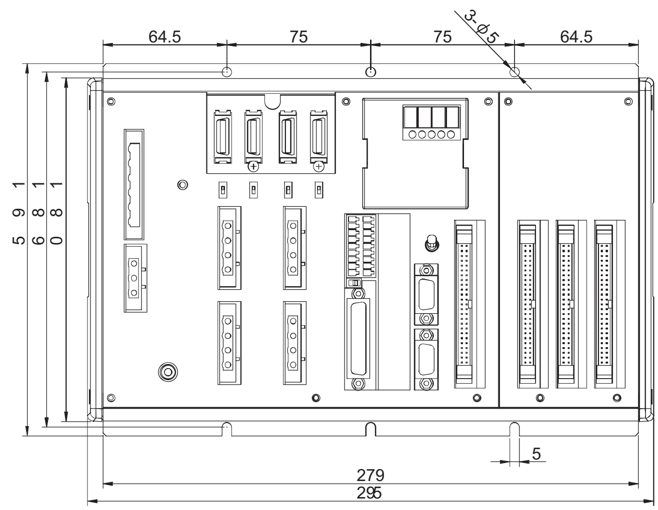
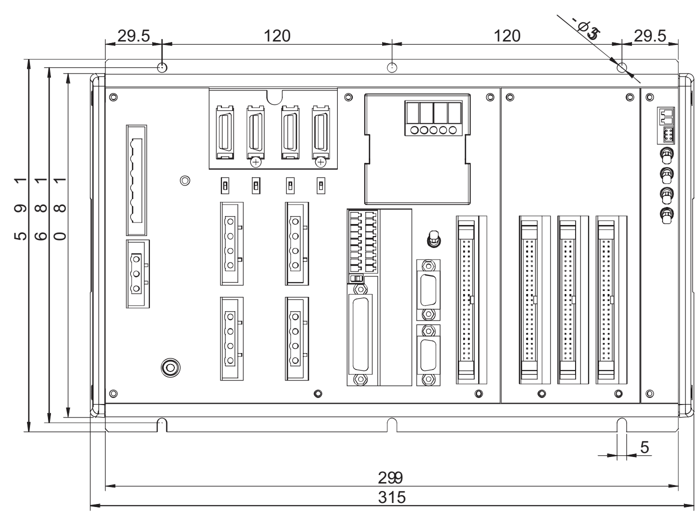


Fig. 4-12 Q/QCT Type 4-axis Controller with Expansion I/O Board + Absolute Brake Unit



4.4 Q/QCT Type (Three-phase Global Specification) 6-axis Controller

External views of enclosures for various 6-axis controllers are shown below (the external enclosure dimensions are the same for 5-axis and 6-axis controllers).

Fig. 4-13 Q/QCT Type 6-axis Controller (Incremental Specification) (Three-phase Global Specification)

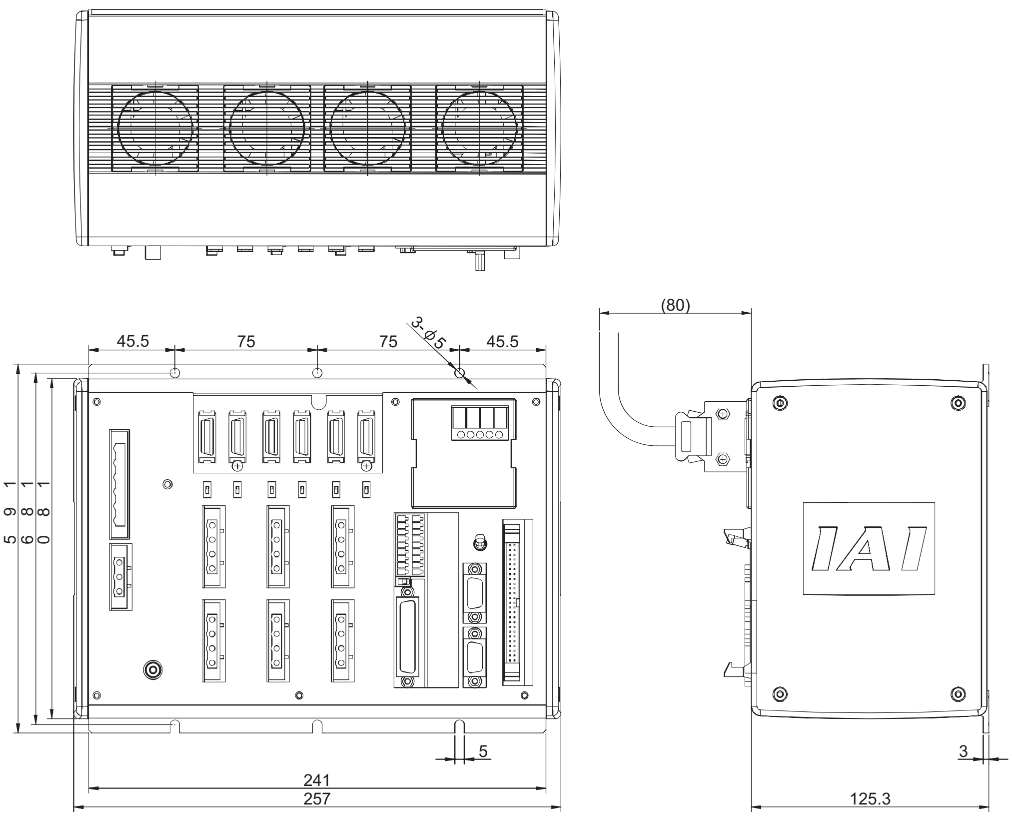


Fig. 4-14 Q/QCT Type 6-axis Controller with Absolute Brake Unit (Three-phase Global Specification)

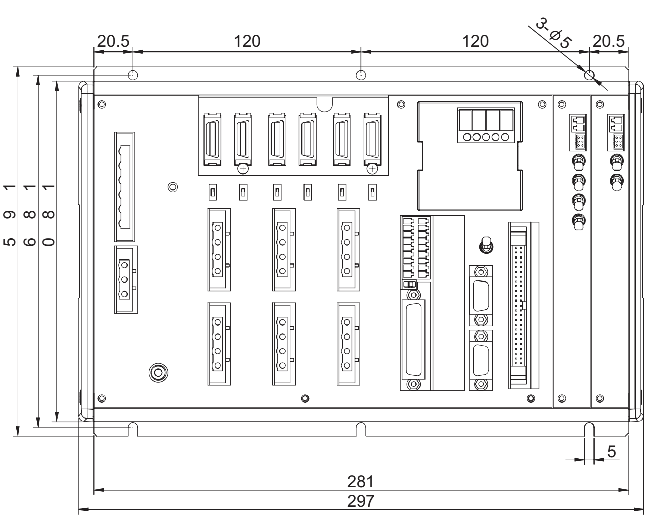


Fig. 4-15 Q/QCT Type 6-axis Controller with Expansion I/O Board (Incremental Specification) (Three-phase Global Specification)

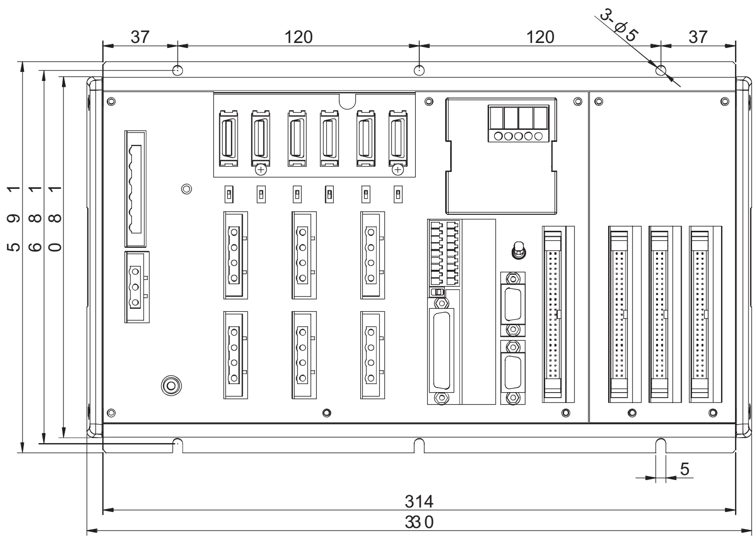
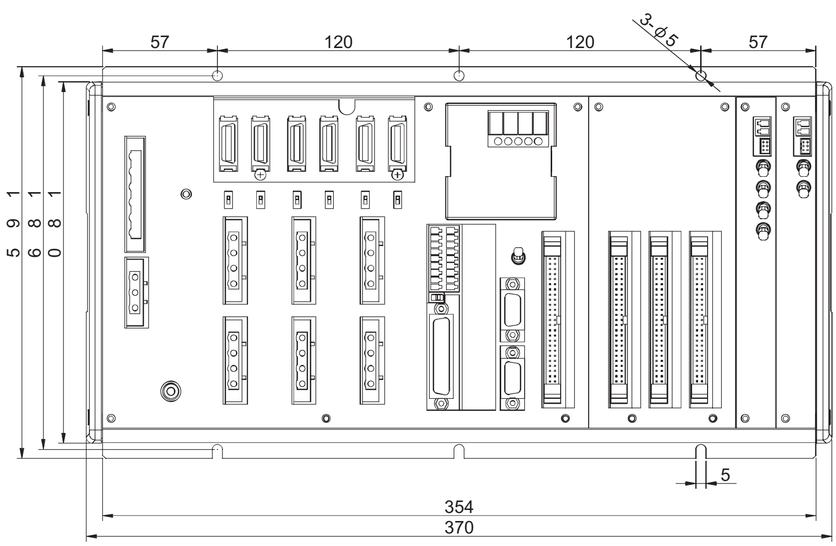


Fig. 4-16 Q/QCT Type 6-axis Controller with Expansion I/O Board + Absolute Brake Unit (Three-phase Global Specification)



Chapter 6 Safety Circuit

The circuit configuration for embodying safety actions such as emergency stop is different between the standard specification and global specification of the XSEL controller.
The standard controller has a built-in drive-source cutoff circuit conforming to safety category B.
The global controller has no built-in drive-source cutoff circuit so that the user can configure an external safety circuit appropriate for their equipment configuration.

1. Items to Notes

The following explains the items to note regarding the safety circuit, which apply to both the standard specification and global specification.

1. Overview of emergency-stop action
   The emergency-stop control line (drive-source cutoff control line) consists entirely of hard wires. When an emergency-stop operation is performed, the controller will execute a stop action of category 1. Specifically, it will stop the actuator at the deceleration for emergency stop as specified by a parameter, and turn off the servo. At this time, the drive source will also be cut off inside the standard controller. With the global controller, the drive source must be cut off externally to the controller.

   As for recovery from an emergency-stop state (including recovery of the drive source), an automatic reset using the emergency-stop switch or a method requiring both an emergency-stop switch action and an external input signal can be selected by a parameter (I/O parameter No. 44).

   During an emergency stop, the status can be output to an external device (set by I/O parameter No. 48).

2. Overview of enabling action
   Enabling operation (via the safety gate or the deadman switch on the teaching pendant) implements an action similar to the emergency-stop action, except that an emergency-stop status is not output.

3. Controller operation modes and safety switches on the teaching pendant
   The deadman switch on the teaching pendant is enabled only when the controller is in the MANU mode. The emergency-stop switch on the teaching pendant is always enabled as long as the teaching pendant is connected to the controller.

4. Connecting a teaching pendant while the controller is operating in the AUTO mode
   Connecting a teaching pendant to the controller or removing the connected teaching pendant while the controller is operating in the AUTO mode may trigger an emergency stop. Do not connect/remove a teaching pendant while the controller is operating in the AUTO mode.

5. Applying voltage to the system I/Os
   The safety circuit of the XSEL controller is designed to operate with 24 VDC. Therefore, never apply 100 or 200 VAC to the system I/Os. Doing so may damage the internal circuits of the controller.

The following pages explain the safety circuit of each controller specification in details.

2. Safety Circuit for P/PCT Type (Standard Specification) Controller

The P/PCT type controller has a built-in drive-source cutoff circuit just like IAI's other controllers.
The drive-source cutoff circuit consists of a relay and conforms to safety category B. If your equipment must meet a higher safety category, use the Q/QCT type (global specification) controller explained later.
The standard controller has a built-in drive-source cutoff circuit. Connect the control power supply and motor power supply to the same power source and also turn on/off the control power supply and motor power supply at the same time.
The teaching port can be connected to either an IAI's standard teaching pendant or ANSI teaching pendant. Note, however, that redundant safety circuits cannot be configured even if an ANSI teaching pendant is used.
Set the teaching-pendant type switch located above the teaching connector to the position appropriate for the teaching pendant used. Set the switch to the left for an ANSI teaching pendant, or to the right for IAI's standard teaching pendant.

Note: If the teaching-pendant type switch is not set properly, the safety gate switch will not function.
The emergency-stop line and enabling line are driven by the controller's internal power supply. It should be noted that the safety circuit cannot be driven by an external power source.
Do not use the internal power supply provided for the system I/O connector, for any other purpose. It may damage the equipment or cause it to malfunction.

The tables below list the signals and wiring methods of the safety-circuit interface connector.

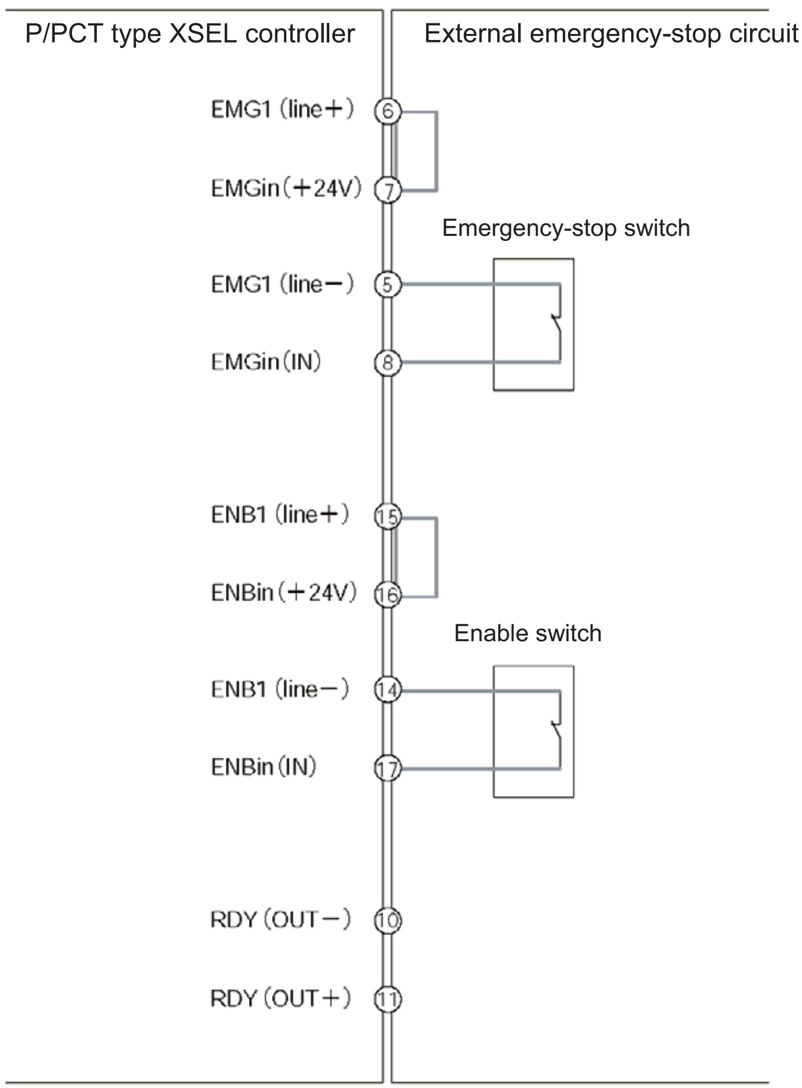
System I/O Connector for P/PCT Type

Item	Overview	Details
Connector	COMBICON (2-row, 9-pin)	MCD1.5/9-G1-3.5P26THR (by Phoenix Contact)
	Cable-end connector	FMC1.5/9-ST-3.5
	Applicable wire size	AWG24 to 16

Terminal Assignments

	Pin No.	Signal name	Overview		Details
Left	9	DET	IN	Not connected	Not used
	8	EMGin	IN	To external EMG	Emergency-stop detection input
	7		+24V	Shorted Wired before shipment	24-V power output for emergency-stop detection input
	6	EMG1	line+		Emergency-stop switch 1 Wire circuit 1 connected to EMG of the TP
	5		line-	To external EMG	
	4	EMG2	line+	Not connected	Not used
	3		line-	Not connected	
	2	SDN	Out+	Not connected	External relay drive cutoff contact outputs
	1		Out-	Not connected	
Right	18	DET	+24V	Not connected	Not used
	17	ENBin	IN	To external ENB	Enable detection input
	16		+24V	Shorted Wired before shipment	24-V power output for enable detection input
	15	ENB1	line+		Enable switch 1 (safety gate, etc.) Wire circuit 1 connected to ENB of the TP
	14		line-	To external ENB	
	13	ENB2	line+	Not connected	Not used
	12		line-	Not connected	
	11	RDY	Out+	May be used if necessary	Ready signal contact outputs (dry contacts) (for inductive load of up to 200 mA)
	10		Out-		

With the P/PCT type, use only the signals shown in the shaded fields of the table for connection with the safety switches.
Exercise caution that opening the specified pins or wiring them differently may compromise the safety actions of the controller.
The RDYOUT contacts will close only when the controller has started properly. By connecting these contacts in series with similar contacts of other equipment, the soundness of the entire system can be checked easily.



3. Safety Circuit for Q/QCT Type (Global Specification) Controller

The global controller has no internal drive-source cutoff circuit so that the user can configure a desired drive-source cutoff circuit externally to the controller to conform to the required safety category.
The safety circuit consists of two circuits: the emergency-stop (EMG) circuit and enable (ENB) circuit. Each circuit adopts a redundant design, so a safety circuit conforming to a higher safety category of up to level 4 can be configured using an external drive-source cutoff circuit.
Since this controller has no built-in drive-source cutoff circuit, be sure to install a drive-source cutoff circuit in the motor power circuit. It is recommended that the control power supply be wired from the same power source as the motor power supply at a point before the drive-source cutoff part is connected.
Please note that IAI is not liable for any losses arising from a malfunction of the safety circuit configured by the user.
The ANSI safety standards can be met only when an ANSI teaching pendant is connected to the teaching port.
The redundant emergency-stop lines and enabling lines are designed with the assumption that they will be driven by a power source external to the controller. Note, however, that the inputs to the contacts that instruct emergency-stop action and enabling action operate on the internal power supply. Bear this in mind and wire these contacts properly.
Do not use the internal power supply provided for the system I/O connector, for any other purpose. It may damage the equipment or cause it to malfunction.

The tables below list the signals and wiring methods of the safety-circuit interface connector. The connector pin assignments and internal circuit components are the same as those of the standard specification.

System I/O Connector for Q/QCT type

Item	Overview	Details
Connector	COMBICON (2-row, 9-pin)	MCD1.5/9-G1-3.5P26THR (by Phoenix Contact)
	Cable-end connector	FMC1.5/9-ST-3.5
	Applicable wire size	AWG24 to 16

Terminal Assignments

	Pin No.	Signal name	Overview		Details
Left	9	DET	IN	To fused-contact detection circuit	External contact error input (paired with No. 18) Connected to the fused-contact detection contacts of the safety circuit.
	8	EMGin	IN	To EMG status of safety circuit	Emergency-stop detection input
	7		+24V		24-V power output for emergency-stop detection input
	6	EMG1	line+	To EMG switch circuit 1	Emergency-stop switch 1 Wire circuit 1 connected to EMG of the TP
	5		line-		
	4	EMG2	line+	To EMG switch circuit 2	Emergency-stop switch 2 Wire circuit 2 connected to EMG of the TP
	3		line-		
	2	SDN	Out+	To interlock of safety circuit	External relay drive source cutoff contact output Signal for requesting the controller to cutoff the drive source
	1		Out-		
Right	18	DET	+24V	To fused-contact detection circuit	24-V power output for external contact error input Connected to the fused-contact detection contacts of the safety circuit.
	17	ENBin	IN	To EMB status of safety circuit	Enable detection input
	16		+24V		24-V power output for enable detection input
	15	ENB1	line+	To enable circuit 1	Enable switch 1 (safety gate, etc.) Wire circuit 1 connected to ENB of the TP
	14		line-		
	13	ENB2	line+	To enable circuit 2	Enable switch 2 Wire circuit 2 connected to ENB of the TP
	12		line-		
	11	RDY	Out+	May be used if necessary	Ready signal contact outputs (dry contacts) (for inductive load of up to 200 mA)
	10		Out-		

In the table, the signals shown in fields (EMGin, EMG1, SDN, ENBin, ENB1) must always be connected regardless of the required safety category. If these signals are connected wrongly or not connected, the safety functions will be compromised.

In the table, the signals shown in fields (EMG2, ENB2) must be connected to meet safety category 3 or above. They are designed to provide redundant safety circuits.

In the table, the signal shown in fields (DET) provides an input for detecting malfunction of the safety circuit (mainly fused relay contacts). Be sure to use this signal if you want the XSEL controller to detect fused contacts. If the safety circuit is configured as a closed system to manage fused contacts and other problems independently, safety category 4 can be met without connecting this signal to the controller.

- DET
  DET (IN) and DET (+24V) are dry contact input terminals consisting of a photocoupler. By inputting fused-contact detection signals from the drive-source cutoff safety circuit, the controller will be able to detect problems in the external safety circuit.

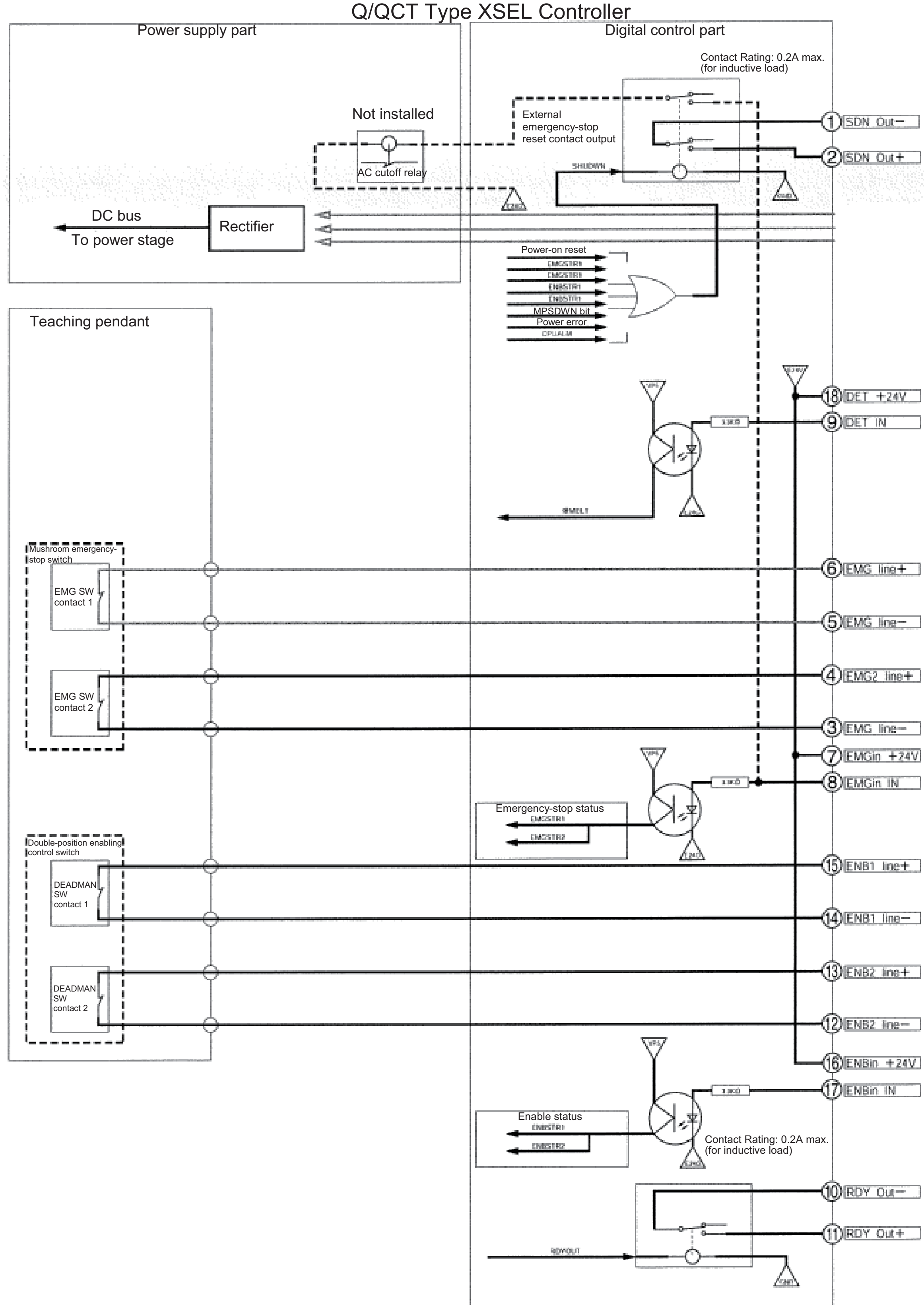
- SDN
  SDN (OUT+) and SDN (OUT-) are output contacts that remain open while the controller is prohibiting the motor power supply from the external power source. This condition will occur immediately after the controller power is turned on, when an error occurs in the equipment, or when a drive-source cutoff cancellation command is not received by the EMG or ENB line. Configure the circuit in such a way that the drive source will never be turned on when these contacts are open.
  When turning on the power, turn on the control power first, confirm that these contacts are closed, and then turn on the drive power. (If the control power and drive power are turned on simultaneously, an “E6D, Drive-source cutoff relay error” may generate.)

- EM1/EMG2, ENB1/ENB2
  EMG1 (line+)/(line-) and EMG2 (line+)/(line-) are redundant emergency-stop control lines.
  ENB1 (line+)/(line-) and ENB2 (line+)/(line-) are redundant enabling control lines.
  Use these lines to cut off the external drive source. Since they are completely dry signal lines, configure a relay circuit using an external power source.

- EMGin, ENBin
  EMGin (IN) and EMGin (+24V) are contact inputs that notify the controller of the drive-source cutoff input received by the drive-source cutoff circuit via an EMG signal.
  ENBin (IN) and ENBin (+24V) are contact inputs that notify the controller of the drive-source cutoff input received by the drive-source cutoff circuit via an ENB signal.
  These contact signals are used to decelerate the actuator to a stop or turn off the servo. Normally, a safety relay output is connected to each of these inputs.

- RDY
  RDY (OUT+) and RDY (OUT-) are output contacts that will close only when the controller has started properly. By connecting these contacts in series with similar contacts of other equipment, the soundness of the entire system can be checked easily.

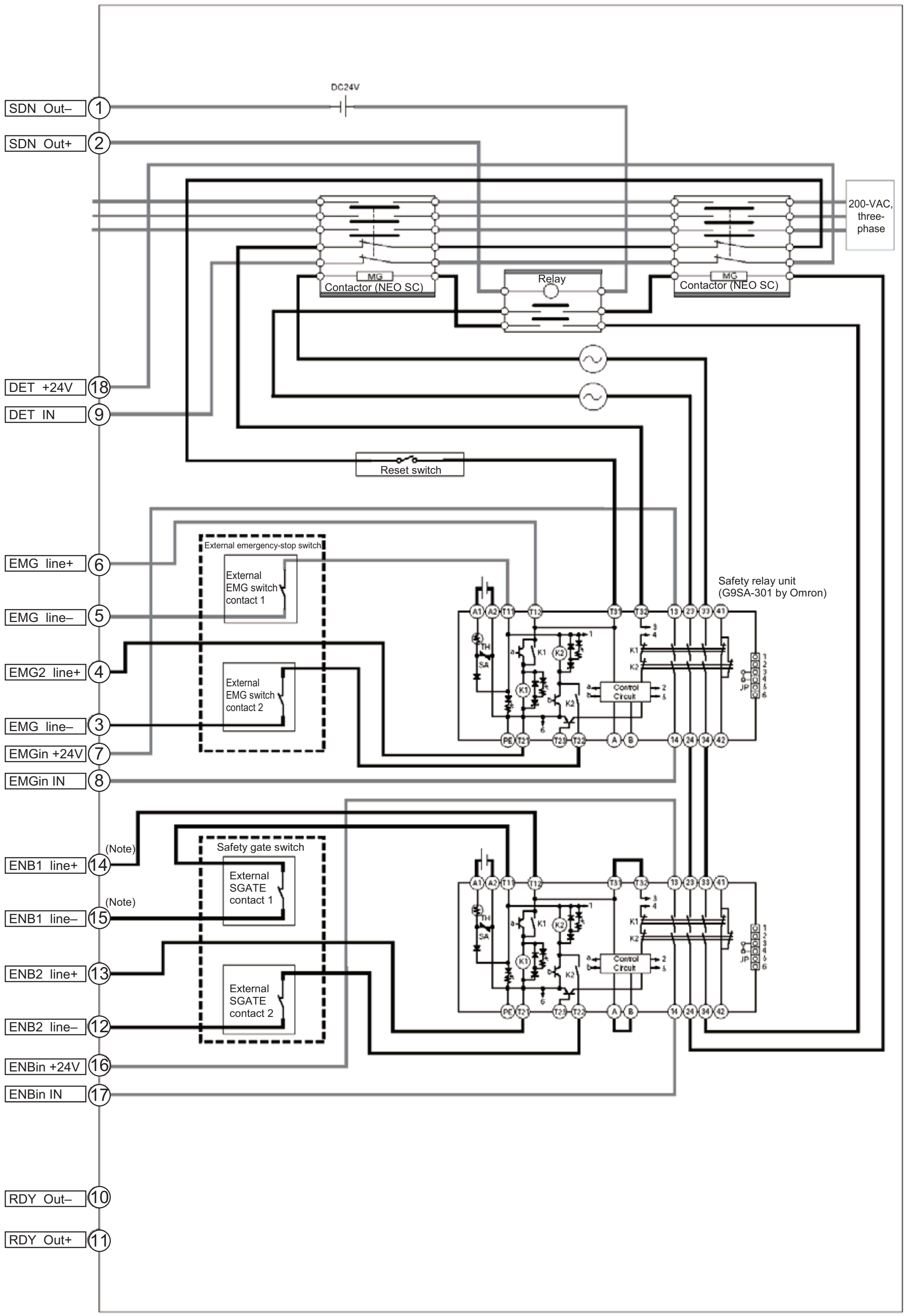
Q/QCT Type XSEL Controller



Part 1 Installation

Chapter 6 Safety Circuit

External Emergency-Stop Circuit

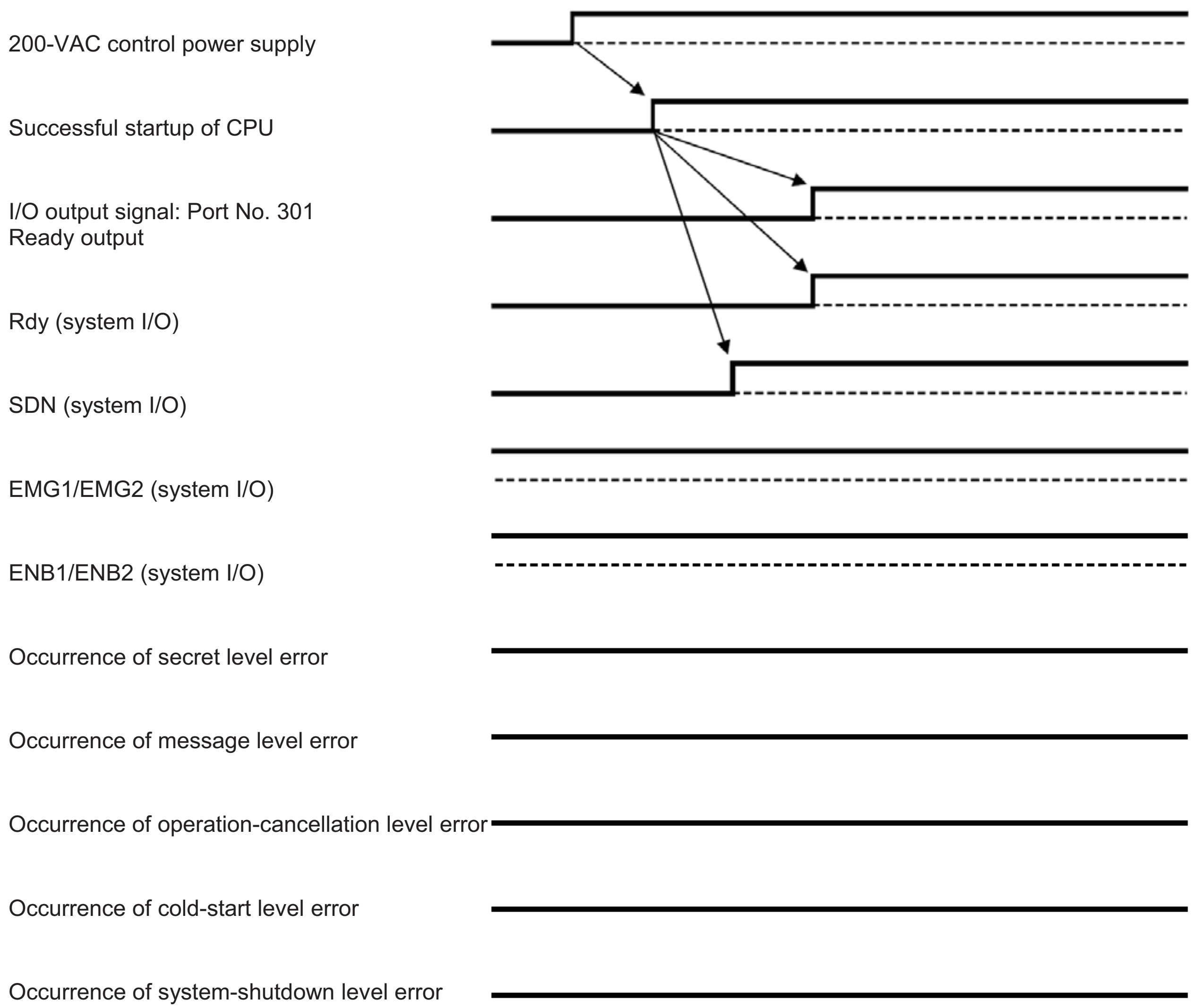


Note: It is recommended to connect ENB1 line+ to 14 and ENB1 line- to 15 so the unit would not get burned even if a standard PC cable (black) is connected accidently to Q/QCT Type. (There should be no problem even if 14 and 15 are swapped around if the appropriate PC cable (gray) is applied.)

4. Safety Circuit Timing Charts for Q/QCT type SEL Controller

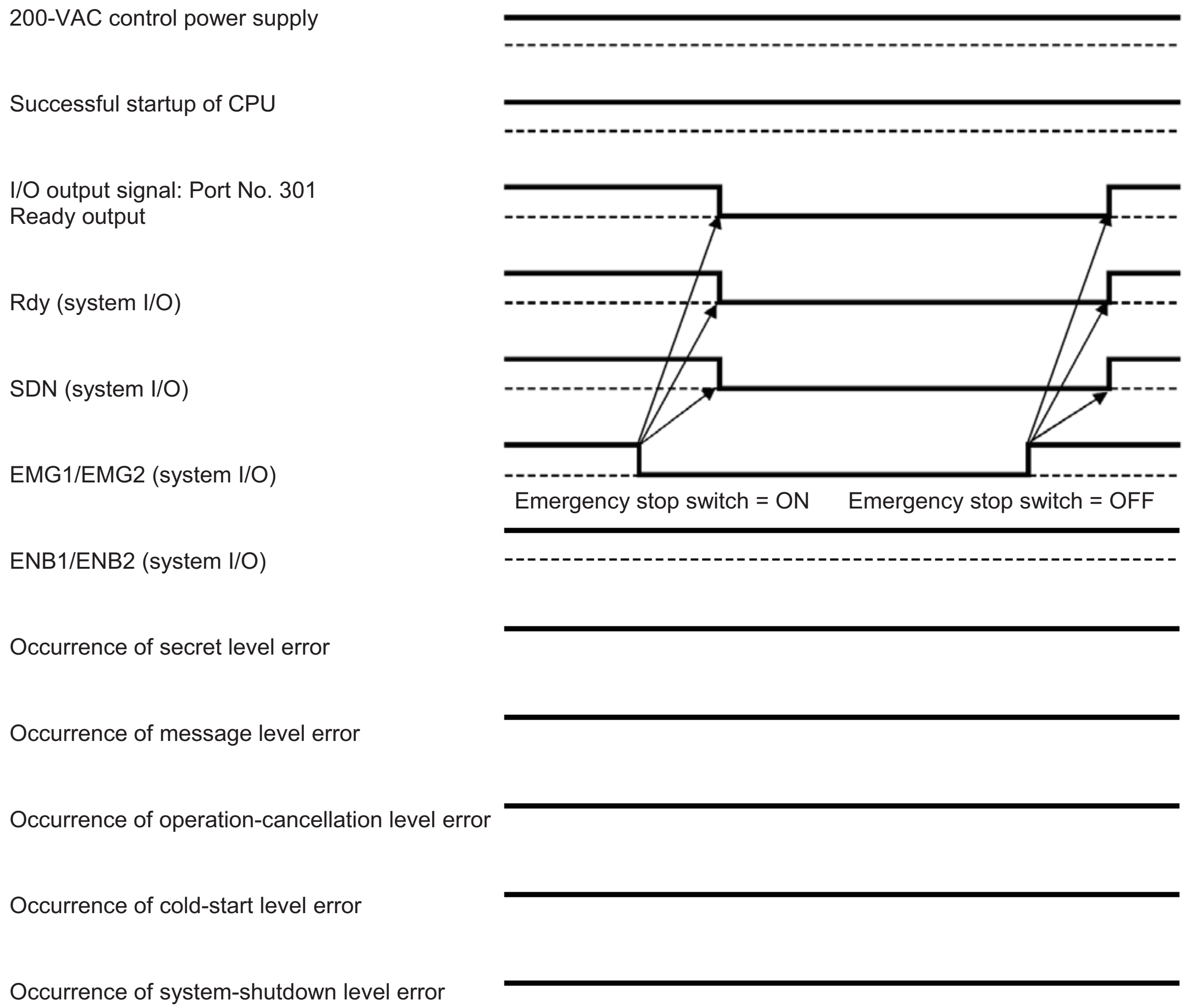
Safety circuit timing charts for Q/QCT type SEL controller are shown below.
The timings covered by the timing charts are as follows: [1], “Power on,” [2], “Emergency stop,” [3], “Power on during emergency stop,” [4], “Enable input,” [5], “System-shutdown level error,” [6], “Cold-start level error,” [7], “Operation-cancellation level error,” [8], “Power on (combined with cutoff reset input), [9], “Emergency stop (combined with cutoff reset input)”

[1] Power on



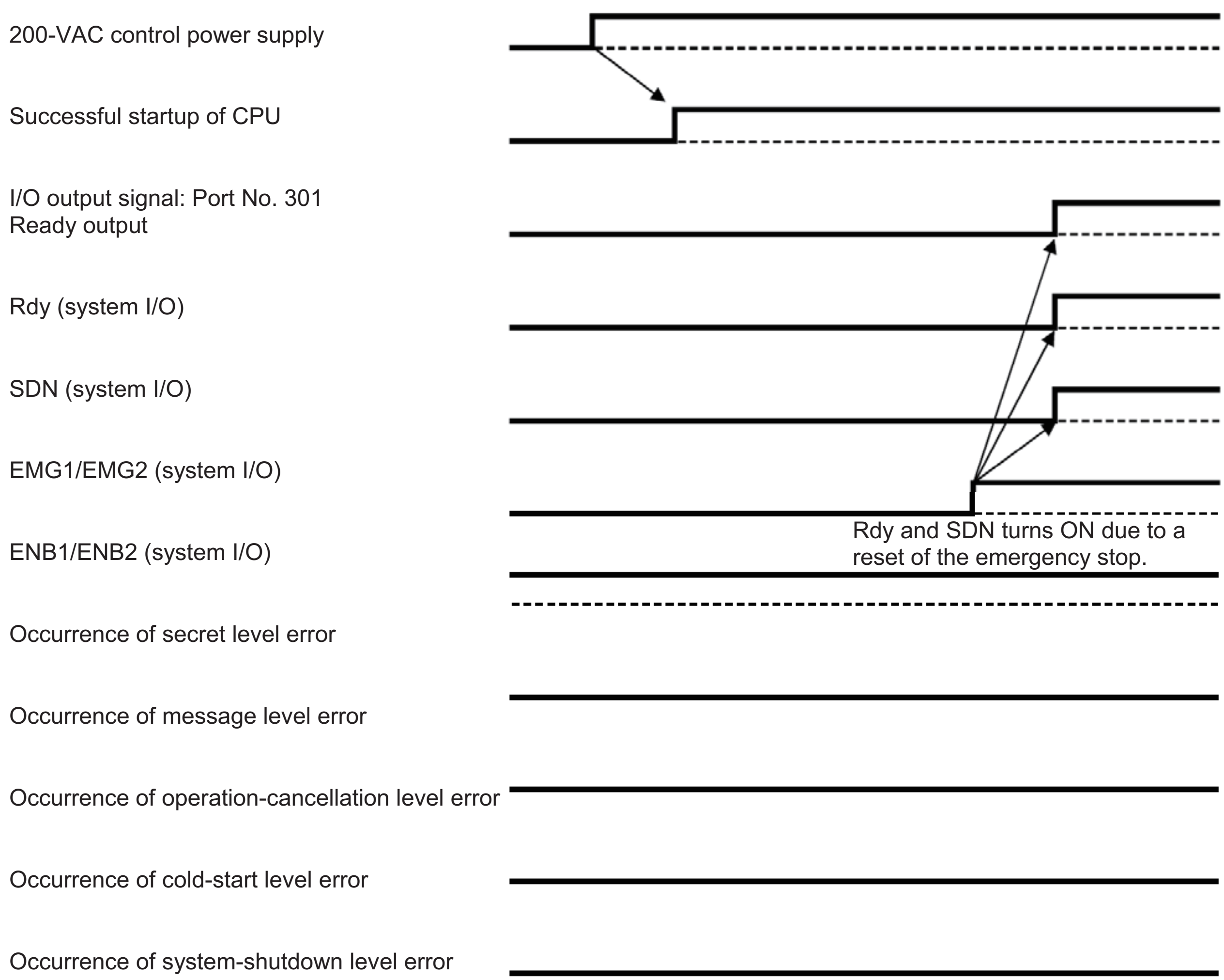
• I/O parameter No. 24, bits 0 to 3 = 0:	The RDYOUT output (system I/O) is SYSRDY (PIO trigger program can be run) and the hardware is normal (emergency stop is not actuated and hardware error is not detected).
• I/O parameter No. 44 = 0:	The drive-source cutoff reset input is not used.
• I/O parameter No. 47 = 3:	Output function 301 = READY output (PIO program can be run and error of cold-start level or higher is not present).

[2] Emergency stop



- I/O parameter No. 24, bits 0 to 3 = 0: The RDYOUT output (system I/O) is SYSRDY (PIO trigger program can be run) and the hardware is normal (emergency stop is not actuated and hardware error is not detected).
- I/O parameter No. 44 = 0: The drive-source cutoff reset input is not used.
- I/O parameter No. 47 = 3: Output function 301 = READY output (PIO program can be run and error of cold-start level or higher is not present).

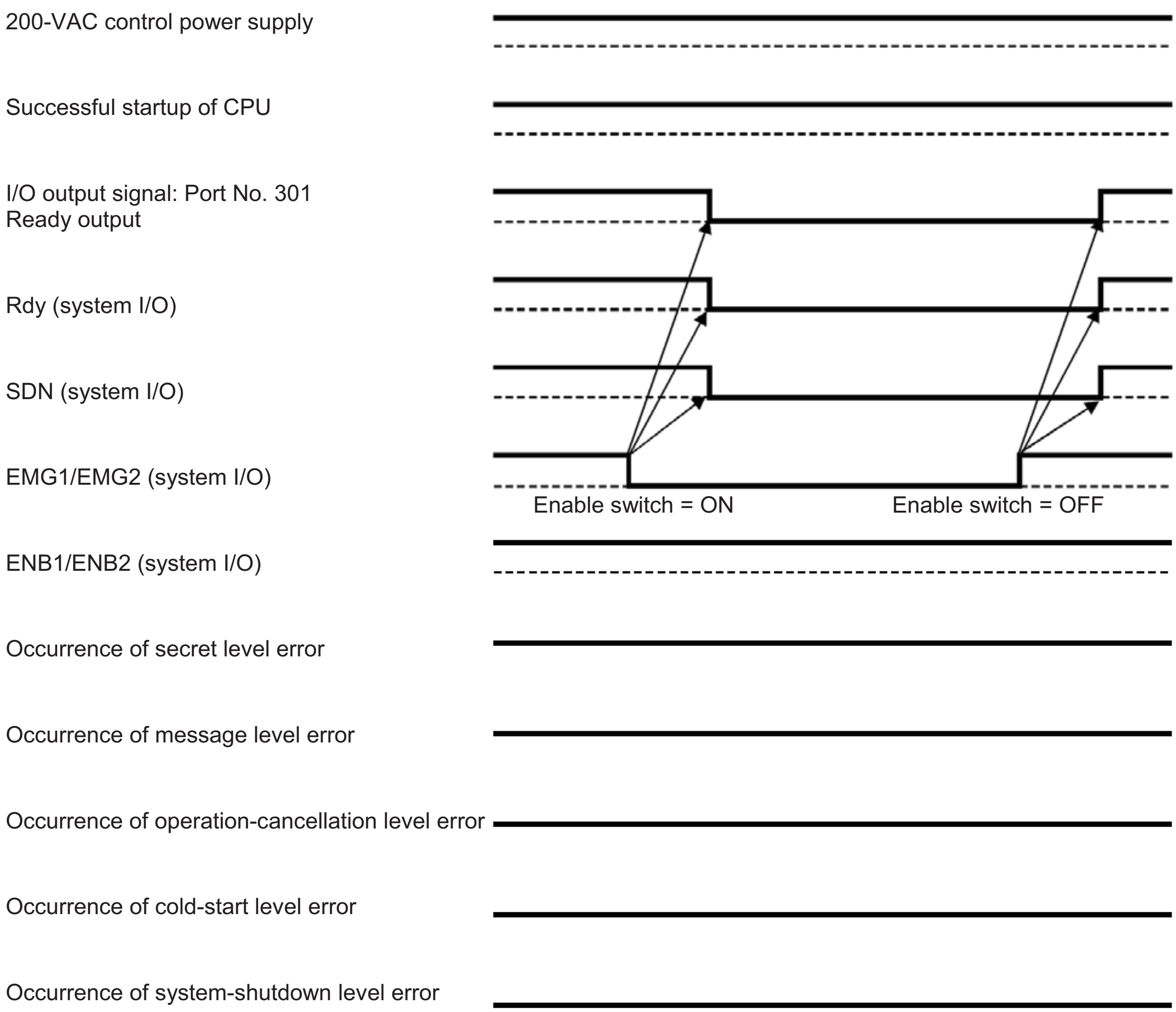
[3] Power on during emergency stop



Virtually the same timing chart is applicable when the power is turned on without enable input.

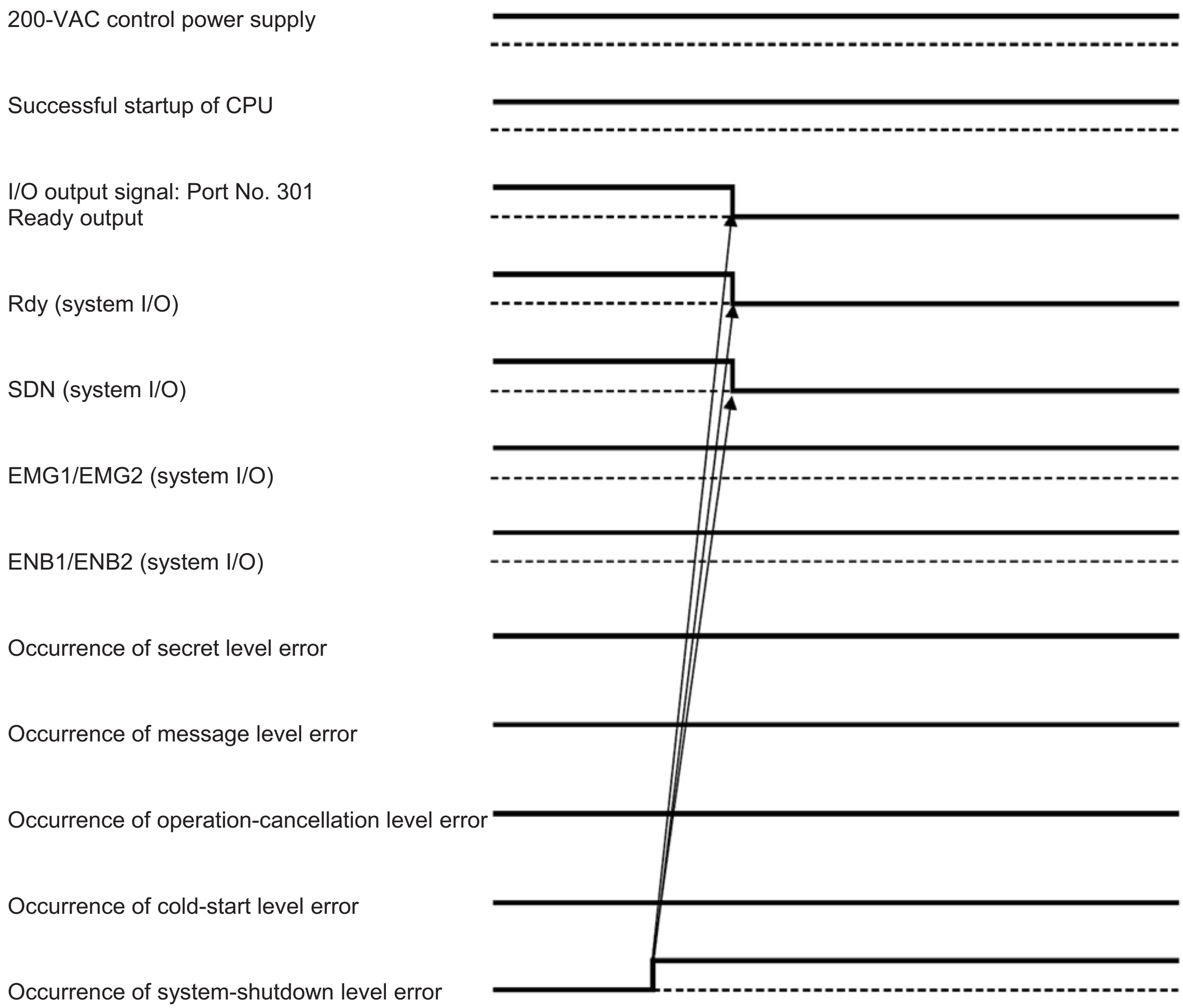
- I/O parameter No. 24, bits 0 to 3 = 0: The RDYOUT output (system I/O) is SYSRDY (PIO trigger program can be run) and the hardware is normal (emergency stop is not actuated and hardware error is not detected).
- I/O parameter No. 44 = 0: The drive-source cutoff reset input is not used.
- I/O parameter No. 47 = 3: Output function 301 = READY output (PIO program can be run and error of cold-start level or higher is not present).

[4] Enable input



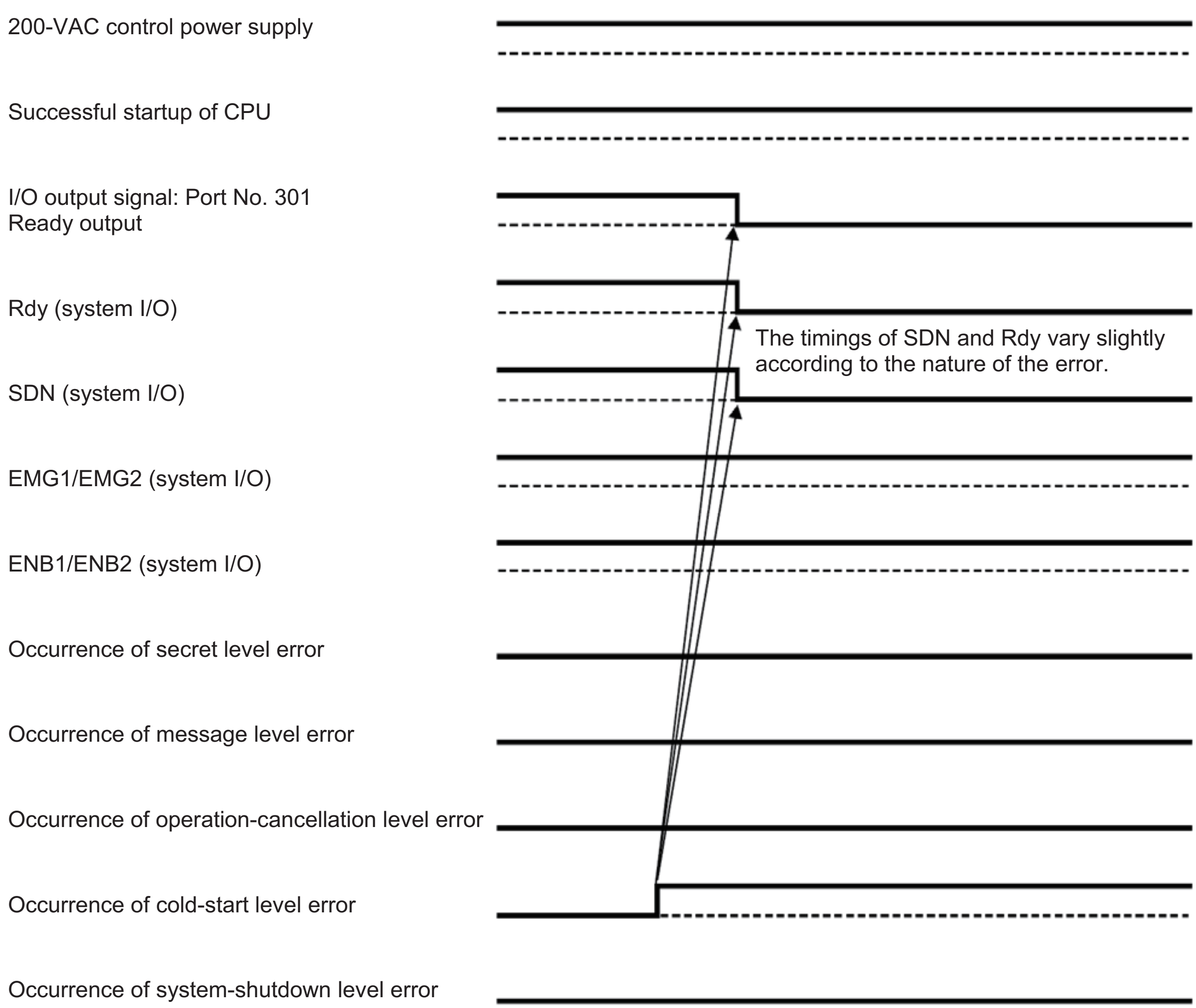
- I/O parameter No. 24, bits 0 to 3 = 0: The RDYOUT output (system I/O) is SYSRDY (PIO trigger program can be run) and the hardware is normal (emergency stop is not actuated and hardware error is not detected).
- I/O parameter No. 44 = 0: The drive-source cutoff reset input is not used.
- I/O parameter No. 47 = 3: Output function 301 = READY output (PIO program can be run and error of cold-start level or higher is not present).

[5] System-shutdown level error



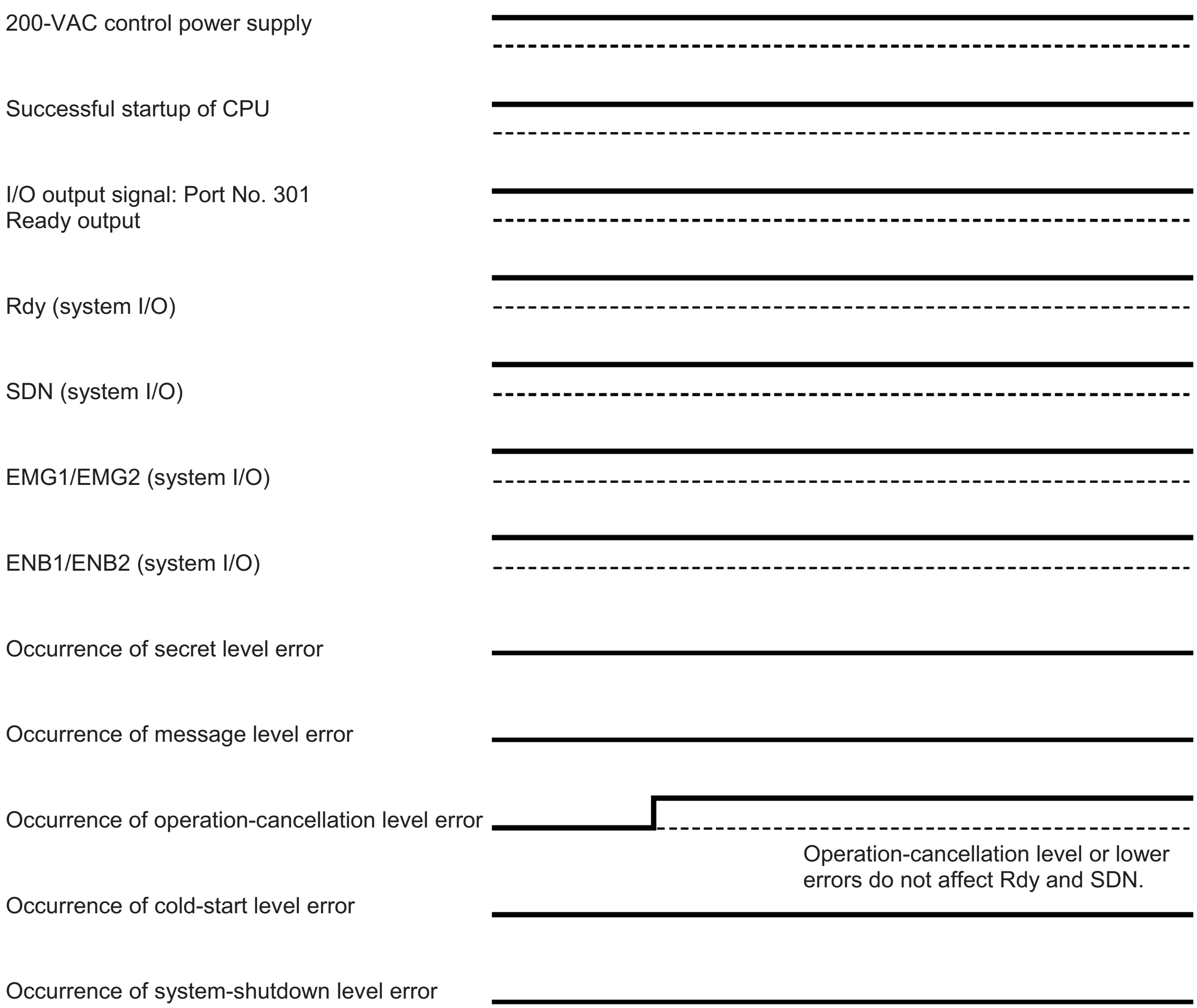
• I/O parameter No. 24, bits 0 to 3 = 0:	The RDYOUT output (system I/O) is SYSRDY (PIO trigger program can be run) and the hardware is normal (emergency stop is not actuated and hardware error is not detected).
• I/O parameter No. 44 = 0:	The drive-source cutoff reset input is not used.
• I/O parameter No. 47 = 3:	Output function 301 = READY output (PIO program can be run and error of cold-start level or higher is not present).

[6] Cold-start level error



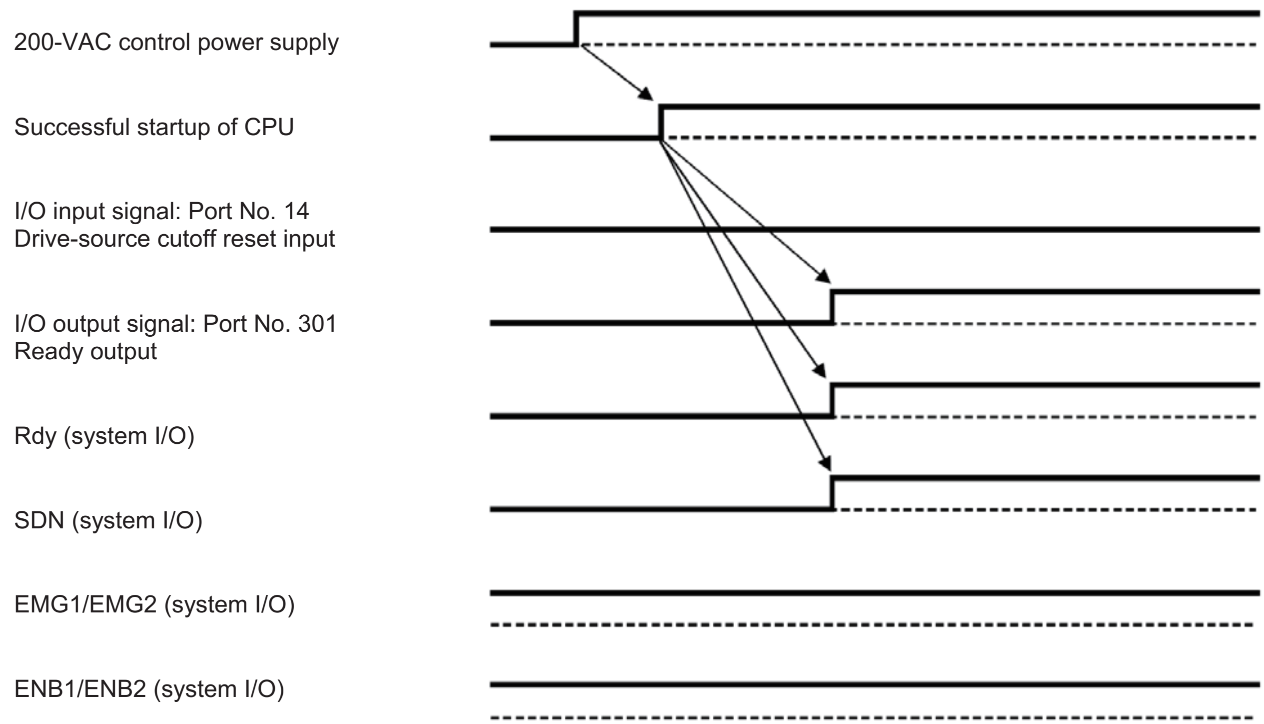
• I/O parameter No. 24, bits 0 to 3 = 0:	The RDYOUT output (system I/O) is SYSRDY (PIO trigger program can be run) and the hardware is normal (emergency stop is not actuated and hardware error is not detected).
• I/O parameter No. 44 = 0:	The drive-source cutoff reset input is not used.
• I/O parameter No. 47 = 3:	Output function 301 = READY output (PIO program can be run and error of cold-start level or higher is not present).

[7] Operation-cancellation level error



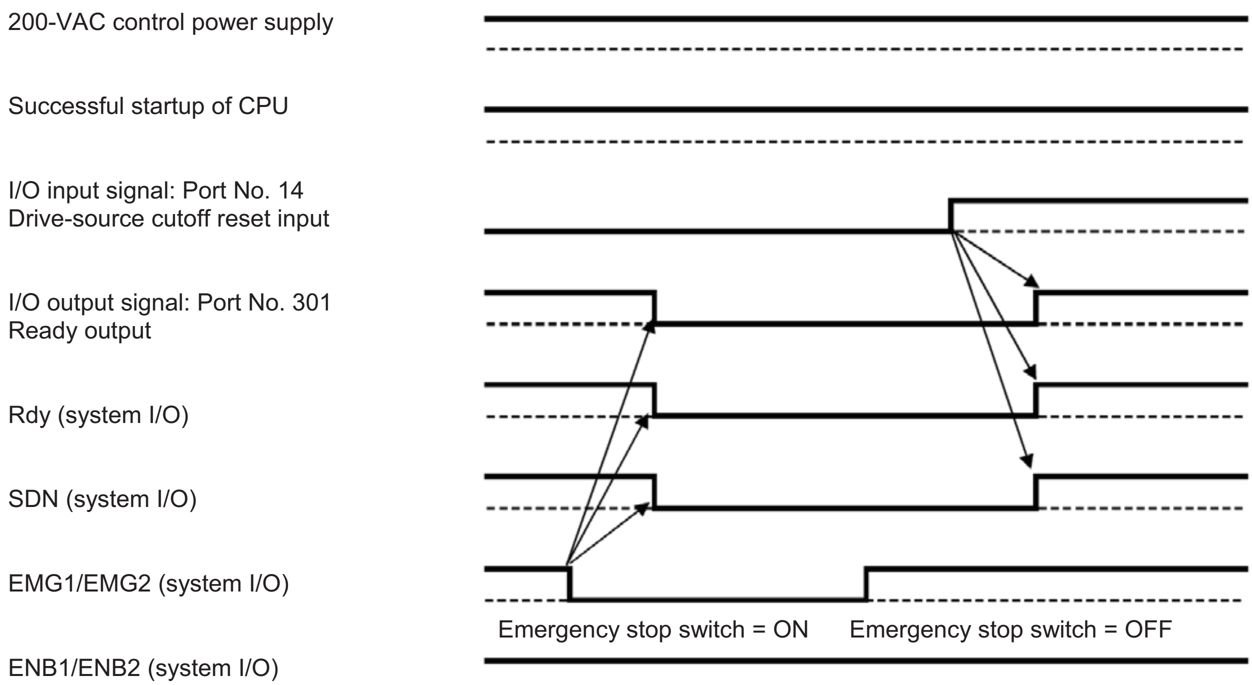
• I/O parameter No. 24, bits 0 to 3 = 0:	The RDYOUT output (system I/O) is SYSRDY (PIO trigger program can be run) and the hardware is normal (emergency stop is not actuated and hardware error is not detected).
• I/O parameter No. 44 = 0:	The drive-source cutoff reset input is not used.
• I/O parameter No. 47 = 3:	Output function 301 = READY output (PIO program can be run and error of cold-start level or higher is not present).

[8] Power ON (combined with drive-source cutoff reset input)



- I/O parameter No. 24, bits 0 to 3 = 0: The RDYOUT output (system I/O) is SYSRDY (PIO trigger program can be run) and the hardware is normal (emergency stop is not actuated and hardware error is not detected).
- I/O parameter No. 44 = 0: The drive-source cutoff reset input is not used.
- I/O parameter No. 47 = 3: Output function 301 = READY output (PIO program can be run and error of cold-start level or higher is not present).

[9] Emergency stop (combined with drive-source cutoff reset input)



• I/O parameter No. 24, bits 0 to 3 = 0:	The RDYOUT output (system I/O) is SYSRDY (PIO trigger program can be run) and the hardware is normal (emergency stop is not actuated and hardware error is not detected).
• I/O parameter No. 44 = 0:	The drive-source cutoff reset input is not used.
• I/O parameter No. 47 = 3:	Output function 301 = READY output (PIO program can be run and error of cold-start level or higher is not present).

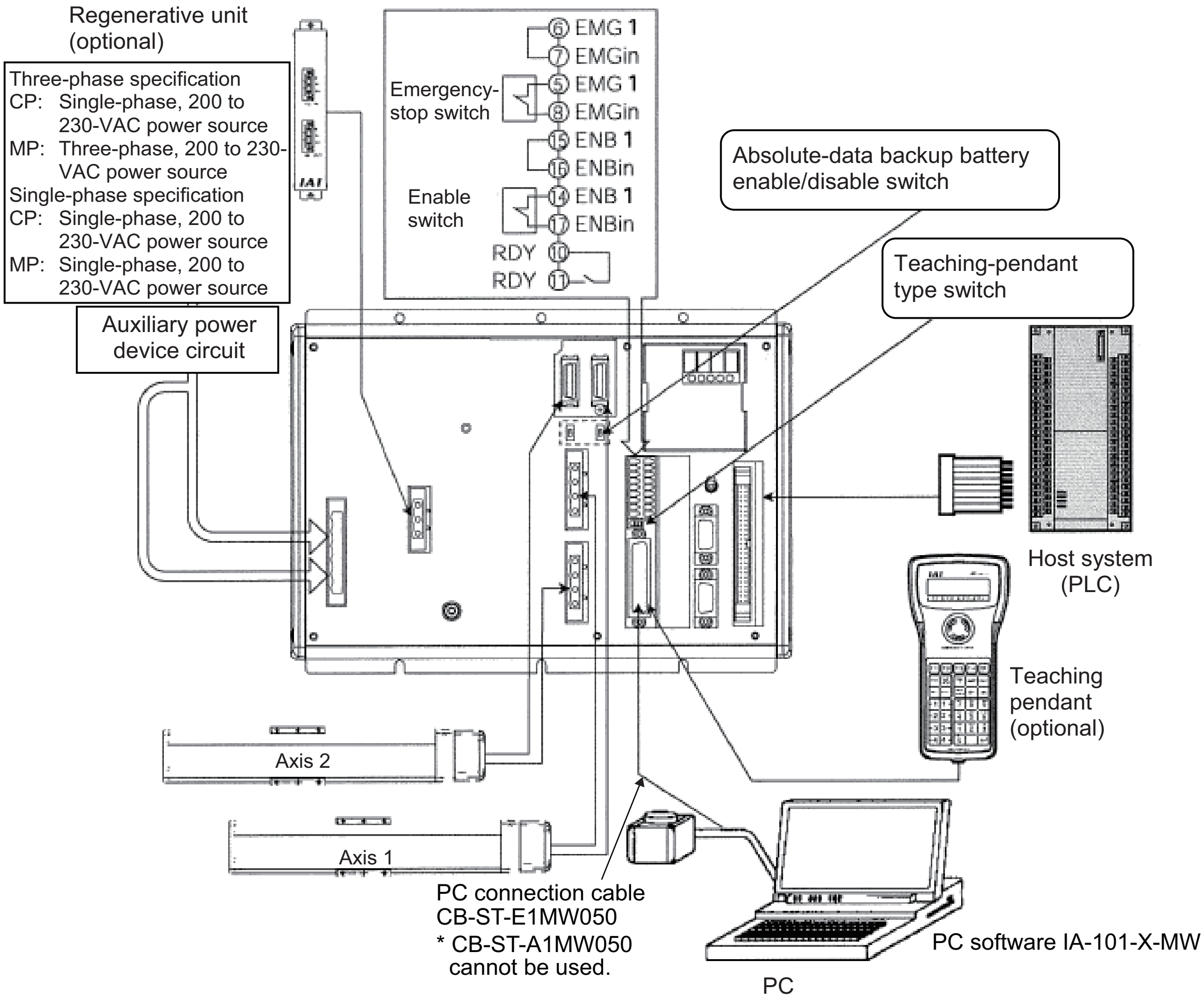
Chapter 7 System Setup

A connection example of a 2-axis controller is given below:

1. Connection Method of Controller and Actuator

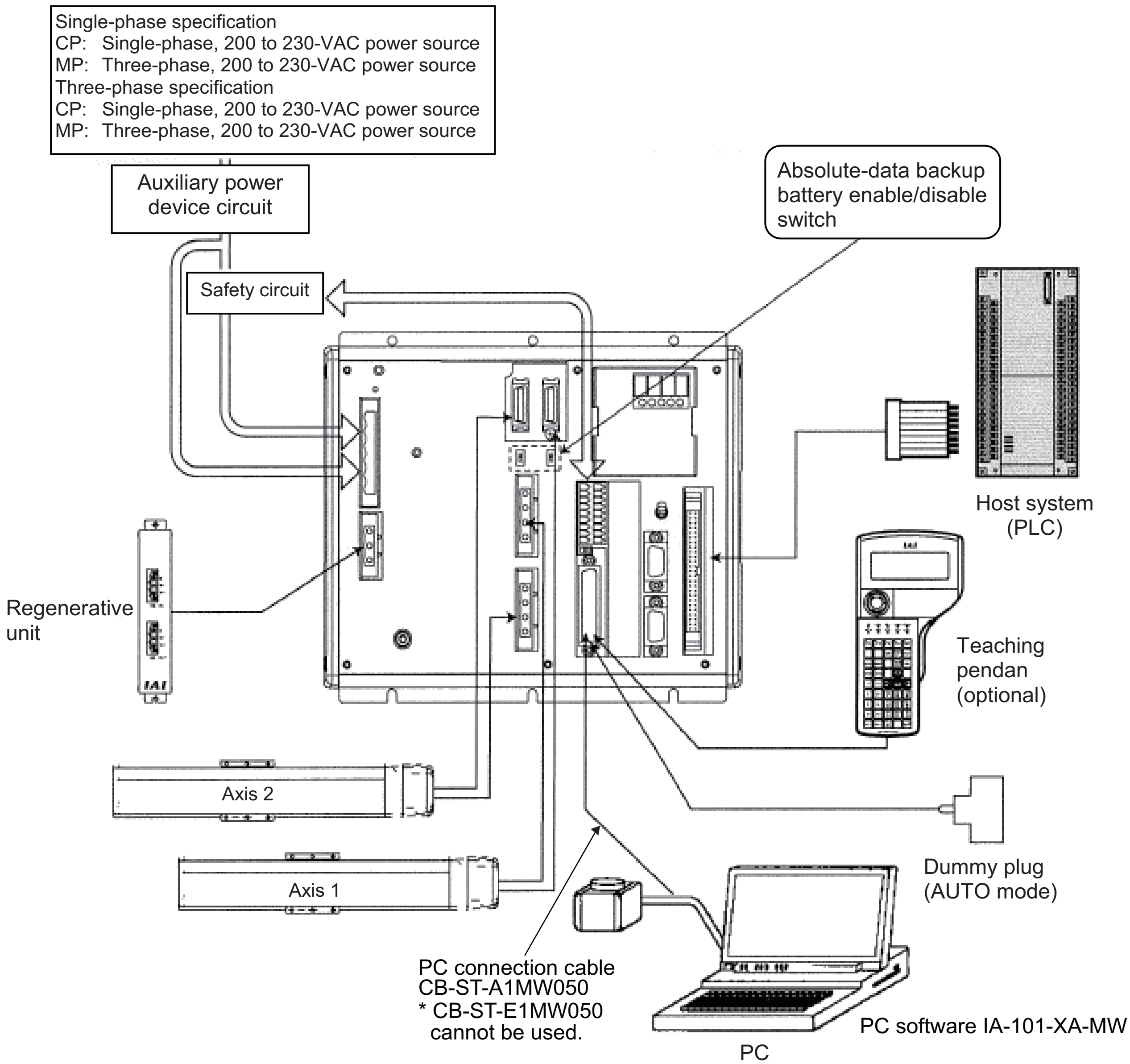
In the case of an absolute specification, perform an absolute reset after the connection (refer to Chapter 8).

1.1 Connection Diagram for P/PCT Type (Standard Specification)



Note 1: With the absolute specification, set the absolute-data backup battery enable/disable switch to the bottom position for all axes before connecting the encoder/axis-sensor cables. (After the cables have been connected and power turned on, set the switch back to the top position.) Note 2: When connecting a teaching pendant or PC cable (PC software), set the teaching-pendant type switch to an appropriate position. Left: ANSI teaching pendant Right: IAI's standard teaching pendant or PC cable

1.2 Connection Diagram for Q/QCT Type (Global Specification)



Note 1: With the absolute specification, set the absolute-data backup battery enable/disable switch to the bottom position for all axes before connecting the encoder/axis-sensor cables. (After the cables have been connected and power turned on, set the switch back to the top position.)

Note 2: Connect the supplied dummy plug to the teaching connector if neither a teaching pendant nor PC cable (PC software) is connected to this connector.

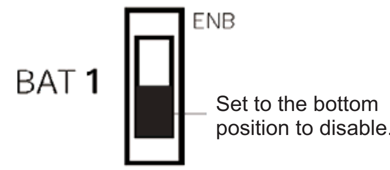
⚠ Warning : The internal components of the controller may burn if the following cable is used to connect XSEL-Q/QCT to a computer.

• Standard PC cable CB-ST-E1MW050 (black) enclosed in PC Software IA-101-X-MW

Even though the PC software can be used, make sure to use the cable CB-ST-A1MW050 (gray).

1.3 Startup procedure

Note:	When installing multiple axes to the controller, be sure to connect the actuator cables to the right connectors. Check the type of the actuator connected to each connector. If the cables and connectors are not connected properly, motor/board damage or malfunction may result.



1. If your controller is of the absolute specification, set the absolute-data backup battery enable/disable switch to the bottom position for all axes.
2. Connect to the controller the motor cable, encoder cable and LS cables (optional) from the actuator. Before turning on the power, be sure to confirm that each connector on the controller is connected to the correct actuator.
3. Connect the teaching pendant cable to the teaching connector. Once the teaching pendant has been connected, set the mode switch to MANU (top position).
   (If the mode switch is set to AUTO, the teaching pendant and RS-232 communication function will not operate after the power is turned on.) (P/PCT type only)
4. Set the teaching-pendant type switch.
   (Note 1) Q/QCT type controllers have no TP-SW.
   (Note 2) Q/QCT type controllers cannot be used with IAI's standard teaching pendants or standard PC cables.
   Left: SEL-T, SEL-TD, SEL-TG teaching pendant
   IA-T-XA teaching pendant
   Right: PC cable |
   IA-T-X, IA-T-XD teaching pendant

5. Turn on the controller power.
6. If your controller is of the absolute specification, set the absolute-data backup battery enable/disable switch to the top position (ENB) for all axes.

7. The panel window will show the code "rdy," indicating that the controller is ready. If "ErG" is shown on the panel window, it means an emergency stop signal has been input. Reset the emergency stop.
   If your controller is of the absolute specification, "E914" or "ECA2" will be shown. Refer to Chapter 8, "How to Perform An Absolute Encoder Reset."

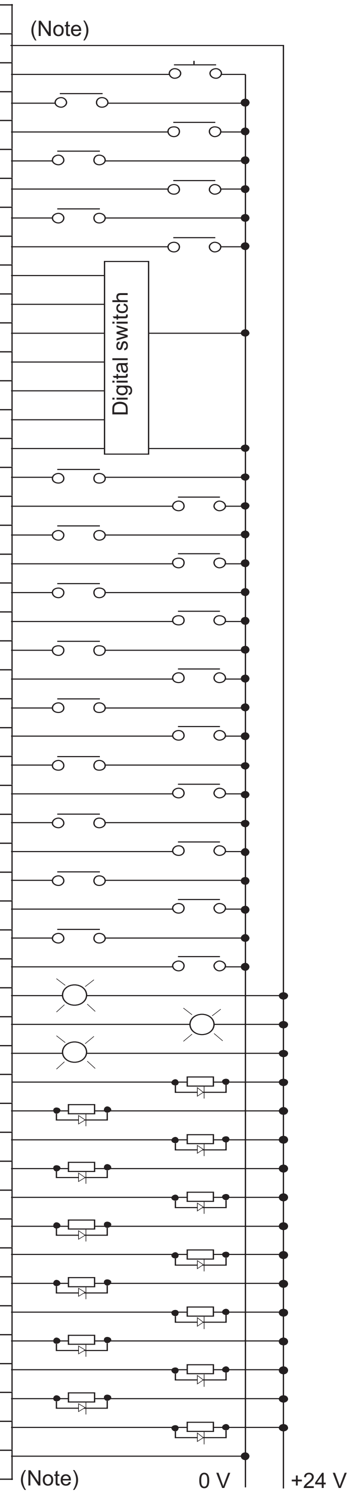
The controller is now ready to operate.

- The RDY terminals (10, 11) in the system I/O connector are relay contact terminals that are shorted when the controller is ready.

2. I/O Connection Diagram

2.1 NPN specification

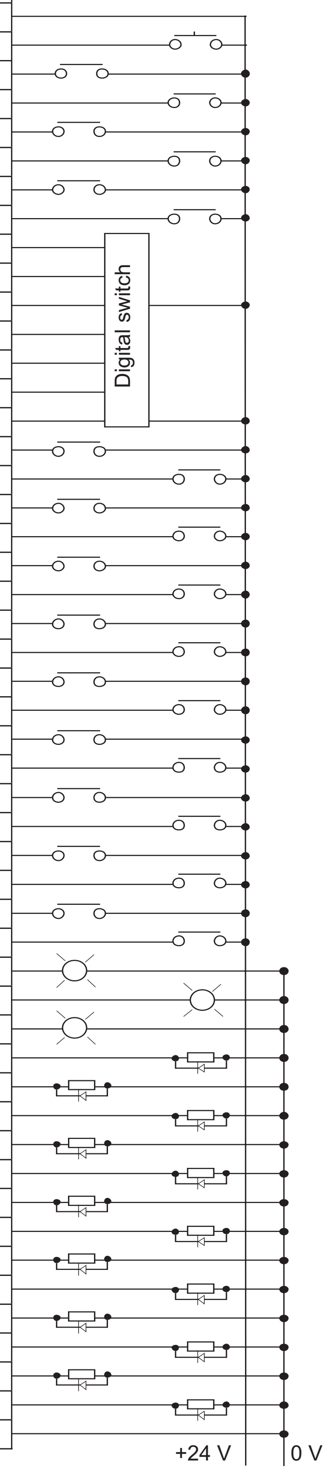
Pin No.	Category	Port No.	Function
1	Input	-	+24-V input
2		000	Program start
3		001	General-purpose input
4		002	General-purpose input
5		003	General-purpose input
6		004	General-purpose input
7		005	General-purpose input
8		006	General-purpose input
9		007	Program specification (PRG No. 1)
10		008	Program specification (PRG No. 2)
11		009	Program specification (PRG No. 4)
12		010	Program specification (PRG No. 8)
13		011	Program specification (PRG No. 10)
14		012	Program specification (PRG No. 20)
15		013	Program specification (PRG No. 40)
16		014	General-purpose input
17		015	General-purpose input
18		016	General-purpose input
19		017	General-purpose input
20		018	General-purpose input
21		019	General-purpose input
22		020	General-purpose input
23		021	General-purpose input
24		022	General-purpose input
25		023	General-purpose input
26		024	General-purpose input
27		025	General-purpose input
28		026	General-purpose input
29		027	General-purpose input
30		028	General-purpose input
31		029	General-purpose input
32		030	General-purpose input
33		031	General-purpose input
34	Output	300	Alarm output
35		301	Ready output
36		302	Emergency-stop output
37		303	General-purpose output
38		304	General-purpose output
39		305	General-purpose output
40		306	General-purpose output
41		307	General-purpose output
42		308	General-purpose output
43		309	General-purpose output
44		310	General-purpose output
45		311	General-purpose output
46		312	General-purpose output
47		313	General-purpose output
48		314	General-purpose output
49		315	General-purpose output
50		-	0 V



Connect +24 V to pin No. 1 and 0 V to pin No. 50.

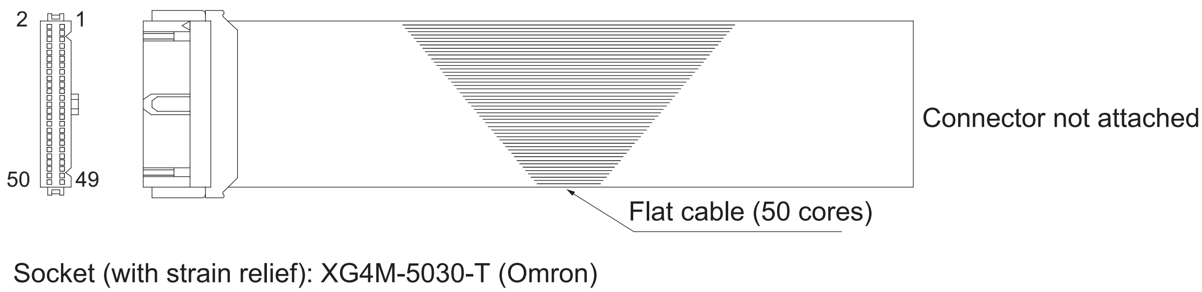
2.2 PNP specification

Pin No.	Category	Port No.	Function
1		-	+24-V input
2		000	Program start
3		001	General-purpose input
4		002	General-purpose input
5		003	General-purpose input
6		004	General-purpose input
7		005	General-purpose input
8		006	General-purpose input
9		007	Program specification (PRG No. 1)
10		008	Program specification (PRG No. 2)
11		009	Program specification (PRG No. 4)
12		010	Program specification (PRG No. 8)
13		011	Program specification (PRG No. 10)
14		012	Program specification (PRG No. 20)
15		013	Program specification (PRG No. 40)
16		014	General-purpose input
17	Input	015	General-purpose input
18		016	General-purpose input
19		017	General-purpose input
20		018	General-purpose input
21		019	General-purpose input
22		020	General-purpose input
23		021	General-purpose input
24		022	General-purpose input
25		023	General-purpose input
26		024	General-purpose input
27		025	General-purpose input
28		026	General-purpose input
29		027	General-purpose input
30		028	General-purpose input
31		029	General-purpose input
32		030	General-purpose input
33		031	General-purpose input
34		300	Alarm output
35		301	Ready output
36		302	Emergency-stop output
37		303	General-purpose output
38		304	General-purpose output
39		305	General-purpose output
40		306	General-purpose output
41		307	General-purpose output
42	Output	308	General-purpose output
43		309	General-purpose output
44		310	General-purpose output
45		311	General-purpose output
46		312	General-purpose output
47		313	General-purpose output
48		314	General-purpose output
49		315	General-purpose output
50		-	0 V



Connect +24 V to pin No. 1 and 0 V to pin No. 50.

2.3 I/O Flat Cable



No.	Color	No.	Color	No.	Color	No.	Color	No.	Color
1	Brown-1	11	Brown-2	21	Brown-3	31	Brown-4	41	Brown-5
2	Red-1	12	Red-2	22	Red-3	32	Red-4	42	Red-5
3	Orange-1	13	Orange-2	23	Orange-3	33	Orange-4	43	Orange-5
4	Yellow-1	14	Yellow-2	24	Yellow-3	34	Yellow-4	44	Yellow-5
5	Green-1	15	Green-2	25	Green-3	35	Green-4	45	Green-5
6	Blue-1	16	Blue-2	26	Blue-3	36	Blue-4	46	Blue-5
7	Purple-1	17	Purple-2	27	Purple-3	37	Purple-4	47	Purple-5
8	Gray-1	18	Gray-2	28	Gray-3	38	Gray-4	48	Gray-5
9	White-1	19	White-2	29	White-3	39	White-4	49	White-5
10	Black-1	20	Black-2	30	Black-3	40	Black-4	50	Black-5

2.4 Changing Port Numbers Assigned to I/O Function Selections (Main (FROM32M) or Later)

You can use I/O parameter Nos. 283 to 298, “Port number assigned to input function selection ***” to assign, to desired input ports, input function selections 000 to 015 whose functions have been set by I/O parameter Nos. 30 to 45, “Input function selection ***.”
You can also use I/O parameter Nos. 299 to 314, “Port number assigned to output function selection ***” to assign, to desired output ports, output function selections 300 to 315 whose functions have been set by I/O parameter Nos. 46 to 61, “Output function selection ***.”
In addition, separately from output function selections 300 to 315 above you can also use I/O parameter Nos. 315 to 330, “Port number assigned to output function selection *** (area 2)” to assign, to desired output ports, output function selections 300 (area 2) to 315 (area 2) whose functions have been set by I/O parameter Nos. 331 to 346, “Output function selection *** (area 2).”

Note: The above functions are supported by XSEL PC software of V7.2.0.0 or later.

(1) Assignment example of input function selection
Given below is an example of assigning input function selection 000 (program start) whose function has been set by I/O parameter No. 30, “Input function selection 000,” to a different input port.
Use I/O parameter No. 30, “Input function selection 000” to set the function of input function selection 000 (program start). For details, refer to ⊙ Appendix, “List of Parameters.”
Set the input port number for input function selection 000 (program start) using I/O parameter No. 283, “Port number assigned to input function selection 000.”
If you set “016”, for example, the function of input function selection 000 (program start) is assigned to “Input port No. 016.”
Accordingly, the signal input port for input function selection 000 (program start) becomes “Input port No. 016.”
After the assignment change, “Input port No. 000” becomes a general-purpose input port.
Note, however, that setting “-1 (default value: standard factory setting)” in I/O parameter No. 283, “Port number assigned to input function selection 000” is invalid, in which case the function of input function selection 000 (program start) will be assigned to “Input port No. 000.”

[Note]
If a network is available, you can also assign input function selections 000 to 015 to network-assigned ports.

Note: Although input port numbers can be set individually as desired, setting duplicate port numbers or discontinuous port number for “Program number specified for program start” will generate Error No. 685, “I/O function selection port number error.”

(2) Assignment example of output function selection
Given below is an example of assigning output function selection 300 (error output) whose function has been set by I/O parameter No. 46, “Output function selection 300,” to a different output port.
Use I/O parameter No. 46, “Output function selection 300” to set the function of output function selection 300 (error output). For details, refer to ⊙ Appendix, “List of Parameters.”
Set the output port number for output function selection 300 (error output) using I/O parameter No. 299, “Port number assigned to output function selection 300.”
If you set “316”, for example, the function of output function selection 300 (error output) is assigned to “Output port No. 316.”
Accordingly, the signal for output function selection 300 (error output) is output to “Output port No. 316.”
Note, however, that setting “0 (default value: standard factory setting)” in I/O parameter No. 299, “Port number assigned to output function selection 300” is invalid, in which case the function of output function selection 300 (error output) will be assigned to “Output port No. 300.”
After the assignment change, “Output port No. 300” becomes a general-purpose input port.

Note: Although output port numbers can be set individually as desired, setting duplicate port numbers will generate Error No. 685, “I/O function selection port number error.”

(3) Assignment example of output function selection (area 2)
Output function selection 300 (area 2) (error output) whose function has been set by I/O parameter No. 331, “Output function selection 300 (area 2)” can be assigned to an output port that has been set by “Port number assigned to output function selection 300 (area 2),” to output a signal. An example is given below.

Use I/O parameter No. 331, “Output function selection 300 (area 2)” to set the function of output function selection 300 (area 2) (error output). For details, refer to ⊙ Appendix, “List of Parameters.”
Set the (area 2) output port number for output function selection 300 (area 2) (error output) using I/O parameter No. 315, “Port number assigned to output function selection 300 (area 2).”
If you set “316”, for example, the function of output function selection 300 (area 2) (error output) is assigned to “Output port No. 316.”
Accordingly, the signal for output function selection 300 (area 2) (error output) is output to “Output port No. 316.”
Note, however, that setting “0 (default value: standard factory setting)” in I/O parameter No. 315, “Port number assigned to output function selection 300 (area 2)” is invalid, in which case no signal will be output.

Note: Although output port numbers can be set individually as desired, setting duplicate port numbers will generate Error No. 685, “I/O function selection port number error.”

(4) Use example
Given below is a setting example of system I/O assignments:

Input port No. 16 = Program start signal (ON edge) (BCD specification)
Input port No. 17 = Servo ON signal
Input port Nos. 18 to 23 = Program number specified for program start
Input port No. 24 = Error reset (ON edge)
Input port No. 25 = Home return of all valid axes (ON edge)
Output port No. 316 = Output of operation-cancellation level or higher error (ON)
Output port No. 317 = READY output (PIO trigger program can be run)
Output port No. 318 = Emergency stop output (ON)
Output port No. 319 = Automatic operation in-progress output (other parameter No. 12)
Output port No. 320 = Output at completion of home return of all valid axes (coordinates conformed)
Output port Nos. 321 to 326 = Axis 1 to 6 servo currently-ON output (system-monitored task output)

I/O Parameter Settings

No.	Parameter name	Setting	Remarks
30	Input function selection 000	1	1 = Program start signal (ON edge) (BCD specification)
32	Input function selection 002	1	1 = Servo ON
37 to 42	Input function selection 007 to input function selection 012	1	1 = Program number specified for program start
43	Input function selection 013	2	2 = Error reset (ON edge)
45	Input function selection 015	1	1 = Home return of all valid axes (ON edge)
46	Output function selection 300	1	1 = Output of operation-cancellation level or higher error (ON)
47	Output function selection 301	1	1 = READY output (PIO trigger program can be run)
48	Output function selection 302	1	1 = Emergency stop output (ON)
49	Output function selection 303	2	2 = Automatic operation in-progress output (other parameter No. 12)
50	Output function selection 304	2	2 = Output at completion of home return of all valid axes (coordinates conformed)
51 to 56	Output function selection 305 to output function selection 310	2	2 = Axis 1 to 6 servo currently-ON output (system-monitored task output)
283	Port number assigned to input function selection 000	16	Input port number = 16
285	Port number assigned to input function selection 002	17	Input port number = 17
290 to 295	Port number assigned to input function selection 007 to port number assigned to input function selection 012	18 to 23	Input port number = 18 to 23
296	Port number assigned to input function selection 013	24	Input port number = 24
298	Port number assigned to input function selection 015	25	Input port number = 25
299 to 309	Port number assigned to output function selection 300 to port number assigned to output function selection 310	316 to 326	Output port numbers = 316 to 326

3. Multi-point DIO Board

This board is a multi-point DIO board equipped with 48 input points and 48 output points for use with XSEL controllers.

3.1 Overview

3.1.1 Features

[1] One board provides a total of 96 input/output points.
Multiple inputs/outputs of your XSEL controller can be controlled with a single board offering 48 input points and 48 output points.

[2] Supporting DIO interfaces of PNP and NPN types
Just like you can with current IO boards, you can also select a desired DIO interface of one of two types, NPN and PNP, for this board.

[3] Overcurrent & I/O power-supply monitoring function
An overcurrent flowing through the DO board is detected. The I/O power-supply voltage is also monitored and if the monitored voltage deviates from the specified range, the DO outputs will be cut off. Take note, however, that unlike with current IO boards, this board detects overcurrent based on a threshold of 400 mA per 24 points (current IO boards: 400 mA per 8 points).

3.1.2 Board Variations

This board is available in the variations shown in the table below.

Model number	
IA-IO-3204-NP	XSEL multi-point IO board of general-purpose, large-capacity type (NPN specification)
IA-IO-3204-NP	XSEL multi-point IO board of general-purpose, large-capacity type (PNP specification)

3.2 Specifications

3.3.1 Input/Output Specifications

Item	Specification
Numbers of input/output points	48 input points, 48 output points
External power-supply voltage	DC24V $\pm$ 10%
Input isolation	Photocoupler isolation
Input current	7 mA max. per point
Input leak current	1 mA max. per point
Output isolation	Photocoupler isolation
Output element	Transistor
Maximum output load current	50 mA per point (400 mA per 24 points)
Output leak current	0.1 mA max. per point

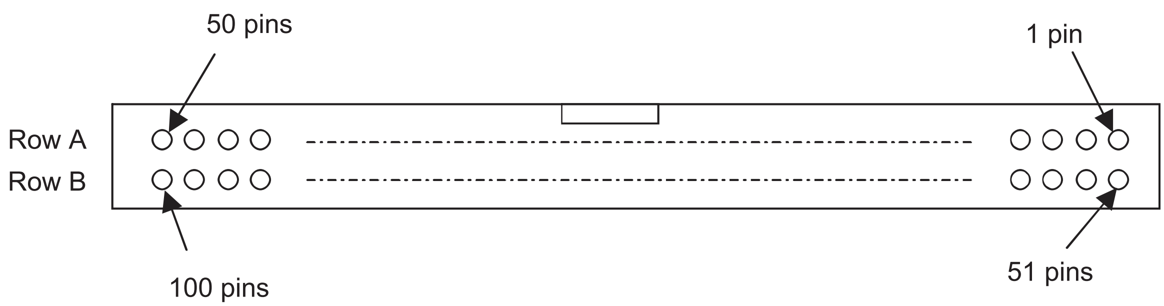
3.3 External Interface Specifications

3.3.1 Terminal Assignment for External DIO Interface

Overview of multi-point DIO interface specifications

Item	Overview	Remarks
Applicable connector	Half-pitch flat connector, 100 pins	HIF6-100PA-1.27DS (Hirose)
Connector name	External DIO connector	
External power supply	DC24V ± 10%	The power line is divided into two circuits, each supplying power to a group of 24 DI points and 24 DO points.
DI	48 points	
DO	48 points	

Pin layout (Connector engagement surface)



3.3.2 24-V I/O Power input

The power-supply circuit for IN000 to 023 and OUT300 to 323 is separated from the power-supply circuit for IN024 to 047 and OUT324 to 347. Connect an external power supply to each of the power-supply terminals corresponding to these circuits.

This board also provides the following error detection functions in connection with I/O power:

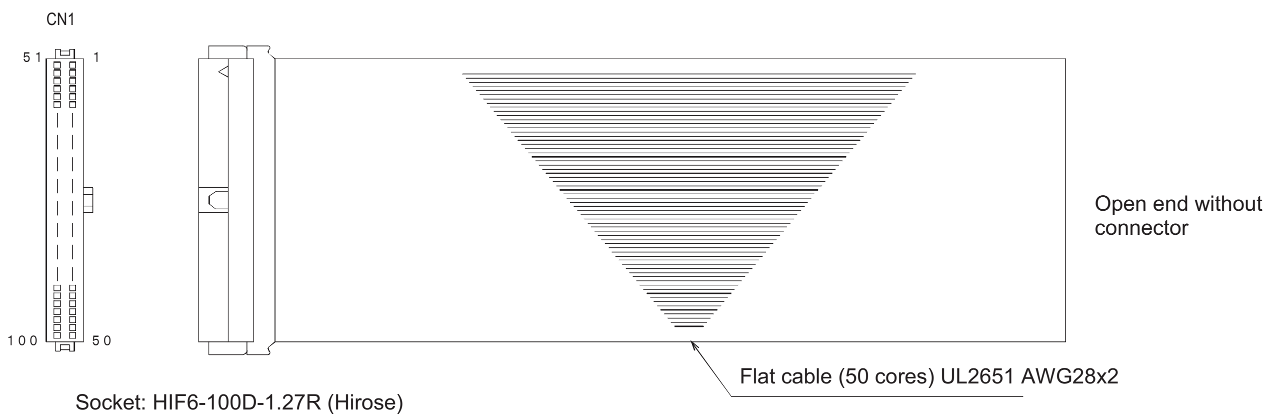
1. Monitoring of external I/O power-supply voltage (+24 V)
2. Monitoring of output current for each group of 24 points

3.4 Connection Cables for Multi-point IO Board

Cable 1					Cable 2				
Category	Pin No.	Color	Port No.	Function	Category	Pin No.	Color	Port No.	Function
-	1	Brown-1	-	External power supply 24 VDC for pin Nos. 2 to 25/51 to 74	Output	51	Brown-1	300	Alarm output
Input	2	Red-1	000	Program start		52	Red-1	301	Ready output
	3	Orange-1	001	General pursose input		53	Orange-1	302	Emergency stop output
	4	Yellow-1	002	General pursose input		54	Yellow-1	303	General purpose output
	5	Green-1	003	General pursose input		55	Green-1	304	General purpose output
	6	Blue-1	004	General pursose input		56	Blue-1	305	General purpose output
	7	Purple-1	005	General pursose input		57	Purple-1	306	General purpose output
	8	Grey-1	006	General pursose input		58	Grey-1	307	General purpose output
	9	White-1	007	Program specification (PRG No.1)		59	White-1	308	General purpose output
	10	Black-1	008	Program specification (PRG No.2)		60	Black-1	309	General purpose output
	11	Brown-2	009	Program specification (PRG No.4)		61	Brown-2	310	General purpose output
	12	Red-2	010	Program specification (PRG No.8)		62	Red-2	311	General purpose output
	13	Orange-2	011	Program specification (PRG No.10)		63	Orange-2	312	General purpose output
	14	Yellow-2	012	Program specification (PRG No.20)		64	Yellow-2	313	General purpose output
	15	Green-2	013	Program specification (PRG No.40)		65	Green-2	314	General purpose output
	16	Blue-2	014	General pursose input		66	Blue-2	315	General purpose output
	17	Purple-2	015	General pursose input		67	Purple-2	316	General purpose output
	18	Grey-2	016	General pursose input		68	Grey-2	317	General purpose output
	19	White-2	017	General pursose input		69	White-2	318	General purpose output
	20	Black-2	018	General pursose input		70	Black-2	319	General purpose output
	21	Brown-3	019	General pursose input		71	Brown-3	320	General purpose output
	22	Red-3	020	General pursose input		72	Red-3	321	General purpose output
	23	Orange-3	021	General pursose input		73	Orange-3	322	General purpose output
	24	Yellow-3	022	General pursose input		74	Yellow-3	323	General purpose output
	25	Green-3	023	General pursose input	-	75	Green-3	-	External power supply 0 V for pin Nos. 2 to 25/51 to 74
-	26	Blue-3	-	External power supply 24 VDC for pin Nos. 27 to 50/76 to 99	Output	76	Blue-3	324	General purpose output
Input	27	Purple-3	024	General pursose input		77	Purple-3	325	General purpose output
	28	Grey-3	025	General pursose input		78	Grey-3	326	General purpose output
	29	White-3	026	General pursose input		79	White-3	327	General purpose output
	30	Black-3	027	General pursose input		80	Black-3	328	General purpose output
	31	Brown-4	028	General pursose input		81	Brown-4	329	General purpose output
	32	Red-4	029	General pursose input		82	Red-4	330	General purpose output
	33	Orange-4	030	General pursose input		83	Orange-4	331	General purpose output
	34	Yellow-4	031	General pursose input		84	Yellow-4	332	General purpose output
	35	Green-4	032	General pursose input		85	Green-4	333	General purpose output
	36	Blue-4	033	General pursose input		86	Blue-4	334	General purpose output
	37	Purple-4	034	General pursose input		87	Purple-4	335	General purpose output
	38	Grey-4	035	General pursose input		88	Grey-4	336	General purpose output
	39	White-4	036	General pursose input		89	White-4	337	General purpose output
	40	Black-4	037	General pursose input		90	Black-4	338	General purpose output
	41	Brown-5	038	General pursose input		91	Brown-5	339	General purpose output
	42	Red-5	039	General pursose input		92	Red-5	340	General purpose output
	43	Orange-5	040	General pursose input		93	Orange-5	341	General purpose output
	44	Yellow-5	041	General pursose input		94	Yellow-5	342	General purpose output
	45	Green-5	042	General pursose input		95	Green-5	343	General purpose output
	46	Blue-5	043	General pursose input		96	Blue-5	344	General purpose output
	47	Purple-5	044	General pursose input		97	Purple-5	345	General purpose output
	48	Grey-5	045	General pursose input		98	Grey-5	346	General purpose output
	49	White-5	046	General pursose input		99	White-5	347	General purpose output
	50	Black-5	047	General pursose input	-	100	Black-5	-	External power supply 0 V for pin Nos. 27 to 50/76 to 99

3.5 Connection Cables for Multi-point IO Board

Model number: CB-X-PIOH020



Socket: HIF6-100D-1.27R (Hirose)

3.6 Input/Output Circuits

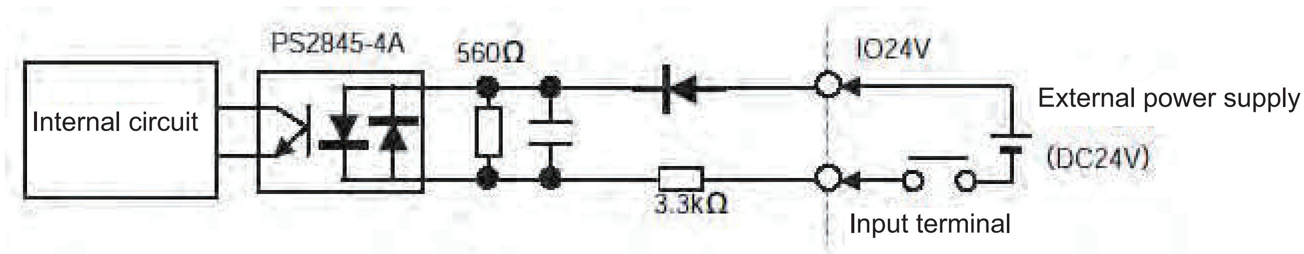
3.6.1 Input

Input specifications

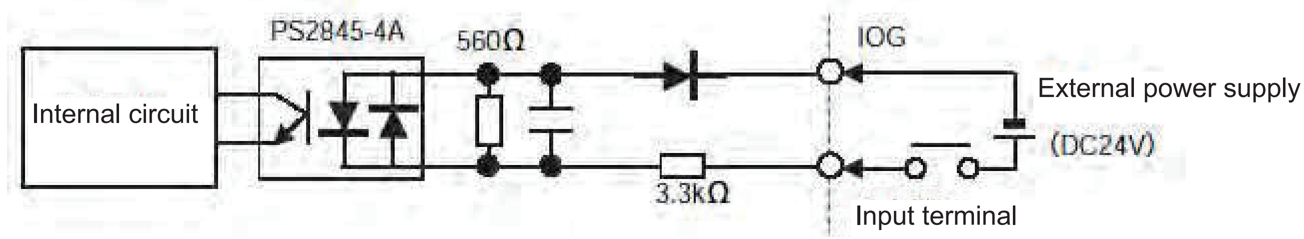
Item	Specification (Common to PNP/NPN specifications)
External power-supply voltage	DC24V ± 10%
Input current	7 mA max. per point
Leak current	1 mA max. per point

Input circuit

• NPN specification



• PNP specification



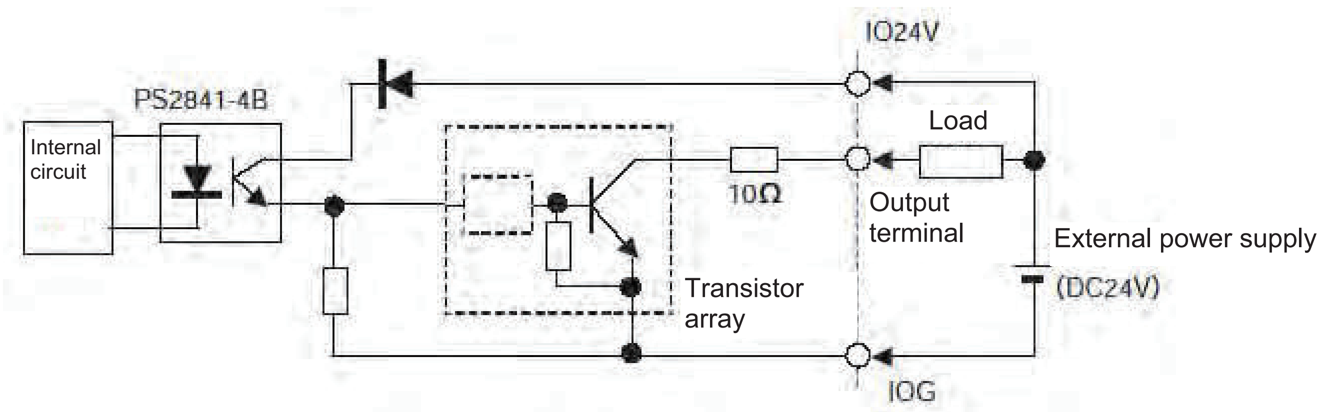
3.6.2 Output

Output specifications

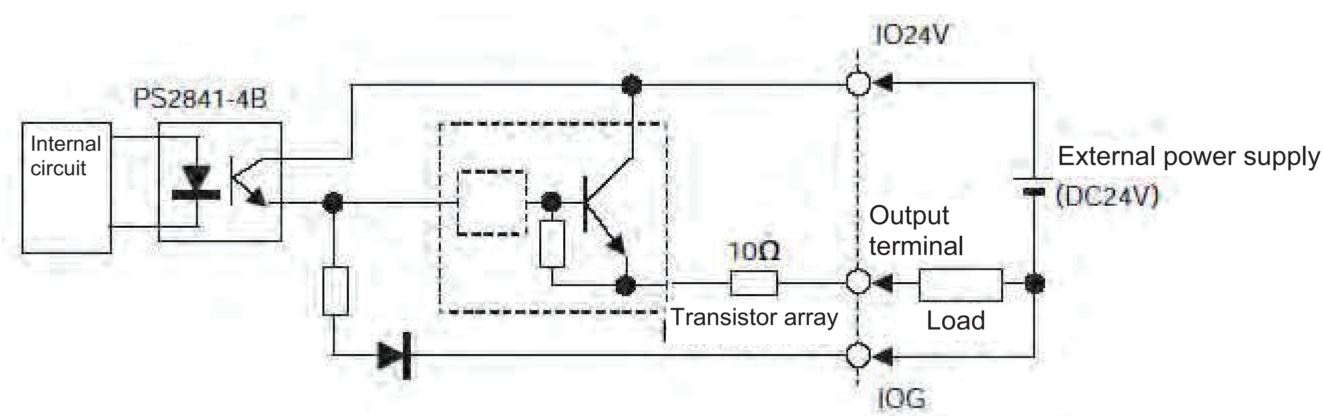
Item	Specification
Output element	Transistor array NPN specification: TD62084AF by Toshiba Corporation PNP specification: TD62784AF by Toshiba Corporation
External power-supply voltage	DC24 ± 10%
Maximum load current	50 mA max. per point (400 mA max. per 24 points): *1
Leak current	0.1 mA max. per point

*1: 400 mA represents the total output current for each group of 24 points.

• NPN specification



• PNP specification



Chapter 8 How to Perform An Absolute Encoder Reset (Absolute Specification)

1. Single Axis, Orthogonal Axis and Rotating Axis

When the absolute-encoder battery voltage of the XSEL Controller is abnormal or when the battery or encoder cable is disconnected, an encoder battery error will occur and an absolute encoder reset must be performed. This chapter explains how to perform an absolute encoder reset using the PC software. For the absolute-encoder reset method using the teaching pendant, refer to the operation manual for the teaching pendant.
In the case of a synchro controller, refer to "◎ Absolute Reset of A Synchro Controller" in Appendix.

1.1 Preparation

(1) PC
A PC in which IAI's XSEL PC software (X_SEL.exe) has been installed

(2) Connection cable (the cable supplied with the PC software)
RS232C cross cable (PC-end: female 9-pin, Controller-end: male 25-pin)

(3) All adjustments other than the absolute reset must have been completed.

1.2 Procedure

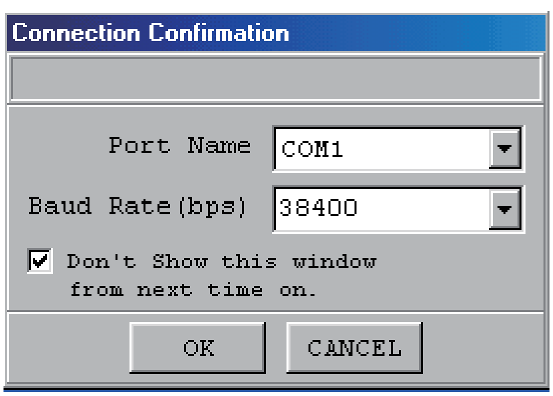
(1) Turn off the XSEL Controller power. Turn on the PC power and wait for the operating system to be started.

(2) Connect the 9-pin, D-sub connector on one end of the connection cable to the communication port on the PC, and connect the 25-pin, D-sub connector on the other end to the 25-pin communication port on the controller.

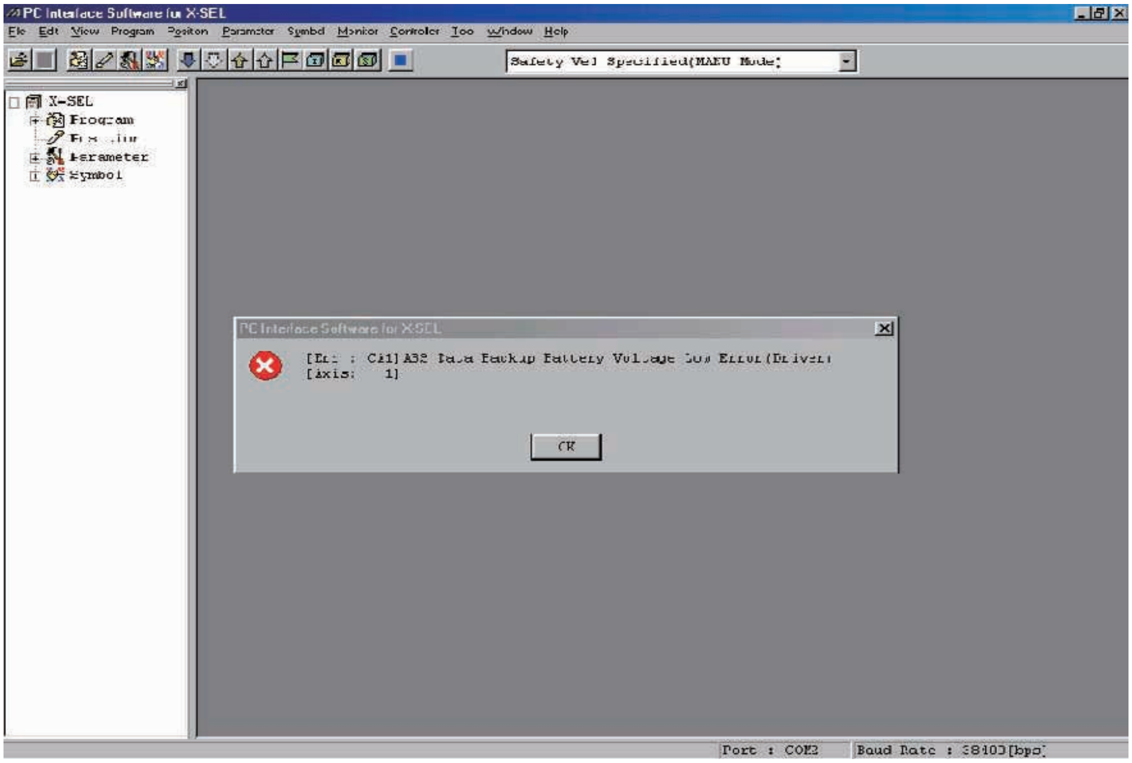
(3) Turn on the controller power. If an encoder battery error is present but no other adjustments are pending, the 7-segment LED display will show "E914" or "ECA2" indicating that the controller has detected an encoder battery error.

(4) Start the XSEL PC software (X_SEL.exe) on the PC. The following explains the operation steps in the XSEL PC software.

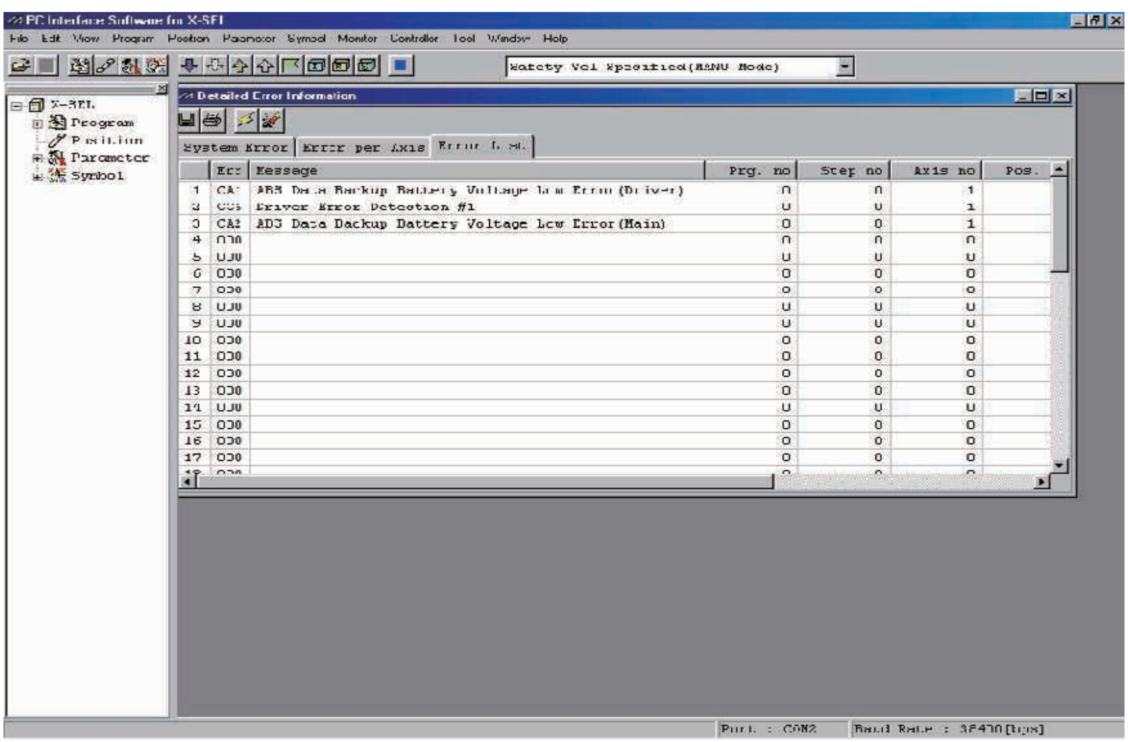
(5) When the [Connection Confirmation] dialog box is displayed, select the port name you are using on the PC. Click the [OK] button.
(The software will automatically detect the baud rate.)



(6) The XSEL PC software window will be displayed. Clicking the [OK] button will clear the error message.

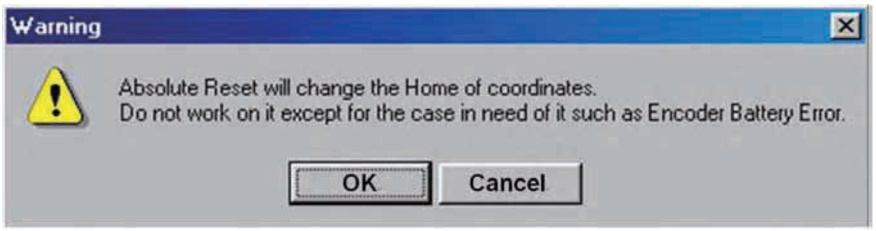


(7) From the [Monitor] menu, select [Detailed Error Information] to check the current error status. In the case of an encoder battery error, the following will be displayed (when axis 4 is using an absolute encoder). After checking the error status, close the [Detailed Error Information] window.

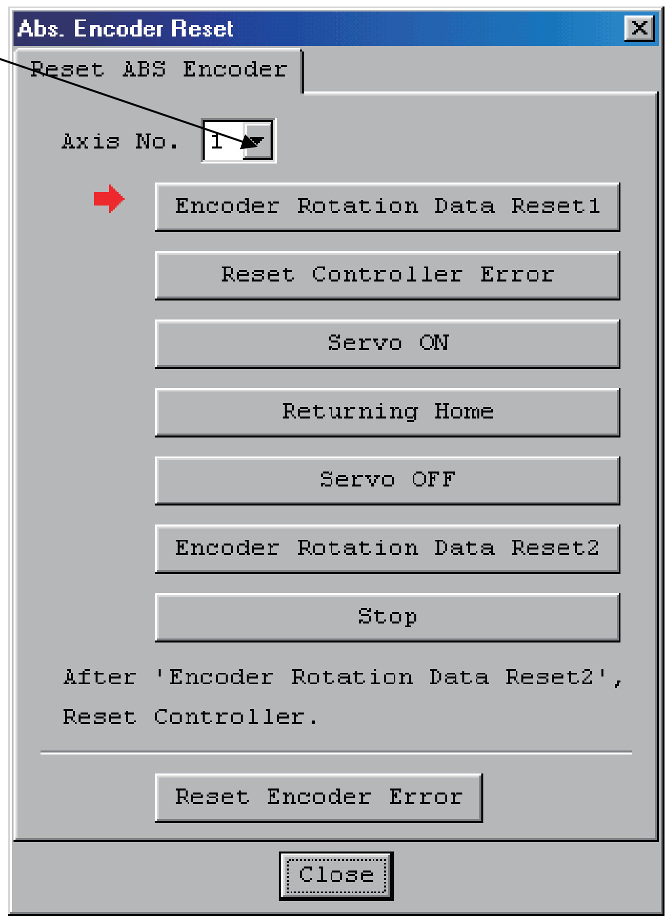


(8) From the [Controller (C)] menu, select [Absolute Reset (A)].

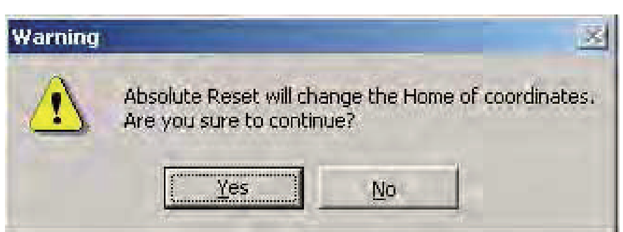
(9) When a [Warning] dialog box is displayed, click the [OK] button.



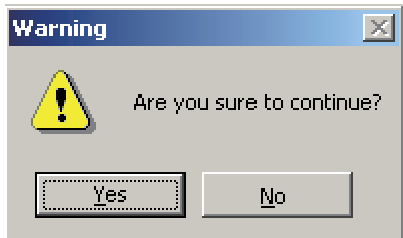
(10) The [Abs. Encoder Reset] dialog box will be displayed.
Click here to select the axis you wish to perform an absolute reset for.



(11) Clicking the [Encoder Rotation Data Reset 1] button will display a [Warning] dialog box. Click the [Yes] button.



(12) Another [Warning] dialog box will be displayed. Click the [Yes] button.



(13) When the processing of "encoder rotation data reset 1" is complete, the red arrow will move to the next item. Press the following processing buttons one by one (the red arrow will move to the next item when each process is completed):

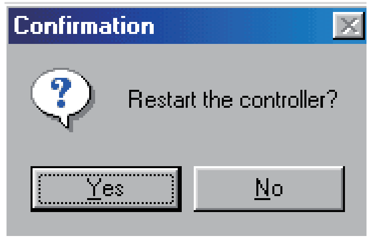
1. Reset Controller Error
2. Servo ON
3. Returning Home
4. Servo OFF
   Note: With PC software version 1.1.0.0 or later, encoder rotation data reset 2 will be performed while the servo is still ON. Accordingly the servo OFF step will be skipped.
5. Encoder Rotation Data Reset 2

When the processing of "encoder rotation data reset 2" is complete, the red arrow will return to the position in (10). If you are performing an absolute encoder reset for another axis, select the target axis and perform the steps after (10).
To close the [Abs. Encoder Reset] dialog box, click the [Close] button.

(Note) If you must perform an absolute encoder reset for multiple axes, always perform steps (10) through (13) for all axes before performing the software reset in step (14).

(14) From the [Controller (C)] menu, select [Software Reset (R)].

(15) When the [Confirmation] dialog box is displayed, click the [Yes] button and restart the controller.



(Note) Commencing the operation without first executing a software reset or reconnecting the power may generate the following errors:
Error No. C70: ABS coordinate non-confirmation error
Error No. C6F: Home-return incomplete error

(16) If no other error is present, the controller's 7-segment LED display will show "rdy."

(17) This completes the absolute encoder reset.
To redo the absolute encoder reset, exit the XSEL PC software and repeat the procedure from the beginning.

(Caution) On certain models, the current value may not return to "0" mm after an absolute encoder reset. However, this does not indicate any abnormality. Refer to the model list below for the coordinates to take effect after an absolute encoder reset.

Model	Lead	Current position after absolute encoder reset
RCS2-SA7C (R)	4	0
	8	1
	16	3
RCS2-SS7C (R)	6	-0.5
	12	1
RCS2-SS8C (R)	10	0
	20	2.5
	30	5
RCS2-RA5C (R)	4	0
	8	0
	16	2

* On all other models, the current value will return to "0" after an absolute encoder reset.

2. How to Perform Absolute Reset on ZR Unit (Absolute Type Only)

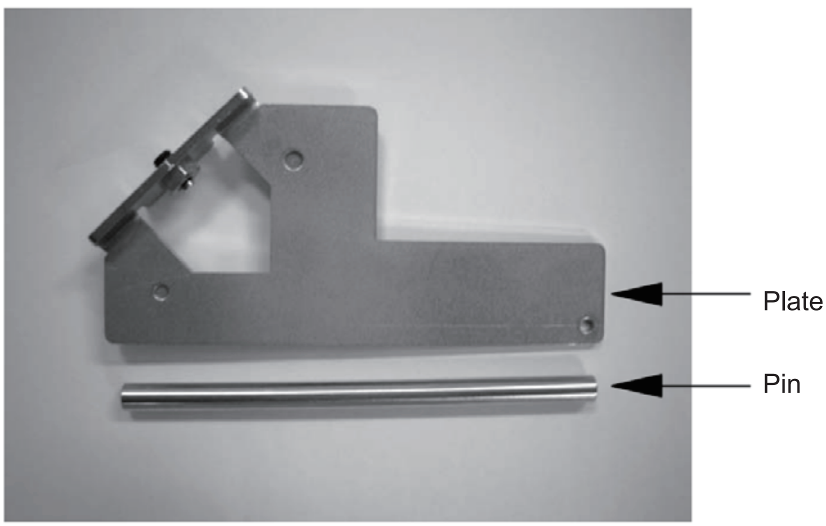
Under certain conditions such as when the ZR unit is connected to the controller for the first time, absolute encoder battery voltage is abnormal, or encoder cable has been disconnected, an encoder battery error will generate and absolute reset will be required.

2.1 Preparing for Absolute Reset

On the ZR unit, an absolute reset is performed from the ball-screw spline adjustment menu in the PC software (or on the teaching pendant). You also need a special jig to perform an absolute reset.

- Versions supporting absolute reset on ZR unit:
  PC software (IA-101-X-**) Ver. V7.4.0.0 or later
  Teaching pendant main application (IA-T - X/IA-T-XD) Ver. 1.5.0 or later
  Teaching pendant main application (SEL-T - SEL-TD) Ver. 1.0.9 or later

- Absolute-reset adjustment jig Model number:JG-ZRS (for ZRS)
  JG-ZRM (for ZRM)



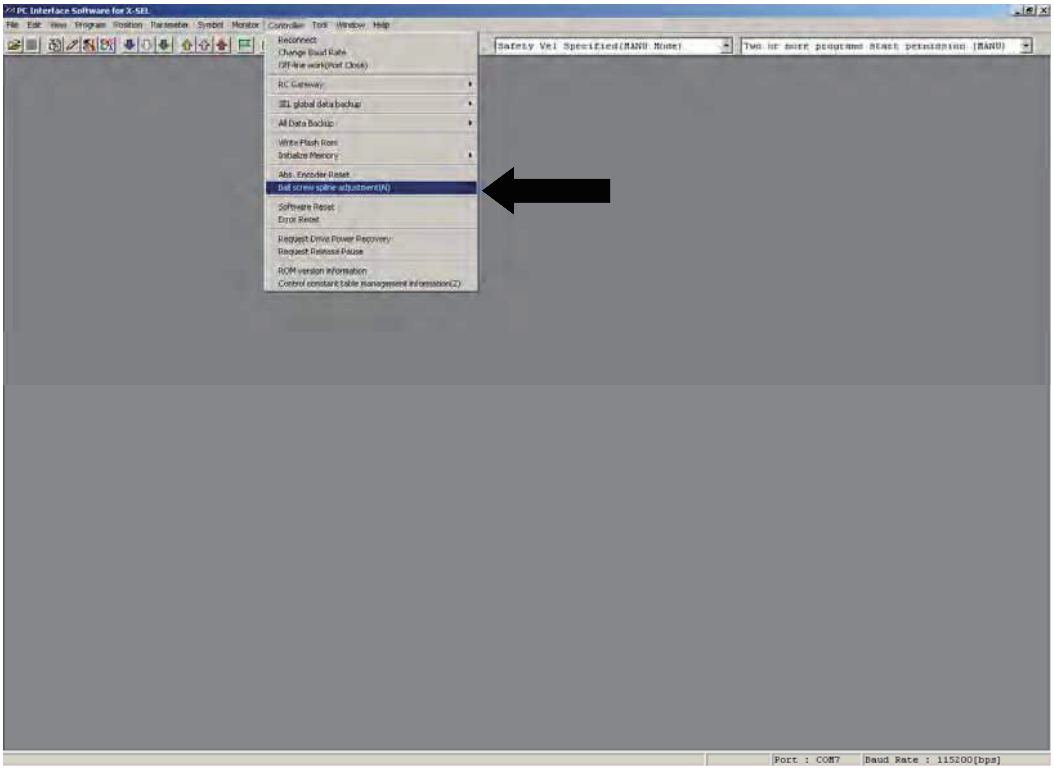
Connect the robot, controller and PC cable to enable operation from the PC software. Before proceeding, be sure to confirm that the EMG switch operates properly.

⚠Warning

- Carrying out any inspection or maintenance work without fully understanding the work may result in serious injury.
- Put up a sign that says “Work in Progress” so as to prevent other operators from accidentally operating the controller, operation panel, etc.
- Back up the parameters before the absolute reset.

2.2 Starting the Absolute Reset Menu (Ball-screw Spline Adjustment Window)

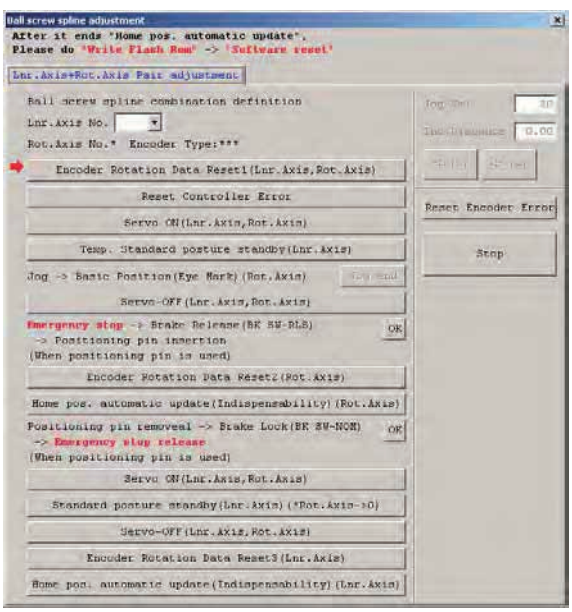
(1) Start the ball-screw spline adjustment window from the PC software.



(2) The ball-screw spline adjustment window starts.

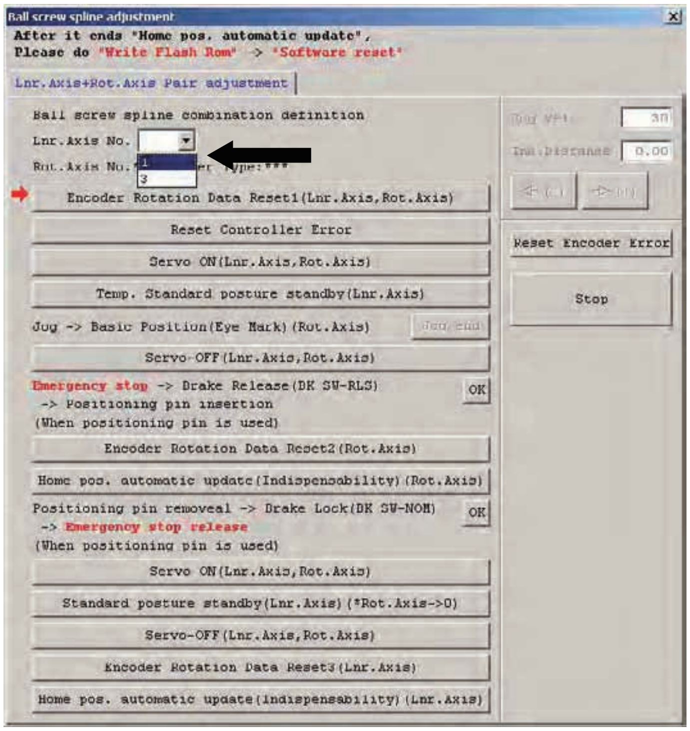
When a linear movement axis number is selected, “Rot. Axis No.” and “Encoder Type” are displayed.

- Ball-screw spline adjustment is performed using a linear movement axis and a rotational movement axis as a pair. Since the adjustment procedure includes items that require robot operation, confirm the range of operation of the actuator, absence of obstructions, etc., to make sure the robot can be operated.

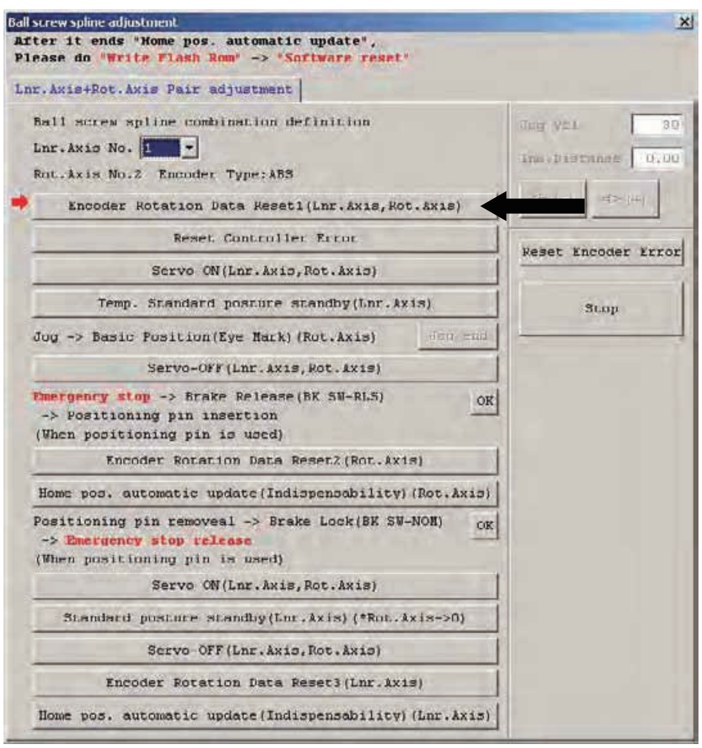


2.3 Absolute Reset (Ball-screw Spline Adjustment) Procedure

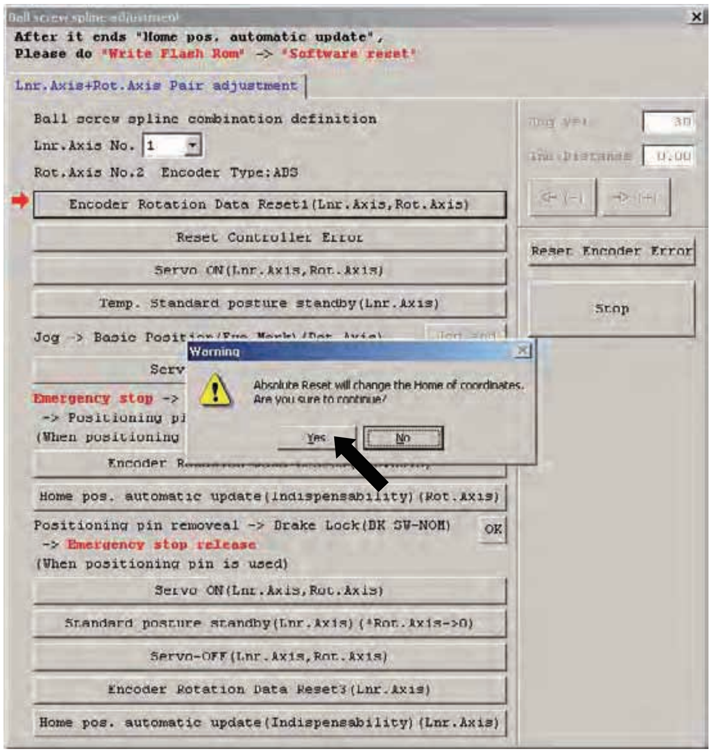
(1) Select a “Lnr. Axis No.” which will be used to perform an absolute reset (ball-screw spline adjustment).



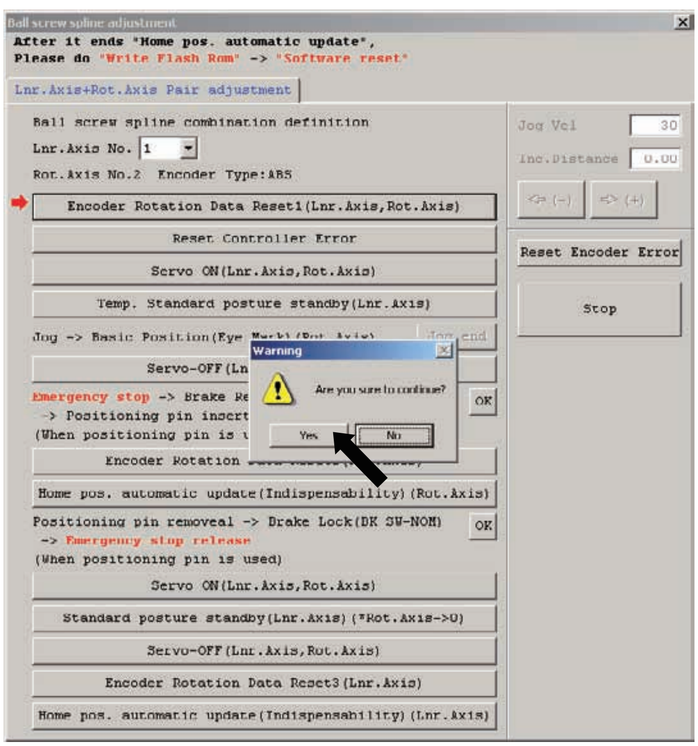
(2) Click the [Reset Rotation Data Reset 1 (Lnr. Axis, Rot. Axis)] button.



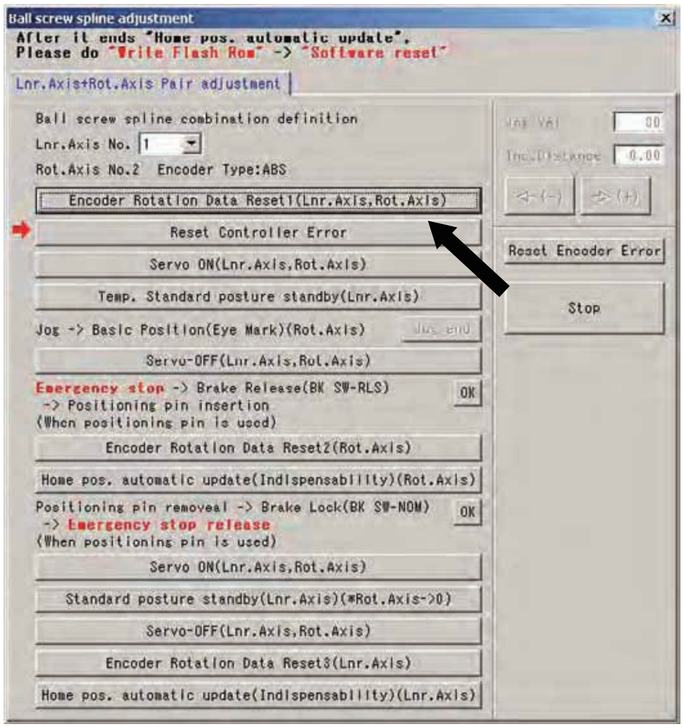
(3) When the dialog box appears, click the [Yes] button.



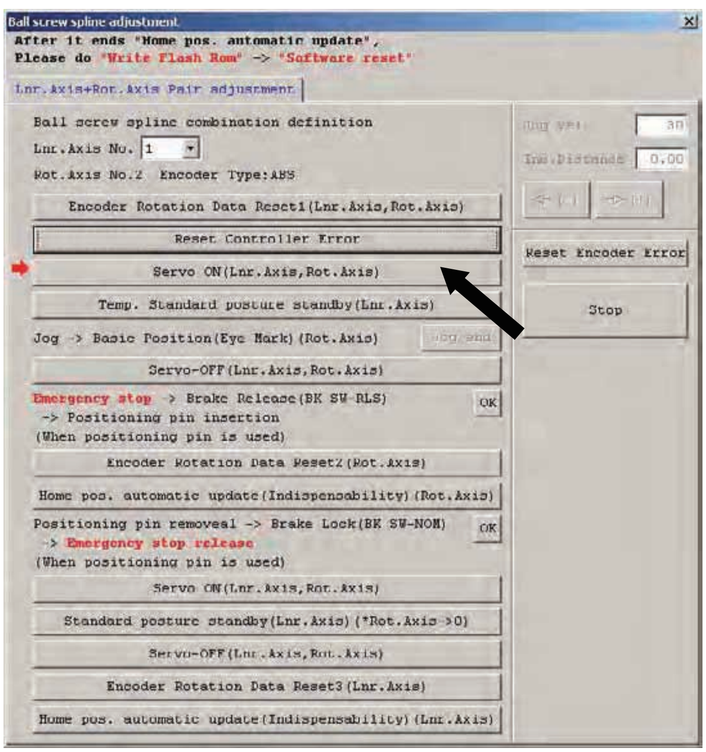
(4) When the dialog box appears, click the [Yes] button.



(5) Click the [Reset Controller Error] button.

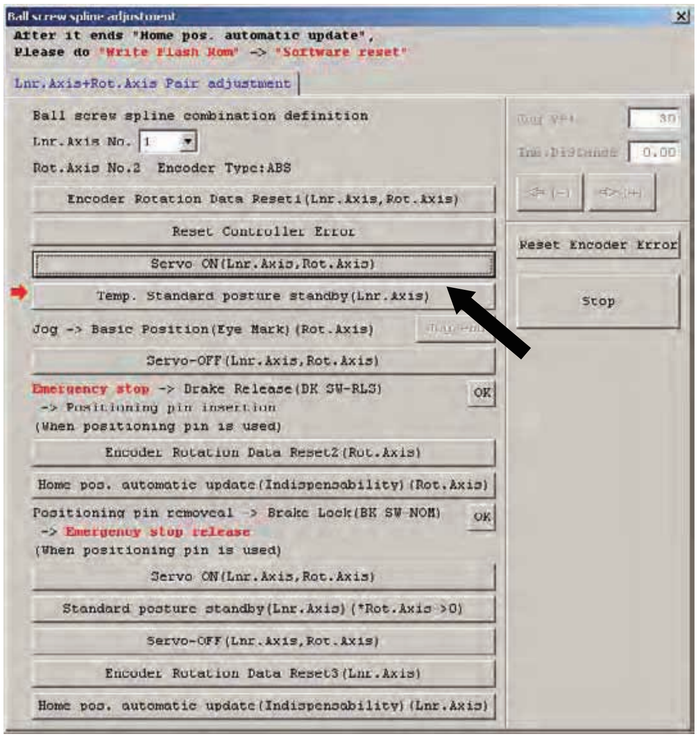


(6) Click the [Servo ON (Lnr. Axis, Rot. Axis)] button.



(7) Click the [Temp. Standard posture standby (Lnr. Axis)] button.

● Be careful because the linear movement axis (Z-axis) returns to its home.



(8) Jog the rotational movement axis (R-axis) to the reference posture position (refer to the illustration of reference posture), and then click the [Jog end] button.

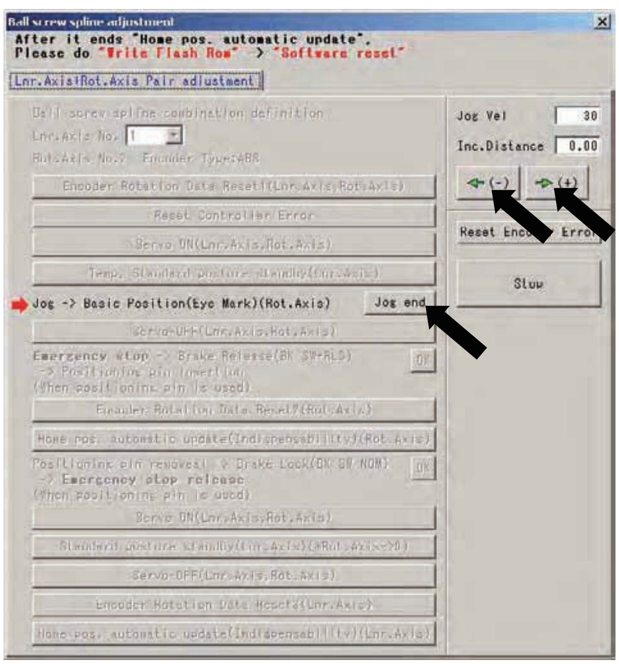
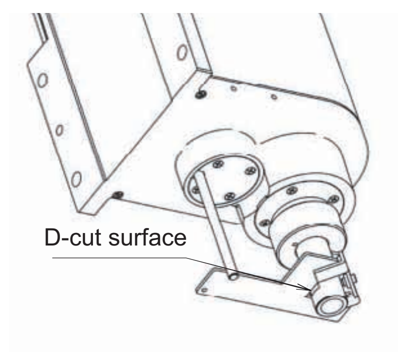
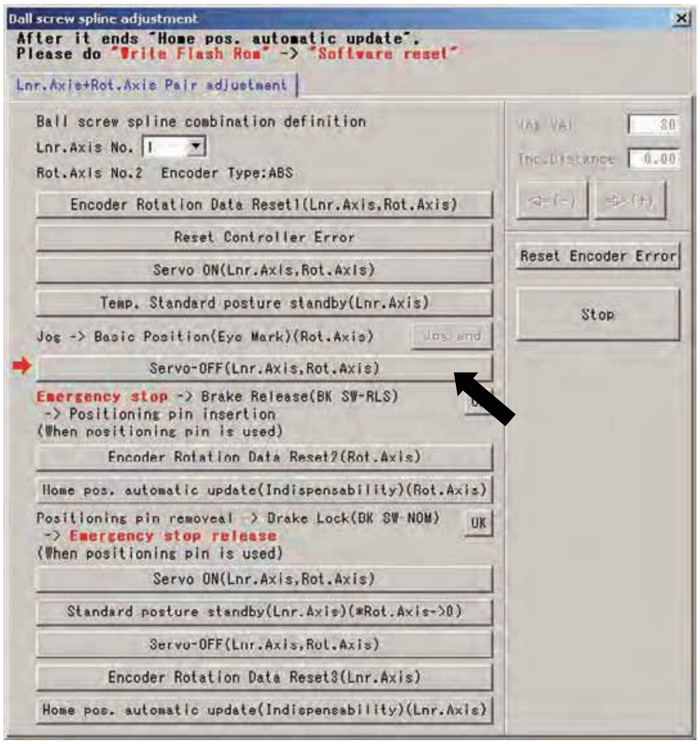


Illustration of reference posture

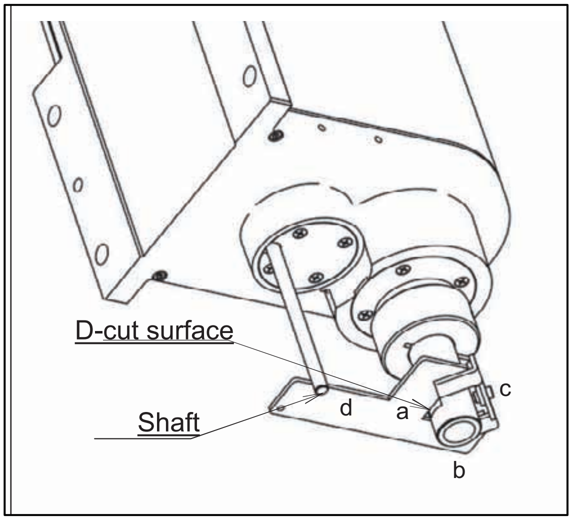


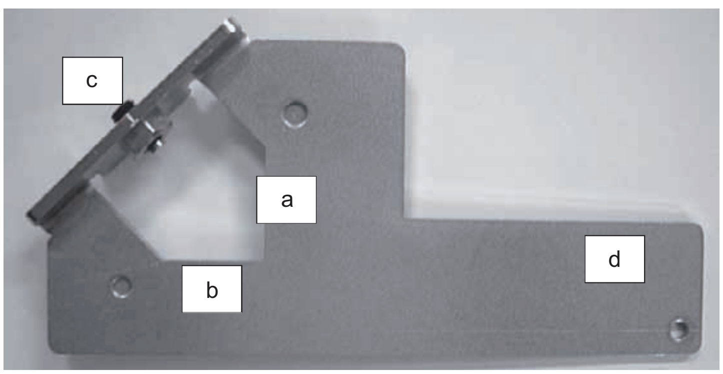
(9) Click the [Servo-OFF (Lnr. Axis, Rot. Axis)] button.



(10) Press the emergency stop switch (emergency stop button on the PC cable).
(11) Release the brake. Release the brake using the switch on the controller side.

(12) Set the plate and pin constituting the adjustment jig, as shown below, to affix the robot in the reference posture.





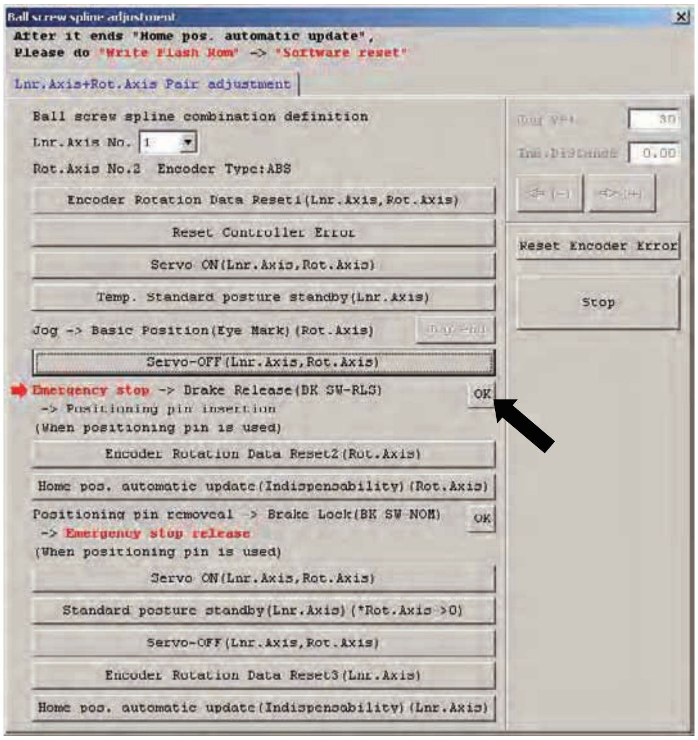
Installation method
[1] Insert the ball-screw spline into the hole in the jig from below.
[2] Cause the D-cut surface of the ball-screw spline to contact the surface a.
[3] Cause the side surface of the ball-screw spline to contact the surface b.
[4] Tighten the screw c to secure the jig onto the ball-screw spline.
- * At this time, confirm that the adjustment jig is vertical to the ball-screw spline and that the D-cut surface and surface a are firmly in contact.
- * Applicable screw: Hexagonal socket head setscrew M5
- * Tightening torque: 20 [N-cm] (reference)

[5] Insert the supplied shaft into the hole in the ZR unit.
- * Exercise caution because the shaft will come off if the hand is released.

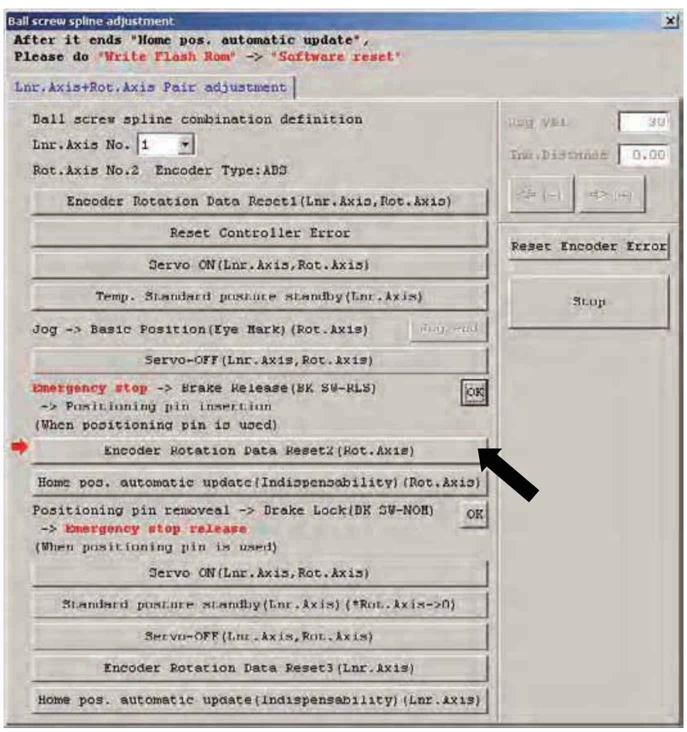
[6] Turn the ball-screw spline until the supplied shaft contacts lightly with the surface d of the jig.

⚠Warning
- Be sure to keep the emergency stop switch pressed while the adjustment jig is set. If not, the robot may malfunction and cause serious injury.

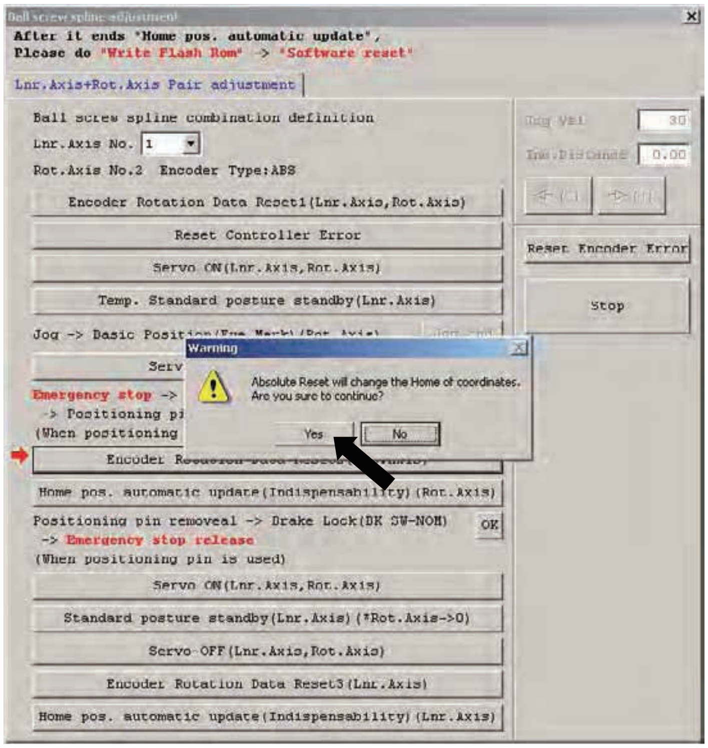
(13) Click the [OK] button.



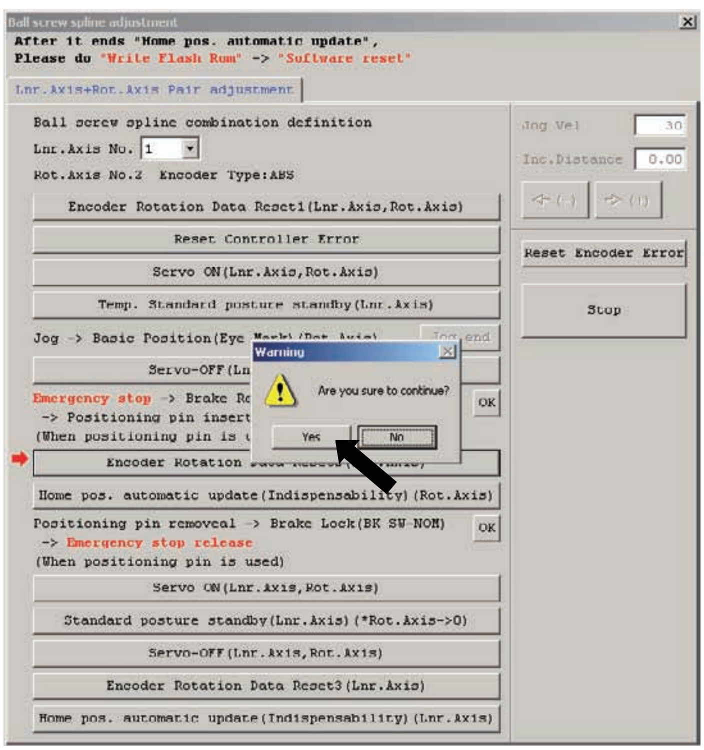
(14) Click the [Encoder Rotation Data Reset 2 (Rot. Axis)] button.



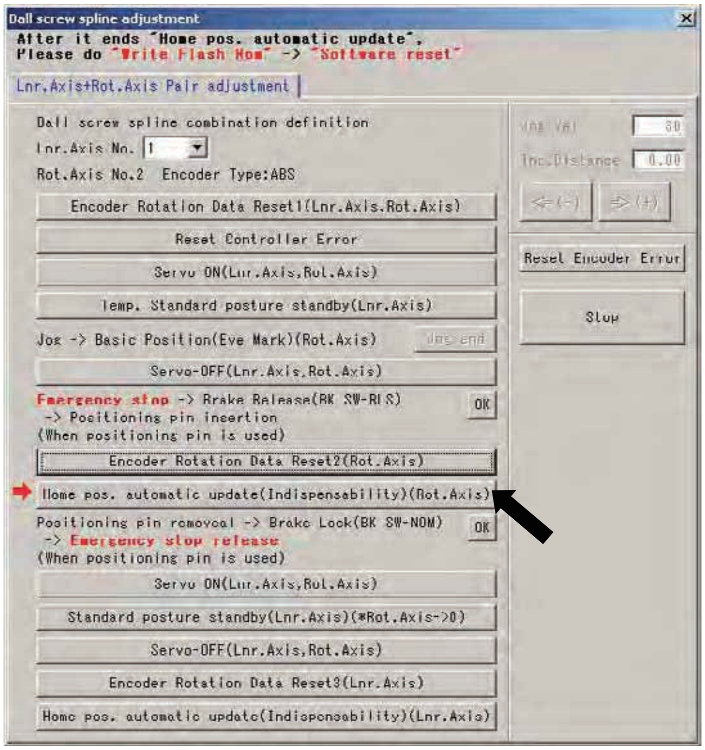
(15) When the dialog box appears, click the [Yes] button.



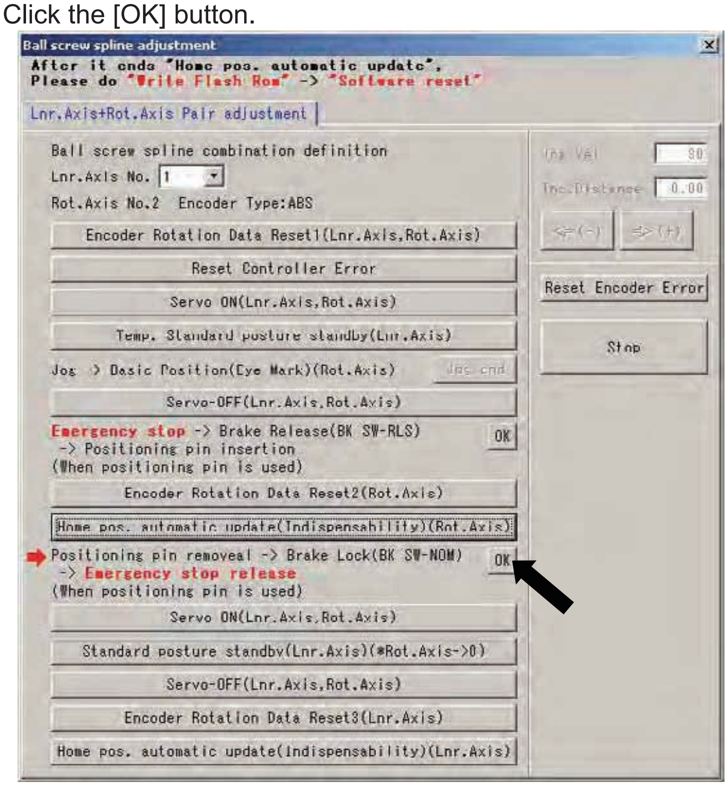
(16) When the dialog box appears, click the [Yes] button.



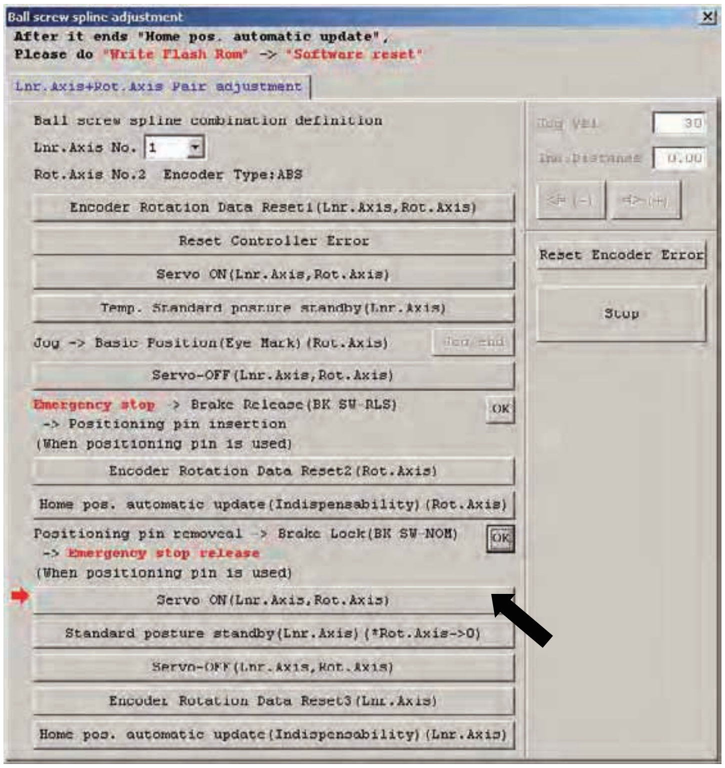
(17) Click the [Home pos. automatic update (Indispensability) (Rot. Axis)] button.



(18) Remove the adjustment jig.
(19) Lock the brake (on the front panel of the controller).
(20) Cancel the emergency stop (by releasing the emergency stop button on the PC cable).
(21) Click the [OK] button.

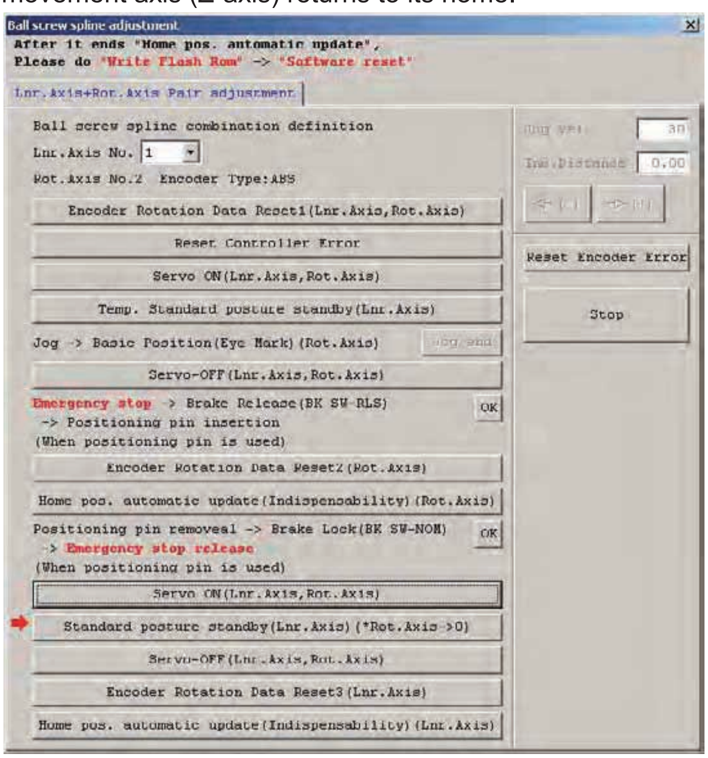


(22) Click the [Servo ON (Lnr. Axis, Rot. Axis)] button.

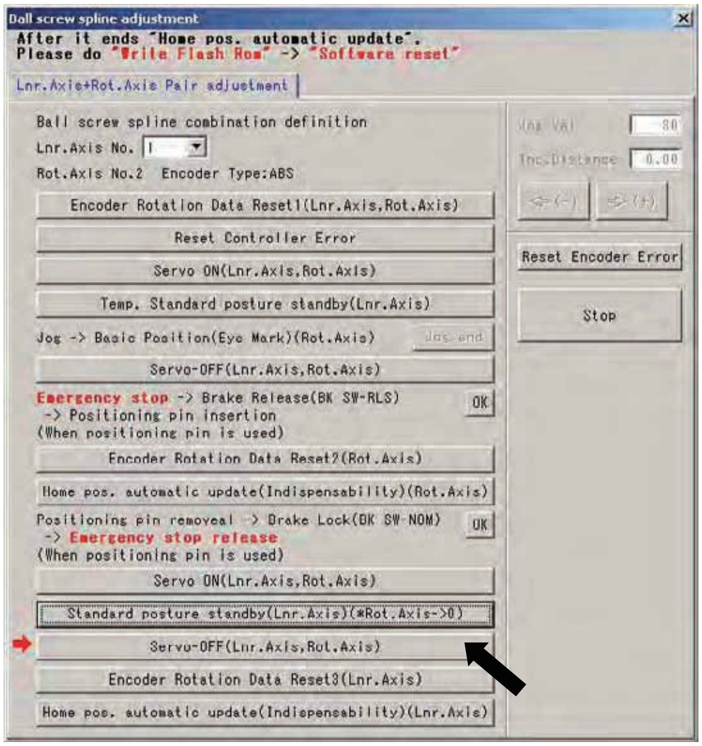


(23) Click the [Standard posture standby (Lnr. Axis) (*Rot. Axis → 0)] button.

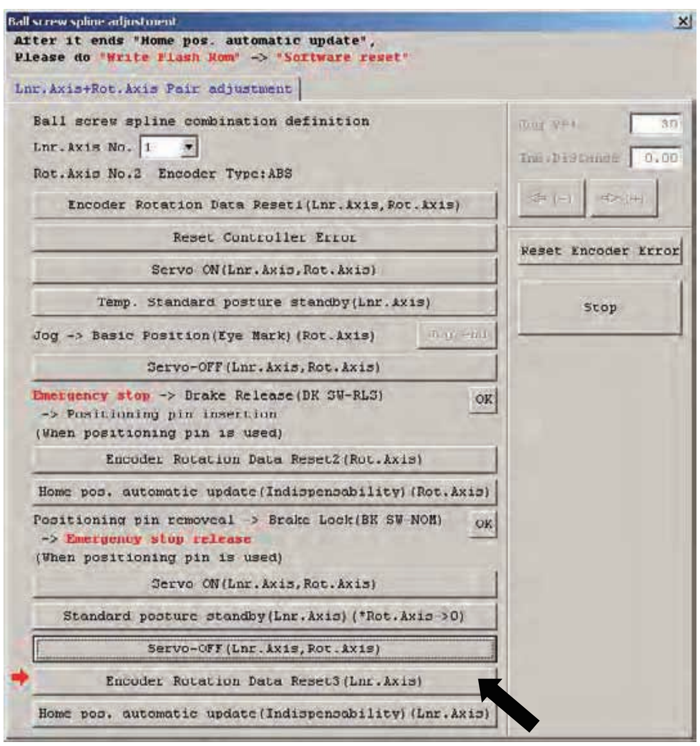
- Be careful because the rotational movement axis (R-axis) moves to the zero point and then the linear movement axis (Z-axis) returns to its home.



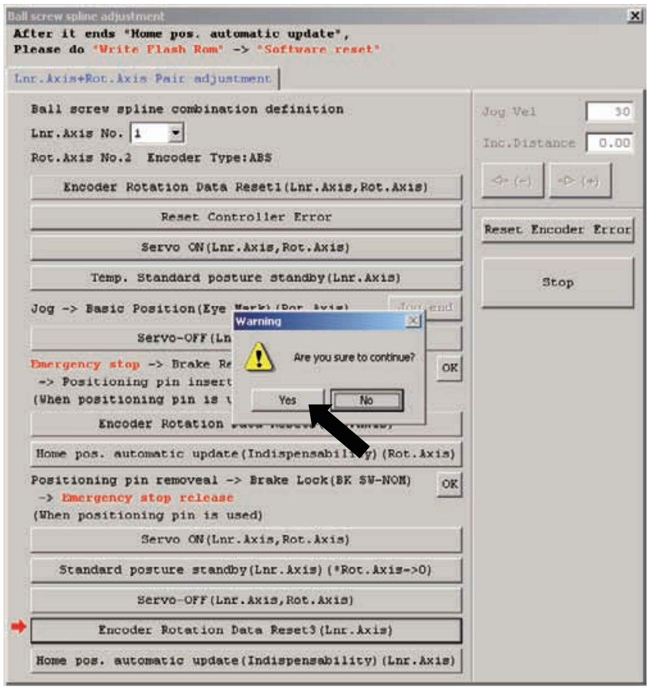
(24) Click the [Servo-OFF (Lnr. Axis, Rot. Axis)] button.



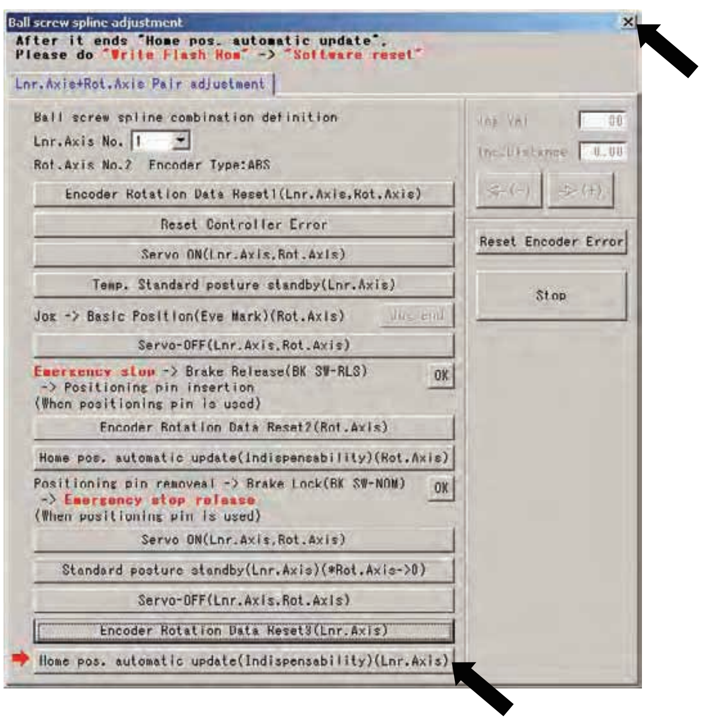
(25) Click the [Encoder Rotation Data Reset 3 (Lnr. Axis)] button.



(26) When the dialog box appears, click the [Yes] button.



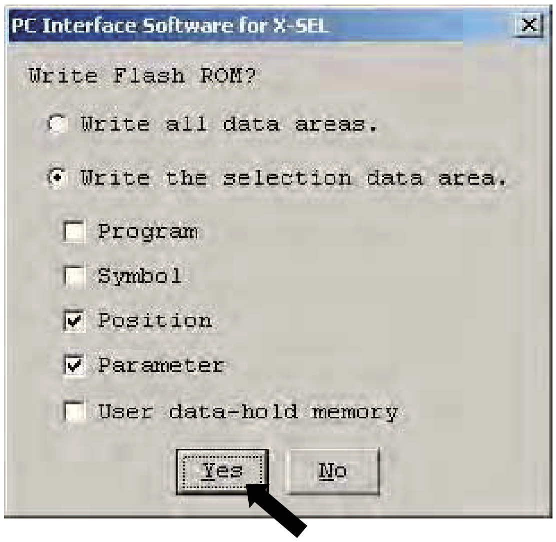
(27) Click the [Home pos. automatic update (Indispensability) (Lnr. Axis)] button, and then click “X” in the top right-hand corner of the window to close the window.



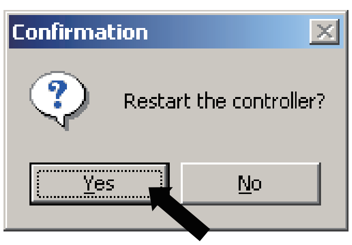
⚠Warning

- Take note that not following the work procedure correctly may result in position displacement.

(28) Closing the ball-screw spline adjustment window following the ball-screw spline adjustment opens the following screen. Click the [Yes] button.



(29) When all data has been written to the flash ROM, the following screen appears. Click the [Yes] button.



Chapter 9 Maintenance

- Routine maintenance and inspection are necessary so that the system will operate properly at all times. Be sure to turn off the power before performing maintenance or inspection.
- The standard inspection interval is six months to one year. If the environment warrants, however, the interval should be shortened.

1. Inspection Points

- Check to see if the supply voltage to the controller is inside the specified range.
- Inspect the ventilation holes in the controller and remove dirt, dust and other foreign attachments, if any.
- Inspect the controller cables (controller → actuator) and check for any loose screws or cable disconnection.
- Check the controller mounting screws, etc., for looseness.
- Inspect each cable (axis link cable, general-purpose I/O cable, system I/O cable, power cable) for loose connection, disconnection, play, etc.

2. Spare Consumable Parts

Without spare parts, a failed controller cannot be repaired even when the problem is identified quickly. We recommend that you keep the following consumable parts as spares:

Consumable parts
- Cables
- System-memory backup battery: CR2032 (Note 1) --- Must be replaced after approx. 1.5 years* (Note 2)
- Absolute-data backup battery: AB-5 by IAI --- Must be replaced after approx. 2 years* (Note 2) (Absolute specification)
- Fuses

(Note 1) CR2032 is a standardized product and can be used with products by any manufacture.
(Note 2) The actual replacement timing will vary depending on the use condition. For details, refer to "⊙ Battery Backup Function" in Appendix.

Memory backup
The XSEL Controller saves program, position and parameter data to its flash memory (when written to the flash memory). The data saved by the battery includes position data, SEL global data, error list and content of the user-data backup memory in the controller with expanded memory (with gateway function).
(Refer to Chapter 1, "How to Save Data," of Part 3.)

Caution

In the case of a controller with expanded memory (with gateway function), only positions from Nos. 1 to 10000 can be saved in the system memory.
To save position data from Nos. 10001 to 20000, the data must be written to the flash ROM.

When the battery voltage drops, an applicable error code will be displayed on the panel window.

Error Codes Indicating Low Battery Voltage

System-memory backup battery	A01 or A02
Absolute-data backup battery	A03 or A23

In the case of a low battery voltage of the absolute-data backup battery, the axis-driver status LED will also illuminate.

3. Replacement Procedure for System-Memory Backup Battery

Backing up the system memory
If "Other parameter No. 20, Backup-battery installation function type" is set to "2" (installed), the following SRAM data in the XSEL Controller will be backed up by the system-memory backup battery on the panel board:

- Position data (positions from Nos. 1 to 10000 in the case of a controller with expanded memory (with gateway function))
- SEL global data (flags, integer/real variables, string variables)
- Error lists
- Content of the user-data backup memory in the controller with expanded memory (with gateway function).

Therefore, the above SRAM data will be destroyed if the system-memory backup battery is removed when "Other parameter No. 20, Backup-battery installation function type" is set to "2" (installed). For this reason, always follow the procedure below when replacing the system-memory backup battery:

(1) Turn on the controller power.

(2) Record (write down) the current setting of "Other parameter No. 20, Backup-battery installation function type." (This will be used when reverting the parameter to its original setting following the replacement of system-memory backup battery.)

(3) If the PC software is installed in your PC, save the position data to a file using the PC software. The data will be used as a backup in case the SRAM data saved to the flash ROM fails.

(4) Change "Other parameter No. 20, Backup-battery installation function type" to "1" and transfer the setting to the controller, and then perform a flash ROM write. (The point data will be saved to the flash ROM.)

* Confirm that the flash ROM writing process has completed.

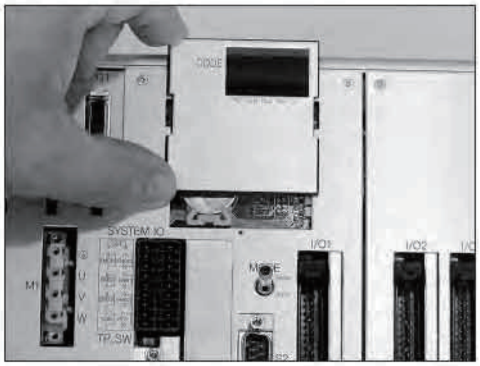
(5) Perform a software reset to restart the controller. (The SEL global data and error lists will be saved to the special area in the flash ROM.)

(6) When the controller has been restarted, turn off the power.

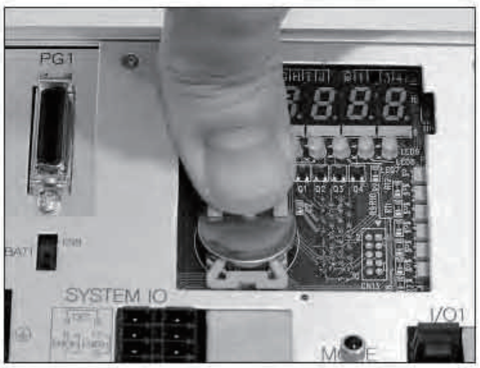
* Once the controller has been restarted, be sure to keep the power on until the initialization sequence number is no longer displayed on the panel window (while "InXX" is displayed following "8888"; XX indicates a number).

(7) Replace the system-memory backup battery. (SRAM data will be destroyed if steps (1) through (6) are not performed properly.)

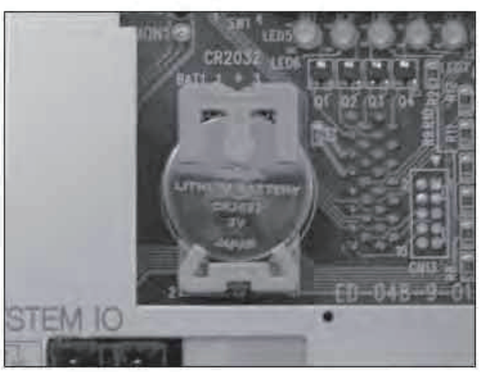
Battery Replacement Procedure



1) Remove the 7-segment LED panel from the controller. Slide the panel upward and pull it toward you to remove.



2) Press the center of the battery using a finger, as shown. The battery will come off from the holder.



3) Install a new battery into the holder. Pay attention to the polarities (the + mark should be facing you).

4) Install the panel in the original position.

(8) When the replacement of system-memory backup battery is complete, confirm that the battery is installed securely and then turn on the controller power.

(9) Revert “Other parameter No. 20, Backup-battery installation function type” to the value recorded in step 2, transfer the setting to the controller, and then perform a flash ROM write.

* Confirm that the flash ROM writing process has completed.

(10) Perform a software reset (restart the controller).
(Note) Commencing the operation without first executing a software reset or reconnecting the power may generate the following errors:
Error No. C70: ABS coordinate non-confirmation error
Error No. C6F: Home-return incomplete error

(11) When the controller has been restarted, confirm that the SRAM data have been restored.

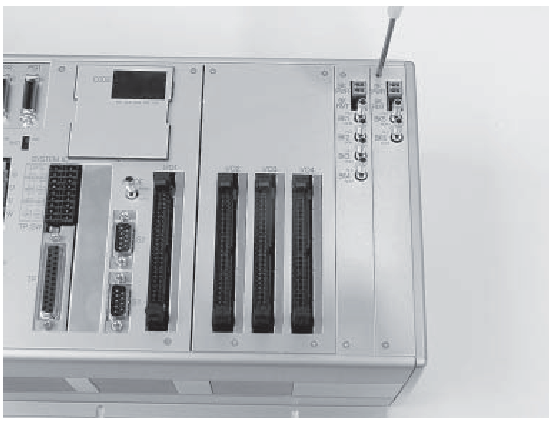
4. Replacement Procedure for Absolute-Data Backup Battery

The replacement procedure will vary depending on if errors are present at the time of replacement and if so, which errors are present (No.A23, 914, CA2).

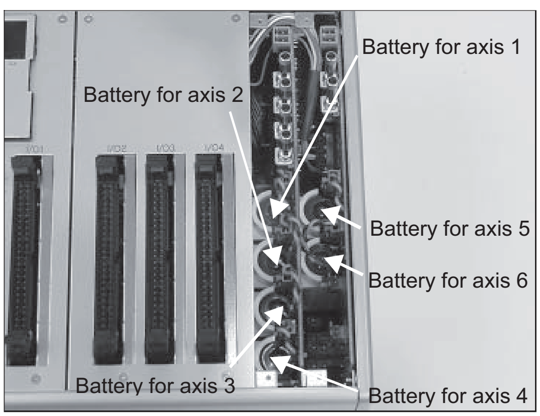
- If no error is present, perform steps (1) to (8).
- If an absolute-data backup battery voltage-low warning (error No. A23) is present, perform steps (1) to (15).
- If an absolute-data backup battery voltage error (error No. 914 or CA2) is present, perform steps (1) to (8), and then perform an absolute encoder reset by referring to Chapter 8, "How to Perform An Absolute Encoder Reset."

Note: Of the following steps, complete steps (3) to (6) within 15 minutes.

(1) Turn off the controller power (both the control power and drive power).

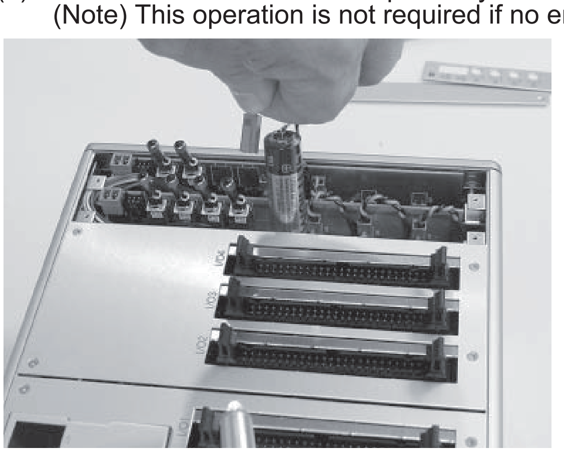


(2) Remove screws attaching the brake switch panel, and take out the panel.



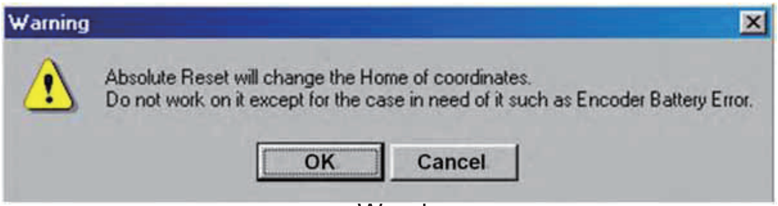
(3) Remove the applicable battery connector and pull out the battery.

(4) Set the absolute-data backup battery enable/disable switch to the bottom position.
(Note) This operation is not required if no error has generated or when an A23 error has generated.



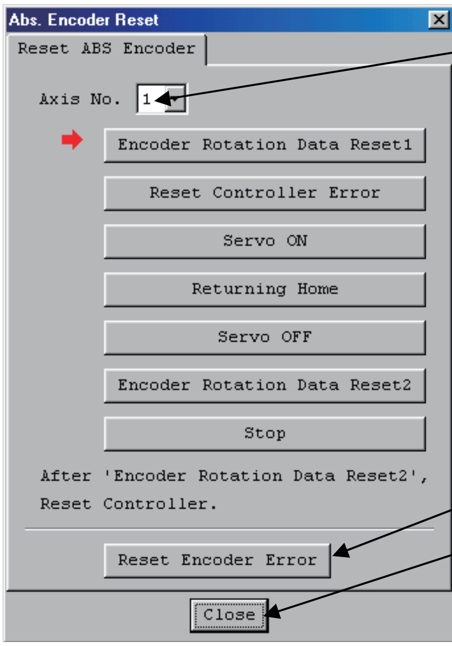
(5) Insert a new battery into the holder and plug in the battery connector.

(6) Turn on the controller power.
(7) Set the absolute-data backup battery enable/disable switch to the top (ENB) position.
(Note) This operation is not required if no error has generated or when an A23 error has generated.
(8) Turn off the controller power and install the brake switch panel with the screws. When the switch panel has been installed, turn on the power.
(9) Start the PC software online. From the [Controller (C)] menu, select [Absolute Reset (A)].
(10) When a [Warning] dialog box is displayed, click the [OK] button.



Warning

(11) The [Abs. Encoder Reset] dialog box will be displayed.

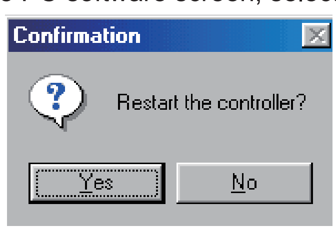


(12) For Axis No., select the number of the axis for which you have just replaced the battery.
Note) Do not click the [Encoder Rotation Data Reset 1] button.

(13) Click the [Reset Encoder Error] button.

(14) Close the dialog box.

(15) From the [Controller (C)] menu on the PC software screen, select [Software Reset (R)], and restart the controller.



Confirmation

(Note) Commencing the operation without first executing a software reset or reconnecting the power may generate the following errors:
Error No. C70: ABS coordinate non-confirmation error
Error No. C6F: Home-return incomplete error

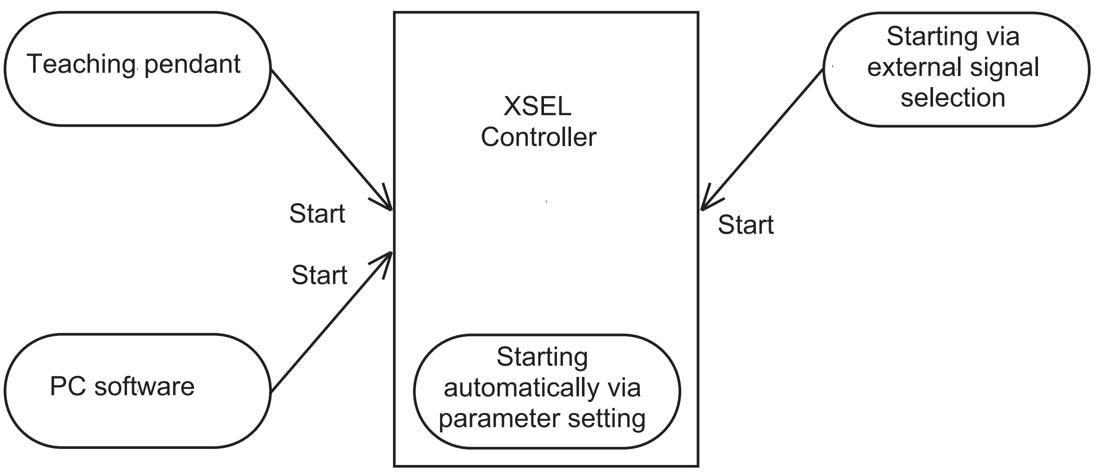
This completes the reset procedure following a battery-voltage low warning.

Part 2 Operation

Chapter 1 Operation

How to Start a Program

With the XSEL Controller, the stored programs can be started (run) using four methods. Of these methods, two are mainly used to debug programs or perform trial operations, while the remaining two are used in general applications on site.
The former two methods are "starting from the teaching pendant" and "starting from the PC software."
These methods provide simple means of checking the operation. For details on "starting from the teaching pendant," read the operation manual for the optional teaching pendant. For "starting from the PC software," read the applicable explanation in the manual supplied with the PC software.
The latter two methods are "starting automatically via parameter setting" and "starting via external signal selection." This chapter only explains the methods for "starting automatically via parameter setting" and "starting via external signal selection."



1. Starting a Program by Auto-Start via Parameter Setting

I/O parameter No. 33 (input function selection 003) = 1 (default factory setting)

This parameter is set using the teaching pendant or PC software.

Set an auto-start program number

Set the number of the program you wish to start automatically in other parameter No. 1 (auto-start program number).
Set the controller mode to AUTO.

⇩

Reset the controller

Reconnect the power, and the controller will be reset.

⇩

Automatically starting the program

Once the controller is reset in the above step, the program of the set number will start automatically.
*

Caution

[Note on starting a program by auto-start]
The automatic operation will begin immediately after the controller is reset, so the user may be surprised by unexpected movements of the equipment, particularly those caused by a sudden activation of the servo actuator. To ensure safety, always provide an interlocking function, such as allowing the program execution to proceed only after receiving a confirmation signal at the beginning of the program.

If you wish to start multiple programs at the same time, write multiple “EXPG” commands at the beginning of the main program to start the remaining programs. Provide safety measures for each program to be started.

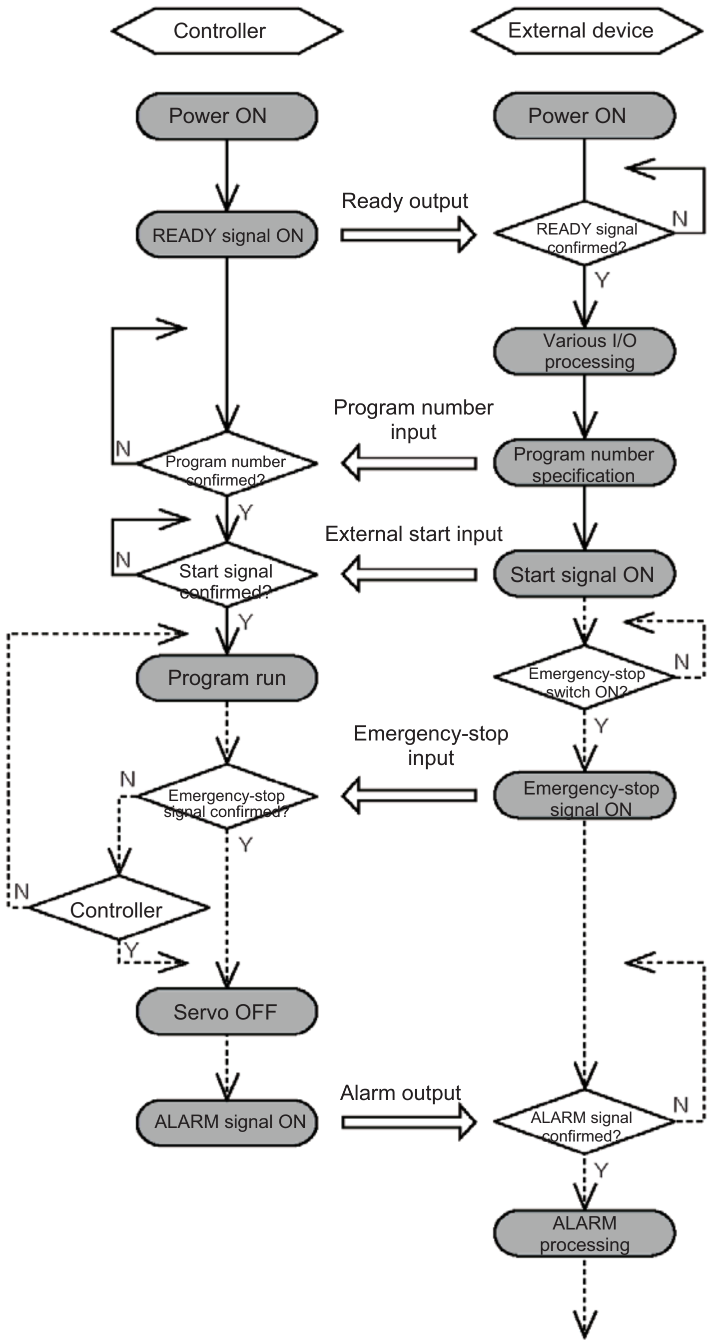
* When I/O parameter No. 33 is set to “2”
The program of the selected number will start automatically at the ON edge of input signal received by input port No. 3.
The program will be terminated at the OFF edge.

[Caution for when inputting and cancelling EMG (emergency stop)]
When EMG is input, the program in operation will stop and the servo will turn OFF.
Even if EMG is cancelled afterwards, the auto start program would not start.
To start the program, set I/O Parameter No. 31 (Input Function Select) = 1, and input the signal to Input Port 000.

2. Starting via External Signal Selection

Select a desired program number externally and then input a start signal.

(1) Flow chart



When the READY signal turns ON, the RDY lamp (green) on the controller front panel will illuminate.

Input a desired program number as a BCD code from the external device.

Input a start signal from the external device.

When the program is run, the number of the started program will be shown in the CODE display area of the controller front panel.

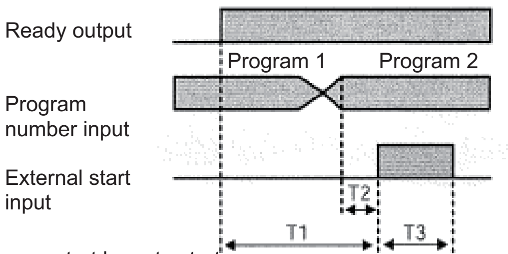
If an emergency-stop signal was input from the external device or a controller error occurred, the controller will turn off the servo power. (The RDY lamp will turn off.)

*1 By setting I/O parameter 30 (input function selection 000) to "2," you can input program numbers using binary codes. (The factory setting is "1," which indicates BCD code specification.)

Note: In the case of a controller with expanded memory (with gateway function), up to 128 programs can be stored. However, only program Nos. 1 to 79 can be started by BCD code specification. To start program Nos. 80 to 128 using BCD codes, use the auto program start function or program start command "EXPG."

(2) Timing chart

[1] Program start

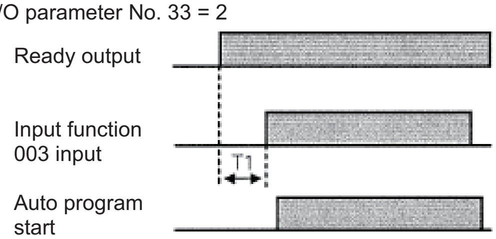


T1: Duration after the ready output turns ON until input of external start signal is permitted
T1 = 10 msec min.

T2: Duration after the program number is input until input of external start signal is permitted
T2 = 50 msec min.

T3: Input duration of external start signal
T3 = 100 msec min.

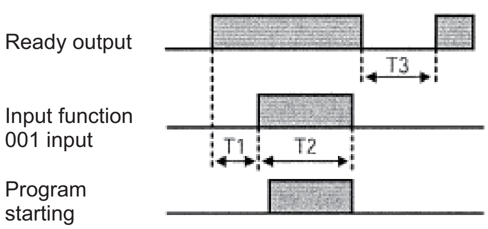
[2] Program start by auto start
* I/O parameter No. 33 = 2



T1: Duration after the ready output turns ON until input of input function 003 is permitted
T1 = 10 msec min.

* Auto program start:
Set the program you want to start automatically as the auto start program number in other parameter No. 1.

[3] Software reset signal
* I/O parameter No. 31 = 1

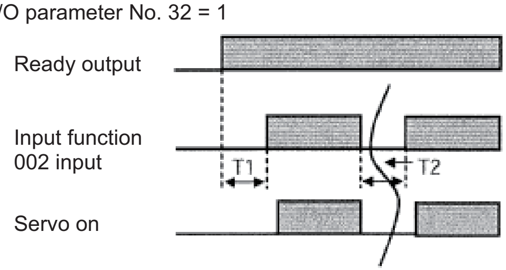


T1: Duration after the ready output turns ON until input of input function 001 is permitted
T1 = 10 msec min.

T2: Time before the software reset signal starts functioning
T2 = 1 sec min.

T3: Duration after the software reset signal is reset until the ready signal is output

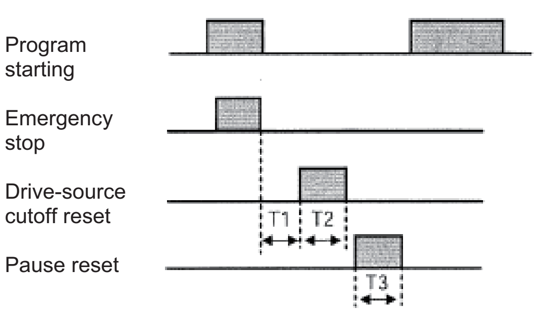
[4] Servo on signal
* I/O parameter No. 32 = 1



T1: Duration after the ready output turns ON until input of input function 002 is permitted
T1 = 10 msec min.

T2: Interval after the servo is turned off until the servo is turned on again
T2 = 1.5 sec min.

[5] When the recovery type after emergency stop or enable action is set to "Continued operation"
* Other parameter No. 10 = 2
Set I/O parameter No. 35 to "1" (Operation-pause reset signal)
Set I/O parameter No. 44 to "1" (Drive-source cutoff reset input)



T1: Duration after the emergency-stop input is reset until input of drive-source cutoff reset signal is permitted
T1 = 2 sec min.

T2: Drive-source cutoff reset input duration
T2 = 10 msec min.

T3: Pause reset input duration
T3 = 10 msec min.

3. Drive-Source Recovery Request and Operation-Pause Reset Request

(1) Drive-source recovery request

1) How to request a drive-source recovery

A drive-source recovery request can be issued using one of the following methods:

- Set I/O parameter No. 44 to “1” (Input selection function 014 = Drive-source cutoff reset input), then input the ON edge to input port No. 14.
- Select [Drive-Source Recovery Request (P)] from the [Controller (C)] menu on the PC software screen.
- Select Ctl (controller operation) and RPwr (drive-source recovery request) on the mode selection screen of the teaching pendant.

2) Case where a drive-source request is required

A drive-source recovery request is required in the following case:

- A drive-source cutoff factor occurred when I/O parameter No. 44 was set to “1” → Recovery after the cutoff factor is removed.

(2) Operation-pause reset request

1) How to request an operation-pause reset

An operation-pause reset request can be issued using one of the following methods:

- Set I/O parameter No. 35 to “1” (Input selection function 005 = Operation-pause reset signal), then input the ON edge to input port No. 5.
- Select [Operation-Pause Reset Request (L)] from the [Controller (C)] menu on the PC software screen.
- Select Ctl (controller operation) and RAct (operation-pause reset request) on the mode selection screen of the teaching pendant.

2) Cases where an operation-pause reset request is required

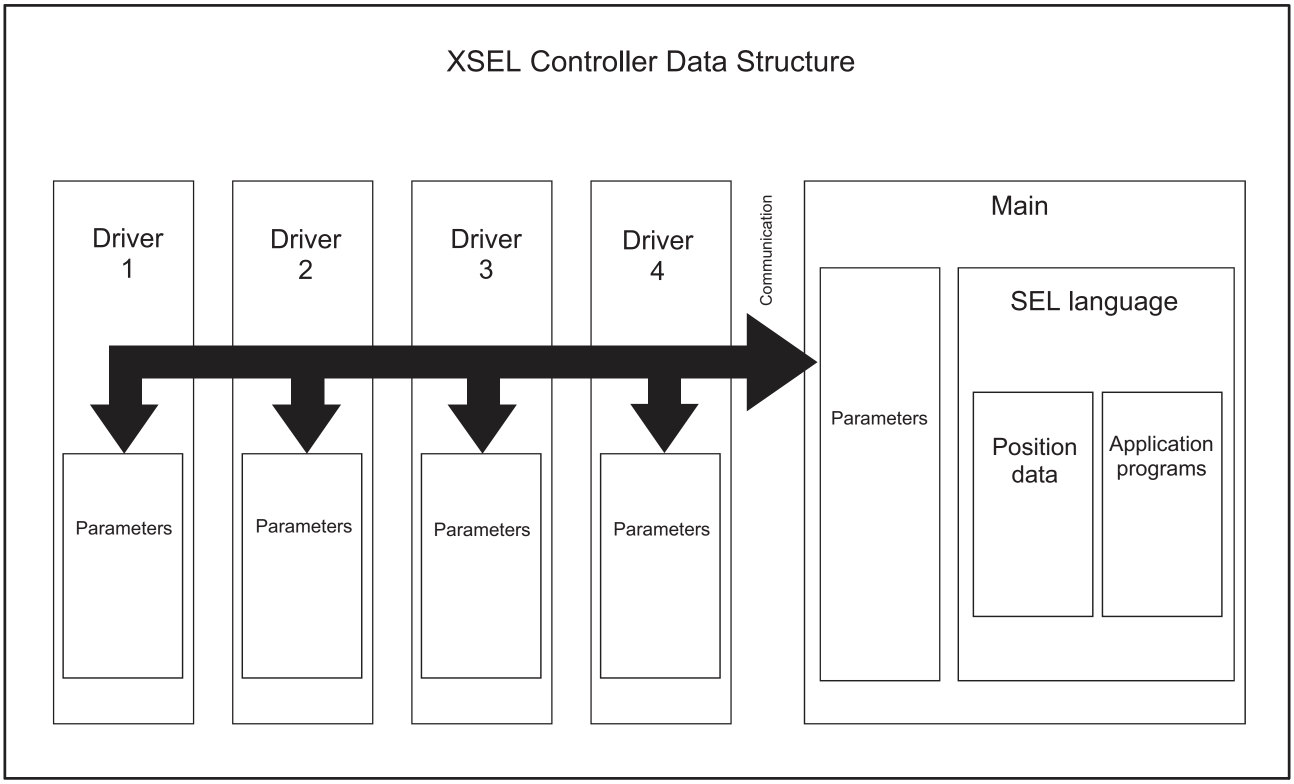
An operation-pause reset request is required in any of the following cases:

- An emergency stop was actuated during automatic operation when other parameter No. 10 was set to “2” (Emergency-stop recovery type = Continued operation) (only during automatic operation) → Recovery (reset of operation pause) after the emergency stop is reset.
- The automatic operation was stopped using the deadman switch or enable switch when other parameter No. 11 was set to “2” (Deadman/enable switch recovery type = Continued operation) (only during automatic operation) → Recovery (reset of operation pause) after the stop is reset.
- An OFF-level input signal was received by input port No. 6 when I/O parameter No. 36 was set to “1” (Input selection function 006 = Operation-pause signal) → Recovery (reset of operation pause) after an ON-level input signal is received by input port No. 6.

* If the case in 2 of (1) and any of the cases in 2 of (2) are present at the same time, a drive-source recovery request must be issued first, followed by an operation-pause reset request.

Part 3 Controller Data Structure

The controller data consists of parameters as well as position data and application programs used to implement SEL language.



The user must create position data and application programs. The parameters are predefined, but their settings can be changed in accordance with the user's system.
Refer to Appendix, "List of Parameters," for details on the parameters.

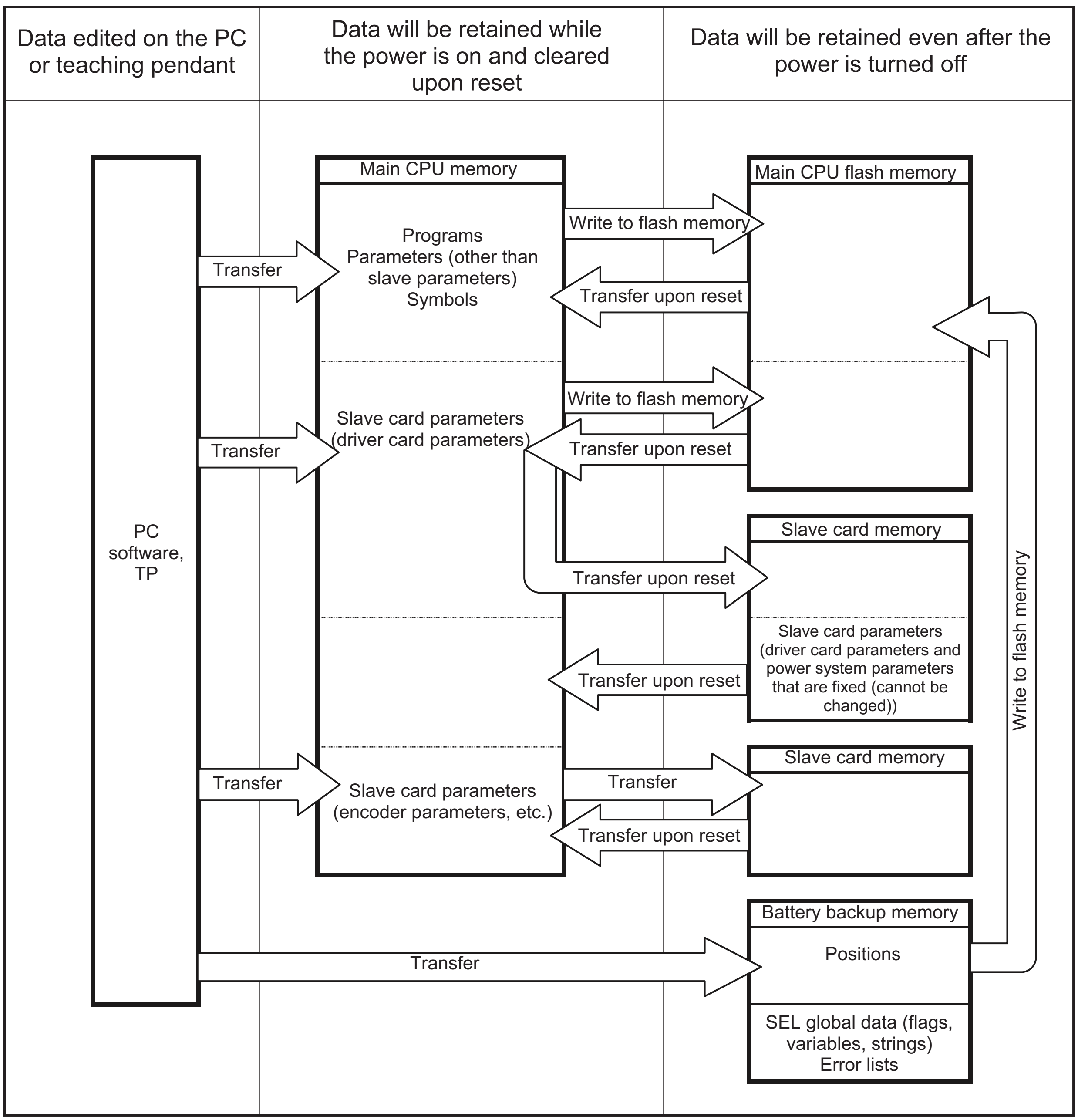
Chapter 1 How to Save Data

Since the XSEL Controller uses flash memory, some data are saved by battery backup while others are saved in the flash memory.
When data is transferred from the PC software or teaching pendant to the controller, the data is only written to the main CPU memory as shown in the diagram below and will be erased once the controller is powered down or reset.
For important data, always write to the flash memory so that they will not be lost.

1. Factory Settings: When the System-Memory Backup Battery is Used

1.1 Controller without Expanded Memory

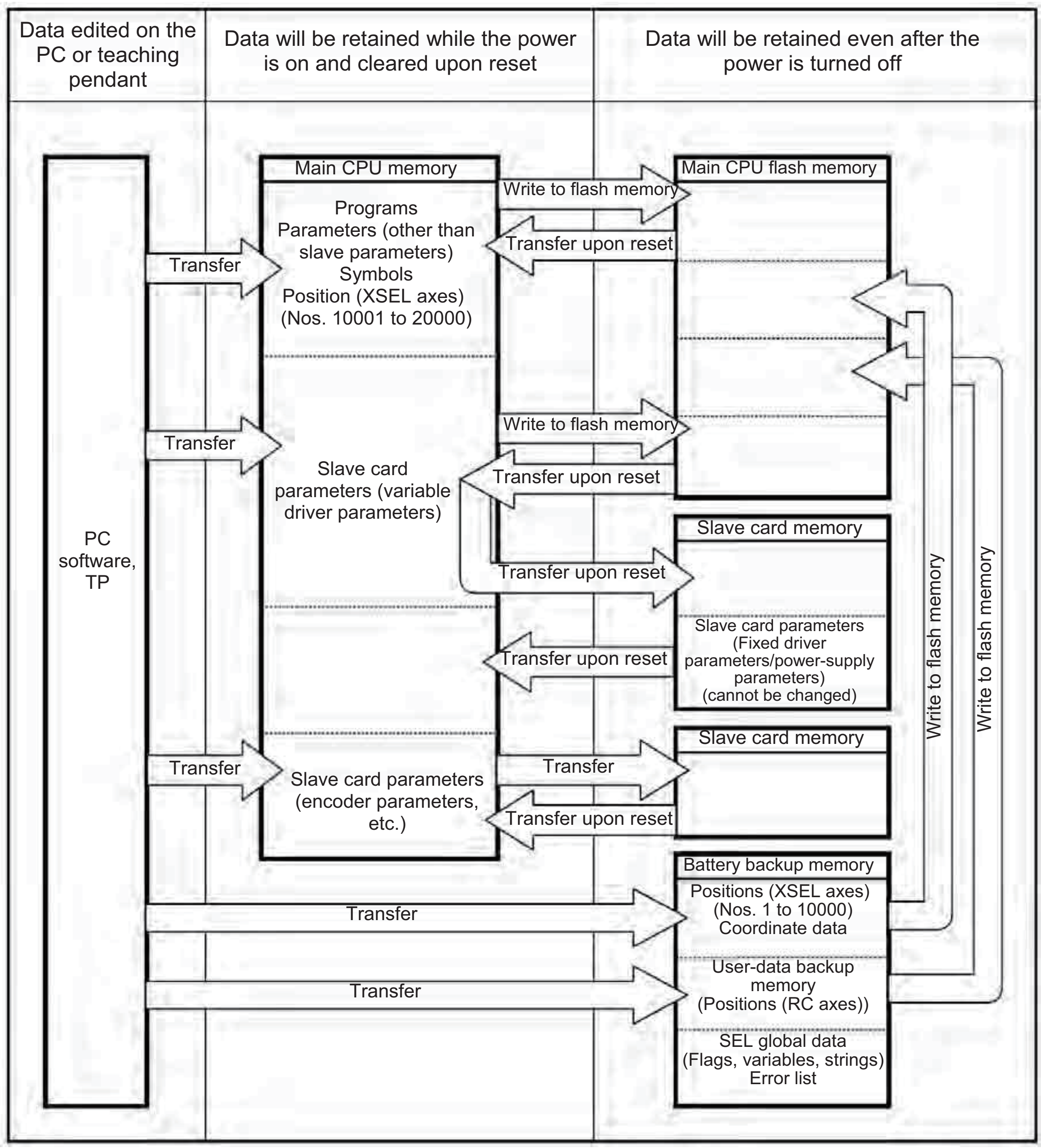
(Other parameter No. 20 = 2 (System-memory backup battery installed))



Since the programs, parameters and symbols are read from the flash memory at restart, the data in the temporary memory will remain the same as the original data before edit unless the edited data are written to the flash memory.
The controller always operates in accordance with the data in the main CPU memory (excluding the parameters).

1.2 Controller with Expanded Memory (with Gateway Function)

(Other parameter No. 20 = 0 (System-memory backup battery installed))

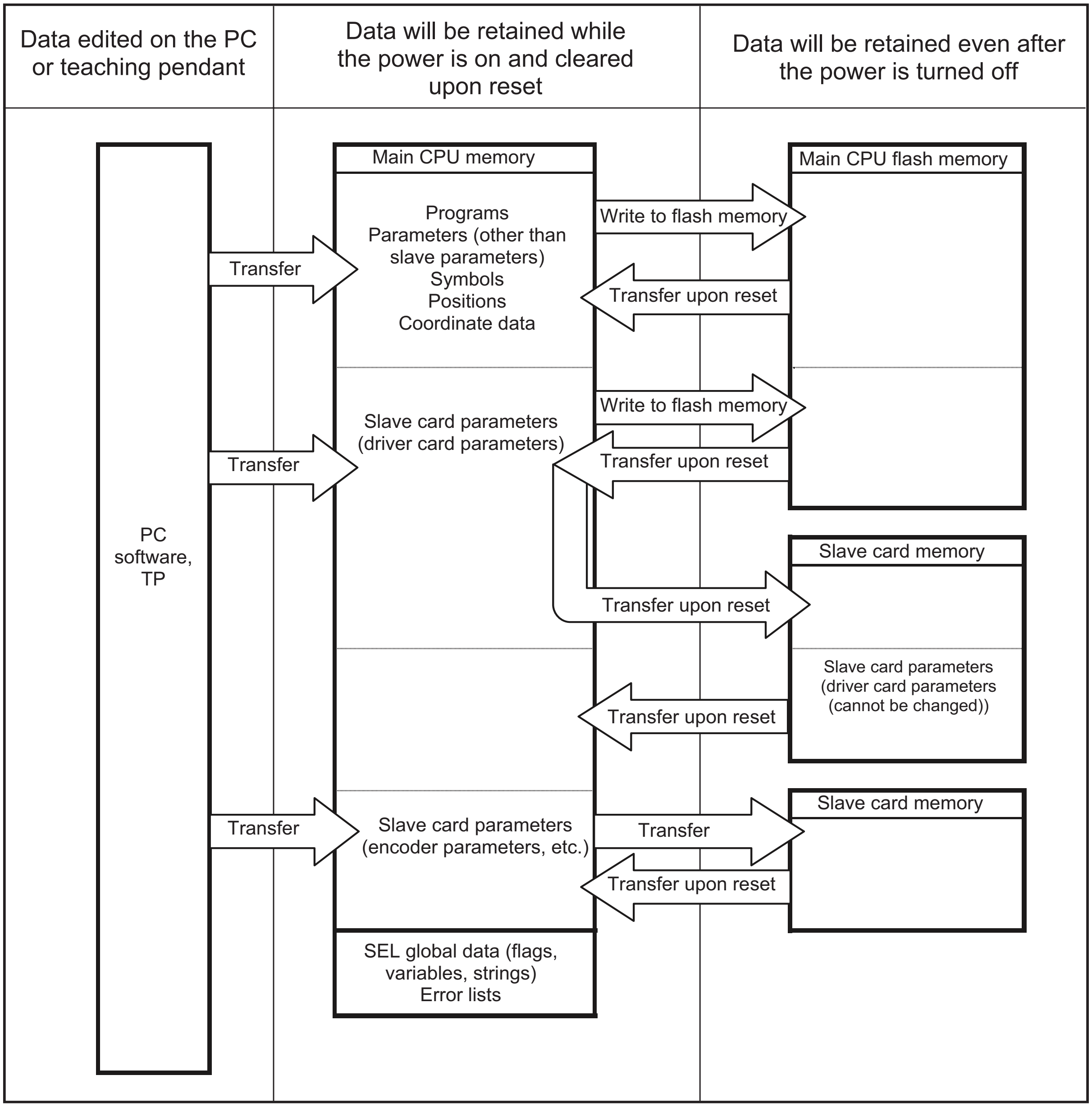


Since the programs, parameters and symbols are read from the flash memory at restart, the data in the temporary memory will remain the same as the original data before edit unless the edited data are written to the flash memory.
The controller always operates in accordance with the data in the main CPU memory (excluding the parameters).

2. When the System-Memory Backup Battery is Not Used

2.1 Controller without Expanded Memory

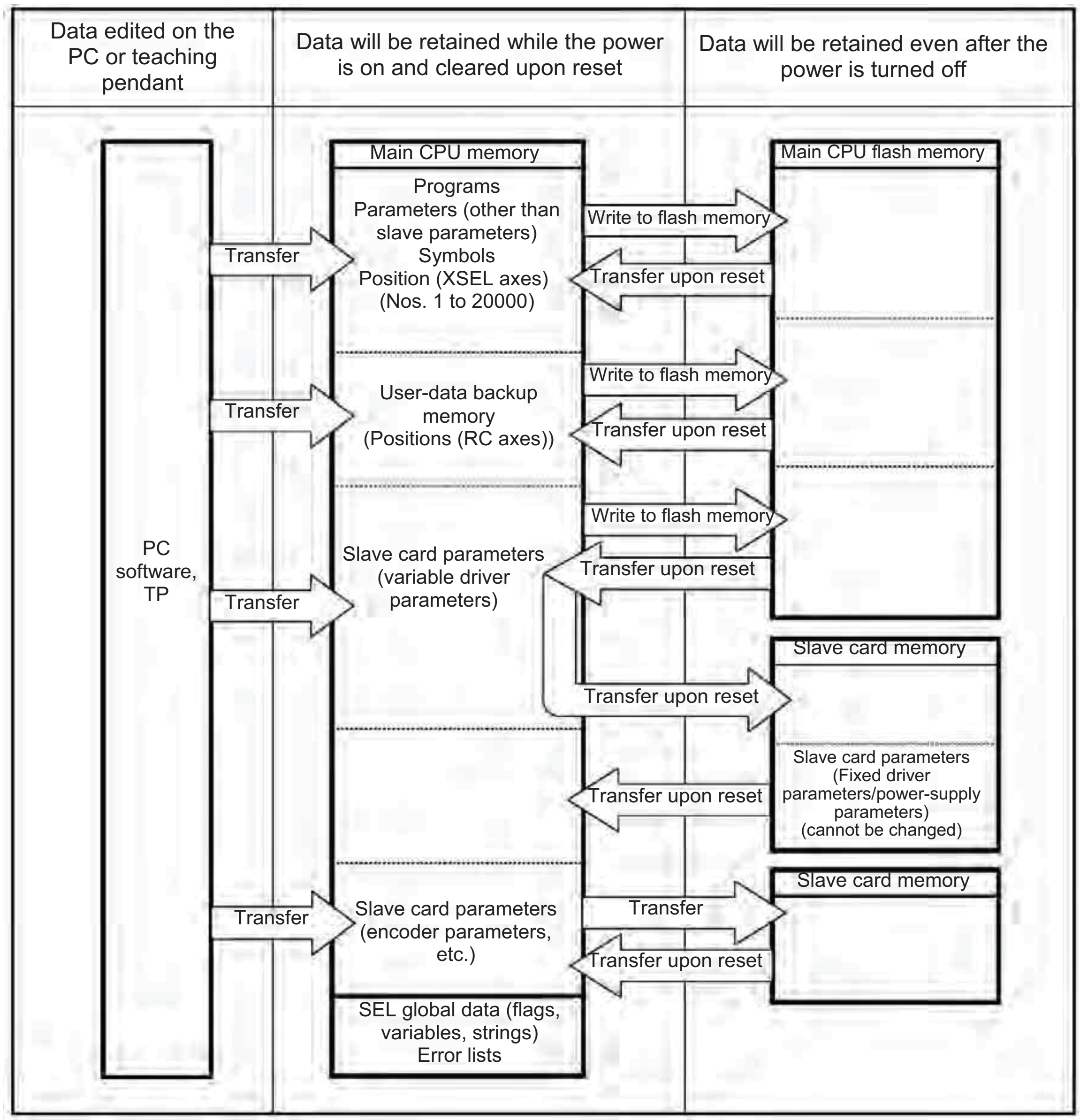
Other parameter No. 20 = 0 (System-memory backup battery not installed)



The programs, parameters, symbols and positions are read from the flash memory at restart. The data in the main CPU memory will remain the same as the original data before edit unless the edited data are written to the flash memory.
The controller always operates in accordance with the data in the main CPU memory (excluding the parameters).
Note: SEL global data cannot be retained if the backup battery is not installed.

2.2 Controller with Expanded Memory (with Gateway Function)

(Other parameter No. 20 = 0 (System-memory backup battery not installed))



The programs, parameters, symbols and positions are read from the flash memory at restart. The data in the main CPU memory will remain the same as the original data before edit unless the edited data are written to the flash memory.

The controller always operates in accordance with the data in the main CPU memory (excluding the parameters).

Note: SEL global data cannot be retained if the backup battery is not installed.

3. Points to Note

Point to note when transferring data and writing to the flash memory

Never turn off the main power while data is being transferred or written to the flash memory. The data will be lost and the controller operation may be disabled.

Point to note when saving parameters to a file

The encoder parameters are stored in the EEPROM of the actuator's encoder itself (unlike other parameters, they are not stored in the EEPROM of the controller). The encoder parameters will be read from the encoder's EEPROM to the controller when the power is turned on or upon software reset.

Therefore, if the parameters are saved to a file after turning on the controller (or restarting it via a software reset) without an actuator (encoder) connected, the encoder parameters saved to the file will become invalid.

Point to note when transferring a parameter file to the controller

When a parameter file is transferred to the controller, the encoder parameters will be transferred to the EEPROM of the encoder (excluding manufacturing/function information).

Therefore, if the parameter file transferred to the controller has been read from a controller that was started without an actuator connected, invalid encoder parameters will be written to the encoder's EEPROM (provided that an actuator is connected to the controller to which the file was transferred).

When saving the parameters to a file, do so with an actuator connected to the controller.

Note on increased number of positions

On a controller with expanded memory (with gateway function), the number of position data has been increased to 20000 points.

Accordingly, take note of the following point:

* If a battery backup memory is used (other parameter No. 20 = 2), position Nos. 1 to 10000 are saved in the battery backup memory, while position Nos. 10001 to 20000 are saved in the flash ROM of the main CPU. Accordingly, <u>data of position Nos. 10001 to 20000 will be lost if the power is turned off or a software reset is performed without writing the data to the flash ROM first, and next time the controller is started the data last written to the flash ROM will be loaded</u>. To save this data, write it to the flash ROM. Also note that if a battery backup memory is not used (other parameter No. 20 = 2), all data from position data Nos. 1 to 20000 is saved in the flash ROM of the main CPU. To save this data, also write it to the flash ROM.

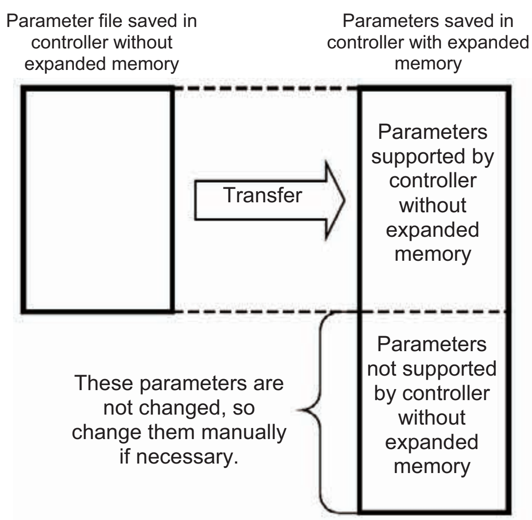
Note on increased number of parameters

On a controller with expanded memory (with gateway function), the number of parameters has increased.

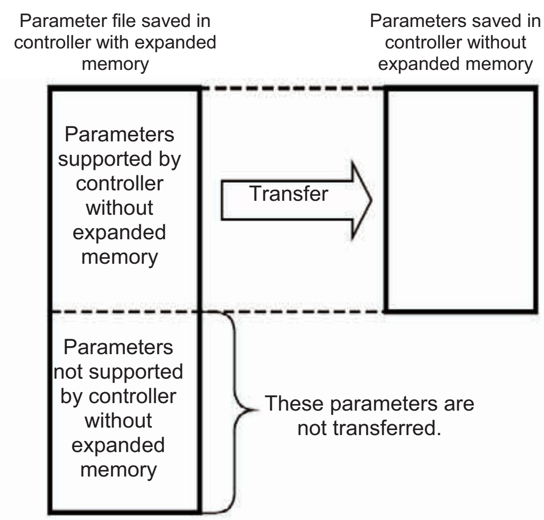
	Number of parameters	
	Without expanded memory	With expanded memory
I/O	400	600
All-axis	300	400
Axis-specific	220	250
Driver	97	97
Encoder	30	30
I/O device	82	82
Other	120	200

Take note of the following point:

* If a parameter file saved in a controller without expanded memory is transferred to a controller with expanded memory, or if a parameter file saved in a controller with expanded memory is transferred to a controller without expanded memory, only the parameters supported by the controller without expanded memory will be transferred, as shown below.



Transferring a parameter file saved in a controller without expanded memory to a controller with expanded memory



Transferring a parameter file saved in a controller with expanded memory to a controller without expanded memory

Chapter 2 XSEL Language Data

1. Values and Symbols Used in SEL Language

1.1 List of Values and Symbols Used

The various functions required in a program are represented by values and symbols.

Function		Global range	Local range	Remarks
Input port		000 to 299 (300)		Varies depending on the function.
Output port		300 to 599 (300)		Varies depending on the function.
Flag		600 to 899 (300)	900 to 999 (100)	
Variable (integer)		200 to 299 (100) 1200 to 1299 (100)	1 to 99 (99) 1001 to 1099 (99)	99 is used for IN, INB, OUT, OUTB, etc.
Variable (real)		300 to 399 (100) 1300 to 1399 (100)	100 to 199 (100) 1100 to 1199 (100)	199 is used for PPUT, PGET, PARG, etc.
String		300 to 999 (700)	1 to 299 (299)	
Tag number			1 to 256 (256)	1 to 99 (99) (~ Ver. 0.31) 1 to 256 (256) (Ver. 0.32 ~)
Subroutine number			1 to 99 (99)	
Zone number		1 to 4 (4)		
Pallet number			1 to 10 (10)	
Axis number		1 to 6 (6)		Varies depending on the function.
Axis pattern		0 to 111111		
Position number	Controller with expanded memory (with gateway function)	1 to 20000 (20000)		
	Controller without expanded memory	1 to 4000 (4000)		
Program number	Controller with expanded memory (with gateway function)	1 to 128 (128)		
	Controller without expanded memory	1 to 64 (64)		
Step number	Controller with expanded memory (with gateway function)	1 to 9999 (9999)		
	Controller without expanded memory	1 to 6000 (6000)		
Task level		NORMAL/HIGH (2)		
SIO channel number		1 to 2 (2)		
Wait timer			1	
1-shot pulse timer			16 (Number of timers that can be operated simultaneously)	
Ladder timer			Local flag (100)	
Virtual input port (SEL system → SEL user program)		7000 to 7299 (300)		
Virtual output port (SEL user program → SEL system)		7300 to 7599 (300)		
Number of symbol definitions		1000		
Number of times symbol can be used in commands		5000 (including literals)		
		Used in common from any program.	Referenced separately in each program. Cleared when the program is started.	

⚠ Caution

- Variables 99 and 199 are special variables this system uses in operations. Avoid using these two variables for general purposes.
- The values in the table represent ranges that can be processed by software. Items that require physical devices, such as I/O ports and functions relating to axis number and SIO, will be determined by possible combinations and models of commercial boards, etc., available for each device application.

- The variables and flags in the global range will be retained even after the controller power is turned off. (When other parameter No. 20 is set to "2." Refer to Chapter 1, "How to Save Data," of Part 3.)

- The variables and flags in the local range will be cleared when the program is started.

- Ranges of values that can be used in SEL language

Integers and real numbers can be used. However, pay due attention to the following limitations:

1) Numeric data
   The XSEL Controller can handle values of maximum eight digits including a sign and a decimal point.
   Integer: -9,999,999 to 99,999,999
   Real number: Maximum eight digits including a sign and decimal point, regardless of the size of value
   Example) 999999.9, 0.123456, -0.12345
   If a floating point is used in operations, the number of valid digits will be limited to seven. Also note that operations using a floating point are subject to error.

2) Position data
   The input range of position data consists of four integer digits and three decimal digits.
   –9999.999 to 9999.999
   (The maximum value varies depending on the actuator model.)
   If position data are used in internal operations as numeric data (repeated multiplications and divisions), the precision of the last digit may decrease.

Consider the above limitations fully when using values. Particularly when the CPEQ command is used in a comparison operation using real numbers, a match will rarely result. In this case, the CPLE or CPGE command that looks at the magnitude relationship of two terms must be used.

1.2 I/O Ports

(1) Input ports
Used as input ports for limit switches, sensor switches, etc.

Input number assignment
000 to 031 (standard)

(2) Output ports
Used as various output ports.

Output number assignment
300 to 315 (standard)

1.3 Virtual I/O Ports

(1) Virtual input ports

Port No.	Function
7000	Always OFF
7001	Always ON
7002	Voltage low warning for system-memory backup battery
7003	Abnormal voltage of system-memory backup battery
7004	(For future expansion = Use strictly prohibited)
7005	(For future expansion = Use strictly prohibited)
7006	Top-level system error = Message level error is present
7007	Top-level system error = Operation-cancellation level error is present
7008	Top-level system error = Cold-start level error is present
7009	(For future expansion = Use strictly prohibited)
7010	Drive-source cutoff factor is present (including when waiting for cutoff reset input)
7011	Latch signal indicating that all-operation-cancellation factor is present (latch signal for recognizing 1-shot cancellation factor; latch is cancelled by 7300-ON)
7012	All-operation-pause factor is present (including when waiting for restart switch signal) (Valid only during automatic operation recognition)
7013	All-servo-axis-interlock factor is present (all-operation-pause factor + interlock input-port factor)
7014	(For future expansion = Use strictly prohibited)
7015	Voltage low warning for axis-1 absolute-data backup battery
7016	Abnormal voltage of axis-1 absolute-data backup battery (latched until power-on reset or software reset)
7017	Voltage low warning for axis-2 absolute-data backup battery (main application version 0.28 or later)
7018	Abnormal voltage of axis-2 absolute-data backup battery (latched until power-on reset or software reset)
7019	Voltage low warning for axis-3 absolute-data backup battery
7020	Abnormal voltage of axis-3 absolute-data backup battery (latched until power-on reset or software reset)
7021	Voltage low warning for axis-4 absolute-data backup battery
7022	Abnormal voltage of axis-4 absolute-data backup battery (latched until power-on reset or software reset)
7023	Voltage low warning for axis-5 absolute-data backup battery (valid only when the controller supports up to 6 axes)
7024	Abnormal voltage of axis-5 absolute-data backup battery (latched until power-on reset or software reset) (valid only when the controller supports up to 6 axes)
7025	Voltage low warning for axis-6 absolute-data backup battery (valid only when the controller supports up to 6 axes)
7026	Abnormal voltage of axis-6 absolute-data backup battery (latched until power-on reset or software reset) (valid only when the controller supports up to 6 axes)
7027 to 7040	(For future expansion = Use strictly prohibited)
7041 to 7042	(For future expansion = Use strictly prohibited)
7043	Axis 1 home return complete (Effective from main application version 1.09 or later)
7044	Axis 2 home return complete (Effective from main application version 1.09 or later)
7045	Axis 3 home return complete (Effective from main application version 1.09 or later)
7046	Axis 4 home return complete (Effective from main application version 1.09 or later)
7047	Axis 5 home return complete (Effective from main application version 1.09 or later)
7048	Axis 6 home return complete (Effective from main application version 1.09 or later)
7049 to 7070	(For future expansion = Use strictly prohibited)
7071	In AUTO mode
7072	During automatic operation
7073 to 7100	(For future expansion = Use strictly prohibited)
7101	Running program No. 01 (including during pause)
~	~

Port No.	Function
7164	Running program No. 64 (including during pause)
7165	Running program No. 65 (including during pause) (Controller with expanded memory (with gateway function) only)
~	~
7228	Running program No. 128 (including during pause) (Controller with expanded memory (with gateway function) only)
7229 to 7299	(For future expansion = Use strictly prohibited)

(2) Virtual output ports

Port No.	Function
7300	A latch cancellation signal is output to cancel the latch signal indicating a cause of all-operation cancellation (7011). (Unlatched only when the cause of operation cancellation is no longer present.) (7300 is turned OFF after latch cancellation is attempted.)
7301	1st axis grip release output (ON: Release command, OFF: Grip command) (Note 1) (Note 2)
7302	2nd axis grip release output (ON: Release command, OFF: Grip command) (Note 1) (Note 2)
7303	3rd axis grip release output (ON: Release command, OFF: Grip command) (Note 1) (Note 2)
7304	4th axis grip release output (ON: Release command, OFF: Grip command) (Note 1) (Note 2)
7305	5th axis grip release output (ON: Release command, OFF: Grip command) (Note 1) (Note 2)
7306	6th axis grip release output (ON: Release command, OFF: Grip command) (Note 1) (Note 2)
7307	Reserved by the system
7308	Reserved by the system
7309~7380	(For future expansion = Use strictly prohibited)
7381~7399	(Reserved by the system = Use strictly prohibited)
7400~7500	(For future expansion = Use strictly prohibited)

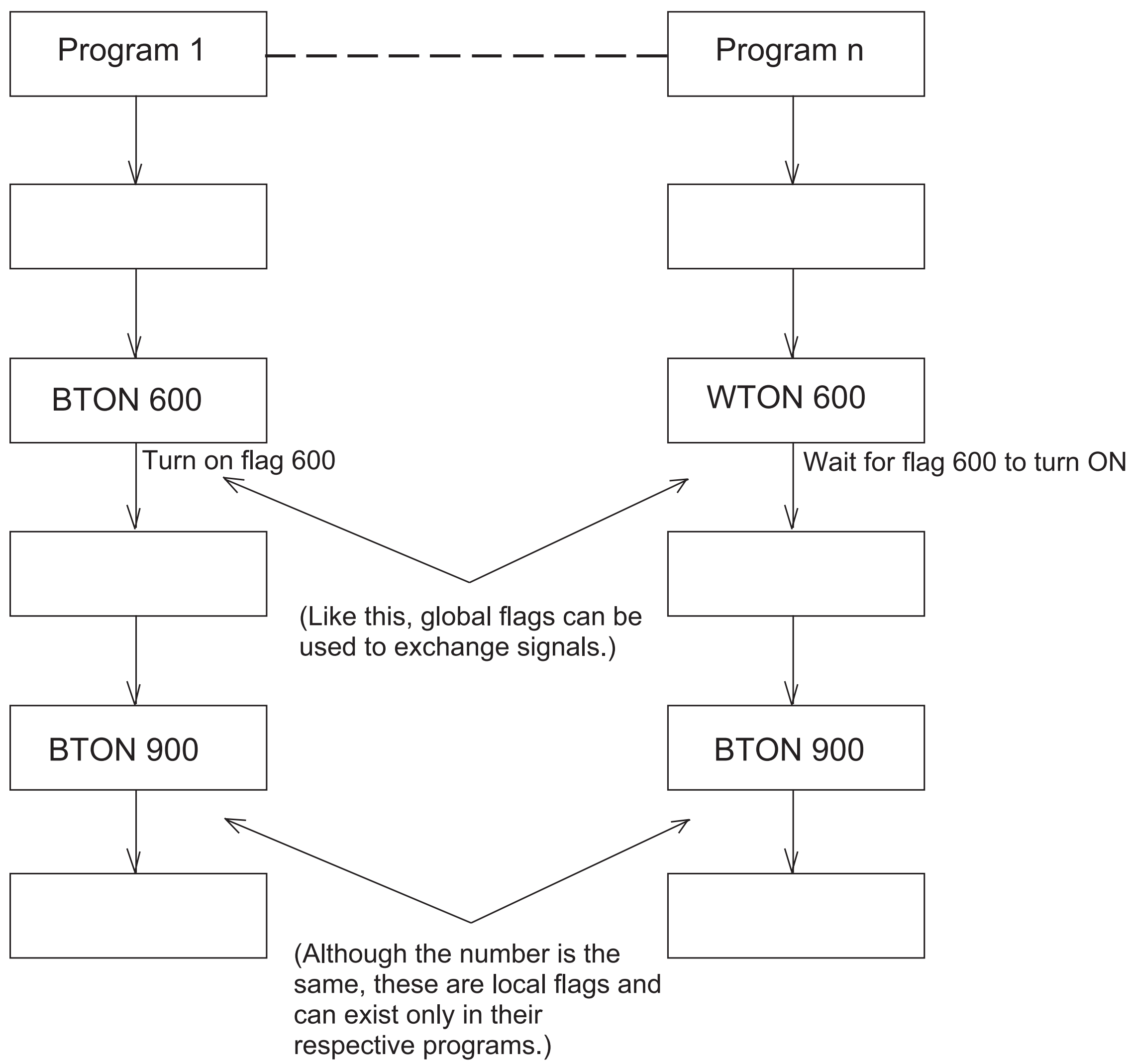
Note 1: Effective when Each Axis Parameter No. 103 “Brake Output Control Method Select” = 1 (User Control)

Note 2: The ways to use the signals may differ depending on the mounted actuators.

1.4 Flags

Contrary to its common meaning, the term “flag” as used in programming means “memory.” Flags are used to set or reset data. They correspond to “auxiliary relays” in a sequencer.
Flags are divided into global flags (Nos. 600 to 899) that can be used in all programs, and local flags (Nos. 900 to 999) that can be used only in each program.
Global flags will be retained (backed up by battery) even after the power is turned off.
Local flags will be cleared when the power is turned off.

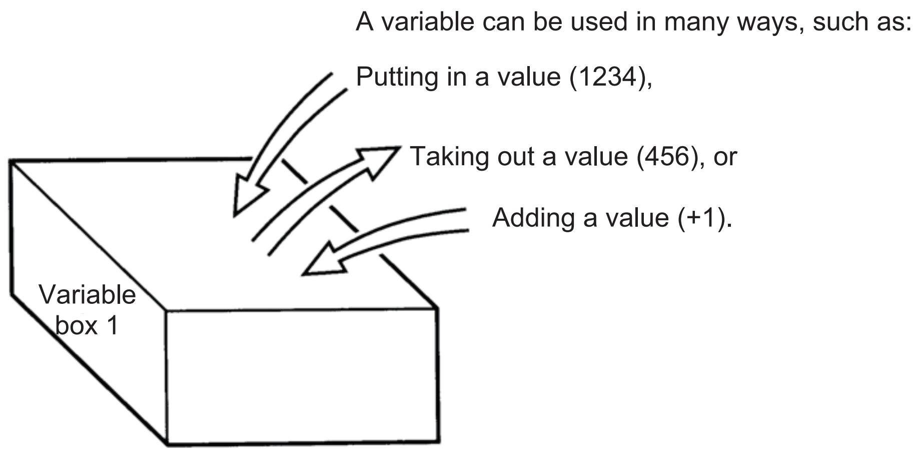
Flag number	600 to 899	Can be used in all programs	“Global flags”
Flag number	900 to 999	Used only in each program	“Local flags”



1.5 Variables

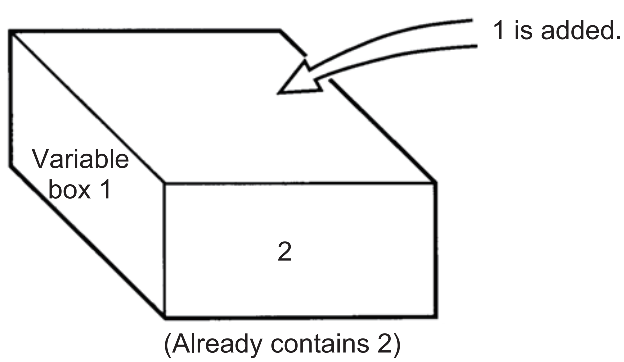
(1) Meaning of variable

"Variable" is a technical term used in software programming. Simply put, it means "a box in which a value is put." Variables can be used in many ways, such as putting in or taking out a value and performing addition or subtraction.



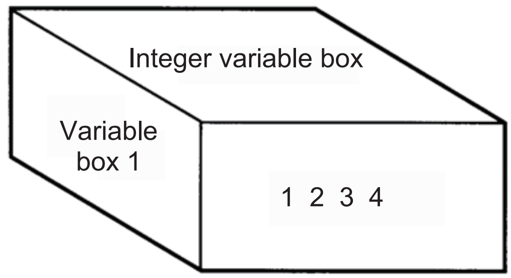
Command	Operand 1	Operand 2
ADD	1	1

If this command is applied to variable box 1, which already contains 2, then 1 will be added to the current value and 3 will result.



(2) Types of variables
Variables are classified into two types, as follows:

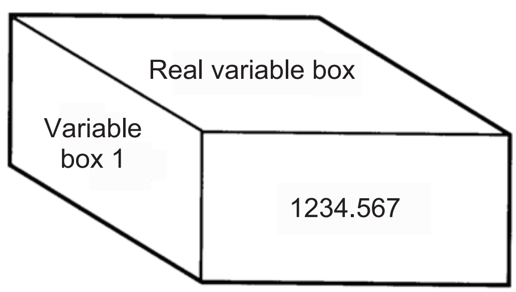
1) Integer variables
These variables cannot handle decimal places.
[Example] 1234



Integer variable number	200 to 299 1200 to 1299	Can be used in all programs	“Global integer variables”
Integer variable number	1 to 99 1001 to 1099	Used only in each program	“Local integer variables”

Caution Integer 99 is a special register this system uses in integer operations. Any value in the range from –9,999,999 to 99,999,999 can be input in programs.

2) Real variables
Actual values. These variables can handle decimal places.
[Example] 1234.567
(Decimal point)

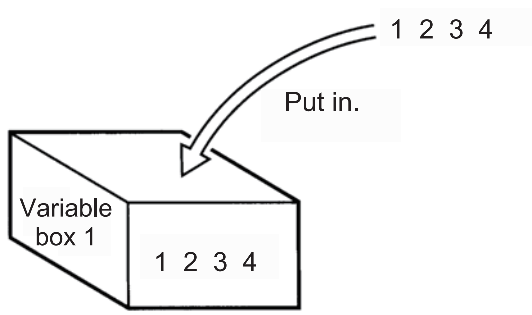


Real variable number	300 to 399 1300 to 1399	Can be used in all programs	“Global real variables”
Real variable number	100 to 199 1100 to 1199	Used only in each program	“Local real variables”

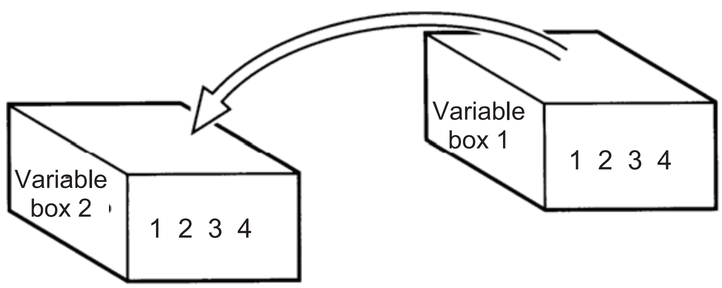
Caution Real number 199 is a special register this system uses in real-number operations. Any value in the range from –99,999.9 to 999,999.9 (eight digits including a sign) can be input in programs.

3) Variables with “*” (asterisk) (indirect specification)
An “*” (asterisk) is used to specify a variable.
In the following example, the content of variable box 1 will be put in variable box 2. If variable box 1 contains “1234,” then “1234” will be put in variable box 2.

Command	Operand 1	Operand 2
LET	1	1234



Command	Operand 1	Operand 2
LET	2	*1



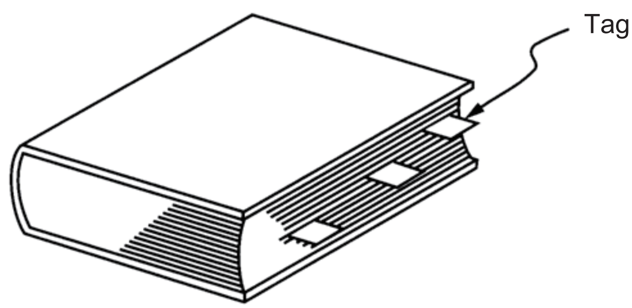
The above use of variables is called “indirect specification.”

An “*” is also used when indirectly specifying a symbol variable (refer to 1.8, “Symbols”).

Command	Operand 1	Operand 2	
LET	ABC	1	Put 1 in variable ABC.
LET	BCD	2	Put 2 in variable BCD.
ADD	ABC	*BCD	Add the content of variable BCD, or 2, to variable ABC. (The content of variable ABC becomes 3.)

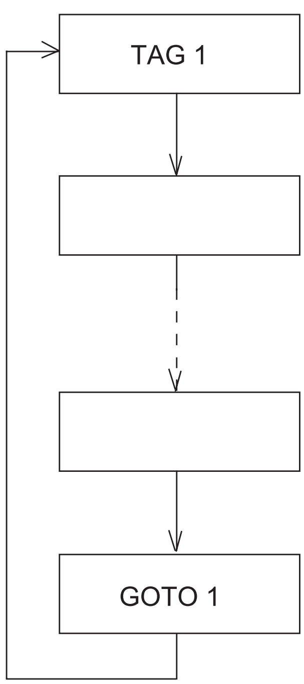
1.6 Tags

The term “tag” means “heading.”
Tags are used in the same way you attach labels to the pages in a book you want to reference frequently.
A tag is a destination specified in a jump command “GOTO.”



Command	Operand 1
TAG	Tag number (Integer between 1 and 99)

They are used only in each program.



1.7 Subroutines

By taking out the parts of a program that are used repeatedly and registering them as “subroutines,” the same processing can be performed with fewer steps. (A maximum of 15 nests are accommodated.)

They are used only in each program.

Command	Operand 1
EXSR	Subroutine number (Integer between 1 and 99; variable is also supported)

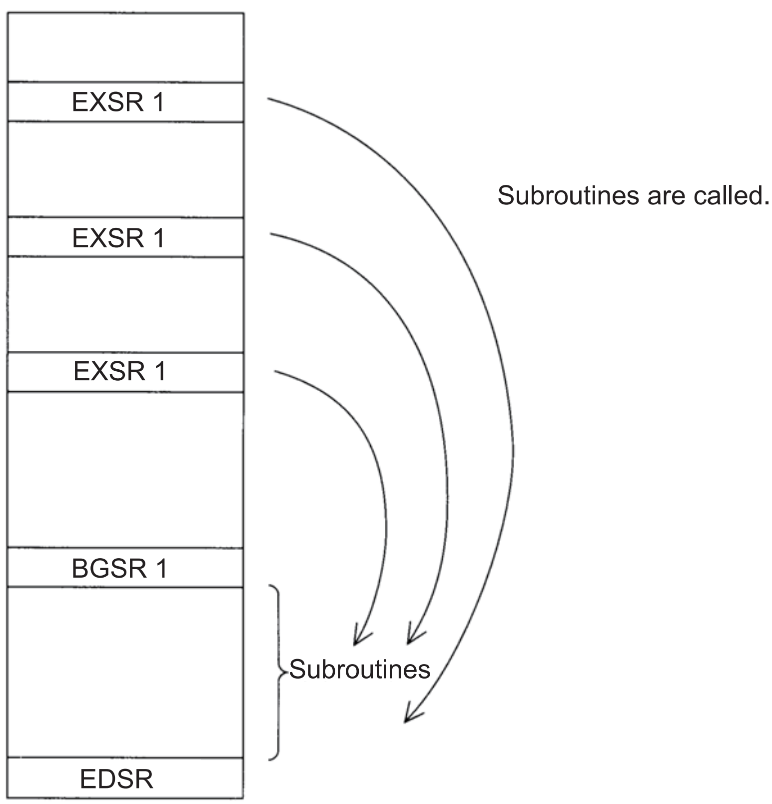
Subroutine execution command

Command	Operand 1
BGSR	Subroutine number (Integer between 1 and 99)

Subroutine start declaration

Command	Operand 1
EDSR	—

Subroutine end declaration



1.8 Symbols

In the XSEL Controller, values such as variable numbers and flag numbers can be handled as symbols. For the method to edit symbols, refer to "Editing Symbols" in the operation manual for XSEL teaching pendant or "Symbol Edit Window" in the operation manual for XSEL PC software.

(1) Supported symbols
The following items can be expressed using symbols:
Variable number, flag number, tag number, subroutine number, program number, position number, input port number, output port number, axis number, constant

(2) Description rules of symbols
1) A maximum of nine single-byte alphanumeric characters or underscore starting with an alphabet (Note: The length of a character-string literal must not exceed eight single-byte characters.)
   * If the PC software version is 1.1.0.5 or later or the teaching pendant version is 1.04 or later, an underscore can be used as the first character in a symbol.
   * If the PC software version is 1.1.05 or later, single-byte ASCII code characters from 21h to 7Eh (limited to those that can be input via keyboard) can be used as the second and subsequent characters.
   * Exercise caution that the same ASCII code may be expressed differently between the PC software and the teaching pendant because of the different fonts used by the two. (The same applies to character-string literals.)
     5Ch --- PC software: Backslash \ (overseas specifications, etc.)
     Teaching pendant: Yen mark ¥
     7Eh --- PC software: ~
     Teaching pendant: Right arrow →
2) Symbols of the same name must not be defined within each function. (The same local symbol can be used in different programs.)
3) Symbols of the same name must not be defined within the flag number, input-port number or output-port number group. (The same local symbol can be used in different programs.)
4) Symbols of the same name must not be defined within the integer-variable number or real-variable number group. (The same local symbol can be used in different programs.)
5) Symbols of the same name must not be defined within the integer constant or real constant group.

(3) Number of symbols that can be defined: Maximum 1000

(4) Number of times symbols can be used in all SEL programs: Maximum 5000 times including character-string literals
   * If symbol is used in all of the input condition, operand 1, operand 2 and output fields, it is deemed that symbol is used four times in one step.

1.9 Character-String Literals

Character-string literals are used in certain string-operation commands and consist of the portion enclosed by single quotation marks (' ') (maximum eight single-byte characters).
With the PC software, single-byte ASCII code characters from 20h to 7Eh (limited to those that can be input via keyboard) can be used inside the single quotation marks. With the teaching pendant, single-byte alphanumeric characters and single-byte underscores can be used.

1.10 Axis Specification

Axes can be specified based on axis number or axis pattern.

(1) Axis numbers and how axes are stated
Each of multiple axes is stated as follows:

Axis number	How axis is stated
1	Axis 1
2	Axis 2
3	Axis 3
4	Axis 4
5	Axis 5
6	Axis 6

↑

The axis numbers stated above can also be expressed using symbols.

Use axis number if you wish to specify only one of multiple axes.

- Commands that use axis specification based on axis number
  BASE, PPUT, PGET, ACHZ, AXST, PASE, PCHZ, ACHZ, PARG

(2) Axis pattern
Whether or not each axis will be used is indicated by “1” or “0.”

(Upper) (Lower)

Axis number	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1
Used	1	1	1	1	1	1
Not used	0	0	0	0	0	0

[Example] When axes 1 and 2 are used

Axis 2

000011 --- (The 0s in front are not necessary. With the 0s removed, the expression reads “11.”)

Axis 1

[Example] When axes 1 and 4 are used

Axis 4

1001 --- (In this case, the 0s are needed to indicate the position of axis 4.)

Axis 1

Indirect specification of axis pattern in a variable
The axis pattern is considered a binary value, and a converted decimal value is assigned to a variable.

[Example] To perform home return for axis 3 only, you can specify as follows based on axis pattern:

```
HOME    100
```

In indirect specification, 100 (binary) is expressed as 4 (decimal), so the same operation can be specified as follows:

```
LET     6   4
HOME    *6
```

If you must select and specify multiple axes at the same time, use axis pattern.

- Commands that use axis specification based on axis pattern
  OFST, GRP, SVON, SVOF, HOME, JFWN, JFWF, JBWN, JBWF, STOP, PTST, PRED
  CHVL, PBND, WZNA, WZNO, WZFA, WZFO

XSEL language consists of a position part (position data = coordinates, etc.) and a command part (application program).

2. Position Part

As position data, coordinates, speeds, accelerations and decelerations are set and stored.

± 99999.999 mm

*1, 2
1 ~ 2500/mmsec

*2
Standard
0.3 G

*2
Standard
0.3 G

Position No.	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Speed	Acceleration	Deceleration
1									
2									
3									
3998									
3999									
4000									

*1 Varies depending on the actuator model.
*2 If speed, acceleration or deceleration is set in the position data, the setting will be given priority over the corresponding data set in the application program. Leave the position data fields empty if you wish to enable the corresponding data in the application program.

Values pertaining to a rotating axis are processed in degrees instead of millimeters.

If axis-specific parameter No. 1 (axis operation type) is set to “1” (rotational movement axis (angle control)) for a given axis, all millimeter values pertaining to that axis (including parameters, etc.) will be processed in degrees.

If the gear ratio parameters (axis-specific parameter Nos. 50 and 51) are set correctly, the angles (deg) will represent those of the body of rotation at the end.

Example)	Distance	1 mm	→ 1 deg
	Speed	1 mm/sec	→ 1 deg/sec
	Acceleration/deceleration	1 G = 9807 mm/sec^2	→ 9807 deg/sec^2

3. Command Part

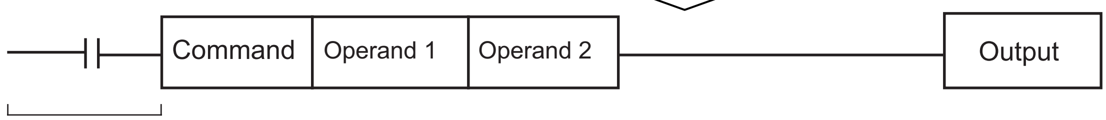
The primary feature of SEL language is its very simple command structure. Since the structure is simple, there is no need for a compiler (to translate into computer language) and high-speed operation is possible via an interpreter (the program runs as commands are translated).

3.1 SEL language Structure

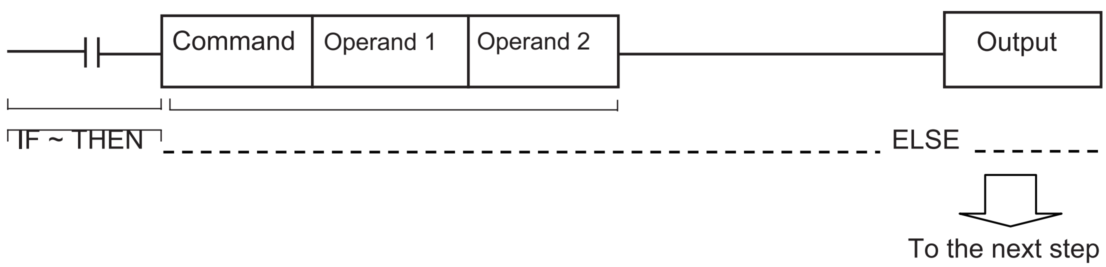
The table below shows the structure of one command step.

Extension condition (AND, OR)	Input condition (I/O, flag)	Command, declaration			Output (Output port, flag)
		Command, declaration	Operand 1	Operand 2	

Using a ladder diagram, this is expressed as follows:

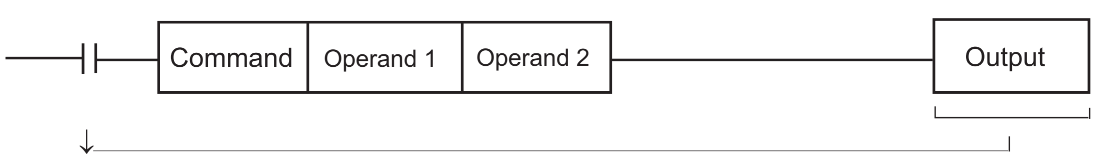


(1) The condition before the command is equivalent to "IF to THEN…" in BASIC.



1. If the input condition is satisfied, the command will be executed. If there is an output specification, the specified output port will be turned ON. If the input condition is not satisfied, the program will proceed to the next step regardless of the command that follows (e.g., WTON, WTOF). Obviously nothing will happen at the output port, but caution must be exercised.
2. If no condition is set, the command will be executed unconditionally.
3. To use the condition in reverse logic (so-called "contact b logic"), add "N" (NOT) to the condition.
4. The input condition supports input port, output port and flag.
5. The operand 1, operand 2 and output fields can be specified indirectly.

(2) The output field, which follows the command, operand 1 and operand 2 fields, will specify the following action:

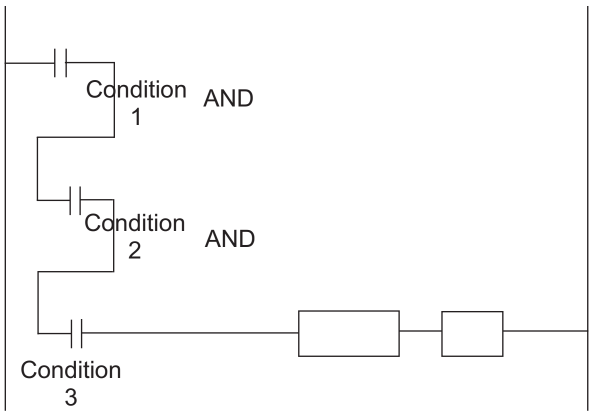


1. In the case of a control command relating to actuator operation, etc., the output will turn OFF the moment the execution of command is started, and turn ON when the execution is completed. In the case of a calculation operation command, etc., the output will turn ON if the result corresponds to a certain value, and turn OFF if not.
2. The output field supports output port and flag.

3.2 Extension Condition

Conditions can be combined in a complex manner.

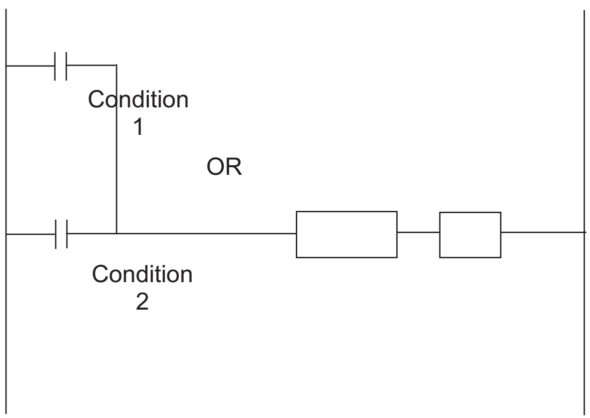
AND extension (Ladder diagram)



(SEL language)

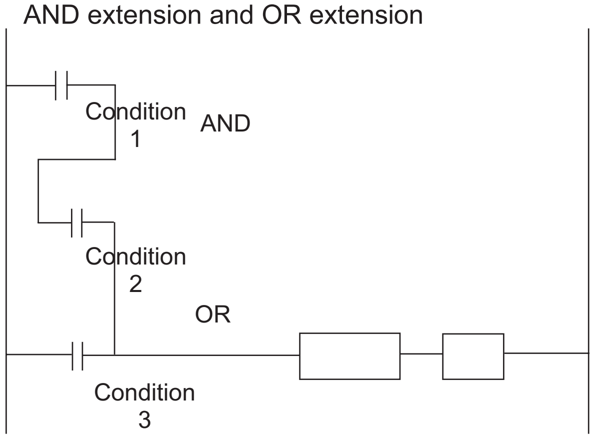
Extension condition	Input condition	Command			Output
		Command	Operand 1	Operand 2	
	Condition 1				
A	Condition 2				
A	Condition 3	Command	Operand 1	Operand 2	

OR extension



Extension condition	Input condition	Command			Output
		Command	Operand 1	Operand 2	
	Condition 1				
O	Condition 2	Command	Operand 1	Operand 2	

AND extension and OR extension



Extension condition	Input condition	Command			Output
		Command	Operand 1	Operand 2	
	Condition 1				
A	Condition 2				
O	Condition 3	Command	Operand 1	Operand 2	

Part 4 Commands

Chapter 1 List of SEL Language Command Codes

1. By Function

Variables can be specified indirectly in the operand 1, operand 2 and output fields.
Symbols can be input in the condition, operand 1, operand 2 and output fields.
The input items in ( ) under operand 1 and operand 2 are optional.
Once an “actuator control declaration” command is executed in a program, the command will remain valid as long as the program is running. To change the values (in operand 1, operand 2, etc.) already set by the “actuator control declaration” command, the necessary parts of the program must be set again. In other words, the values set by the last executed command will prevail.
The output field will be turned OFF when the command is executed. Once the execution is completed, the output field may be turned ON depending on the operation type condition in the output field. (The output field will remain OFF if the condition is not satisfied.)

Note: The output field of a comparison command CPxx (CPEQ, CPNE, CPGT, CPGE, CPLT and CPLE), ECMD will not be turned OFF when the command is executed.

Operation type in the output field
CC: Command was executed successfully,
ZR: Operation result is zero, PE: Operation is complete,
CP: Command part has passed, TU: Time up
EQ: Operand 1 = Operand 2, NE: Operand 1 ≠ Operand 2,
GT: Operand 1 > Operand 2, GE: Operand 1 ≥ Operand 2,
LT: Operand 1 < Operand 2, LE: Operand 1 ≤ Operand 2

Category	Condition	Command	Operand 1	Operand 2	Output	Function	Page
Variable assignment	Optional	LET	Assignment variable	Assigned value	ZR	Assign	151
	Optional	TRAN	Copy-destination variable	Copy-source variable	ZR	Copy	151
	Optional	CLR	Start-of-clear variable	End-of-clear variable	ZR	Clear variable	152
Arithmetic operation	Optional	ADD	Augend variable	Addend	ZR	Add	153
	Optional	SUB	Minuend variable	Subtrahend	ZR	Subtract	153
	Optional	MULT	Multiplicand variable	Multiplier	ZR	Multiply	154
	Optional	DIV	Dividend variable	Divisor	ZR	Divide	154
	Optional	MOD	Remainder assignment variable	Divisor	ZR	Calculate remainder	155
Function operation	Optional	SIN	Sine assignment variable	Operand [radian]	ZR	Sine	156
	Optional	COS	Cosine assignment variable	Operand [radian]	ZR	Cosine	156
	Optional	TAN	Tangent assignment variable	Operand [radian]	ZR	Tangent	157
	Optional	ATN	Inverse-tangent assignment operation	Operand	ZR	Inverse tangent	157
	Optional	SQR	Root assignment variable	Operand	ZR	Root	158
Logical operation	Optional	AND	AND operand variable	Operand	ZR	Logical AND	159
	Optional	OR	OR operand variable	Operand	ZR	Logical OR	160
	Optional	EOR	Exclusive-OR operand variable	Operand	ZR	Logical exclusive-OR	161
Comparison	Optional	CP□□	Comparison variable	Comparison value	EQ, NE, GT, GE, LT, LE	Compare	162
Timer	Optional	TIMW	Wait time (sec)	Prohibited	TU	Wait	163
	Optional	TIMC	Program number	Prohibited	CP	Cancel waiting	164
	Optional	GTTM	Time assignment variable	Prohibited	CP	Get time	165
I/O, flag operation	Optional	BT□□	Start output, flag	(End output, flag)	CP	Output, flag [ON, OF, NT]	166
	Optional	BTPN	Output port, flag	Timer setting	CP	Output ON pulse	167
	Optional	BTPF	Output port, flag	Timer setting	CP	Output OFF pulse	168
	Optional	WT□□	I/O, flag	(Wait time)	TU	Wait for I/O, flag [ON, OF]	169
	Optional	IN	Head I/O, flag	End I/O, flag	CC	Input binary (32 bits max.)	170
	Optional	INB	Head I/O, flag	Conversion digits	CC	Input BCD (8 digits max.)	171
	Optional	OUT	Head output, flag	End I/O, flag	CC	Output binary (32 bits max.)	172
	Optional	OUTB	Head output, flag	Conversion digits	CC	Output BCD (8 digits max.)	173
	Optional	FMIO	Format type	Prohibited	CP	Set IN (B)/OUT (B) command format	174

Operation type in the output field
CC: Command was executed successfully, ZR: Operation result is zero,
PE: Operation is complete, CP: Command part has passed, TU: Time up
EQ: Operand 1 = Operand 2, NE: Operand 1 ≠ Operand 2,
GT: Operand 1 > Operand 2, GE: Operand 1 ≥ Operand 2,
LT: Operand 1 < Operand 2, LE: Operand 1 ≤ Operand 2

Category	Condition	Command	Operand 1	Operand 2	Output	Function	Page
Program control	Optional	GOTO	Jump-destination tag number	Prohibited	CP	Jump	177
	Prohibited	TAG	Declaration tag number	Prohibited	CP	Declare jump destination	177
	Optional	EXSR	Execution subroutine number	Prohibited	CP	Execute subroutine	178
	Prohibited	BGSR	Declaration subroutine number	Prohibited	CP	Start subroutine	178
	Prohibited	EDSR	Prohibited	Prohibited	CP	End subroutine	179
Task management	Optional	EXIT	Prohibited	Prohibited	CP	End program	180
	Optional	EXPG	Execution program number	(Execution program number)	CC	Start program	181
	Optional	ABPG	Stop program number	(Stop program number)	CC	Stop other program	182
	Optional	SSPG	Pause program number	(Pause program number)	CC	Pause program	183
	Optional	RSPG	Resumption program number	(Resumption program number)	CC	Resume program	184
Position operation	Optional	PGET	Axis number	Position number	CC	Assign position to variable 199	185
	Optional	PPUT	Axis number	Position number	CP	Assign value of variable 199	186
	Optional	PCLR	Start position number	End position number	CP	Clear position data	187
	Optional	PCPY	Copy-destination position number	Copy-source position number	CP	Copy position data	188
	Optional	PRED	Read axis pattern	Save-destination position number	CP	Read current axis position	189
	Optional	PRDQ	Axis number	Variable number	CP	Read current axis position (1 axis direct)	190
	Optional	PTST	Confirmation axis pattern	Confirmation position number	CC	Confirm position data	191
	Optional	PVEL	Speed [mm/sec]	Assignment-destination position number	CP	Assign position speed	192
	Optional	PACC	Acceleration [G]	Assignment-destination position number	CP	Assign position acceleration	193
	Optional	PDCL	Deceleration [G]	Assignment-destination position number	CP	Assign position deceleration	194
	Optional	PAXS	Axis-pattern assignment variable number	Position number	CP	Read axis pattern	195
	Optional	PSIZ	Size assignment variable number		CP	Confirm position size	196
	Optional	GVEL	Variable number	Position number	CP	Get speed data	197
	Optional	GACC	Variable number	Position number	CP	Get acceleration data	198
	Optional	GDCL	Variable number	Position number	CP	Get deceleration data	199
Actuator control declaration	Optional	VEL	Speed [mm/sec]	Prohibited	CP	Set speed	200
	Optional	OVRD	Speed ratio [%]	Prohibited	CP	Set speed coefficient	201
	Optional	ACC	Acceleration [G]	Prohibited	CP	Set acceleration	202
	Optional	DCL	Deceleration [G]	Prohibited	CP	Set deceleration	203
	Optional	SCRV	Ratio [%]	Prohibited	CP	Set sigmoid motion ratio	204
	Optional	OFST	Setting axis pattern	Offset value [mm]	CP	Set offset	205
	Optional	DEG	Division angle [deg]	Prohibited	CP	Set division angle	206
	Optional	BASE	Reference axis number	Prohibited	CP	Set reference axis	207
	Optional	GRP	Valid axis pattern	Prohibited	CP	Set group axes	208
	Optional	HOLD	(Input port to pause)	(HOLD type)	CP	Declare port to pause	209
	Optional	CANC	(Input port to abort)	(CANC type)	CP	Declare port to abort	210
	Optional	VLMX	Prohibited	Prohibited	CP	Specify VLMX speed	211
	Optional	ACMX	ACMX acceleration number	Prohibited	CP	Indicate ACMX acceleration	212
	Optional	DIS	Distance	Prohibited	CP	Set spline division distance	215
	Optional	POTP	0 or 1	Prohibited	CP	Set PATH output type	216
	Optional	PAPR	Distance	Speed	CP	Set PUSH command distance, speed	217
	Optional	QRTN	0 or 1	Prohibited	CP	Set quick-return mode	218

Operation type in the output field
CC: Command was executed successfully, ZR: Operation result is zero,
PE: Operation is complete, CP: Command part has passed, TU: Time up
EQ: Operand 1 = Operand 2, NE: Operand 1 ≠ Operand 2,
GT: Operand 1 > Operand 2, GE: Operand 1 ≥ Operand 2,
LT: Operand 1 < Operand 2, LE: Operand 1 ≤ Operand 2

Category	Condition	Command	Operand 1	Operand 2	Output	Function	Page
Actuator control command	Optional	SV□□	Operation axis pattern	Prohibited	PE	Servo [ON, OF]	220
	Optional	HOME	Home-return axis pattern	Prohibited	PE	Return to home	221
	Optional	MOVP	Destination position number	Prohibited	PE	Move to specified position	222
	Optional	MOVL	Destination position number	Prohibited	PE	Move to specified position via interpolation	223
	Optional	MVPI	Travel position number	Prohibited	PE	Move to relative position	224
	Optional	MVLI	Travel position number	Prohibited	PE	Move to relative position via interpolation	225
	Optional	PATH	Start position number	End position number	PE	Move along path	226
	Optional	J□W□	Axis operation pattern	Start I/O, flag	PE	Jog [FN, FF, BN, BF]	227
	Optional	STOP	Axis stop pattern	Prohibited	CP	Decelerate and stop axis	228
	Optional	PSPL	Start position number	End position number	PE	Move along spline	229
	Optional	PUSH	Target position number	Prohibited	PE	Move by push motion	230
	Optional	PTRQ	Axis pattern	Ratio [%]	CC	Change push torque limit parameter	232
	Optional	CIR2	Passing position 1 number	Passing position 2 number	PE	Move along circle 2 (arc interpolation)	233
	Optional	ARC2	Passing position number	End position number	PE	Move along arc 2 (arc interpolation)	234
	Optional	CIRS	Passing position 1 number	Passing position 2 number	PE	Move three-dimensionally along circle	235
	Optional	ARCS	Passing position number	Passing position number	PE	Move three-dimensionally along arc	236
	Optional	CHVL	Axis pattern	Speed	CP	Change speed	237
	Optional	ARCD	End position number	Center angle [deg]	PE	Move along arc via specification of end position and center angle	238
	Optional	ARCC	Center position number	Center angle [deg]	PE	Move along arc via specification of center position and center angle	239
	Optional	PBND	Axis pattern	Distance	CP	Set positioning band	240
	Optional	CIR	Passing position 1 number	Passing position 2 number	PE	Move along circle (CIR2 is recommended)	241
	Optional	ARC	Passing position number	End position number	PE	Move along arc (ARC2 is recommended)	242
	Refer to the page on palletizing for commands relating to arch motion.						
	Optional	ARCH	Position number	Position number	PE	Arch motion	295
	Optional	ACHZ	Axis number	Prohibited	CP	Declare arch-motion Z-axis	285
	Optional	ATRG	Position number	Position number	CP	Set arch trigger	286
	Optional	AEXT	(Position number)	Prohibited	CP	Set arch-motion composition	287
	Optional	OFAZ	Offset value	Prohibited	CP	Set arch-motion Z-axis offset	287
Structural IF	Optional	IF□□	Comparison variable	Comparison value	CP	Compare [EQ, NE, GT, GE, LT, LE]	243
	Optional	IS□□	Column number	Column number, character literal	CP	Compare strings	244
	Prohibited	ELSE	Prohibited	Prohibited	CP	Declare execution destination when IF command condition is not satisfied	245
	Prohibited	EDIF	Prohibited	Prohibited	CP	Declare end of IF	245
Structural DO	Optional	DW□□	Comparison variable	Comparison value	CP	Loop [EQ, NE, GT, GE, LT, LE]	246
	Optional	LEAV	Prohibited	Prohibited	CP	Pull out from DO	246
	Optional	ITER	Prohibited	Prohibited	CP	Repeat DO	247
	Prohibited	EDDO	Prohibited	Prohibited	CP	Declare end of DO	247
Multi-branching	Optional	SLCT	Prohibited	Prohibited	CP	Declare start of multi-branching	248
	Prohibited	WH□□	Comparison variable	Comparison value	CP	Branch value [EQ, NE, GT, GE, LT, LE]	249
	Prohibited	WS□□	Column number	Column number, character literal	CP	Branch character string [EQ, NE]	250
	Prohibited	OTHE	Prohibited	Prohibited	CP	Declare branching destination when condition is not satisfied	251
	Prohibited	EDSL	Prohibited	Prohibited	CP	Declare end of SLCT	251

Operation type in the output field
CC: Command was executed successfully, ZR: Operation result is zero,
PE: Operation is complete, CP: Command part has passed, TU: Time up
EQ: Operand 1 = Operand 2, NE: Operand 1 ≠ Operand 2,
GT: Operand 1 > Operand 2, GE: Operand 1 ≥ Operand 2,
LT: Operand 1 < Operand 2, LE: Operand 1 ≤ Operand 2

Category	Condition	Command	Operand 1	Operand 2	Output	Function	Page
System information acquisition	Optional	AXST	Variable number	Axis number	CP	Get axis status	252
	Optional	PGST	Variable number	Program number	CP	Get program status	253
	Optional	SYST	Variable number	Prohibited	CP	Get system status	254
Zone	Optional	WZNA	Zone number	Axis pattern	CP	Wait for zone ON, with AND	255
	Optional	WZNO	Zone number	Axis pattern	CP	Wait for zone ON, with OR	256
	Optional	WZFA	Zone number	Axis pattern	CP	Wait for zone OFF, with AND	257
	Optional	WZFO	Zone number	Axis pattern	CP	Wait for zone OFF, with OR	258
Communication	Optional	OPEN	Channel number	Prohibited	CP	Open channel	259
	Optional	CLOS	Channel number	Prohibited	CP	Close channel	259
	Optional	READ	Channel number	Column number	CC	Read from channel	260
	Optional	TMRW	Read timer setting	(Write timer setting)	CP	Set READ timeout value	262
	Optional	WRIT	Channel number	Column number	CC	Output to channel	263
	Optional	SCHA	Character code	Prohibited	CP	Set end character	264
String operation	Optional	SCPY	Column number	Column number, character literal	CC	Copy character string	265
	Optional	SCMP	Column number	Column number, character literal	EQ	Compare character strings	266
	Optional	SGET	Variable number	Column number, character literal	CP	Get character	267
	Optional	SPUT	Column number	Data	CP	Set character	268
	Optional	STR	Column number	Data	CC	Convert character string; decimal	269
	Optional	STRH	Column number	Data	CC	Convert character string; hexadecimal	270
	Optional	VAL	Variable number	Column number, character literal	CC	Convert character string data; decimal	271
	Optional	VALH	Variable number	Column number, character literal	CC	Convert character string data; hexadecimal	272
	Optional	SLEN	Character string length	Prohibited	CP	Set length	273

Operation type in the output field
CC: Command was executed successfully, ZR: Operation result is zero,
PE: Operation is complete, CP: Command part has passed, TU: Time up
EQ: Operand 1 = Operand 2, NE: Operand 1 ≠ Operand 2,
GT: Operand 1 > Operand 2, GE: Operand 1 ≥ Operand 2,
LT: Operand 1 < Operand 2, LE: Operand 1 ≤ Operand 2

Category	Condition	Command	Operand 1	Operand 2	Output	Function	Page
Palletizing-related	Optional	BGPA	Palletizing number	Prohibited	CP	Declare start of palletizing setting	274
	Prohibited	EDPA	Prohibited	Prohibited	CP	Declare end of palletizing setting	274
	Optional	PAPI	Count	Count	CP	Set palletizing counts	275
	Optional	PAPN	Pattern number	Prohibited	CP	Set palletizing pattern	275
	Optional	PASE	Axis number	Axis number	CP	Set palletizing axes	276
	Optional	PAPT	Pitch	Pitch	CP	Set palletizing pitches	276
	Optional	PAST	(Position number)	Prohibited	CP	Set palletizing reference point	277
	Optional	PAPS	Position number	Prohibited	CP	Set 3 palletizing points for teaching	278
	Optional	PSLI	Offset amount	(Count)	CP	Set zigzag	281
	Optional	PCHZ	(Axis number)	Prohibited	CP	Set palletizing Z-axis	282
	Optional	PTRG	Position number	Position number	CP	Set palletizing arch triggers	283
	Optional	PEXT	(Position number)	Prohibited	CP	Set palletizing composition	284
	Optional	OFPZ	Offset amount	Prohibited	CP	Set palletizing Z-axis offset	284
	Optional	ACHZ	Axis number	Prohibited	CP	Declare arch-motion Z-axis	285
	Optional	ATRG	Position number	Position number	CP	Set arch triggers	286
	Optional	AEXT	(Position number)	Prohibited	CP	Set arch-motion composition	287
	Optional	OFAZ	Offset amount	Prohibited	CP	Set arch-motion Z-axis offset	287
	Optional	PTNG	Palletizing number	Variable number	CP	Get palletizing position number	288
	Optional	PINC	Palletizing number	Prohibited	CC	Increment palletizing position number by 1	288
	Optional	PDEC	Palletizing number	Prohibited	CC	Decrement palletizing position number by 1	289
	Optional	PSET	Palletizing number	Data	CC	Set palletizing position number directly	289
	Optional	PARG	Palletizing number	Axis number	CP	Get palletizing angle	290
	Optional	PAPG	Palletizing number	Position number	CP	Get palletizing calculation data	290
	Optional	PMVP	Palletizing number	(Position number)	PE	Move to palletizing points via PTP	291
	Optional	PMVL	Palletizing number	(Position number)	PE	Move to palletizing points via interpolation	292
	Optional	PACH	Palletizing number	Position number	PE	Palletizing-point arch motion	293
	Optional	ARCH	Position number	Position number	PE	Arch motion	295
Building of pseudo-ladder task	Extension conditions LD (LOAD), A (AND), O (OR), AB (AND BLOCK) and OB (OR BLOCK) are supported.						
	Optional	CHPR	0 or 1	Prohibited	CP	Change task level	297
	Prohibited	TPCD	0 or 1	Prohibited	CP	Specify processing to be performed when input condition is not specified	297
	Prohibited	TSLP	Time	Prohibited	CP	Task sleep	298
	Optional	OUTR	Output, flag number	Prohibited	CP	Output relay for ladder	Ref. 328
	Optional	TIMR	Local flag number	Timer setting	CP	Timer relay for ladder	Ref. 328
Extended commands	Optional	ECMD	1	Axis number	CC	Get motor current value	299
	Optional	ECMD	2	Axis number	CC	Get home sensor status	300
	Optional	ECMD	3	Axis number	CC	Get overrun sensor status	301
	Optional	ECMD	4	Axis number	CC	Get creep sensor status	302
	Optional	ECMD	5	Axis pattern	CC	Axis operation status	303
	Optional	ECMD	20	Variable number	CC	Parameter value acquisition	304
	Optional	ECMD	250	Axis pattern	CC	Set torque limit/" torque limit over" detection time	305
	Optional	NTCH	Axis pattern	Parameter set number	CC	Vibration control parameter set selection	219

2. Alphabetical Order

Operation type in the output field
CC: Command was executed successfully,
ZR: Operation result is zero, PE: Operation is complete,
CP: Command part has passed, TU: Time up

EQ: Operand 1 = Operand 2, NE: Operand 1 ≠ Operand 2,
GT: Operand 1 > Operand 2, GE: Operand 1 ≥ Operand 2,
LT: Operand 1 < Operand 2, LE: Operand 1 ≤ Operand 2

Command	Page	Condition	Operand 1	Operand 2	Output	Function
A						
ABPG	182	Optional	End program number	(End program number)	CC	Abort other program
ACC	202	Optional	Acceleration	Prohibited	CP	Set acceleration
ACHZ	285	Optional	Axis number	Prohibited	CP	Declare arch-motion Z-axis
ACMX	212	Optional	ACMX acceleration number	Prohibited	CP	Indicate ACMX acceleration
ADD	153	Optional	Augend variable	Addend	ZR	Add
AEXT	287	Optional	(Position number)	Prohibited	CP	Set arch-motion composition
AND	159	Optional	AND operand variable	Operand	ZR	Logical AND
ARC	242	Optional	Passing position number	End position number	PE	Move along arc
ARC2	234	Optional	Passing position number	End position number	PE	Move along arc 2
ARCC	239	Optional	Center position number	Center angle	PE	Move along arc via specification of center position and center angle
ARCD	238	Optional	End position number	Center angle	PE	Move along arc via specification of end position and center angle
ARCH	295	Optional	Position number	Position number	PE	Arch motion
ARCS	236	Optional	Passing position number	Passing position number	PE	Move three-dimensionally along arc
ATN	157	Optional	Inverse-tangent assignment operation	Operand	ZR	Inverse tangent
ATRG	286	Optional	Position number	Position number	CP	Set arch trigger
AXST	252	Optional	Variable number	Axis number	CP	Get axis status
B						
BASE	207	Optional	Reference axis number	Prohibited	CP	Set reference axis
BGPA	274	Optional	Palletizing number	Prohibited	CP	Declare start of palletizing setting
BGSR	178	Prohibited	Declaration subroutine number	Prohibited	CP	Start subroutine
BTPF	168	Optional	Output port, flag	Timer setting	CP	Output OFF pulse
BTPN	167	Optional	Output port, flag	Timer setting	CP	Output ON pulse
BT□□	166	Optional	Start output, flag	(End output, flag)	CP	Output, flag [ON, OF, NT]
C						
CANC	210	Optional	(Input port to abort)	(CANC type)	CP	Declare port to abort
CHPR	297	Optional	0 or 1	Prohibited	CP	Change task level
CHVL	237	Optional	Axis pattern	Speed	CP	Change speed
CIR	241	Optional	Passing position 1 number	Passing position 2 number	PE	Move along circle
CIR2	233	Optional	Passing position 1 number	Passing position 2 number	PE	Move along circle 2
CIRS	235	Optional	Passing position 1 number	Passing position 2 number	PE	Move three-dimensionally along circle
CLOS	259	Optional	Channel number	Prohibited	CP	Close channel
CLR	152	Optional	Start-of-clear variable	End-of-clear variable	ZR	Clear variable
COS	156	Optional	Cosine assignment variable	Operand	ZR	Cosine
CP□□	162	Optional	Comparison variable	Comparison value	EQ NE GT GE LT LE	Compare
D						
DCL	203	Optional	Deceleration	Prohibited	CP	Set deceleration
DEG	206	Optional	Division angle	Prohibited	CP	Set division angle
DIS	215	Optional	Distance	Prohibited	CP	Set spline division distance
DIV	154	Optional	Dividend variable	Divisor	ZR	Divide
DW□□	246	Optional	Comparison variable	Comparison value	CP	Loop [EQ, NE, GT, GE, LT, LE]

Operation type in the output field
CC: Command was executed successfully, ZR: Operation result is zero,
PE: Operation is complete, CP: Command part has passed, TU: Time up
EQ: Operand 1 = Operand 2, NE: Operand 1 ≠ Operand 2,
GT: Operand 1 > Operand 2, GE: Operand 1 ≥ Operand 2,
LT: Operand 1 < Operand 2, LE: Operand 1 ≤ Operand 2

Command	Page	Condition	Operand 1	Operand 2	Output	Function
E						
ECMD	299	Optional	1	Axis number	CC	Get motor current value
ECMD	300	Optional	2	Axis number	CC	Get home sensor status
ECMD	301	Optional	3	Axis number	CC	Get overrun sensor status
ECMD	302	Optional	4	Axis number	CC	Get creep sensor status
ECMD	303	Optional	5	Axis number	CC	Axis operation status
ECMD	304	Optional	20	Variable number	CC	Parameter value acquisition
ECMD	305	Optional	250	Axis pattern	CC	Set torque limit/" torque limit over" detection time
EDDO	247	Prohibited	Prohibited	Prohibited	CP	Declare end of DO
EDIF	245	Prohibited	Prohibited	Prohibited	CP	Declare end of IF
EDPA	274	Prohibited	Prohibited	Prohibited	CP	Declare end of palletizing setting
EDSL	251	Prohibited	Prohibited	Prohibited	CP	Declare end of SLCT
EDSR	179	Prohibited	Prohibited	Prohibited	CP	End subroutine
ELSE	245	Prohibited	Prohibited	Prohibited	CP	Declare execution destination when IF command condition is not satisfied
EOR	161	Optional	Exclusive-OR operand variable	Operand	ZR	Logical exclusive-OR
EXIT	180	Optional	Prohibited	Prohibited	CP	End program
EXPG	181	Optional	Execution program number	(Execution program number)	CC	Start program
EXSR	178	Optional	Execution subroutine number	Prohibited	CP	Execute subroutine
F						
FMIO	174	Optional	Format type	Prohibited	CP	Set IN (B)/OUT (B) command format
G						
GACC	198	Optional	Variable number	Position number	CP	Get acceleration data
GDCL	199	Optional	Variable number	Position number	CP	Get deceleration data
GOTO	177	Optional	Jump-destination tag number	Prohibited	CP	Jump
GRP	208	Optional	Valid axis pattern	Prohibited	CP	Set group axes
GTTM	165	Optional	Time assignment variable	Prohibited	CP	Get time
GVEL	197	Optional	Variable number	Position number	CP	Get speed data
H						
HOLD	209	Optional	(Input port to pause)	(HOLD type)	CP	Declare port to pause
HOME	221	Optional	Home-return axis pattern	Prohibited	PE	Return to home
I						
IF□□	243	Optional	Comparison variable	Comparison value	CP	Compare [EQ, NE, GT, GE, LT, LE]
INB	171	Optional	Head I/O, flag	Conversion digits	CC	Input BCD (8 digits max.)
IN	170	Optional	Head I/O, flag	End I/O, flag	CC	Input binary (32 bits max.)
IS□□	244	Optional	Column number	Column number, character literal	CP	Compare strings
ITER	247	Optional	Prohibited	Prohibited	CP	Repeat DO
J						
J□W□	227	Optional	Axis operation pattern	Start I/O, flag	PE	Jog [FN, FF, BN, BF]
L						
LEAV	246	Optional	Prohibited	Prohibited	CP	Pull out from DO
LET	151	Optional	Assignment variable	Assigned value	ZR	Assign

Operation type in the output field
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PE: Operation is complete, CP: Command part has passed, TU: Time up
EQ: Operand 1 = Operand 2, NE: Operand 1 ≠ Operand 2,
GT: Operand 1 > Operand 2, GE: Operand 1 ≥ Operand 2,
LT: Operand 1 < Operand 2, LE: Operand 1 ≤ Operand 2

Command	Page	Condition	Operand 1	Operand 2	Output	Function
M						
MOD	155	Optional	Remainder assignment variable	Divisor	ZR	Calculate remainder
MOVL	223	Optional	Destination position number	Prohibited	PE	Move to specified position via interpolation
MOVP	222	Optional	Destination position number	Prohibited	PE	Move to specified position
MULT	154	Optional	Multiplicand variable	Multiplier	ZR	Multiply
MVLI	225	Optional	Travel position number	Prohibited	PE	Move to relative position via interpolation
MVPI	224	Optional	Travel position number	Prohibited	PE	Move to relative position
N						
NTCH	219	Optional	Axis pattern	Parameter set number	PE	Vibration control parameter set selection
O						
OFAZ	287	Optional	Offset amount	Prohibited	CP	Set arch-motion Z-axis offset
OFPZ	284	Optional	Offset amount	Prohibited	CP	Set palletizing Z-axis offset
OFST	205	Optional	Setting axis pattern	Offset value	CP	Set offset
OPEN	259	Optional	Channel number	Prohibited	CP	Open channel
OR	160	Optional	OR operand variable	Operand	ZR	Logical OR
OTHE	251	Prohibited	Prohibited	Prohibited	CP	Declare branching destination when condition is not satisfied
OUT	172	Optional	Head output, flag	End I/O, flag	CC	Output binary (32 bits max.)
OUTB	173	Optional	Head output, flag	Conversion digits	CC	Output BCD (8 digits max.)
OUTR	328	Optional	Output, flag number	Prohibited	CP	Output relay for ladder
OVRD	201	Optional	Speed ratio	Prohibited	CP	Set speed ratio
P						
PACC	193	Optional	Acceleration	Assignment-destination position number	CP	Assign position acceleration
PACH	293	Optional	Palletizing number	Position number	PE	Palletizing-point arch motion
PAPG	290	Optional	Palletizing number	Position number	CP	Get palletizing calculation data
PAPI	275	Optional	Count	Count	CP	Set palletizing counts
PAPN	275	Optional	Pattern number	Prohibited	CP	Set palletizing pattern
PAPR	217	Optional	Distance	Speed	CP	Set PUSH command distance, speed
PAPS	278	Optional	Position number	Prohibited	CP	Set 3 palletizing points for teaching
PAPT	276	Optional	Pitch	Pitch	CP	Set palletizing pitches
PARG	290	Optional	Palletizing number	Axis number	CP	Get palletizing angle
PASE	276	Optional	Axis number	Axis number	CP	Set palletizing axes
PAST	277	Optional	(Position number)	Prohibited	CP	Set palletizing reference point
PATH	226	Optional	Start position number	End position number	PE	Move along path
PAXS	195	Optional	Axis-pattern assignment variable number	Position number	CP	Read axis pattern
PBND	240	Optional	Axis pattern	Distance	CP	Set positioning band
PCHZ	282	Optional	(Axis number)	Prohibited	CP	Set palletizing Z-axis
PCLR	187	Optional	Start position number	End position number	CP	Clear position data
PCPY	188	Optional	Copy-destination position number	Copy-source position number	CP	Copy position data
PDCL	194	Optional	Deceleration	Assignment-destination position number	CP	Assign position deceleration
PDEC	289	Optional	Palletizing number	Prohibited	CC	Decrement palletizing position number by 1
PEXT	284	Optional	(Position number)	Prohibited	CP	Set palletizing composition
PGET	185	Optional	Axis number	Position number	CC	Assign position to variable 199
PGST	253	Optional	Variable number	Program number	CP	Get program status
PINC	288	Optional	Palletizing number	Prohibited	CC	Increment palletizing position number by 1
PMVL	292	Optional	Palletizing number	(Position number)	PE	Move to palletizing points via interpolation
PMVP	291	Optional	Palletizing number	(Position number)	PE	Move to palletizing points via PTP

Operation type in the output field
CC: Command was executed successfully, ZR: Operation result is zero,
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EQ: Operand 1 = Operand 2, NE: Operand 1 ≠ Operand 2,
GT: Operand 1 > Operand 2, GE: Operand 1 ≥ Operand 2,
LT: Operand 1 < Operand 2, LE: Operand 1 ≤ Operand 2

Command	Page	Condition	Operand 1	Operand 2	Output	Function
P						
POTP	216	Optional	0 or 1	Prohibited	CP	Set PATH output type
PPUT	186	Optional	Axis number	Position number	CP	Write position data
PRDQ	190	Optional	Axis number	Variable number	PE	Read current axis position (1 axis direct)
PRED	189	Optional	Read axis pattern	Save-destination position number	CP	Read current axis position
PSET	289	Optional	Palletizing number	Data	CP	Set palletizing position number directly
PSIZ	196	Optional	Size assignment variable number		CP	Confirm position size
PSLI	281	Optional	Offset amount	(Count)	CP	Set zigzag
PSPL	229	Optional	Start position number	End position number	CC	Move along spline
PTNG	288	Optional	Palletizing number	Variable number	CP	Get palletizing position number
PTRG	283	Optional	Position number	Position number	CP	Set palletizing arch triggers
PTRQ	232	Optional	Axis pattern	Ratio	CE	Change push torque limit parameter
PTST	191	Optional	Confirmation axis pattern	Confirmation position number	CP	Confirm position data
PUSH	230	Optional	Target position number	Prohibited	PE	Move by push motion
PVEL	192	Optional	Speed	Assignment-destination position number	CP	Assign position speed
Q						
QRTN	218	Optional	0 or 1	Prohibited	CP	Set quick-return mode
R						
READ	260	Optional	Channel number	Column number	CC	Read from channel
RSPG	184	Optional	Resumption program number	(Resumption program number)	CC	Resume program
S						
SCHA	264	Optional	Character code	Prohibited	CP	Set end character
SCMP	266	Optional	Column number	Column number, character literal	EQ	Compare character strings
SCPY	265	Optional	Column number	Column number, character literal	CC	Copy character string
SCRV	204	Optional	Ratio	Prohibited	CP	Set sigmoid motion ratio
SGET	267	Optional	Variable number	Column number, character literal	CP	Get character
SIN	156	Optional	Sine assignment variable	Operand	ZR	Sine
SLCT	248	Optional	Prohibited	Prohibited	CP	Declare start of multi-branching
SLEN	273	Optional	Character string length	Prohibited	CP	Set length
SPUT	268	Optional	Column number	Data	CP	Set character
SQR	158	Optional	Root assignment variable	Operand	ZR	Root
SSPG	183	Optional	Pause program number	(Pause program number)	CC	Pause program
STOP	228	Optional	Axis stop pattern	Prohibited	CP	Decelerate and stop axis
STR	269	Optional	Column number	Data	CC	Convert character string; decimal
STRH	270	Optional	Column number	Data	CC	Convert character string; hexadecimal
SUB	153	Optional	Minuend variable	Subtrahend	ZR	Subtract
SV□□	220	Optional	Operation axis pattern	Prohibited	PE	Servo [ON, OF]
SYST	254	Optional	Variable number	Prohibited	CP	Get system status

Operation type in the output field
CC: Command was executed successfully, ZR: Operation result is zero,
PE: Operation is complete, CP: Command part has passed, TU: Time up
EQ: Operand 1 = Operand 2, NE: Operand 1 ≠ Operand 2,
GT: Operand 1 > Operand 2, GE: Operand 1 ≥ Operand 2,
LT: Operand 1 < Operand 2, LE: Operand 1 ≤ Operand 2

Command	Page	Condition	Operand 1	Operand 2	Output	Function
T						
TAG	177	Prohibited	Declaration tag number	Prohibited	CP	Declare jump destination
TAN	157	Optional	Tangent assignment variable	Operand	ZR	Tangent
TIMC	164	Optional	Program number	Prohibited	CP	Cancel waiting
TIMR	328	Optional	Local flag number	Timer setting	CP	Timer relay for ladder
TIMW	163	Optional	Wait time	Prohibited	TU	Wait
TMRW	262	Optional	Read timer setting	(Write timer setting)	CP	Set READ timeout value
TPCD	297	Prohibited	0 or 1	Prohibited	CP	Specify processing to be performed when input condition is not specified
TRAN	151	Optional	Copy-destination variable	Copy-source variable	ZR	Copy
TSLP	298	Prohibited	Time	Prohibited	CP	Task sleep
V						
VAL	271	Optional	Variable number	Column number, character literal	CC	Convert character string data; decimal
VALH	272	Optional	Variable number	Column number, character literal	CC	Convert character string data; hexadecimal
VEL	200	Optional	Speed	Prohibited	CP	Set speed
VLMX	211	Optional	Prohibited	Prohibited	CP	Specify VLMX speed
W						
WH□□	249	Prohibited	Comparison variable	Comparison value	CP	Branch value [EQ, NE, GT, GE, LT, LE]
WRIT	263	Optional	Channel number	Column number	CC	Output to channel
WS□□	250	Prohibited	Column number	Column number, character literal	CP	Branch character string [EQ, NE]
WT□□	169	Optional	I/O, flag	(Wait time)	TU	Wait for I/O, flag [ON, OF]
WZFA	257	Optional	Zone number	Axis pattern	CP	Wait for zone OFF, with AND
WZFO	258	Optional	Zone number	Axis pattern	CP	Wait for zone OFF, with OR
WZNA	255	Optional	Zone number	Axis pattern	CP	Wait for zone ON, with AND
WZNO	256	Optional	Zone number	Axis pattern	CP	Wait for zone ON, with OR

RC Gateway Function Commands (Controller with Gateway Function Only)

* For commands relating to the RC gateway function, refer to the “Operation Manual for XSEL Controller P/Q/PCT/QCT/PX/QX RC Gateway Function.”

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EQ: Operand 1 = Operand 2, NE: Operand 1 ≠ Operand 2, GT: Operand 1 > Operand 2, GE: Operand 1 ≥ Operand 2, LT: Operand 1 < Operand 2, LE: Operand 1 ≤ Operand 2

Category	Condition	Command	How RC position data is used		Operand 1	Operand 2	Output	Function	
			Within XSEL	Within RC					
RC-axis position operations	Optional	RPGT	○	X	RC-axis number	Position number	CC	Assign RC-axis position to variable 199	
	Optional	RPPT	○	X	RC-axis number	Position number	CP	Assign content of variable 199 to RC-axis position	
	Optional	RPCR	○	X	RC-axis number	Variable number	CP	Clear RC-axis position data	
	Optional	RPCP	○	X	RC-axis number	Variable number	CP	Copy RC-axis position data	
	Optional	RPRD	○	X	Position number	Prohibited	CP	Read current RC-axis position	
	Optional	RPRQ	○	○	RC-axis number	Variable number	CP	Read current RC-axis position (direct reading for one axis)	
	Optional	RPVL	○	X	RC-axis number	Position number	CP	Assign content of variable 199 to speed under RC-axis position	
	Optional	RPAD	○	X	RC-axis number	Position number	CP	Assign content of variable 199 to acceleration/deceleration under RC-axis position	
	Optional	RPIP	○	X	RC-axis number	Position number	CP	Assign content of variable 199 to positioning band under RC-axis position	
	Optional	RPTQ	○	X	RC-axis number	Position number	CP	Assign content of variable 199 to current-limiting value under RC-axis position	
	Optional	RGVL	○	X	RC-axis number	Position number	CP	Assign speed under RC-axis position to variable 199	
	Optional	RGAD	○	X	RC-axis number	Position number	CP	Assign acceleration/deceleration under RC-axis position to variable 199	
	Optional	RGIP	○	X	RC-axis number	Position number	CP	Assign positioning band under RC-axis position to variable 199	
	Optional	RGTQ	○	X	RC-axis number	Position number	CP	Assign current-limiting value under RC-axis position to variable 199	
RC-actuator control commands	Optional	RAXS	○	○	Axis pattern, upper byte	Axis pattern, lower byte	CP	Set RC-axis pattern	
	Optional	RSCN	○	○	Prohibited	Prohibited	PE	Turn RC-axis servo ON	
	Optional	RSOF	○	○	Prohibited	Prohibited	PE	Turn RC-axis servo OFF	
	Optional	RHCM	○	○	Prohibited	Prohibited	PE	Return RC-axis to home	
	Optional	RMVP	○	○	Position number	Prohibited	PE	Move RC-axis via position specification	
	Optional	RMPI	○	X	Position number	Prohibited	PE	Move RC-axis position relatively	
	Optional	RMVD	○	X	RC-axis number	Variable number	PE	Move RC-axis via direct value specification	
	Optional	RMDI	○	X	RC-axis number	Variable number	PE	Move RC-axis relatively via direct value specification	
	Optional	RPUS	○	X	RC-axis number	Position number	PE	Move RC-axis via push-motion action	
	Optional	RSTP	○	○	Prohibited	Prohibited	PE	Decelerate RC-axis to stop	
RC-axis information acquisition	Optional	RCST	○	○	Variable number	RC-axis number	PE	Acquire RC-axis status	

Commands Relating to Electronic Cam Function (Applicable only to controllers with electronic cam function)

*** For the details of electronic cam commands, refer to the "Operation Manual for XSEL Controller P/Q/PCT/QCT: Electronic Cam Function."**

Operation type in the output field
CC: Command was executed successfully, CP: Command part has passed, PE: Operation is complete

Category	Condition	Command	Operand 1	Operand 2	Output	Function	
Extended motion board input operation	Optional	XCRP	Pulse input channel number	Prohibited	CP	Pulse I/O board axis input counter clear	
	Optional	XGTP	Pulse input channel number	Prohibited	CP	Pulse I/O board axis input counter present value acquisition	
Extended motion board axis position operation	Optional	XPGT	Axis number	Position number	CC	Pulse I/O board axis position data read	
	Optional	RPPT	Axis number	Position number	CP	Pulse I/O board axis position data write	
	Optional	XPCR	Axis number	Variable number	CP	Pulse I/O board axis position data clear	
	Optional	XPCP	Axis number	Variable number	CP	Pulse I/O board axis position data copy	
	Optional	XPRD	Position number	Prohibited	CP	Pulse I/O board axis current command position read	
	Optional	XPRQ	Axis number	Variable number	CP	Pulse I/O board axis current command position read (1-axis direct)	
	Optional	XPVL	Axis number	Position number	CP	Pulse I/O board axis speed data write	
	Optional	XPAC	Axis number	Position number	CP	Pulse I/O board axis acceleration data write	
	Optional	XPDC	Axis number	Position number	CP	Pulse I/O board axis deceleration data write	
	Optional	XPIP	Axis number	Position number	CP	Pulse I/O board axis positioning complete band data write	
	Optional	XGVL	Axis number	Position number	CP	Pulse I/O board axis speed data read	
	Optional	XGAC	Axis number	Position number	CP	Pulse I/O board axis acceleration data read	
	Optional	XGDC	Axis number	Position number	CP	Pulse I/O board axis deceleration data read	
	Optional	XGIP	Axis number	Position number	CP	Pulse I/O board axis positioning band data read	
Extended motion board axis actuator control declaration	Optional	XAXS	Axis pattern, upper byte	Axis pattern, upper byte	CP	Pulse I/O board axis extended pattern setting	
Extended motion board axis actuator control command	Optional	XSON	Prohibited	Axis pattern, lower byte	CP	Pulse I/O board axis servo ON	
	Optional	XSOF	Prohibited	Prohibited	CP	Pulse I/O board axis servo OFF	
	Optional	XHOM	Prohibited	Prohibited	PE	Pulse I/O board axis home return	
	Optional	XMVP	Position number	Prohibited	PE	Pulse I/O board axis move to specified position	
	Optional	XMPI	Position number	Prohibited	PE	Pulse I/O board axis move to relative position	
	Optional	XMVL	Position number	Prohibited	PE	Pulse I/O board axis move by interpolation to specified position	
	Optional	XMLI	Position number	Prohibited	PE	Pulse I/O board axis move by interpolation to relative position	
	Optional	XMVD	Axis number	Variable number	PE	Pulse I/O board axis move to absolute position by direct value specification	
	Optional	XMDI	Axis number	Variable number	PE	Pulse I/O board axis move to relative position by direct value specification	
	Optional	XPED	Prohibited	Prohibited	PE	Pulse I/O board axis in use by own program – Wait for end of axis positioning operation	
	Optional	XSTP	Prohibited	Prohibited	PE	Pulse I/O board axis movement stop	
	Optional	XCAS	Slave axis number	Variable number	PE	Pulse I/O board axis synchronization electronic cams (principle axis specification) synchronization start	
	Optional	XCTM	Slave axis number	Variable number	PE	Pulse I/O board axis independent electronic cam (time specification) movement	
	Optional	XSFS	Slave axis number	Variable number	PE	Pulse I/O board axis electronic shaft synchronization start	
	Optional	XSYE	Slave axis number	(End type)	PE	Pulse I/O board axis synchronization operation end	
Extended motion board axis status acquisition	Optional	XAST	Variable number	Axis number	CP	Pulse I/O board axis status acquisition	

Chapter 2 Explanation of Commands

1. Commands

1.1 Variable Assignment

● LET (Assign)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	LET	Variable number	Data	ZR

[Function] Assign the value specified in operand 2 to the variable specified in operand 1.
The output will turn ON when 0 is assigned to the variable specified in operand 1.

[Example 1]	LET	1	10	Assign 10 to variable 1.
[Example 2]	LET	1	2	Assign 2 to variable 1.
	LET	3	10	Assign 10 to variable 3.
	LET	*1	*3	Assign the content of variable 3 (10) to the variable of the content of variable 1 (variable 2).

● TRAN (Copy)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	TRAN	Variable number	Variable number	ZR

[Function] Assign the content of the variable specified in operand 2 to the variable specified in operand 1.
The output will turn ON when 0 is assigned to the variable specified in operand 1.

[Example 1]	TRAN	1	2	Assign the content of variable 2 to variable 1.
	LET	1	*2	A LET command of the same effect as the above operation
[Example 2]	LET	1	2	Assign 2 to variable 1.
	LET	2	3	Assign 3 to variable 2.
	LET	3	4	Assign 4 to variable 3.
	LET	4	10	Assign 10 to variable 4.
	TRAN	*1	*3	Assign the content of variable 3 (which is variable 4, or 10) to the variable of the content of variable 1 (variable 2).

The variables change as follows:

1	2	3	4		1	2	3	4
2	3	4	10	→	2	10	4	10

- CLR (Clear variable)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	CLR	Variable number	Variable number	ZR

[Function] Clear the variables from the one specified in operand 1 through the other specified in operand 2.
The contents of the variables that have been cleared become 0.
The output will turn ON when 0 is assigned to the variable specified in operand 1.

[Example 1]	CLR	1	5	Clear variables 1 through 5.
[Example 2]	LET	1	10	Assign 10 to variable 1.
	LET	2	20	Assign 20 to variable 2.
	CLR	*1	*2	Clear the variables from the content of variable 1 (variable 10) through the content of variable 2 (variable 20).

1.2 Arithmetic Operation

- ADD (Add)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	ADD	Variable number	Data	ZR

[Function] Add the content of the variable specified in operand 1 and the value specified in operand 2, and assign the result to the variable specified in operand 1.
The output will turn ON when the operation result becomes 0.

[Example 1]	LET	1	3	Assign 3 to variable 1.
	ADD	1	2	Add 2 to the content of variable 1 (3). 5 (3+2=5) will be stored in variable 1.
[Example 2]	LET	1	2	Assign 2 to variable 1.
	LET	2	3	Assign 3 to variable 2.
	LET	3	2	Assign 2 to variable 3.
	ADD	*1	*3	Add the content of variable 3 (2) to the content of variable 1 (variable 2). 5 (3+2=5) will be stored in variable 2.

- SUB (Subtract)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	SUB	Variable number	Data	ZR

[Function] Subtract the value specified in operand 2 from the content of the variable specified in operand 1, and assign the result to the variable specified in operand 1.
The output will turn ON when the operation result becomes 0.

[Example 1]	LET	1	3	Assign 3 to variable 1.
	SUB	1	2	Subtract 2 from the content of variable 1 (3). 1 (3–2=1) will be stored in variable 1.
[Example 2]	LET	1	2	Assign 2 to variable 1.
	LET	2	3	Assign 3 to variable 2.
	LET	3	2	Assign 2 to variable 3.
	SUB	*1	*3	Subtract the content of variable 3 (2) from the content of variable 1 (variable 2). 1 (3–2=1) will be stored in variable 2.

● MULT (Multiply)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	MULT	Variable number	Data	ZR

[Function] Multiply the content of the variable specified in operand 1 by the value specified in operand 2, and assign the result to the variable specified in operand 1.
The output will turn ON when the operation result becomes 0.

[Example 1]	LET	1	3	Assign 3 to variable 1.
	MULT	1	2	Multiply the content of variable 1 (3) by 2. 6 (3x2=6) will be stored in variable 1.
[Example 2]	LET	1	2	Assign 2 to variable 1.
	LET	2	3	Assign 3 to variable 2.
	LET	3	2	Assign 2 to variable 3.
	MULT	*1	*3	Multiply the content of variable 1 (variable 2) by the content of variable 3 (2). 6 (3x2=6) will be stored in variable 2.

● DIV (Divide)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	DIV	Variable number	Data	ZR

[Function] Divide the content of the variable specified in operand 1 by the value specified in operand 2, and assign the result to the variable specified in operand 1.
The output will turn ON when the operation result becomes 0.

(Note) If the variable specified in operand 1 is an integer variable, any decimal places will be rounded off.

[Example 1]	LET	1	6	Assign 6 to variable 1.
	DIV	1	2	Divide the content of variable 1 (6) by 2. 3 (6÷2=3) will be stored in variable 1.
[Example 2]	LET	1	2	Assign 2 to variable 1.
	LET	2	6	Assign 6 to variable 2.
	LET	3	2	Assign 2 to variable 3.
	DIV	*1	*3	Divide the content of variable 1 (variable 2) by the content of variable 3 (2). 3 (6÷2=3) will be stored in variable 2.

● MOD (Remainder of division)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	MOD	Variable number	Data	ZR

[Function] Assign, to the variable specified in 1, the remainder obtained by dividing the content of the variable specified in operand 1 by the value specified in operand 2.
The output will turn ON when the operation result becomes 0.

(Note) A MOD command is used with integer variables.

[Example 1]	LET	1	7	Assign 7 to variable 1.
	MOD	1	3	Obtain the remainder of dividing the content of variable 1 (7) by 3. 1 (7÷3=2 with a remainder of 1) will be assigned to variable 1.

[Example 2]	LET	1	2	Assign 2 to variable 1.
	LET	2	7	Assign 7 to variable 2.
	LET	3	3	Assign 3 to variable 3.
	MOD	*1	*3	Obtain the remainder of dividing the content of variable 1 (variable 2) by the content of variable 3 (3). 1 (7÷3=2 with a remainder of 1) will be assigned to variable 2.

1.3 Function Operation

- SIN (Sine operation)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	SIN	Variable number	Data	ZR

[Function] Assign the sine of the data specified in operand 2 to the variable specified in operand 1.
The output will turn ON when the operation result becomes 0.
The setting in operand 1 must be a real variable in a range of 100 to 199, 1100 to 1199, 300 to 399 or 1300 to 1399.
The unit of data in operand 2 is radian.

(Note 1) Radian = Angle x $\pi \div 180$

[Example 1]	SIN	100	0.523599	Assign the sine of 0.523599 (0.5) to variable 100.
[Example 2]	LET	1	100	Assign 100 to variable 1.
	LET	101	30	30 x $\pi \div 180$ (radian) (30° will be converted to radian and assigned to variable 101.)
	MULT	101	3.141592	
	DIV	101	180	
	SIN	*1	*101	Assign the sine of the content of variable 101 (0.5) to the content of variable 1 (variable 100).

- COS (Cosine operation)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	COS	Variable number	Data	ZR

[Function] Assign the cosine of the data specified in operand 2 to the variable specified in operand 1.
The output will turn ON when the operation result becomes 0.
The setting in operand 1 must be a real variable in a range of 100 to 199, 1100 to 1199, 300 to 399 or 1300 to 1399.
The unit of data in operand 2 is radian.

(Note 1) Radian = Angle x $\pi \div 180$

[Example 1]	COS	100	1.047197	Assign the cosine of 1.047197 (0.5) to variable 100.
[Example 2]	LET	1	100	Assign 100 to variable 1.
	LET	101	60	60 x $\pi \div 180$ (radian) (60° will be converted to radian and assigned to variable 101.)
	MULT	101	3.141592	
	DIV	101	180	
	COS	*1	*101	Assign the cosine of the content of variable 101 (0.5) to the content of variable 1 (variable 100).

- TAN (Tangent operation)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	TAN	Variable number	Data	ZR

[Function] Assign the tangent of the data specified in operand 2 to the variable specified in operand 1.
The output will turn ON when the operation result becomes 0.
The setting in operand 1 must be a real variable in a range of 100 to 199, 1100 to 1199, 300 to 399 or 1300 to 1399.
The unit of data in operand 2 is radian.

(Note 1) Radian = Angle x π ÷ 180

[Example 1]

TAN	100	0.785398	Assign the tangent of 0.785398 (1) to variable 100.

[Example 2]

LET	1	100	Assign 100 to variable 1.
LET	101	45	45 x π ÷ 180 (radian)
MULT	101	3.141592	(45° will be converted to radian and assigned to
DIV	101	180	variable 101.)
TAN	*1	*101	Assign the tangent of the content of variable 101 (1) to the content of variable 1 (variable 100).

- ATN (Inverse-tangent operation)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	ATN	Variable number	Data	ZR

[Function] Assign the inverse tangent of the data specified in operand 2 to the variable specified in operand 1.
The output will turn ON when the operation result becomes 0.
The setting in operand 1 must be a real variable in a range of 100 to 199, 1100 to 1199, 300 to 399 or 1300 to 1399.
The unit of inverse tangent is radian.

(Note 1) Radian = Angle x π ÷ 180

[Example 1]

ATN	100	1	Assign the inverse tangent of 1 (0.785398) to variable 100.

[Example 2]

LET	1	100	Assign 100 to variable 1.
LET	101	1	Assign 1 to variable 101.
ATN	*1	*101	Assign the inverse tangent of the content of variable 101 (0.785398) to the content of variable 1 (variable 100).

● SQR (Root operation)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	SQR	Variable number	Data	ZR

[Function] Assign the root of the data specified in operand 2 to the variable specified in operand 1. The output will turn ON when the operation result becomes 0.

[Example 1]	SQR	1	4	Assign the root of 4 (2) to variable 1.
[Example 2]	LET	1	10	Assign 10 to variable 1.
	LET	2	4	Assign 4 to variable 2.
	SQR	*1	*2	Assign the root of the content of variable 2 (4) to the content of variable 1 (variable 10).

1.4 Logical Operation

- AND (Logical AND)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	AND	Variable number	Data	ZR

[Function] Assign the logical AND operation result of the content of the variable specified in operand 1 and the value specified in operand 2, to the variable specified in operand 1.
The output will turn ON when the operation result becomes 0.

[Example 1]	LET	1	204	Assign 204 to variable 1.
	AND	1	170	Assign the logical AND operation result (136) of the content of variable 1 (204) and 170, to variable 1.

[Example 2]	LET	1	2	Assign 2 to variable 1.
	LET	2	204	Assign 204 to variable 2.
	LET	3	170	Assign 170 to variable 3.
	AND	*1	*3	Assign the logical AND operation result (136) of the content of variable 1 (which is variable 2, or 204) and the content of variable 3 (170), to the content of variable 1 (variable 2).

	Decimal		Binary
	204		11001100
AND	170	AND	10101010
	136		10001000

- OR (Logical OR)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	OR	Variable number	Data	ZR

[Function] Assign the logical OR operation result of the content of the variable specified in operand 1 and the value specified in operand 2, to the variable specified in operand 1.
The output will turn ON when the operation result becomes 0.

[Example 1]	LET	1	204	Assign 204 to variable 1.
	OR	1	170	Assign the logical OR operation result (238) of the content of variable 1 (204) and 170, to variable 1.
[Example 2]	LET	1	2	Assign 2 to variable 1.
	LET	2	204	Assign 204 to variable 2.
	LET	3	170	Assign 170 to variable 3.
	OR	*1	*3	Assign the logical OR operation result (238) of the content of variable 1 (which is variable 2, or 204) and the content of variable 3 (170), to the content of variable 1 (variable 2).

Decimal	Binary
204	11001100
OR 170	OR 10101010
238	11101110

- EOR (Logical exclusive-OR)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	EOR	Variable number	Data	ZR

[Function] Assign the logical exclusive-OR operation result of the content of the variable specified in operand 1 and the value specified in operand 2, to the variable specified in operand 1.
The output will turn ON when the operation result becomes 0.

[Example 1]	LET	1	204	Assign 204 to variable 1.
	EOR	1	170	Assign the logical exclusive-OR operation result (102) of the content of variable 1 (204) and 170, to variable 1.
[Example 2]	LET	1	2	Assign 2 to variable 1.
	LET	2	204	Assign 204 to variable 2.
	LET	3	170	Assign 170 to variable 3.
	EOR	*1	*3	Assign the logical exclusive-OR operation result (102) of the content of variable 1 (which is variable 2, or 204) and the content of variable 3 (170), to the content of variable 1 (variable 2).

Decimal	Binary
204	11001100
EOR 170	EOR 10101010
102	01100110

1.5 Comparison Operation

● CP□□ (Compare)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	CP□□	Variable number	Data	EQ NE GT GE LT LE

[Function] The output will be turned ON if the comparison result of the content of the variable specified in operand 1 and the value specified in operand 2 satisfies the condition.
The value in the variable does not change.
The output will be turned OFF if the condition is not satisfied.

(Note) The output will not be turned OFF when the command is executed.

CP□□
- EQ .... Operand 1 = Operand 2
- NE .... Operand 1 ≠ Operand 2
- GT .... Operand 1 > Operand 2
- GE .... Operand 1 ≥ Operand 2
- LT .... Operand 1 < Operand 2
- LE .... Operand 1 ≤ Operand 2

[Example 1]

	LET	1	10		Assign 10 to variable 1.
	CPEQ	1	10	600	Turn ON flag 600 if the content of variable 1 is 10.
600	ADD	2	1		Add 1 to variable 2 if flag 600 is ON.

[Example 2]

	LET	1	2		Assign 2 to variable 1.
	LET	2	10		Assign 10 to variable 2.
	LET	3	10		Assign 10 to variable 3.
	CPEQ	*1	*3	310	Turn ON output 310 if the content of variable 1 (variable 2) is equal to the content of variable 3.

1.6 Timer

- TIMW (Timer)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	TIMW	Time	Prohibited	TU

[Function] Stop the program and wait for the time specified in operand 1.
The setting range is 0.01 to 99, and the unit is second.
The output will turn ON when the specified time has elapsed and the program proceeds to the next step.

[Example 1]

```
TIMW    1.5             Wait for 1.5 seconds.
```

[Example 2]

```
LET     1       10      Assign 10 to variable 1.
TIMW    *1              Wait for the content of variable 1 (10 seconds).
```

● TIMC (Cancel timer)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	TIMC	Program number	Prohibited	CP

[Function] Cancel a timer in other program running in parallel.

(Note) Timers in TIMW, WTON, WTOF and READ commands can be cancelled. In the case of WTON, WTOF and READ commands, even if timeout is not specified it is assumed that an unlimited timer has been specified and the wait time will be cancelled.

[Example 1]

```
TIMC     10                     Cancel the wait time in program 10.
```

[Example 2]

```
LET      1    10                Assign 10 to variable 1.
TIMC     *1                     Cancel the wait time in the content of variable 1
                                (program 10).
```

[Example 3]

```
Program 1          Program 10

    :                  :
    :              WTON 8 20          Program 10 waits for input 8 for 20 seconds.
    :              (Wait for input 8)
TIMC     10        (Wait for input 8) Cancel the wait time in program 10.
    :                  :
```

(Note) The steps shown in the above example represent those executed simultaneously in different programs.

- GTTM (Get time)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	GTTM	Variable number	Prohibited	CP

[Function] Read system time to the variable specified in operand 1. The time is specified in units of 10 milliseconds.
The time obtained here has no base number. Therefore, this command is called twice and the difference will be used to calculate the elapsed time.

[Example 1]

```
GTTM   1          Read the reference time to variable 1.
ADD    1    500   Set the ending time to 5 seconds later.
GTTM   2          Read the current system time to variable 2.
DWLE   2    *1    Proceed to the step next to EDDO when 5 seconds elapsed.
  :               The above process will be repeated for 5 seconds.
  :
GTTM   2          Read the current system time to variable 2.
EDDO
```

[Example 2]

```
LET    1    5     Assign 5 to variable 1.
GTTM   *1         Store the current system time in the content of variable 1
                  (variable 5).
```

(Note) The system time is counted in 32 bits, where the time the controller is started represents 0. Accordingly, the elapsed time during a given period during continuous operation up to approx. 248 days (2147836.47 seconds) after the controller is started can be checked from the difference between the two acquired times.

1.7 I/O, Flag Operation

● BT□□ (Output port, flag operation)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	BT□□	Output, flag	(Output, flag)	CP

[Function] Reverse the ON/OFF status of the output ports or flags from the one specified in operand 1 through the other specified in operand 2.

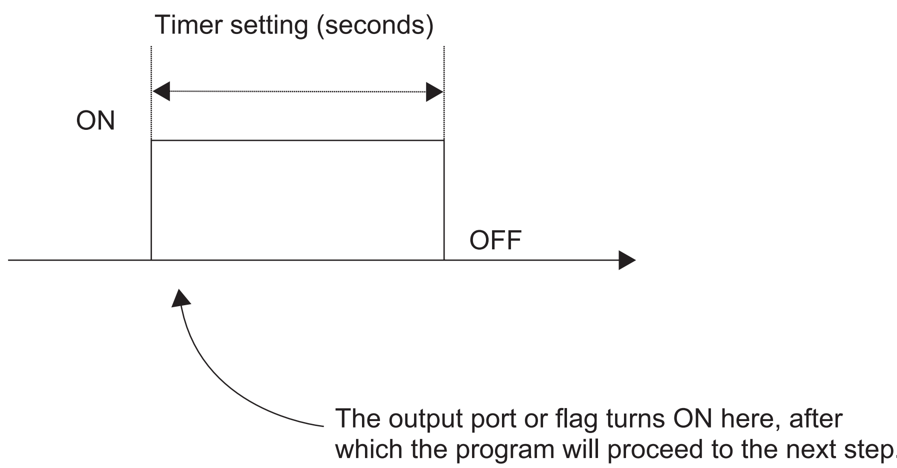
```
BT□□
 └─┬─ON ............ Switch the status to ON.
   ├─OF ............ Switch the status to OFF.
   └─NT ............ Reverse the status.
```

[Example 1]	BTON	300		Turn ON output port 300.
[Example 2]	BTOF	300	307	Turn OFF output ports 300 through 307.
[Example 3]	LET	1	600	Assign 600 to variable 1.
	BTNT	*1		Reverse the content of variable 1 (flag 600).
[Example 4]	LET	1	600	Assign 600 to variable 1.
	LET	2	607	Assign 607 to variable 2.
	BTON	*1	*2	Turn ON the flags from the content of variable 1 (flag 600) through the content of variable 2 (flag 607).

- BTPN (Output ON pulse)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	BTPN	Output port, flag	Timer setting	CP

[Function] Turn ON the specified output port or flag for the specified time.
When this command is executed, the output port or flag specified in operand 1 will be turned ON and then the program will proceed to the next step. The output port or flag will be turned OFF automatically upon elapse of the timer setting specified in operand 2.
The timer is set in a range from 0.01 to 99.00 seconds (including up to two decimal places).



(Note 1) If this command is executed with respect to an output port or flag already ON, the output port or flag will be turned OFF upon elapse of the timer setting.

(Note 2) If the program ends after the command has been executed but before the timer is up, the output port or flag will not be turned OFF.

(Note 3) This command will not be cancelled by a TIMC command.

(Note 4) A maximum of 16 timers, including BTPN and BTPF, can be operated simultaneously in a single program. (There is no limitation as to how many times these timers can be used in a single program.)

(Note 5) If other task or interruption process cuts in after the port was turned ON and before it is turned OFF again, an error will occur in the pulse output time. Accordingly, this command cannot be used to output an ON pulse over a specified time.

(Note 6) Dedicated outputs (system outputs) other than general-purpose outputs cannot be specified in operand 1.

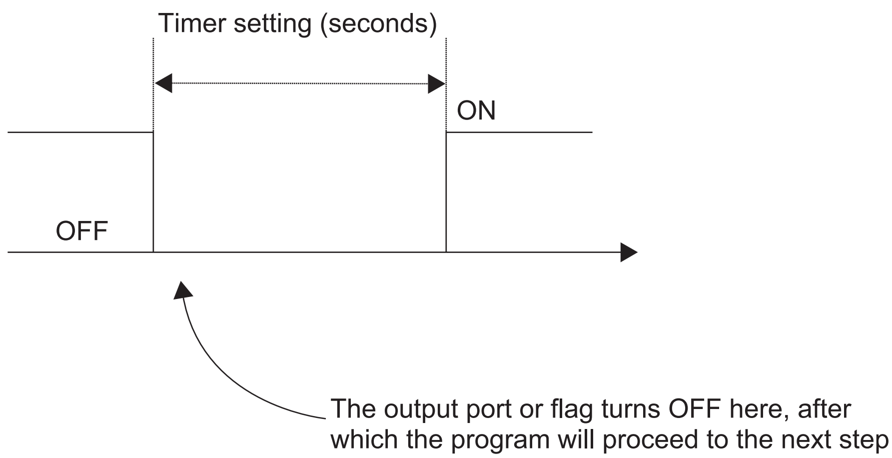
[Example]

BTPN	300	1	Turn ON output port 300 for 1 second.
BTPN	600	10	Turn ON flag 600 for 10 seconds.

- BTPF (Output OFF pulse)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	BTPF	Output port, flag	Timer setting	CP

[Function] Turn OFF the specified output port or flag for the specified time.
When this command is executed, the output port or flag specified in operand 1 will be turned OFF and then the program will proceed to the next step. The output port or flag will be turned ON automatically upon elapse of the timer setting specified in operand 2.
The timer is set in a range from 0.01 to 99.00 seconds (including up to two decimal places).



(Note 1) If this command is executed with respect to an output port or flag already OFF, the output port or flag will be turned ON upon elapse of the timer setting.

(Note 2) If the program ends after the command has been executed but before the timer is up, the output port or flag will not be turned ON.

(Note 3) This command will not be cancelled by a TIMC command.

(Note 4) A maximum of 16 timers, including BTPN and BTPF, can be operated simultaneously in a single program. (There is no limitation as to how many times these timers can be used in a single program.)

(Note 5) If other task or interruption process cuts in after the port was turned ON and before it is turned OFF again, an error will occur in the pulse output time. Accordingly, this command cannot be used to output an ON pulse over a specified time.

(Note 6) Dedicated outputs (system outputs) other than general-purpose outputs cannot be specified in operand 1.

[Example]

BTPF	300	1	Turn OFF output port 300 for 1 second.
BTPF	600	10	Turn OFF flag 600 for 10 seconds.

● WT□□ (Wait for I/O port, flag)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	WT□□	I/O, flag	(Time)	TU

[Function] Wait for the I/O port or flag specified in operand 1 to turn ON/OFF.
The program can be aborted after the specified time by setting the time in operand 2.
The setting range is 0.01 to 99 seconds.
The output will turn ON upon elapse of the specified time (only when operand 2 is specified).
Note) A local flag cannot be entered in operand 1.

```
WT□□
 └┬ON ............ Wait for the applicable I/O port or flag to turn ON.
  └OF ............ Wait for the applicable I/O port or flag to turn OFF.
```

[Example 1]	WTON	15		Wait for input port 15 to turn ON.
[Example 2]	WTOF	308	10	Wait for 10 seconds for output port 308 to turn OFF.
[Example 3]	LET	1	600	Assign 600 to variable 1.
	WTON	*1		Wait for the content of variable 1 (flag 600) to turn ON.
[Example 4]	LET	1	8	Assign 8 to variable 1.
	LET	2	5	Assign 5 to variable 2.
	WTOF	*1	*2	Wait for the content of variable 2 (5 seconds) for the content of variable 1 (input port 8) to turn OFF.

- IN (Read I/O, flag as binary)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	IN	I/O, flag	I/O, flag	CC

[Function] Read the I/O ports or flags from the one specified in operand 1 through the other specified in operand 2, to variable 99 as a binary.

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	.... Binary
15	14	13	12	11	10	9	8	.... Input port number
ON	OFF	OFF	OFF	OFF	ON	OFF	ON	

⇩

1	0	0	0	0	1	0	1	.... Binary

$2^7 + 0 + 0 + 0 + 0 + 2^2 + 0 + 2^0$

$128 + 0 + 0 + 0 + 0 + 4 + 0 + 1 = 133$

⇩

133 .... Variable 99

(Note 1) A maximum of 32 bits can be input.

(Note 2) When 32 bits have been input and the most significant bit is ON, the value read to variable 99 will be treated as a negative value.

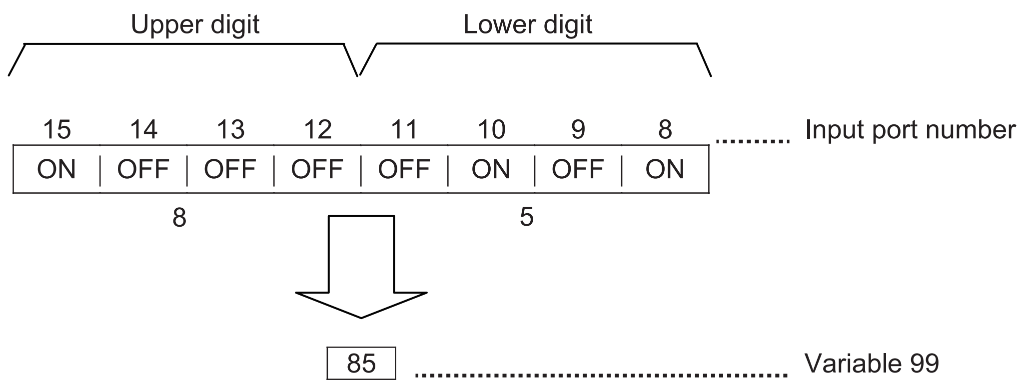
(Note 3) The read data format can be changed using a FMIO command (refer to the section on FMIO command).

[Example 1]	IN	8	15	Read input ports 8 through 15, to variable 99 as a binary.
[Example 2]	LET	1	8	Assign 8 to variable 1.
	LET	2	15	Assign 15 to variable 2.
	IN	*1	*2	Read the input ports from the content of variable 1 (input port 8) through the content of variable 2 (input port 15), to variable 99 as a binary.

- INB (Read I/O, flag as BCD)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	INB	I/O, flag	BCD digits	CC

[Function] Read the I/O ports or flags from the one specified in operand 1 for the number of digits specified in operand 2, to variable 99 as a BCD.



(Note 1) A maximum of eight digits (32 bits) can be input.

(Note 2) The number of I/O ports and flags that can be used is 4 x n (digits).

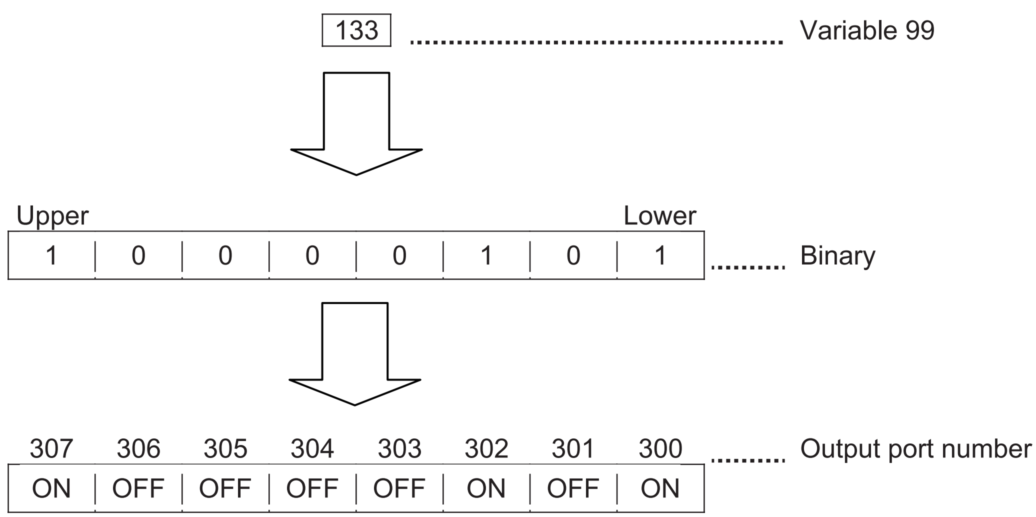
(Note 3) The read data format can be changed using a FMIO command (refer to the section on FMIO command).

[Example 1]	INB	8	2	Read input ports 8 through 15, to variable 99 as a BCD.
[Example 2]	LET	1	8	Assign 8 to variable 1.
	LET	2	2	Assign 2 to variable 2.
	INB	*1	*2	Read the input ports from the content of variable 1 (input port 8) for the content of variable 2 (two digits) (until input port 15), to variable 99 as a BCD.

- OUT (Write output, flag as binary)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	OUT	Output, flag	Output, flag	CC

[Function] Write the value in variable 99 to the output ports or flags from the one specified in operand 1 through the other specified in operand 2.



(Note 1) A maximum of 32 bits can be output.

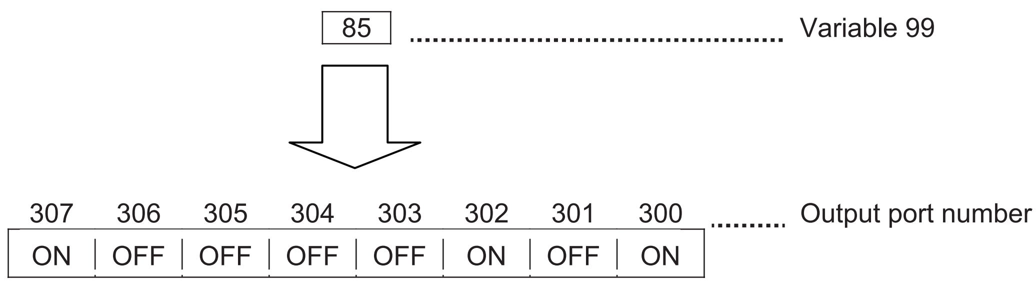
(Note 2) The write data format can be changed using a FMIO command (refer to the section on FMIO command).

[Example 1]	OUT	300	307	Write the value in variable 99 to output ports 300 through 307 as a binary.
[Example 2]	LET	1	300	Assign 300 to variable 1.
	LET	2	307	Assign 307 to variable 2.
	OUT	*1	*2	Write the value in variable 99 to the output ports from the content of variable 1 (output port 300) through the content of variable 2 (output port 307) as a binary.

- OUTB (Write output, flag as BCD)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	OUTB	Output, flag	BCD digits	CC

[Function] Write the value in variable 99 to the output ports or flags from the one specified in operand 1 for the number of digits specified in operand 2 as a BCD.



(Note 1) A maximum of eight digits (32 bits) can be output.

(Note 2) The number of output ports and flags that can be used is 4 x n (digits).

(Note 3) The write data format can be changed using a FMIO command (refer to the section on FMIO command).

[Example 1]	OUTB	300	2	Write the value in variable 99 to the output ports from 300 for two digits (until output port 307) as a BCD.
[Example 2]	LET	1	300	Assign 300 to variable 1.
	LET	2	2	Assign 2 to variable 2.
	OUTB	*1	*2	Write the value in variable 99 to the output ports from the content of variable 1 (output port 300) for the content of variable 2 (two digits) (until output port 307) as a BCD.

- FMIO (Set IN, INB, OUT, OUTB command format)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	FMIO	Format type	Prohibited	CP

[Function] Set the data format for reading or writing I/O ports and flags with an IN, INB, OUT or OUTB command.

(1) Operand 1 = 0 (Default status when a FMIO command has not been executed)
Data is read or written without being reversed.

							(I/O, flag number upper)		(I/O, flag number lower)	
01234567h	⇔	01h	23h	45h	67h	⇔	0000 0001	0010 0011	0100 0101	0110 0111
Variable 99		Temporary data					I/O port, flag status (0 = OFF, 1 = ON)			

OUT(B) command →

← IN(B) command

(2) Operand 1 = 1
Data is read or written after its upper eight bits and lower eight bits are reversed every 16 bits.

							(I/O, flag number upper)		(I/O, flag number lower)	
01234567h	⇔	23h	01h	67h	45h	⇔	0010 0011	0000 0001	0110 0111	0100 0101
Variable 99							I/O port, flag status (0 = OFF, 1 = ON)			

Temporary data

OUT(B) command →

← IN(B) command

(3) Operand 1 = 2
Data is read or written after its upper 16 bits and lower 16 bits are reversed every 32 bits.

							(I/O, flag number upper)		(I/O, flag number lower)	
01234567h	⇔	45h	67h	01h	23h	⇔	0100 0101	0110 0111	0000 0001	0010 0011
Variable 99							I/O port, flag status (0 = OFF, 1 = ON)			

Temporary data

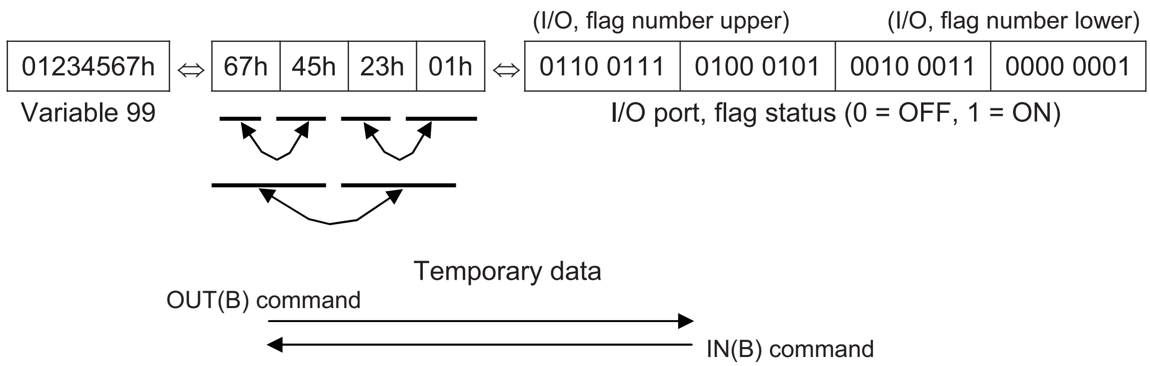
OUT(B) command →

← IN(B) command

Part 4 Commands

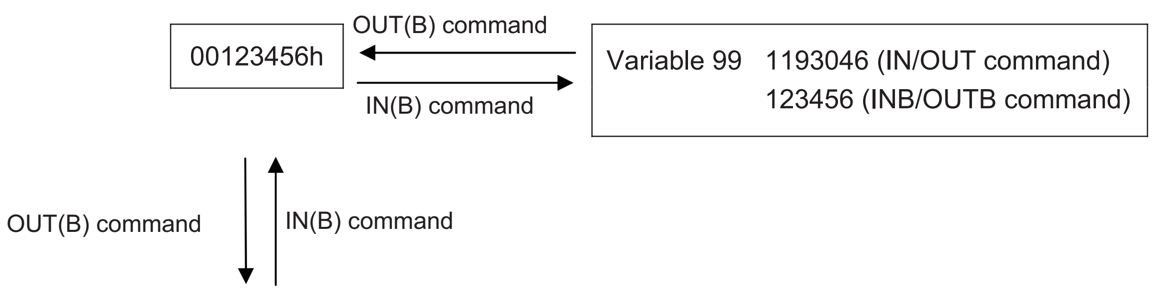
Chapter 2 Explanation of Commands

(4) Operand 1 = 3
Data is read or written after its upper 16 bits and lower 16 bits are reversed every 32 bits and its upper eight bits and lower eight bits are reversed every 16 bits.



(Note) FMIO command is supported in PC software version 2.0.45 or later and teaching pendant version 1.13 or later.

[Example 1] Variable 99 = 00123456h (Decimal: 1193046, BCD: 123456)



	Temporary data					I/O port, flag status (0 = OFF, 1 = ON) (I/O, flag number upper)		(I/O, flag number lower)	
FMIO = 0	00h	12h	34h	56h	⇔	0000 0000	0001 0010	0011 0100	0101 0110
FMIO = 1	12h	00h	56h	34h	⇔	0001 0010	0000 0000	0101 0110	0011 0100
FMIO = 2	34h	56h	00h	12h	⇔	0011 0100	0101 0110	0000 0000	0001 0010
FMIO = 3	56h	34h	12h	00h	⇔	0101 0110	0011 0100	0001 0010	0000 0000

OUT(B) command →
← IN(B) command

[Example 2] Variable 99 = 00001234h (Decimal: 4660, BCD: 1234)

00001234h → OUT(B) command → Variable 99 4660 (IN/OUT command), 1234 (INB/OUTB command)
00001234h ← IN(B) command ← Variable 99

OUT(B) command ↓ ↑ IN(B) command

	Temporary data					I/O, flag number upper		I/O, flag number lower	
FMIO = 0	00h	00h	12h	34h	⇔	0000 0000	0000 0000	0001 0010	0011 0100
FMIO = 1	00h	00h	34h	12h	⇔	0000 0000	0000 0000	0011 0100	0001 0010
FMIO = 2	12h	34h	00h	00h	⇔	0001 0010	0011 0100	0000 0000	0000 0000
FMIO = 3	34h	12h	00h	00h	⇔	0011 0100	0001 0010	0000 0000	0000 0000

Temporary data → OUT(B) command → I/O port, flag status (0 = OFF, 1 = ON)
Temporary data ← IN(B) command ← I/O port, flag status

[Example 3] Variable 99 = 00000012h (Decimal: 18, BCD: 12)

00000012h → OUT(B) command → Variable 99 18 (IN/OUT command), 12 (INB/OUTB command)
00000012h ← IN(B) command ← Variable 99

OUT(B) command ↓ ↑ IN(B) command

	Temporary data					I/O, flag number upper		I/O, flag number lower	
FMIO = 0	00h	00h	00h	12h	⇔	0000 0000	0000 0000	0000 0000	0001 0010
FMIO = 1	00h	00h	12h	00h	⇔	0000 0000	0000 0000	0001 0010	0000 0000
FMIO = 2	00h	12h	00h	00h	⇔	0000 0000	0001 0010	0000 0000	0000 0000
FMIO = 3	12h	00h	00h	00h	⇔	0001 0010	0000 0000	0000 0000	0000 0000

Temporary data → OUT(B) command → I/O port, flag status (0 = OFF, 1 = ON)
Temporary data ← IN(B) command ← I/O port, flag status

1.8 Program Control

- GOTO (Jump)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	GOTO	Tag number	Prohibited	CP

[Function] Jump to the position of the tag number specified in operand 1.

(Note) A GOTO command is valid only within the same program.

[Example 1]

```
TAG     1       Set a tag.
 :
 :
 :
GOTO    1       Jump to tag 1.
```

Using a GOTO command to branch out of or into any of the syntaxes listed below is prohibited.

Since the maximum number of nests is defined for each conditional branching command or subroutine call, a nest will be infinitely repeated if an ED☐☐ is not passed, and a nest overflow error will generate. In the case of palletizing setting, an error will generate if the second BGPA is declared after the first BGPA declaration without passing an EDPA.

(1) IF☐☐ or IS☐☐ and EDIF syntax
(2) DW☐☐ and EDDO syntax
(3) SLCT and EDSL syntax
(4) BGSR and EDSR syntax
(5) BGPA and EDPA syntax

- TAG (Declare tag)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Prohibited	Prohibited	TAG	Tag number	Prohibited	CP

[Function] Set the tag number specified in operand 1.

[Example 1] Refer to the section on GOTO command.

- EXSR (Execute subroutine)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	EXSR	Subroutine number	Prohibited	CP

[Function] Execute the subroutine specified in operand 1.
A maximum of 15 nested subroutine calls are supported.

(Note) This command is valid only for subroutines within the same program.

[Example 1]

```
EXSR   1          Execute subroutine 1.
  :
  :
EXIT
BGSR   1          Start subroutine 1.
  :
  :
  :
EDSR              End subroutine 1.
```

[Example 2]

```
LET    1    10    Assign 10 to variable 1.
EXSR   *1         Execute the content of variable 1 (subroutine 10).
```

- BGSR (Start subroutine)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Prohibited	Prohibited	BGSR	Subroutine number	Prohibited	CP

[Function] Declare the start of the subroutine specified in operand 1.

[Example 1] Refer to the section on EXSR command.

(Note) Using a GOTO command to branch out of or into a BGSR-EDSR syntax is prohibited.

- EDSR (End subroutine)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Prohibited	Prohibited	EDSR	Prohibited	Prohibited	CP

[Function] Declare the end of a subroutine.
This command is always required at the end of a subroutine.
Thereafter, the program will proceed to the step next to the EXSR that has been called.

[Example 1] Refer to the section on EXSR command.

1.9 Task Management

- EXIT (End program)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	EXIT	Prohibited	Prohibited	CP

[Function] End the program.
If the last step has been reached without encountering any EXIT command, the program will return to the beginning.

(Note) Status at program end

- Output ports.......................Retained
- Local flags.........................Cleared
- Local variables...................Cleared
- Current values....................Retained
- Global flags........................Retained
- Global variables..................Retained

[Example 1]

```
:
:
EXIT        End the program.
```

- EXPG (Start other program)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	EXPG	Program number	(Program number)	CC

[Function] Start the programs from the one specified in operand 1 through the other specified in operand 2, and run them in parallel. Specification in operand 1 only is allowed.

[Example 1] EXPG 10 12 Start program Nos. 10, 11 and 12.

Error-generation/output-operation conditions
When one EXPG program is specified (only operand 1 is specified)

Status of the specified program	No program number error *1			Program number error *1
	Program already registered		Program not yet registered	
	Program running	Program not running		
Error	A57 “Multiple program start error”	None	C03 “Non-registered program specification error”	C2C “Program number error”
Output operation	ON	ON	OFF	OFF

* The errors shown in the table represent those that generate in accordance with the status of the specified program. Errors caused by other factors are excluded.
* 1 --- A program number error indicates that a number smaller than 1 or exceeding the maximum number of supported programs has been specified.

When multiple EXPG programs are specified (both operands 1 and 2 are specified)

Status of the specified program	No program number error *2			Program number error *1
	Registered program exists inside the specified range *3		None of programs inside the specified range are registered	
	Running program exists inside the specified range	None of programs inside the specified range are running		
Error	A57 “Multiple program start error”	None	C03 “Non-registered program specification error”	C2C “Program number error”
Output operation	ON	ON	OFF	OFF

* The errors shown in the table represent those that generate in accordance with the status of the specified program. Errors caused by other factors are excluded.
* 2 --- Program number error indicates specification of a number smaller than 1 or exceeding 64.
* 3 --- In this case, non-registered programs inside the specified range are not treated as a target of operation. This will not affect error generation or output operation.

- ABPG (Abort other program)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	ABPG	Program number	(Program number)	CC

[Function] Forcibly end the programs from the one specified in operand 1 to the other specified in operand 2. Specification in operand 1 only is allowed.

(Note 1) If an ABPG command is issued while a movement command is being executed, the axes will immediately decelerate and stop.

(Note 2) Not only the operation but also the execution of the step itself will be terminated.

[Example 1] ABPG 10 12 End program Nos. 10, 11 and 12.

Error-generation/output-operation conditions

When one ABPG program is specified (only operand 1 is specified)

Status of the specified program	No program number error *1			Program number error *1
	Program already registered		Program not yet registered	
	Program running	Program not running		
Error	None	None	None	C2C “Program number error”
Output operation	ON (OFF *2)	ON	ON	OFF

* The errors shown in the table represent those that generate in accordance with the status of the specified program. Errors caused by other factors are excluded.

* 1 --- A program number error indicates that a number smaller than 1 or exceeding the maximum number of supported programs has been specified.

* 2 --- If an own task (own program) is specified in an ABPG command, the own task will be terminated and then deleted. The output will turn OFF.

When multiple ABPG programs are specified (both operands 1 and 2 are specified)

Status of the specified program	No program number error *3			Program number error *1
	Registered program exists inside the specified range *4		None of programs inside the specified range are registered	
	Running program exists inside the specified range	None of programs inside the specified range are running		
Error	None	None	None	C2C “Program number error”
Output operation	ON (OFF *5)	ON	ON	OFF

* The errors shown in the table represent those that generate in accordance with the status of the specified program. Errors caused by other factors are excluded.

* 3 --- Program number error indicates specification of a number smaller than 1 or exceeding 64.

* 4 --- In this case, non-registered programs inside the specified range are not treated as a target of operation. This will not affect error generation or output operation.

* 5 --- If an own task (own program) is included in the specified range, the own task will be terminated, upon which the processing of the ABPG command will end. Since the own task will be deleted, the result of ending the processing of specified programs will become indeterminable. Exercise caution. The output will always turn OFF regardless of the result.

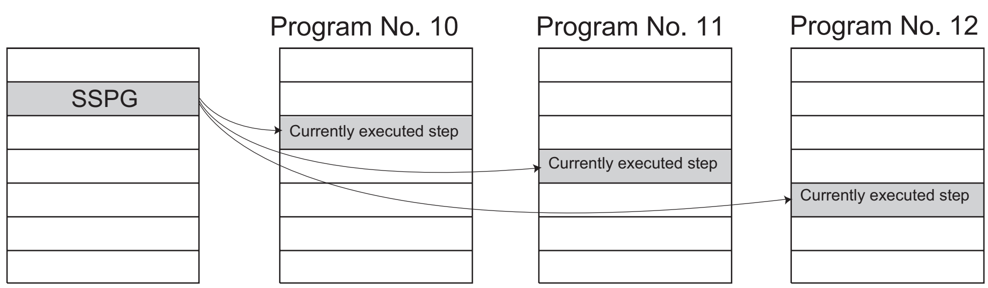
- SSPG (Pause program)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	SSPG	Program number	(Program number)	CC

[Function] Pause the program from the one specified in operand 1 through the other specified in operand 2, at the current step. Specification in operand 1 only is allowed.

(Note 1) Pausing a program will also pause the operation the program has been executing.
(Note 2) Not only the operation but also the execution of the step itself will be paused.

[Example 1] SSPG 10 12 Pause program Nos. 10, 11 and 12 at the current step.



Error-generation/output-operation conditions
When one SSPG program is specified (only operand 1 is specified)

Status of the specified program	No program number error *1			Program number error *1
	Program already registered		Program not yet registered	
	Program running	Program not running		
Error	None	None	C03 “Non-registered program specification error”	C2C “Program number error”
Output operation	ON	OFF	OFF	OFF

* The errors shown in the table represent those that generate in accordance with the status of the specified program. Errors caused by other factors are excluded.
* 1 --- A program number error indicates that a number smaller than 1 or exceeding the maximum number of supported programs has been specified.

When multiple SSPG programs are specified (both operands 1 and 2 are specified)

Status of the specified program	No program number error *2			Program number error *1
	Registered program exists inside the specified range *3		None of programs inside the specified range are registered	
	Running program exists inside the specified range *4	None of programs inside the specified range are running		
Error	None	None	C03 “Non-registered program specification error”	C2C “Program number error”
Output operation	ON	OFF	OFF	OFF

* The errors shown in the table represent those that generate in accordance with the status of the specified program. Errors caused by other factors are excluded.
* 2 --- A program number error indicates that a number smaller than 1 or exceeding the maximum number of supported programs has been specified.
* 3 --- In this case, non-registered programs inside the specified range are not treated as a target of operation with EXPG, ABPG, SSPG and PSPG commands. This will not affect error generation or output operation.
* 4 --- In this case, programs not running (but already registered) inside the specified range are not treated as a target of operation with SSPG and RSPG commands. This will not affect error generation or output operation.

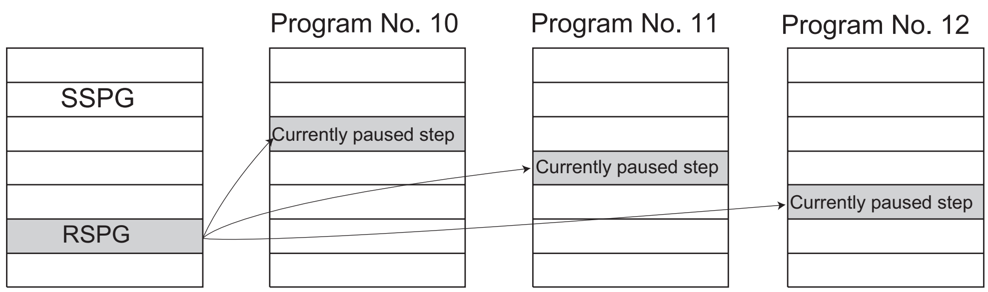
- RSPG (Resume program)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	RSPG	Program number	(Program number)	CC

[Function] Resume the programs from the one specified in operand 1 through the other specified in operand 2. Specification in operand 1 only is allowed.

(Note 1) Resuming a program will also resume the operation the program had been executing before the pause.

[Example 1] RSPG 10 12 Resume program Nos. 10, 11 and 12 from the paused step.



Error-generation/output-operation conditions
When one RSPG program is specified (only operand 1 is specified)

Status of the specified program	No program number error *1			Program number error *1
	Program already registered		Program not yet registered	
	Program running	Program not running		
Error	None	None	C03 "Non-registered program specification error"	C2C "Program number error"
Output operation	ON	OFF	OFF	OFF

* The errors shown in the table represent those that generate in accordance with the status of the specified program. Errors caused by other factors are excluded.
* 1 --- A program number error indicates that a number smaller than 1 or exceeding the maximum number of supported programs has been specified.

When multiple RSPG programs are specified (both operands 1 and 2 are specified)

Status of the specified program	No program number error *2			Program number error *1
	Registered program exists inside the specified range *3		None of programs inside the specified range are registered	
	Running program exists inside the specified range *4	None of programs inside the specified range are running		
Error	None	None	C03 "Non-registered program specification error"	C2C "Program number error"
Output operation	ON	OFF	OFF	OFF

* The errors shown in the table represent those that generate in accordance with the status of the specified program. Errors caused by other factors are excluded.
* 2 --- A program number error indicates that a number smaller than 1 or exceeding the maximum number of supported programs has been specified.
* 3 --- In this case, non-registered programs inside the specified range are not treated as a target of operation. This will not affect error generation or output operation.
* 4 --- In this case, programs not running (but already registered) inside the specified range are not treated as a target of operation with SSPG and RSPG commands. This will not affect error generation or output operation.

1.10 Position Operation

- PGET (Read position data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PGET	Axis number	Position number	CC

[Function] Read to variable 199 the data of the axis number specified in operand 1 in the position data specified in operand 2.
Even if a PGET command is executed, data will not be stored in variable 199 (the PGET command will not be executed) if there is no position data to be read (the position data fields on the teaching pendant show "X.XXX" or the position data fields in the PC software are blank).

[Example 1]	PGET	2	3	Read to variable 199 the data of axis 2 at position 3.
[Example 2]	LET	1	2	Assign 2 to variable 1.
	LET	2	3	Assign 3 to variable 2.
	PGET	*1	*2	Read to variable 199 the data of the content of variable 1 (axis 2) at the content of variable 2 (position 3).

- PPUT (Write position data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PPUT	Axis number	Position number	CP

[Function] Write the value in variable 199 to the axis number specified in operand 1 in the position data specified in operand 2.

[Example 1]	LET	199	150	Assign 150 to variable 199.
	PPUT	2	3	Write the content of variable 199 (150) to axis 2 at position 3.

[Example 2]	LET	199	150	Assign 150 to variable 199.
	LET	1	2	Assign 2 to variable 1.
	LET	2	3	Assign 3 to variable 2
	PPUT	*1	*2	Write the content of variable 199 (150) to the content of variable 1 (axis 2) at the content of variable 2 (position 3).

- PCLR (Clear position data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PCLR	Position number	Position number	CP

[Function] Clear the position data from the one specified in operand 1 through the other specified in operand 2.
The cleared data will be in the condition without a data and will not be 0.000. The position data display will read X.XXX on the teaching pendant and blank on the PC software.

[Example 1]

```
PCLR    10    20    Clear the data from position Nos. 10 through 20.
```

[Example 2]

```
LET     1     10    Assign 10 to variable 1.
LET     2     20    Assign 20 to variable 2.
PCLR    *1    *2    Clear the data of the content of variable 1 (position 10)
                    through the content of variable 2 (position 20).
```

- PCPY (Copy position data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PCPY	Position number	Position number	CP

[Function] Copy the position data specified in operand 2 to the position number specified in operand 1.

[Example 1]	PCPY	20	10	Copy the data of position No. 10 to position No. 20.
[Example 2]	LET	1	20	Assign 20 to variable 1.
	LET	2	10	Assign 10 to variable 2.
	PCPY	*1	*2	Copy the data of the content of variable 2 (position 10) to the content of variable 1 (position 20).

● PRED (Read current position)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PRED	Axis pattern	Position number	CP

[Function] Read the current position of the axis specified in operand 1 to the position specified in operand 2.

[Example 1]	PRED	11	10	Read the current positions of axes 1 and 2 to position No. 10.

[Example 2] The axis pattern can be specified indirectly using a variable.
When the command in [Example 1] is rephrased based on indirect specification using a variable:
11 (binary) → 3 (decimal)

LET	1	3	Assign 3 to variable 1.
PRED	*1	10	

[Example 3]	LET	1	10	Assign 10 to variable 1.
	PRED	11	*1	Read the current positions of axes 1 and 2 to the content of variable 1 (position 10).

- PRDQ (Read current axis position (1 axis direct))

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PRDQ	Axis number	Variable number	CP

This command can be input using the PC software of version 1.1.0.5 or later or teaching pendant of version 1.05 or later.

[Function] Read the current position of the axis number specified in operand 1 to the variable specified in operand 2.
The current position can be obtained more quickly than when a PRED command is used.
The current position of a synchronized slave axis can also be read.

[Example] PRDQ 2 100 Read the current position of axis 2 to variable 100.

- PTST (Check position data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PTST	Axis pattern	Position number	CC

[Function] Check if valid data is contained in the axis pattern specified in operand 1 at the position number specified in operand 2.
The output will turn ON if none of the data specified by the axis pattern is available (the position data fields on the teaching pendant show “X.XXX” or the position data fields in the PC software are blank). “0” is treated as valid data.

[Example 1] PTST 11 10 300 Turn ON output 300 if there are no valid values of axes 1 and 2 at position 10.
Output 300 will turn OFF if the position data is given as follows:

[Example 2] The axis pattern can be specified indirectly using a variable.
When the command in [Example 1] is rephrased based on indirect specification using a variable:
11 (binary) → 3 (decimal)

```
LET    1     3            Assign 3 to variable 1.
PTST   *1    10    300
```

[Example 3]

```
LET    1     11           Assign 11 to variable 1.
PTST   11    *1    600    Turn ON flag 600 if there are no valid values in the data
                          of axes 1 and 2 at the content of variable 1 (position
                          11).
                          Flag 600 will turn ON if the position data is given as
                          follows:
```

No.	Axis 1	Axis 2	Axis 3	Speed	Acceleration	Deceleration
10	100.000	50.000				
11			200.000			

Part 4 Commands

Chapter 2 Explanation of Commands

● PVEL (Assign speed data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PVEL	Speed	Position number	CP

[Function] Write the speed specified in operand 1 to the position number specified in operand 2.

(Note) If a negative value is written with a PVEL command, an alarm will generate when that position is specified in a movement operation, etc. Exercise caution.

[Example 1]	PVEL	100	10	Write speed 100 mm/s to position No. 10.
[Example 2]	LET	1	100	Assign 100 to variable 1.
	LET	2	10	Assign 10 to variable 2.
	PVEL	*1	*2	Write the content of variable 1 (speed 100 mm/s) to the content of variable 2 (position 10).

● PACC (Assign acceleration data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PACC	Acceleration	Position number	CP

[Function] Write the acceleration specified in operand 1 to the position number specified in operand 2.

(Note) Range check is not performed for a PACC command. Be careful not to exceed the limit set for each actuator.

[Example 1]	PACC	0.3	10	Write acceleration 0.3 G to position No. 10.
[Example 2]	LET	100	0.3	Assign 0.3 to variable 100.
	LET	2	10	Assign 10 to variable 2.
	PACC	*100	*2	Write the content of variable 100 (acceleration 0.3 G) to the content of variable 2 (position 10).

- PDCL (Assign deceleration data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PDCL	Deceleration	Position number	CP

[Function] Assign the deceleration data specified in operand 1 to the deceleration item in the position data specified in operand 2.
The deceleration is set in G and may include up to two decimal places.

[Example 1] PDCL 0.3 3 Assign 0.3 to the deceleration data at position No. 3.

● PAXS (Read axis pattern)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PAXS	Variable number	Position number	CP

[Function] Store the axis pattern at the position specified in operand 2 to the variable specified in operand 1.

[Example 1]	PAXS	1	99	Read the axis pattern at position 99 to variable 1. If the position is given as follows, “1” (binary 01) will be read to variable 1.
[Example 2]	LET	1	3	Assign 3 to variable 1.
	LET	2	101	Assign 101 to variable 2.
	PAXS	*1	*2	Read the axis pattern at the content of variable 2 (position 101) to the content of variable 1 (variable 3). If the point is given as follows, “3” (binary 11) will be stored in variable 3.

The table below shows different positions and corresponding values stored in a variable.

	Axis 1	Axis 2		
98			....	0 0 = 0 + 0 = 0
99	100.XXX		....	0 1 = 0 + 1 = 1
100		150.000	....	1 0 = 2 + 0 = 2
101	100.000	50.000	....	1 1 = 2 + 1 = 3

● PSIZ (Check position data size)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PSIZ	Variable number	Prohibited	CP

[Function] Set an appropriate value in the variable specified in operand 1 in accordance with the parameter setting.

- When "Other parameter No. 23, PSIZ function type" = 0
  The maximum number of position data that can be stored in the controller will be set. (Regardless of whether the data are used or not.)
- When "Other parameter No. 23, PSIZ function type" = 1
  The number of point data used will be set.

[Example] PSIZ 1

When "Other parameter No. 23, PSIZ function type" = 0
The maximum number of position data that can be stored in variable 1 will be set.
When "Other parameter No. 23, PSIZ function type" = 1
The number of point data currently used will be set in variable 1.

● GVEL (Get speed data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	GVEL	Variable number	Position number	CP

[Function] Obtain speed data from the speed item in the position data specified in operand 2, and set the value in the variable specified in operand 1.

[Example] GVEL 100 10 Set the speed data at position No. 10 in variable 100.

Position No.	Axis 1	Axis 2	Axis 3	Vel	Acc	Dcl
1						
2						
• • • •						
10	50.000	100.000	150.000	200	0.30	0.30
• •						

If the position data is set as above when the command is executed, 200 will be set in variable 100.

● GACC (Get acceleration data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	GACC	Variable number	Position number	CP

[Function] Obtain acceleration data from the acceleration item in the position data specified in operand 2, and set the value in the variable specified in operand 1.

[Example] GACC 100 10 Set the acceleration data at position No. 10 in variable 100.

Position No.	Axis 1	Axis 2	Axis 3	Vel	Acc	Dcl
1						
2						
• • • •						
10	50.000	100.000	150.000	200	0.30	0.30
• •						

If the position data is set as above when the command is executed, 0.3 will be set in variable 100.

- GDCL (Get deceleration data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	GDCL	Variable number	Position number	CP

[Function] Obtain deceleration data from the deceleration item in the position data specified in operand 2, and set the value in the variable specified in operand 1.

[Example] GDCL 100 10 Set the deceleration data at position No. 10 in variable 100.

Position No.	Axis 1	Axis 2	Axis 3	Vel	Acc	Dcl
1						
2						
• • • •						
10	50.000	100.000	150.000	200	0.30	0.30
• •						

If the position data is set as above when the command is executed, 0.3 will be set in variable 100.

1.11 Actuator Control Declaration

- VEL (Set speed)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	VEL	Speed	Prohibited	CP

[Function] Set the actuator travel speed in the value specified in operand 1.
The unit is mm/s.
The maximum speed will vary depending on the model of the actuator connected. Set a speed not exceeding the applicable maximum speed.

(Note 1) Decimal places cannot be used. An error will generate
(Note 2) The minimum speed is 1 mm/s.

[Example 1]	VEL	100		Set the speed to 100 mm/s.
	MOVP	1		Move to point 1 at 100 mm/s.
[Example 2]	VEL	500		Set the speed to 500 mm/s.
	MOVP	2		Move to point 2 at 500 mm/s.
[Example 3]	LET	1	300	Assign 300 to variable 1.
	VEL	*1		Set the speed to the content of variable 1 (300 mm/s).

● OVRD (Override)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	OVRD	Speed ratio	Prohibited	CP

[Function] Reduce the speed in accordance with the ratio specified in operand 1 (speed coefficient setting). The speed ratio is set in a range from 1 to 100%.
A speed command specifying a speed below 1 mm/sec can be generated using OVRD.
Command limit speed for smooth operation: 1 pulse/msec
Command limit speed that can be generated: 1 pulse/256 msec
(Smoothness of actual operation cannot be guaranteed. Movement must be checked on the actual machine.)
1 pulse: Lead [mm] / 16384 --- Standard product with a gear ratio of 1:1
(The speed set in a PAPR command (push-motion approach speed) will be clamped by the minimum speed of 1 mm/sec.)

[Example 1]

```
VEL     100     Set the speed to 100 mm/s.
OVRD    50      Reduce the speed to 50%.
                As a result, the actual speed will become 50 mm/s.
```

- ACC (Set acceleration)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	ACC	Acceleration	Prohibited	CP

[Function] Set the travel acceleration of the actuator.
The maximum acceleration will vary depending on the load and model of the actuator connected.
The acceleration is set in G and may include up to two decimal places.

(Note) If the position data contains no acceleration AND acceleration is not set by an ACC command, the actuator will move based on the default value set in "All-axis parameter No. 11, Default acceleration."

[Example 1] ACC 0.3 Set the acceleration to 0.3 G.

(Note) Setting an acceleration exceeding the specified range for the actuator may generate an error. It may also result in a failure or shorter product life.

● DCL (Set deceleration)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	DCL	Deceleration	Prohibited	CP

[Function] Set the travel deceleration of the actuator.
The maximum deceleration will vary depending on the load and model of the actuator connected.
The deceleration is set in G and may include up to two decimal places.

(Note) If the position data contains no deceleration AND deceleration is not set by a DCL command, the actuator will move based on the default value set in “All-axis parameter No. 12, Default deceleration.”
A DCL command cannot be used with CIR and ARC commands.

[Example] DCL 0.3 Set the deceleration to 0.3 G.

(Note) Setting a deceleration exceeding the specified range for the actuator may generate an error.
It may also result in a failure or shorter product life.

- SCRV (Set sigmoid motion ratio)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	SCRV	Ratio	Prohibited	CP

[Function] Set the ratio of sigmoid motion control of the actuator in the value specified in operand 1.
The ratio is set as an integer in a range from 0 to 50 (%).
When the ratio is not set or is set to 0%, the movement is set to the trapezoid motion.
S-shaped type is available to set in Operation 2. (Main application of Ver. 1.25 or later)
Refer to the instruction manual of the PC software and teaching pendant for the version of each device that can have the setting for Operation 2.

Model Name	Setting in Operation 2 (S-shaped Type)	S-shaped Motion Class	S-shaped Motion Effective Command Group (See the table below)
XSEL-P/Q	Not set, 0	A	1)
	1	B	1)
	2	A	2) (Note 2)
	3	B	2) (Note 2)
XSEL-PCT/QCT	Not set, 0	B (Note 1)	1)
	1		1)
	2		2) (Note 2)
	3		2) (Note 2)

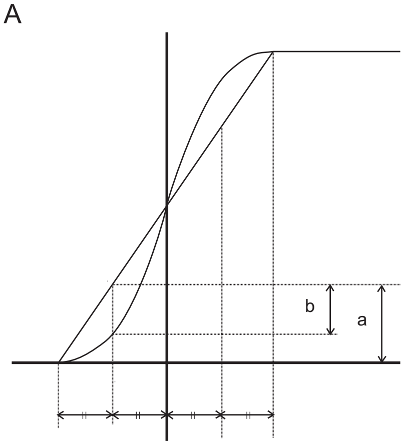
Note 1 The class of S-shaped motion is compulsorily B.
Note 2 S-shaped Motion is effective also at the speed change point (position joint point) during PATH Command. If S-shaped Motion is activated, constant velocity or track could be lost. Use the unit with S-shaped Motion ineffective in such processes as applying paint or glue, in which the constant velocity and track are important.

Effective Command Group	SCRV Effective Command
1)	MOVP,MOVL,MVPI,MVLI,JBWF,JBWN,JFWF,JFWN
2)	MOVP,MOVL,MVPI,MVLI,JBWF,JBWN,JFWF,JFWN,PATH,ARCH,PACH

[Example] SCRV 30 1 Set S-shaped motion ratio 30% and S-shaped motion class A.

- S-shaped Motion Class A

$\frac{b}{a}$ X 100 (%)



- S-shaped Motion Class B

In this class, operates with a speed pattern smoother than the control of S-shaped Motion Class A. (Estrangement peak with Trapezoid Motion becomes small.)

● OFST (Set offset)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	OFST	Axis pattern	Offset value	CP

[Function] Reset the target value by adding the offset value specified in operand 2 to the original target value when performing the actuator movement specified in operand 1.
The offset is set in mm, and the effective resolution is 0.001 mm.
A negative offset may be specified as long as the operation range is not exceeded.
An OFST command is processed with respect to soft axes before a BASE shift.

(Note) An OFST command cannot be used outside the applicable program. To use OFST in multiple programs, the command must be executed in each program.
An OFST command cannot be used with MVPI and MVLI commands.

[Example 1]

```
OFST   1100   50     Add 50 mm to the specified positions of axes 3 and 4.
  :
OFST   1100   0      Return the offsets of axes 3 and 4 to 0.
```

[Example 2] The axis pattern can be specified indirectly using a variable.
When the command in [Example 1] is rephrased based on indirect specification using a variable:
1100 (binary) → 12 (decimal)

```
LET    1      12     Assign 12 to variable 1.
OFST   *1     50
  :
OFST   *1     0
```

[Example 3]

```
LET    1      100    Assign 100 to variable 1.
OFST   1010   *1     Add the content of variable 1 (100 mm) to the specified
                     positions of axes 2 and 4.
```

- DEG (Set arc angle)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	DEG	Angle	Prohibited	CP

[Function] Set a division angle for the interpolation implemented by a CIR (move along circle) or ARC (move along arc) command.
When CIR or ARC is executed, a circle will be divided by the angle set here to calculate the passing points.
The angle is set in a range from 0 to 120 degrees.
If the angle is set to “0,” an appropriate division angle will be calculated automatically so that the actuator will operate at the set speed (maximum 180 degrees).
The angle is set in degrees and may include up to one decimal place.

(Note) If a CIR or ARC command is executed without setting an angle with this command, the default value registered in “All-axis parameter No. 30, Default division angle” will be used.

[Example] DEG 10 Set the division angle to 10 degrees.

- BASE (Specify axis base)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	BASE	Axis number	Prohibited	CP

[Function] Count the axes sequentially based on the axis number specified in operand 1 being the first axis.
A BASE command can be used with PRED, PRDQ, AXST, actuator-control, ARCH, PACH, PMVP, PMVL and zone commands. Note that each zone range is assigned to the actuator via parameter.

[Example 1]

HOME	1		Axis 1 returns to the home.
BASE	2		Axis 2 is considered the first axis.
HOME	1		Axis 2 returns to the home.

Hereafter, axes 2 to 4 will operate based on the specifications for axes 1 to 3 (axis number, axis pattern, position data, etc.).

[Example 2]

LET	1	3	Assign 3 to variable 1.
BASE	*1		The content of variable 1 (axis 3) will be considered as the first axis.

Hereafter, axes 3 and 4 will operate based on the specifications for axes 1 and 2.

- GRP (Set group axes)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	GRP	Axis pattern	Prohibited	CP

[Function] Allow only the position data of the axis pattern specified in operand 1 to become valid.
The program assumes that there are no data for other axes not specified.
When multiple programs are run simultaneously, assigning axes will allow the same position data to be used effectively among the programs.
A GRP command can be used with operand axis-pattern specification commands excluding an OFST command, as well as with servo operation commands using position data.
A GRP command is processed with respect to soft axes before a BASE shift.

[Example] Express what axis is to be used by using either “1” or “0”.

	(Host)					(Slave)
Axis No.	6-axis	5-axis	4-axis	3-axis	2-axis	1-axis
Use	1	1	1	1	1	1
Unused	0	0	0	0	0	0

- When the 1-axis and 2-axis are used

2-axis
↓
It should be 000011… (0 in front are not necessary. Remove 0 and make it 11.)
↑
1-axis

- When the 1-axis and 4-axis are used

4-axis
↓
It should be 1001… (In this case, 0 are necessary to express the position of the 4th axis.)
↑
1-axis

- HOLD (Hold: Declare axis port to pause)

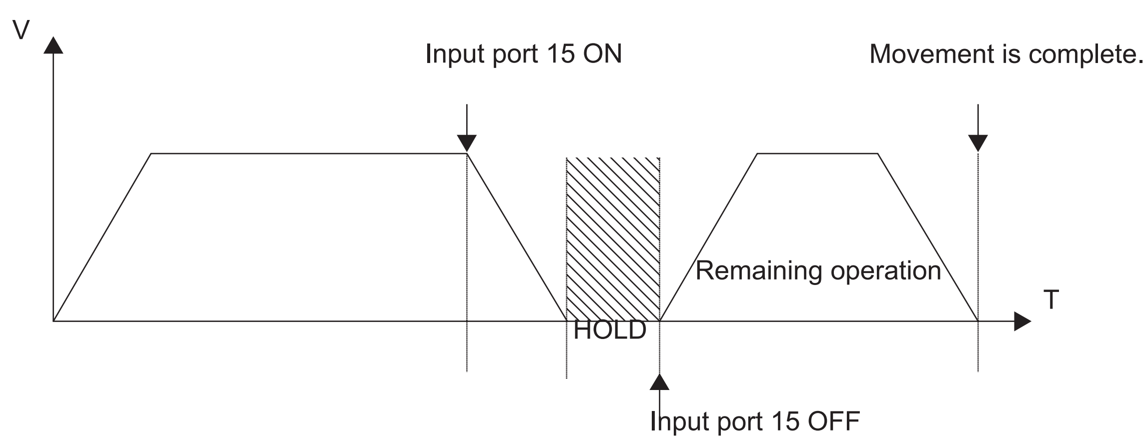
Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	HOLD	(Input port, global flag)	(HOLD type)	CP

[Function] Declare an input port or global flag to pause while a servo command is being executed. When operation is performed on the input port or global flag specified in operand 1, the current servo processing will pause. (If the axes are moving, they will decelerate to a stop.) If nothing is specified in operand 1, the current pause declaration will become invalid.

A HOLD type can be specified in operand 2.
[HOLD type]
0 = Contact a (Deceleration stop)
1 = Contact b (Deceleration stop)
2 = Contact b (Deceleration stop → Servo OFF (The drive source will not be cut off))
The HOLD type is set to "0" (contact a) when the program is started.
If nothing is specified in operand 2, the current HOLD type will be used.
Using other task to issue a servo ON command to any axis currently stopped via a HOLD servo OFF will generate an "Error No. C66, Axis duplication error." If the servo of that axis was ON prior to the HOLD stop, the system will automatically turn on the servo when the HOLD is cancelled. Therefore, do not issue a servo ON command to any axis currently stopped via a HOLD servo OFF.
If any axis currently stopped via a HOLD servo OFF is moved by external force, etc., from the stopped position, and when the servo of that axis was ON prior to the HOLD stop, the axis will move to the original stopped position when the HOLD is cancelled before resuming operation.

(Note 1) The input port or global flag specified by a HOLD declaration will only pause the axes used in the task (program) in which the HOLD is declared. The declaration will not be valid on axes used in different tasks (programs).
(Note 2) An input port or global flag to pause is valid for all active servo commands other than a SVOF command. (A deceleration stop will also be triggered in J☐W☐ and PATH operations.)
(Note 3) Following a pause of home return, the operation will resume from the beginning of the home-return sequence.

[Example] HOLD 15 0 The axes will decelerate to a stop when input port 15 turns ON.



Part 4 Commands

Chapter 2 Explanation of Commands

- CANC (Cancel: Declare axis port to abort)

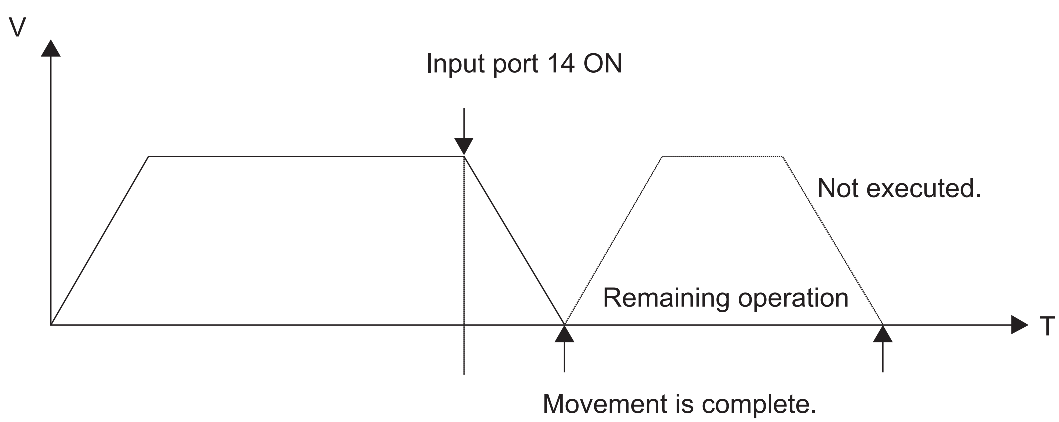
Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	CANC	(Input port, global flag)	(CANC type)	CP

[Function] Declare an input port or global flag to abort while a servo command is being executed. When operation is performed on the input port or global flag specified in operand 1, the current servo processing will be aborted. (If the axes are moving, they will decelerate to a stop before the processing is aborted.)
If nothing is specified in operand 1, the current abort declaration will become invalid.

A CANC type can be specified in operand 2.
[CANC type]
0 = Contact a (Deceleration stop)
1 = Contact b (Deceleration stop)
The CANC type is set to “0” (contact a) when the program is started.
If nothing is specified in operand 2, the current CANC type will be used.

(Note 1) The input port or global flag specified by a CANC command will only abort the axes used in the task (program) in which the CANC is declared. The declaration will not be valid on axes used in different tasks (programs).
(Note 2) An input port or global flag to pause is valid for all active servo commands other than a SVOF command. (A deceleration stop will also be triggered in JXWX and PATH operations.)

[Example] CANC 14 0 The axes will decelerate to a stop when input port 14 turns ON.



● VLMX (Specify VLMX speed)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	VLMX	Prohibited	Prohibited	CP

[Function] Set the actuator travel speed to the VLMX speed (normally maximum speed).
Executing a VLMX command will set the value registered in “Axis-specific parameter No. 29, VLMX speed” as the travel speed.

(Note) If the VLMX speed is specified in a continuous position travel command (PATH, PSPL), the target speed to each position will become a composite VLMX speed not exceeding the maximum speed of each axis set in “Axis-specific parameter No. 28, Maximum operating speed of each axis.” To make the target speed constant, a desired speed must be expressly specified using a VEL command.

[Example]

```
VEL     1000  ┐
MOVP    1     │ The speed becomes 1000 mm/sec in this section.
MOVP    2     ┘
VLMX          ┐
MOVP    3     │ The speed becomes VLMX mm/sec in this section.
MOVP    4     ┘
```

- ACMX (Indicate ACMX acceleration)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	ACMX	ACMX acceleration number	Prohibited	CP

[Function] Set the movement acceleration and deceleration of the actuator to the ACMX acceleration of the number indicated in Operation 1.
Once ACMX Command is executed, the parameters registered in ACMX Acceleration No.1 to 4 (Each Axis Parameters No.2 to 5 and 194 to 197) are set as the movement acceleration and deceleration. It is necessary to set the parameters of ACMX acceleration in advance considering the conditions how to use the actuator (transportation weight, installation condition, etc.).

ACMX Acceleration Number	Movement Direction	Acceleration	Deceleration
1	Positive	Axis Parameter No.2 Setting of “ACMX + Acceleration 1”	Axis Parameter No.3 Setting of “ACMX - Acceleration 1”
	Negative	Axis Parameter No.3 Setting of “ACMX - Acceleration 1”	Axis Parameter No.2 Setting of “ACMX + Acceleration 1”
2	Positive	Axis Parameter No.4 Setting of “ACMX + Acceleration 2”	Axis Parameter No.5 Setting of “ACMX - Acceleration 2”
	Negative	Axis Parameter No.5 Setting of “ACMX - Acceleration 2”	Axis Parameter No.4 Setting of “ACMX + Acceleration 2”
3	Positive	Axis Parameter No.194 Setting of “ACMX + Acceleration 3”	Axis Parameter No.195 Setting of “ACMX - Acceleration 3”
	Negative	Axis Parameter No.195 Setting of “ACMX - Acceleration 3”	Axis Parameter No.194 Setting of “ACMX + Acceleration 3”
4	Positive	Axis Parameter No.196 Setting of “ACMX + Acceleration 4”	Axis Parameter No.197 Setting of “ACMX - Acceleration 4”
	Negative	Axis Parameter No.197 Setting of “ACMX - Acceleration 4”	Axis Parameter No.196 Setting of “ACMX + Acceleration 4”

(Note 1) It may generate an error is the acceleration or deceleration is set above the actuator specifications.
Also, it cause a malfunction or drop of the production life.
(Note 2) The priority is put to the setting of acceleration and deceleration in the position data indicated with a movement command if there is any.
(Note 3) An operation is made within the range of the maximum acceleration and deceleration that would not exceed the ACMX acceleration/deceleration of each movement axis during the CP operation such as MOVL Command. In case constancy is required in the target acceleration/deceleration, indicate the acceleration and deceleration in ACC, DCL Command and the position data.
(Note 4) Do not attempt to indicate the ACMX acceleration/deceleration to the continuous movement related commands (PATH, PSPL, etc.). It may cause a big speed drop depending on the direction of the movement position. Indicate the acceleration and deceleration in ACC, DCL Command and the position data.
(Note 5) Do not attempt to indicate the ACMX acceleration/deceleration to the extended motion control board axis movement commands. It would cause Error No.C89 “Acceleration/Deceleration Indication Error”. Indicate the acceleration and deceleration in ACC, DCL Command and the position data.
(Note 6) This command language is applicable for XSEL-P/Q/PCT/QCT controller main application Ver. 1.15 and later. It is available to input for PC software Ver. 7.07.04.00 and later.

Example for Use

<u>Example. 1 For arch motion movement (vertical axis to move up/down)</u>

VLMX			Set the speed setting in VLMX Speed.
ACMX	1		Set the ACMX acceleration/deceleration of No.1.
ACHZ	3		Indicate the 3rd axis to Z-axis for arch motion.
ATRG	13	11	
ARCH	10	12	With Position No.12 as the peak point, move with the arch motion to Position No.10.

ACMX Acceleration Number	Axis Parameter No.	Parameter Name	Example for Setting	
			1st Axis	3rd Axis
1	2	ACMX + Acceleration 1	300 (3.0G)	50 (0.5G)
	3	ACMX - Acceleration 1	300 (3.0G)	60 (0.6G)

If the ACMX acceleration/deceleration is set as described above, the acceleration/deceleration speed will be as shown in Figure 1.

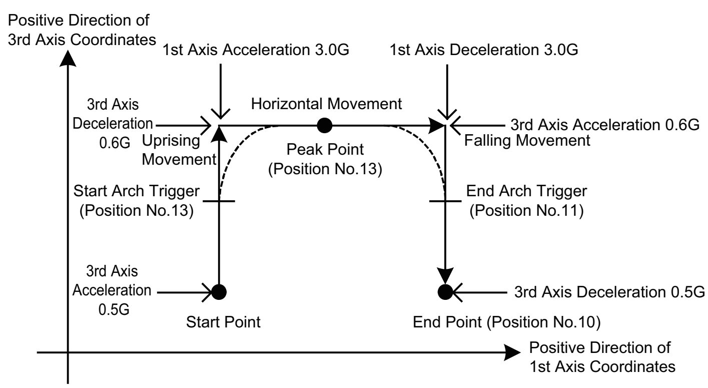


Figure 1 Acceleration/Deceleration in Arch Motion Movement

Example. 2 When the transported weight differs for going forward and backward

VLMX		Set the speed setting in VLMX Speed.
ACMX	1	Set the ACMX acceleration/deceleration of No.1.
MOVP	10	PTP movement is made to Position No.10.
ACMX	2	Set the ACMX acceleration/deceleration of No.2.
MOVP	11	PTP movement is made to Position No.11.

ACMX Acceleration Number	Axis Parameter No.	Parameter Name	Example for Setting
			1st Axis
1	2	ACMX + Acceleration 1	30 (3.0G)
	3	ACMX - Acceleration 1	30 (3.0G)
2	4	ACMX + Acceleration 2	100 (1.0G)
	5	ACMX - Acceleration 2	100 (1.0G)

If the ACMX acceleration/deceleration is set as described above, the acceleration/deceleration speed will be as shown in Figure 2.

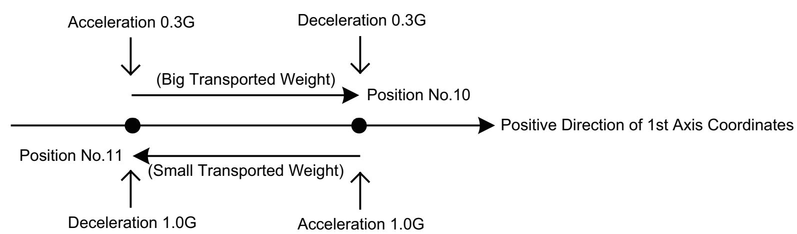
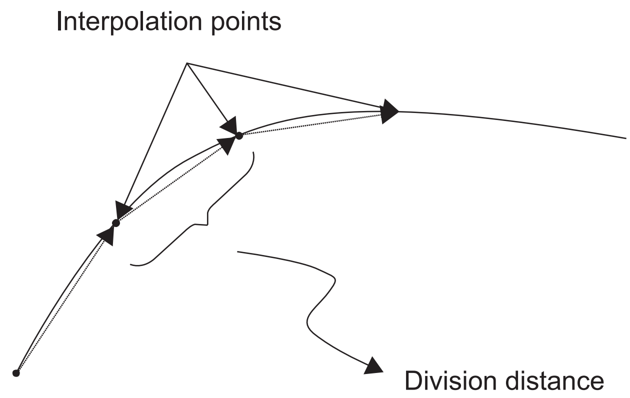


Figure 2 Acceleration/Deceleration when Transported Weight Differs in Going Forward and Backward

● DIS (Set division distance at spline movement)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	DIS	Distance	Prohibited	CP

[Function] Set a division distance for the interpolation implemented by a PSPL (move along spline) command.
When a PSPL command is executed, a passing point will be calculated at each distance set here and the calculated passing points will be used as interpolation points.
If the distance is set to “0,” an appropriate division distance will be calculated automatically so that the actuator will operate at the set speed
The distance is input in mm.



(Note) If a PSPL command is executed without setting a distance with a DIS command, the default value registered in “All-axis parameter No. 31, Default division distance” will be used.

[Example] DIS 10 Set the division distance to 10 mm.

● POTP (Set PATH output type)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	POTP	0 or 1	Prohibited	CP

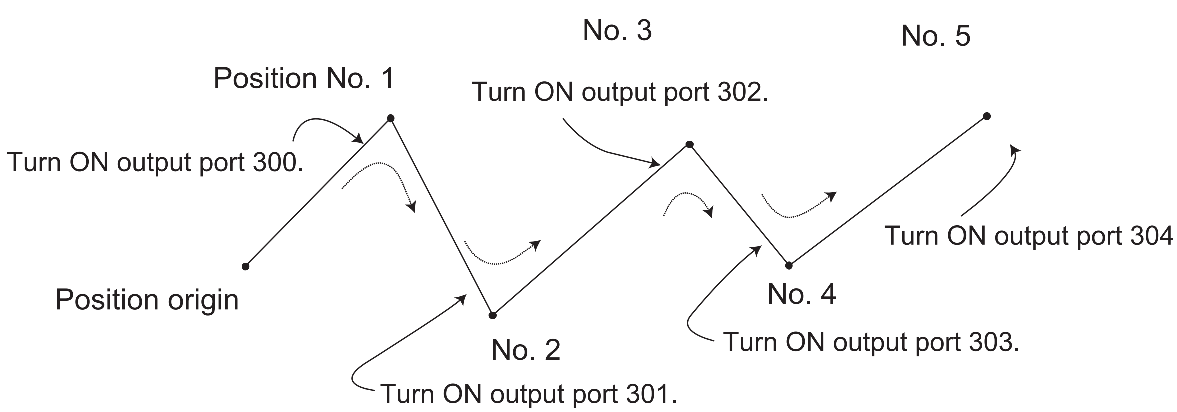
[Function] Set the output type in the output field to be used when a PATH or PSPL command is executed.
When a PATH or PSPL command is executed, the output will operate as follows in accordance with the setting of the POTP command.

(1) POTP [Operand 1] = 0 (ON upon completion of operation)
The output port or flag will turn ON upon completion of operation.
(2) POTP [Operand 1] = 1 (Increment and output on approaching each position; ON upon completion of operation for the last position)
During PATH or PSPL operation, the output port number or flag number specified in the output field will be incremented and turned ON when each specified position approaches. At the last position, however, the output will turn ON upon completion of operation. This setting provides a rough guide for output in sequence control.

(Note 1) The default value of POTP, before it is set, is “0.”
(Note 2) If POTP = 1 and there is no valid data at the specified position, the output number will be incremented but the output will not turn ON. (The output number will be incremented regardless of the size of position numbers specified in operands 1 and 2 in a PATH or PSPL command.)

[Example]

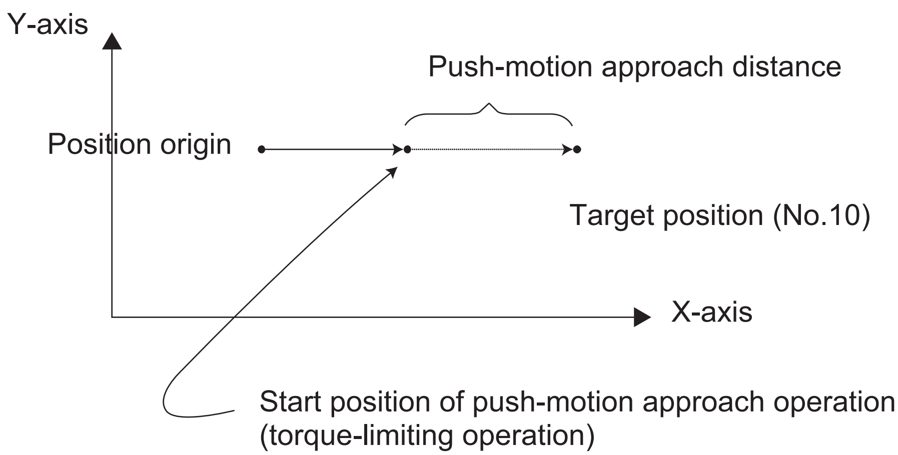
POTP	1			
PATH	1	5	300	Turn ON output port Nos. 300 through 304 sequentially each time a specified position approaches during a pass movement from position Nos. 1 through 5, starting from the first position.



● PAPR (Set push-motion approach distance, speed)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PAPR	Distance	Speed	CP

[Function] Set the operation to be performed when a PUSH command is executed.
Set the distance (push-motion approach distance) over which push-motion approach operation (torque-limiting operation) will be performed in operand 1 (in mm), and set the speed (push-motion approach speed) at which push-motion approach operation (torque-limiting operation) will be performed in operand 2 (in mm/sec).
The push-motion approach distance specified in operand 1 may contain up to three decimal places, while the speed specified in operand 2 cannot contain any decimal place.



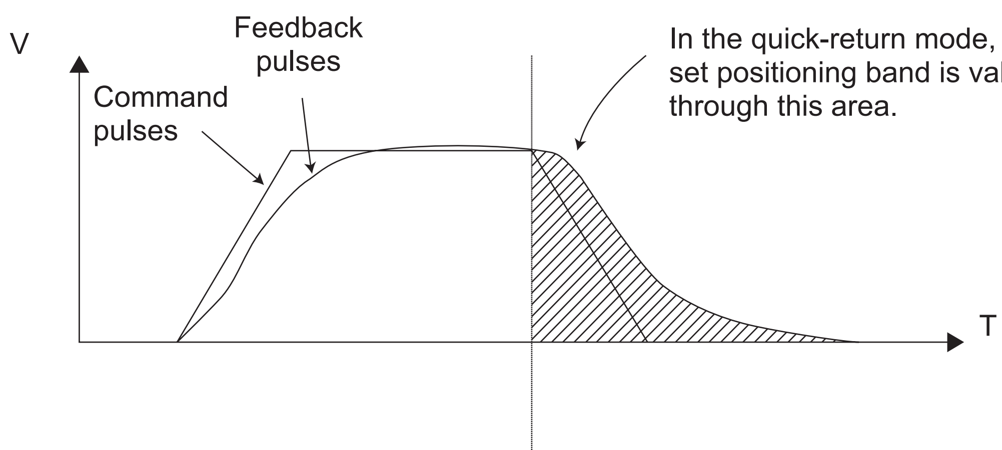
[Example]	PAPR	100	30	Set the push-motion approach distance in a PUSH command to 100 mm and the push-motion approach speed to 30 mm/sec.
	MOVP	2		Move to position No. 2.
	PUSH	10		Move by push motion from position No. 2 to position No. 10.

(Note) The push-motion approach speed in an OVRD command will be clamped by the minimum speed of 1 mm/sec. (Correct push-motion operation is not guaranteed at the minimum speed. Operation at slow push-motion approach must be checked on the actual machine by considering the effects of mechanical characteristics, etc.)

- QRTN (Set quick-return mode)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	QRTN	0 or 1	Prohibited	CP

[Function] Set and cancel the quick-return mode.
(1) QRTN [Operand 1] = 0 (Normal mode)
Positioning is deemed complete when all command pulses have been output and the current position is inside the positioning band.
* If a deceleration command is currently executed in the quick-return mode, the system will wait for all command pulses to be output.
(2) QRTN [Operand 1] = 1 (Quick-return mode)
Positioning is deemed complete when “a normal deceleration command is currently executed (excluding deceleration due to a stop command, etc.) or all command pulses have been output” AND “the current position is inside the positioning band.” This setting is used to perform other processing during deceleration, in conjunction with a PBND command.



(Note 1) The quick-return mode will be cancelled when the program ends. (The positioning band set by a PBND command will not be cancelled.)
(Note 2) If a given axis is used even once in the quick-return mode, the program will not release the right to use the axis until the QRTN is set to “0” (normal mode) or the program ends. Any attempt to use the axis from other program will generate an “Error No. C66, Axis duplication error.”
(Note 3) Following a return from a normal deceleration command in the quick-return mode, the next positioning will start after all command pulses for the previous positioning have been output. Therefore, in the quick-return mode a simple reciprocating operation will require a longer tact time because of the extra completion check. In this sense, this setting should be used only if you wish to reduce the overall tact time by performing other processing during deceleration.
(Note 4) The quick-return mode represents very irregular processing. Therefore, be sure to revert to the normal mode when the overlay processing is completed in the necessary section.
(Note 5) The quick-return mode cannot be used with a push-motion travel command or arc interpolation command.

- NTCH (Vibration control parameter set selection)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	NTCH	Axis pattern	Parameter set number	CC

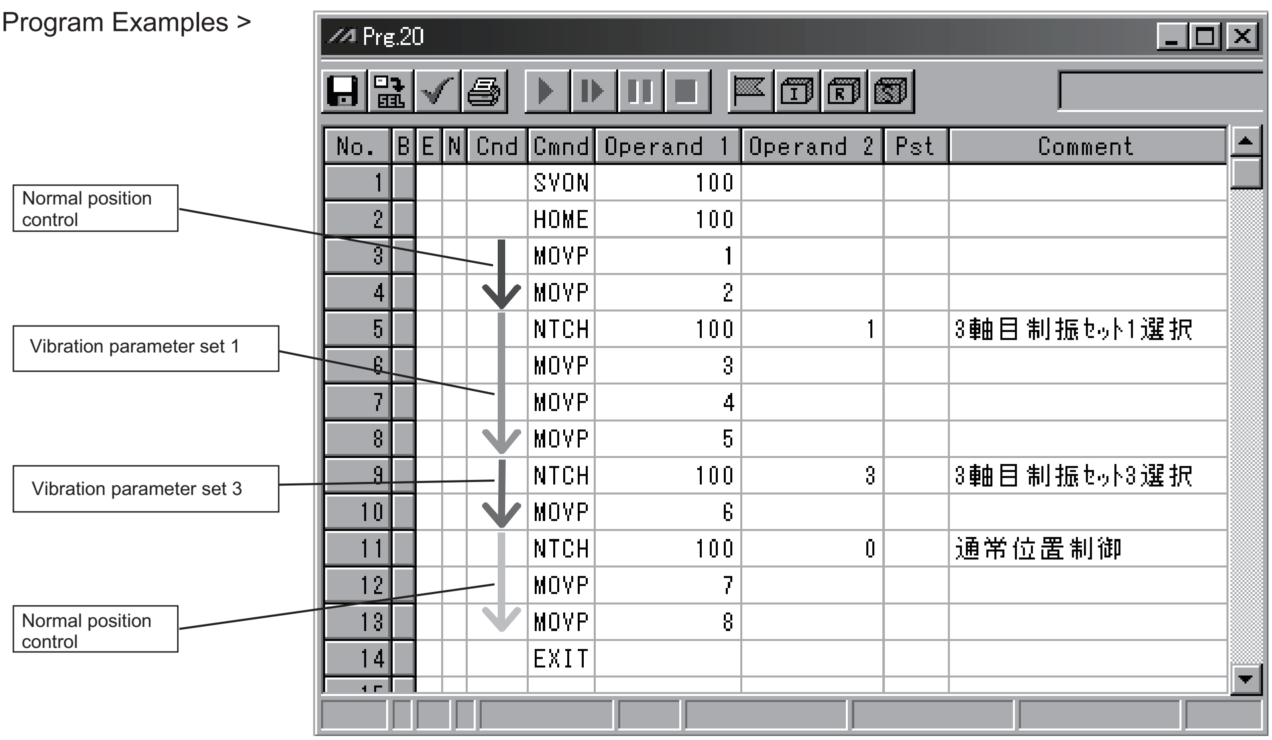
[Function] Declare for the axis pattern set in operand 1 which of the natural vibration frequencies registered in parameters will be used to perform vibration control.

- Operand 1 Axis patterns selection
  Specify 1 for an axis for which a vibration control parameter is selected, and 0 for an axis for which no vibration control parameter is selected.
- Operand 2 Parameter set number
  Select whether or not to use vibration control and, if vibration control is used, which natural vibration frequency (parameter set) will be used.

0: Normal position control (Vibration control is not performed.)
1: Vibration control parameter set 1.(Axis-specific parameter Nos. 151 to 154)
2: Vibration control parameter set 2 (Axis-specific parameter Nos. 156 to 159)
3: Vibration control parameter set 3 (Axis-specific parameter Nos. 161 to 164)
Other than 0 to 3: Normal position control (Vibration control is not performed.)

[Example] NTCH 110 2 Set vibration control parameter set 2 for axes 2 and 3.

< Program Examples >



No.	B	E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
1					SVON	100			
2					HOME	100			
3					MOVP	1			
4					MOVP	2			
5					NTCH	100	1		3軸目制振ｾｯﾄ1選択
6					MOVP	3			
7					MOVP	4			
8					MOVP	5			
9					NTCH	100	3		3軸目制振ｾｯﾄ3選択
10					MOVP	6			
11					NTCH	100	0		通常位置制御
12					MOVP	7			
13					MOVP	8			
14					EXIT				

1.12 Actuator Control Command

- SV☐☐ (Turn ON/OFF servo)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	SV☐☐	Axis pattern	Prohibited	PE

[Function] Turn ON/OFF the servos of the axes specified by the axis pattern in operand 1.

SV☐☐
- ON .... Turn ON the servo.
- OF .... Turn OFF the servo.

[Example 1] SVON 1100 Turn ON the servos of axes 3 and 4. Nothing will occur if the axis servos are already ON.

[Example 2] The axis pattern can be specified indirectly using a variable.
When the command in [Example 1] is rephrased based on indirect specification using a variable:
1100 (binary) → 12 (decimal)
LET 1 12 Assign 12 to variable 1.
SVON *1

- HOME (Return to home)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	HOME	Axis pattern	Prohibited	PE

[Function] Perform home return of the axes specified by the axis pattern in operand 1.
The servo of each home-return axis will turn ON automatically.
The output will turn OFF at the start of home return, and turn ON when the home return is completed.

(Note) Following a pause of home return, the operation will resume from the beginning of the home-return sequence.
Home-return operation of an absolute-encoder axis is a movement to a rotation data reset position, and may not be a movement to the preset home coordinates (including 0). Use a MOVP command instead of a HOME command, if you wish to perform home return for the purpose of turning ON output 304 when “I/O parameter No. 50, Output function selection 304” is set to “1” (Output if all valid axes are at the home (= 0)) or “3” (Output if all valid axes are at the preset home coordinates).
If the operation is stopped or cancelled while a HOME command is being executed for an absolute-encoder axis in a mode other than the absolute reset mode provided by the PC software or teaching pendant, an “actual-position soft limit error” may generate depending on the position. It is not recommended to perform home return other than for the purpose of adjusting an absolute-encoder axis.

[Example 1] HOME 1100 Axes 3 and 4 return to the home.

[Example 2] The axis pattern can be specified indirectly using a variable.
When the command in [Example 1] is rephrased based on indirect specification using a variable:
1100 (binary) → 12 (decimal)
LET 1 12 Assign 12 to variable 1.
HOME *1

> ⚠ Caution: Take note that if you are using the linear servo actuator LSAS-N10/N15 of quasi-absolute type, after completing a home return operation following power on the actuator moves in a range of approx. 16 mm from the stopped position to confirm the current position.

- MOVP (Move PTP by specifying position data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	MOVP	Position number	Prohibited	PE

[Function] Move the actuator to the position corresponding to the position number specified in operand 1, without interpolation (PTP stands for "Point-to-Point").
The output will turn OFF at the start of axis movement, and turn ON when the movement is complete.

[Example 1]

VEL	100		Set the speed to 100 mm/s.
MOVP	1		Move the axes to the position corresponding to position No. 1 (200, 100).

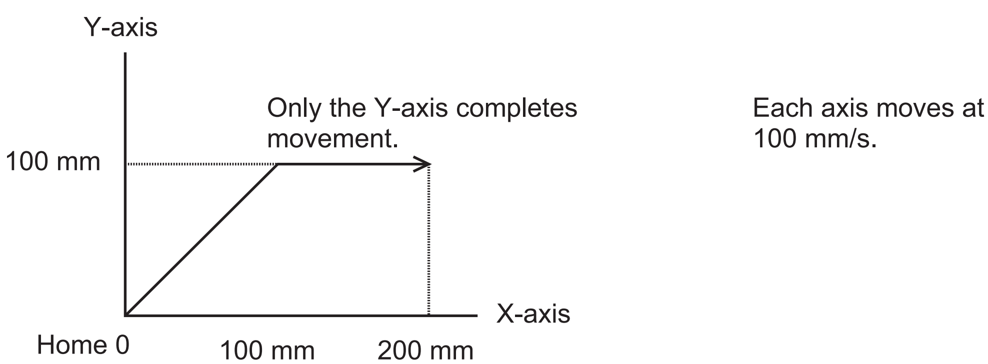
[Example 2]

VEL	100		Set the speed to 100 mm/s.
LET	1	2	Assign 2 to variable 1.
MOVP	*1		Move the axes to the position corresponding to the content of variable 1 (position No. 2, or (100, 100)).

No.	X-axis	Y-axis	Speed	Acceleration	Deceleration
1	200.000	100.000			
2	100.000	100.000			

(Note) If no acceleration or deceleration is specified in the position data table or using an ACC (DCL) command, the actuator will operate according to the default acceleration set in all-axis parameter No. 11 or default deceleration set in all-axis parameter No. 12.

Travel path from the home to the position corresponding to position No. 1 (200, 100)



- MOVL (Move by specifying position data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	MOVL	Position number	Prohibited	PE

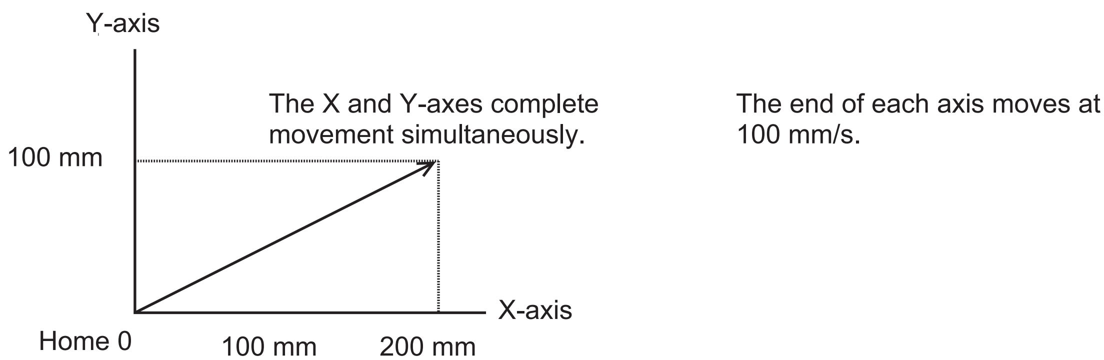
[Function] Move the actuator to the position corresponding to the position number specified in operand 1, with interpolation.
The output will turn OFF at the start of axis movement, and turn ON when the movement is complete.

[Example 1]	VEL	100		Set the speed to 100 mm/s.
	MOVL	1		Move the axes to the position corresponding to position No. 1 (200, 100), with interpolation.
[Example 2]	VEL	100		Set the speed to 100 mm/s.
	LET	1	2	Assign 2 to variable 1.
	MOVL	*1		Move the axes to the position corresponding to the content of variable 1 (position No. 2, or (100, 100)), with interpolation.

No.	X-axis	Y-axis	Speed	Acceleration	Deceleration
1	200.000	100.000			
2	100.000	100.000			

(Note) If no acceleration or deceleration is specified in the position data table or using an ACC (DCL) command, the actuator will operate according to the default acceleration set in all-axis parameter No. 11 or default deceleration set in all-axis parameter No. 12.

Travel path from the home to the position corresponding to position No. 1 (200, 100)



- MVPI (Move via incremental PTP)

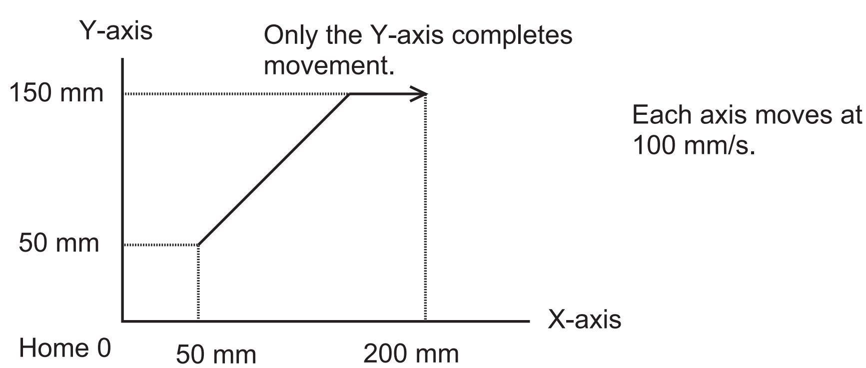
Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	MVPI	Position number	Prohibited	PE

[Function] Move the actuator, without interpolation, from the current position by the travel distance corresponding to the position number specified in operand 1.
The output will turn OFF at the start of axis movement, and turn ON when the movement is complete.
Movement may not occur if the specified travel distance is below the resolution (1 pulse):
1 pulse: Lead [mm] / 16384 --- Standard product with a gear ratio of 1:1

[Example 1]	VEL	100		Set the speed to 100 mm/s.
	MVPI	1		If the current position is (50, 50) and position No. 1 is set to (150, 100), the axes will move 150 in the X direction and 100 in the Y direction (200, 150) from the current position.
[Example 2]	VEL	100		Set the speed to 100 mm/s.
	LET	1	2	Assign 2 to variable 1.
	MVPI	*1		Move from the current position by the travel distance corresponding to the content of variable 1 (position No. 2, or (100, 100)).

No.	X-axis	Y-axis	Speed	Acceleration	Deceleration
1	150.000	100.000			
2	100.000	100.000			

Travel path from (50, 50) by the travel distance corresponding to position No. 1 (150, 100)



(Note) If no acceleration or deceleration is specified in the position data table or using an ACC (DCL) command, the actuator will operate according to the default acceleration set in all-axis parameter No. 11 or default deceleration set in all-axis parameter No. 12.

> ⚠ Caution
> A margin of error could accumulate between each pitch if the incremental (relative position indication) movement commands are repeated continuously.
> To avoid accumulation of errors, utilize the movement command to indicate the absolute position (MOVP Command).

● MVLI (Move via incremental interpolation)

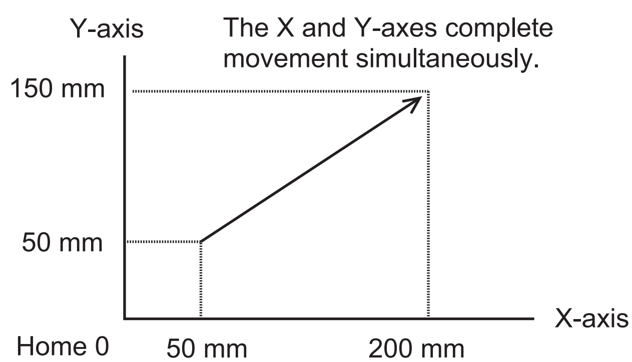
Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	MVLI	Position number	Prohibited	PE

[Function] Move the actuator, with interpolation, from the current position by the travel distance corresponding to the position number specified in operand 1.
The output will turn OFF at the start of axis movement, and turn ON when the movement is complete.
Movement may not occur if the specified travel distance is below the resolution (1 pulse):
1 pulse: Lead [mm] / 16384 --- Standard product with a gear ratio of 1:1

[Example 1]	VEL	100		Set the speed to 100 mm/s.
	MVLI	1		If the current position is (50, 50) and position No. 1 is set to (150, 100), the axes will move 150 in the X direction and 100 in the Y direction (200, 150) from the current position, with interpolation.
[Example 2]	VEL	100		Set the speed to 100 mm/s.
	LET	1	2	Assign 2 to variable 1.
	MVLI	*1		Move from the current position by the travel distance corresponding to the content of variable 1 (position No. 2, or (100, 100)).

No.	X-axis	Y-axis	Speed	Acceleration	Deceleration
1	200.000	100.000			
2	100.000	100.000			

Travel path from (50, 50) by the travel distance corresponding to position No. 1 (150, 100)



The end of each axis moves at 100 mm/s.

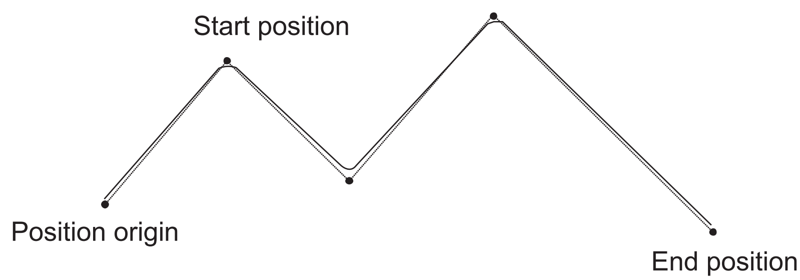
(Note) If no acceleration or deceleration is specified in the position data table or using an ACC (DCL) command, the actuator will operate according to the default acceleration set in all-axis parameter No. 11 or default deceleration set in all-axis parameter No. 12.

> ⚠ Caution
> A margin of error could accumulate between each pitch if the incremental (relative position indication) movement commands are repeated continuously.
> To avoid accumulation of errors, utilize the movement command to indicate the absolute position (MOVL Command).

- PATH (Move along path)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PATH	Start position number	End position number	PE

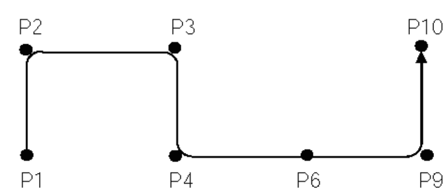
[Function] Move continuously from the position specified in operand 1 to the position specified in operand 2.
The output type in the output field can be set using an actuator-declaration command POTP.
Increasing the acceleration will make the passing points closer to the specified positions.
If invalid data is set for any position number between the start and end position numbers, that position number will be skipped during continuous movement.



(Note 1) Multi-dimensional movement can be performed using a PATH command.
In this case, input in operand 1 the point number of the next target, instead of the predicted current position upon execution of the applicable command.
(Inputting a point number corresponding to the predicted current position will trigger movement to the same point during continuous movement, thereby causing the speed to drop.)

(Note 2) The actuator can be moved continuously along a series of continuous positions including one discontinuous position.
To do this, as shown in the example specify the position number corresponding to the discontinuous position as both the start position number and end position number of a PATH command. Position No. 6 is the discontinuous position in this example.
[Example] The actuator will move continuously along the path of position Nos. 1 → 2 → 3 → 4 → 6 → 9 → 10.

```
PATH    1    4
PATH    6    6    Discontinuous position
PATH    9    10
```



[Example 1]

```
VEL     100          Set the speed to 100 mm/s.
PATH    100   120    Move continuously from position Nos. 100 to 120.
```

[Example 2]

```
VEL     100          Set the speed to 100 mm/s.
LET     1     50     Assign 50 to variable 1.
LET     2     100    Assign 100 to variable 2.
PATH    *1    *2     Move continuously along the positions from the content of
                     variable 1 (position No. 50) to the content of variable 2
                     (position No. 100).
```

● J☐W☐ (Jog)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	J☐W☐	Axis pattern	Input, output, flag number	PE

[Function] The axes in the axis pattern specified in operand 1 will move forward or backward while the input or output port or flag specified in operand 2 is ON or OFF.

JBWF.......... Move backward while the specified port is OFF.
JBWN.......... Move backward while the specified port is ON.
JFWF.......... Move forward while the specified port is OFF.
JFWN.......... Move forward while the specified port is ON.

(Note 1) This command is also valid on an axis not yet completing home return. In this case, the maximum speed will be limited by "All-axis parameter No. 15, Maximum jog speed before home return." Since coordinate values do not mean anything before home return, pay due attention to prevent contact with the stroke ends.

(Note 2) If an axis moving in accordance with JXWX has its "Axis-specific parameter No. 1, Axis operation type" set to "0" (Linear-movement axis) AND "Axis-specific parameter No. 68, Linear-movement mode selection" to "1" (Infinite-stroke mode*), the axis will operate based on an infinite stroke. When infinite stroke is enabled, the current position will cycle between approx. –10 m and 10 m.
Any positioning command other than the above to a position exceeding a coordinate range from approx. –9990 to +9990 will generate an "Error No. CBE, Target-data boundary over error."
Executing any positioning command other than the above outside a coordinate range from approx. –9990 to +9990 will also generate an "Error No. CC5, Positioning-boundary deviation error."
In case there is a possibility that the current value is out of the coordinate range between about -9990 to +9990 (after turning servo on and having JOG movement), execute the movement command by combining with "Each Axis Parameter No. 10 Home-Return Method" and after resetting the current value by HOME Command.
(Limitation is purposely established because the user cannot certainly identify the direction of movement around the boundary.)

The infinite-stroke mode can be specified only for an incremental-encoder axis.

[Example 1]

	VEL	100		Set the speed to 100 mm/s.
	JBWF	1100	10	Move axes 3 and 4 backward while input 10 is OFF.

[Example 2] The axis pattern can be specified indirectly using a variable.
When the command in [Example 1] is rephrased based on indirect specification using a variable:
1100 (binary) → 12 (decimal)

VEL	100		Set the speed to 100 mm/s.
LET	1	12	Assign 12 to variable 1.
JBWF	*1	10	

[Example 3]

VEL	100		Set the speed to 100 mm/s.
LET	5	20	Assign 20 to variable 5.
JFWN	1010	*5	Move axes 2 and 4 forward while the content of variable 5 (input port 20), is ON.

- STOP (Stop movement)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	STOP	Axis pattern	Prohibited	CP

[Function] Decelerate and stop the axes specified by the axis pattern in operand 1.

(Note 1) A STOP command can be used with all active servo commands other than a SVOF command.

(Note 2) A STOP command only issues a deceleration-stop command (operation stop) to a specified axis pattern and does not wait for stopping to complete. Issuing other servo commands to a decelerating axis will either become invalid or generate an “axis duplication error,” etc.
Set a timer, etc., in the program so that the next servo command will be issued after a sufficient deceleration-stop processing time elapses.
Even when a STOP command is to be issued to an axis currently stopped, provide a minimum interval of 0.1 second before the next servo command is issued.

[Example 1] STOP 1100 Decelerate and stop axes 3 and 4.

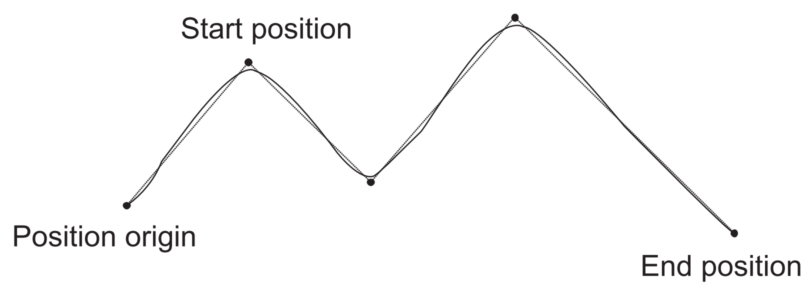
[Example 2] The axis pattern can be specified indirectly using a variable.
When the command in [Example 1] is rephrased based on indirect specification using a variable:
1100 (binary) → 12 (decimal)

```
LET    1    12    Assign 12 to variable 1.
STOP   *1
```

● PSPL (Move along spline)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PSPL	Start position number	End position number	PE

[Function] Continuously move from the specified start position to end position via interpolation along a spline-interpolation curve.
The output type in the output field can be set using an actuator-declaration command POTP.
If invalid data is set for any position number between the start and end position numbers, that position number will be skipped during continuous movement.



(The above diagram is only an example.)

(Note) If the acceleration and deceleration are different between points, the speeds will not be connected smoothly.

In this case, input in operand 1 the point number of the next target, instead of the predicted current position upon execution of the applicable command.
(Inputting a point number corresponding to the predicted current position will trigger movement to the same point during continuous movement, thereby causing the speed to drop.)

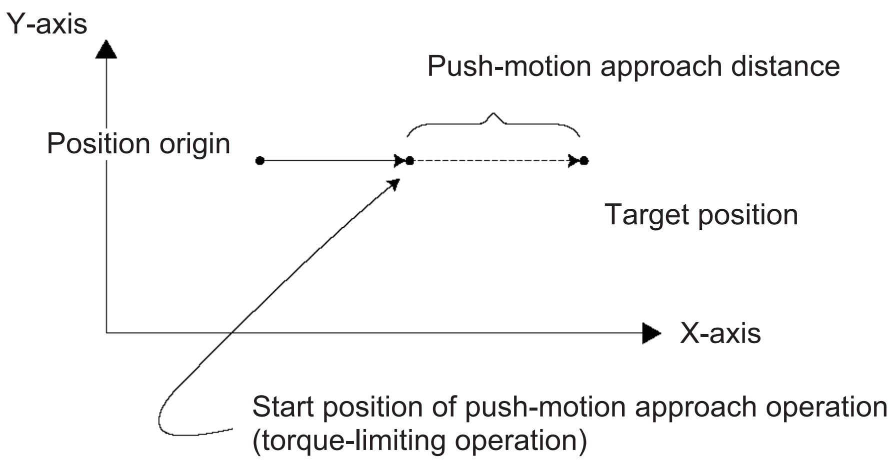
[Example]

VEL	100		Set the speed to 100 mm/s.
PSPL	100	120	Continuously move from position Nos. 100 to 120 along a spline-interpolation curve.

- PUSH (Move by push motion)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PUSH	Target position number	Prohibited	PE

[Function] Perform push-motion operation until the target position specified in operand 1 is reached. The axes move in a normal mode from the position origin to the push-motion approach start position as determined by a PAPR command, after which push-motion approach operation (toque-limiting operation) will be performed. The speed of push-motion approach operation (toque-limiting operation) is determined by the push-motion approach speed specified by a PAPR command. If the output field is specified, the output will turn ON when a contact is confirmed, and turn OFF when a missed contact is detected.



The push force can be adjusted using “Driver-card parameter No. 38, Push torque limit at positioning” (default value: 70%).

(Note 1) A PUSH command only moves a single axis. If multiple axes are specified, an “Error No. C91, Multiple push-axes specification error” will generate.

(Note 2) A push-motion approach speed exceeding the maximum speed permitted by the system will be clamped at the maximum speed. (The maximum system speed is not the maximum practical speed. Determine a practical speed by considering the impact upon contact, etc.)

(Note 3) Push-motion operation cannot be performed with a synchro controller.

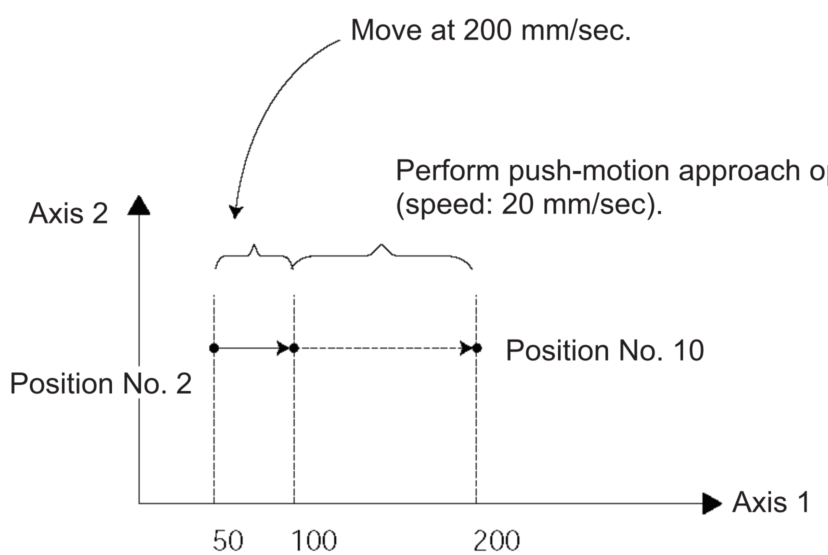
(Note 4) With the ZR unit, pushing may not be detected if the R-axis operates while the Z-axis is pushing the work part.

[Example]	PAPR	100	20
	MOVP	2	
	PUSH	10	

Set the push-motion approach distance to 100 mm and push-motion approach speed to 20 mm/sec.
Move from the current position to position No. 2.
Perform push-motion movement from position Nos. 2 to 10.

The diagram below describes a push-motion movement based on the position data shown in the table below:

Position No.	Axis 1	Axis 2	Axis 3	Vel	Acc	Dcl
1	XXX.XXX	XXX.XXX	XXX.XXX	XXX	X.XX	X.XX
2	50.000	100.000	XXX.XXX	XXX	X.XX	X.XX
•						
•						
•						
•						
10	200.000			200	0.30	0.30
•						
•						



● PTRQ (Change push torque limit parameter)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PTRQ	Axis pattern	Ratio	CC

[Function] Change the push torque limit parameter of the axis pattern specified in operand 1 to the value in operand 2. Operand 2 is set as an integer (unit: %).
A PTRQ command temporarily rewrites "Driver card parameter No. 38: Push torque limit at positioning."

(Note 1) If a push torque limit is not set by a PTRQ command, the value set in "Driver card parameter No. 38: Push torque limit at positioning" will be used.

(Note 2) The new push torque limit will remain effective even after the program ends. Therefore, when building a system using the PTRQ command, in every program explicitly specify a push torque limit using a PTRQ command before each push-motion operation. Assuming that the push torque limit will be reset to the original value when push-motion operation ends in one program can cause an unexpected problem in another program, because a different push torque limit will be used if the program is aborted due to an error, etc.

(Note 3) The new value set by a PTRQ command will become ineffective after a power-on reset or software reset.

(Note 4) A PTRQ command does not rewrite "Driver card parameter No. 38: Push torque limit at positioning" (main CPU flash memory (non-volatile memory)).

[Example]

PTRQ	100	50	Change the push torque limit parameter for axis 3 to 50%.
PAPR	100	20	Set the push-motion approach distance to 100 mm and the push-motion approach speed to 20 mm/sec.
MOVP	2		Move to position No. 2.
PUSH	10		Move by push motion from position No. 2 to position No. 10.

- CIR2 (Move along circle 2 (arc interpolation))

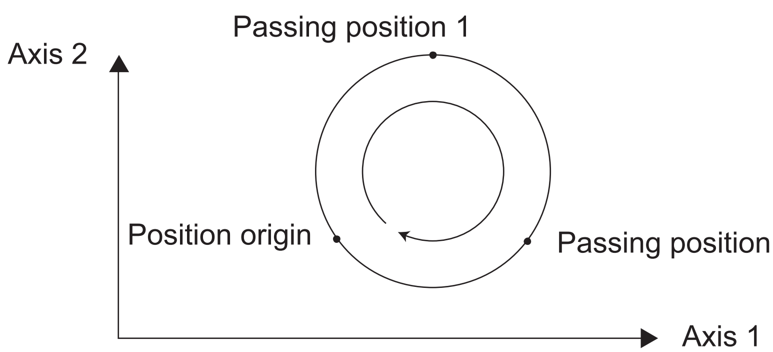
Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	CIR2	Passing position 1 number	Passing position 2 number	PE

[Function] Move along a circle originating from the current position and passing positions 1 and 2, via arc interpolation.
The rotating direction of the circle is determined by the given position data.
The diagram below describes a CW (clockwise) movement. Reversing passing positions 1 and 2 will change the direction of movement to CCW (counterclockwise).

The speed and acceleration will take valid values based on the following priorities:

Priority	Speed	Acceleration (deceleration)
1	Setting in the position data specified in operand 1	Setting in the position data specified in operand 1
2	Setting by VEL command	Setting by ACC (DCL) command
3		Default acceleration in all-axis parameter No. 11 (Default deceleration in all-axis parameter No. 12)

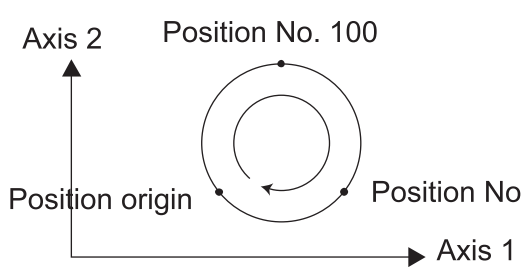
If speed is not set, a “C88 speed specification error” will generate.
If acceleration/deceleration is not valid, a “C89 acceleration/deceleration specification error” will generate.



(Note) This command is valid on arbitrary orthogonal planes. (Axis 2 may be selected automatically prior to axis 1 in accordance with the position data.)

[Example]

VEL	100		Set the speed to 100 mm/s.
CIR2	100	101	Move along a circle (circular interpolation) passing position Nos. 100 and 101.



- ARC2 (Move along circle 2 (arc interpolation))

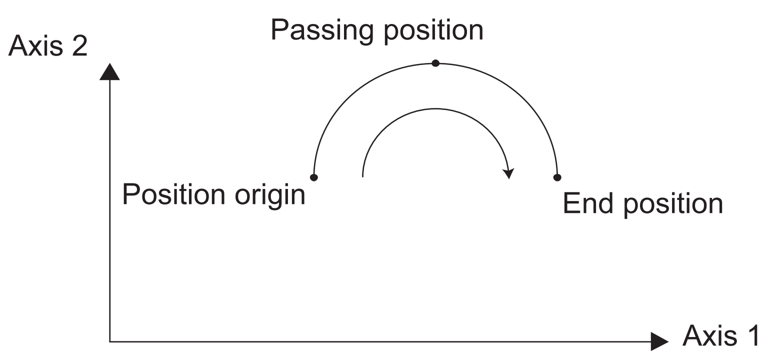
Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	ARC2	Passing position number	End position number	PE

[Function] Move along an arc originating from the current position, passing the specified position and terminating at the end position, via arc interpolation.

The speed and acceleration will take valid values based on the following priorities:

Priority	Speed	Acceleration (deceleration)
1	Setting in the position data specified in operand 1	Setting in the position data specified in operand 1
2	Setting by VEL command	Setting by ACC (DCL) command
3		Default acceleration in all-axis parameter No. 11 (Default deceleration in all-axis parameter No. 12)

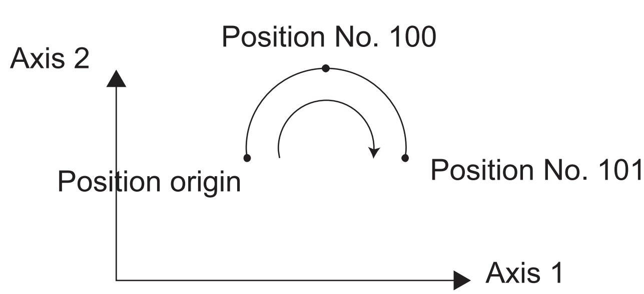
If speed is not set, a “C88 speed specification error” will generate.
If acceleration/deceleration is not valid, a “C89 acceleration/deceleration specification error” will generate.



(Note) This command is valid on arbitrary orthogonal planes. (Axis 2 may be selected automatically prior to axis 1 in accordance with the position data.)

[Example]

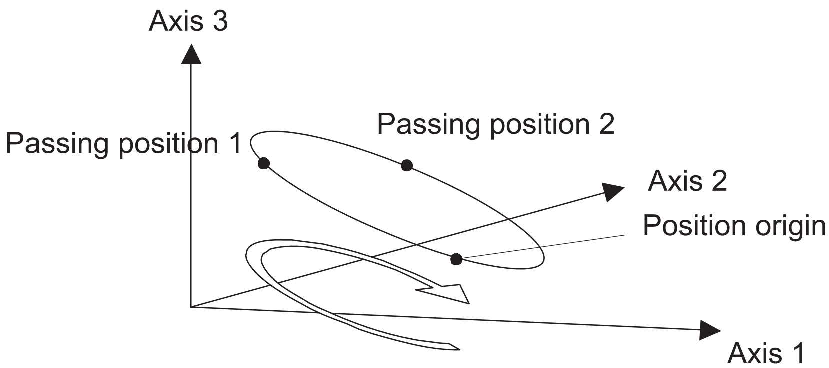
VEL	100		Set the speed to 100 mm/s.
ARC2	100	101	Move along an arc (circular interpolation) from the current position to position No. 101 by passing position No. 100.



- CIRS (Move three-dimensionally along circle)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	CIRS	Passing position 1 number	Passing position 2 number	PE

[Function] Move along a circle (three-dimensional movement) originating from the current position and passing positions 1 and 2 sequentially.
The rotating direction of the circle is determined by the given position data.
The movement in the diagram below will be performed in the reverse direction if passing positions 1 and 2 are reversed.



The speed and acceleration will take valid values based on the following priorities:

Priority	Speed	Acceleration	Deceleration
1	Setting in the position data specified in operand 1	Setting in the position data specified in operand 1	Same as the valid acceleration value
2	Setting by VEL command	Setting by ACC command	
3		Default acceleration in all-axis parameter No. 11	

If speed is not set, a “C88 speed specification error” will generate.
If acceleration/deceleration is not valid, a “C89 acceleration/deceleration specification error” will generate.

(Note 1) This command is valid on arbitrary planes in a three-dimensional space. (Axis 2 (if there are only two valid axes) or axis 3 may be selected automatically prior to axis 1 in accordance with the position data.)

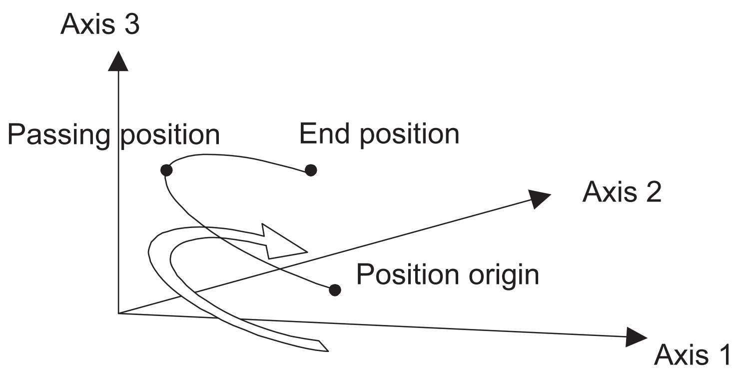
(Note 2) The locus tends to shift inward as the speed increases. Minor adjustment, such as setting the position data slightly outward, may be required.

(Note 3) If the circle diameter is small with respect to the set speed, the speed may be limited. (Increasing the acceleration/deceleration will reduce the speed limitation, but they must not exceed the range permitted by the actuator.)

- ARCS (Move three-dimensionally along arc)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	ARCS	Passing position number	End position number	PE

[Function] Move along an arc (three-dimensional movement) originating from the current position, passing the specified position and terminating at the end position.



The speed and acceleration will take valid values based on the following priorities:

Priority	Speed	Acceleration	Deceleration
1	Setting in the position data specified in operand 1	Setting in the position data specified in operand 1	Same as the valid acceleration value
2	Setting by VEL command	Setting by ACC command	
3		Default acceleration in all-axis parameter No. 11	

If speed is not set, a “C88 speed specification error” will generate.
If acceleration/deceleration is not valid, a “C89 acceleration/deceleration specification error” will generate.

(Note 1) This command is valid on arbitrary planes in a three-dimensional space. (Axis 2 (if there are only two valid axes) or axis 3 may be selected automatically prior to axis 1 in accordance with the position data.)

(Note 2) The locus tends to shift inward as the speed increases. Minor adjustment, such as setting the position data slightly outward, may be required.

(Note 3) If the arc diameter is small with respect to the set speed, the speed may be limited. (Increasing the acceleration/deceleration will reduce the speed limitation, but they must not exceed the range permitted by the actuator.)

● CHVL (Change speed)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	CHVL	Axis pattern	Speed	CP

[Function] Change the speed of the axes operating in other task.
When a CHVL command is executed, the speed of the axes specified in operand 1 will change to the value specified in operand 2.

(Note 1) This command is not valid on an axis operated by a CIR, ARC, PSPL, PUSH, ARCH, PACH, CIRS or ARCS command.

(Note 2) Executing a CHVL command for an axis operating in sigmoid motion (SCRV command) will generate an "Error No. CC1, Speed-change condition error."

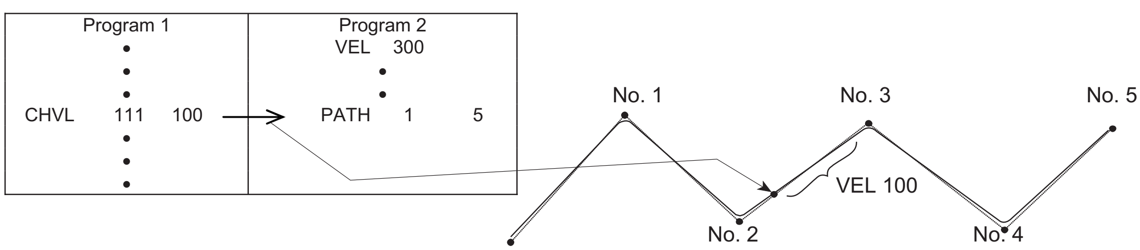
(Note 3) This is a temporary speed-change command issued from other task to the active packet (point). It is not affected by the data declared by VEL.

Program 1	Program 2
	VEL 300
	•
	•
	MOVP 1
CHVL 111 100	MOVP 2
	MOVP 3
	•

If CHVL is executed in program 1 while MOVP 2 is executed in program 2, the travel speed of MOVP 2 will become 100 mm/sec.
The speeds of other move commands will remain 300 mm/sec.

The axis pattern can be specified indirectly using a variable.
When program 1 is rephrased based on indirect specification using a variable:
111 (binary) → 7 (decimal)
LET 1 7 Assign 7 to variable 1.
CHVL *1 100

(Note 4) Since this command is valid only for the packet that is active at the time of execution of the command for an axis subject to continuous motion in a PATH command, etc., caution must be exercised against the timing shift. The packet handling will be put on hold during speed-change processing, so caution must also be exercised against the locus shift.



If CHVL is executed in program 1 while PATH is executed in program 2, or specifically during the PATH movement from point No. 2 to point No. 3, the speed specified by CHVL (100 mm/sec in the above example) will become valid only during the PATH movement to point No. 3. Other travel speeds will remain at the speed specified by VEL (300 mm/sec in the above example).

(Note 5) Override of the CHVL call task will be applied, so caution must be exercised.

(Note 6) The maximum speed of the specified axis completing home return will be clamped by the minimum value set in "Axis-specific parameter No. 28, Maximum operating speed of each axis" or "Axis-specific parameter No. 27, Maximum speed limited by maximum motor speed" with respect to the specified axis and related interpolation axes currently operating. To prevent the maximum speed from being limited due to the effect of other axis whose maximum speed is lower than the speed specified in the CHVL command, issue a CHVL command in multiple steps corresponding to the respective axes having different maximum speeds. In particular, specification of a CHVL command in a separate step is recommended for a rotating axis.

[Example] CHVL 1111 500 ⇒ CHVL 111 500
CHVL 1000 500

- ARCD (Move along arc via specification of end position and center angle (arc interpolation))

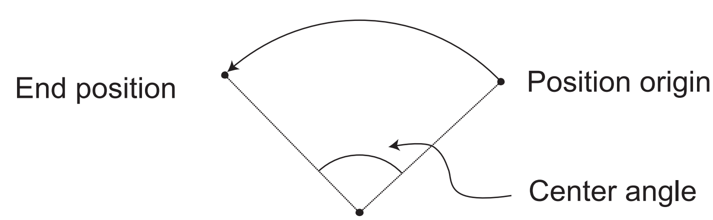
Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	ARCD	End position number	Center angle	PE

[Function] Move along an arc originating from the current position and terminating at the end position, via arc interpolation.
Specify the end position of movement in operand 1, and the center angle formed by the position origin and end position in operand 2. The center angle is set in a range from –359.999 to –0.001 or from 0.001 to 359.999. A positive value indicates CCW (counterclockwise) movement, while a negative value indicates CW (clockwise) movement. The center angle is set in degrees and may include up to three decimal places.

The speed and acceleration will take valid values based on the following priorities:

Priority	Speed	Acceleration (deceleration)
1	Setting in the position data specified in operand 1	Setting in the position data specified in operand 1
2	Setting by VEL command	Setting by ACC (DCL) command
3		Default acceleration in all-axis parameter No. 11 (Default deceleration in all-axis parameter No. 12)

If speed is not set, a “C88 speed specification error” will generate.
If acceleration/deceleration is not valid, a “C89 acceleration/deceleration specification error” will generate.



(Note 1) The rotating direction of actual operation locus may vary depending on the installation method of each axis, how axes are combined, and so on. Always check the rotating direction by test operation.
(Note 2) This command is valid on arbitrary orthogonal planes. (Axis 2 may be selected automatically prior to axis 1 in accordance with the position data.)

[Example]

VEL	100		Set the speed to 100 mm/s.
ARCD	100	120	Move along an arc from the position origin to position No. 100 for a center angle of 120 degrees (CCW direction).

- ARCC (Move along arc via specification of center position and center angle (arc interpolation))

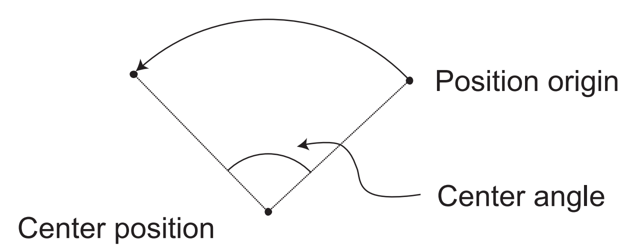
Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	ARCC	Center position number	Center angle	PE

[Function] Move along an arc originating from the current position by keeping a specified radius from the center position, via arc interpolation.
Specify the center position in operand 1, and the center angle formed by the position origin and end position in operand 2. The center angle is set in a range from –3600 to 3600 degrees (±10 revolutions). A positive value indicates CCW (counterclockwise-direction) movement, while a negative value indicates CW (clockwise-direction) movement (setting unit: degree).
The center angle is set in degrees and may include up to three decimal places.

The speed and acceleration will take valid values based on the following priorities:

Priority	Speed	Acceleration (deceleration)
1	Setting in the position data specified in operand 1	Setting in the position data specified in operand 1
2	Setting by VEL command	Setting by ACC (DCL) command
3		Default acceleration in all-axis parameter No. 11 (Default deceleration in all-axis parameter No. 12)

If speed is not set, a "C88 speed specification error" will generate.
If acceleration/deceleration is not valid, a "C89 acceleration/deceleration specification error" will generate.



(Note 1) The rotating direction of actual operation locus may vary depending on the installation method of each axis, how axes are combined, and so on. Always check the rotating direction by test operation.

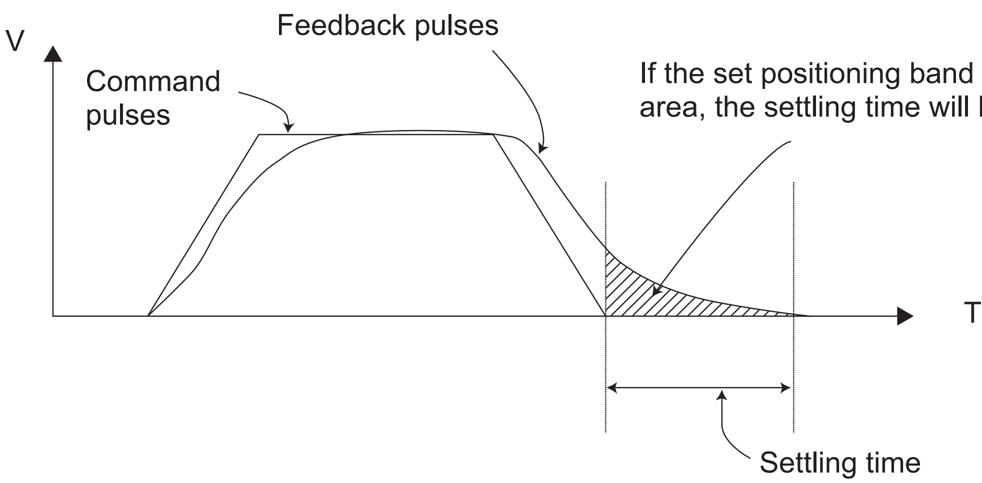
(Note 2) This command is valid on arbitrary orthogonal planes. (Axis 2 may be selected automatically prior to axis 1 in accordance with the position data.)

[Example]				
	VEL	100		Set the speed to 100 mm/s.
	ARCC	100	120	Move along an arc from the position origin for a center angle of 120 degrees around position No. 100 being the center (CCW direction).

- PBND (Set positioning band)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PBND	Axis pattern	Distance	CP

[Function] Set the position complete width for the axes in the axis pattern specified in operand 1. The distance in operand 2 is set in mm.
As a rule, positioning is deemed complete when all command pulses have been output and the current position is inside the positioning band. Therefore, this command is effective if you wish to reduce the tact time by shortening the approximate positioning settling time. (Normally a setting of approx. 3 to 5 mm will have effect, but the effect must be confirmed on the actual machine.)
(This command can be combined with a QRTN command for special purposes. Refer to the section on QRTN command for details.)



(Note 1) If positioning band is not set with a PBND command, the value set in "Axis-specific parameter No. 58, Positioning band" will be used.
(Note 2) If the positioning band is changed, the new setting will remain valid even after the program ends. Therefore, to build a system using PBND commands, a positioning band must be expressly specified with a PBND command before operation of each program. An assumption that the positioning band will be reset to the original value when the operation ends in other program may lead to an unexpected problem, because the positioning band will become different from what is anticipated in case the applicable program is aborted due to error, etc.
(Note 3) The value set in "Axis-specific parameter No. 58, Positioning band" will not be written by a PBND command.

[Example 1] PBND 11 5 Set the positioning band for axes 1 and 2 to 5 mm after this command.

[Example 2] The axis pattern can be specified indirectly using a variable.
When the command in [Example 1] is rephrased based on indirect specification using a variable:
11 (binary) → 3 (decimal)
LET 1 3 Assign 3 to variable 1.
PBND *1 5

- CIR (Move along circle)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	CIR	Passing position 1 number	Passing position 2 number	PE

[Function] Move along a circle originating from the current position and passing the positions specified in operands 1 and 2.
Therefore, reversing the settings of operands 1 and 2 will implement a circular movement in the reverse direction.
The output will turn OFF at the start of circular movement, and turn ON when the movement is complete.
Difference from CIR2:
CIR processing resembles moving along a polygon with a PATH command, while CIR2 actually performs arc interpolation.
Select an applicable command by considering the characteristics of each command. (Normally CIR2 is used.)

(Note 1) If the division angle is set to “0” with a DEG command (division angle is calculated automatically based on priority speed setting), the speed set in the data at passing position 1 or speed set by a VEL command will be used (former is given priority). The speed set in the data at passing position 2 will have no meaning.

(Note 2) If the division angle is set to a value other than “0” with a DEG command (normal division angle), the speed specified in the target position data will be used. (The speed set by a VEL command will become valid if position data is not specified.)
In the case of circular movement, the axes will return from passing position 2 to the start position at the speed declared by a VEL command. Therefore, a VEL command must always be used with a CIR command.

(Note 3) The acceleration is selected in the order of the acceleration in the data at passing position 1, followed by the value in “All-axis parameter No. 11, Default acceleration.”
The deceleration will become the same value as the valid acceleration selected above.
Therefore, the deceleration in the data at passing position 1 and the acceleration/deceleration in the data at passing position 2 will not have any meaning.

(Note 4) This command is valid on arbitrary orthogonal planes. (Axis 2 may be selected automatically prior to axis 1 in accordance with the position data.)

[Example 1]	VEL	100		Set the speed to 100 mm/s.
	CIR	100	101	Move along a circle from the current position by passing positions 100 and 101 sequentially.

[Example 2]	VEL	100		Set the speed to 100 mm/s.
	LET	1	5	Assign 5 to variable 1.
	LET	2	6	Assign 6 to variable 2.
	CIR	*1	*2	Move along a circle from the current position by passing the contents of variables 1 and 2 (positions 5 and 6) sequentially.

● ARC (Move along arc)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	ARC	Passing position number	End position number	PE

[Function] Move along an arc from the current position to the position specified in operand 2, by passing the position specified in operand 1.
The output will turn OFF at the start of arc movement, and turn ON when the movement is complete.
Difference from ARC2:
ARC processing resembles moving along a polygon with a PATH command, while ARC2 actually performs arc interpolation.
Select an applicable command by considering the characteristics of each command. (Normally ARC2 is used.)

(Note 1) If the division angle is set to “0” with a DEG command (division angle is calculated automatically based on priority speed setting), the speed set in the data at passing position 1 or speed set by a VEL command will be used (former is given priority). The speed set in the data at passing position 2 will have no meaning.

(Note 2) If the division angle is set to a value other than “0” with a DEG command (normal division angle), the speed specified in the target position data will be used. (The speed set by a VEL command will become valid if position data is not specified.)

(Note 3) The acceleration is selected in the order of the acceleration in the data at passing position 1, followed by the value in “All-axis parameter No. 11, Default acceleration.”
The deceleration will become the same value as the valid acceleration selected above. Therefore, the deceleration in the data at passing position 1 and the acceleration/deceleration in the data at passing position 2 will not have any meaning.

(Note 4) This command is valid on arbitrary orthogonal planes. (Axis 2 may be selected automatically prior to axis 1 in accordance with the position data.).

[Example 1]

VEL	100		Set the speed to 100 mm/s.
ARC	100	101	Move along an arc from the current position to position 101 by passing position 100.

[Example 2]

VEL	100		Set the speed to 100 mm/s.
LET	1	5	Assign 5 to variable 1.
LET	2	6	Assign 6 to variable 2.
ARC	*1	*2	Move along an arc from the current position to the content of variable 2 (position 6) by passing the content of variable 1 (position 5).

1.13 Structural IF

● IF☐☐ (Structural IF)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	IF☐☐	Variable number	Data	CP

[Function] Compare the content of the variable specified in operand 1 with the value specified in operand 2, and proceed to the next step if the condition is satisfied.
If the condition is not satisfied, the program will proceed to the step next to the corresponding ELSE command, if any, or to the step next to the corresponding EDIF command.
If the input condition is not satisfied and the IF☐☐ command is not executed, the program will proceed to the step next to the corresponding EDIF.
A maximum of 15 nests are supported when IS☐☐ and DW☐☐ are combined.

IF☐☐
- EQ .... Operand 1 = Operand 2
- NE .... Operand 1 ≠ Operand 2
- GT .... Operand 1 > Operand 2
- GE .... Operand 1 ≥ Operand 2
- LT .... Operand 1 < Operand 2
- LE .... Operand 1 ≤ Operand 2

[Example 1]

```
600   IFEQ   1    1    Select an axis.
      IFGE   2    0    Select a moving direction.
      JFWN   01   5    Move axis 1 forward.
      ELSE
      JBWN   01   5    Move axis 1 backward.
      EDIF
      ELSE
      IFLT   2    0    Select a moving direction.
      JBWN   10   5    Move axis 2 backward.
      ELSE
      JFWN   10   5    Move axis 2 forward.
      EDIF
      EDIF
```

Jog by selecting axis 1/axis 2 by variable 1 and forward/backward (+/–) by variable 2.
Nothing will happen if flag 600 is OFF, in which case the program will proceed to the step next to the last EDIF.

(Note) Using a GOTO command to branch out of or into an IF☐☐-EDIF syntax is prohibited.

- IS□□ (Compare strings)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	IS□□	Column number	Column number, character literal	CP

[Function] Compare the character strings in the columns specified in operands 1 and 2, and proceed to the next step if the condition is satisfied.
If the condition is not satisfied, the program will proceed to the step next to the corresponding ELSE command, if any, or to the step next to the corresponding EDIF command.
Comparison will be performed for the length set by a SLEN command.
If a character literal is specified in operand 2, comparison will be performed for the entire length of the literal.
If the input condition is not satisfied and the IS□□ command is not executed, the program will proceed to the step next to the EDIF.
A maximum of 15 nests are supported when IF□□ and DW□□ are combined.

```
IS□□
  ├─ EQ  ............. Operand 1 = Operand 2
  └─ NE  ............. Operand 1 ≠ Operand 2
```

[Example 1]

```
       SCPY  10   'GOFD' (Move forward)
       SCPY  14   'GOBK' (Move backward)
       LET   1    5
       LET   2    14
       SLEN  4                      Set the number of comparing characters to 4.
600    ISEQ  1    '1AXS' (Axis 1)   Select an axis.
       ISEQ  5    10                Select a moving direction.
       JFWN  01   5                 Move axis 1 forward.
       ELSE
       JBWN  01   5                 Move axis 1 backward.
       EDIF
       ELSE
       ISNE  *1   *2                Select a moving direction.
       JFWN  10   5                 Move axis 2 backward.
       ELSE
       JBWN  10   5                 Move axis 2 forward.
       EDIF
       EDIF
```

Jog by selecting axis 1/axis 2 by columns 1 to 4 and forward/backward by columns 5 to 8.
Nothing will happen if flag 600 is OFF, in which case the program will proceed to the step next to the last EDIF.
If columns 1 to 8 contain the following data, axis 1 will be moved forward.

1 2	3 4	5 6	7 8	
1A	XS	GO	FD	

(Note) Using a GOTO command to branch out of or into an IS□□-EDIF syntax is prohibited.

● ELSE (Else)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Prohibited	Prohibited	ELSE	Prohibited	Prohibited	CP

[Function] An ELSE command is used arbitrarily in conjunction with an IF☐☐ or IS☐☐ command to declare the command part to be executed when the condition is not satisfied.

[Example 1] Refer to the sections on IF☐☐ and IS☐☐.

● EDIF (End IF☐☐)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Prohibited	Prohibited	EDIF	Prohibited	Prohibited	CP

[Function] Declare the end of an IF☐☐ or IS☐☐ command.

[Example 1] Refer to the sections on IF☐☐ and IS☐☐.

1.14 Structural DO

- DW□□ (DO WHILE)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	DW□□	Variable number	Data	CP

[Function] Compare the content of the variable specified in operand 1 with the value specified in operand 2, and execute the subsequent commands up to EDDO while the condition is satisfied.
The program will proceed to the step next to the corresponding EDDO if the condition is no longer satisfied.
A LEAV command can be used to forcibly end a loop.
If the input condition is not satisfied and the DW□□ command is not executed, the program will proceed to the step next to the corresponding EDDO.
A maximum of 15 nests are supported when IF□□ and IS□□ are combined.

DW□□
- EQ .... Operand 1 = Operand 2
- NE .... Operand 1 ≠ Operand 2
- GT .... Operand 1 > Operand 2
- GE .... Operand 1 ≥ Operand 2
- LT .... Operand 1 < Operand 2
- LE .... Operand 1 ≤ Operand 2

[Example 1]

008	DWEQ	1	0	Repeat the command up to an EDDO command while variable 1 contains "0."
	:			
	:			
	EDDO			

If DW□□ is specified at the start and input 8 is OFF, nothing will occur and the program will proceed to the step next to EDDO.

(Note) Using a GOTO command to branch out of or into a DW□□-EDDO syntax is prohibited.

- LEAV (Pull out of DO WHILE)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	LEAV	Prohibited	Prohibited	CP

[Function] Pull out of a DO□□ loop and proceed to the step next to EDDO.

[Example 1]

	DWEQ	1	0	Repeat the commands up to an EDDO command while variable 1 contains '0."
	:			
600	LEAV			Forcibly end the loop if flag 600 is ON and proceed to the step next to an EDDO command.
	:			
	EDDO			

- ITER (Repeat)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	ITER	Prohibited	Prohibited	CP

[Function] Forcibly switch the control to EDDO while in a DO☐☐ loop.

[Example 1]

```
        DWEQ   1   0    Repeat the commands up to an EDDO command while
                        variable 1 contains "0."
          :
  600   ITER            Forcibly switch the control to an EDDO command and
          :             perform end judgment, if flag 600 is ON.
        EDDO
```

- EDDO (End DO WHILE)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Prohibited	Prohibited	EDDO	Prohibited	Prohibited	CP

[Function] Declare the end of a loop that began with DW☐☐.
If the DW☐☐ condition is not satisfied, the program will proceed to the step next to this command.

[Example 1] Refer to the section on DW☐☐.

1.15 Multi-Branching

- SLCT (Start selected group)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	SLCT	Prohibited	Prohibited	CP

[Function] Branch to the step next to any WH☐☐ or WS☐☐ command that exists before an EDSL command and whose condition is satisfied, or to the step next to an OTHE command if none of the conditions are satisfied.
A SLCT command must be followed by a WH☐☐, WS☐☐ or EDSL command.
A maximum of 15 nests are supported.

(Note) Using a GOTO command to branch out of the SLCT-EDSL syntax or to other branching processing within the syntax is prohibited.

[Example 1]

	SCPY	1	'Right'	Assign 'right' to columns 1 and 2.
	:			
600	SLCT			Jump to a WXXX whose condition is satisfied.
	WSEQ	1	'Right'	If 'right' is stored in columns 1 and 2, this command will be executed.
	:			
	WSEQ	1	'Left'	If 'left' is stored, this command will be executed.
	:			
	OTHE			If the content of columns 1 and 2 is neither of the above, this command will be executed.
	:			
	EDSL			If flag 600 is OFF, the processing will move here upon execution of any of the conditions.

● WH□□ (Select if true; variable)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Prohibited	Prohibited	WH□□	Variable number	Data	CP

[Function] This command is used between SLCT and EDSL commands to execute the subsequent commands up to the next W□□□ command or an OTHE or EDSL command when the comparison result of the content of the variable specified in operand 1 with the value specified in operand 2 satisfies the condition.

```
WH□□
  ┌ EQ ............ Operand 1 = Operand 2
  │ NE ............ Operand 1 ≠ Operand 2
  │ GT ............ Operand 1 > Operand 2
  │ GE ............ Operand 1 ≥ Operand 2
  │ LT ............ Operand 1 < Operand 2
  └ LE ............ Operand 1 ≤ Operand 2
```

[Example 1]

LET	1	20	Assign 20 to variable 1.
LET	2	10	Assign 10 to variable 2.
:			
SLCT			Execute multi-branching.
WHEQ	1	10	(1) will be executed if the content of variable 1 is 10.
:			Since variable 1 contains 20, however, the next
(1)			condition will be referenced.
:			
WHGT	1	*2	This command will be executed if the content of variable
:			1 is greater than the content of variable 2.
(2)			Since variable 1 (= 20) > variable 2 (=10), (2) will be executed.
OTHE			This command will be executed if none of the conditions
:			are satisfied. In this example, since (2) was executed,
(3)			(3) will not be executed.
:			The processing will move here if any of the conditions
EDSL			were satisfied and the applicable command executed. In
:			this example, (2) and (4) will be executed.
(4)			
:			

* If multiple conditions are likely to be satisfied, remember that the first W□□□ will become valid and any subsequent commands will not be executed. Therefore, state from the command with the most difficult condition or highest priority.

- WS□□ (Select if true; character)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Prohibited	Prohibited	WS□□	Column number	Column number, character literal	CP

[Function] This command is used between SLCT and EDSL commands to execute the subsequent commands up to the next W□□□ command or an OTHE or EDSL command when the comparison result of the character strings in the columns specified in operands 1 and 2 satisfies the condition.
Comparison will be performed for the length set by a SLEN command.
If a character literal is specified in operand 2, comparison will be performed for the entire length of the literal.

```
WS□□
 └┬─ EQ ............. Operand 1 = Operand 2
  └─ NE ............. Operand 1 ≠ Operand 2
```

[Example 1]

SLEN	3		Set the number of comparing characters to 3.
SCPY	1	'ABC'	Assign 'ABC' to column 1.
LET	1	2	Assign 2 to variable 1.
:			
SLCT			Execute multi-branching.
WSEQ	1	'XYZ'	(1) will be executed if columns 1 to 3 contain 'XYZ.' Since columns 1 to 3 contain 'ABC,' however, this command will not be executed.
:			
(1)			
:			
WSEQ	2	*1	(2) will be executed if the content of the number of characters specified by SLEN after column 2 is the same as the content of the column specified in variable 1.
:			
(2)			
:			
OTHE			This command will be executed if none of the conditions are satisfied. In this example, since (2) was executed, (3) will not be executed.
:			
(3)			
:			
EDSL			The processing will move here if any of the conditions were satisfied and the applicable command executed. In this example, (2) and (4) will be executed.
:			
(4)			
:			

* If multiple conditions are likely to be satisfied, remember that the first W□□□ will become valid and any subsequent commands will not be executed. Therefore, state from the command with the most difficult condition or highest priority.

- OTHE (Select other)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Prohibited	Prohibited	OTHE	Prohibited	Prohibited	CP

[Function] This command is used between SLCT and EDSL commands to declare the command to be executed when none of the conditions are satisfied.

[Example 1] Refer to the sections on SLCT, WH□□ and WS□□.

- EDSL (End selected group)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Prohibited	Prohibited	EDSL	Prohibited	Prohibited	CP

[Function] Declare the end of a SLCT command.

[Example 1] Refer to the sections on SLCT, WH□□ and WS□□.

1.16 System Information Acquisition

- AXST (Get axis status)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	AXST	Variable number	Axis number	CP

[Function] Store in the variable specified in operand 1 the status (axis error number) of the axis specified in operand 2.

(Note 1) If the obtained result is “0,” it means no axis error is present.
(Note 2) Since the error lists are written in hexadecimals, they must be converted to decimals.

[Example] AXST 1 2 Read the error number for axis 2 to variable 1.

If 3188 (decimal) is stored in variable 1 after the execution of this command:

$3188 \div 16 = 199$,,,4
$199 \div 16 = 12$ (= C) ,,,7

$3188 = 12 (= C) \times 16^2 + 7 \times 16^2 + 4$
= C74 (HEX) (Hexadecimal number)

Therefore, an “Error No. C74, Actual-position soft limit over error” is present.

● PGST (Get program status)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PGST	Variable number	Program number	CP

[Function] Store in the variable specified in operand 1 the status (program error number) of the program specified in operand 2.

(Note 1) If the obtained result is "0," it means no program error is present.
(Note 2) Although the error lists are written in hexadecimals, the status to be stored (program error number) is a decimal. Therefore, the decimal program error numbers must be converted to hexadecimals.

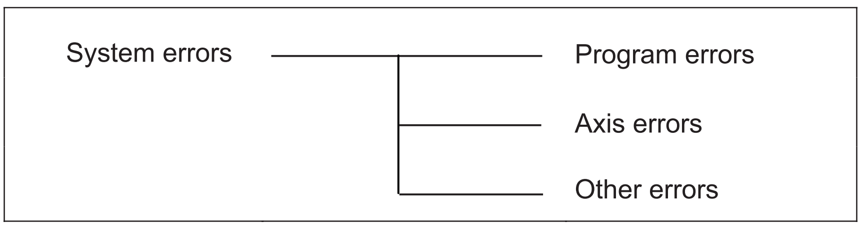
[Example]	PGST	1	2	Read the error number for program No. 2 to variable 1.

- SYST (Get system status)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	SYST	Variable number	Prohibited	CP

[Function] Store the system status (top-priority system error number) in the variable specified in operand 1.

(Note 1) If the obtained result is “0,” it means no system error is present.
(Note 2) Since the error lists are written in hexadecimals, they must be converted to decimals.
(Note 3) Relationship of error statuses



* An axis error that generates during operation with a program command will be registered both as a program error and an axis error.

[Example] SYST 1 Read the system error number to variable 1.

1.17 Zone

- WZNA (Wait for zone ON, with AND)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	WZNA	Zone number	Axis pattern	CP

[Function] Wait for the zone status of all axes (AND) specified by the axis pattern in operand 2 to become ON (inside zone) with respect to the zone specified in operand 1.

(Note 1) The zone status of axes not yet completing home return will remain OFF (outside zone).
(Note 2) A maximum of four areas can be set as zones for each axis ("Axis-specific parameter Nos. 86 to 97").
(Note 3) Zone output can be specified using "Axis-specific parameter Nos. 88, 91, 94 and 97" irrespective of this command.

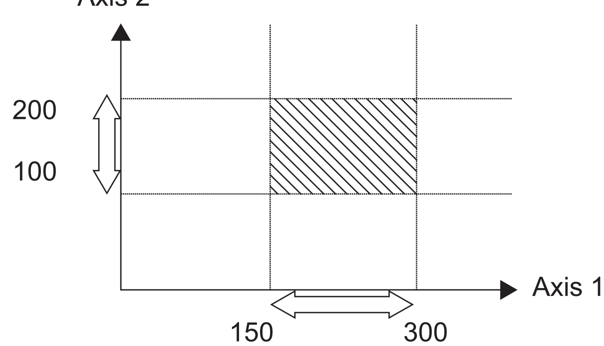
[Example 1] WZNA 1 11 If the parameters are set as follows, the program will wait until the zone status of axes 1 and 2 becomes ON (inside the shaded area shown in the diagram below).

[Example 2] The axis pattern can be specified indirectly using a variable.
When the command in [Example 1] is rephrased based on indirect specification using a variable:
11 (binary) → 3 (decimal)

```
LET     5     3        Assign 3 to variable 5.
WZNA    1     *5
```

	Axis 1	Axis 2
"Axis-specific parameter No. 86, Zone 1 max." (Value is set in units of 0.001 mm)	300000	200000
"Axis-specific parameter No. 87, Zone 1 min." (Value is set in units of 0.001 mm)	150000	100000

The program will proceed to the next step if both axes 1 and 2 are inside the shaded area.



- WZNO (Wait for zone ON, with OR)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	WZNO	Zone number	Axis pattern	CP

[Function] Wait for the zone status of any of the axes (OR) specified by the axis pattern in operand 2 to become ON (inside zone) with respect to the zone specified in operand 1.

(Note 1) The zone status of axes not yet completing home return will remain OFF (outside zone).
(Note 2) A maximum of four areas can be set as zones for each axis (“Axis-specific parameter Nos. 86 to 97”).
(Note 3) Zone output can be specified using “Axis-specific parameter Nos. 88, 91, 94 and 97” irrespective of this command.

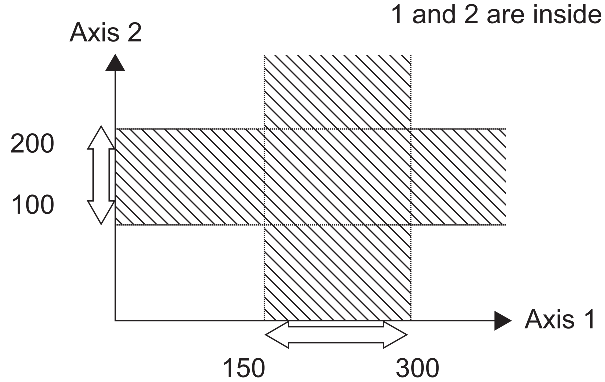
[Example 1] WZNO 1 11 If the parameters are set as follows, the program will wait until the zone status of axes 1 or 2 becomes ON (inside the shaded area shown in the diagram below).

[Example 2] The axis pattern can be specified indirectly using a variable.
When the command in [Example 1] is rephrased based on indirect specification using a variable:
11 (binary) → 3 (decimal)

```
LET    5    3      Assign 3 to variable 5.
WZNO   1    *5
```

	Axis 1	Axis 2
“Axis-specific parameter No. 86, Zone 1 max.” (Value is set in units of 0.001 mm)	300000	200000
“Axis-specific parameter No. 87, Zone 1 min.” (Value is set in units of 0.001 mm)	150000	100000

The program will proceed to the next step if both axes 1 and 2 are inside the shaded area.



- WZFA (Wait for zone OFF, with AND)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	WZFA	Zone number	Axis pattern	CP

[Function] Wait for the zone status of all axes (AND) specified by the axis pattern in operand 2 to become OFF (outside zone) with respect to the zone specified in operand 1.

(Note 1) The zone status of axes not yet completing home return will remain OFF (outside zone).
(Note 2) A maximum of four areas can be set as zones for each axis ("Axis-specific parameter Nos. 86 to 97").
(Note 3) Zone output can be specified using "Axis-specific parameter Nos. 88, 91, 94 and 97" irrespective of this command.

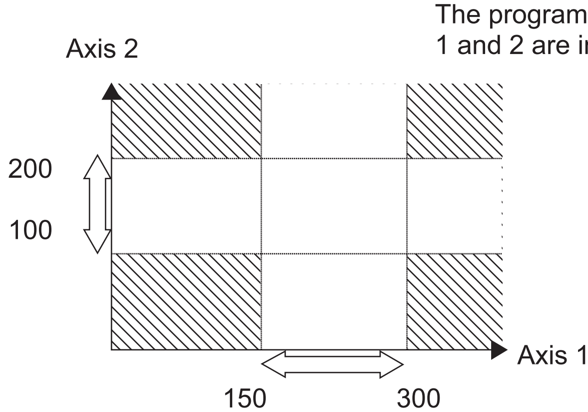
[Example] WZFA 1 11 — If the parameters are set as follows, the program will wait until the zone status of axes 1 and 2 becomes OFF (inside the shaded area shown in the diagram below)

[Example 2] The axis pattern can be specified indirectly using a variable.
When the command in [Example 1] is rephrased based on indirect specification using a variable:
11 (binary) → 3 (decimal)

LET	5	3	Assign 3 to variable 5.
WZFA	1	*5	

	Axis 1	Axis 2
"Axis-specific parameter No. 86, Zone 1 max." (Value is set in units of 0.001 mm)	300000	200000
"Axis-specific parameter No. 87, Zone 1 min." (Value is set in units of 0.001 mm)	150000	100000

The program will proceed to the next step if both axes 1 and 2 are inside the shaded area.



- WZFO (Wait for zone OFF, with OR)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	WZFO	Zone number	Axis pattern	CP

[Function] Wait for the zone status of any of the axes (OR) specified by the axis pattern in operand 2 to become OFF (outside zone) with respect to the zone specified in operand 1.

(Note 1) The zone status of axes not yet completing home return will remain OFF (outside zone).
(Note 2) A maximum of four areas can be set as zones for each axis ("Axis-specific parameter Nos. 86 to 97").
(Note 3) Zone output can be specified using "Axis-specific parameter Nos. 88, 91, 94 and 97" irrespective of this command.

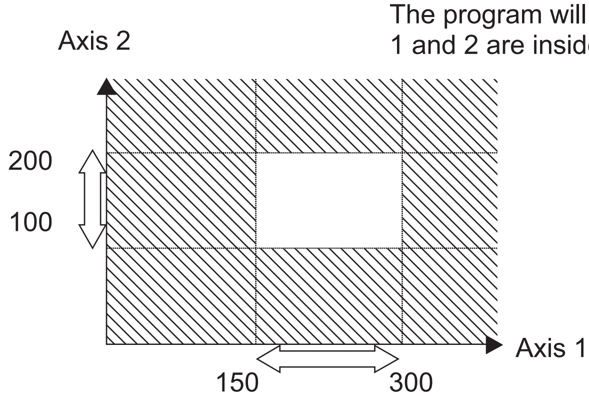
[Example 1] WZFO 1 11 If the parameters are set as follows, the program will wait until the zone status of axes 1 or 2 becomes OFF (inside the shaded area shown in the diagram below).

[Example 2] The axis pattern can be specified indirectly using a variable.
When the command in [Example 1] is rephrased based on indirect specification using a variable:
11 (binary) → 3 (decimal)

```
LET     5     3        Assign 3 to variable 5.
WZFO    1     *5
```

	Axis 1	Axis 2
"Axis-specific parameter No. 86, Zone 1 max." (Value is set in units of 0.001 mm)	300000	200000
"Axis-specific parameter No. 87, Zone 1 min." (Value is set in units of 0.001 mm)	150000	100000

The program will proceed to the next step if both axes 1 and 2 are inside the shaded area.



1.18 Communication

● OPEN (Open channel)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	OPEN	Channel number	Prohibited	CP

[Function] Open the channel specified in operand 1.
The specified channel will be enabled to send/receive hereafter.
Prior to executing this command, a SCHA command must be used to set an end character.

[Example]

```
SCHA    10
OPEN    1
        Specify 10 (= LF) as the end character.
        Open channel 1.
```

Note 1: If “OPEN 0” is executed in Channel No.0, a connection cannot be made with the teaching pendant or PC software since the channel number is in common for the connections with the teaching pendant and PC software. Also, when in the manual mode, it will generate Error No.A5D “SCIF Open Error in Non-AUTO Mode” even though the program operation continues.

Note 2: During the manual mode, Channel No.0 cannot be open when the axis is in use. It will cause Error No.E89 “SCIF Open Error (Servo in use) in Non-AUTO Mode” .

● CLOS (Close channel)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	CLOS	Channel number	Prohibited	CP

[Function] Close the channel specified in operand 1.
The specified channel will be disabled to send/receive hereafter.

[Example]

```
CLOS    1
Close channel 1.

LET     1       2
CLOS    *1
        Assign 2 to variable 1.
        Close the content of variable 1 (channel 2).
```

- READ (Read)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	READ	Channel number	Column number	CC

[Function] Read a character string from the channel specified in operand 1 to the column specified in operand 2.
Read will end when the character specified by a SCHA command is received.
Either a local or global column may be specified.
Immediately after this command is executed, a return code will be stored in a local variable (factory setting: variable 99). Whether or not the command was executed successfully can be checked using this return code. If necessary, specify an appropriate processing to be performed when the command was terminated due to an error.
In main application version 0.41 or later, a dummy read (receive buffer cleared & receive disabled) can be performed if “0” is specified in operand 2 (the return code will indicate successful completion). The tool versions that support “0” input in operand 2 are listed below. If “0” cannot be input directly from the tool, it can be specified indirectly:
- PC software version 1.1.1.0 or later
- Teaching pendant application version 1.06 or later

[Example]

SCHA	10		Set LF (= 10) as the end character.
OPEN	1		Open channel 1.
READ	1	2	Read a character string from channel 1 to column 2 until LF is received.
TRAN	1	99	Assign a return code (variable 99) to variable 1.
CLOS	1		Close the channel.
SLCT			Branch to the processing corresponding to each return code. (Note) Using a GOTO command to branch out of the SLCT-EDSL syntax or to other branching processing within the syntax is prohibited.
WHEQ : (1) :	1	0	If the content of variable 1 is “0” (successful completion), (1) will be performed. Accordingly, specify the processing to be performed upon successful completion in (1).
WHEQ : (2) :	1	1	If the content of variable 1 is “1” (timeout), (2) will be performed. Accordingly, specify an appropriate processing to be performed in (2), if necessary.
WHEQ : (3) :	1	2	If the content of variable 1 is “2” (timer cancelled), (3) will be performed. Accordingly, specify an appropriate processing to be performed in (3), if necessary.
OTHE : (4) :			If the content of variable 1 is other than “0,” “1” or “2,” (4) will be performed. Accordingly, specify an error handling in (4), if necessary.
EDSL			The program moves here if any of the conditions was established and the corresponding command was executed.

(Note1) A READ command must be executed before the other side sends the end character.
(Note2) Channel Nos. 31 to 34 (available with the Ethernet option) cannot be specified for dummy read (operand 2: 0).

```
SCHA    10
OPEN    1
READ    1         2
                            Other side
CLOS    1
```

- Return code of the READ command

  The return code is stored in a local variable. The variable number can be set by "Other parameter No. 24." The default variable number is 99.

  0: READ completed successfully (Receive complete)
  1: READ timeout (the timeout value is set by a TMRD command) (Continue to receive)
  2: READ timer cancelled (the wait status is cancelled by a TIMC command) (Continue to receive)
  3: READ SCIF overrun error (Receive disabled)
  4: READ SCIF receive error (framing error or parity error) (Receive disabled)
  5: READ factor error (program abort error) (Receive disabled)
  (Cannot be recognized by SEL commands)
  6: READ task ended (program end request, etc.) (Receive disabled)
  (Cannot be recognized by SEL commands)
  7: READ SCIF receive error due to other factor (Receive disabled)
  8: READ SIO overrun error (Receive disabled)
  9: READ SIO parity error (Receive disabled)
  10: READ SIO framing error (Receive disabled)
  11: READ SIO buffer overflow error (Receive disabled)
  12: READ SIO receive error due to other factor (Receive disabled)
  13 ~ 20: Used only in Ethernet (optional)
  21: READ SIO receive temporary queue overflow error (Receive disabled)
  22: READ SIO slave receive queue overflow error (Receive disabled)

- TMRW (Set READ/WRIT timeout value)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	TMRW	Read timer setting	(Write timer setting)	CC

[Function] Set the timeout setting to be applied to a READ command.
The timer setting specified in operand 1 will set the maximum time the program will wait for the character string read to end when a READ command is executed.
If the end character could not be read before the timer is up during the execution of the READ command, a timeout will occur and the program will move to the next step.
(Whether or not a timeout occurred can be checked using the return code to be stored in variable 99 (factory setting) immediately after a READ command is executed. If necessary, specify an appropriate processing to be performed when a timeout occurred.)
Setting the timer to "0" will allow the READ command to wait infinitely, without timeout, until the end character is read.
The timer setting is input in seconds (setting range: 0 to 99.00 seconds) including up to two decimal places.
Operand 1 can be specified indirectly using a variable.

(Note) TMRW is set to "0" in the default condition before TMRW setting is performed.

[Example]

SCHA	10		Set LF (=10) as the end character.
TMRW	30		Set the READ timeout value to 30 seconds.
OPEN	1		Open channel 1.
READ	1	2	Read the character string from channel 1 to column 2 until LF is read.
TRAN	1	99	Assign the return code to variable 1.
CLOS	1		Close the channel.

Read completes successfully within 30 seconds → Variable No. 1 = 0
Timeout occurs → Variable No. 1 = 1

* The return code of READ command may not be limited to 0 or 1. The variable to store the return code can be set in "Other parameter No. 24." Refer to the explanation of READ command for details.

The timer setting specified in operand 2 sets the timeout value to be applied when a WRIT command is executed (maximum time to wait for completion of send) (maximum time to wait for send based on flow control) (optional).
The WRIT timer setting is effective only for standard SIOs (channel 1 or 2 supporting flow control).
TMRD used in the XSEL-J/K type controller is treated as TMRW in the XSEL-P/Q/PCT/QCT type controller.
If a program file created for an XSEL-J/K controller is transferred to an XSEL-P/Q/PCT/QCT controller, the PC software will automatically convert "TMRD" to "TMRW" before the file is transferred.

- WRIT (Write)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	WRIT	Channel number	Column number	CC (Note 1)

[Function] Write the character string in the column specified in operand 2 to the channel specified in operand 1.
The operation will end when the character specified by a SCHA command is written.
Either a local or global column can be specified.

[Example]

SCHA	10		Set LF (= 10) as the end character.
OPEN	1		Open channel 1.
WRIT	1	2	Write the character string in column 2 to channel 1 until LF is written.
CLOS	1		Close the channel.

As long as a standard SIO port (channel 1 or 2) is open, a task other than the one that opened the port can be used to execute (send) a WRIT command. Accordingly, if a READ command is executed in a port-opening task and then a WRIT command is executed in other task, the response from the other side can be received without delay after the command is sent from the XSEL.

(Note 1) CP for channels other than 1 and 2.

Return code of the WRIT command (channels 1 and 2 only)
The return code is stored in a local variable. The variable number can be set by "Other parameter No. 24." The default variable number is 99.
0: WRIT completed successfully
1: WRIT timeout (the timeout value is set by a TMRW command)
2: WRIT timer cancelled (the wait status is cancelled by a TIMC command)
3 to 4: For future expansion
5: WRIT factor error (program abort error) (Cannot be recognized by SEL commands)
6: WRIT task ended (program end request, etc.) (Cannot be recognized by SEL commands)

- SCHA (Set end character)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	SCHA	Character code	Prohibited	CP

[Function] Set the end character to be used by a READ or WRIT command.
Any character from 0 to 255 (character code used in BASIC, etc.) can be specified.

[Example] Refer to the sections on READ and WRIT commands.

1.19 String Operation

- SCPY (Copy character string)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	SCPY	Column number	Column number, character literal	CC

[Function] Copy the character string in the column specified in operand 2 to the column specified in operand 1.
Copy will be performed for the length set by a SLEN command.
If a character literal is specified in operand 2, copy will be performed for the entire length of the literal.

[Example]

SCPY	1	'ABC'	Copy 'ABC' to column 1.
SLEN	10		Set the copying length to 10 bytes.
SCPY	100	200	Copy 10 bytes from column 200 to column 100.

- SCMP (Compare character strings)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	SCMP	Column number	Column number, character literal	EQ

[Function] Compare the column specified in operand 1 with the column specified in operand 2. Comparison will be performed for the length set by a SLEN command.
If a character literal is specified in operand 2, comparison will be performed for the entire length of the literal.

[Example]

SCMP	1	'ABC'	600	Flag 600 will turn ON if columns 1 to 3 contain 'ABC.'
SLEN	5			Set the comparing length to five bytes.
SCMP	10	30	999	Turn ON flag 999 if five bytes from columns 30 and 10 match.

- SGET (Get character)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	SGET	Variable number	Column number, character literal	CP

[Function] Assign one character from the column specified in operand 2 to the variable specified in operand 1.
If a character-string literal is specified in operand 2, the first character will be assigned.

[Example]

SGET	1	100	
Assign one byte from column 100 to variable 1.			
LET	1	3	Assign 3 to variable 1.
LET	2	1	Assign 1 to variable 2.
SCPY	1	‘A’	Copy ‘A’ to column 1.
SGET	*1	*2	Assign ‘A’ from the content of variable 2 (column 1) to the content of variable 1 (variable 3).

- SPUT (Set character)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	SPUT	Column number	Data	CP

[Function] Set the data specified in operand 2 in the column specified in operand 1.

[Example]	SPUT	5	10	Set 10 (LF) in column 5.
	LET	1	100	Assign 100 to variable 1.
	LET	2	50	Assign 50 to variable 2.
	SPUT	*1	*2	Set the content of variable 2 (50 (‘2’)) in the content of variable 1 (column 100).

- STR (Convert character string; decimal)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	STR	Column number	Data	CC

[Function] Copy to the column specified in operand 1 a decimal character string converted from the data specified in operand 2.
The data will be adjusted to the length set by a SLEN command.
If the data exceeds the specified length, it will be cut off at the length set by a SLEN command.
If the entire data has been converted within the length set by a SLEN command, the output will turn ON.

(Note) If the data specified in operand 2 is a 10-digit integer including eight or more valid digits, conversion of the values in the eighth and subsequent digits will not be guaranteed (the values through the seventh digits will be converted properly.)

[Example]

SLEN	5.3		Set a length consisting of five integer digits and three decimal digits.
STR	1	123	The following values will be set in columns 1 to 9:

1	2	3	4	5	6	7	8	9
		1	2	3	.	0	0	0

LET	1	10	Assign 10 to variable 1.
LET	102	987.6543	Assign 987.6543 to variable 102.
SLEN	2.3		Set a length consisting of two integer digits and three decimal digits.
STR	*1	*102	The following values will be set in columns 10 to 15:

10	11	12	13	14	15
8	7	.	6	5	4

Since the data is greater than the length, 87 is set in the integer part after rounding off 9 in the 100’s place, while 654 is set in the fraction part after rounding 3 in the fourth decimal place.

- STRH (Convert character string; hexadecimal)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	STRH	Column number	Data	CC

[Function] Copy to the column specified in operand 1 a hexadecimal character string converted from the data specified in operand 2.
Only the integer part will be adjusted to the length set by a SLEN command.
If the data exceeds the specified length, it will be cut off at the length set by a SLEN command.
If the entire data has been converted within the length set by a SLEN command, the output will turn ON.

(Note) If the data specified in operand 2 is a negative value, eight columns will be required to covert the entire data.

[Example]

SLEN	5		Set a format consisting of five integer digits.
STRH	1	255	The following values will be set in columns 1 to 5:

1	2	3	4	5
			F	F

LET	1	10	Assign 10 to variable 1.
LET	102	987.6543	Assign 987.6543 to variable 102.
SLEN	2.3		Set a length consisting of two integer digits and three decimal digits.
STRH	*1	*102	The following values will be set in columns 10 and 11:

10	11
D	B

“.3” in the SLEN command and “.6543” in variable 102, which are the decimal part, will be ignored.
The integer part is expressed as ‘3DB’ in hexadecimal.
Since the length is two digits, however, “3” in the third digit will be cut off.

- VAL (Convert character string data; decimal)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	VAL	Variable number	Column number, character literal	CC

[Function] Convert the decimal data in the column specified in operand 2 to a binary and assign the result to the variable specified in operand 1.
Conversion will be performed for the length set by a SLEN command.
If a character-string literal is specified in operand 2, conversion will be performed for the entire length of the literal.

(Note) Keep the converting length to 18 characters or less.

[Example]

SCPY	10	'1234'	Set '1234' in column 10.
SLEN	4		Set the converting length to four bytes.
VAL	1	10	Assign 1234, which is a binary converted from '1234' in column 10, to variable 1.

LET	1	100	Assign 100 to variable 1.
LET	2	20	Assign 20 to variable 2.
SCPY	20	'1234'	Copy '1234' to column 20.
SCPY	24	'.567'	Copy '.567' to column 24.
SLEN	8		Set the converting length to eight bytes.
VAL	*1	*2	Assign 1234.567, which is a binary converted from '1234.567' in the content of variable 2 (column 20) to the content of variable 1 (variable 100).

● VALH (Convert character string data; hexadecimal)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	VALH	Variable number	Column number, character literal	CC

[Function] Convert the hexadecimal data in the column specified in operand 2 to a binary and assign the result to the variable specified in operand 1.
Conversion will be performed for the length set by a SLEN command.
Only the integer part will be converted, with the decimal part being ignored.
If a character-string literal is specified in operand 2, conversion will be performed for the entire length of the literal.

(Note) Keep the converting length to 8 characters or less.

[Example]

SCPY	10	‘1234’	Set ‘1234’ in column 10.
SLEN	4		Set the converting length to four bytes.
VALH	1	10	Assign 4660, which is a binary converted from hexadecimal ‘1234’ in column 10, to variable 1.

LET	1	100	Assign 100 to variable 1.
LET	2	20	Assign 20 to variable 2.
SCPY	20	‘ABCD’	Copy ‘ABCD’ to column 20.
SLEN	4		Set the converting length to four bytes.
VALH	*1	*2	Assign 43981, which is a binary converted from hexadecimal ‘ABCD’ in the content of variable 2 (column 20) to the content of variable 1 (variable 100).

- SLEN (Set length)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	SLEN	Character string length	Prohibited	CP

[Function] Set the length to be processed by a string command.
This must always be set before using the following commands:

SCMP	....	Decimal part is invalid.
SCPY	....	Decimal part is invalid.
IS☐☐	....	Decimal part is invalid.
WS☐☐	....	Decimal part is invalid.
STRH	....	Decimal part is invalid.
VAL, VALH	....	Decimal part is invalid.
STR	....	Decimal part is valid.

[Example] Refer to the examples of the above commands:

1.20 Palletizing-Related

- BGPA (Declare start of palletizing setting)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	BGPA	Palletizing number	Prohibited	CP

Declare the start of a palletizing setting.
Once this command is executed, palletizing setting for the palletizing number specified in operand 1 will be enabled.
(In the case of an ACHZ, AEXT, OFAZ or ATRG command, setting is enabled without declaring BGPA.)
The input range of palletizing number is from 1 to 10.
When the palletizing setting is complete, execute EDPA.
Nested BGPAs are not supported. To declare start of another palletizing setting, execute an EDPA command and then execute a BGPA command again.
If the output field is specified, the output will turn ON after this command is executed.
Palletizing numbers are in the local range. Therefore, a given palletizing setting is valid only within the program in which it is set.

(Note) Using a GOTO command to branch out of or into a BGPA-EDPA syntax is prohibited.

- EDPA (Declare end of palletizing setting)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Prohibited	Prohibited	EDPA	Prohibited	Prohibited	CP

Declare the end of a palletizing setting.
If a palletizing-setting command (excluding BGPA, ACHZ, ATRG, AEXT and OFAZ) is executed before another BGPA is declared following an execution of this command (= while palletizing setting is not enabled), an error will generate.
If the output field is specified, the output will turn ON after this command is executed.

- PAPI (Set palletizing counts)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PAPI	Count	Count	CP

Set counts in the palletizing-axis directions.
The count specified in operand 1 will apply to the preferential-axis (PX-axis) direction, while the count specified in operand 2 will apply to the PY-axis direction.
If this command is executed before BGPA is declared (= while palletizing setting is not enabled), an error will generate.
If the output field is specified, the output will turn ON after this command is executed.

- PAPN (Set palletizing pattern)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PAPN	Pattern number	Prohibited	CP

Set a palletizing pattern.
The palletizing pattern specified in operand 1 will be set (1 = Pattern 1, 2 = Pattern 2).
If this command is not declared, pattern 1 will be used.
If this command is executed before BGPA is declared (= while palletizing setting is not enabled), an error will generate.
If the output field is specified, the output will turn ON after this command is executed.

- PASE (Declare palletizing axes)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PASE	Axis number	Axis number	CP

Set the two axes to be used in palletizing (PX and PY-axes).
The axis specified in operand 1 will be set as the preferential axis (PX-axis).
The axis specified in operand 2 will be set as the PY-axis.
This command is used in conjunction with PAPT and PAST.
It cannot be used together with a 3-point teaching (PAPS) command. Whichever is set later will be given priority.

It is recommended to use a 3-point teaching (PAPS) command if the palletizing requires high precision.

If this command is executed before BGPA is declared (= while palletizing setting is not enabled), an error will generate.
If the output field is specified, the output will turn ON after this command is executed.

- PAPT (Set palletizing pitches)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PAPT	Pitch	Pitch	CP

Set palletizing pitches.
The value specified in operand 1 will be set as the pitch for the preferential axis (PX-axis), while the value specified in operand 2 will be set as the pitch for the PY-axis.
This command is used in conjunction with PASE and PAST.
If this command is executed before BGPA is declared (= while palletizing setting is not enabled), an error will generate.
If the output field is specified, the output will turn ON after this command is executed.

- PAST (Set palletizing reference point)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PAST	(Position number)	Prohibited	CP

Set the reference point used in palletizing.
If a value is set in operand 1, that position number specified in operand 1 will be used to store the reference point data.
If no value is set in operand 1, the position-number setting for storing reference point data will become invalid.
This command is used in conjunction with PASE and PAPT.
If this command is not set, coordinates (0, 0) are used as the reference point. If this command is set, the set coordinates are used as the reference point in calculating the position coordinates of palletizing points.
Coordinates in both the PX and PY-axis directions must always be set as the reference-point coordinates. If a palletizing movement command such as PMVP or PMVL is executed, however, specification of palletizing Z-axis (PZ-axis) coordinate is optional. If a Z-axis coordinate is specified, movement in the PZ-axis direction will become enabled. Even if PZ-axis coordinate is not specified, operation will still be performed—just that the position will not move in the PZ-axis direction. Note, however, that an error will generate in the following cases:
If this command and PZ-axis are set but the PX, PY and PZ-axes are not set as valid axes in the reference point data, an error will generate when position coordinates are calculated. If the palletizing Z-axis is not set and the PX and PY-axes are not set as valid axes in the reference point data, an error will also generate when position coordinates are calculated. “When position coordinates are calculated” means when PAPG (get palletizing calculation data) or any palletizing movement command such as PMVP, PMVL or PACH is executed.
If this command is executed before BGPA is declared (= while palletizing setting is not enabled), an error will generate.
If the output field is specified, the output will turn ON after this command is executed.

● PAPS (Set palletizing points) for 3-point & 4-point teaching

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PAPS	Position number	(Palletizing position setting type)	CP

Set palletizing positions by means of 3-point teaching.

Palletizing positions can also be set by means of 4-point teaching. In 4-point teaching, the pallet surface can be defined as any quadrangle other than a square, rectangle or parallelogram.

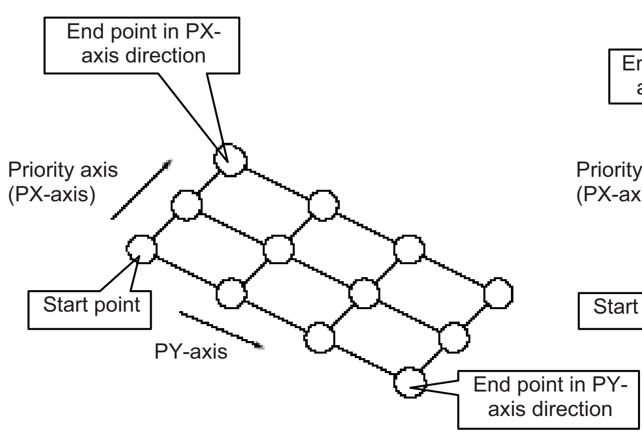
In operand 1, specify the position number to be used as the start point required in the setting of palletizing positions by 3-point teaching. If “n” is set as the position number corresponding to the start point, store position data corresponding to the end point in PX-axis direction in position No. n+1, and store position data corresponding to the end point in PY-axis direction in position No. n+2.
In the case of 4-point teaching, position data corresponding to the end point must also be stored in position No. n+3.

In operand 2, specify the palletizing position setting type.

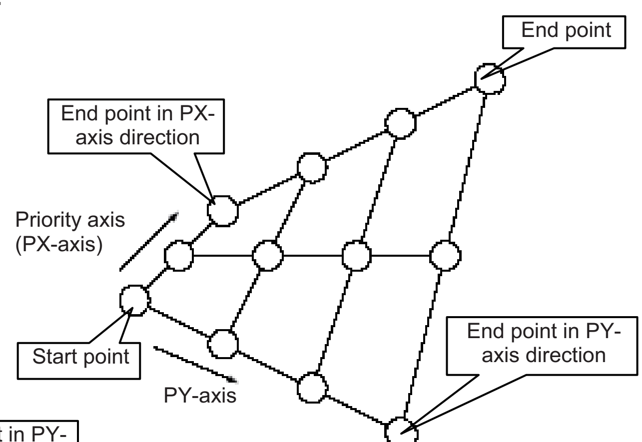
[Palletizing position setting type]
If “0” is set or nothing is specified in operand 2, palletizing positions will be set by 3-point teaching.
As shown in Fig. 1 (a), palletizing positions will be placed on the quadrangular pallet surface determined by the three points including the start point, end point in PX-axis direction, and end point in PY-axis direction.

If “2” is specified in operand 2, palletizing positions will be set by 4-point teaching (non-planar type).
As shown in Fig. 1 (b), palletizing positions will be placed on the quadrangular pallet surface determined by the four points including the start point, end point in PX-axis direction, end point in PY-axis direction, and end point. Take note that whether the shape becomes planar or not depends on the point data of the end point.

Fig. 1 shows how palletizing positions are placed.



(a) 3-point teaching



(b) 4-point teaching

Fig. 1 Placement of Palletizing Positions

- <u>If palletizing positions are set by means of 4-point teaching and a certain level of palletizing precision is required in a condition where all four points used in the setting of palletizing positions are known to be on a plane, it is recommended that palletizing positions be set in a non-planar manner.</u>

  If "1" is specified in operand 2, palletizing positions will be set by 4-point teaching (planar type).
  Fig. 2 (a)
  The plane is determined by the three points including the start point, end point in PX-axis direction, and end point in PY-axis direction. Shift the end point in parallel in PZ direction (vertical direction) and define a new end point as a point of intersection of the lines extending from the original end point and other end points on the original plane.
  Palletizing positions will be placed on the quadrangular pallet surface determined by the four points, including the new end point.

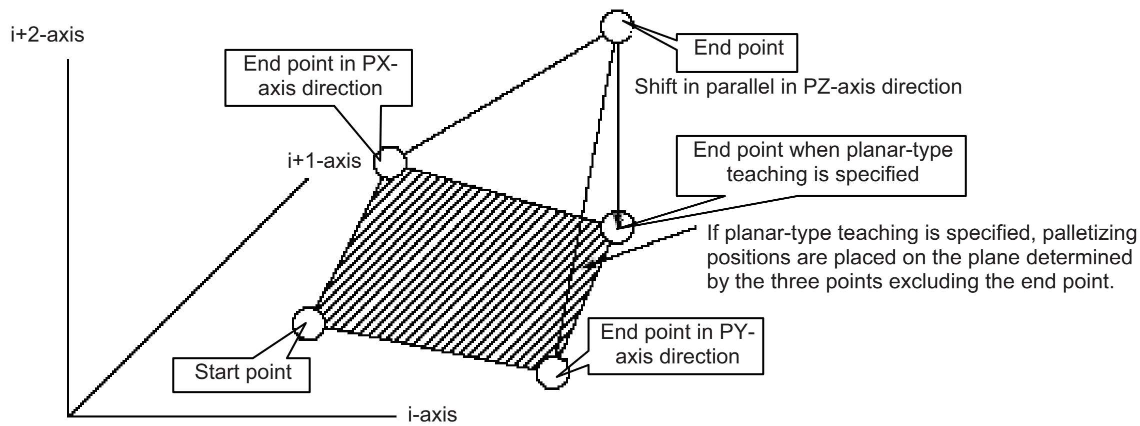


Figure.2-(a)

Take note that if any of the conditions shown in Table 1 is satisfied by any two or all of the remaining three points as applicable, other than the end point, then the end point will shift in a different direction. These conditions apply to situations where the plane determined by the three points excluding the end point is lying vertically to the ground. The shifting direction of the end point must be changed in these cases, because shifting the end point in parallel in PZ direction (vertical direction) will not provide a new end point intersecting with the original plane.

Table 1 Shifting Direction of End Point When Planar-type Teaching Is Specified

Condition	Shifting direction of end point
The point data of the i-axis component is the same among all three points other than the end point. (Refer to Fig. 2 (b).)	Shift the end point in parallel in i-axis direction.
The point data of any component other than the PZ-axis component is the same between the start point and the end point in PX-axis direction. (Refer to Fig. 2 (c).)	Shift the end point in parallel in the direction of either of the two axes other than the PZ-axis, whichever has the younger axis number.
The point data of any component other than the PZ-axis component is the same between the start point and the end point in PY-axis direction. (Refer to Fig. 2 (c).)	
The point data of any component other than the PZ-axis component is the same between the end point in PX-axis direction and the end point in PY-axis direction. (Refer to Fig. 2 (c).)	

* i indicates the axis number of either of the two axes other than the PZ-axis.

Part 4 Commands

Chapter 2 Explanation of Commands

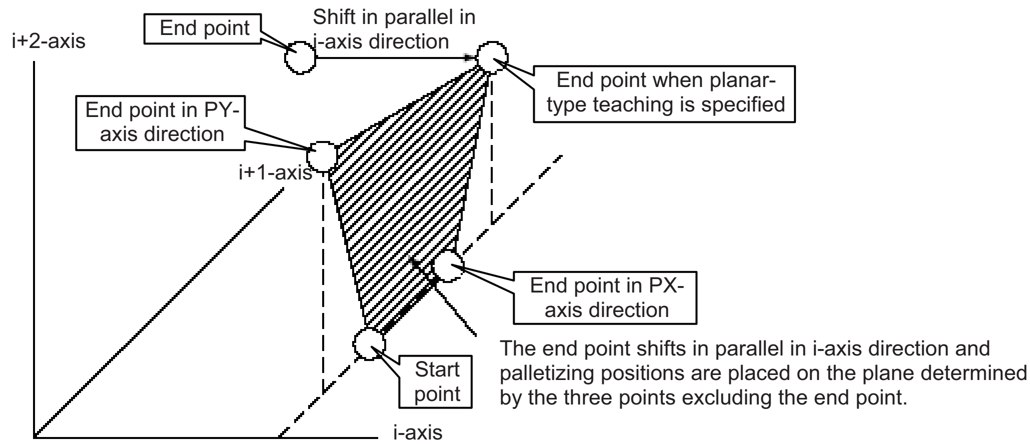


Figure.2-(b)

When the point data of the i-axis component is the same among all three points other than the end point

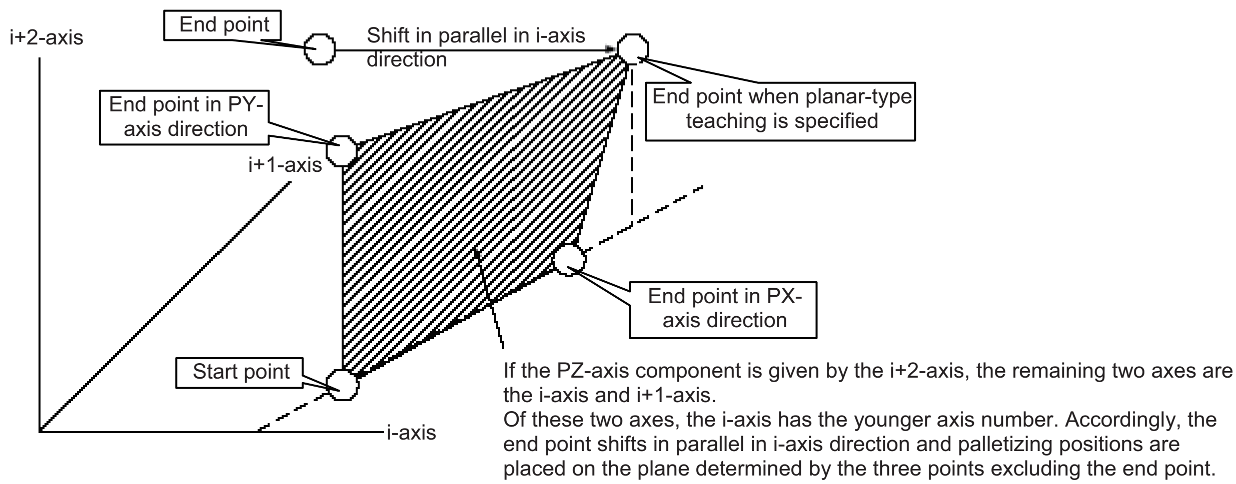


Figure.2-(c)

When the point data of any component other than the PZ-axis component is the same between any two points among the three points other than the end point
(In the above figure, the point data of a component other than the PZ-axis component is the same between the start point and the end point in PY-axis direction.)

- If the valid axis pattern of the point data used for 3-point or 4-point teaching does not match, an error “CB0, Mismatched valid axes and palletizing 3-point teaching data” will generate. Take note, however, that if this command is executed after specifying an axis used in a GRP command, only the specified axis among the valid point-data axes will be used as the source of palletizing point data. Executing the GRP command thereafter under a different setting will not have any negative effect.
- If a PZ-axis is already declared, there must be two valid axes excluding the PZ-axis. If a PZ-axis is not declared yet, there must be two or three valid axes. If there are not enough valid axes, an error “CAE: Insufficient valid axes for palletizing 3-point teaching data” will generate. If there are too many valid axes, on the other hand, an error “CAF: Excessive valid axes for palletizing 3-point teaching data” will generate. If planar-type teaching is specified and a PZ-axis is not declared yet, specify two valid axes. If there are fewer or more than two valid axes, a “CB4: Arch-motion Z-axis non-declaration error” will generate.

- PSLI (Set zigzag)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PSLI	Offset amount	(Count)	CP

Set a zigzag palletizing.
The value specified in operand 1 will be set as the offset amount for even-numbered rows.
The count specified in operand 2 will be set as the count for even-numbered rows.
(Refer to “Palletizing Setting” – “Zigzag setting” under "How to Use.")
If operand 2 is not specified, the count for even-numbered rows will become the same as the count for odd-numbered rows.
If a setting is performed by 3-point teaching with PAPS (set palletizing points), the PX and PY-axes need not be parallel with the physical axes. In this case, the offset will apply in parallel with the PX-axis. If the offset is a positive value, the absolute value of offset will be applied toward the end-point direction of the PX-axis. If the offset is a negative value, the absolute value will be applied toward the start-point direction.
If this command is executed before a BGPA is declared (= while palletizing setting is not enabled), an error will generate.
If the output field is specified, the output will turn ON after this command is executed.

● PCHZ (Declare palletizing Z-axis) Only when there are at least three axes.

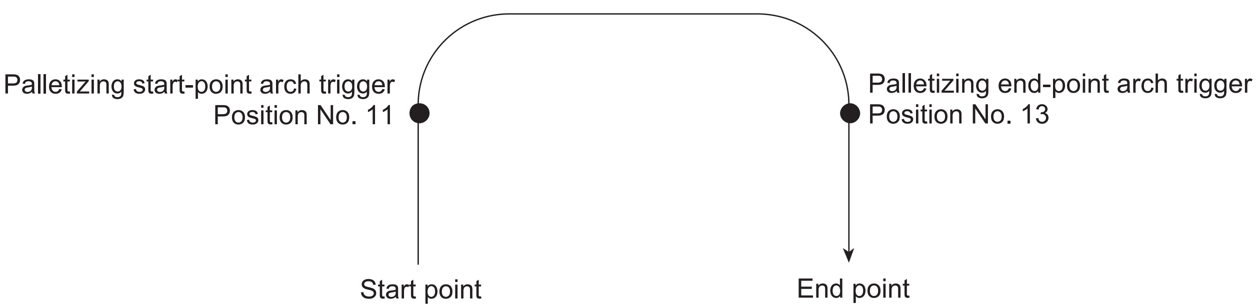
Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PCHZ	(Axis number)	Prohibited	CP

Specify the axis number representing the palletizing Z direction.
The axis number specified in operand 1 will be set as the axis number representing the palletizing Z direction.
If operand 1 is not specified, the specification of palletizing Z-axis that was already declared will become invalid.
If this command is executed before a BGPA is declared (= while palletizing setting is not enabled), an error will generate.
If the output field is specified, the output will turn ON after this command is executed.

● PTRG (Set palletizing arch triggers)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PTRG	Position number	Position number	CP

Set the arch triggers to be used for arch motion along the palletizing points.
(This setting becomes valid when a PACH command is executed.)
Set the palletizing Z-axis (PZ-axis) position data in the point data specified in operand 1 as the palletizing start-point arch trigger, and set the PZ-axis position data in the point data specified in operand 2 as the palletizing end-point arch trigger.




```
PTRG      11        13
```

(Refer to “Palletizing Setting” – “Palletizing arch triggers” under "How to Use.")
As for the point data, the PZ-axis data specified by a PCHZ command must be valid.
For an arch-motion operation along the palletizing points, set it so that a horizontal movement will begin when the start-point arch trigger is reached during ascent from the start point, and that the end-point arch trigger will be reached after a horizontal movement is completed during descent.
If this command is executed before a BGPA is declared (= while palletizing setting is not enabled), an error will generate.
If the output field is specified, the output will turn ON after this command is executed.

- PEXT (Set palletizing composition)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PEXT	(Position number)	Prohibited	CP

Set palletizing composition.
The position number specified in operand 1 will be set for use in composition.
When a palletizing movement command is executed, the data of any valid axes other than the PX, PY (and PZ)-axes in the specified point data will comprise the end-point coordinates of the composite axis.
If operand 1 is not specified, the position number for composition setting that was already declared will become invalid.
If this command is executed before a BGPA is declared (= while palletizing setting is not enabled), an error will generate.
If the output field is specified, the output will turn ON after this command is executed.

- OFPZ (Set palletizing Z-axis offset)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	OFPZ	Offset value	Prohibited	CP

Set the offset in the palletizing Z-axis direction.
The value specified in operand 1 will be set as the offset in the palletizing Z-axis direction.
The offset amount is set in mm and the effective resolution is 0.001 mm.
A negative value can also be specified as the offset, as long as the operation range will not be exceeded.
This offset is valid only at the end point of PACH (palletizing-point arch motion) operation.
If this command is executed before a BGPA is declared (= while palletizing setting is not enabled), an error will generate.
If the output field is specified, the output will turn ON after this command is executed.

- ACHZ (Declare arch-motion Z-axis)

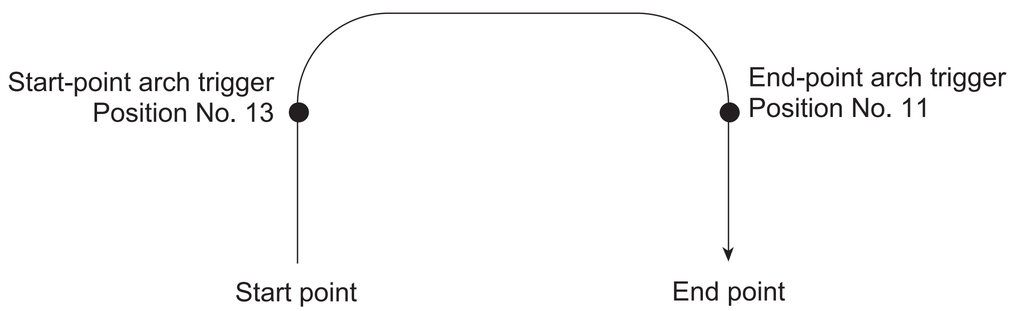
Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	ACHZ	Axis number	Prohibited	CP

Specify the axis number representing the arch-motion Z direction.
The axis number specified in operand 1 will be set as the axis number representing the arch-motion Z direction.
If the output field is specified, the output will turn ON after this command is executed.

- ATRG (Set arch triggers)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	ATRG	Position number	Position number	CP

Set the arch triggers used for arch motion.
(This setting becomes valid when an ARCH command is executed.)
Set the arch-motion Z-axis position data in the point data specified in operand 1 as the start-point arch trigger, and set the arch-motion Z-axis position data in the point data specified in operand 2 as the end-point arch trigger.



ATRG 13 11

(Refer to "Palletizing Setting" – "Arch triggers" under "How to Use.")
For an arch-motion operation, set it so that a horizontal movement will begin when the start-point arch trigger is reached during ascent from the start point, and that the end-point arch trigger will be reached after a horizontal movement is completed during descent.
If the output field is specified, the output will turn ON after this command is executed.

- AEXT (Set arch-motion composition)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	AEXT	(Position number)	Prohibited	CP

Set arch-motion composition.
The position number specified in operand 1 will be set for use in composition.
When an arch motion is executed, the data of valid axes in the point data specified in this command, except for the data of valid axes in the arch-motion end-point data as well as the arch-motion Z-axis data, will comprise the end-point coordinates of the composite axis.
If operand 1 is not specified, the position number for composition setting that was already declared will become invalid.
If the output field is specified, the output will turn ON after this command is executed.

- OFAZ (Set arch-motion Z-axis offset)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	OFAZ	Offset value	Prohibited	CP

Set the offset in the arch-motion Z-axis direction.
The value specified in operand 1 will be set as the offset in the arch-motion Z-axis direction.
The offset amount is set in mm and the effective resolution is 0.001 mm.
A negative value can also be specified as the offset, as long as the operation range will not be exceeded.
This offset is valid only at the end point of ARCH (arch motion) operation.
If the output field is specified, the output will turn ON after this command is executed.

1.21 Palletizing Calculation Command

- PTNG (Get palletizing position number)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PTNG	Palletizing number	Variable number	CP

Assign the palletizing position number for the palletizing number specified in operand 1 to the variable specified in operand 2.
If the output field is specified, the output will turn ON after this command is executed.

- PINC (Increment palletizing position number by 1)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PINC	Palletizing number	Prohibited	CC

Increment by 1 the palletizing position number for the palletizing number specified in operand 1.
If the incremented value is considered normal as a palletizing position number calculated under the current palletizing setting, the value will be updated. If not, the value will not be updated.
If the output field is specified, the output will turn ON when the value was successfully incremented, and turn OFF if the increment failed.

- PDEC (Decrement palletizing position number by 1)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PDEC	Palletizing number	Prohibited	CC

Decrement by 1 the palletizing position number for the palletizing number specified in operand 1.
If the decremented value is considered normal as a palletizing position calculated under the current palletizing setting, the value will be updated. If not, the value will not be updated.
If the output field is specified, the output will turn ON when the value was successfully decremented, and turn OFF if the decrement failed.

- PSET (Set palletizing position number directly)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PSET	Palletizing number	Data	CC

Set the value specified in operand 2 as the palletizing position number for the palletizing number specified in operand 1.
If the specified value is considered normal as a palletizing position calculated under the current palletizing setting, the value will be set. If not, the value will not be set.
If the output field is specified, the output will turn ON when the palletizing position number was successfully updated, and turn OFF if the update failed.

● PARG (Get palletizing angle)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PARG	Palletizing number	Axis number	CP

Obtain the palletizing angle.
Calculate the palletizing angle (degrees) from the physical axis specified in operand 2 for the palletizing number specified in operand 1, and store the result in variable 199.

This command need not be executed, if not necessary.
If this command is executed after PAPS (set 3 palletizing points for teaching) is executed, the angle formed by the preferential axis and the specified physical axis will be calculated automatically. If this command is executed before PAPS is executed, or after both PAPS and PASE are executed in this order, an error will generate.
The axes to be used can be specified with a GRP command before PAPS is executed (refer to the detailed explanation of PAPS). If the valid axis pattern of the 3-point teaching data does not match, an error “CB0, Mismatched valid axes and palletizing 3-point teaching data” will generate.
If the number of valid point-data axes (the number of valid axes excluding the PZ-axis, if a palletizing Z-axis (PZ-axis) has already been declared) is less than two, an error “CAE, Insufficient valid axes for palletizing 3-point teaching data” will generate. If the number of valid point-data axes is more than two, an error “CB9, PX/PY-axes indeterminable when obtaining palletizing angle” will generate.
If the axis number specified in operand 2 is neither of the two valid axes in the point data excluding the PZ-axis, an error “CBA, Reference axis and PX/PY-axes mismatch when obtaining palletizing angle” will generate.
If the reference point among the three teaching points is the same as the point data at the PX-axis end point other than the PZ-axis component, an error “Reference point and PX-axis end point identical when obtaining palletizing angle” will generate, and angle calculation will be disabled.
The actual operating direction may have been reversed depending on the mechanism of the rotating axis and the setting of axis-specific parameter No. 6, “Operating-direction reversing selection.” To use the value obtained by this command, be sure to confirm the actual operating direction.
If the output field is specified, the output will turn ON after this command is executed.

● PAPG (Get palletizing calculation data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PAPG	Palletizing number	Position number	CP

Store the position coordinate data of the palletizing points for the palletizing number specified in operand 1, in the position number specified in operand 2.
If the output field is specified, the output will turn ON after this command is executed.

1.22 Palletizing Movement Command

- PMVP (Move to palletizing points via PTP)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PMVP	Palletizing number	(Position number)	PE

Move to the calculated palletizing points via PTP.
The axes will move to the palletizing points specified in operand 1, via PTP.
If the palletizing points are valid only for the PX/PY-axes (when palletizing Z-axis (PZ-axis) is not specified, etc.), movement in directions other than the PX/PY-axis directions will not be performed. If the PZ-axis coordinates of the palletizing points are also valid, movement in the PZ-axis direction will also be performed. However, if a position number is specified in operand 2, the PZ-direction position will move to the height of the specified position number by ignoring the palletizing calculation (only when three or more axes are available). Any data other than PZ-axis data contained in the position number specified in operand 2 will be ignored. Absence of Z-axis data will be handled as an error.
If palletizing composition is set, any axes other than the PX, PY (and PZ)-axes will also be operated if data is available for such axes.
Executing this command will not increment the palletizing position number by 1.
Before specifying operand 2, a palletizing Z-axis must have been declared (PCHZ) in the palletizing setting. If palletizing Z-axis has not been declared, an error will generate.

● PMVL (Move to palletizing points via interpolation)

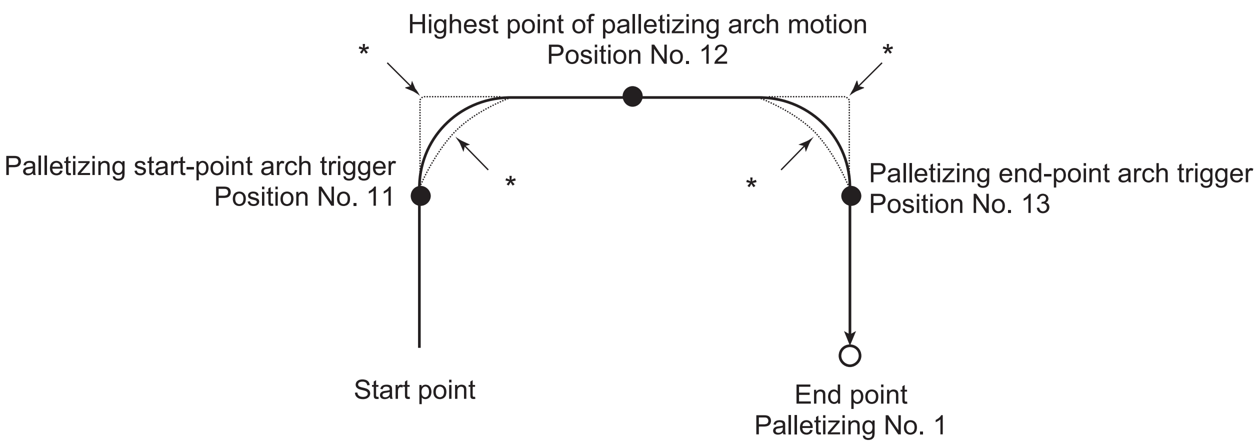
Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PMVL	Palletizing number	(Position number)	PE

Move to the calculated palletizing points via interpolation.
The axes will move to the palletizing points specified in operand 1, via interpolation.
If the palletizing points are valid only for the PX/PY-axes (when palletizing Z-axis (PZ-axis) is not specified, etc.), movement in directions other than the PX/PY-axis directions will not be performed. If the PZ-axis coordinates of the palletizing points are also valid, movement in the PZ-axis direction will also be performed. However, if a position number is specified in operand 2, the PZ-direction position will move to the height of the specified position number by ignoring the palletizing calculation (only when three or more axes are available). Any data other than PZ-axis data contained in the position number specified in operand 2 will be ignored. Absence of Z-axis data will be handled as an error.
If palletizing composition is set, any axes other than the PX, PY (and PZ)-axes will also be operated if data is available for such axes.
Executing this command will not increment the palletizing position number by 1.
Before specifying operand 2, a palletizing Z-axis must have been declared (PCHZ) in the palletizing setting.
If palletizing Z-axis has not been declared, an error will generate.

● PACH (Palletizing-point arch motion)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	PACH	Palletizing number	Position number	PE

Perform arch motion from the current point and move to the palletizing points.
- Move to the palletizing points specified in operand 1, via arch motion.
- Movements in the PX/PY-axis directions will begin after rising from the current point to the palletizing start-point arch trigger. After the Z point specified in operand 2 (as the highest point) is passed and movements in the PX/PY-axis directions are complete, the axes will pass near the palletizing end-point arch trigger and reach the calculated palletizing point.
- Palletizing arch triggers must have been set using a PTRG command.




```
PCHZ    3
PTRG    11    13
  |
  |
  |
PACH    1     12
```

* When the operation is resumed after a pause, depending on the position where the operation is resumed the locus may follow the lines (dotted lines) indicated by asterisks in the diagram for the composite section from ascent to horizontal movement or from horizontal movement to descent. Be careful not to cause interference.

- The PZ-axis coordinate of the end point will become the PZ-axis component of the position coordinates of the palletizing point, if any, plus the palletizing Z-axis offset. If there is no PZ component, the PZ-axis coordinate of the end point will become the PZ-axis coordinate of the start point plus the palletizing Z-axis offset. (Normally the offset is added to all palletizing positions, such as the arch triggers and Z point.)
- An error will generate if the palletizing start-point arch trigger is set below the start point or the palletizing end-point arch trigger is set below the end point. (Note: Up/down has nothing to do with +/– on the coordinate system.)
- The PZ-axis up direction refers to the direction toward the Z point from the start point (the down direction refers to the opposite direction), and has nothing to do with the size of coordinate value. Therefore, be sure to confirm the actual operating direction when using this command.
- The PZ-axis will come down after a rise-process command value is output. Therefore, the operation may follow the locus shown below depending on the settings of palletizing arch-trigger points and Z point:

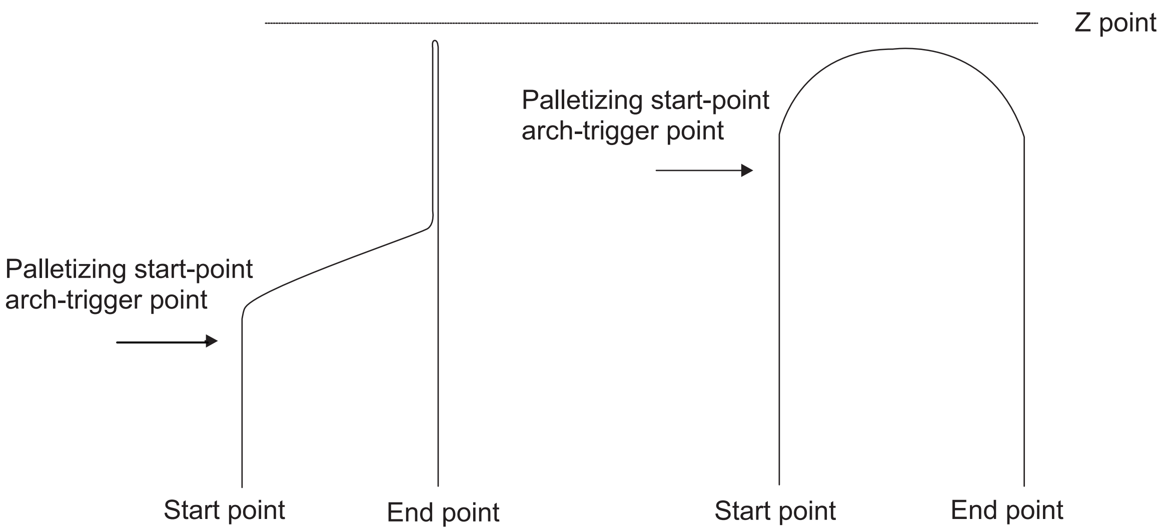


Fig. 5

In this case, change the palletizing arch triggers and Z point to increase the operation efficiency.

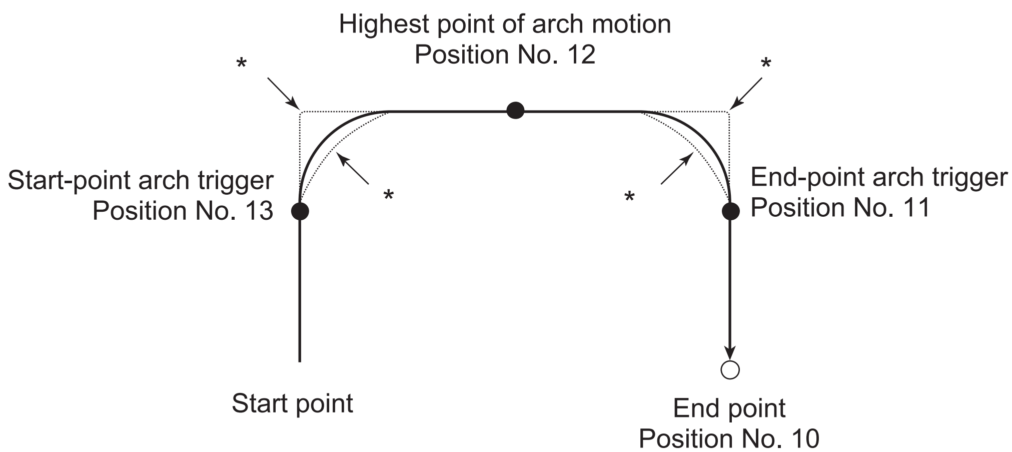
- If palletizing composition is set, axes other than the PX, PY and PZ-axes will also be operated if data is available for such axes. However, the composite axis will start/end operation at positions above the arch triggers.
- Executing this command will not increment the palletizing position number by 1.

● ARCH (Arch motion)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	ARCH	Position number	Position number	PE

Perform arch motion from the current point and move to the specified points.

- Move to the points specified in operand 1, via arch motion.
- Movements in directions other than the arch-motion Z-axis direction will begin after rising from the current point to the start-point arch trigger. After the Z point specified in operand 2 (as the highest point) is passed and movements in directions other than the arch-motion Z-axis direction are complete, the axes will pass near the end-point arch trigger and reach the specified point.
- Palletizing arch triggers must be set using an ATRG command.




```
ACHZ   3
ATRG   13    11
  |
  |
  |
ARCH   10    12
```

* When the operation is resumed after a pause, depending on the position where the operation is resumed the locus may follow the lines (dotted lines) indicated by asterisks in the diagram for the composite section from ascent to horizontal movement or from horizontal movement to descent. Be careful not to cause interference.

- The arch-motion Z-axis coordinate of the end point will become the arch-motion Z-axis component of the point data specified in operand 1, if any, plus the arch-motion Z-axis offset. If there is no arch-motion Z component, the arch-motion Z-axis coordinate of the end point will become the arch-motion Z-axis coordinate of the start point plus the arch-motion Z-axis offset. (Normally the offset is added to all arch-motion positions, such as the arch triggers and Z point.)
- An error will generate if the start-point arch trigger is set below the start point or the end-point arch trigger is set below the end point. (Note: Up/down has nothing to do with +/– on the coordinate system.)
- The arch-motion Z-axis up direction refers to the direction toward the Z point from the start point (the down direction refers to the opposite direction), and has nothing to do with the size of coordinate value. Therefore, be sure to confirm the actual operating direction when using this command.

- The arch-motion Z-axis will come down after a rise-process command value is output. Therefore, the operation may follow the locus in Fig. 5 given in the aforementioned explanation of PACH command, depending on the settings of arch-trigger points and Z point. In this case, change the arch triggers and Z point to increase the operation efficiency.
- As for the arch-trigger end-point data, if there is any valid axis data other than the data of the arch-motion Z-axis, then operation will be started/ended for the applicable axes in the same manner—but above the arch triggers.
- If arch-trigger composition is set, any valid axes other than those set in the end-point data or the arch-motion Z-axis will also be operated as long as data is available for such axes. In this case, operation of the applicable axes will also be started/ended above the arch triggers.

1.23 Building of Pseudo-Ladder Task

- CHPR (Change task level)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	CHPR	0 or 1	Prohibited	CP

[Function] Specify "1" (User HIGH) if you wish the target task to be processed before other tasks.
This command can also be used with non-ladder tasks.
Task level change (0: User NORMAL, 1: User HIGH) is not a required component, but specifying User HIGH will require a TSLP command explained below. (Without TSLP, tasks of the User NORMAL level will not be processed.)

- TPCD (Specify processing to be performed when input condition is not specified)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Prohibited	Prohibited	TPCD	0 or 1	Prohibited	CP

[Function] Specify the processing to be performed when input condition is not specified.
(0: Execute, 1: Follow the input condition in the last executed step)
In a ladder task, always input "1" (Follow the input condition in the last executed step) in operand 1.
In a non-ladder task, always input "0" (Execute). (The default value is "0.")

- TSLP (Task sleep)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Prohibited	Prohibited	TSLP	Time	Prohibited	CP

[Function] Set the time during which the applicable task will sleep, in order to distribute the processing time to other tasks.
If the task level is set to User HIGH, this command must always be specified.
The applicable task will sleep during the set time.
The time in operand 1 is set in msec.
An appropriate time setting must be examined on the actual system. (Normally approx. 1 to 3 is set.)
(If the ladder statement becomes long, state this command multiple times between steps, as necessary.)
This command can also be used with non-ladder tasks.

1.24 Extended Commands

- ECMD1 (Get motor current value (as percentage of rated current))

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	ECMD	1	Axis number	CC

This command is supported by controllers of main application version 0.37 or later.
This command can be entered using PC software of version 4.0.0.1 or later, ANSI teaching pendants of version 1.05 or later, or IAI's standard teaching pendants of version 1.31 or later.

[Function] Store in variable 99 the motor current value (percentage of the rated current) of the "axis number" specified in operand 2.

(Note) • The motor current value to be obtained (as a percentage of the rated current) represents filtered fed-back current data subject to analog error. Accordingly, provide a margin of 5% or more if the obtained motor current is to be compared against the "steady-state (non-push motion) torque limit (maximum limit)" set by expanded command code 250.

[Example] ECMD 1 2 Extended command 1
Store the motor current value (percentage of the rated current) of axis 2 in variable 99.

- ECMD2 (Get home sensor status)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	ECMD	2	Axis number	CC

This command is supported by controllers of main application version 0.41 or later.
This command can be entered using PC software of version 4.0.0.1 or later, ANSI teaching pendants of version 1.05 or later, or IAI's standard teaching pendants of version 1.31 or later.

[Function] Reflect in the output the home sensor status of the "axis number" specified in operand 2.

(Note) The home sensor status to be obtained is not an electrical H/L level, but a differential operation /non-operation status that takes into consideration axis-specific parameter No. 14, "Home-sensor input polarity."
If "0" (Do not use) is set in axis-specific parameter No. 14, "Home-sensor input polarity," the sensor status (output) is deemed indeterminable and use of the sensor is prohibited.
The output port/flag specified in the output will be operated only when this command is executed.
Accordingly, this command must be executed repeatedly in order to always reflect the sensor status in the output port/flag.

[Example]	ECMD	2	3	315	Output the home sensor status of axis 3 to output port No. 315.

- ECMD3 (Get overrun sensor status)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	ECMD	3	Axis number	CC

This command is supported by controllers of main application version 0.41 or later.
This command can be entered using PC software of version 4.0.0.1 or later, ANSI teaching pendants of version 1.05 or later, or IAI's standard teaching pendants of version 1.31 or later.

[Function] Reflect in the output the overrun sensor status of the "axis number" specified in operand 2.

(Note) The overrun sensor status to be obtained is not an electrical H/L level, but a differential operation/non-operation status that takes into consideration axis-specific parameter No. 15, "Overrun-sensor input polarity."
If "0" (Do not use) is set in axis-specific parameter No. 15, "Overrun-sensor input polarity," the sensor status (output) is deemed indeterminable and use of the sensor is prohibited.
The output port/flag specified in the output will be operated only when this command is executed. Accordingly, this command must be executed repeatedly in order to always reflect the sensor status in the output port/flag.

[Example] ECMD 3 1 890 Output the overrun sensor status of axis 1 to global flag No. 890.

- ECMD4 (Get creep sensor status)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	ECMD	4	Axis number	CC

This command is supported by controllers of main application version 0.41 or later.
This command can be entered using PC software of version 4.0.0.1 or later, ANSI teaching pendants of version 1.05 or later, or IAI's standard teaching pendants of version 1.31 or later.

[Function] Reflect in the output the creep sensor status of the "axis number" specified in operand 2.

(Note) The creep sensor status to be obtained is not an electrical H/L level, but a differential operation/non-operation status that takes into consideration axis-specific parameter No. 16, "Creep-sensor input polarity."
If "0" (Do not use) is set in axis-specific parameter No. 16, "Creep-sensor input polarity," the sensor status (output) is deemed indeterminable and use of the sensor is prohibited.
The output port/flag specified in the output will be operated only when this command is executed. Accordingly, this command must be executed repeatedly in order to always reflect the sensor status in the output port/flag.

[Example]	ECMD	4	2	315	Output the creep sensor status of axis 2 to output port No. 315.

- ECMD5 (Axis operation status)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	ECMD	5	Axis number	CC

[Function] Store the status of the axis specified in operand 2, in variable 99.
The axis status is indicated by the ON/OFF stage of each bit, as shown below. Accordingly, the acquired value must be converted to a binary value to determine the applicable status.

Variable number 99							
7	6	5	4	3	2	1	0

- Bit 0: Servo axis in use (0 = Not in use, 1 = In use)
- Bits 2–1: Home return (00 = Not yet complete, 01 = In progress, 10 = Complete)
- Bit 3: Servo ON/OFF (0 = OFF, 1 = ON)
- Bit 4: Operation command successful (= Not yet complete, 1 = Successful)
- Bit 5: Missed work part during push-motion operation detected (0 = Not detected, 1 = Detected)

(Note) If an invalid axis number is specified in operand 2, “C44: SEL data error” will occur.

[Example] ECMD 5 2 Store the status of axis 2 in variable 99. If 28 (decimal value) is stored in variable 99 following the execution of this command, the status of axis 2 is determined as follows.

Variable number 99
28

Binary notation

Variable number 99							
0	0	0	1	1	1	0	0

Status of axis 2:
- Servo axis not in use
- Home return complete
- Servo ON
- Operation command successful
- Missed work part during push-motion operation not detected

- ECMD20 (Get a parameter value)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	ECMD	20	Variable number	CC

[Function] Use the data stored in three consecutive variables starting from the one whose variable number is specified in operand 2, to store the value of the specified parameter in variable 99. The setting items and ranges of variable data are shown below. If an out-of-range value is specified, "C44: SEL data error" will occur.

- Operand 2 = n

Variable number	Setting item	Set value/setting range of each variable						
		I/O	All-axis	Axis-specific	Driver	Encoder	I/O device	Other
n	Parameter type	0	1	2	3	4	5	7
n + 1	Device number/axis number	0	0	1 to 6	1 to 6	1 to 6	0 to 9	0
n + 2	Parameter number	1 to 999	1 to 400	1 to 250	1 to 97	1 to 30	1 to 82	1 to 200

Specify an integer variable in operand 2 (integer variables 98, 99, 298, 299, 1098, 1099, 1298 and 1299 cannot be specified because if any of these variables is specified, there won't be three consecutive integer variables).
If a variable not of the integer type is specified, "C3C: Variable number error" will occur.

(Note) Pulse I/O board parameters can be acquired when the parameter type is set to 10.
For details, refer to the Operation Manual for "XSEL-P/Q/PCT/QCT Controller: Electronic Cam Function."

[Example]

LET	1250	0	Variable No. 1250 = Parameter type (I/O)
LET	1251	0	Variable No. 1251 = Device number (0 for I/O parameters)
LET	1252	30	Variable No. 1252 = Parameter number (No. 30)
ECMD	20	1250	Extended command 20 (Use variable Nos. 1250 to 1252) Store the value of input function selection 000 in I/O parameter No. 30, in variable 99.

- ECMD250 (Set torque limit/"torque limit over" detection time)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	ECMD	250	Integer variable number	CC

This command is supported by controllers of main application version 0.47 or later.
This command can be entered using PC software of version 4.0.0.1 or later, ANSI teaching pendants of version 1.05 or later, or IAI's standard teaching pendants of version 1.31 or later.

[Function] Set the steady-state (non-push motion) torque limit (maximum limit) and "steady-state (non-push motion) torque limit over" detection time.
The data stored in three consecutive integer variables starting from the integer variable number specified in operand 2 is used to change the applicable parameter (including an internal parameter) temporarily.

When operand 2 = n

Variable No. n --- Target axis pattern (entered as a decimal value)
* Example of decimal value entry: When "1" is entered = Axis 1 only
When "2" is entered = Axis 2 only
When "3" is entered = Axes 1 and 2
When "7" is entered = Axes 1, 2 and 3
When "15" is entered = Axes 1, 2, 3 and 4

Variable No. n+1 --- Value set for steady-state (non-push motion) torque limit (maximum limit)
(1% of the rated torque to the value specified in driver card parameter No. 40, "Maximum torque limit (%)")
* If a value greater than the maximum limit set for each axis is specified, the maximum limit set for each axis will be set.

Variable No. n+2 --- Value set for "steady-state (non-push motion) torque limit (maximum limit) over" detection time
(0 to 20,000 msec)
* Set "1" or a greater value when this command is used to detect interference or heavy load or move an axis.
* If "0" (unlimited) is set, the maximum steady-state (non-push motion) torque limit will be limited to 70% to prevent overheating.

Variable No. n+3 --- "0" is set. (Reserved. * This data may be made accessible in the future.)

Variable No. n+4 --- "0" is set. (Reserved. * This data may be made accessible in the future.)

Processing will be performed according to the parameter below if the period during which the command value has breached the "steady-state (non-push motion) torque limit (maximum limit)" has continued for the "steady-state (non-push motion) torque limit over" detection time or longer in a steady state (non-push motion). Take note, however, that processing according to the parameter below will not be performed if the "steady-state (non-push motion) torque limit over" detection time" is set to "0" (infinite).

All-axis parameter No. 19, "Processing type upon steady-state (non-push motion) torque limit over (priority on driver errors such as overload)"

0: Operation-cancellation level error (Recommended)
(Error No. 420, "Steady-state (non-push motion) torque limit over error)

1: Operation cancellation (The SEL command output turns OFF.)

[Example1]

LET	290	3	Set the target axis pattern (axes 1 and 2) in integer variable 290.
LET	291	80	Set a steady-state torque limit in integer variable 291.
LET	292	1000	Set the "steady-state torque limit over" detection time in integer variable 292.
ECMD	250	290	Read the values of three consecutive variables starting from variable 290. Target axis pattern = Axes 1 and 2 Steady-state torque limit = 80% "Steady-state torque limit over" detection time = 1,000 msec
MOVP	2		Move to position No. 2 under the conditions set by ECMD250.

* When reverting the conditions to their defaults

[Example2]	LET	290	3	Set the target axis pattern (axes 1 and 2) in integer variable 290.
	LET	291	1000	Set a steady-state torque limit (maximum limit set for each axis) in integer variable 291.
	LET	292	20000	Clear the “steady-state torque limit over” detection time in integer variable 292. (Set “20000” to clear the setting.)
	STOP	*290		Clear a low-torque axis deviation counter.
	ECMD	250	290	Read the values of three consecutive variables starting from variable 290. Target axis pattern = Axes 1 and 2 Steady-state torque limit = Maximum limit set for each axis (The setting is reverted to the maximum torque.) “Steady-state torque limit over” detection time = 20,000 msec
	MOVP	2		Move to position No. 2 at the steady-state torque.

(Note1) When a low torque is set, the load may drop (in the case of a vertical axis, etc.) or overshoot may occur. If the torque is reduced during high-speed operation, overshoot may occur due to insufficient torque.

(Note2) It is dangerous to change the torque to a lower setting during high-speed operation, because the actuator may not decelerate normally due to insufficient torque and overshoot as a result.

(Note3) If positioning operation is performed at low torque, the axis may stop and remain stationary near the target position due to insufficient torque. Before commencing axis movement, always set the “steady-state (non-push motion) torque limit over” detection time to 1 msec or longer to detect a condition of steady-state (non-push motion) torque limit over (timeout).

* If the “steady-state (non-push motion) torque limit over” detection time is set to “0” for the purpose of setting a “torque limit for the supporting axis during engagement (applicable to a horizontal axis only)” and the position data used in the return operation following the engagement operation (as a result of a PUSH command, etc.) includes the coordinates of the supporting axis during engagement (whose torque is limited), positioning operation will be performed during the return operation following the engagement operation to move the actuator position to the coordinates of the axis whose torque is limited, in which case the actuator may stop near the target value due to insufficient torque. When setting position data for the return operation following the engagement operation, be sure to set only the coordinates of the operating axis during engagement (axis used in the PUSH command, etc.)

(Note4) If an extremely low torque is set, a servo-ON axis may move at a very slow speed due to an analog offset error, etc.

(Note5) The torque increases during acceleration/deceleration even under a normal load condition. Accordingly, determine each setting (steady-state torque limit, “steady-state torque limit over” detection time) as deemed appropriate so that a steady-state torque limit over error will not be detected.

(Note6) An “Error No. C6B, Deviation overflow error” or “Error No. CA5, Stop-deviation overflow error” may generate before an “Error No. 420, Steady-state (non-push motion) torque limit over error” is detected. This is normal and does not indicate a malfunction.

(Note7) When changing to a high torque setting from a low torque setting at which axis movement cannot be assured, be sure to issue a STOP command to the low-torque axis to clear the deviation counter before changing to the high torque setting (i.e., while the torque is still low). If the torque setting is changed from low to high while deviation pulses are still stored, the axis may move at an uncontrolled speed and create a dangerous situation.

(Note8) When returning to a normal condition (maximum torque), expressly specify “1000%” as the “steady-state (non-push motion) torque limit (maximum limit)” and “20000 msec” as the “steady-state (non-push motion) torque limit over” detection time.

* If a value exceeding the maximum limit of a given axis is specified as the “steady-state (non-push motion) torque limit (maximum limit)” of that axis, the maximum limit of the axis (between approx. 200 and 400%) will be set.

(Note9) The following values will become effective upon a power ON reset or software reset or when home return is started:
Steady-state (non-push motion) torque limit (maximum limit) = “Driver card parameter No. 40, Maximum torque limit (%)”
“Steady-state (non-push motion) torque limit over” detection time = 20000 msec

(Note10) The new settings of steady-state (non-push motion) torque limit (maximum limit) and “steady-state (non-push motion) torque limit over” detection time will remain effective even after the SEL program ends.
If a system is constructed using this expanded command, therefore, be sure to use this expanded command to expressly set the “steady-state (non-push motion) torque limit (maximum limit)” and “steady-state (non-push motion) torque limit over” detection time in all SEL programs before commencing the operation. If it is assumed that the “steady-state (non-push motion) torque limit (maximum limit)” and “steady-state (non-push motion) torque limit over” detection time will return to their original values when the operation ends in other program, a different “steady-state (non-push motion) torque limit (maximum limit)” or “steady-state (non-push motion) torque limit over” detection time may be applied in the event that the program is aborted due to an error, etc., in which case an unforeseen trouble may result.

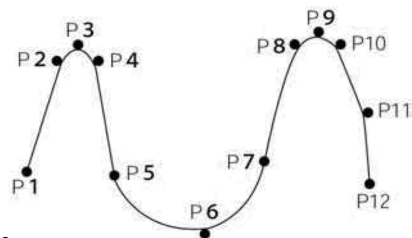
(Note11) This expanded command will not rewrite the value of “Driver card parameter No. 40, Maximum torque limit” (main CPU flash memory) (in the non-volatile memory) itself.

Chapter 3 Key Characteristics of Actuator Control Commands and Points to Note

1. Continuous Movement Commands [PATH, CIR, ARC, PSPL, CIR2, ARC2, ARCD, ARCC, CIRS, ARCS]

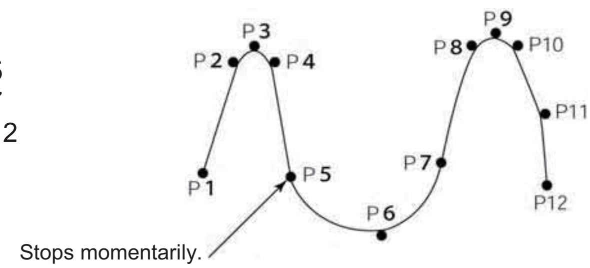
(1) By running a program with continuous movement commands input in a series of continuous program steps, you can allow the actuators to perform operations continuously without stopping between steps.

```
PATH   1   5
ARC2   6   7
PATH   8   12
```

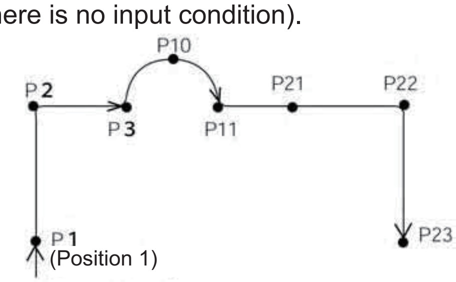


(2) Continuous movement will not be achieved if an input condition is specified for any continuous movement command.

```
      PATH   1   5
20    ARC2   6   7
      PATH   8   12
```



(3) The output field of each command will turn ON as the end position of that command approaches. Only with the last command in a series of continuous movement commands, the output will turn ON upon completion of operation (if there is no input condition).



[Example 1]

```
(POTP = 1)
POTP   1
  |
  |
  |
PATH   1    3    308
ARC2   10   11   311
PATH   21   23   312
  |
  |
```

Output field	Timing
308	Turn ON as P1 approaches.
309	Turn ON as P2 approaches.
310	Turn ON as P3 approaches.
311	Turn ON as P11 approaches.
312	Turn ON as P21 approaches.
313	Turn ON as P22 approaches.
314	Turn ON when P23 operation is complete.

[Example 2]

```
(POTP = 0)
PATH   1    3    308
ARC2   10   11   311
```

Output field	Timing
308	Turn ON as P3 approaches.
311	Turn ON as P11 approaches.
312	Turn ON when P23 operation is complete.

```
PATH  21  23  312
```

[Example 3] If an input condition is specified, the output will turn ON upon completion of operation in the step before the one in which the input condition is specified.

```
    POTP  1
     |
     |
     |
    PATH  1   3   308
20  ARC2  10  11  311
    PATH  21  23  312
```

Output field	Timing
308	Turn ON as P1 approaches.
309	Turn ON as P2 approaches.
310	Turn ON when P3 operation is complete.
311	Turn ON as P11 approaches.
312	Turn ON as P21 approaches.
313	Turn ON as P22 approaches.
314	Turn ON when P23 operation is complete.

(4) When executing continuous movement commands sequentially, the controller is calculating approx. 100 positions ahead. This is why the steps are displayed continuously on the PC screen or teaching-pendant screen, regardless of the actual operation. The last step in the continuous operation section executed by continuous movement commands will wait for the applicable operation to complete.

```
 |
 |      ←  Actuator operation
 |
PATH  1   5
ARC   6   7   ←  Step displayed on the PC software or teaching pendant
PATH  8   12
BTON  310
 |
 |
```

(5) Do not allow the output fields to duplicate in the continuous operation section executed by continuous movement commands.
Duplicating output fields in the continuous operation section will not achieve the expected result.
The output field will turn OFF at the start of processing of each command.

```
POTP  1
PATH  1   5   305
 |
 |
PATH  11  15  304
```

Do not let outputs 305 through 308 to duplicate, as in the example shown at left.

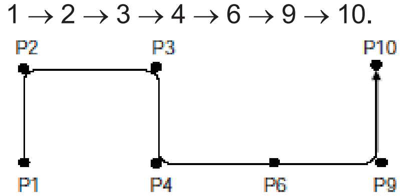
Continuous operation section executed by continuous movement commands

The final output status of duplicate 305 through 308 is indeterminable, because it is affected by the positioning calculation time and the relationship of durations of actual operations.

(6) The actuator can be moved continuously along a series of continuous positions including one discontinuous position. Specify the position number corresponding to the discontinuous position as both the start position number and end position number of a PATH command. Position No. 6 is the discontinuous point to be passed in this example.

The actuator will move continuously along the path of position Nos. 1 → 2 → 3 → 4 → 6 → 9 → 10.

```
PATH  1   4
PATH  6   6    Discontinuous position
PATH  9   10
```

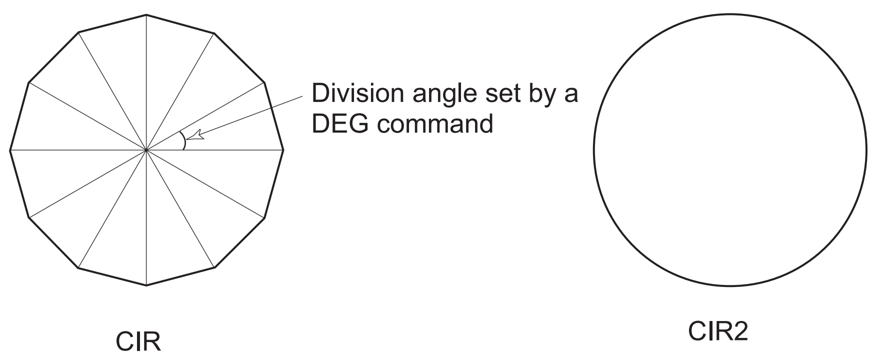


2. PATH/PSPL Commands

When executing a PATH or PSPL command, pay attention to the locus because it will change if the acceleration/deceleration is different between points.
The locus can be fine-tuned by changing the acceleration/deceleration, but different acceleration/deceleration settings between points will prevent smooth transition of speeds when moving from one position to another.
If there is a large difference in deceleration/acceleration between points and the positioning distance is small, the speed may drop. Exercise caution.

3. CIR/ARC Commands

The processing by a CIR or ARC command resembles moving along a polygon with a PATH command.
A small division angle may cause the speed to drop.
CIR2, ARC2, ARCD and ARCC commands actually perform arc interpolation.



4. CIR2/ARC2/ARCD/ARCC Commands

With a CIR2, ARC2, ARCD or ARCC command, the speed can be changed (only in the arc interpolation section) by inputting a speed for the point specified in operand 1. These commands are effective when you must lower the speed partially because the radius is small and the arc locus cannot be maintained inside the allowable range.

The speed and acceleration will take valid values based on the following priorities:

Priority	Speed	Acceleration (deceleration)
1	Setting in the position data specified in operand 1	Setting in the position data specified in operand 1
2	Setting by VEL command	Setting by ACC (DCL) command
3		Default acceleration in all-axis parameter No. 11 (Default deceleration in all-axis parameter No. 12)

Chapter 4 Palletizing Function

The SEL language used by the XSEL Controller provides palletizing commands that support palletizing operation. These commands allow simple specification of various palletizing settings and enable arch motion ideal for palletizing.

1. How to Use

Use palletizing commands in the following steps:

(1) Palletizing setting
Set palletizing positions, arch motion, etc., using palletizing setting commands.

(2) Palletizing calculation
Specify palletizing positions using palletizing calculation commands.

(3) Palletizing movement
Execute motion using palletizing movement commands.

2. Palletizing Setting

Use the palletizing setting commands to set items necessary for palletizing operation. The setting items include the following:

(1) Palletizing number setting --- Command: BGPA
At the beginning of a palletizing setting, determine a palletizing number using a BGPA command to declare the start of palletizing setting.
At the end, declare the end of palletizing setting using an EDPA command.

BGPA	1	Declare the start of setting for palletizing No. 1.
⋮		Set palletizing in these steps.
EDPA		Declare the end of palletizing setting at the end.

A maximum of 10 sets (palletizing Nos. 1 to 10) of palletizing setting can be specified for each program.

(2) Palletizing pattern --- Command: PAPN
Select a pattern indicating the palletizing order.
The two patterns illustrated below are available.
The encircled numbers indicate the order of palletizing and are called “palletizing position numbers.”

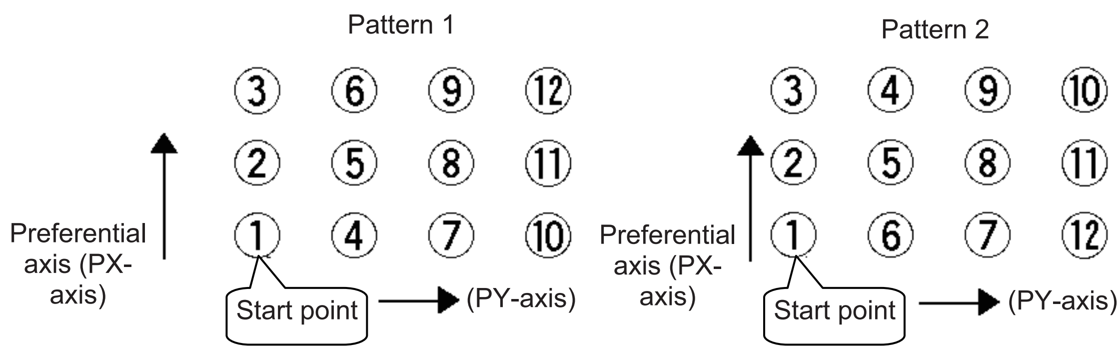


Fig. 1

PAPN	2	When pattern 2 is selected (Setting is not necessary if pattern 1 is selected.)

The row from 1 to 3 to be placed first is called the “preferential axis (PX-axis),” while the other direction comprising the palletizing plane is called the “PY-axis.”

(3) Palletizing counts --- Command: PAPI
Set the palletizing counts.

PAPI	3	4	Count for preferential axis (PX-axis): 3, Count for PY-axis: 4

(4) Palletizing position setting
Palletizing position setting is performed mainly by method A or B, as explained below. Set the palletizing positions for each palletizing setting based on method A or B.

	Setting method	Commands
A	3-point teaching method Set three position-data points specifying the palletizing positions.	PAPS
B	Method to set palletizing positions in parallel with the actuators Set from the palletizing axes, palletizing reference point and palletizing pitches.	PASE, PAST, PAPT

A. 3-point teaching method

To set the palletizing positions by 3-point teaching, store desired positions in position data fields as three continuous position data and then specify the first position number using a PAPS command.
This method allows you to set the PX-axis and PY-axis as three-dimensional axes not parallel with the actuators and not crossing with each other.
In the example shown below, position data ①, ③ and ⑩ are stored in three continuous position data fields.

When three points are taught from position No. 11

Position No. 11 ①: Start point (First palletizing position)
Position No. 12 ③: Palletizing position corresponding to the end point in the PX-axis direction
Position No. 13 ⑩: Palletizing position corresponding to the end point in the PY-axis direction
The encircled numbers indicate palletizing position numbers (palletizing order).

Use a PAPS command to specify the position number corresponding to the start point.

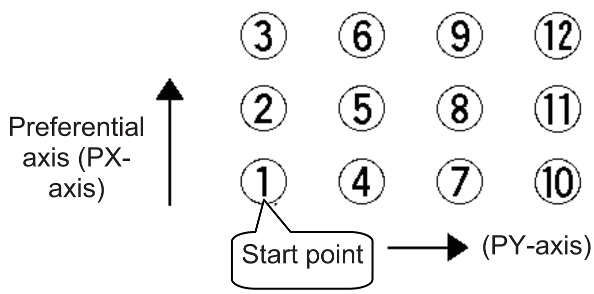


Fig. 1

PAPS 11

The pitches are calculated automatically from the count set for each axis.
In 3-point teaching, you can specify position data for two axes or three axes. If data are specified for three axes, the palletizing plane will become a three-dimensional plane.

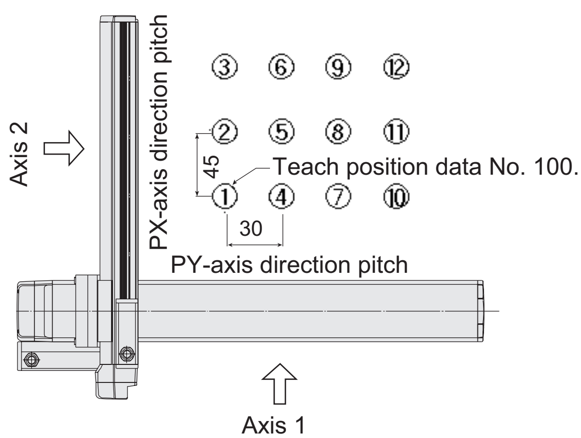
B. Method to set palletizing positions in parallel with the actuators

Palletizing reference point: Store the position data of the start point (palletizing position No. 1) in a position data field and specify the applicable position number using a PAST command, as shown below.

Palletizing pitches: Use a PAPT command to specify the pitches in the PX-axis and PY-axis directions.

Palletizing axes: Use a PASE command to specify the two axes, one representing the PX-axis direction and the other representing the PY-axis direction, to be used in palletizing.

(An actuator axis number parallel with the preferential axis (PX-axis) and another perpendicular to the preferential axis)



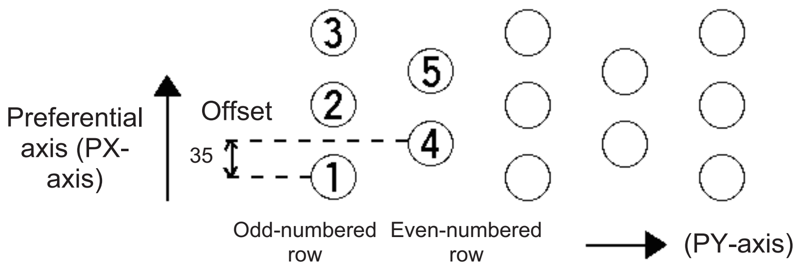
PAST	100		Teach position data No. 100 as the start point.
PAPT	45	30	The PX-axis direction pitch is 45 mm and the PY-axis direction pitch is 30 mm.
PASE	2	1	Set axis 2 as the preferential axis (PX-axis) and axis 1 as the axis perpendicular to the preferential axis.

(Note) When the above palletizing axes, palletizing pitches and palletizing reference point are used, the PX-axis and PY-axis must be parallel with the actuators and crossing with each other.

Select either method A or B for each palletizing setting.

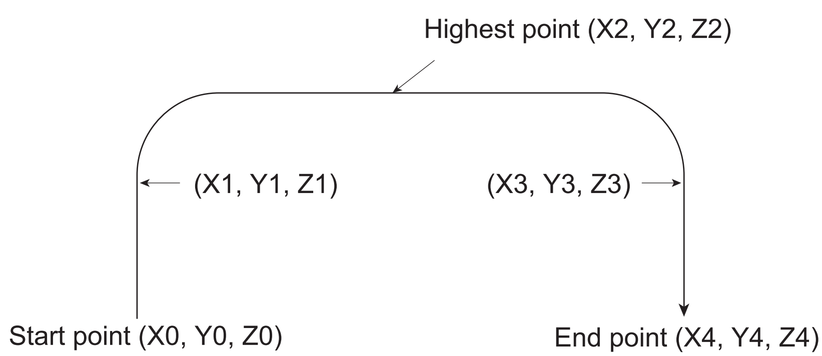
(5) Zigzag setting --- Command: PSLI
Use a PSLI command to set a zigzag layout as shown below.
Zigzag offset: Offset amount in the preferential-axis direction, which will be applied when even-numbered rows are placed.
"Even-numbered rows" refer to the rows occurring at the even numbers based on the row placed first representing the first row.

Zigzag count: Number in the even-numbered rows. Two in the diagram below.



PSLI 35 2

(6) Arch-motion setting
(a) Arch-motion Z-axis number --- Command: ACHZ
(b) Arch-motion Z-axis offset --- Command: OFAZ
(c) Arch-motion composition --- Command: AEXT
Composition data refers to position data of any additional axis you wish to use in arch-motion operation, other than the valid end-point axes or arch-motion Z-axis. Examples include rotation angle.
Note that operation of the composite axis will start and end above the arch triggers.
In an arch-motion composition setting command, specify a position number storing arch-motion composition data.
(d) Arch triggers --- Command: ATRG
The arch-trigger settings used for arch motion include the items specified below.
In an arch-trigger setting command, specify position numbers storing arch-trigger coordinate data.
(d-1) Start-point arch trigger
Specify when to start moving in other axis direction after the start of arch motion from the start point, as an arch-motion Z-direction coordinate position reached.
Start-point arch trigger = Z1
(d-2) End-point arch trigger
Specify when to end moving in other axis direction during downward arch motion, as an arch-motion Z-direction coordinate position reached.
End-point arch trigger = Z3



(7) Palletizing arch-motion setting
 (a) Palletizing Z-direction axis number --- Command: PCHZ
 (b) Palletizing Z-axis offset --- Command: OFPZ
 (c) Palletizing composition --- Command: PEXT
 Composition data refers to position data of any additional axis you wish to use with palletizing movement commands, other than the PX, PY (and PZ)-axes. Examples include rotation angle. Note that operation of the composite axis will start and end above the palletizing arch triggers. In a palletizing-composition setting command, specify a position number storing palletizing composition data.

 (d) Palletizing arch triggers --- Command: PTRG
 If the end point is a palletizing point, a palletizing arch trigger must be set just like an arch trigger. In a palletizing arch-trigger setting command, specify position numbers storing palletizing arch-trigger coordinate data.
 (d-1) Palletizing start-point arch trigger
 (d-2) Palletizing end-point arch trigger

3. Palletizing Calculation

The items that can be operated or obtained using palletizing calculation commands are shown below:

(1) Palletizing position number Commands --- PSET, PINC, PDEC, PTNG
Number showing the ordinal number of a palletizing point.
(In Fig. 1 given in the explanation of palletizing pattern, the encircled numbers are palletizing position numbers.)

Always set this command before executing a palletizing movement command (excluding ARCH) --- PSET

For example, executing a palletizing movement command by setting 1 as the palletizing position number will move the axes to the start point. Executing a palletizing movement command by setting 2 as the palletizing position number will move the axes to the point immediately next to the start point in the PX-axis direction.

(2) Palletizing angle Command --- PARG
Angle formed by the physical axis and the palletizing preferential axis (PX-axis) (θ in the figure below).
θ indicates an angle calculated by ignoring the coordinate in the palletizing Z-axis direction.
In the figure below, θ will become a negative value if axis 1 is used as the reference for angle calculation.

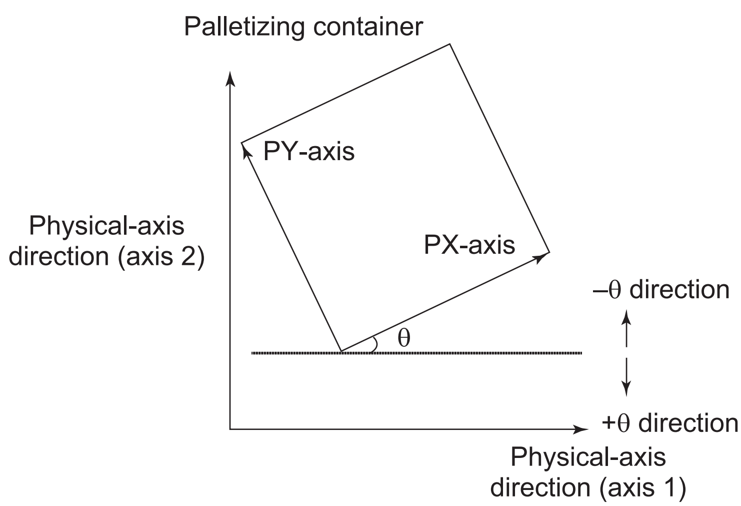


Fig. 4

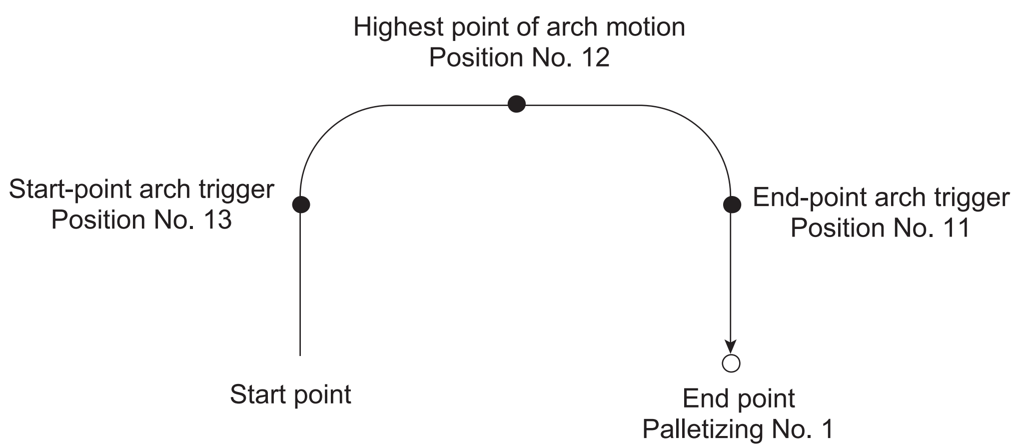
If the composite axis is a rotating axis, obtaining the palletizing angle and adding it to the composite-axis operation as an offset will allow correction of the composite axis against positional shift of the palletizing container.
With XSEL commands, executing a "get palletizing angle" command following a palletizing setting via 3-point teaching will automatically obtain the palletizing angle.
If the setting by 3-point teaching was done three-dimensionally, a palletizing Z-axis must be specified.

(3) Palletizing calculation data Command --- PAPG
When a palletizing position number is set, this data refers to the position coordinate data of the palletizing point corresponding to that palletizing position number.
Note that this position coordinate data does not reflect normal offset or palletizing Z-axis offset.

4. Palletizing Movement

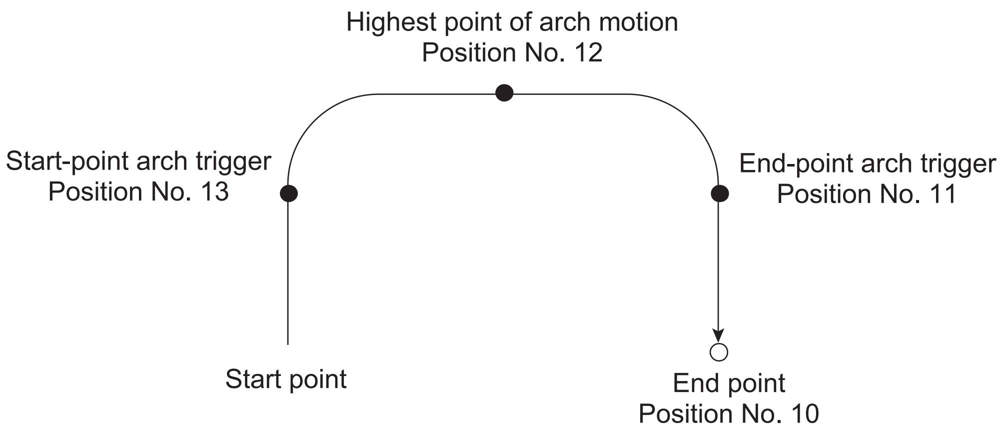
Palletizing movement commands include those used to move to a palletizing point and one used to move to an end point specified by position data.

(1) Movement commands to palletizing point --- PMVP, PMVL, PACH
Position coordinates of a two-dimensionally or three-dimensionally placed palletizing point are calculated and movement is performed using the calculated point as the end point. (The axes will move to the palletizing point of the palletizing position number specified in the executed command.)
Two actuator axes will be required to comprise a two-dimensional plane. If a vertical axis (PZ-axis) is required, another axis must be set.
PMVP: Move from the current position to a palletizing point via PTP.
PMVL: Move from the current position to a palletizing point via interpolation.
PACH: Move from the current position to a palletizing point via arch motion.
Palletizing arch motion must be set in a palletizing setting.




```
PCHZ      3
PTRG      11      13
  |
  |
  |
PACH      1       12
```

(2) Movement comment based on end point specified by point data --- ARCH
Perform arch motion using an end point specified by position data.
In the case of a linear movement in parallel with an actuator, operation can be performed only with two axes including the applicable axis and the PZ-axis.
Arch motion must be set.



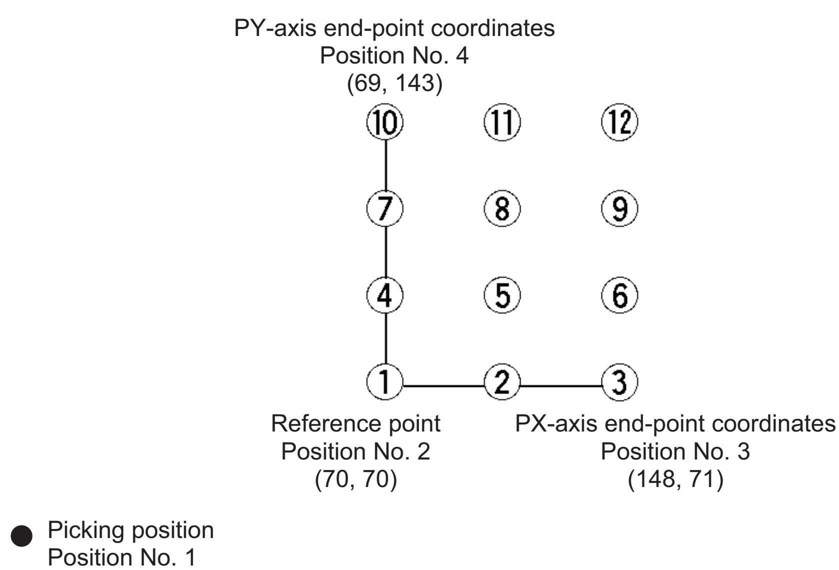

```
ACHZ    3
ATRG    13    11
  |
  |
  |
ARCH    10    12
```

5. Program Examples

(1) Simple program example (two-axis specification) using PAPS (set by 3-point teaching)
The example below specifies movement only and does not cover picking operation.

Step	E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
1				BGPA	1			Start setting palletizing No. 1.
2				PAPI	3	4		Palletizing counts: 3 x 4
3				PAPS	2			Set by 3-point teaching.
4				EDPA				End setting palletizing No. 1.
5								
6				VEL	200			Speed: 200 mm/sec
7				MOVL	1			Move to picking position.
8				PSET	1			Set palletizing position number to 1.
9				TAG	1	1		
10				PMVL	1			Move to palletizing position via interpolation.
11				MOVL	1			Move to picking position via interpolation.
12				PINC	1		600	Increment palletizing position number by 1.
13			600	GOTO	1			Beginning of loop if PINC is successful.
14				EXIT				End

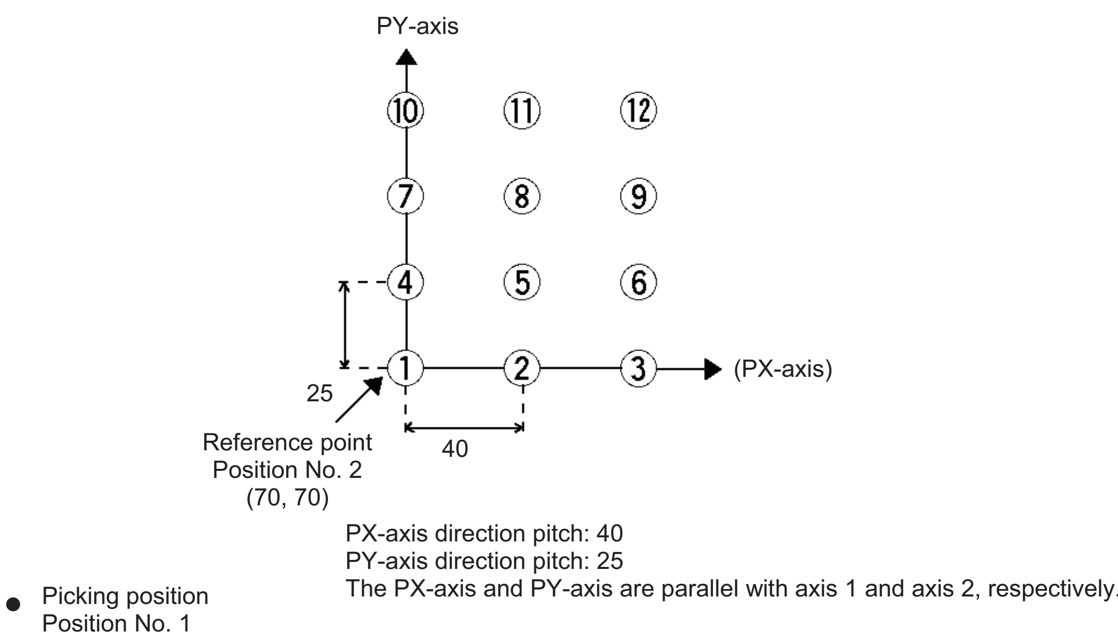
No.	Axis 1	Axis 2	Vel	Acc	Dcl	Remarks
1	10.000	10.000				Picking position
2	70.000	70.000				Reference-point position data
3	148.000	71.000				PX-axis end-point position data
4	69.000	143.000				PY-axis end-point position data



(2) Simple program example (two-axis specification) using PAPT, PAST and PASE
The example below specifies movement only and does not cover picking operation.

Step	E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
1				BGPA	1			Start setting palletizing No. 1.
2				PAPI	3	4		Palletizing counts: 3 x 4
3				PASE	1	2		PX-axis = Axis 1, PY-axis = Axis 2
4				PAPT	40	25		Pitch: X = 40, Y = 25
5				PAST	2			Position No. 2 as reference point
6				EDPA				End setting palletizing No. 1.
7								
8				VEL	200			Speed: 200 mm/sec
9				MOVL	1			Move to picking position.
10				PSET	1	1		Set palletizing position number to 1.
11				TAG	1			
12				PMVL	1			Move to palletizing position via interpolation.
13				MOVL	1			Move to picking position via interpolation.
14				PINC	1		600	Increment palletizing position number by 1.
15			600	GOTO	1			Beginning of loop if PINC is successful.
16				EXIT				End

No.	Axis 1	Axis 2	Vel	Acc	Dcl	Remarks
1	10.000	10.000				Picking position
2	70.000	70.000				Reference-point position data



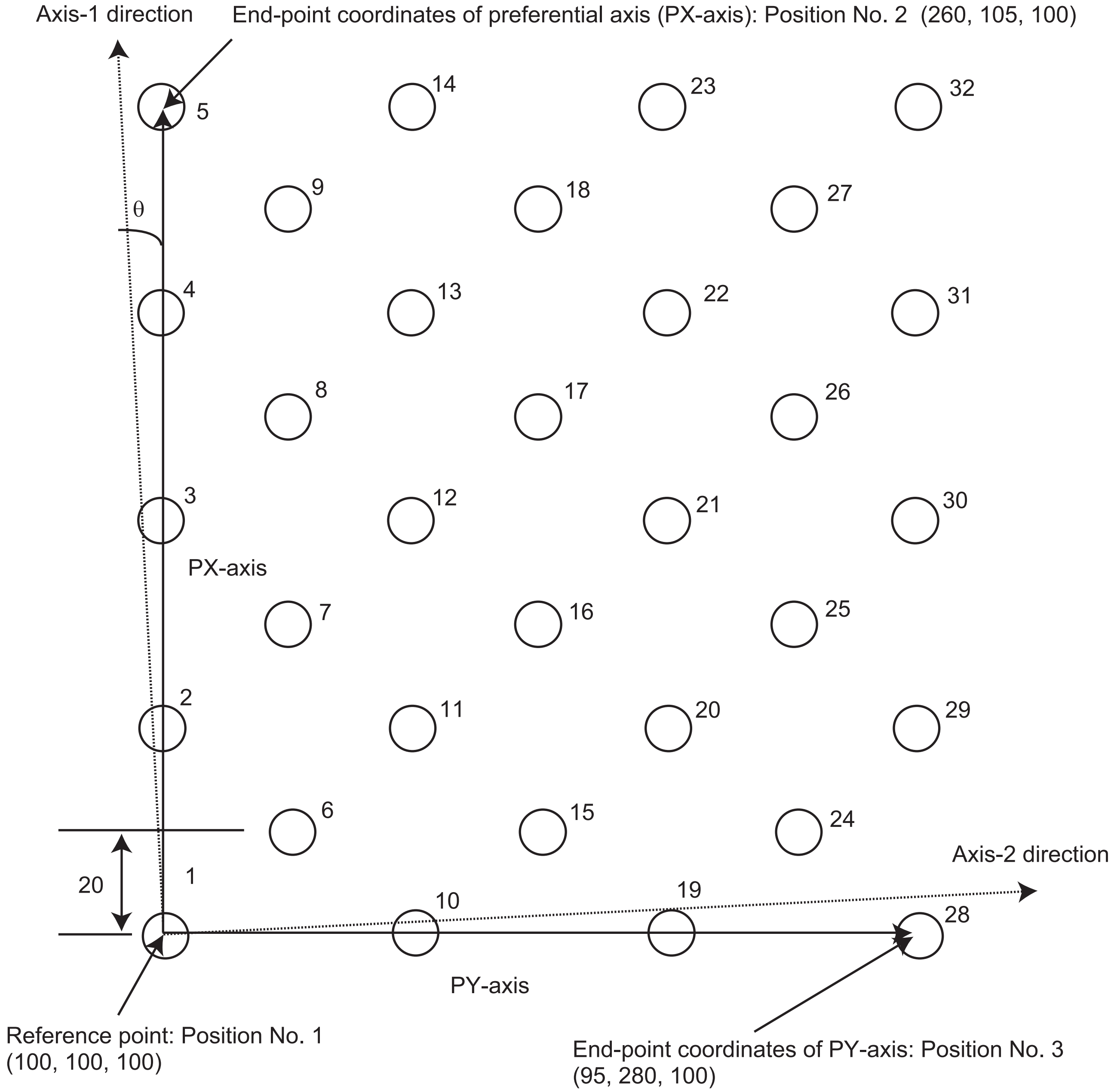
(3) Simple program example using PAPS (set by 3-point teaching)
The example below specifies movement only and does not cover picking operation.

Step	E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
1				BGPA	1			Start setting palletizing No. 1.
2								
3				PAPI	5	7		Palletizing counts: 5 x 7
4				PAPN	1			Palletizing pattern 1
5				PAPS	1			Set by 3-point teaching.
6								Use position No. 1 data.
7				PSLI	20	4		Zigzag offset = 20 mm
8				PCHZ	3			Palletizing Z-axis = Axis 3
9				PTRG	4	4		Set palletizing arch triggers.
10								Use position No. 4 data.
11				OFPZ	100			PZ-axis offset = 100 mm
12				PEXT	6			Set palletizing composition.
13								Use position No. 6 data.
14				EDPA				
15								
16				PARG	1	1		Get palletizing angle.
17								Stored in variable 199.
18				PPUT	4	6		Store angle data of variable
19								199 in axis 4 at position No. 6.
20	* //							
21								
22				ATRG	4	4		Set arch triggers.
23								Use position No. 4 data.
24				ACHZ	3			Set arch-motion Z-axis.
25								
26				ACC	0.3			Acceleration
27				DCL	0.3			Deceleration
28				VLMX				
29								
30				PSET	1	1		Set palletizing position number to 1.

Step	E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
31				MOVP	8			Move to picking position.
32								
33				TAG	1			Beginning of loop processing
34				PACH	1	9		Palletizing arch motion
35								Z point specified by Position No. 9
36				ARCH	8	9		Arch motion
37								Z point specified by Position No. 9
38				PINC	1		600	Increment palletizing position number by 1.
39			600	GOTO	1			Go to beginning of loop if PINC is successful.
40								
41				EXIT				End of task
42								
43								
44								
45								

No.	Axis 1	Axis 2	Axis 3	Axis 4	Remarks
1	100.000	100.000	100.000	*.***	Reference point data
2	260.000	105.000	100.000	*.***	PX-axis end-point data
3	95.000	280.000	100.000	*.***	PY-axis end-point data
4	*.***	*.***	50.000	*.***	Arch-trigger point data
5	*.***	*.***	*.***	*.***	(Not used)
6	*.***	*.***	*.***	-1.79	Palletizing-composition point data
7	*.***	*.***	*.***	*.***	(Not used)
8	0.000	0.000	100.000	0.000	Picking-position point data
9	*.***	*.***	0.000	*.***	Z point data
10					

Schematic diagram of placement-point positions based on the above program



- The number shown at the top right of each circle indicates a palletizing position number.
- Count in PX-axis direction = 5, Count in PY-axis direction = 7
- Zigzag offset: 20
- Zigzag count: 4
- Pallet shift angle θ: –1.79°

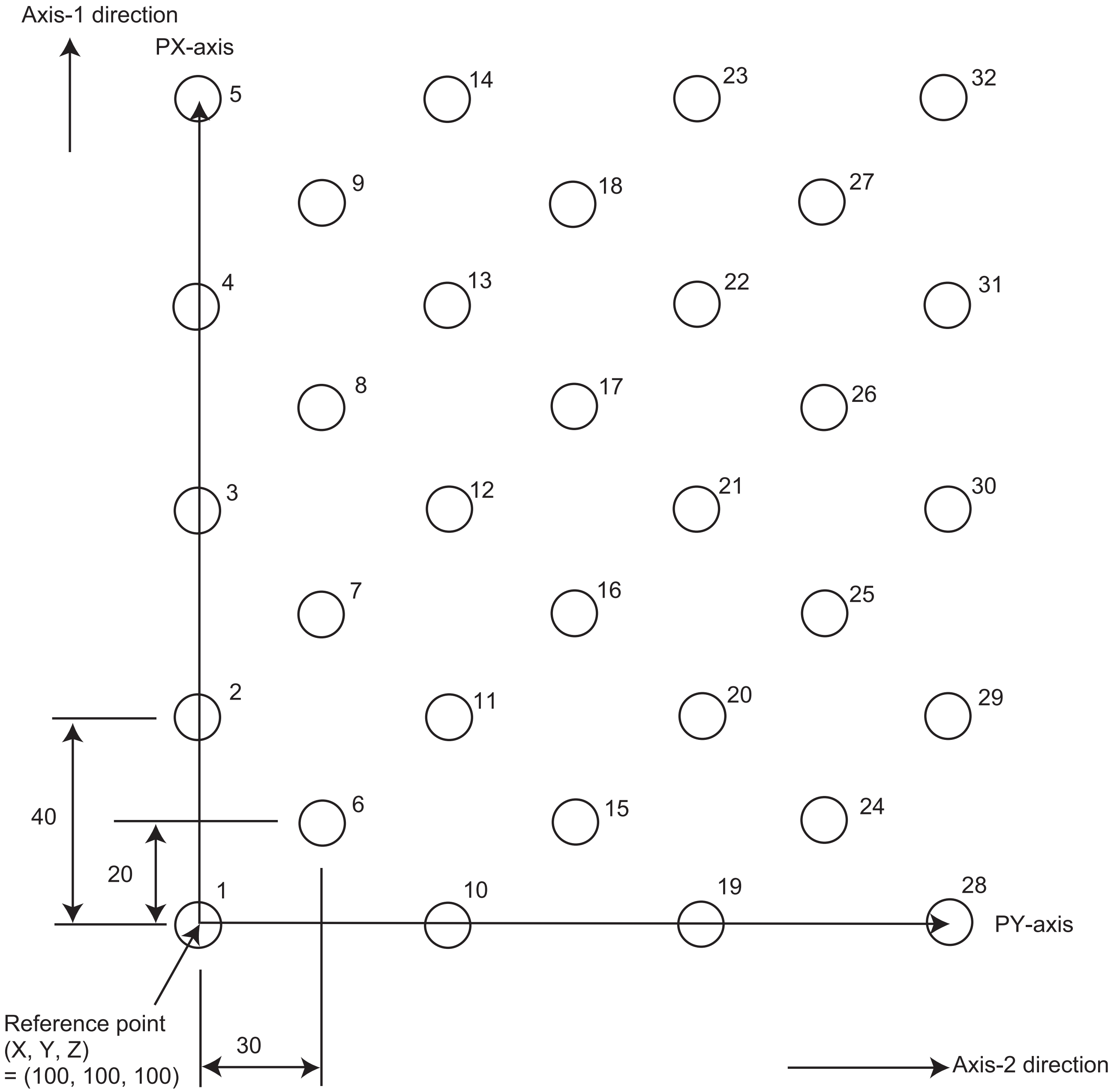
(4) Simple program example using PASE, PAPT and PAST
The example below specifies movement only and does not cover picking operation.

Step	E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
1				BGPA	1			Start setting palletizing No. 1.
2								
3				PAPI	5	7		Palletizing counts: 5 x 7
4				PAPN	1			Palletizing pattern 1
5				PASE	1	2		PX-axis = Axis 1, PY-axis = Axis 2
6				PAPT	40	30		Pitch (X = 40 mm, Y = 30 mm)
7				PAST	1			Set reference point data.
8								Use position No. 1 data.
9				PSLI	20	4		Zigzag offset = 20 mm
10								Zigzag count = 4
11				PCHZ	3			Palletizing Z-axis = Axis 3
12				PTRG	4	4		Set palletizing arch triggers.
13								Use position No. 4 data.
14				OFPZ	100			PZ-axis offset = 100 mm
15								
16				EDPA				
17								
18	*///							
19				ATRG	4	4		Set arch triggers.
20								Use position No. 4 data.
21				ACHZ	3			Set arch-motion Z-axis.
22								
23				ACC	0.3			Acceleration
24				DCL	0.3			Deceleration
25				VLMX				
26								
27				PSET	1	1		Set palletizing position number.
28				MOVP	8			Move to picking position.
29	*///							
30								

Step	E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
31				TAG	1			Beginning of loop processing
32				PACH	1	9		Palletizing arch motion
33								Z point specified by Position No. 9
34				ARCH	8	9		Arch motion
35								Z point specified by Position No. 9
36				PINC	1		600	Increment palletizing position number by 1.
37			600	GOTO	1			Go to beginning of loop if PINC is successful.
38								
39				EXIT				End of task
40								

No.	Axis 1	Axis 2	Axis 3	Axis 4	Remarks
1	100.000	100.000	100.000	*.***	Reference point data
2	*.***	*.***	*.***	*.***	(Not used)
3	*.***	*.***	*.***	*.***	(Not used)
4	*.***	*.***	50.000	*.***	Arch-trigger point data
5	*.***	*.***	*.***	*.***	(Not used)
6	*.***	*.***	*.***	*.***	(Not used)
7	*.***	*.***	*.***	*.***	(Not used)
8	0.000	0.000	100.000	0.000	Picking-position point data
9	*.***	*.***	0.000	*.***	Z point data
10					

Schematic diagram of placement-point positions based on the above program



- The number shown at the top right of each circle indicates a palletizing position number.
- Count in PX-axis direction = 5, Count in PY-axis direction = 7
- Pitch in PX-axis direction: 40
- Pitch in PY-axis direction: 30
- Zigzag offset: 20
- Zigzag count: 4

Chapter 5 Pseudo-Ladder Task

With the XSEL Controller, a pseudo-ladder task function can be used depending on the command and extension condition.
The input format is shown below. Note that this function must be used by expert engineers with a full knowledge of PLC software design.

1. Basic Frame

<table>
<tr><th>Extension condition
E</th><th>N</th><th>Input condition
Cnd</th><th>Command
Cmnd</th><th>Operand 1</th><th>Operand 2</th><th>Output
Pst</th><th></th></tr>
<tr><td>LD</td><td></td><td>7001</td><td>CHPR</td><td>1</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td>TPCD</td><td>1</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td>TAG</td><td>1</td><td></td><td></td><td></td></tr>
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|</td><td></td><td></td><td>Ladder statement field</td></tr>
<tr><td>LD</td><td></td><td>7001</td><td>TSLP</td><td>1 to 100</td><td></td><td></td><td></td></tr>
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<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>LD</td><td></td><td>7001</td><td>TSLP</td><td>1 to 100</td><td></td><td></td><td></td></tr>
<tr><td>LD</td><td></td><td>7001</td><td>GOTO</td><td>1</td><td></td><td></td><td></td></tr>
<tr><td>LD</td><td></td><td>7001</td><td>EXIT</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>*</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

* Virtual input 7001: “Normally ON” contact

2. Ladder Statement Field

(1) Extension conditions

LD .... LOAD
A .... AND
O .... OR
AB .... AND BLOCK
OB .... OR BLOCK

All of the above extension conditions can be used in non-ladder tasks.

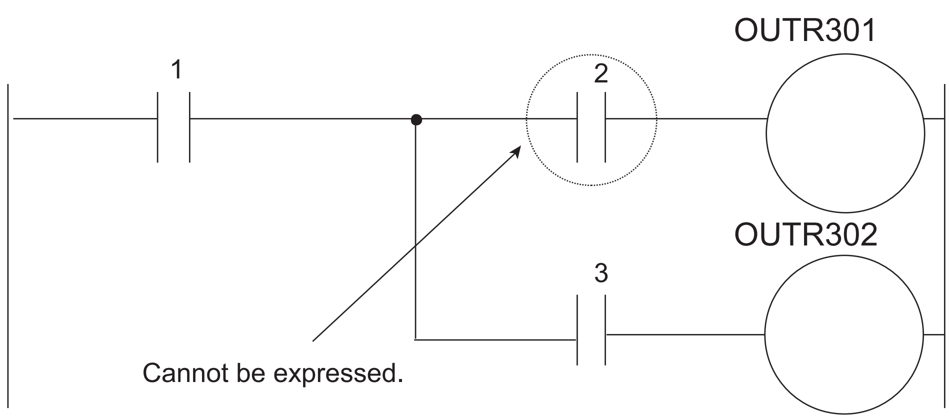
(2) Ladder commands

OUTR .... Ladder output relay (Operand 1 = Output, flag number)
TIMR .... Ladder timer relay (Operand 1 = Local flag number, Operand 2 = Timer setting (sec))

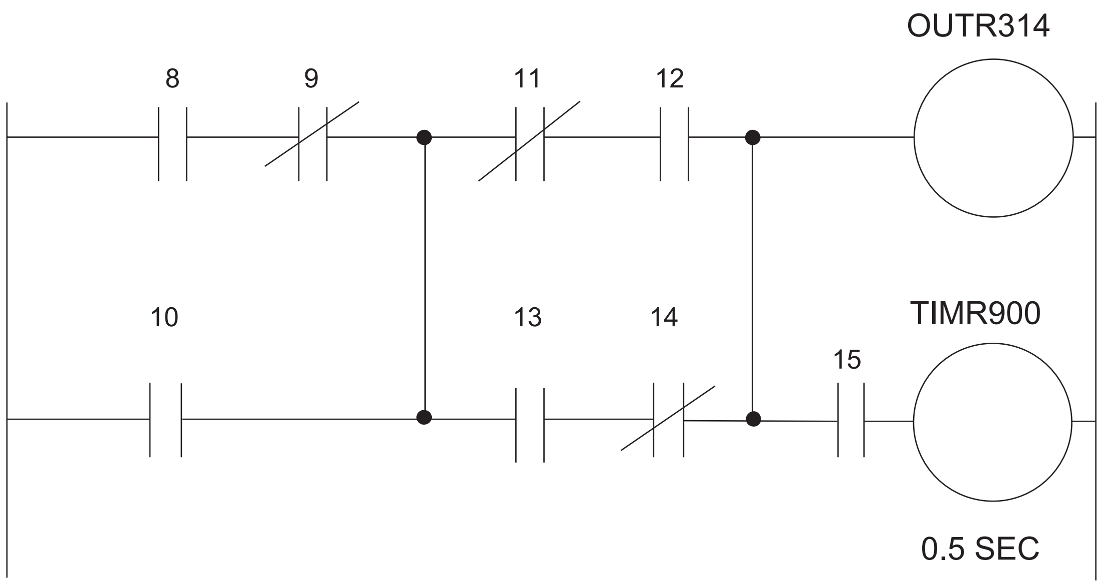
3. Points to Note

- This system only processes software ladders using an interpreter. Therefore, the processing time is much longer than that of a dedicated commercial sequencer.
  (This system is not suitable for large-scale ladder processing.)
- If an extension condition is not specified for steps in which an input condition is specified, the steps will be treated as LD (LOAD).
- Always specify a "normally ON" contact for those steps that must be processed without fail, such as CHPR, TSLP and GOTO. (LD 7001)
  Virtual input 7001: "Normally ON" contact

- The following circuit cannot be expressed. Create an equivalent circuit.



4. Program Example

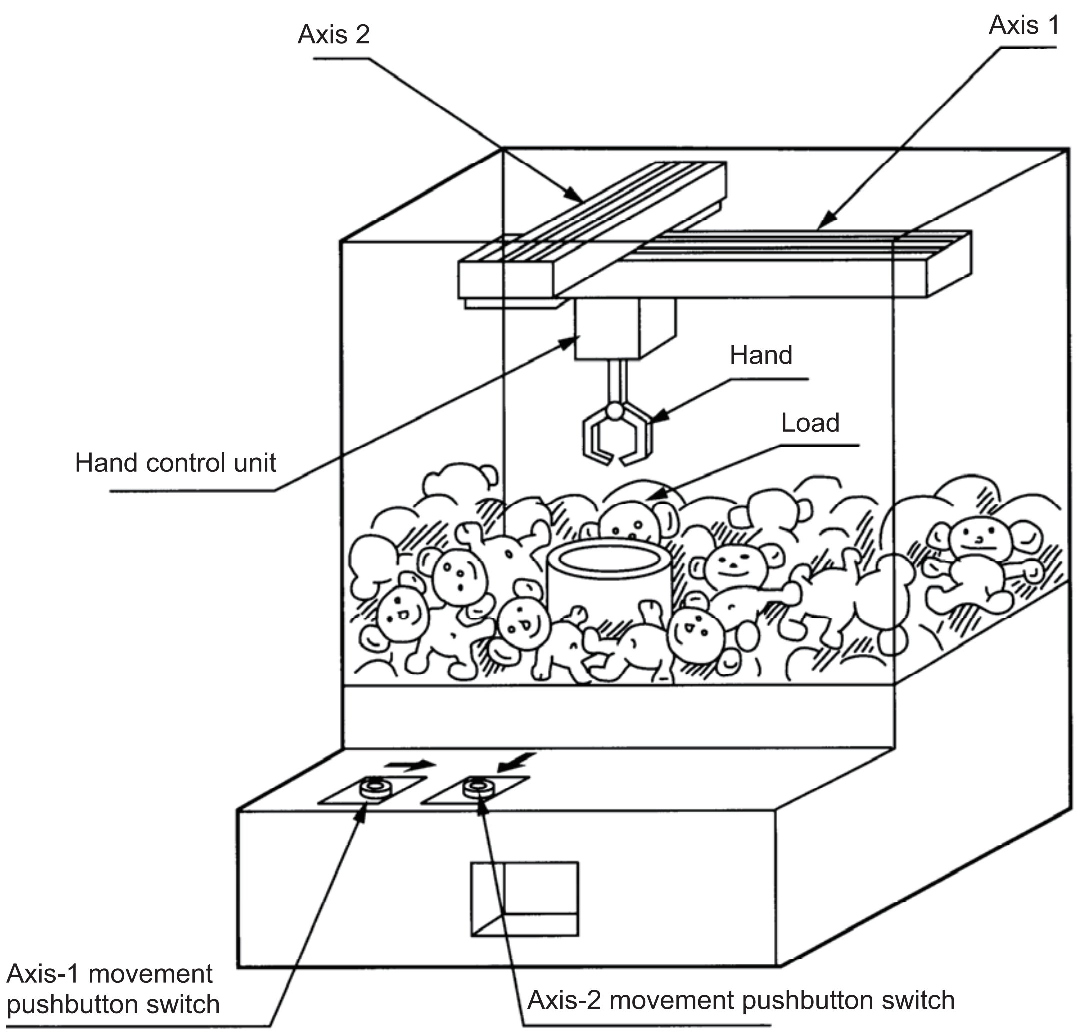


Extension condition E	N	Input condition Cnd	Command Cmnd	Operand 1	Operand 2	Output Pst
LD		7001	CHPR	1		
			TPCD	1		
			TAG	1		
LD		8				
A	N	9				
O		10				
LD	N	11				
A		12				
LD		13				
A	N	14				
OB						
AB			OUTR	314		
A		15	TIMR	900	0.5	
LD		7001	TSLP	3		
LD		7001	GOTO	1		
LD		7001	EXIT			

Chapter 6 Application Program Examples

1. Operation by Jog Command [Doll-Picking Game Machine]

(1) Overview of the system
This system is a doll-picking game machine consisting of axis-1 and axis-2 actuators. Pushbutton switches corresponding to the two axes are provided on an external operation switch box, and these switches are used to move the actuators to a desired position to grab and pick up dolls inside the case.

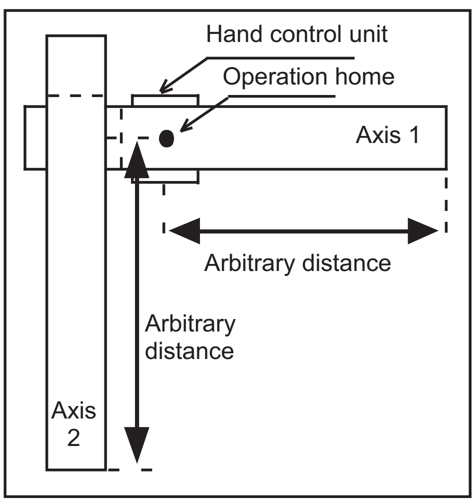


(2) Explanation of the operation

1. Wait for the axis-1 movement pushbutton switch to turn ON.
2. The X-axis moves while the pushbutton switch is ON, and stops when the switch turns OFF.
3. Wait for the axis-2 movement pushbutton switch to turn ON.
4. The Y-axis moves while the pushbutton switch is ON, and stops when the switch turns OFF.
5. Output a start command to the hand control unit.
6. Wait for an operation completion input from the hand control unit.
7. Move to the home after the input is received.

The above operation will be repeated. The operation position, external I/O assignments and operation flow chart of this operation are shown below:

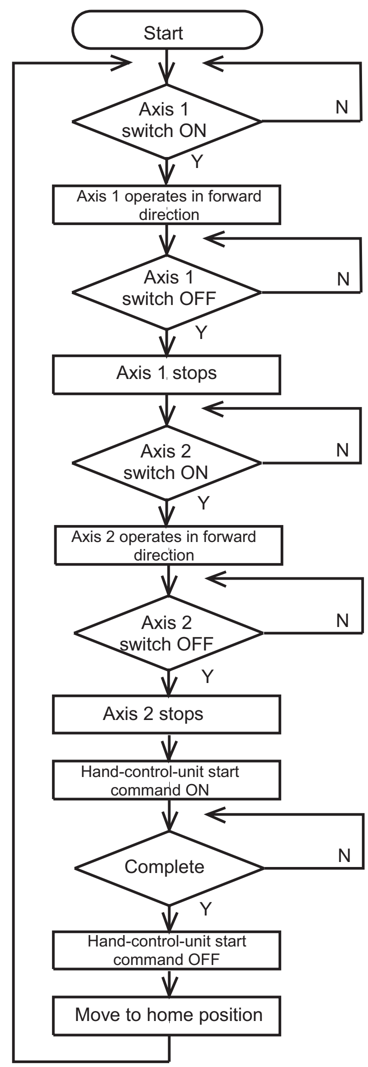
Operation Position



I/O Assignments

Category		I/O No.	Signal name	Specification
XSEL	Input	16	Axis-1 movement command	Pushbutton switch
		17	Axis-2 movement command	Pushbutton switch
		18	Hand operation completion	External control unit
	Output	309	Hand start command	24 VDC
	* Flag is not used.			

Operation Flow Chart



(3) XSEL Controller application program

Step	E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
1				HOME	11			Axes 1 and 2 return to home (servo ON).
2				VEL	400			Set speed to 400 mm/s.
3				TAG	1			
4				WTON	16			Wait for input from axis-1 movement switch.
5				JFWN	1	16		Move forward while axis-1 movement switch is ON.
6				WTON	17			Wait for input from axis-2 movement switch.
7				JFWN	10	17		Move forward while axis-2 movement switch is ON.
8				BTON	309			Start command for external control unit turns ON.
9				WTON	18			Wait for external control unit to complete operation.
10				BTOF	309			Start command for external control unit turns OFF.
11				JBWF	11	18		Axes 1 and 2 move backward while 18 is ON.
12				GOTO	1			Jump to TAG1.
13								
14								
15								
16								
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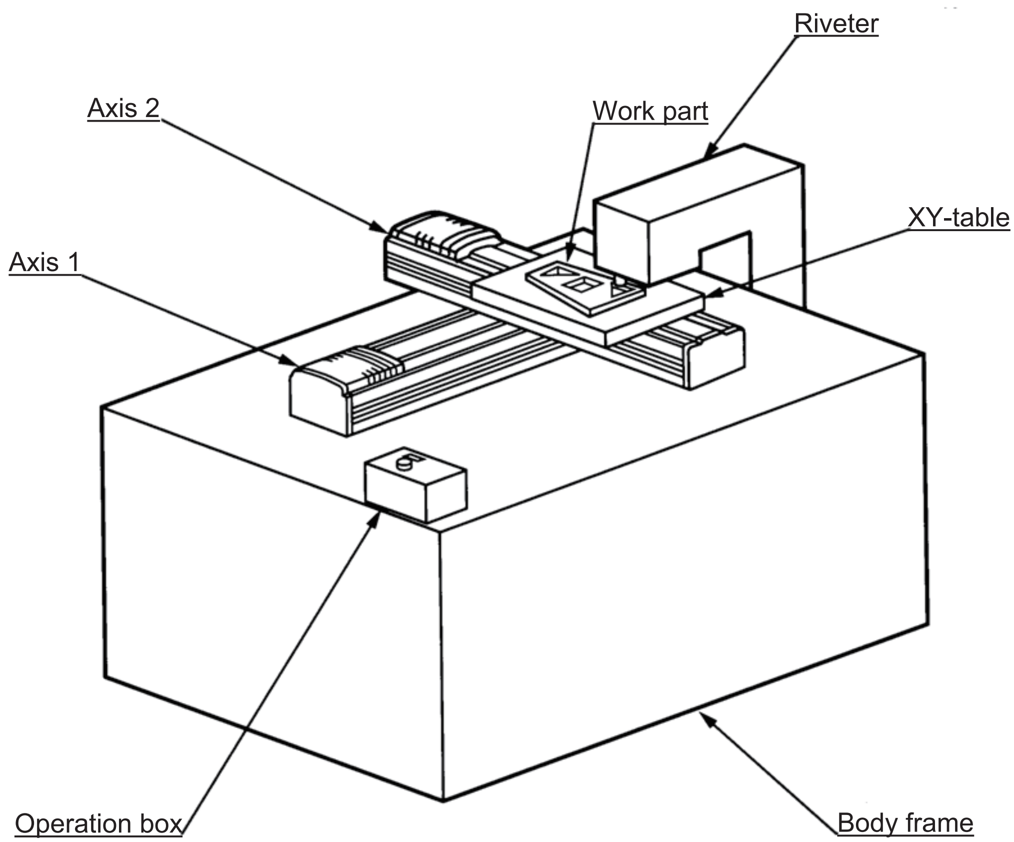
2. Operation by Point Movement Command [Riveting System]

(1) Overview of the system

This system is a riveting system consisting of an XY-table operated by axis-1 and axis-2 actuators and a riveter. By setting a work part on the XY-table at the operation home and turning on the start switch, rivets will be driven at the three points specified on the work part.

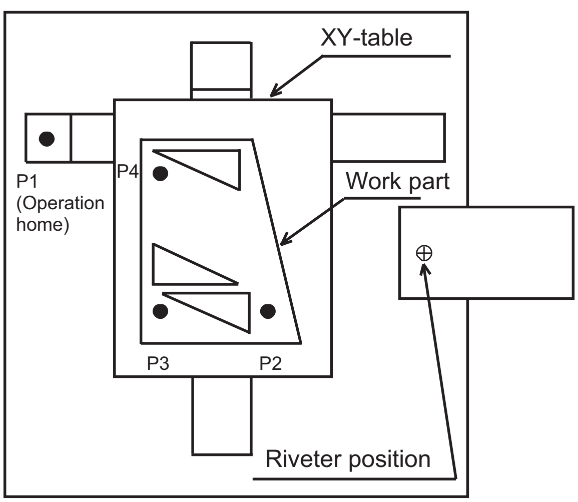


(2) Explanation of the operation

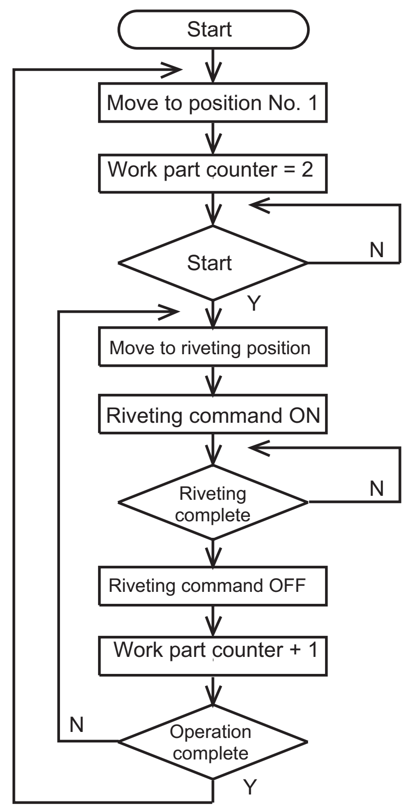
1. The XY-table moves to the operation home (P1) and waits.
2. The operator sets a load on the XY-table and turns on the start switch.
3. The XY-table moves to riveting position No. 1 (P2) on the work part and a riveting command is output to the riveter.
4. When the riveter completes the riveting operation and a completion signal is input, the table will move to riveting position No. 2 (P3) and then No. 3 (P4), in the same manner.
5. When all three points have been riveted, the table will return to the operation home (P1).

The above operation will be repeated. The operation position, external I/O assignments and operation flow chart of this operation are shown below:

Operation Position



Operation Flow Chart



I/O Assignments

Category		I/O No.	Signal name	Specification
XSEL	Input	16	Start command	Pushbutton switch
		17	Riveting completion	Contact signal
	Output	309	Riveting command	24 VDC
	* Flag is used from 600.			

(3) XSEL Controller application program

Step	E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
1				HOME	11			XY-table returns to home (servo ON).
2				VEL	400			Set speed to 400 mm/s.
3				TAG	1			
4				MOVL	1			Move to position No. 1 (home of work).
5				LET	1	2		Set 2 in work part counter.
6				BTOF	600			Clear completion flag.
7				WTON	16			Wait for start command.
8				TAG	2			
9				MOVL	*1			Move to work part counter position.
10				BTON	309			Riveting command turns ON.
11				WTON	17			Wait for riveting to complete.
12				BTOF	309			Riveting command turns OFF.
13				ADD	1	1		Increment work part counter by 1.
14				CPEQ	1	5	600	Turns ON flag if operation is complete.
15		N	600	GOTO	2			Jump to TAG2 if not complete.
16				GOTO	1			Jump to TAG1 if complete.
17								
18								
19								
20								
21								
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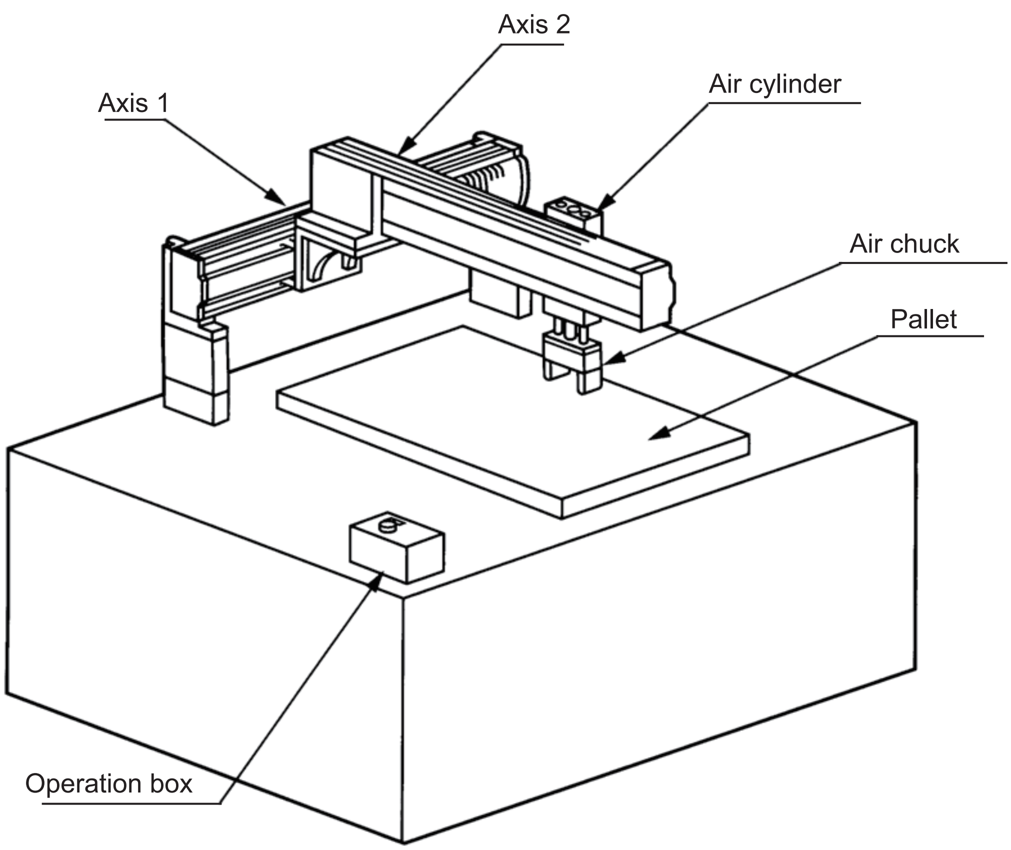
28								
29								
30								
31								
32								

3. Palletizing Operation [Palletizing System]

(1) Overview of the system
This system is a palletizing system consisting of axis-1 and axis-2 actuators and a Z-axis air cylinder. It clamps a work part at the work part feed point and transfers it onto a pallet, and repeats this operation in a sequence.
(Operation is implemented by an offset command without using a palletizing function.)

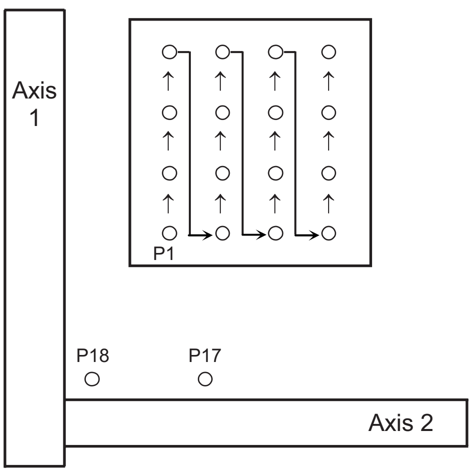


(2) Explanation of the operation

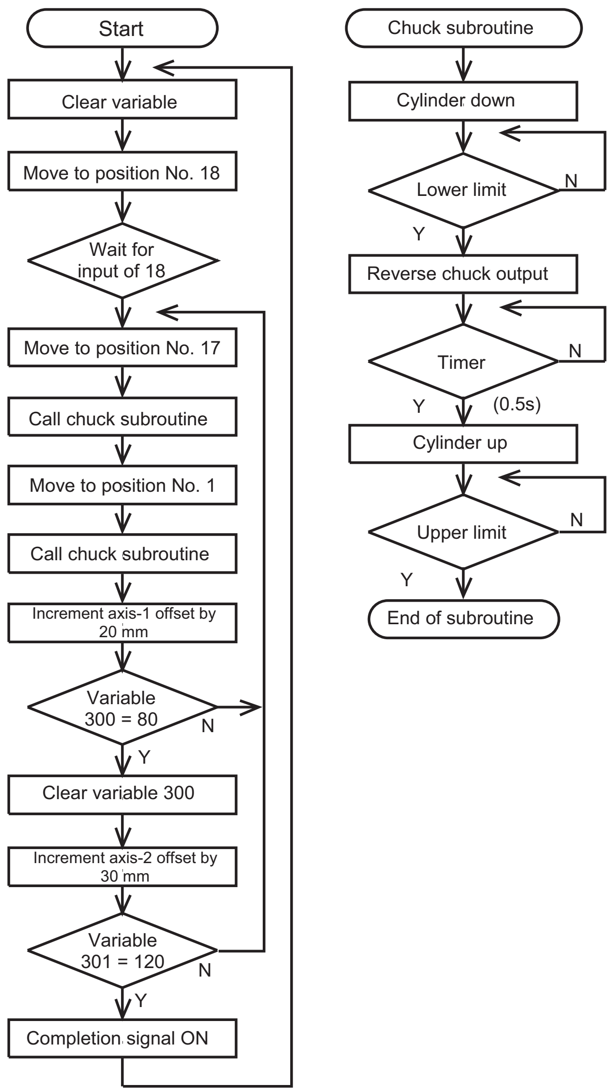
1. Move to the standby point and wait for a start input.
2. Move to the work part feed point after a start input is received.
3. The Z-axis comes down and the air chuck clamps the work part.
4. The Z-axis rises and moves to above the pallet.
5. The Z-axis comes down and releases the work part.
6. The Z-axis rises and moves to above the work part feed point.
7. When the pallet becomes full, a pallet-completion indicator signal is output. The axes move to P18 and then wait for restart.

The above operation will be repeated. The operation position, external I/O assignments and operation flow chart of this operation are shown below:

Operation Position



Operation Flow Chart



I/O Assignments

Category		I/O No.	Signal name	Specification
XSEL	Input	16	Z-axis cylinder upper limit	Proximity SW
		17	Z-axis cylinder lower limit	Proximity SW
		18	Start	Pushbutton switch
	Output	309	Z-axis cylinder SV	24 VDC
		310	Z-axis chuck SV	24 VDC
		311	Pallet-completion indicator	24 VDC
	* Flag is used from 600.			

Pallet specifications
Axis-1 direction: 20-mm pitch
Axis-2 direction: 30-mm pitch

(3) XSEL Controller application program

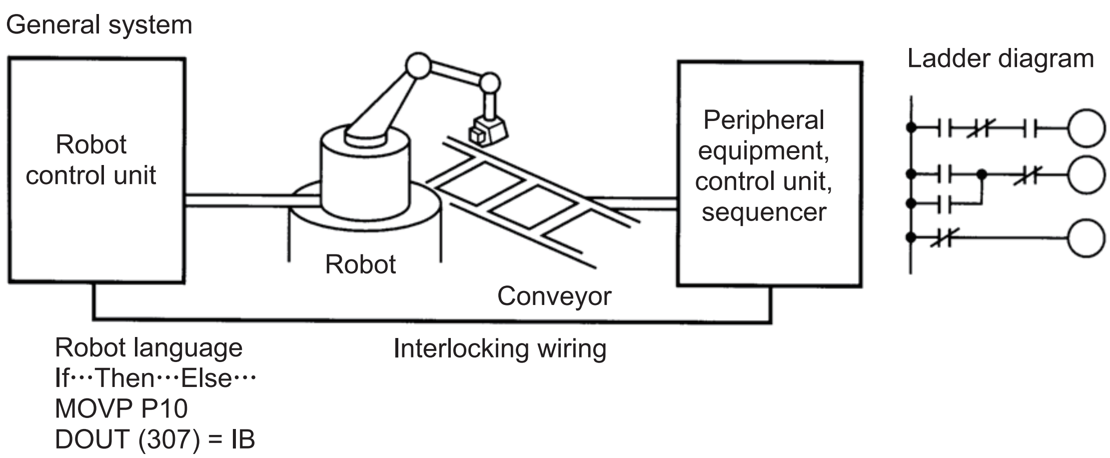
Step	E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
1				HOME	11			Axes 1 and 2 return to home.
2				VEL	100			Set speed to 100 mm/s.
3				ACC	0.2			Acceleration/deceleration: 0.2 G
4				TAG	1			
5				LET	300	0		Clear variable.
6				LET	301	0		Clear variable.
7				OFST	11	0		Clear offset value.
8				MOVL	18			Move to position No. 18.
9				WTON	18			Wait for start input.
10				BTOF	311			Output 311 turns OFF.
11				TAG	2			
12				OFST	11	0		Clear offset value.
13				MOVL	17			Move to position No. 17.
14				EXSR	1			Call chuck subroutine (chuck).
15				OFST	1	*300		Offset axis 1 by value in variable 300.
16				OFST	10	*301		Offset axis 2 by value in variable 301.
17				MOVL	1			Move to position No. 1 + offset value.
18				EXSR	1			Call chuck subroutine (unchuck).
19				ADD	300	20		Add 20 to variable 300.
20				CPEQ	300	80	600	Turn ON flag 600 if variable 300 = 80.
21		N	600	GOTO	2			Jump to TAG2 if flag 600 is OFF.
22				LET	300	0		Clear variable 300.
23				ADD	301	30		Add 30 to variable 301.
24				CPEQ	301	120	601	Turn ON flag 601 if variable 301 = 120.
25		N	601	GOTO	2			Jump to TAG2 if flag 601 is OFF.
26				BTON	311			Output 311 turns ON.
27				GOTO	1			Jump to TAG1.
28				BGSR	1			Start chuck subroutine.
29				BTON	309			Z-axis cylinder down
30				WTON	17			Wait for lower-limit input.
31				BTNT	310			Reverse air-chuck output.
32				TIMW	0.5			Timer: 0.5 second
33				BTOF	309			Z-axis cylinder up
34				WTON	16			Wait for upper-limit input.
35				EDSR				End of chuck subroutine
36								
37								
38								
39								

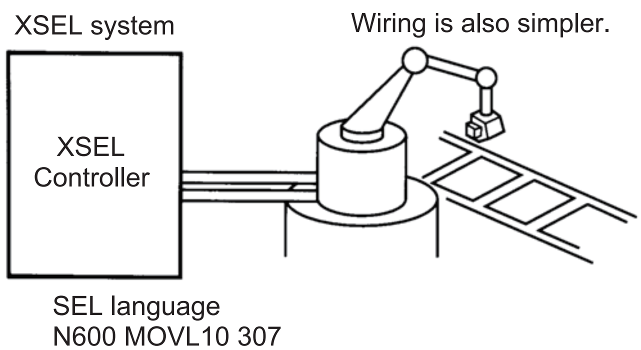
Part 5 Multi-Tasking

Chapter 1 Real-Time Multi-Tasking

1. SEL Language

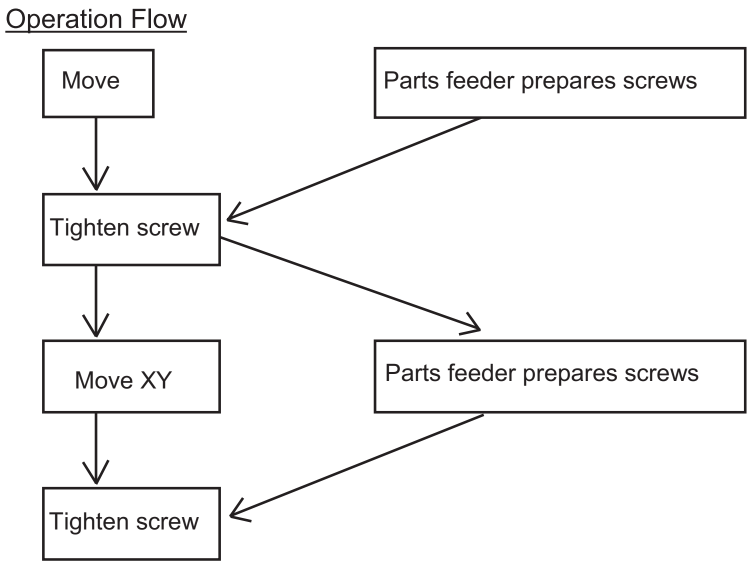
The XSEL Controller allows integrated control of actuators and peripherals with a single controller using its 32-bit RISC CPU and high-speed real-time operating system. There is no need to learn various languages for different units, such as robot language for robots and sequencer language for peripherals. Since SEL language is the only language used, an efficient system can be designed.
The current version of SEL language represents a pioneering evolution of the widely proven programming language, evidenced by higher-performance features and advanced functions. The latest version is also easier to use compared with the conventional SEL language.



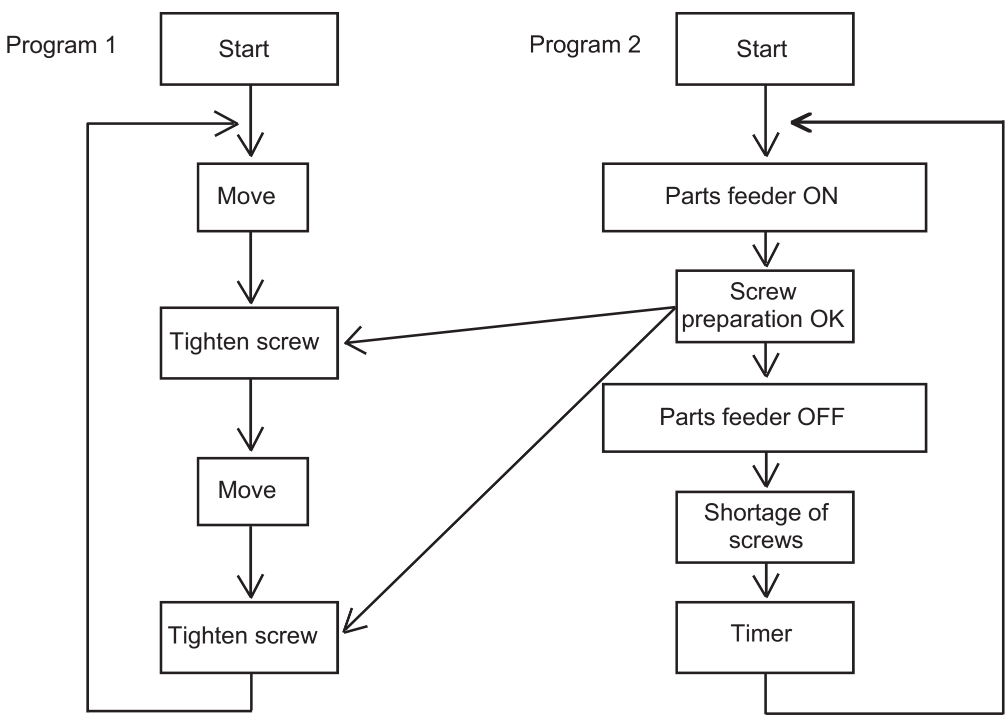


2. Multi-Tasking

"Multi-tasking" operation may not be a familiar term, but it is widely used in computer programming to refer to parallel processing. Simply put, multi-tasking means running several programs in parallel.
Take a screw-tightening robot, for example.
In general, a screw-tightening robot consists of axis-1 and axis-2 actuators and a screw-tightening machine (up/down air cylinder, etc.).



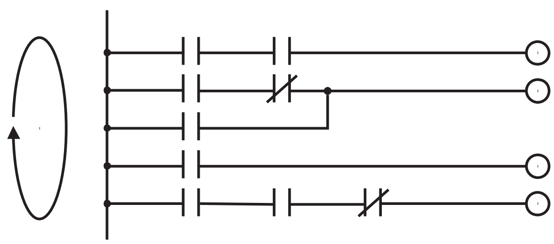
Although the flow chart is simple, the movement of axis-1 and axis 2 actuators and the operation of the parts feeder must take place simultaneously. This requires "multi-tasking" operation.



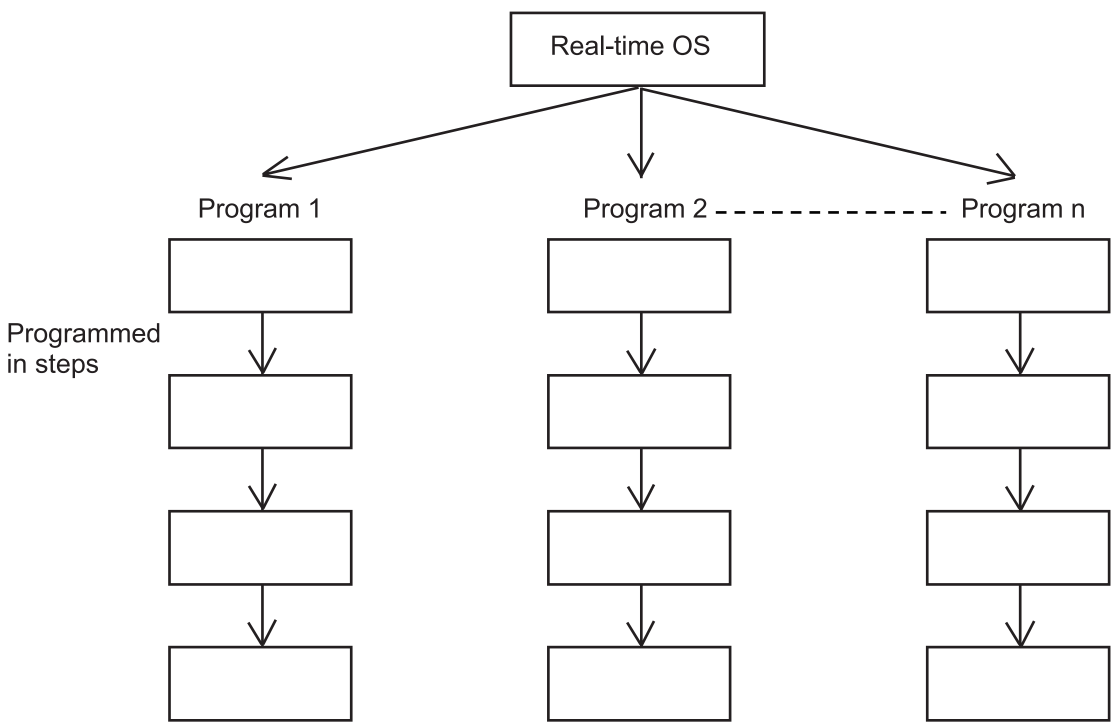
3. Difference from a Sequencer

The parallel processing method has evolved from the traditional method of using a sequence control circuit consisting of relays to a more recent one using a sequencer equipped with a microcomputer.
Since a microcomputer basically allows one process for each clock, a sequence control circuit with a microcomputer must scan the entire program to achieve apparent parallel processing. For this reason, a scan time is required, which adds to overhead (dead time).

The microcomputer scans the enter program and outputs only where the condition is satisfied.



On the other hand, a system consisting of a microcomputer and a real-time operating system no longer uses parallel processing scan (by always scanning the entire program), but adopts an event-driven method instead (whereby the system operates only when an event occurs, such as upon receipt of an input signal). Since no extra scan is necessary, the system can operate at high speed. In addition, each program to be processed in parallel is programmed in steps, so the program is easy to understand and maintain.



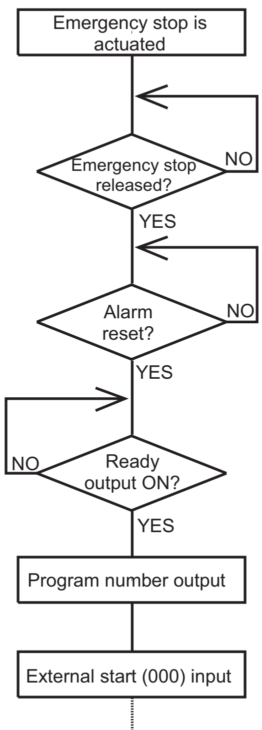
The programmer need not worry about running all programs in parallel, which is controlled by the real-time operating system.

4. Release of Emergency Stop

Default factory settings of parameters
"Other parameter No. 10, Emergency-stop recovery type" = 0
"Other parameter No. 11, Safety-gate open recovery type" = 0
"Other parameter No. 12, Recognition type during automatic operation" = 0

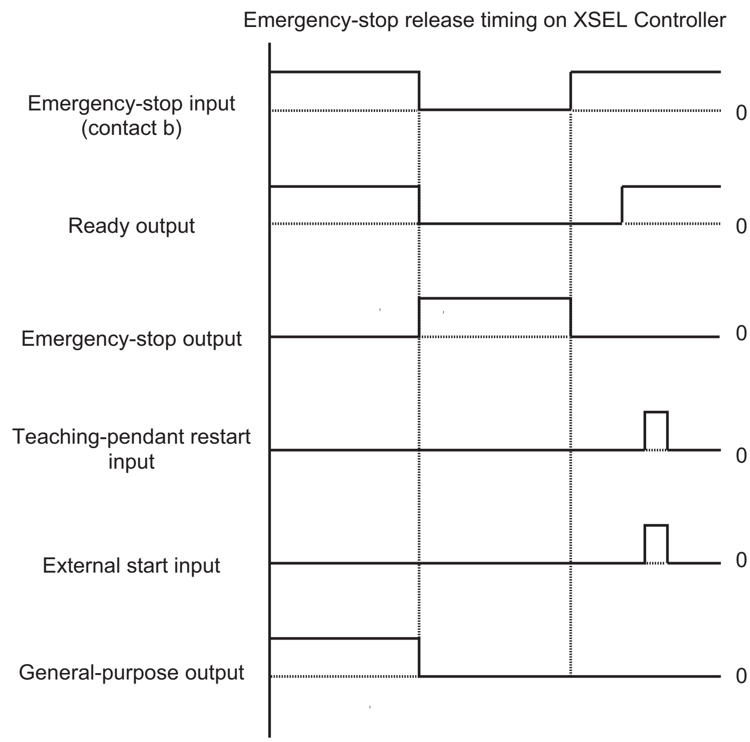
An emergency stop is actuated by turning the emergency-stop contact b input to OFF, and released by turning the input to ON.

(1) Flow chart



The selected program is executed from step 1.

(2) Timing chart



◎ The internal conditions of the controller during an emergency stop are as follows:

- Programs .... Aborted (excluding "I/O processing programs operation when program is aborted")
- Output ports, local flags, local variables .... Cleared
- Global flags, global variables .... Retained

If the peripherals are to be controlled by program, create a management program beforehand and use the program to control the peripherals. Alternatively, start (EXPG) or abort (ABPG) other programs in accordance with the status of each general-purpose input.

5. Program Switching

Various methods are available to switch between programs, depending on the purpose of programs. The representative methods are explained below.

- Program switching
  - External start
  - Program
    - Single-tasking .... EXIT command
    - Multi-tasking .... EXPG command

First, the program switching methods are largely divided into switching by external start and switching by application program.

(1) External start method............Refer to Chapter 1, “Operation” (Starting via External Signal Selection) in Part 2, “Operation.”

(2) Program method

○ Single-tasking
Executing an EXIT command (end program) at the end of each program will end the program and cause the system to return to the condition immediately after the power is turned on. However, since the home position is retained, another program can be started by an external start input with the corresponding program number specified.

○ Multi-tasking
Creating a management program and executing EXPG commands (start other program) will allow a series of programs to be run in parallel.

Chapter 2 Example of Building a System

How to build hardware and software is explained in details by using a screw-tightening robot as an example.

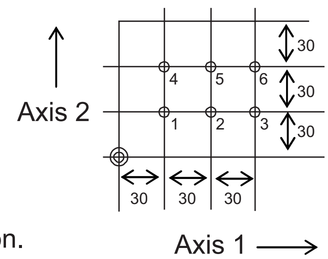
1. Equipment

Screw-tightening machine (for Z-axis)	
Actuators (for axes 1 and 2)	IAI's 60-W servo motor with 300-mm stroke x 2
Controller	IAI's XSEL Controller

2. Operation

(1) Tighten six screws at 30-mm pitches on axes 1 and 2.
1. The actuators move to a screw-tightening position.
2. The Z-axis air cylinder of the screw-tightening machine comes down.
3. The screw-tightening machine starts operating.
4. When the screw tightening is complete, the Z-axis air cylinder rises.
5. The actuators move to the next position.

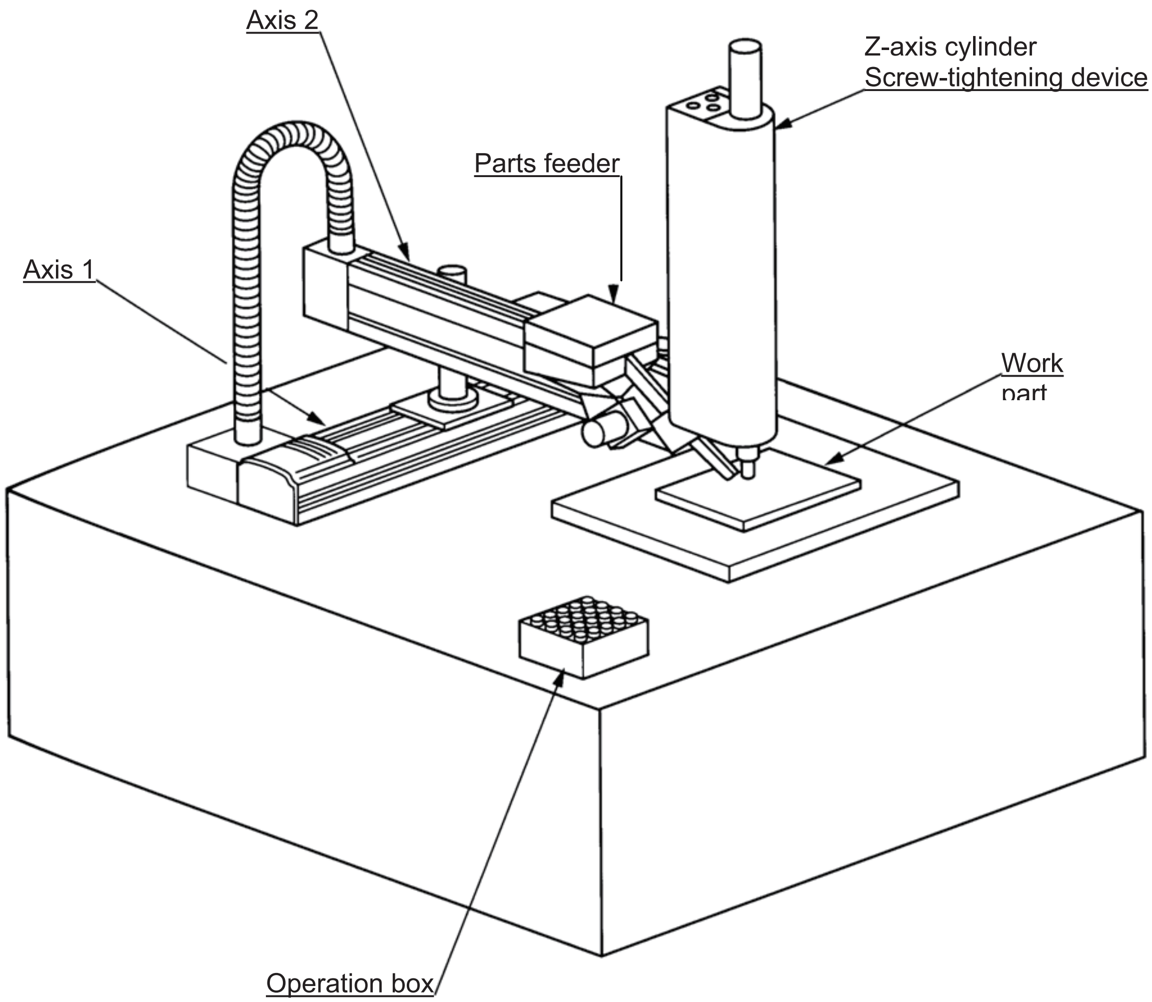
Coordinates



(2) The parts feeder operates in parallel with the above operation.
1. The parts feeder starts when screws are short.
2. The parts feeder stops when the screws are fully loaded.

3. Overview of the Screw-Tightening System

This system consists of axis-1 and axis-2 actuators, Z-axis cylinder, screw-tightening device and parts feeder, and tightens the screws fed by the parts feeder at the specified positions on the work part.



4. Hardware

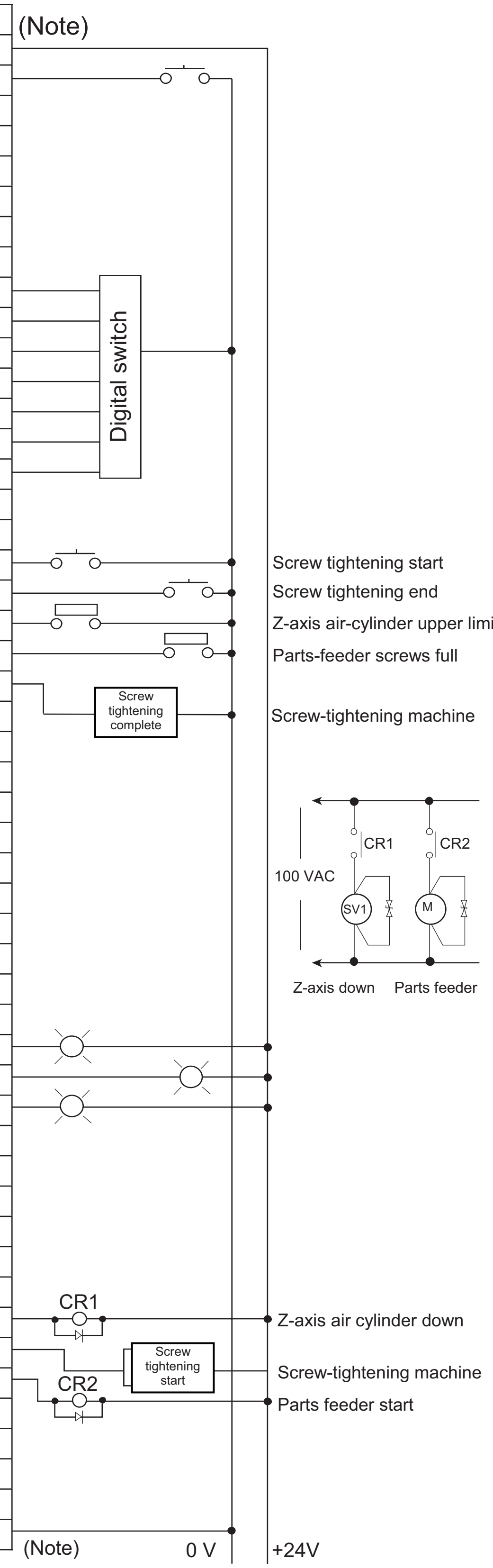
(1) I/O assignments

I/O connector (50-pin)

Pin No.	Category	Port No.	Function	Cable color
1	Input	-	+24-V input	Brown – 1
2		000	Program start	Red – 1
3		001	General-purpose input	Orange – 1
4		002	General-purpose input	Yellow – 1
5		003	General-purpose input	Green – 1
6		004	General-purpose input	Blue – 1
7		005	General-purpose input	Purple – 1
8		006	General-purpose input	Gray – 1
9		007	Program specification (PRG No. 1)	White – 1
10		008	Program specification (PRG No. 2)	Black – 1
11		009	Program specification (PRG No. 4)	Brown – 2
12		010	Program specification (PRG No. 8)	Red – 2
13		011	Program specification (PRG No. 10)	Orange – 2
14		012	Program specification (PRG No. 20)	Yellow – 2
15		013	Program specification (PRG No. 40)	Green – 2
16		014	General-purpose input	Blue – 2
17		015	General-purpose input	Purple – 2
18		016	Screw tightening start	Gray – 2
19		017	Screw tightening end	White – 2
20		018	Z-axis air-cylinder upper limit	Black – 2
21		019	Parts-feeder screws full	Brown – 3
22		020	Screw tightening complete	Red – 3
23		021	General-purpose input	Orange – 3
24		022	General-purpose input	Yellow – 3
25		023	General-purpose input	Green – 3
26		024	General-purpose input	Blue – 3
27		025	General-purpose input	Purple – 3
28		026	General-purpose input	Gray – 3
29		027	General-purpose input	White – 3
30		028	General-purpose input	Black – 3
31		029	General-purpose input	Brown – 4
32		030	General-purpose input	Red – 4
33		031	General-purpose input	Orange – 4
34	Output	300	Alarm output	Yellow – 4
35		301	Ready output	Green – 4
36		302	Emergency-stop output	Blue – 4
37		303	General-purpose output	Purple – 4
38		304	General-purpose output	Gray – 4
39		305	General-purpose output	White – 4
40		306	General-purpose output	Black – 4
41		307	General-purpose output	Brown – 5
42		308	General-purpose output	Red – 5
43		309	Z-axis air cylinder down	Orange – 5
44		310	Screw tightening start	Yellow – 5
45		311	Parts feeder start	Green – 5
46		312	General-purpose output	Blue – 5
47		313	General-purpose output	Purple – 5
48		314	General-purpose output	Gray – 5
49		315	General-purpose output	White – 5
50		-	General-purpose: NC, Compact: 0 V	Black – 5

(2) Layout diagram

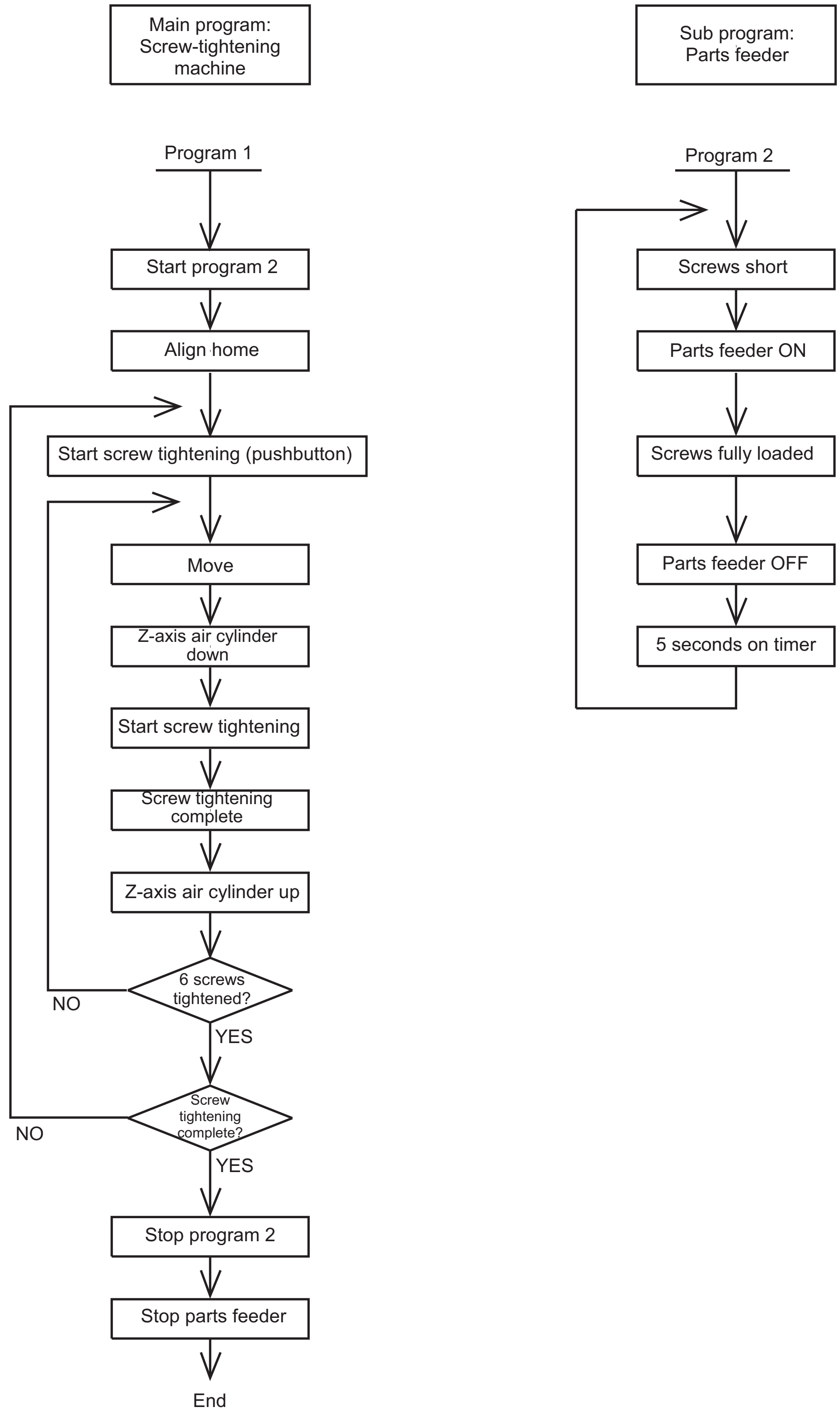
Pin No.	Category	Port No.	Function
1		-	General-purpose: NC, Compact: +24-V input
2		000	Program start
3		001	General-purpose input
4		002	General-purpose input
5		003	General-purpose input
6		004	General-purpose input
7		005	General-purpose input
8		006	General-purpose input
9		007	Program specification (PRG No. 1)
10		008	Program specification (PRG No. 2)
11		009	Program specification (PRG No. 4)
12		010	Program specification (PRG No. 8)
13		011	Program specification (PRG No. 10)
14		012	Program specification (PRG No. 20)
15		013	Program specification (PRG No. 40)
16		014	General-purpose input
17	Input	015	General-purpose input
18		016	Screw tightening start
19		017	Screw tightening end
20		018	Z-axis air-cylinder upper limit
21		019	Parts-feeder screws full
22		020	Screw tightening complete
23		021	General-purpose input
24		022	General-purpose input
25		023	General-purpose input
26		024	General-purpose input
27		025	General-purpose input
28		026	General-purpose input
29		027	General-purpose input
30		028	General-purpose input
31		029	General-purpose input
32		030	General-purpose input
33		031	General-purpose input
34		300	Alarm output
35		301	Ready output
36		302	Emergency-stop output
37		303	General-purpose output
38		304	General-purpose output
39		305	General-purpose output
40		306	General-purpose output
41		307	General-purpose output
42	Output	308	General-purpose output
43		309	Z-axis air cylinder down
44		310	Screw tightening start
45		311	Parts feeder start
46		312	General-purpose output
47		313	General-purpose output
48		314	General-purpose output
49		315	General-purpose output
50		-	General-purpose: NC, Compact: 0 V



Pin No. 1 is connected to +24 V and No. 50 to 0 V on a compact type.

5. Software

(1) Control flow chart



(2) Main program
Screw-tightening program No. 1

Application program

Comment	Extension condition	Input condition	Command			Output condition	Comment
	AND, OR	I/O, flag	Command	Operand 1	Operand 2	Output port, flag	
1			EXPG	2			Start program 2.
2			HOME	11			Align home.
3			VEL	100			Speed: 100 mm/sec
4			ACC	0.3			Acceleration: 0.3 G
5			TAG	1			Jump destination at restart
6			WTON	16			Screw-tightening start pushbutton
7			LET	1	1		Set screw counter.
8			TAG	2			Jump destination after tightening one screw
9			MOVL	*1			Move.
10			BTON	309			Z-axis air cylinder down
11			BTON	310			Start screw tightening.
12			WTON	20			Screw tightening complete.
13			BTOF	309	310		Cylinder up, screw tightening stopped.
14			WTON	18			Check Z-axis air cylinder top position.
15			ADD	1	1		Increment screw counter by 1.
16			CPEQ	1	7	900	Compare after tightening six screws.
17		N900	GOTO	2			Go to next screw-tightening cycle after tightening one screw.
18		N17	GOTO	1			Restart screw tightening.
19			ABPG	2			Stop program 2.
20			BTOF	311			Stop parts feeder.
21			EXIT				End of program 1

Position program

No.	X	Y
1	30	30
2	60	30
3	90	30
4	30	60
5	60	60
6	90	60

(3) Sub program
Parts feeder program No. 2

Application program

Comment	Extension condition	Input condition	Command			Output condition	Comment
	AND, OR	I/O, flag	Command	Operand 1	Operand 2	Output port, flag	
1			TAG	1			Jump destination for repeating
2			WTOF	19			Screws short.
3			BTON	311			Start parts feeder.
4			WTON	19			Screws fully loaded.
5			BTOF	311			Stop parts feeder.
6			TIMW	5			5 seconds on restart timer
7			GOTO	1			Repeat.

Appendix

⊙ Actuator Specification List

	Model number	Stroke (mm) and maximum speed (mm/sec) (Note 1)	Payload capacity (Note 2) Horizontal (kg)	Payload capacity (Note 2) Vertical (kg)	Rated acceleration Horizontal (G)	Rated acceleration Vertical (G)
RCS2 (Slider type)	RCS2-SA4C-□-20-10-□□□	665	4	1	0.3	0.3
	RCS2-SA4C-□-20-5-□□□	330	6	2.5	0.3	0.3
	RCS2-SA4C-□-20-2.5-□□□	165	8	4.5	0.2	0.2
	RCS2-SA5C-□-20-12-□□□	800 / 760	4	1	0.3	0.3
	RCS2-SA5C-□-20-6-□□□	400 / 380	8	2	0.3	0.3
	RCS2-SA5C-□-20-3-□□□	200 / 190	12	4	0.2	0.2
	RCS2-SA6C-□-30-12-□□□	800 / 760 / 640 / 540	6	1.5	0.3	0.3
	RCS2-SA6C-□-30-6-□□□	400 / 380 / 320 / 270	12	3	0.3	0.3
	RCS2-SA6C-□-30-3-□□□	200 / 190 / 160 / 135	18	6	0.2	0.2
	RCS2-SA7C-□-60-16-□□□	800 / 640 / 480	12	3	0.3	0.3
	RCS2-SA7C-□-60-8-□□□	400 / 320 / 240	25	6	0.3	0.3
	RCS2-SA7C-□-60-4-□□□	200 / 160 / 120	40	12	0.2	0.2
	RCS2-SS7C-□-60-12-□□□	600 / 470	15	4	0.3	0.3
	RCS2-SS7C-□-60-6-□□□	300 / 230	30	8	0.3	0.3
	RCS2-SS8C-□-100-20-□□□	1000 / 980 / 765 / 625 / 515	20	4	0.3	0.3
	RCS2-SS8C-□-100-10-□□□	500 / 480 / 380 / 310 / 255	40	8	0.3	0.3
	RCS2-SS8C-□-150-20-□□□	1000 / 960 / 765 / 625 / 515	30	6	0.3	0.3
	RCS2-SS8C-□-150-10-□□□	500 / 480 / 380 / 310 / 255	60	12	0.3	0.3
RCS2 (Rod type)	RCS2-RA4C-□-20-12-□□□	600	3	1	0.3	0.3
	RCS2-RA4C-□-20-6-□□□	300	6	2	0.3	0.3
	RCS2-RA4C-□-20-3-□□□	150	12	4	0.2	0.2
	RCS2-RA4C-□-30-12-□□□	600	4	1.5	0.3	0.3
	RCS2-RA4C-□-30-6-□□□	300	9	3	0.3	0.3
	RCS2-RA4C-□-30-3-□□□	150	18	6.5	0.2	0.2
	RCS2-RA5C-□-60-16-□□□	800 / 755	12	2	0.3	0.3
	RCS2-RA5C-□-60-8-□□□	400 / 377	25	5	0.3	0.3
	RCS2-RA5C-□-60-4-□□□	200 / 188	50	11.5	0.2	0.2
	RCS2-RA5C-□-100-16-□□□	800 / 755	15	3.5	0.3	0.3
	RCS2-RA5C-□-100-8-□□□	400 / 377	30	9	0.3	0.3
	RCS2-RA5C-□-100-4-□□□	200 / 188	60	18	0.2	0.2
	RCS2-RA7AD-I-60-12-□□□	600 / 505	10	2.5	0.15	0.15
	RCS2-RA7AD-I-60-6-□□□	300 / 250	20	7	0.1	0.1
	RCS2-RA7AD-I-60-3-□□□	150 / 125	40	15	0.05	0.05
	RCS2-RA7AD-I-100-12-□□□	600 / 505	15	5.5	0.2	0.2
	RCS2-RA7AD-I-100-6-□□□	300 / 250	30	12.5	0.1	0.1
	RCS2-RA7BD-I-100-16-□□□	800	10	3.5	0.25	0.25
	RCS2-RA7BD-I-100-8-□□□	400	22	9	0.17	0.17
	RCS2-RA7BD-I-100-4-□□□	200	40	19.5	0.1	0.1
	RCS2-RA7BD-I-150-16-□□□	800	15	6.5	0.3	0.3
	RCS2-RA7BD-I-150-8-□□□	400	35	14.5	0.2	0.2
RCS2 (Arm/flat type)	RCS2-A4R-□-20-10-□□□	330	–	2.5	–	0.2
	RCS2-A4R-□-20-5-□□□	165	–	4.5	–	0.2
	RCS2-A5R-□-30-12-□□□	400	–	2	–	0.2
	RCS2-A5R-□-30-6-□□□	200	–	4	–	0.2
	RCS2-A6R-□-30-12-□□□	400	–	3	–	0.2
	RCS2-A6R-□-30-6-□□□	200	–	6	–	0.2
	RCS2-F5D-□-60-16-□□□	800	–	2	–	0.3
	RCS2-F5D-□-60-8-□□□	400	–	5	–	0.3
	RCS2-F5D-□-60-4-□□□	200	–	11.5	–	0.2
	RCS2-F5D-□-100-16-□□□	800	–	3.5	–	0.3
	RCS2-F5D-□-100-8-□□□	400	–	9	–	0.3
	RCS2-F5D-□-100-4-□□□	200	–	18	–	0.2

(Note 1) The figure in each elongated circle indicates the maximum speed for the applicable stroke(s).
(Note 2) The payload capacity is based on operation at the rated acceleration.
(Note 3) RCS2-R**7 series actuators cannot be used as axis 5 or 6.

	Model number	Stroke (mm) and maximum speed (mm/sec) (Note 1)	Payload capacity (Note 2) Horizontal (kg)	Payload capacity (Note 2) Vertical (kg)	Rated acceleration Horizontal (G)	Rated acceleration Vertical (G)
RCS2 (Rotary type)	RCS2-RT6-I-60-18-300	500度/sec	–	–	–	–
	RCS2-RT6R-I-60-18-300	500度/sec	–	–	–	–
	RCS2-RT7R-I-60-4-300	500度/sec	–	–	–	–
RCS2CR (Slider type)	RCS2CR-SA4C-□-20-10-□□□	665	4	1	0.3	0.3
	RCS2CR-SA4C-□-20-5-□□□	330	6	2.5	0.3	0.3
	RCS2CR-SA4C-□-20-2.5-□□□	165	8	4.5	0.2	0.2
	RCS2CR-SA5C-□-20-12-□□□	800 / 760	4	1	0.3	0.3
	RCS2CR-SA5C-□-20-6-□□□	400 / 380	8	2	0.3	0.3
	RCS2CR-SA5C-□-20-3-□□□	200 / 190	12	4	0.2	0.2
	RCS2CR-SA6C-□-30-12-□□□	800 / 760 / 640 / 540	6	1.5	0.3	0.3
	RCS2CR-SA6C-□-30-6-□□□	400 / 380 / 320 / 270	12	3	0.3	0.3
	RCS2CR-SA6C-□-30-3-□□□	200 / 190 / 160 / 135	18	6	0.2	0.2
	RCS2CR-SA7C-□-60-16-□□□	600 / 640 / 480	12	3	0.3	0.3
	RCS2CR-SA7C-□-60-8-□□□	400 / 320 / 240	25	6	0.3	0.3
	RCS2CR-SA7C-□-60-4-□□□	200 / 160 / 120	40	12	0.2	0.2
	RCS2CR-SS7C-□-60-12-□□□	600 / 470	15	4	0.3	0.3
	RCS2CR-SS7C-□-60-6-□□□	300 / 230	30	8	0.3	0.3
	RCS2CR-SS8C-□-100-20-□□□	1000 / 900 / 765 / 625 / 515	20	4	0.3	0.3
	RCS2CR-SS8C-□-100-10-□□□	500 / 480 / 380 / 310 / 255	40	8	0.3	0.3
	RCS2CR-SS8C-□-150-20-□□□	1000 / 900 / 765 / 625 / 515	30	6	0.3	0.3
	RCS2CR-SS8C-□-150-10-□□□	500 / 480 / 380 / 310 / 255	60	12	0.3	0.3
RCS2W (Dustproof/splash-proof type)	RCS2W-RA4□-□-30-12-□□□	600	4	1.5	0.3	0.3
	RCS2W-RA4□-□-30-6-□□□	300	9	3	0.3	0.3
	RCS2W-RA4□-□-30-3-□□□	150	18	6.5	0.2	0.2

Stroke scale (mm): 50, 100, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 700, 800, 900, 1000, 1100, 1200

(Note 1) The figure in each elongated circle indicates the maximum speed for the applicable stroke(s).
(Note 2) The payload capacity is based on operation at the rated acceleration.

Appendix

	Model number	Stroke (mm) and maximum speed (mm/sec) (Note 1) 50 100 150 200 250 300 350 400 450 500 550 600 700 800 900 1000	Payload capacity (Note 2) Horizontal (kg)	Payload capacity (Note 2) Vertical (kg)	Rated acceleration Horizontal (G)	Rated acceleration Vertical (G)
RCS (Slider type)	RCS-SS-□-60-H-□□□	600 / 470	15	4	0.3	0.2
	RCS-SS-□-60-M-□□□	300 / 230	30	8		
	RCS-SM-□-100-H-□□□	1000 / 960 / 765 / 625 / 515	20	4		
	RCS-SM-□-100-M-□□□	500 / 480 / 380 / 310 / 255	40	8		
	RCS-SM-□-150-H-□□□	1000 / 960 / 765 / 625 / 515	30	6		
	RCS-SM-□-150-M-□□□	500 / 480 / 380 / 310 / 255	60	12		
	RCS-SSR-□-60-H-□□□	600 / 470	15	4		
	RCS-SSR-□-60-M-□□□	300 / 230	30	8		
	RCS-SMR-□-100-H-□□□	1000 / 960 / 765 / 625 / 515	20	4		
	RCS-SMR-□-100-M-□□□	500 / 480 / 380 / 310 / 255	40	8		
	RCS-SMR-□-150-H-□□□	1000 / 960 / 765 / 625 / 515	30	6		
	RCS-SMR-□-150-M-□□□	500 / 480 / 380 / 310 / 255	60	12		
RCS (Rod type)	RCS-RA55-□-60-H-□□□	800 / 755	12	2	0.3	0.2
	RCS-RA55-□-60-M-□□□	400 / 377	25	5		
	RCS-RA55-□-60-L-□□□	200 / 188	50	11.5	0.2	
	RCS-RA55-□-100-H-□□□	800 / 755	15	3.5	0.3	
	RCS-RA55-□-100-M-□□□	400 / 377	30	9		
	RCS-RA55-□-100-L-□□□	200 / 188	60	18	0.2	
	RCS-RA55R-□-60-H-□□□	800 / 755	12	2	0.3	
	RCS-RA55R-□-60-M-□□□	400 / 377	25	5		
	RCS-RA55R-□-60-L-□□□	200 / 188	50	11.5	0.2	
	RCS-RB7530-I-60-H-□□□	600 / 505	10	2.5	0.15	0.15
	RCS-RB7530-I-60-M-□□□	300 / 250	20	7	0.1	0.1
	RCS-RB7530-I-60-L-□□□	150 / 125	40	15.5	0.05	0.05
	RCS-RB7530-I-100-H-□□□	600 / 505	15	5.5	0.2	0.2
	RCS-RB7530-I-100-M-□□□	300 / 250	30	12.5	0.1	0.1
	RCS-RB7535-I-100-H-□□□	800	10	3.5	0.25	0.25
	RCS-RB7535-I-100-M-□□□	400	22	9	0.17	0.17
	RCS-RB7535-I-100-L-□□□	200	40	19.5	0.1	0.1
	RCS-RB7535-I-150-H-□□□	800	15	6.5	0.3	0.3
	RCS-RB7535-I-150-M-□□□	400	35	14.5	0.2	0.2
RCS (Flat type)	RCS-F55-□-60-H-□□□	800	–	2	0.3	0.2
	RCS-F55-□-60-M-□□□	400		5		
	RCS-F55-□-60-L-□□□	200		11.5	0.2	
	RCS-F55-□-100-H-□□□	800		3.5	0.3	
	RCS-F55-□-100-M-□□□	400		9		
	RCS-F55-□-100-L-□□□	200		18	0.2	

(Note 1) The figure in each elongated circle indicates the maximum speed for the applicable stroke(s).
(Note 2) The payload capacity is based on operation at the rated acceleration.
(Note 3) RCS-RB75 series actuators cannot be used as axis 5 or 6.

	Model number	Stroke (mm) and maximum speed (mm/sec) (Note 1)	Payload capacity (Note 2) Horizontal (kg)	Payload capacity (Note 2) Vertical (kg)	Rated acceleration Horizontal (G)	Rated acceleration Vertical (G)
		50 · 100 · 150 · 200 · 250 · 300 · 350 · 400 · 450 · 500 · 550 · 600 · 700 · 800 · 900 · 1000				
DS	DS-SA4-□-20-10-□□□	665	4	1	0.3	0.3
	DS-SA4-□-20-5-□□□	330	5	2.5		
	DS-SA4-□-20-2.5-□□□	165	5	4.5	0.2	0.2
	DS-SA5-□-20-12-□□□	800, 760	4	1	0.3	0.3
	DS-SA5-□-20-6-□□□	400, 380	8	2		
	DS-SA5-□-20-3-□□□	200, 190	8	4	0.2	0.2
	DS-SA6-□-30-12-□□□	800, 760, 640, 540	6	1.5	0.3	0.3
	DS-SA6-□-30-6-□□□	400, 380, 320, 270	12	3		
	DS-SA6-□-30-3-□□□	200, 190, 160, 135	12	6	0.2	0.2
	DS-A4-□-20-10-□□□	330	–	2.5	–	0.2
	DS-A4-□-20-5-□□□	165	–	4.5		
	DS-A5-□-20-12-□□□	400	–	2		
	DS-A5-□-20-6-□□□	200	–	4		
	DS-A6-□-30-12-□□□	400	–	3		
	DS-A6-□-30-6-□□□	200	–	6		
		100 · 200 · 300 · 400 · 500 · 600 · 700 · 800 · 900 · 1000 · 1100 · 1200 · 1300 · 1400 · 1500 · 2000				
SS	SS-S-□-60-12-□□□	600, 470	15	4	0.3	0.3
	SS-S-□-60-6-□□□	300, 230	30	8		
	SS-M-□-100-20-□□□	1000, 960, 765, 625, 515	20	4		
	SS-M-□-100-10-□□□	500, 480, 380, 310, 255	40	8		
	SS-M-□-150-20-□□□	1000, 960, 765, 625, 515	30	6		
	SS-M-□-150-10-□□□	500, 480, 380, 310, 255	60	12		
ISA ISPA	ISA(ISPA)-SXM-□-60-16-□□□	800	12	3	0.3	0.3
	ISA(ISPA)-SXM-□-60-8-□□□	400	25	6		
	ISA(ISPA)-SXM-□-60-4-□□□	200	50	14	0.15	0.15
	ISA(ISPA)-SYM-□-60-16-□□□	800	12	3	0.3	0.3
	ISA(ISPA)-SYM-□-60-8-□□□	400	25	6		
	ISA(ISPA)-SYM-□-60-4-□□□	200	50	14	0.15	0.15
	ISA(ISPA)-SZM-□-60-8-□□□	400	–	6	–	0.3
	ISA(ISPA)-SZM-□-60-4-□□□	200	–	14	–	0.15
	ISA(ISPA)-MXM-□-100-20-□□□	1000, 1000, 795, 645, 540	20	5	0.3	0.3
	ISA(ISPA)-MXM-□-100-10-□□□	500, 480, 380, 310, 255	40	9		
	ISA(ISPA)-MXM-□-100-5-□□□	250, 220, 175, 145, 120	80	19	0.15	0.15
	ISA(ISPA)-MXM-□-200-30-□□□	1500, 1500, 1190, 965, 810	25	6	0.3	0.3
	ISA(ISPA)-MXM-□-200-20-□□□	1000, 1000, 795, 645, 540	40	9		
	ISA(ISPA)-MXM-□-200-10-□□□	500, 480, 380, 310, 255	80	19		
	ISA(ISPA)-MXMX-□-200-30-□□□	1500, 1425, 1200, 675	25	–		–
	ISA(ISPA)-MXMX-□-200-20-□□□	1000, 950, 800, 450	40	–		
	ISA(ISPA)-MYM-□-100-20-□□□	1000, 1000, 795, 645, 540	20	5		0.3
	ISA(ISPA)-MYM-□-100-10-□□□	500, 480, 380, 310, 255	40	9		
	ISA(ISPA)-MYM-□-100-5-□□□	250, 220, 175, 145, 120	80	19	0.15	0.15
	ISA(ISPA)-MYM-□-200-30-□□□	1500, 1500, 1190, 965, 810	25	6	0.3	0.3
	ISA(ISPA)-MYM-□-200-20-□□□	1000, 1000, 795, 645, 540	40	9		
	ISA(ISPA)-MYM-□-200-10-□□□	500, 480, 380, 310, 255	80	19		
	ISA(ISPA)-MZM-□-100-10-□□□	500, 480, 380, 310, 255	–	9		
	ISA(ISPA)-MZM-□-100-5-□□□	250, 220, 175, 145, 120	–	19	0.15	0.15
	ISA(ISPA)-MZM-□-200-10-□□□	500, 480, 380, 310, 255	–	19	–	0.3

(Note 1) The figure in each elongated circle indicates the maximum speed for the applicable stroke(s).
(Note 2) The payload capacity is based on operation at the rated acceleration.

<table>
<tr><th rowspan="3"></th><th rowspan="3">Model number</th><th colspan="15">Stroke (mm) and maximum speed (mm/sec) (Note 1)</th><th colspan="2">Payload capacity (Note 2)</th><th colspan="2">Rated acceleration</th></tr>
<tr><th rowspan="2">100~500</th><th rowspan="2">600</th><th rowspan="2">700</th><th rowspan="2">800</th><th rowspan="2">900</th><th rowspan="2">1000</th><th rowspan="2">1100</th><th rowspan="2">1200</th><th rowspan="2">1300</th><th rowspan="2">1400</th><th rowspan="2">1500</th><th rowspan="2">1600</th><th rowspan="2">1700~2000</th><th rowspan="2">2100~2500</th><th rowspan="2">3000</th><th>Horizontal</th><th>Vertical</th><th>Horizontal</th><th>Vertical</th></tr>
<tr><th>(kg)</th><th>(kg)</th><th>(G)</th><th>(G)</th></tr>
<tr><td rowspan="16">ISA
ISPA</td><td>ISA(ISPA)-LXM-□-200-40-□□□</td><td colspan="3">1000</td><td>1000</td><td>830</td><td>690</td><td>585</td><td>500</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>40</td><td>9</td><td rowspan="4">0.3</td><td rowspan="4">0.3</td></tr>
<tr><td>ISA(ISPA)-LXM-□-200-20-□□□</td><td colspan="3">500</td><td>470</td><td>385</td><td>320</td><td>270</td><td>235</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>80</td><td>19</td></tr>
<tr><td>ISA(ISPA)-LXM-□-400-40-□□□</td><td colspan="3">2000</td><td>2000</td><td>1660</td><td>1380</td><td>1170</td><td>1000</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>40</td><td>9</td></tr>
<tr><td>ISA(ISPA)-LXM-□-400-20-□□□</td><td colspan="3">1000</td><td>1000</td><td>830</td><td>690</td><td>585</td><td>500</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>80</td><td>19</td></tr>
<tr><td>ISA(ISPA)-LXMX-□-200-20-□□□</td><td></td><td></td><td></td><td></td><td></td><td colspan="5">1000</td><td>950</td><td>830</td><td>740~540</td><td>490~340</td><td></td><td>40</td><td>–</td><td rowspan="6">0.3</td><td rowspan="6">–</td></tr>
<tr><td>ISA(ISPA)-LXMX-□-400-40-□□□</td><td></td><td></td><td></td><td></td><td></td><td colspan="5">2000</td><td>1900</td><td>1660</td><td>1480~1080</td><td>980~680</td><td></td><td>40</td><td>–</td></tr>
<tr><td>ISA(ISPA)-LXMX-□-400-20-□□□</td><td></td><td></td><td></td><td></td><td></td><td colspan="5">1000</td><td>950</td><td>830</td><td>740~540</td><td>490~340</td><td></td><td>80</td><td>–</td></tr>
<tr><td>ISA(ISPA)-LXUWX-□-200-20-□□□</td><td></td><td></td><td></td><td></td><td></td><td colspan="5">1000</td><td>950</td><td>830</td><td>740~540</td><td>490~340</td><td></td><td>40</td><td>–</td></tr>
<tr><td>ISA(ISPA)-LXUWX-□-400-40-□□□</td><td></td><td></td><td></td><td></td><td></td><td colspan="5">2000</td><td>1900</td><td>1660</td><td>1480~1080</td><td>980~680</td><td></td><td>40</td><td>–</td></tr>
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<tr><td>ISA(ISPA)-LYM-□-200-20-□□□</td><td colspan="3">1000</td><td>1000</td><td>830</td><td>690</td><td>585</td><td>500</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>40</td><td>9</td><td rowspan="6">0.3</td><td rowspan="6">0.3</td></tr>
<tr><td>ISA(ISPA)-LYM-□-200-10-□□□</td><td colspan="3">500</td><td>470</td><td>385</td><td>320</td><td>270</td><td>235</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>80</td><td>19</td></tr>
<tr><td>ISA(ISPA)-LYM-□-400-40-□□□</td><td colspan="3">2000</td><td>2000</td><td>1660</td><td>1300</td><td>1170</td><td>1000</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>40</td><td>9</td></tr>
<tr><td>ISA(ISPA)-LYM-□-400-20-□□□</td><td colspan="3">1000</td><td>1000</td><td>830</td><td>690</td><td>585</td><td>500</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>80</td><td>19</td></tr>
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<tr><td rowspan="9">ISP</td><td>ISP-WXM-□-600-40-□□□</td><td colspan="4">2000</td><td>1670</td><td>1390</td><td>1170</td><td>1000</td><td>865</td><td></td><td></td><td></td><td></td><td></td><td></td><td>60</td><td>14</td><td rowspan="9">0.3</td><td rowspan="5">0.3</td></tr>
<tr><td>ISP-WXM-□-600-20-□□□</td><td colspan="4">1000</td><td>835</td><td>695</td><td>585</td><td>500</td><td>430</td><td></td><td></td><td></td><td></td><td></td><td></td><td>120</td><td>29</td></tr>
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<tr><td>ISP-WXMX-□-600-20-□□□</td><td></td><td></td><td></td><td></td><td colspan="5">1000</td><td>980</td><td>860</td><td>765</td><td>680~500</td><td>455~325</td><td></td><td>120</td><td>–</td></tr>
<tr><td>ISP-WXMX-□-750-40-□□□</td><td></td><td></td><td></td><td></td><td colspan="5">2000</td><td>1965</td><td>1725</td><td>1530</td><td>1365~1005</td><td></td><td></td><td>75</td><td>–</td></tr>
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<tr><td rowspan="14">ISD</td><td>ISD-S-□-60-16-□□□</td><td>800</td><td>760</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>12</td><td>3</td><td rowspan="2">0.3</td><td rowspan="2">0.3</td></tr>
<tr><td>ISD-S-□-60-8-□□□</td><td>400</td><td>380</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>25</td><td>6</td></tr>
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<tr><td>ISD-M-□-100-10-□□□</td><td colspan="2">500</td><td>455</td><td>365</td><td>300</td><td>250</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>40</td><td>9</td></tr>
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<tr><td>ISD-M-□-200-20-□□□</td><td colspan="2">1000</td><td>915</td><td>735</td><td>600</td><td>500</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>40</td><td>9</td><td rowspan="2">0.3</td><td rowspan="2">0.3</td></tr>
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<tr><td>ISD-MX-□-200-20-□□□</td><td></td><td></td><td></td><td colspan="6">1000</td><td>950</td><td>800</td><td>700</td><td></td><td></td><td></td><td>40</td><td>–</td><td>0.3</td><td>–</td></tr>
<tr><td>ISD-L-□-200-20-□□□</td><td colspan="3">1000</td><td>930</td><td>765</td><td>640</td><td>545</td><td>465</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>40</td><td>9</td><td rowspan="3">0.3</td><td rowspan="3">0.3</td></tr>
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<tr><td>ISD-L-□-400-20-□□□</td><td colspan="3">1000</td><td>930</td><td>765</td><td>640</td><td>545</td><td>465</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>80</td><td>19</td></tr>
<tr><td>ISD-LX-□-200-20-□□□</td><td></td><td></td><td></td><td></td><td></td><td colspan="5">1000</td><td>950</td><td>830</td><td></td><td></td><td></td><td>40</td><td>–</td><td rowspan="2">0.3</td><td rowspan="2">–</td></tr>
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<tr><td rowspan="4">IF</td><td>IF-SA□□-□-60-□□□</td><td colspan="13">1750</td><td></td><td></td><td>5</td><td>–</td><td rowspan="4">0.3</td><td rowspan="4">–</td></tr>
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<tr><td>IF-MA□□-□-200-□□□</td><td colspan="14">1750</td><td></td><td>20</td><td>–</td></tr>
<tr><td>IF-MA□□-□-400-□□□</td><td colspan="14">1750</td><td></td><td>40</td><td>–</td></tr>
<tr><td rowspan="12">FS</td><td>FS-11NM-□-60-□□□</td><td colspan="6">1250</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>2</td><td>–</td><td rowspan="12">0.3</td><td rowspan="12">–</td></tr>
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<tr><td>FS-11NM-□-100-□□□</td><td colspan="6">1250</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>3</td><td>–</td></tr>
<tr><td>FS-12NM-□-100-□□□</td><td colspan="6">1250</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>9~15</td><td>–</td></tr>
<tr><td>FS-11WM-□-100-□□□</td><td colspan="14">1250</td><td></td><td>3</td><td>–</td></tr>
<tr><td>FS-12WM-□-100-□□□</td><td colspan="14">1250</td><td></td><td>9~15</td><td>–</td></tr>
<tr><td>FS-11WM-□-200-□□□</td><td colspan="14">1250</td><td></td><td>6</td><td>–</td></tr>
<tr><td>FS-12WM-□-200-□□□</td><td colspan="14">1250</td><td></td><td>18~30</td><td>–</td></tr>
<tr><td>FS-11LM-□-400-□□□</td><td></td><td></td><td></td><td></td><td></td><td colspan="10">1250</td><td>15</td><td>–</td></tr>
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<tr><td>FS-11HM-□-400-□□□</td><td></td><td></td><td></td><td></td><td></td><td colspan="10">2000</td><td>10</td><td>–</td></tr>
<tr><td>FS-12HM-□-400-□□□</td><td></td><td></td><td></td><td></td><td></td><td colspan="10">2000</td><td>20~40</td><td>–</td></tr>
</table>

(Note 1) The figure in each elongated circle indicates the maximum speed for the applicable stroke(s).
(Note 2) The payload capacity is based on operation at the rated acceleration.

	Model number	Stroke (mm)	Payload capacity		Thrust (N)	Maximum speed (mm/sec) (Note 1)	Maximum acceleration (G) (Note 2)
			Horizontal (kg)	Vertical (kg)			
LSA (Linear type)	S6SS	48～1248	3	–	15	2500	3
	S6SM	40～1048	3	–	15	2500	3
	S8SS	60～1620	5	–	25	2500	3
	S8SM	60～1440	5	–	25	2500	3
	S8HS	60～1620	7	–	35	2500	3
	S8HM	60～1380	7	–	35	2500	3
	S10SS	90～2070	15	–	65	2500	3
	S10SM	60～1860	15	–	65	2500	3
	S10HS	90～2070	20	–	80	2500	3
	S10HM	105～1815	20	–	80	2500	3
	H8SS	50～1650	5	–	30	2500	3
	H8SM	130～1430	5	–	30	2500	3
	H8HS	50～1550	8	–	60	2500	3
	H8HM	130～1230	8	–	60	2500	3
	L15SS	150～1650	5	–	30	2500	3
	L15SM	50～1450	5	–	30	2500	3
	M19SS	136～1576	15	–	100	2500	3
	W21SS	1050～4155	60	–	200	2500	3
	W21SM	730～3835	60	–	200	2500	3
	W21HS	895～4000	120	–	400	2500	3
	W21HM	420～3525	120	–	400	2500	3

(Note 1) The maximum speed may not be reached with short stroke models.
(Note 2) The actual value may vary depending on the operating condition.
(Note 3) LSA type actuators cannot be used as axis 5 or 6.

⊙ How to Create a Program

1. Position Table

Position Table

With P/Q/PCT/QCT type XSEL controllers without expanded memory, up to 4000 position points can be registered.
With expanded memory, these controllers let you register up to 20000 positions.
Positions are registered using the PC software or teaching pendant.

(Example of 6-axis System)

No.	Axis1	Axis2	Axis3	Axis4	Axis5	Axis6	Vel	Acc	Dcl
1	0.000	250.000	0.000	0.000	10.000	10.000			
2	0.000	200.000	0.000	30.000	20.000	20.000			
3	10.000	190.000	50.000	40.000					
4	23.000	298.000	40.000	20.000	0.000				
5	50.000	170.000	30.000	10.000					
6									
	⋮	⋮	⋮	⋮	⋮	⋮			
3994									
3995									
3996									
3997									
3998									
3999									
4000									

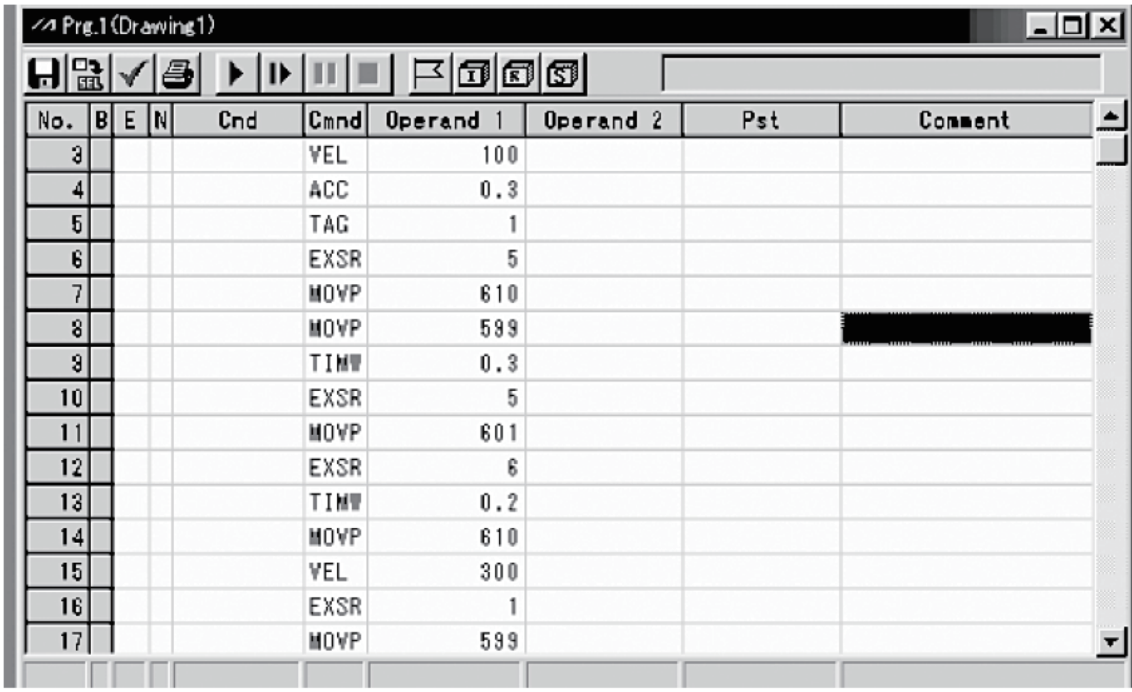
Appendix

- No.: Specify a number, and the actuator will move to the position registered for the specified number in the program.
- Axis1 to Axis3: Enter the target position of each axis for each position number.
- Vel: Set a speed. The speed set in this field takes precedence over the speed specified in the program. In other words, the actuator uses the speed specified here when moving to the position specified for the corresponding position number.
- Acc: Set an acceleration. The acceleration set in this field takes precedence over the acceleration specified in the program or one set by the applicable parameter.
- Dcl: Set a deceleration. The deceleration set in this field takes precedence over the deceleration specified by the program or one set by the applicable parameter.

2. Programming Format

Program Edit Screen (PC Software)

With XSEL controllers without expanded memory, programs consisting of up to 6000 steps can be created. With expanded memory, these controllers let you create programs consisting of up to 9999 steps.
Programs are edited using the PC software or teaching pendant.



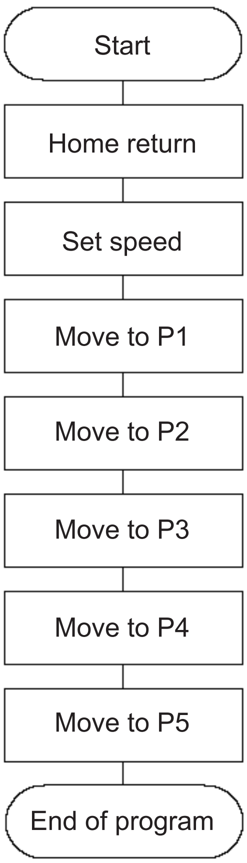
No.: Step number
B: Set a breakpoint (this field becomes editable during online edit).
Click the "B" field in the line where you want to set a breakpoint. Once a breakpoint has been set, "B" is shown in the line.
* Breakpoint --- A breakpoint is set in a step where you want to stop the program temporarily while the program is run from the PC software.
E: Enter a desired extension condition (A, O, LD, AB or OB).
N: Specify "N" to indicate negation of the input condition.
Cnd: Enter an input condition.
Cmnd: Enter a SEL command.
Operand 1: Enter operand 1.
Operand 2: Enter operand 2.
Pst: Enter an output (operand 3).
Comment: Enter a comment, if necessary (using up to 18 single-byte characters).

3. Positioning to Five Positions

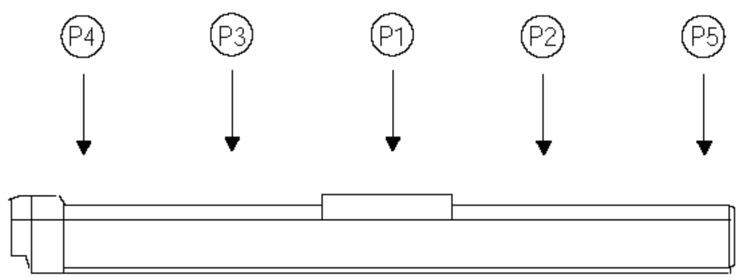
Description

Move the actuator to positions 1 through 5 at a speed of 100 mm/sec after home return.
Use of only 1 axis is assumed.

Flowchart



- Home return must be performed and a speed must be set, before the actuator can be operated.
- The actuator moves to the position data coordinates specified by the respective move commands.
- With the absolute specification, home return (HOME command) is not required.



Application program

No.	B	E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
1					HOME	1			Home Axis 1
2					VEL	100			Set velocity- mm/s
3					MOVL	1			Move to point 1
4					MOVL	2			Move to point 2
5					MOVL	3			Move to point 3
6					MOVL	4			Move to point 4
7					MOVL	5			Move to point 5
8					EXIT				End Program

Position data

No.	Axis1
1	100.000
2	150.000
3	50.000
4	0.000
5	200.000
6	
7	
8	
9	

4. How to Use TAG and GOTO

Description

Use GOTO and TAG commands to repeat the same operation within the program or to jump to a desired step if a condition is satisfied. A TAG command can be written in a step either before or after a GOTO command.

Example of Use 1

Repeat the same operation.

```
:
TAG    1
MOVP   1
MOVP   2
GOTO   1
```

Repeated.

Steps to be repeated (MOVP 1, MOVP 2)

Example of Use 2

Skip steps.

```
:
GOTO   2
MOVP   1
MOVP   2
TAG    2
```

Jump.

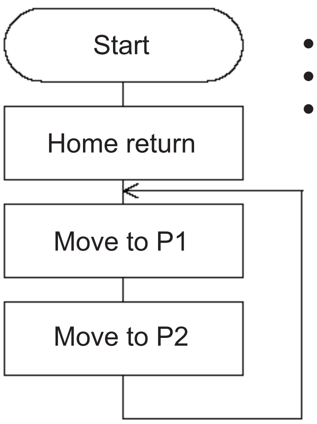
Steps to be ignored (MOVP 1, MOVP 2)

5. Moving Back and Forth between Two Points

Description

Moves back and forth between two points.

Flowchart



- The actuator moves back and forth between P1 and P2 indefinitely.
- Use of only 1 axis is assumed.
- Enter TAG in the first of the steps to be repeated, and enter GOTO in the last of the steps to be repeated.

Application program

No.	B	E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
1					HOME	1			Home Axis 1
2					VEL	100			Set velocity- mm/s
3					TAG	1			Set loop marker 1
4					MOVL	1			Move to point 1
5					MOVL	2			Move to point 2
6					GOTO	1			Loop to TAG 1
7									

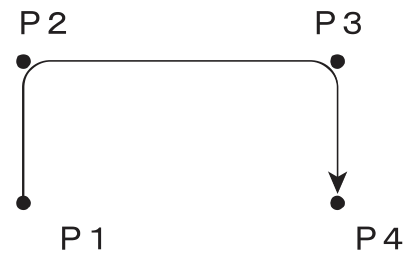
Position data

No.	Axis1
1	100.000
2	150.000
3	
4	
5	
6	

6. Path Operation

Description

Move continuously through four arbitrary points without stopping (PATH movement).



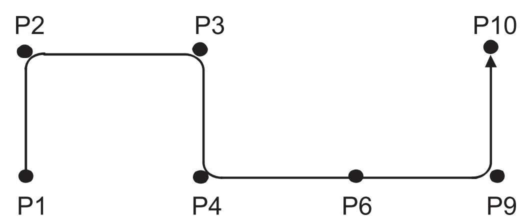
The actuator moves along the path shown at right, without stopping at P2 and P3.
Compared with MOVP and MOVL, this command does not require the actuator to position exactly at P2 and P3, and thus the movement tact time can be reduced.
Assume the following command is executed when the actuator is stopped at P1:
PATH 2 4
The actuator will move from P1 to P4 by passing points near P2 and P3. (The passing points can be brought closer to the specified positions by increasing the acceleration.)

Even if “PATH 2 3” and “PATH 3 4” are input successively, the actuator will still move in the same way as when “PATH 2 4” is input.

If “PATH 4 1” is executed while the actuator is stopped at P4, the actuator will move along the same path in the opposite direction (P4 → P3 → P2 → P1).

The actuator can be moved continuously along a series of continuous positions including one discontinuous position.

PATH	1	4	
PATH	6	6	Discontinuous position
PATH	9	10	



As shown above, specify the position number corresponding to the discontinuous position, or position No. 6 in this case, as both the start position number and end position number of a PATH command. The actuator will move continuously along the path of position Nos. P1 → P2 → P3 → P4 → P6 → P9 → P10.

7. Output Control during Path Movement

Description

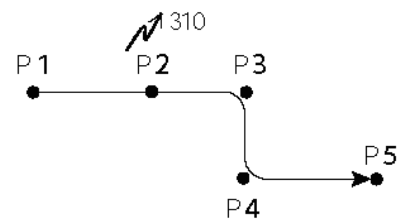
In spray operation, etc., output control may be required while the actuator is moving. The XSEL controller can output signals while the actuator is moving with a PATH command.

How to Use

Before executing a PATH command, declare a POTP command to specify signal output during movement.
If a given output or global flag is specified in the output field of the PATH command, the output or flag specified in the output field will turn ON as the actuator approaches, via path movement, the position specified in the PATH command.

Example of Use 1

The actuator moves from P1 to P5 along the positions shown at right, without stopping. As the actuator approaches P2, output port 310 turns ON.



Cmnd	Operand 1	Operand 2	Pst
VEL	100		
POTP	1		
PATH	1	1	
PATH	2	2	310
PATH	3	5	

← A declaration command to specify signal output during path movement. (POTP)
← 310 turns ON when the actuator approaches P2 specified in this step. (PATH 2 2 310)

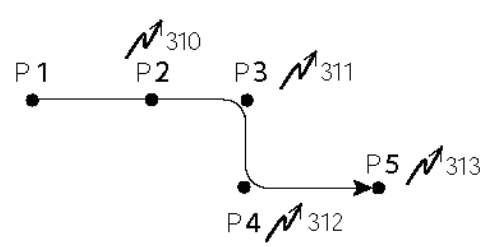
Outputs and flags can only be turned ON. The output or flag that was turned ON during path operation must be turned OFF (using a BTOF command) after the operation is completed.

Example of Use 2

Outputs 310 to 313 can be turned ON sequentially at the respective points of P2 to P5.

Cmnd	Operand 1	Operand 2	Pst
VEL	100		
POTP	1		
PATH	1	1	
PATH	2	5	310

← A declaration command to specify signal output during path movement. (POTP)
← 310 to 313 turn ON sequentially at P2 to P5 specified in this step. (PATH 2 5 310)



8. Circle/Arc Operation

Description

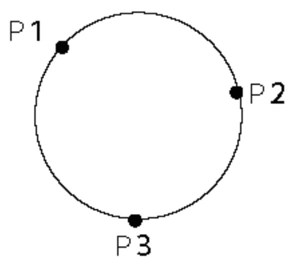
The actuator moves along a two-dimensional circle or arc.

How to Use

To specify a circle, specify three points the actuator will pass. To specify an arc, specify the starting point, passing point and end point.

Example of Use 1

Circle



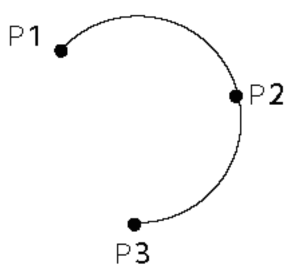
- Specify "CIR2 2 3" after the actuator has moved to P1.
- If "CIR2 2 3" is specified in the figure shown at left, the actuator will move along this circle clockwise.

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst
			VEL	100		
			MOVP	1		
			CIR2	2	3	

- To cause the actuator to move counterclockwise, specify "CIR2 3 2."

Example of Use 2

Arc



- Specify "ARC2 2 3" after the actuator has moved to P1.

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst
			VEL	100		
			MOVP	1		
			ARC2	2	3	

Reference

Circle and arc commands can be executed not only two-dimensionally (between two actuator axes) but also three-dimensionally (among three actuator axes).

CIRS: Three-dimensional circle movement
ARCS: Three-dimensional arc movement

Appendix

Appendix

9. Output of Home Return and Home Return Complete Signal

Description

Output a signal to confirm completion of home return (incremental specification or quasi-absolute specification). With the XSEL controller, a home return completion signal can be output using an I/O parameter. However, the following explains how to output a home return completion signal within a program using a general-purpose output.
Once turned ON, a general-purpose output will remain ON even after the current program ends or other program is started. (It will turn OFF upon emergency stop, etc., but the ON status can be maintained using an I/O parameter (I/O parameter Nos. 70 and 71).)

Example of Use

a. Output a home return completion signal.

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	
			HOME	11			Execute home return.
			BTON	303			General-purpose output (arbitrary)

b. Use a home return completion signal to make sure the actuator will not perform home return if it has already been performed.

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	
	N	303	HOME	11			Execute home return if output 303 is OFF.
			BTON	303			Home return completion output

c. Use the output field instead of a BTON command.

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	
	N	303	HOME	11		303	Execute the same processing performed with the above two steps.

Reference

Output port No. 304 can be used as a home return completion output (dedicated output) by setting I/O parameter No. 50 to “2.”

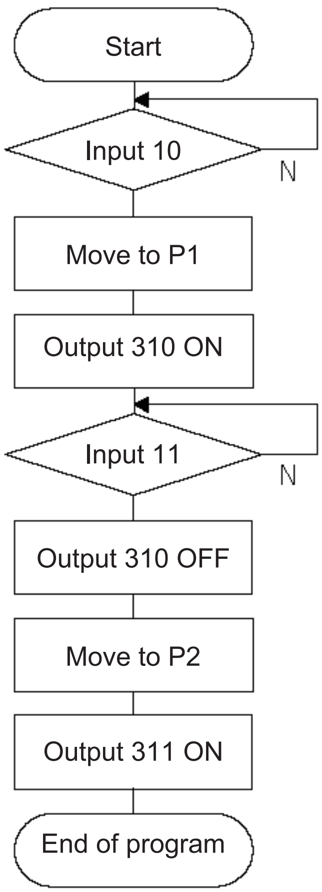
> ⚠ Caution: Take note that if you are using the linear servo actuator LSAS-N10/N15 of quasi-absolute type, after completing a home return operation following power on the actuator moves in a range of approx. 16 mm from the stopped position to confirm the current position.

10. Axis Movement by Input Waiting and Completion Output

Description

How to perform input waiting and output a processing completion signal is explained.

Flowchart



Example of Use

The actuator waits until input port 10 turns ON, and then moves to P1.
The actuator waits until input port 11 turns ON, and then moves to P2.
A movement completion signal is output from 310 upon reaching P1, and from 311 upon reaching P2.

Application program

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
			VEL	100			Set velocity- mm/s
			WTON	10			Wait on input 10
			MOVP	1			Move to point 1
			BTON	310			Turn ON output 310
			WTON	11			Wait on input 11
			BTOF	310			Turn OFF outpt 310
			MOVP	2			Move to point 2
			BTON	311			Turn ON output 310
			EXIT				End Program

11. Changing the Moving Speed

Description

Change the moving speed.

How to Use

With the XSEL controller, the speed can be set using the following two methods:
a: Use a VEL command within the application program
b: Use a speed setting in the position data table

Example of Use

Application program

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst
			MOVP	1		
			VEL	1000		
			MOVP	2		
			MOVP	3		
			VEL	50		
			MOVP	4		

Position data

No.	Axis1	Vel	Acc	Dcl
1	100.000	100		
2	200.000	500		
3	300.000			
4	400.000			

Moving speeds in the above program

Position at 100 mm --- The actuator moves at 100 mm/sec.
Position at 200 mm --- The actuator moves at 500 mm/sec.
Position at 300 mm --- The actuator moves at 1000 mm/sec.
Position at 400 mm --- The actuator moves at 50 mm/sec.

If a speed is specified in the position data table, this speed takes precedence over the speed specified in the application program, as shown above. In general, speeds are set in the application program using VEL.

Vel in Point Data Table and PATH Command

The speed can be changed without stopping the actuator, by using a PATH command and Vel in the position data table. (Refer to the next page.)

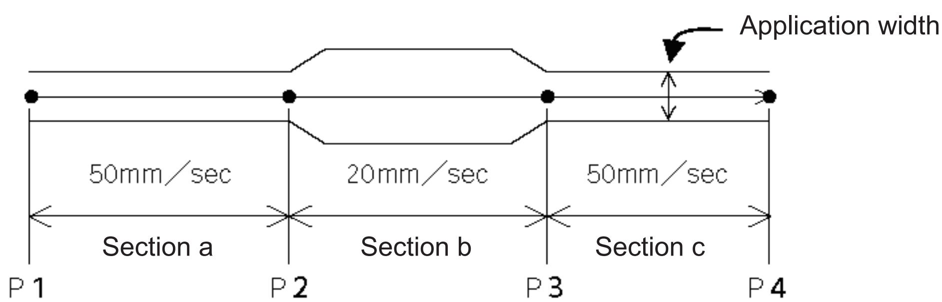
12. Changing the Speed during Operation

Description

Use a PATH command to change the speed while the actuator is moving.
For example, this command is useful in a paint dispensing application where the application volume changes in the middle.

Example of Use

The actuator moves through linear sections a, b and c at 50 mm/sec, 20 mm/sec and 50 mm/sec, respectively, without stopping (PATH movement).



Position data

No.	Axis1	Vel	Acc	Dcl
1	0.000	50		
2	100.000	50		
3	200.000	20		
4	300.000	50		

Application program

“PATH 1 4” is the only movement command required.

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst
			PATH	1	4	

Reference

The speed can also be changed from other program using a CHVL (speed change) command (in the multi-tasking mode).

13. Local/Global Variables and Flags

Description

The internal variables and flags used in the SEL language are classified into local and global types.
The data range used commonly by all programs is called the global range, while the data range used only by each program is called the local range. When multi-tasking programs are run simultaneously, the global range must be used to synchronize the programs and allow cross-referencing of variables among the programs.

Example of Use

Program handshake

Program A

Cmnd	Operand 1
MOVL	1
BTON	600
WTON	601
MOVL	3

Program B

Cmnd	Operand 1
WTON	600
MOVL	2
BTON	601

Use of global flags with the above two programs permits handshake between the programs, and the actuator moves per “MOVL 1” in program A, moves per “MOVL 2” in program B, and then move per “MOVL 3” in program A, for example.

Backup in Battery

The XSEL controller has a built-in battery for retaining variables and flags used in the programs. For both variables and flags, only those in the global range will be retained after the controller power is turned off. The variables and flags in the local range are cleared when the program is started (the variables are reset to “0,” while the flags turn OFF).

14. How to Use Subroutines

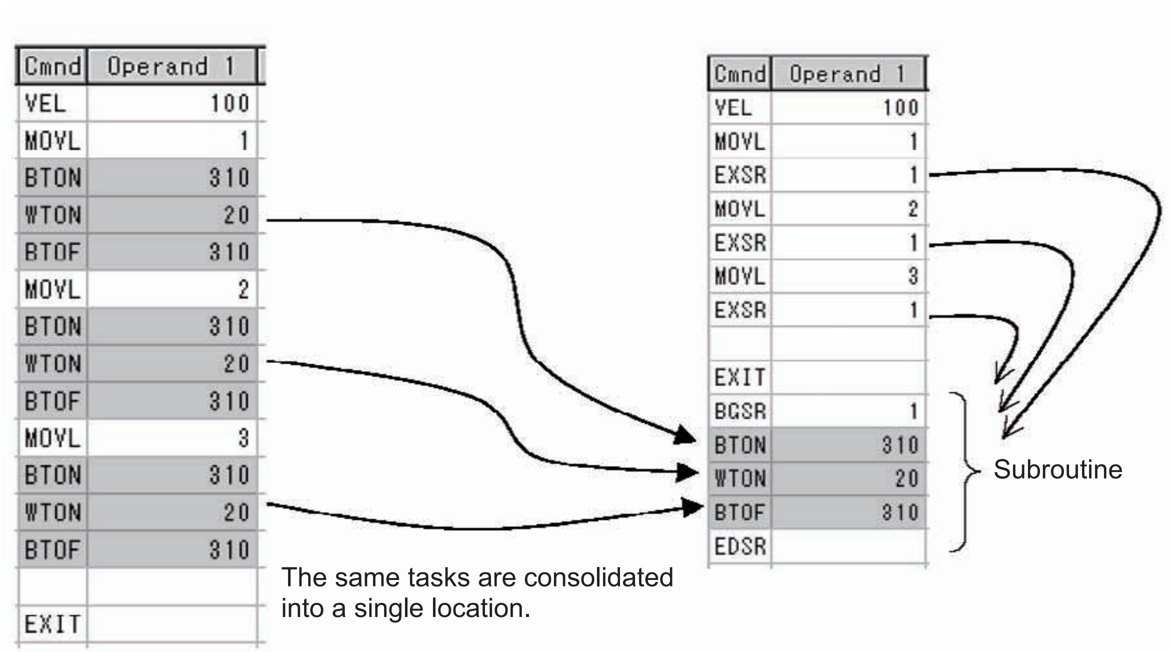
Description

A subroutine is a group of steps that are called and executed several times within a program. Subroutines are used to reduce the number of program steps and make the program easy to read. Up to 99 subroutines can be used in one program. Up to 15 subroutine calls can be nested.

How to Use

Declare/call subroutines using the following commands:
EXSR: Call a subroutine
BGSR: Declare the start of a subroutine (start of a group of steps)
EDSR: Declare the end of a subroutine (end of a group of steps)

Example of Use



Caution

Jumping from within a subroutine to a TAG position outside the subroutine using a GOTO command is prohibited.

15. Pausing the Operation

Description

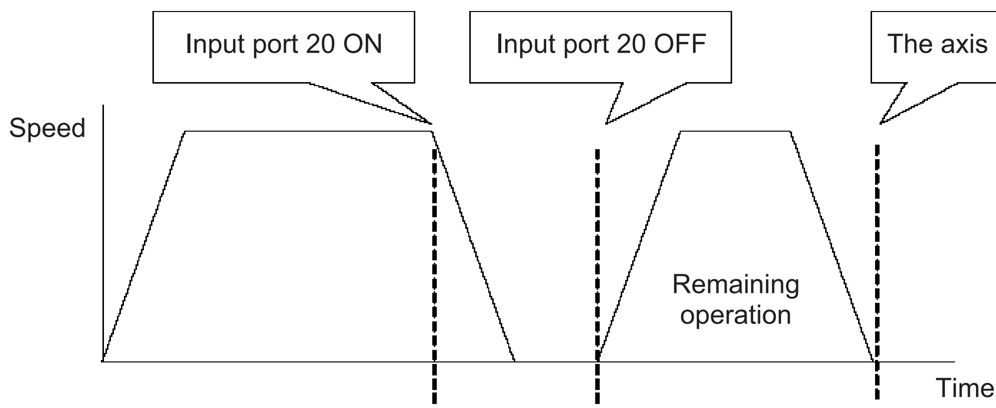
Use a declaration command HOLD to pause the moving axis temporarily via external input.

How to Use

A pause interruption operation can be executed to a moving axis (to decelerate the axis to a stop) by declaring a HOLD command within the program.
While HOLD is input, the actuator pauses (decelerates to a stop, if currently moving) against all moving commands in the same program.

Example of Use

HOLD 20 A declaration to execute pause if general-purpose input 20 turns ON.



Application

You can specify a global flag, instead of an input port, in Operand 1 of the HOLD command.
Use of a global flag allows the actuator to be paused from other program.
The input signal pattern and stop action can be selected using Operand 2.

0 = Contact a (Decelerates to a stop) ⇒ Same as when Operand 2 is not specified.
1 = Contact b (Decelerates to a stop)
2 = Contact b (Decelerates to a stop, and then servo OFF ⇒ The drive power is not cut off.)

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
			HOLD	20	2		SVOF when input 20

Caution

If the actuator is paused during home return, it will start the home return sequence from the beginning upon restart.

16. Canceling the Operation 1 (CANC)

Description

Use a declaration command CANC to decelerate the moving axis to a stop and cancel the remaining operation.

How to Use

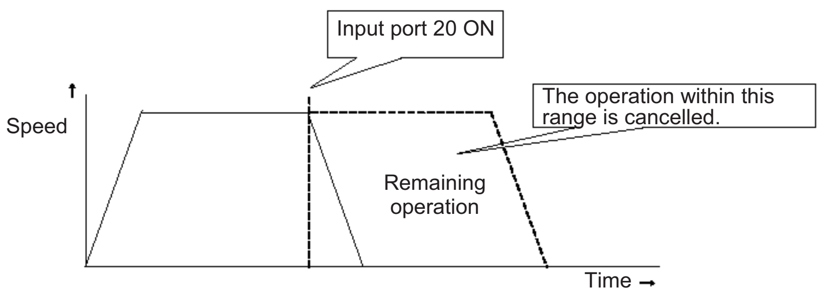
While CAN is input, all movement commands in the same program are cancelled.

Example of Use

CANC command

```
CANC    20          Cancel the movement commands if input port 20 turns ON (declaration).
     :
MOVP     1
MOVP     2
     :
WTON    21
     :
```

* Declare this command in a step before the movement commands you want to cancel.
* While CANC is input, all operation commands are cancelled sequentially, while tasks other than operation commands (such as I/O processing and calculation processing) are executed sequentially.



Caution

Since execution of this command makes it no longer possible to specify which program step is currently executed, it is recommended that a WTON command be used to create an input wait step.

Application

A desired input signal pattern can be selected for a CANC command using Operand 2.

0 = Contact a (Decelerates to a stop) ⇒ Same as when Operand 2 is not specified.
1 = Contact b (Decelerates to a stop)

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
			CANC	20	1		Halt when input 20

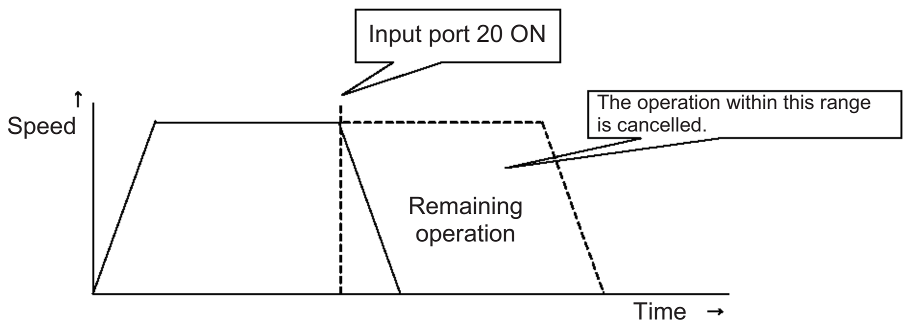
17. Canceling the Operation 2 (STOP)

Description

Decelerate the moving axis to a stop and cancel the remaining operation. (STOP)

How to Use

Execute a STOP command from other program to forcibly stop the operation (in the multi-tasking mode). Specify the axis you want to stop using an axis pattern.



Example of Use 1

STOP command
Main program

```
EXPG   n     The stop program starts.
  :
MOVL   1
MOVL   2
  :
```

Stop control program

```
WTON   20    Wait for stop input.
STOP   11    Axes 1 and 2 stop.
```

If “STOP 11” is executed while “MOVL 1” is being executed, “MOVL 1” will be cancelled and the actuator will continue its operation from “MOVL 2.”

Example of Use 2

Main program

```
EXPG   n     The stop program starts.
  :
MOVP   1
MOVP   2
  :
```

Stop control program

```
WTON   20    Wait for stop input.
STOP   10    Axis 2 stops.
```

If “STOP 10” is executed while “MOVL 1” is being executed, only the axis 2 part of “MOVL 1” will be cancelled. Both axes 1 and 2 will operate under “MOVL 2.”

Caution

If a STOP command is executed during a CP operation (interpolation operation) initiated by MOVL, etc., the operations of all axes will be cancelled regardless of the axis pattern specified in the STOP command.

18. Movement by Position Number Specification

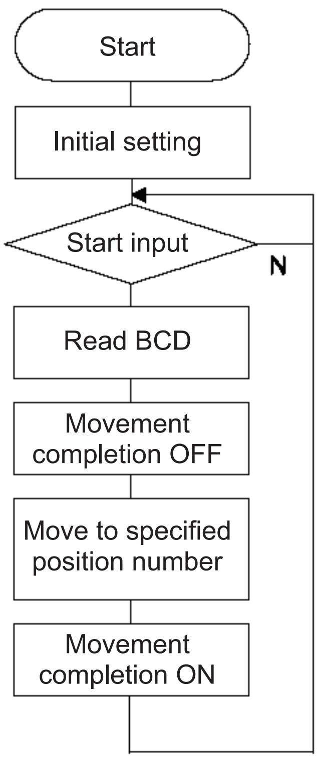
Description

Load externally input BCD codes as position numbers to execute movements.

Example of Use

Use an INB command to load a position number as a BCD code from an input port.
A position number can be specified using a value consisting of up to three digits.

Flowchart



Input assignment

Port	Description
1	Start input
15	Position specification 1
16	Position specification 2
17	Position specification 4
18	Position specification 8
19	Position specification 10
20	Position specification 20
21	Position specification 40
22	Position specification 80
23	Position specification 100
24	Position specification 200
25	Position specification 400
26	Position specification 800

Output

303 Movement completion

Application program

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
			HOME	11			Home axis 1 & 2
			VEL	100			Set velocity- mm/s
			TAG	1			Set loop marker 1
			WTON	1			Wait on start inpt
			INB	15	3		Read position #
			BTOF	303			Mov cmplt sgnl OFF
			MOVL	*99			Move to position
			BTON	303			Move cmplt sgnl ON
			GOTO	1			Jump to marker 1 ^

19. Movement by External Position Data Input

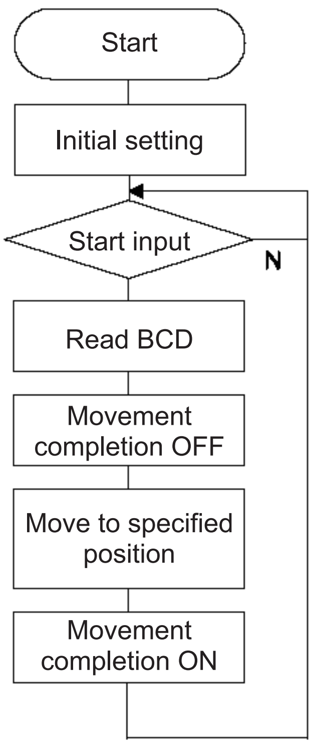
Description

Receive target position data as absolute values from a host device to execute movements.

Example of Use

Use an INB command to load position data as a BCD code from an input port.
Each BCD value should consist of four digits, with the last digit indicating a decimal place.
The moving axis is axis 1.
Example: If a BCD of "1234" is received, the axis will move to the position at 123.4 mm.

Flowchart



Input assignment

Port	Description
1	Start input
15	0.1mm
16	0.2mm
17	0.4mm
18	0.8mm
19	1mm
20	2mm
21	4mm
22	8mm
23	10mm
24	20mm
25	40mm
26	80mm
27	100mm
28	200mm
29	400mm
30	800mm

Output

303 Movement completion

Application program

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
			HOME	11			Home axis 1 & 2
			VEL	100			Set velocity- mm/s
			TAG	1			Set loop marker 1
			WTON	1			Wait on start inpt
			INB	15	4		Read position #
			LET	199	*99		Indirect refernce
			DIV	199	10		Div by 10 resolutn
			PPUT	1	1000		Put 1K for axis 1
			BTOF	303			Mov cmplt sigl OFF
			MOVL	1000			Move to entry pos.
			BTON	303			Mov cmplt signl ON
			GOTO	1			Jump to marker 1 ^

20. Outputting Coordinates

Description

Read the current actuator coordinate in real time and output the reading from an output port as BCD data.

Example of Use

Use a PRDQ command to load the current coordinate position of axis 1.
The current coordinate data of axis 1 is output as BCD data at 0.2-second intervals.
The output range is 0.00 to 999.99 mm.

BCD output assignment

Output port No.	Description	Output port No.	Description
324	0.01	336	10
325	0.02	337	20
326	0.04	338	40
327	0.08	339	80
328	0.1	340	100
329	0.2	341	200
330	0.4	342	400
331	0.8	343	800
332	1		
333	2		
334	4		
335	8		

Unit: mm

Application program

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
			TAG	1			Loop marker 1
			PRDQ	1	101		Place data in 101
			MULT	101	100		Round to thousanth
			LET	99	*101		Copy indirect valu
			OUTB	324	5		Output 5 digts BCD
			TIMW	0.2			Time wait (secs)
			GOTO	1			Loop to marker 1 ^

* With a PRDQ command, the current position coordinate is written to variable 101.
Since the coordinate is read by the variable in the “XXX.XXX” format, the unused digits are moved to decimal place to enable BCD output.
In the above example, the third and subsequent decimal places are not required, so the read value is multiplied by 100 to obtain data in the “XXXXX.X” format.
Next, this value is copied to variable 99 used exclusively for BCD output.
During this conversion, the decimal place is rounded off.
Then, the copied value is output to an external device using an OUTB command.
This program is used as a subprogram in the multi-tasking mode.

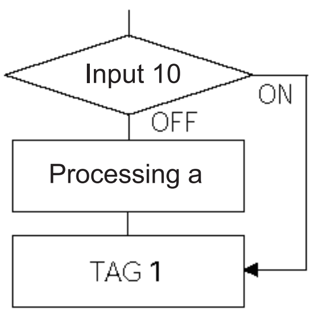
21. Conditional Jump

Description

Select the destination to jump to via GOTO using the external input, output and/or internal flag statuses as a condition.
The controller waits for multiple inputs, and performs processing according to the received input(s).

Example of Use 1

If input 10 turns ON, the actuator will jump to TAG 1. If it turns OFF, the actuator will proceed to the next processing.



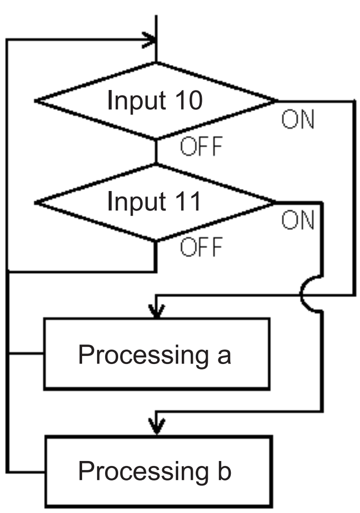
E	N	Cnd	Cmnd	Operand 1
		10	GOTO	1
Processing a				
			TAG	1
Processing b				

Execute GOTO 1 if input 10 turns ON.

* If input 10 turns ON, the actuator will skip processing a and perform processing b.
If input 10 turns OFF, the actuator will perform processing a, and then perform processing b.

Example of Use 2

The controller waits for an input signal to be received at input port 10 or 11. If an input signal is received at input 10, the actuator will perform processing a. If an input signal is received at input 11, it will perform processing b.



E	N	Cnd	Cmnd	Operand 1
			TAG	1
		10	GOTO	2
		11	GOTO	3
			GOTO	1
			TAG	2
Processing a				
			GOTO	1
			TAG	3
Processing b				
			GOTO	1

No input.
Input 10 turns ON.
Input 11 turns ON.

If both inputs 10 and 11 turn ON, the actuator will perform processing a.

22. Waiting Multiple Inputs

Description

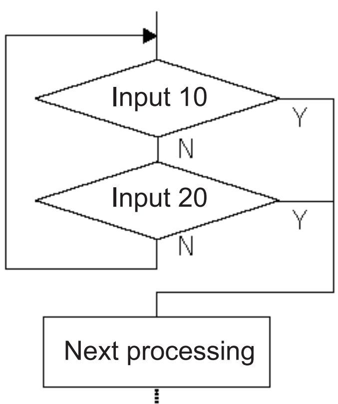
The controller waits for multiple different inputs and performs processing upon reception of any of these inputs.

Point

A WTON command permits processing only when the specified input is received. The controller cannot wait for multiple inputs.

Example of Use

Inputs 10 and 20 are monitored, and the actuator will proceed to the next step when either input is received (OR logic).



Program a

E	N	Cnd	Cmnd	Operand 1
			TAG	1
		10		
O		20	GOTO	2
			GOTO	1
			TAG	2

Next processing

Program b

E	N	Cnd	Cmnd	Operand 1
			TAG	1
	N	10		
A	N	20	GOTO	1

Next processing

* Both programs a and b perform the same processing.

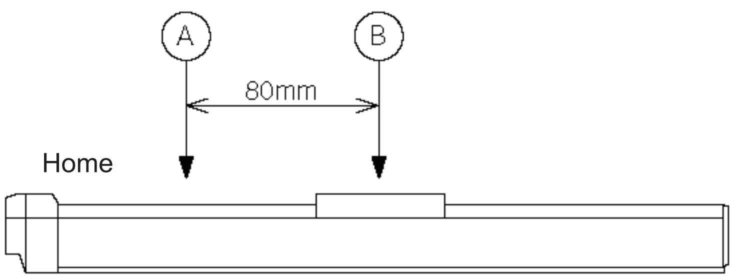
As shown in the sample, the controller waits for input without using a WTON command.
This method can also be used when multiple input conditions must be combined.

23. How to Use Offset

Description

With an OFST command, an offset can be specified for position data when you want to shift (offset) all teaching points by several millimeters because the actuator was not installed exactly in the specified position or for other reasons.
An OFST command can also be used to perform pitch feed. (Refer to 25, "Constant-pitch Feed.")

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
			VEL	100			Set velocity- mm/s
			MOVP	1			Move to point 1
			OFST	1	80		Offset axis 1 80mm
			MOVP	1			Move to point 1



Caution

Once an offset has been set, the offset applies to all movement commands executed thereafter. To cancel the offset, execute an offset command again by specifying "0" mm. An offset does not apply to other programs (even in the multi-tasking mode). If a given offset must be applied to all programs, it must be set for all programs individually.

24. Executing an Operation N times

Description

Execute a specific operation n times.

Example of Use

The actuator moves back and forth between P1 and P2 ten times, and then the program ends.
Use a CPEQ command to compare the number of times the movement has been actually repeated, against 10.
It is assumed that home return has been completed.

Application program

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
			VEL	100			Set velocity- mm/s
			LET	1	0		Initlz counter 1
			TAG	1			Set loop marker 1
			MOVP	1			Move to point 1
			MOVP	2			Move to point 2
			ADD	1	1		Incrmt cntr by 1
			CPEQ	1	10	900	Repeat 10 times
	N	900	GOTO	1			Loop if not done
			EXIT				Else end program

Reference

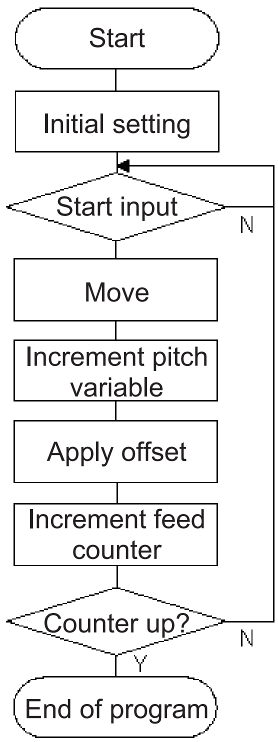
The same operation can also be performed using a DWEQ command.

25. Constant-pitch Feed

Description

Feed the actuator by a specified pitch n times from a reference point.
The pitch and number of repetitions are specified by variables in advance.

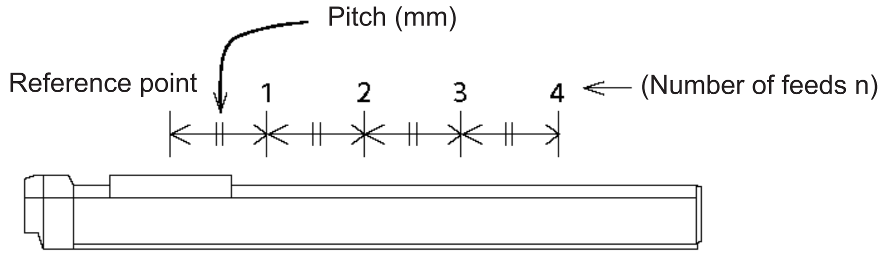
Flowchart



Example of Use

Use an OFST command to perform pitch feed.
The number of times the actuator has been fed is counted by a counter variable.
The X-axis is fed in the positive direction.

Point
An OFST command applies to movement commands.
Executing an OFST command alone does not move the axis.



Application program

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
			LET	1	4		Variable feed #= 4
			LET	100	80		Var. pitch = 80mm
			LET	2	0		Clear counter 2
			LET	101	0		Initializ var. 101
			HOME	1			Home axis 1
			VEL	100			Set velocity- mm/s
			TAG	1			Set loop marker 1
			WTON	1			Wait on start inpt
			MOVP	1			Move to point 1
			ADD	101	*100		Add pitch to offst
			OFST	1	*101		Process x offset
			ADD	2	1		Add 1 to counter 2
			CPGT	2	*1	900	Confirm feed cmplt
	N	900	GOTO	1			Repeat if needed
			EXIT				End Program

Reference

Pitch feed can also be performed using a MVPI or MVLI command.

26. Jogging

Description

The slider moves forward or backward while an input is ON or OFF.
Instead of an input, an output or global flag can be used as a cue.
The slider will move directly to the next step if the specified input does not satisfy the condition when the command is executed.
Regardless of the input status, the slider will stop upon reaching the soft limit, and the command in the next step will be executed.

How to Use

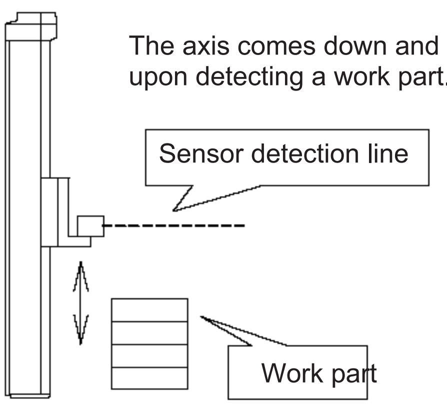
- Explanation of commands

JFWN	1	20	Axis 1 moves forward while input 20 is ON.
JFWF	1	21	Axis 1 moves forward while input 21 is OFF.
JBWN	10	22	Axis 2 moves backward while input 22 is ON.
JBWF	10	23	Axis 2 moves backward while input 23 is OFF.

Example of Use 1

- Stop the axis when a sensor input is received.

The axis comes down and stops upon detecting a work part.



:

VEL	50		Specify a low speed.
JFWF	1	20	Move until a sensor input (20) is received.
EXIT			The program ends.

Example of Use 2

- Cause the actuator to jog just like in teaching pendant operation (2 axes are operated).

Application program

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst
			TAG	1		
			JFWN	1	20	
			JBWN	1	21	
			JFWN	10	22	
			JBWN	10	23	
	N	24	GOTO	1		
			EXIT			

Reference

HOLD, STOP and CANC commands remain valid while the actuators are jogging.

27. Switching Programs

Description

Use EXPG/ABPG commands to switch programs using a program.

Example of Use 1

Start program 2 once the processing of program 1 is completed, and then end program 1.

Program 1	Program 2
:	:
EXPG 2	:
EXIT	

Example of Use 2

Start a program via an external signal, and then end the other program.

Program 1	Program 2
ABPG 2	ABPG 1
:	:

If program 2 is started while program 1 is running, program 1 will be aborted.
If program 1 is started while program 2 is running, program 2 will be aborted.

Application

If a program number is specified in operand 2, the programs from the one corresponding to the program number in operand 1 to the other corresponding to the program number in operand 2 can be started (EXPG) or ended (ABPG) simultaneously.

Caution

- The XSEL controller supports multi-tasking. Up to 16 programs can be run at the same time. To use other programs when the controller is already running 16 programs, switch programs by closing a program or programs that are not required.
- If an ABPG command was executed to end a program while the program was executing a movement command, the actuator immediately decelerates to a stop.

28. Aborting a Program

Description

Abort a program currently running.
Execute an ABPG command (command to abort other program) from other program in the multi-tasking mode.

Caution

* If the target program was executing a movement command, the actuator immediately decelerates to a stop and the program ends.

Example of Use

Main program (Prg. 1)

```
EXPG    n     The abort control program starts.
WTON    10
MOVP    1
BTON    303
    :
    :
```

Abort control program (Prg. n)

```
WTON    20    Wait for an abort input.
ABPG    1     Prg. 1 is aborted.
EXIT          The program ends.
```

* If ABPG was executed while the actuator was moving via a MOVP command, the actuator immediately decelerates to a stop and the program ends.

⦿ Battery Backup Function

The XSEL controller uses the following two batteries.

- System-memory backup battery
  A coin-type battery is used to back up the position data, SEL program variables, etc., in the controller. Each controller is shipped with the system-memory backup battery.

- Absolute-data backup battery
  A separate battery is used to retain the absolute encoder's rotation data, so that the motor rotation data can be retained/refreshed when the controller power is cut off. A controller specified with an absolute-type actuator is shipped with the absolute-data backup battery.

Each battery is explained in details.

1. System-Memory Backup Battery

A coin-type battery with holder is installed in the panel on the front side of the controller, in order to retain the various data stored in the system memory (SRAM) of the XSEL controller even when the power is cut off, thus effectively implementing a system memory backup.

The data backed up in the system memory (SRAM) includes SEL global data, position data, coordinate definition data and content of the user-data backup memory in the controller with expanded memory (with gateway function). This data will be retained even after the power is cut off.
Take note that position data and content of the user-data backup memory are also stored in the flash ROM. Accordingly, no battery is required if operation is always resumed using the data in the flash ROM after the power has been cut off or a software reset has been performed (in which case the value set in other parameter No. 20 must be changed to "0" (no backup memory)).

Note: On a controller with expanded memory (with gateway function), only position data from Nos. 1 to 10000 will be backed up. To also back up position data of No. 10001 onward, write the data to the flash ROM before the power is cut off.

The system-memory backup battery is a coin-type battery (model number CR2032). Since the retention characteristics of this battery will vary significantly depending on the storage temperature and operating environment, due caution must be exercised when handling the battery.
Although this coin-type battery is readily available in supermarkets, convenience stores, etc., batteries by other manufacturers may offer different retention characteristics. To maintain consistency, use a battery by the same manufacturer whenever possible.

<Backup Time>
The recommended replacement interval for the system-memory backup battery is one and a half years. This may be a little misleading. It means that if the battery is left at ambient temperature of 40°C, it will retain the stored data for one and a half years. In normal operating conditions, the battery can retain data for a longer period.
As a guide, the battery will last for around three years if the controller is used at ambient temperature of 40°C with the controller powered up 50% of the time.

<Battery Replacement>
To replace the system-memory backup battery, open the panel window on the front side of the controller and replace the coin-type battery in the battery holder.
It is recommended that the battery be replaced regularly in accordance with the power-on frequency/duration of the controller.
The battery must be replaced as soon as the controller's battery voltage monitor function generates a battery voltage low alarm.
After an alarm is detected, a battery error will occur in approx. 10 days at ambient temperature of 20°C if the power is supplied to the controller continuously. Once a battery error occurs, the data will be physically lost in approx. four days.
If the controller is not operated, the above periods should be reduced to 80% at 20°C or to 25% at 40°C.
The controller is designed so that the data will not be lost for at least 30 minutes without a battery if the controller is not detecting a battery error. Keep in mind to complete the battery replacement—taking out the current battery from the battery holder and placing a new battery in the holder—within 30 minutes.
To prevent the risk of data loss, you can use the PC software to evacuate the data in the SRAM to the flash ROM and then reload the flash ROM data to the SRAM after a new battery is installed.

The battery specifications are shown in the table below.

List of System-Memory Backup Battery Functions

Battery type	CR2032 (Note)	
Battery voltage	3 V	
Current capacity	220 mAH	
Switching voltage at momentary power failure	(Typical) 2.81 V (2.7 V ~ 2.93 V)	System reset detection voltage
Power-source voltage drop at backup	(Typical) 0.3 V	
Detection voltage for battery voltage low alarm	(Typical) 2.65 V ± 5%	
Detection voltage for battery voltage low error	(Typical) 2.37 V ± 5%	
Time after alarm detection until error detection (reference)	10 days at 20°C based on continuous operation; 8 days if the power is not supplied. 10 days at 40°C based on continuous operation; 2.5 days if the power is not supplied.	
Minimum data retention voltage	Min. 2.0 V (Varies depending on the SRAM characteristics.)	
Time after error detection until data loss (reference)	4 days at 20°C based on continuous operation; 3 days if the power is not supplied. 4 days at 40°C based on continuous operation; 1 day if the power is not supplied.	
Data protection time during battery replacement	30 minutes (Maximum retention time when no battery is installed in the battery holder)	Data is retained by the super capacitor inside the controller.
Guide on when to replace battery	Temperature 40°C, power ON time 0%	1.5 years
	Temperature 40°C, power ON time 50%	3 years

(Note) "CR2032" is the standard name, and any conforming battery by any manufacturer can be used.

Appendix

2. Absolute-Data Backup Battery

If the XSEL controller is to drive an absolute-type actuator, an absolute-data backup battery must be installed in the controller.
An absolute encoder is designed to retain rotation data and detect rotations using the power supplied from the absolute-data backup battery, even when the controller's control power is not supplied, thus allowing the controller to resume positioning control immediately after the controller power is restored, without performing home return.

<Backup Time>
The recommended replacement interval for the absolute-data backup battery is two years. This may be a little misleading. It means that if the battery is left at ambeinet temperature of 40°C, it will retain the stored data for two years. In normal operating conditions, the battery can retain data for a longer period.
As a guide, the battery will last for around four years if the controller is used at ambient temperature of 40°C with the controller powered up 50% of the time.

<Battery Replacement>
To replace the absolute-data backup battery, open the panel on the front side of the absolute brake unit in the controller and replace the battery in the battery holder.
It is recommended that the battery be replaced regularly in accordance with the power-on frequency/duration of the controller.
The battery must be replaced as soon as the controller's battery voltage monitor function generates a battery voltage low alarm.
After an alarm is detected, a battery error will occur in approx. 10 days at ambient temperature of 20°C if the power is supplied to the controller continuously. Once a battery error occurs, operations can no longer be performed unless the battery is replaced and an absolute encoder reset is performed.
If the controller is not operated, the above periods should be reduced to 70% at 20°C or to 60% at 40°C.
The controller is designed so that the data will not be lost for at least 15 minutes without a battery if the controller is not detecting a battery error. Keep in mind to complete the battery replacement—taking out the current battery from the battery holder and placing a new battery in the holder—within 15 minutes.
To prevent the risk of data loss, you can use the PC software to evacuate the data in the SRAM to the flash ROM and then reload the flash ROM data to the SRAM after a new battery is installed.

The absolute-data backup battery is replaced differently depending on whether a battery error has generated or not. If an error has not been detected, all you need is to replace the battery and the absolute encoder need not be reset. If an error has been detected, an absolute encoder reset will be required.

The XSEL controller provides an enable switch for absolute-data backup battery for each controller axis. When replacing any absolute-data backup battery following a battery error, turn the absolute-data backup battery enable/disable switch of the target axis to OFF (the controller power should be turned off during the replacement). Once a new battery has been installed, turn on the controller power, and then reset the absolute-data backup battery enable/disable switch to the ENB (enable) position. If this order (turn on the controller power → enable the switch) is not followed, the absolute-encoder data will not be backed up properly and the absolute-data backup battery will consume abnormally large amounts of power. In the worst condition, the battery voltage may drop to zero in several weeks.

The battery specifications are shown in the table below.

List of Absolute-Data Backup Battery Functions

Battery type	AB-5 (by IAI)	
Battery voltage	3.6 V	
Current capacity	2000 mAH	
Detection voltage for battery voltage low alarm	(Typical) 3.1 V, 3.0 V ~ 3.2 V	
Detection voltage for battery voltage low error	(Typical) 2.5 V, 2.3 V ~ 2.7 V	
Time after alarm detection until error detection (reference)	10 days at 20°C based on continuous operation; 7 days if the power is not supplied. 10 days at 40°C based on continuous operation; 2.5 days if the power is not supplied.	
Minimum data retention voltage	Min. 2.7 V (Varies depending on the encoder characteristics.)	
Time after error detection until data loss (reference)	With the absolute-data backup battery, an absolute encoder reset will be required following a battery error.	
Data protection time during battery replacement	15 minutes (Maximum retention time when no battery is installed in the battery holder)	Data is retained by the super capacitor inside the absolute brake unit.
Guide on when to replace battery	Temperature 40°C, power ON time 0%	2 years
	Temperature 40°C, power ON time 50%	4 years

⊙ Expansion I/O Board (Optional)

Type: IA-103-X-32

Pin No.	Category	Port No.	Function
1	Input	-	+24-V input
2		32	General-purpose input
3		33	General-purpose input
4		34	General-purpose input
5		35	General-purpose input
6		36	General-purpose input
7		37	General-purpose input
8		38	General-purpose input
9		39	General-purpose input
10		40	General-purpose input
11		41	General-purpose input
12		42	General-purpose input
13		43	General-purpose input
14		44	General-purpose input
15		45	General-purpose input
16		46	General-purpose input
17		47	General-purpose input
18		48	General-purpose input
19		49	General-purpose input
20		50	General-purpose input
21		51	General-purpose input
22		52	General-purpose input
23		53	General-purpose input
24		54	General-purpose input
25		55	General-purpose input
26		56	General-purpose input
27		57	General-purpose input
28		58	General-purpose input
29		59	General-purpose input
30		60	General-purpose input
31		61	General-purpose input
32		62	General-purpose input
33		63	General-purpose input
34	Output	316	General-purpose output
35		317	General-purpose output
36		318	General-purpose output
37		319	General-purpose output
38		320	General-purpose output
39		321	General-purpose output
40		322	General-purpose output
41		323	General-purpose output
42		324	General-purpose output
43		325	General-purpose output
44		326	General-purpose output
45		327	General-purpose output
46		328	General-purpose output
47		329	General-purpose output
48		330	General-purpose output
49		331	General-purpose output
50		-	0 V

Note) Port numbers indicate ports on an I/O1 (I/O2) expansion board.

Type: IA-103-X-16

Pin No.		Port No.	Function
1	Input	-	+24-V input
2		32	General-purpose input
3		33	General-purpose input
4		34	General-purpose input
5		35	General-purpose input
6		36	General-purpose input
7		37	General-purpose input
8		38	General-purpose input
9		39	General-purpose input
10		40	General-purpose input
11		41	General-purpose input
12		42	General-purpose input
13		43	General-purpose input
14		44	General-purpose input
15		45	General-purpose input
16		46	General-purpose input
17		47	General-purpose input
18	Output	316	General-purpose output
19		317	General-purpose output
20		318	General-purpose output
21		319	General-purpose output
22		320	General-purpose output
23		321	General-purpose output
24		322	General-purpose output
25		323	General-purpose output
26		324	General-purpose output
27		325	General-purpose output
28		326	General-purpose output
29		327	General-purpose output
30		328	General-purpose output
31		329	General-purpose output
32		330	General-purpose output
33		331	General-purpose output
34		332	General-purpose output
35		333	General-purpose output
36		334	General-purpose output
37		335	General-purpose output
38		336	General-purpose output
39		337	General-purpose output
40		338	General-purpose output
41		339	General-purpose output
42		340	General-purpose output
43		341	General-purpose output
44		342	General-purpose output
45		343	General-purpose output
46		344	General-purpose output
47		345	General-purpose output
48		346	General-purpose output
49		347	General-purpose output
50		-	0 V

Operation of High Speed Cartesian Robot (CT4)

1. Connectionof Regenerative Resistors
   The number of necessary regenerative resistors is two pieces.
   It is capable up to 100W with two resistors when an additional axis such as a gripper is added.

2. Creating a Program
   For the CT4 operation, set the S-shaped motion acceleration/deceleration and anti-vibration control be-forestarting the robot operation with SEL language program.

   1) Setting of S-shaped Motion Acceleration/Deceleration
      Set the ratio to 50%.
      SCRV 50
      [Refer to Part 4. Commands.]

   2) Setting of Anti-Vibration Control
      As the specific frequency, the initial value 40Hz is set in Specific Frequency (Parameter Set 1) in Each Axis Parameter No. 153.
      The axis pattern is all the four axes. Set 1101.
      NTCH 1101 1
      [Refer to Part 4. Commands.]

3. Connection and Operation of Pick & Rotary Axis dedicated for CT4

   Grip and release are performed by supply/cutoff of the driving source.
   Also, the driving source is supplied by sharing the brake control cables.

   1) It is necessary to supply 24V DC and 0.5A (max.) as the driving source.
      Supply power to the supportive power input connector (brake power input connector) on the front panel of the controller.
      [Refer to Part 1, Chapter 4, 1. Front View of Controller]

   2) Confirm that the settings in Axis-Specific Parameter No. 34 and No. 103 on the axis number that Pick & Rotary Axis is connected (ordinary the 5th axis) are established as follows;
      No. 34 (Brake equipment specification) = 1
      No. 103 (Brake output control method select) = 1

   3) Refer to CT4 Actuator Instruction Manual to set up the appropriate gain.

   4) The operation of the rotary axis is conducted by the operation commands in SEL language.
      Grip is conducted by turning off the indicated virtual output port, and release is conducted by turning on the same virtual output port.
      Control on/off of the virtual output port (Port No. 7305 for the 5th axis) applicable for the axis number (ordinary the 5th axis) that Pick & Rotary Axis is connected with BTON and BTOF Commands in SEL language.
      [Refer to Part 3, Chapter 2, 1.3 Virtual I/O Ports]

> ⚠ Caution
> Caution for Pick & Rotary Axis Operation
> - The virtual output port controls the brake output independent from such conditions as the error detection.
> - Grip and release operation requires 0.5sec (reference).Therefore, when executing TIMW Command (Time Wait) after conducting grip or release command, adjust the necessary time to finish the operation considering your operation program.
> - The virtual output port condition and brake output condition may not match with each other depending on the condition of such devices as the brake power input and brake switch (for compulsory release).

⊙ Number of Regenerative Resistance Units to Be Connected

Regenerative resistance unit: A unit that converts to heat the regenerative current generating when the motor decelerates.

[Installation standards]
When used horizontally

Total sum of motor capacities of connected actuators	XSEL-P/Q
0 to 100 W	Not required
to 600 W	1 unit
to 1200 W	2 units
to 1800 W	3 units
to 2400 W	4 units

When used vertically

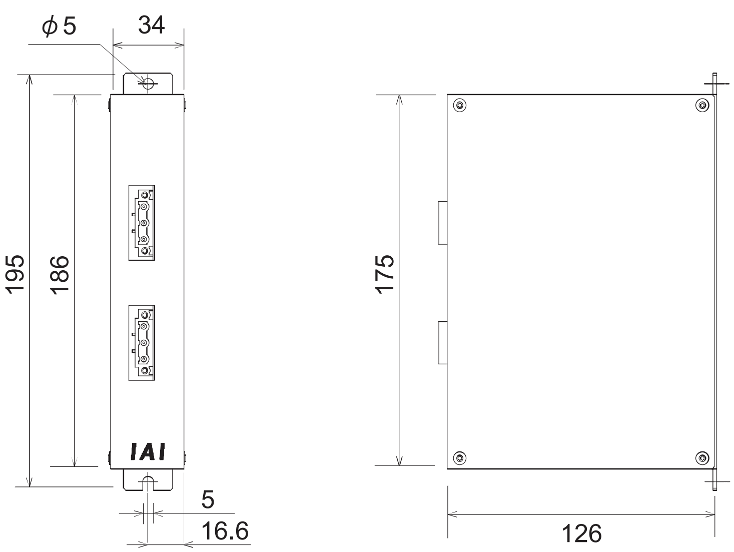
Total sum of motor capacities of connected actuators	XSEL-P/Q
0 to 100 W	Not required
to 600 W	1 unit
to 1000 W	2 units
to 1400 W	3 units
to 2000 W	4 units
to 2400 W	5 units

If actuators used horizontally and vertically are combined, the required quantity is the sum of the quantity calculated from the total sum of motor capacities of horizontal axes and the quantity calculated from the total sum of motor capacities of vertical axes.
(Note) For High-Speed Cartesian Axis (CT4) and High-Torque Type DD Motor, connect two units of regenerative resistor to each unit.
For Robo Cylinder High-Speed Type (RCS3-CT8C-□-400) and Standard Type DD Motor, connect one unit per unit.

[Specifications]

Item	Specification
Controller dimension	W34 mm x H195 mm x D126 mm
Controller weight	0.9 kg
Built-in regenerative resistance	220 Ω, 80 W
Accessory	Controller connection cable (model number CB-ST-REU010), 1 m

[External dimensions]

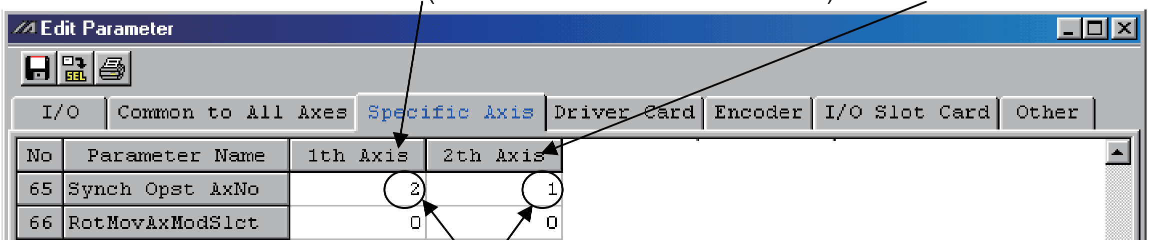


⦿ Synchro Function

1. Common Items (Applicable to both the absolute specification and incremental specification)

Synchro axes consist of a master axis and a slave axis. The axis with the smaller axis number becomes the master axis. When the unit is delivered, a combination of master-axis and slave-axis numbers is set in axis-specific parameter No. 65. The mating synchro axis is set for each axis. (If the axis is not a synchro axis, “0” is set.)
Example) 2-axis connection

Master axis (one with the smaller axis number) Slave axis



Axis number of mating axis

(The settings of other parameters vary partially between the absolute specification and the incremental specification.)

Movement commands in the program are valid only for the master axis. The position data of the slave axis will be ignored.
Only the master axis executes home return (including home return following an absolute reset).
Example)

HOME 1

(Do not perform home return on an absolute controller, except after an absolute reset.)

As a rule, the synchro function must be implemented by coupling the master-axis and slave-axis sliders using a bracket, etc. Consider the relative positioning of the master-axis and slave-axis sliders so that the slave slider will not contact the mechanical ends during home return or full-stroke movement.

2. Incremental Specification

With the incremental specification, the relative positioning of the master-axis and slave-axis sliders remains fixed while the power is on. (If the sliders were moved while the power was turned off, synchro movement will begin from the positions after the movement.)
Absolute reset is not performed on an incremental controller. Home return must be executed at software reset after the power is turned on.

3. Absolute Specification (When both the master axis and slave axis are of the absolute specification)

An absolute reset is performed after the relative positioning of the master axis and slave axis is determined.
Even when the sliders were moved while the power was turned off, the positions will be corrected automatically when a servo ON (SVON) command is executed. (The slave slider will move to the displayed coordinate position of the master slider in a fine-drive mode.)

If your controller is of the absolute specification, refer to the next page to conduct the absolute reset.

⊙ Absolute Reset of A Synchro Controller

If you have specified the synchro specification at the time of order, the controller has been shipped with their parameters set for the synchro specification.
To perform an absolute reset, however, the parameters must be changed.
The explanation given below is based on the operation in the PC software. Read the operation manual for the PC software before performing an absolute reset.

1. Synchro Axes

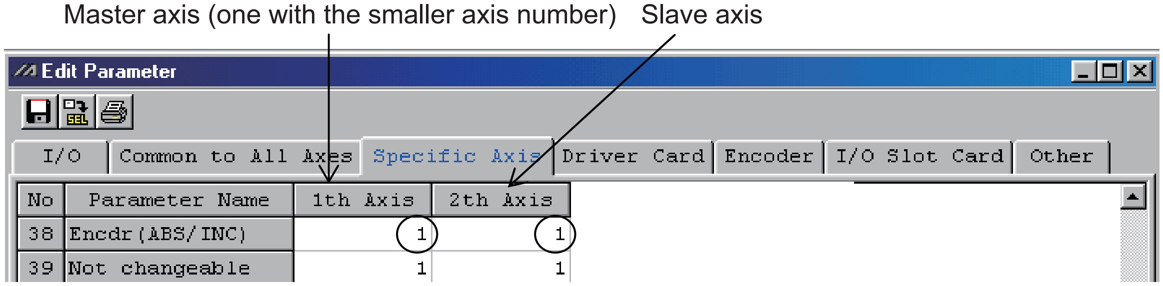
Synchro axes consist of a master axis and a slave axis. The axis with the smaller axis number becomes the master axis.
Program commands are valid only for the master axis (issuance of commands to the slave axis is prohibited).
Absolute reset can be performed using the standard procedure or special procedure. Which procedure to use is determined by the values set for the master axis and slave axis in "Axis-specific parameter No. 38, Encoder ABS/INC type."

Values in "Axis-specific parameter No. 38, Encoder ABS/INC type"		Absolute reset method
Master axis	Slave axis	
1	1	Special procedure
1	0	Standard procedure
0	0	

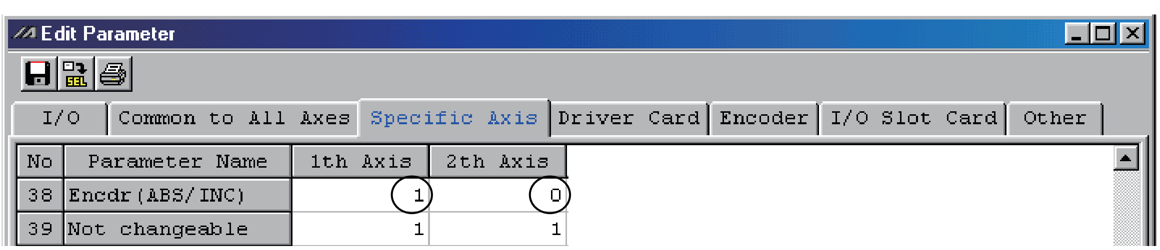
(If master axis = 0 and slave axis = 0, it is the increment type, thus the absolute reset is not necessary. Have a home-return operation when the power is turned on or at the software reset.)

Example 1) Absolute reset of a 2-axis connection using the special procedure

Master axis (one with the smaller axis number) Slave axis



Example 2) Absolute reset of a 2-axis connection using the standard procedure



2. Position Adjustment of Synchro-Axis Sliders

The positions of synchro-axis sliders are adjusted (physically adjusted for parallelism).

(1) With the axes and controller not connected by cables (main controller power is off), adjust the relative positioning of the master axis and slave axis and couple the axes.

(2) If position adjustment cannot be performed with the axes and controller not connected by cables (when a brake is equipped, etc.), follow the steps below:

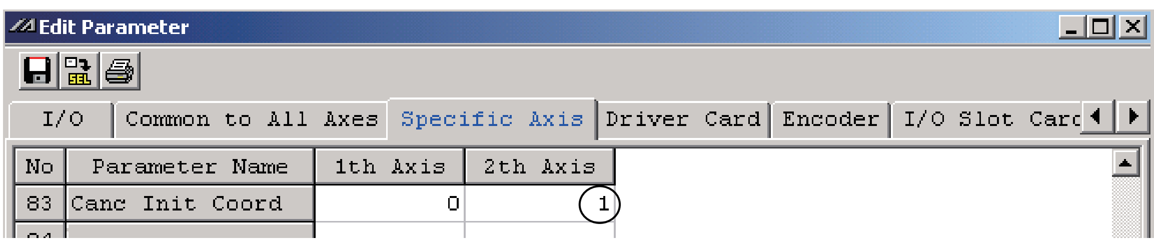
1. Decouple the sliders and connect the axes and controller using cables.
2. Record the values currently set for the master axis and slave axis in “Axis-specific parameter No. 65, Mating synchro-axis number.” (These values will be used to revert the parameters to the original settings in a subsequent process.)
3. Enter “0” for both the master axis and slave axis in “Axis-specific parameter No. 65, Mating synchro-axis number,” in order to temporarily disable the synchro function. Then, select [Transfer to Controller] → [Write to Flash ROM] → [Restart Controller] (software reset).
4. Perform an absolute reset separately for the master axis and slave axis, using the standard procedure.
5. Adjust the relative slider positions via jog operation, etc., and couple the sliders.
6. To enable the synchro function again, enter the values of the master axis and slave axis recorded in step 2 in “Axis-specific parameter No. 65, Mating synchro-axis number.” Then, select [Transfer to Controller] → [Write to Flash ROM] → [Restart Controller] (software reset).

3. Special Absolute-Reset Procedure

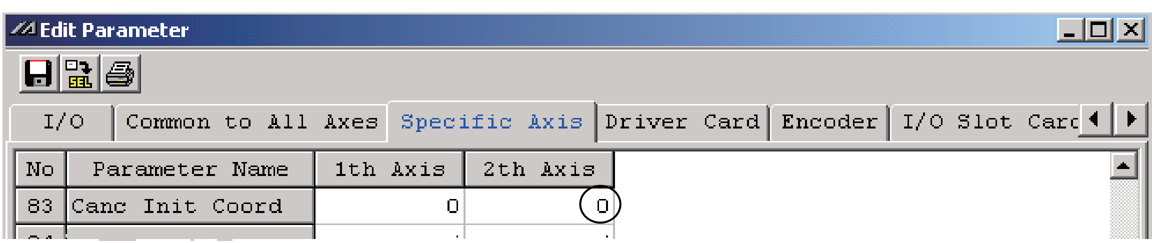
When the master axis = 1 and slave axis = 1 in “Axis-specific parameter No. 38, Encoder ABS/INC type”

(Note) Follow the steps described in [Important] Preparation for and Process of Re-execution of Absolute Reset at the end of this section when a re-execution of absolute reset is required to the already adjusted synchronized axes.

(1) Record the value currently set for the slave axis in “Axis-specific parameter No. 83, ABS synchro slave-axis coordinate initialization cancellation.”
(This value will be used to revert the parameter to the original setting in a subsequent process.)



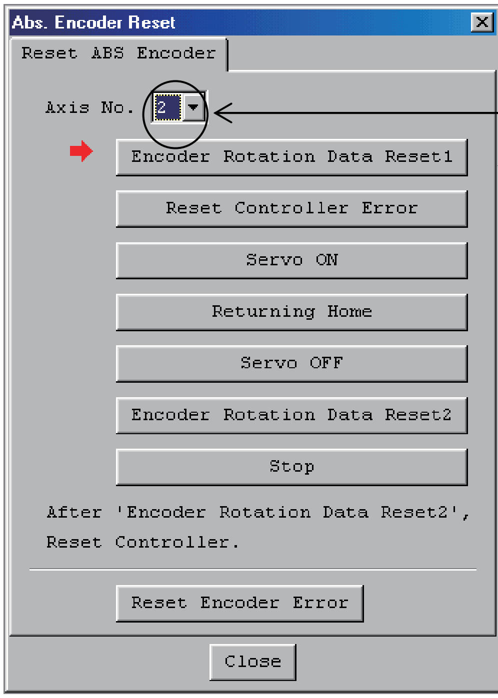
(2) Enter “0” for the slave axis in “Axis-specific parameter No. 83, ABS synchro slave-axis coordinate initialization cancellation.”



Select [Transfer to Controller] → [Write to Flash ROM] → [Restart Controller] (software reset).

(3) Perform an absolute reset using the special procedure (forced reset by ignoring the on-screen instructions) as explained below:

1. Perform "Encoder Rotation Data Reset 1" for the slave axis.

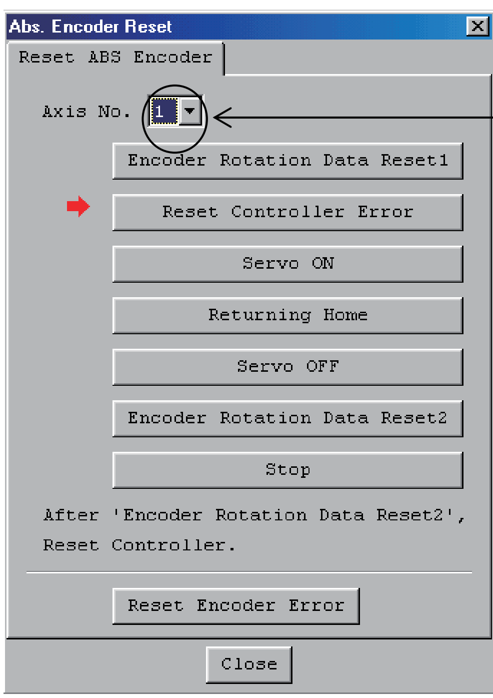


Select the axis number of the slave axis.

Click [Encoder Rotation Data Reset 1]. A series of warning windows will be displayed. Click [Yes] on all windows.

Do not click [Reset Controller Error] and subsequent buttons.

2. Perform "Encoder Rotation Data Reset 1" through "Encoder Rotation Data Reset 2" for the master axis by following the on-screen instructions.



Select the axis number of the master axis.

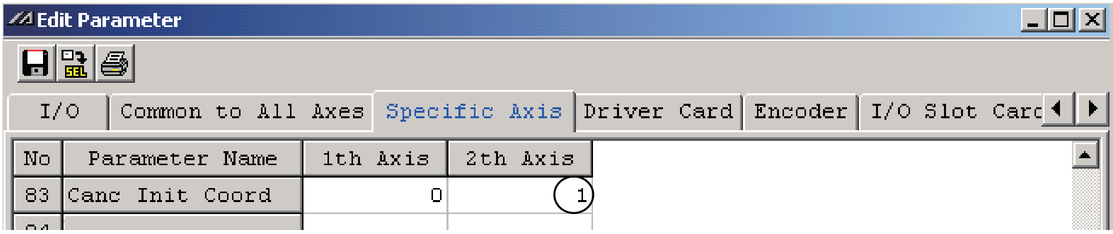
Click [Encoder Rotation Data Reset 1]. A series of warning windows will be displayed. Click [Yes] on all windows.

Follow the on-screen instructions to complete [Reset Controller Error] through [Encoder Rotation Data Reset 2].

3. Perform step 1, "Encoder Rotation Data Reset 1" for the slave axis, again.
Perform the same operation in step 1 and then click [Close].

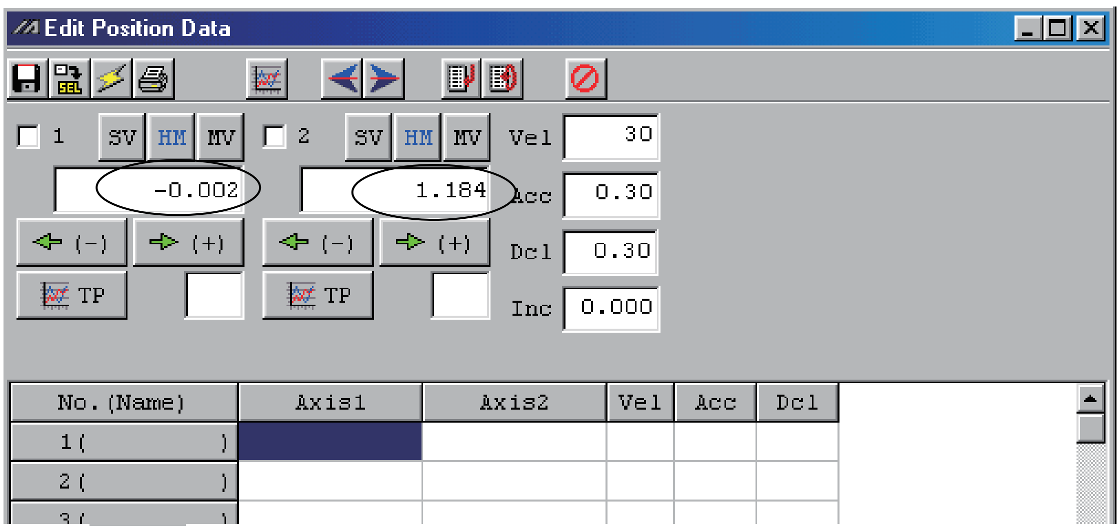
Appendix

(4) Enter the value of the slave axis recorded in (1) in "Axis-specific parameter No. 83, ABS synchro slave-axis coordinate initialization cancellation."



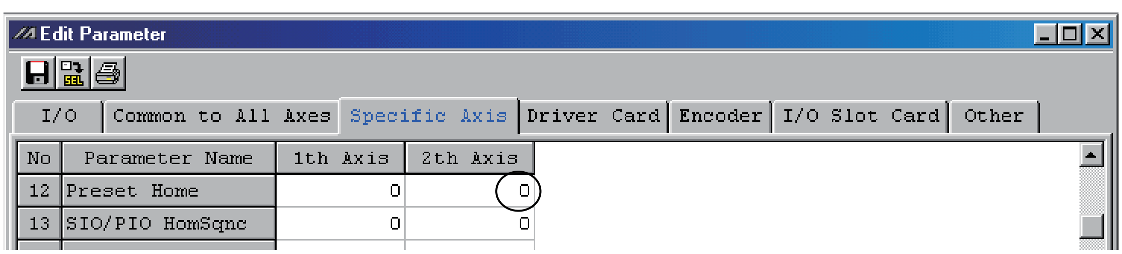
→ Select [Transfer to Controller] → [Write to Flash ROM] → [Restart Controller] (software reset).

(5) Set home preset values and align the master-axis and slave-axis coordinates.
1. If the controller's 7-segment LED display shows "rdy," read the current positions of the master axis and slave axis displayed on the screen with the servo turned off.
(If an "Error No. C74, Actual-position soft limit over error" generates, reset the error. Once "rdy" is displayed, you can read the current positions.)



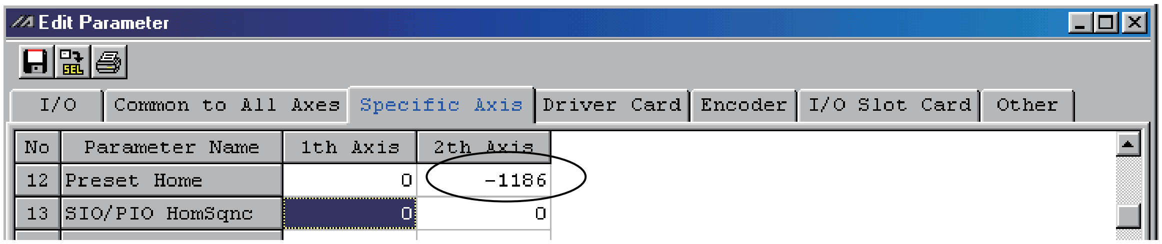
* If the servo is turned on in this stage, an "Error No. D0A, Driver overload error," "Error No. C6B, Deviation overflow error," "Error No. CA5, Stop-deviation overflow error" or other error may generate.

2. Perform the following calculation.
Slave-axis value in "Axis-specific parameter No. 12, Home preset value" [0.001 mm] + ((Displayed current position of master axis [mm] – Displayed current position of slave axis [mm]) x 1000)



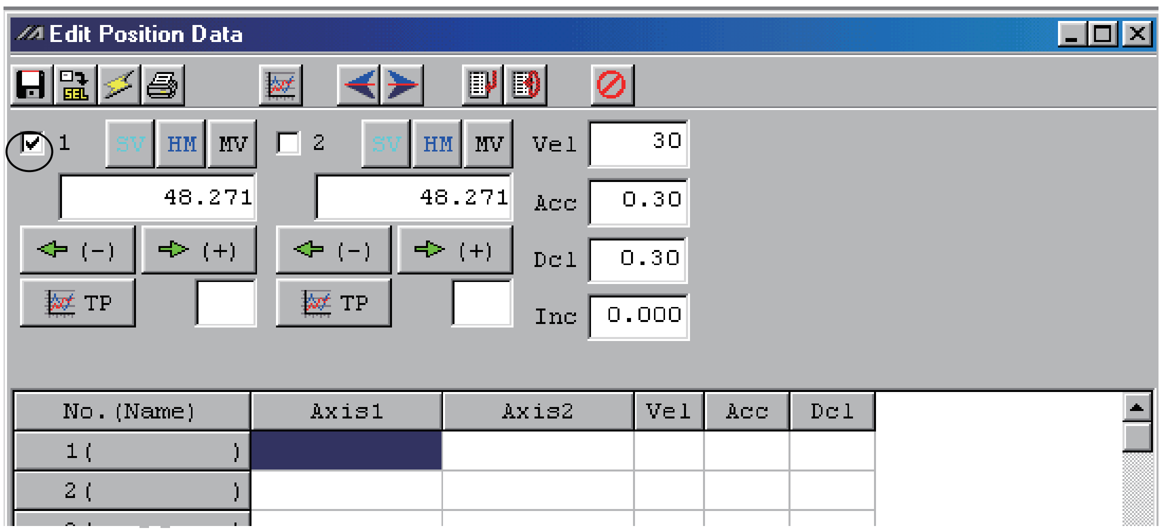
In this example, the above formula is rewritten as follows:
0 + ((-0.002 – 1.184) X 1000) = -1186

3. Enter the calculation result obtained in step 2 above in the slave-axis field of “Axis-specific parameter No. 12, Home preset value.”



→ Select [Transfer to Controller] → [Write to Flash ROM] → [Restart Controller] (software reset).

(6) Turn on the servo and check the operation in the jog mode (operate the master axis).



If an “Error No. D0A, Driver overload error,” “Error No. C6B, Deviation overflow error,” “Error No. CA5, Stop-deviation overflow error” or other error generates, check the following items:

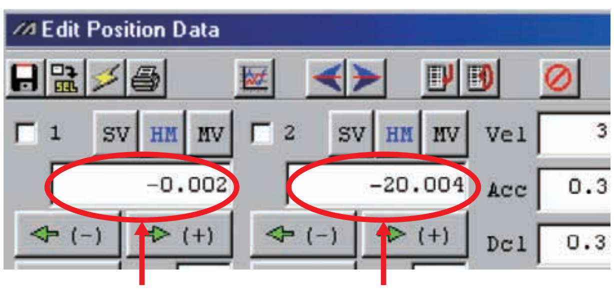
- If the current position of the master axis deviates significantly from that of the slave axis, the setting in (5) may be incorrect.
- Check the following parameters to confirm that the required fields are properly filled or changed:
  “Axis-specific parameter No. 65, Mating synchro-axis number”
  “Axis-specific parameter No. 83, ABS synchro slave-axis coordinate initialization cancellation”
- Check to see if the slider movements are restricted.

Once the absolute reset is completed normally with no error being issued, move the synchronized axes to the specific position such as the home position and make a marking at the slider position of the master axis and slave axis.
(Note) The marking is used for the judgment of the position misalignment at the re-execution of absolute reset.
[Refer to [Important] Preparation for and Process of Re-execution of Absolute Reset in the next page for the details.]

[Important] Preparation for and Process of Re-execution of Absolute Reset

There may be a case that the absolute reset is required to be executed again for such reasons as a trouble. Please refer below for the explanations for the preparation and process in such cases.

1. Home preset in Step (5) is not necessary if the connection of the mechanical links is in the same condition as when the device is booted (at 1st absolute reset) (for cable replacement, cable disconnect/insert or battery replacement). After finishing the procedure in Step (4), proceed to Step (5) to have an operation check. If there is no problem found in the checking, the process for the absolute reset is complete.
2. There is rarely a case that a misalignment in the coordinate display of the slave axis after the absolute reset for the amount close to the ball screw lead length occurs. This is a phenomenon that could occur at absolute reset when the encoder of the slave axis is near the Z-phase.
   The current coordinate is shown by the encoder counting the number of rotation with the Z-phase and adding one rotation of the absolute value. Therefore, the encoder identifies as a movement of one rotation is made if it passes the Z-phase.
   In such a case, repeat the absolute reset until the misalignment of the coordinate display of the slave axis is adjusted.
   The misalignment can be solved as soon as the same condition as the startup is detected.
   If the misalignment of the coordinates cannot be fixed even after several times of absolute reset, see the following and give it a try.
   1) Turn the servo off on the master axis and the slave axis, and move them manually with hands to the position marked in Step (6) at the initial startup.
   2) Read the coordinates of the master axis and slave axis at this time. The picture below is for when the 1st axis is the master and 2nd is the slave.



   Coordinate of Master Axis   Coordinate of Slave Axis

   3) Follow the calculation below to tune the home preset value.
      A. If Coordinate of Master Axis – Coordinate of Slave Axis > 0
         ⇒ Add lead length to current home preset value
      B. If Coordinate of Master Axis – Coordinate of Slave Axis < 0
         ⇒ Subtract lead length from current home preset value
      C. If Coordinate of Master Axis – Coordinate of Slave Axis ≈ 0
         ⇒ Use current home preset value as it is

   ⚠ Caution: When a change is to be made to the home preset value for the fine-tuning of the slave axis at the startup, record and keep the home preset value set in Step (5) in advance.
   When the absolute reset is executed again, put the home preset value back to this value to have the absolute reset process, and then put it back to the current home preset value.

3. As a reason of the position misalignment, it can also be considered that the mechanical distortion of the linking condition may have changed due to the time-dependent change. In such a case, have the absolute reset process same as the one for the initial startup. In this case it is also necessary to conduct the teaching of the position data again.
4. In any case, make sure the positioning to the position data is carried out properly. If a misalignment is occurred to the position, have the absolute reset executed again or conduct the teaching again.
5. Contact us if there is a problem during the process above being carried out or the trouble cannot be solved.

4. Standard Absolute-Reset Procedure

When the master axis = 1 and slave axis = 0 in “Axis-specific parameter No. 38, Encoder ABS/INC type”

After completing 2, “Position Adjustment of Synchro-Axis Sliders,” perform an absolute reset for the master axis only. For the operation procedure, refer to the operation manual for the XSEL Controller or PC software.

Note) A synchro axis that has been reset by the standard procedure is unable to correct any positional shift that may have occurred while the power was turned off, after the servo is turned on.

5. Notes on Use of the Synchro Function

- As a rule, the synchro function must be implemented by coupling the master-axis and slave-axis sliders using a bracket, etc.
- If the current position of the master axis is not aligned with that of the slave axis when the servo is turned on, correction will be made automatically via fine-pitch movement. (The slave-axis slider will move to the displayed coordinate position of the master-axis slider in a fine-drive mode.)
- The function to detect any positional shift that occurred while the power was turned off and correct it after the servo is turned on may not be available depending on the model.
  (This function is enabled if the controller was ordered as a synchro specification and “1” is set for both the master axis and slave axis in “Axis-specific parameter No. 38, Encoder ABS/INC type.”)
- With a system subject to a relatively large positional shift while the servo power is turned off, after turning on the servo obtain the current positions of the master axis and slave axis using a PRDQ command, wait for the distance between the current position of the slave axis and that of the master axis to be reduced to ±0.3 mm or less, and then issue operation commands. (See the reference program below.)
- Reference program
  This program reads the current positions of the master axis and slave axis after the servo is turned on, and turns ON global flag 600 when the distance between the two axes becomes 0.3 mm or less. Operation commands are written so that they will be executed after 600 is turned ON.

SVON	1		Turn on the servos of the synchro axes.
BTOF	600		Turn OFF flag 600.
LET	100	1.000	Assign 1 (or any value larger than 0.2) to variable 100.
DWGT	100	0.300	End the loop when the value in variable 100 becomes 0.3 or less (= when the distance between the master axis and the slave axis becomes 0.3 mm or less).
PRDQ	1	100	Assign the current position of the master axis to variable 100.
PRDQ	2	101	Assign the current position of the slave axis to variable 101.
SUB	100	*101	Subtract the value in variable 101 from the value in variable 100.
IFLT	100	0.000	If the result is a negative value,
MULT	100	-1.000	Multiply the result by –1 to convert it to a positive value.
EDIF			
EDDO			
BTON	600		Turn ON flag 600.
EXIT			

⊙ Vibration Control Function

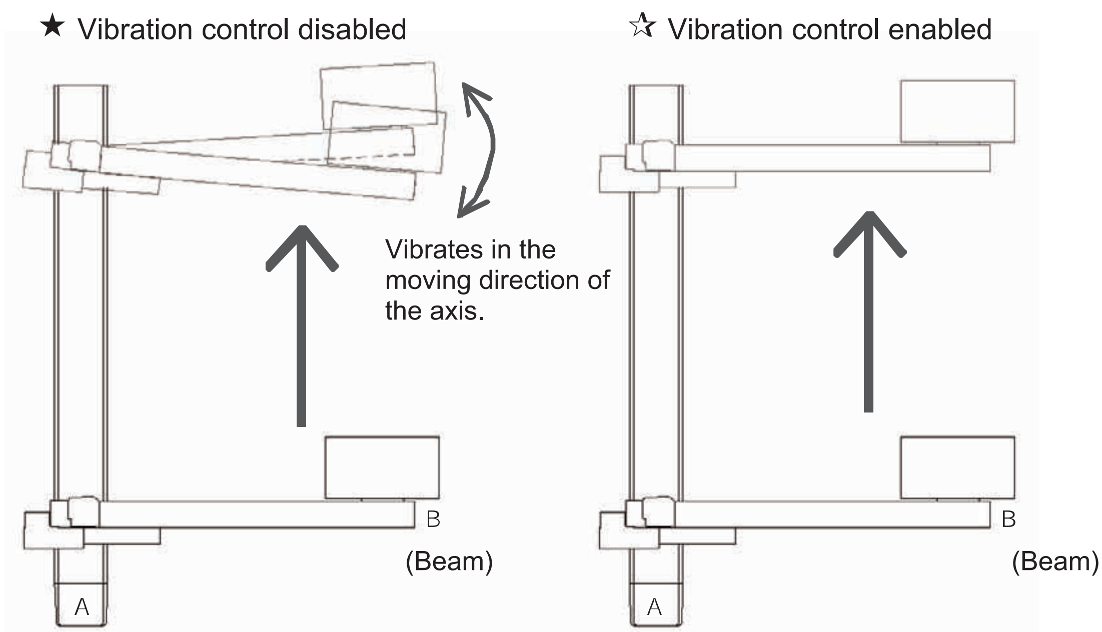
* Applicable versions : XSEL-P/Q/PCT/QCT controller main application version 0.90 or later
: PC software (IA-101-X-**) version 7.6.1.0 or later
(Note) This function cannot be set from a teaching pendant.

Natural vibration (resonance) frequencies are attenuated to dampen vibration.

- Applicable natural vibration frequencies: 0.5 to 30 Hz
- Three natural vibration frequencies can be registered in parameters so that this function can be used with different works. Note, however, that only one of three natural vibration frequencies can be selected and used for one move command. Two or more natural vibration frequencies cannot be set at the same time.

(Note) When this function is used, be sure to check the notes on the following page.

[Image of Operation under This Function]
If actuator B (beam) vibrates as actuator A operates, measure the natural vibration frequency of this vibration and set it in a parameter for actuator A.
Enable vibration control, and the vibration will be dampened.



Caution

- Use of vibration control
  Contact us if it is desired to use the anti-vibration control.

- Vibration covered by vibration control
  Vibration caused by operation of an IAI actuator, generated in the same direction as the operating direction of the actuator
- Vibration not covered by vibration control
  [1] Vibration not caused by operation of an IAI actuator
  [2] Vibration generated in a direction different from the operating direction of the IAI actuator
  [3] Vibration already happening (This function moves an actuator, which will otherwise generates vibration, in a manner not generating vibration. It cannot dampen vibration which is already happening.)

- Conditions under which vibration cannot be dampened effectively
  [1] The vibration dampening effect drops when backlash, motor cogging or other disturbance factor is present.
  [2] Vibration cannot be dampened when the motor output has saturated.

- Vibration control not effective during home return operation/push-motion operation
  Vibration cannot be dampened during home return operation/push-motion operation.

- No combination with feed-forward gain
  This function is in an exclusive-OR relationship with feed-forward gain. The two cannot be combined.

- No switching of vibration control function during actuator movement
  Vibration control and normal positioning operation cannot be switched while the actuator is moving. If a switching command is issued, “Error code 41A: Invalid control system switching command error” will occur.
- Response during vibration control
  Vibration control is a function to filter the operation plan. Accordingly, a “delay” occurs relative to the speed command specified by the operation plan.
  The time constant for this delay is twice the inverse number of the natural vibration frequency set in the parameter.
  Natural vibration frequency 10 [Hz] $\cong$ 62.83 rad/s (10 [Hz] x 2π) 0.0159 (Inverse number) x Time constant 0.0318 [s]
  Natural vibration frequency 0.5 [Hz] $\cong$ 3.14 rad/s (0.5 [Hz] x 2π) 0.3183 (Inverse number) x Time constant 0.6366 [s]
  The lower the natural vibration frequency, the longer the “delay” becomes.

- Combination with synchronization function
  The synchronization function can be combined with vibration control.
  If the two are combined, the vibration control parameters for the master axis and slave axis must be set in the same parameter set. Take note that the axis pattern in the NTCH command should be set only for the master axis.

- Use of continuous move commands
  Vibration control can be used with continuous move commands (PATH, CIR, ARC, PSPL, CIR2, ARC2, ARCD, ARCC, CIRS and ARCS). Note, however, that the vibration control function has the effect of lowering the speed command response, meaning that the lower the natural vibration frequency, the greater the chances of a path error generating.

- Consideration of servo gain
  The vibration damping effect may drop when the servo gain is changed. Adjust the servo gain first, before setting vibration control.

- Preparation Procedure

Follow the procedure below to measure and set applicable items before applying this function.

Step 0

Before setting vibration control
- Contact us if it is desired to use the anti-vibration control.

Step 1

Confirm the vibration to be dampened
- Confirm if the vibration to be dampened is covered by this function.
  Vibration covered
  Vibration caused by an IAI actuator, generated in the same direction as the moving direction of the actuator

Step 2

Measure the natural vibration frequency
- Measure the vibration frequency using a dedicated tool included in the PC software.
  [Refer to the Operation Manual for PC Software.]
- Measure the vibration frequency using other measuring equipment (acceleration pickup, etc.).

Step 3

Set the vibration control parameters. [Refer to the next page.]
- Set the natural vibration frequency. (Register the natural vibration frequency measured in STEP2.)
- Set related parameters.

Step 4

Set the vibration control parameter set number.
- Specify the parameter set number in the SEL program (NTCH command).
  [Refer to 1.11, “Actuator Control Declaration” in Part 4, “Commands.”]

Step 5

Trial operation (Check the vibration damping effect.)
- If vibration is not sufficiently dampened, return to STEP2 (review the natural vibration frequency).

Apply the function.

- [STEP3] Setting the Vibration Control Parameters
  Axis-specific parameters

No.	Parameter set number	Parameter name	Unit	Default value	Input range
151	1	Attenuation characteristic coefficient 1	Rate	10	0 to 1000
152		Attenuation characteristic coefficient 2	Rate	1000	0 to 1000
153		Natural vibration frequency	1/1000 Hz	10000	500 to 30000
154		Notch filter gain	Rate	9550 (*1)	1 to 20000
156	2	Attenuation characteristic coefficient 1	Rate	10	0 to 1000
157		Attenuation characteristic coefficient 2	Rate	1000	0 to 1000
158		Natural vibration frequency	1/1000 Hz	10000	500 to 30000
159		Notch filter gain	Rate	9550 (*1)	1 to 20000
161	3	Attenuation characteristic coefficient 1	Rate	10	0 to 1000
162		Attenuation characteristic coefficient 2	Rate	1000	0 to 1000
163		Natural vibration frequency	1/1000 Hz	10000	500 to 30000
164		Notch filter gain	Rate	9550 (*1)	1 to 20000

(*1) Recommended value for linear axes: 9920

- Attenuation characteristic coefficients 1, 2
  Do not change the default values.

- Natural vibration frequency [1/1000 Hz]
  Set the natural vibration frequency of the work measured in [STEP2]. If the natural vibration frequency measurement tool of the PC software is used, the value measured by the tool can be set directly to the parameter. [Refer to the Operation Manual for PC Software.]
  For greater vibration control performance, set a value as close as possible to the vibration frequency of the work.

- Notch filter gain
  Use the table below as a reference to set a gain appropriate for the measured natural vibration frequency of the work. If overshooting or other problem occurs, fine-tune the gain.

Measured natural vibration frequency [Hz]	Set value of notch filter gain	
	Other than linear actuator	Linear actuator
0.5	10200	10150
1	10200	9980
2	9965	9935
5	9950	9920
10	9950	9915
15	9950	9915
20	9945	9915
30	9945	9915

- Stopping the Actuator Operation

  Actuator operation can be stopped in two methods: normal operation stop and emergency stop.

  [1] Normal operation stop
  Vibration control is active : Set a deceleration operation plan and cause the actuator to decelerate to a stop, according to the plan, under vibration control.
  Normal position control is active: Set a deceleration operation plan and cause the actuator to decelerate to a stop, according to the plan, under normal position control (vibration control is not used).

  [2] Immediate servo OFF
  Cancel the operation plan and immediately turn off the servo (power supply to the motor is cut off).
  How operation is stopped in each condition is explained below.

Stop command	Stopping method	Remarks
Pause	[1]	
Servo OFF	[1]	
Emergency stop	[1]	Since the motor drive source is cut off by hardware means, the deceleration operation plan may have to be forcibly stopped beforehand depending on the use condition.
SEL program command	[1]	Four commands (HOLD, CANC, STOP, ABPG)
Minor error	[1]	Other than major errors
Major error	[1]	Refer to the next page for specific names of errors.

Errors resulting in immediate servo OFF to stop the operation are listed below.

Error No.	Error name
625	Driver-side detection synchronization communication error
626	Driver IPM15V voltage drop error
627	Driver current detection A/D offset exceeded
633	Feedback pulse synchronization error (detected on speed loop side)
634	Feedback pulse synchronization error (detected on position loop side)
651	Speed control interrupt control JOB error
652	Serial encoder command control JOB error
653	Encoder control JOB logic error
677	ABZ encoder Z-phase clear position error
6B5	Belt breaking error
6BB	Deviation overflow error (home return not yet complete)
6BC	Stop deviation overflow error (home return not yet complete)
B05	Estimate stroke exceeded during home return
B10	Z-phase search timeout error
B11	Home sensor pull-out timeout error
C6B	Deviation overflow error
C99	Home sensor non-detection error
C9A	Creep sensor non-detection error
C9B	Z-phase non-detection error
C9C	Z-phase position problem error
CA5	Stop deviation overflow error
CC6	Driver error initial detection
D03	Encoder count error
D0A	Driver overload error
D10	IPM error (POE0)
D15	Driver CPU down status error
D17	Main CPU alarm status error
D19	Encoder receive timeout error
F00 to FBF	All system-down level errors

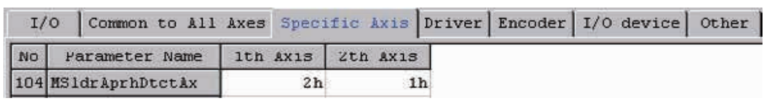
⊙ Multiple-Slider Near-Miss Detection (Collision Prevention) Function

* Applicable versions: XSEL-P/Q/PCT/QCT controllers of main application version 0.51 or later
Teaching pendant main application (IA-T-X, IA-T-XD) version 1.41 or later
Teaching pendant main application (IA-T-X) version 1.31 or later
PC software (IA-101-X-**) version 7.0.1.0 or later

When multiple sliders are used, this function prevents jogging or positioning axes from colliding with one other. The following parameters are set to detect near-miss situations among multiple sliders.

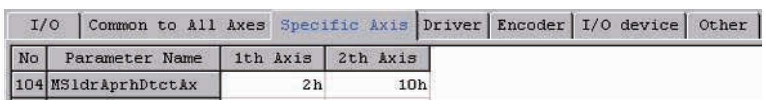
Setting method

[1] Set the mating axis number for each axis in axis-specific parameter No. 104, “Target axis specification for multiple-slider near-miss detection.”
Example 1: 2-axis controller
Set the mating axis number for each axis. (The example below assumes that an interlocked slider exists on the positive side of the coordinate system of the target axis)


I/O | Common to All Axes | Specific Axis | Driver | Encoder | I/O device | Other

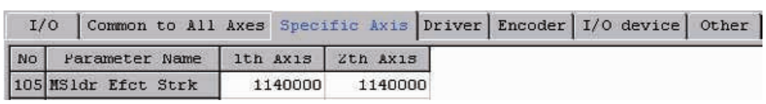
No	Parameter Name	1th Axis	2th Axis
104	MSldrAprhDtctAx	2h	1h

Example 2: When an interlocked slider exists on the negative side of the coordinate system of the target axis (Axis 2 is on the negative side)


I/O | Common to All Axes | Specific Axis | Driver | Encoder | I/O device | Other

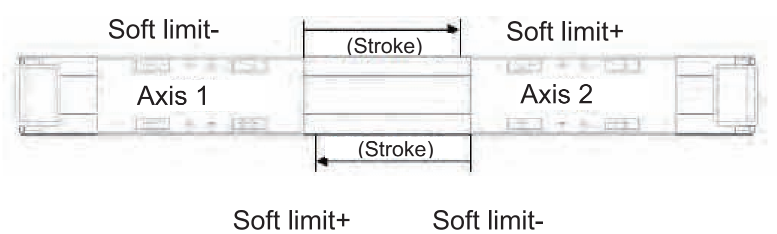
No	Parameter Name	1th Axis	2th Axis
104	MSldrAprhDtctAx	2h	10h

[2] Set the effective stroke in axis-specific parameter No. 105, “Effective stroke of multiple sliders.” (The example below assumes a stroke of 1140.)


I/O | Common to All Axes | Specific Axis | Driver | Encoder | I/O device | Other

No	Parameter Name	1th Axis	2th Axis
105	MSldr Efct Strk	1140000	1140000

(Note 1) The multiple-slider near-miss detection (collision prevention) function is enabled only when coordinates of two target axes (mating axes) are confirmed. This function is disabled if an encoder error is present or when home return is not yet completed on an incremental-encoder controller.



After a near-miss situation is detected, the following errors will generate:
Error No. 422, “Multiple-slider command position near-miss error” (Emergency deceleration will be triggered to stop the sliders, after which the servo will be turned off.)
Error No. 423, “Multiple-slider actual position near-miss error” (Emergency deceleration will be triggered to stop the sliders, after which the servo will be turned off.)
Following a near-miss detection, pull the sliders out of their near-miss positions via jogging, etc.
(The sliders can be jogged in pull-out directions.)

Related Parameters (Axis-specific Parameters)

No.	Parameter name	Default value	Input range	Unit	Remarks
104	Target axis specification for multiple-slider near-miss detection	0H	0H to FFFFFFFFH		Bits 0 to 3: Mating axis number of near-miss detection target (on the positive side of the coordinate system of the target axis) Bits 4 to 7: Mating axis number of near-miss detection target (on the negative side of the coordinate system of the target axis) * The mating axis must be entered for each axis. (Of the pair, the axis with the smaller axis number becomes the main axis for the sake of convenience.) * For each axis, only an axis whose resolution and other related characteristics are the same can be specified as a mating axis. * In the case of synchro axes, always specify the synchro master axis. (Specification of the synchro slave axis is prohibited.) * Specify “0” if no adjacent slider is present on the applicable side of the coordinate system of the target axis.
105	Effective stroke of multiple sliders	0	0 to 99999999	0.001 mm	Effective stroke from the “soft limit” at the end (far end) of the operation range of either axis specified as a target axis for multiple-slider near-miss detection (Of the multiple sliders, only the parameter for the master axis is valid.) * The “soft limit” for each axis must be set correctly to prevent physical slider interference at the far end. (This soft limit is used as a standard for near-miss detection calculation.)
106	Emergency deceleration margin upon multiple-slider near-miss detection	5	0 to 999	0.01 G	
107	Multiple-slider setting: Bit pattern 1	12H	0H to FFFFFFFFH		Bits 0 to 3: Margin for multiple-slider actual position near-miss detection (mm) (Of the multiple sliders, only the parameter for the master axis is valid.) Bits 4 to 7: Margin for multiple-slider command position near-miss detection (mm) (Of the multiple sliders, only the parameter for the master axis is valid.)

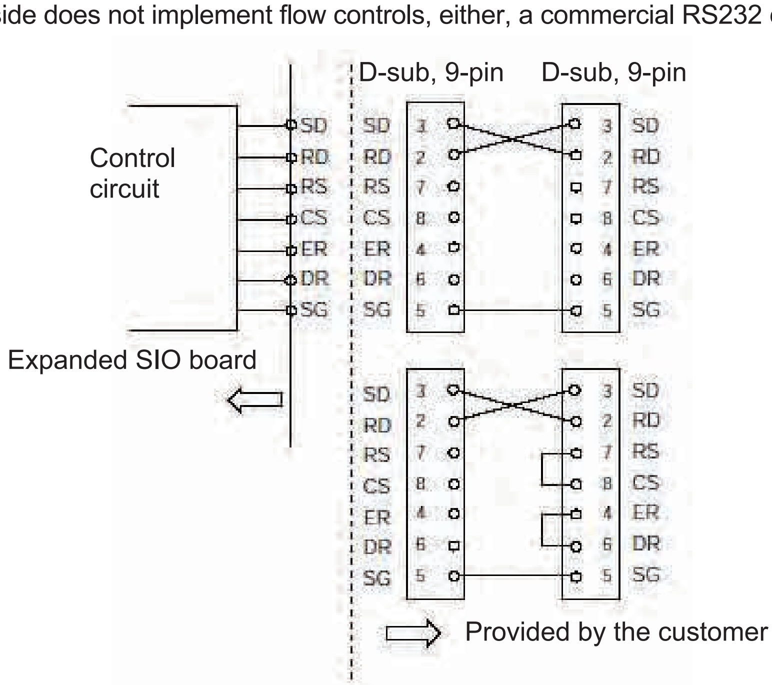
⦿ General-Purpose RS232 (2-Channel RS232 Unit)

(1) Specifications
The 2-channel RS232 unit is a dedicated D-sub, 9-pin RS232 interface. This unit can be used when a general-purpose RS232 device is connected.

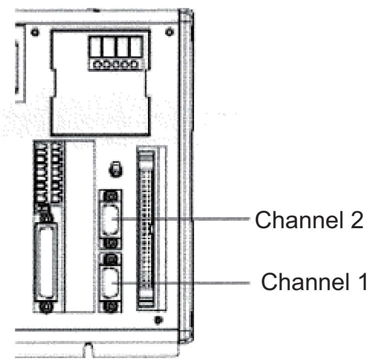
RS232 Connector Specifications

Item	Overview			Details
Applicable connector	D-sub, 9-pin connector (DTE)			XM2C-0942-502L (OMRON)
Connector name	S1/S2			
Maximum connection distance	10M			At 38400 bps
Applicable interface standard	RS232			
Connected unit	AT-compatible PC, etc.			Half-duplex communication
Connection cable				PC-AT standard 232C cross-cable
Terminal assignments	1	in	(CD)	(Carrier detection: Not used)
	2	in	RD	Received data (RXD)
	3	Out	SD	Transmitted data (TXD)
	4	Out	ER	Equipment ready (DTR)
	5	in	SG	Signal ground
	6	in	DR	Data set ready (DSR)
	7	Out	(RS)	(Request to send (RTS): Not used)
	8	in	(CS)	(Clear to send (CTS): Not used)
	9		NC	Not used

(2) Communication Cable
RC232 wiring
Flow controls (software flow controls or hardware flow controls) are not implemented.
If the other side does not implement flow controls, either, a commercial RS232 cross cable can be used.



(3) Parameter Settings
The SIO channel numbers and specifications are set as follows based on the factory settings for applicable parameters:



Specifications
Baud rate: 38.4 kbps
Data length: 8
Stop bit: 1
Parity type: None
Communication mode: RS232

The details are set based on the following parameters:
Channel 1 → I/O parameter Nos. 201 to 203
Channel 2 → I/O parameter Nos. 213 to 215

I/O Parameter Settings (Reference)

No.	Parameter name	Default value	Input range	Unit
201	Attribute 1 of SIO channel 1 opened to user (standard mount)	28100001H	0H to FFFFFFFFH	None
213	Attribute 1 of SIO channel 2 opened to user (standard mount)	28100001H	0H to FFFFFFFFH	None

Bits 28 to 31: Baud rate type (0: 9.6 1: 19.2 2: 38.4 3: 57.6 4: 76.8 5: 115.2 kbps)
Bits 24 to 27: Data length (7 to 8)
Bits 20 to 23: Stop bit length (1 to 2)
Bits 16 to 19: Parity type (0: None, 1: Odd, 2: Even)
Bits 12 to 15: For future expansion
Bits 8 to 11: For future expansion
Bits 4 to 7: For future expansion
Bits 0 to 3: Use selection (0: Do not use, 1: Use)

0: 9.6 kbps 1: 19.2 kbps 2: 38.4 kbps 3: 57.6 kbps 4: 76.8 kbps 5: 115.2 kbps
Data length 7, 8
Stop bit length 1, 2
Parity type 0: None, 1: Odd, 2: Even
For future expansion
For future expansion
For future expansion
Use selection (0: Do not use, 1: Use)

2 8 1 0 0 0 1 1

No.	Parameter name	Default value	Input range	Unit
202	Attribute 2 of SIO channel 1 opened to user (standard mount)	00000001H	0H to FFFFFFFFH	None
214	Attribute 2 of SIO channel 2 opened to user (standard mount)	00000001H	0H to FFFFFFFFH	None

- Settings

Bits 28 to 31: For future expansion
Bits 24 to 27: For future expansion
Bits 20 to 23: For future expansion
Bits 16 to 19: Character transmission interval (msec)
Bits 12 to 15: Communication method (0: Full-duplex, 1: Half-duplex)
Bits 8 to 11: Send operation type in half-duplex communication
(0: Do not check CTS-ON at send,
1: Check CTS-ON at send)
Bits 0 to 3: Minimum delay for receive → send switching in half-duplex communication (msec)

No.	Parameter name	Default value	Input range	Unit
203	Attribute 3 of SIO channel 1 opened to user (standard mount)	01118040H	0H to FFFFFFFFH	None
215	Attribute 3 of SIO channel 2 opened to user (standard mount)	01118040H	0H to FFFFFFFFH	None

- Settings

Bits 28 to 31: Flow control type
(0: None, 1: Xon/Xoff, 2: Hardware)
* Valid only in full-duplex communication.
* If flow control is performed, select 38.4 kbps or below. Use of a higher baud rate may generate an overrun error, etc.

Bits 24 to 27: Xon send selection when send is enabled after SIO-CPU reset
(0: Do not send, 1: Send)
* Valid only in full-duplex communication with Xon/Xoff flow control.

Bits 20 to 23: Send enable selection at port open
(0: Disable, 1: Enable)
* Valid only in full-duplex communication with Xon/Xoff flow control.

Bits 16 to 19: Xon/Xoff send selection at port close
(0: Do not send, 1: Send Xon, 2: Send Xoff)
* Valid only in full-duplex communication with Xon/Xoff flow control.

Bits 8 to 15: Flow control high limit (bytes)
Bits 0 to 7: Flow control low limit (bytes)
* If values are set to a magnitude correlation of “Flow control low limit ≥ SCI receive buffer size - Flow control high limit,” both the flow control high/low limits will be converted to a value corresponding to one-fourth the SCI receive buffer size.
(SCI Receiving Buffer Size＝192 bytes)

(4) Programs

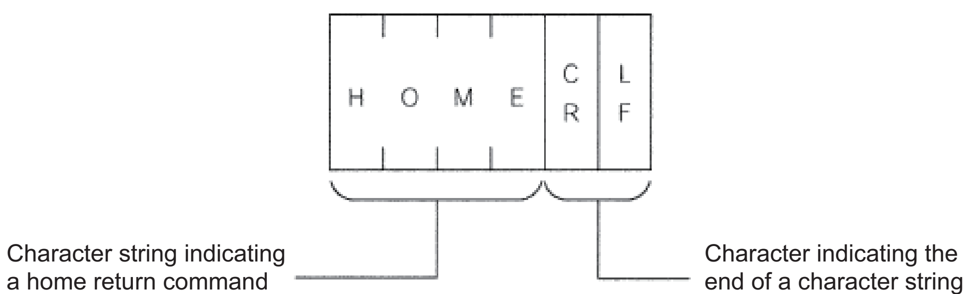
[1] String processing commands

A string refers to a character string. This controller uses global strings and local strings.
Global strings are common strings that can be read or written from any program. Local strings are valid only in the program in which the applicable string is specified and cannot be used in any other program.
For differentiation, both strings are assigned a number in a different range.
Global strings: 300 to 999 (700)
Local strings: 1 to 299 (299)
As a need for string commands, normally these commands are used in serial communication with external equipment.
Serial communication data must be processed as strings. This controller can handle serial communication. In serial communication, strings must be compared, moved and/or converted. This controller provides a range of commands to perform these tasks.

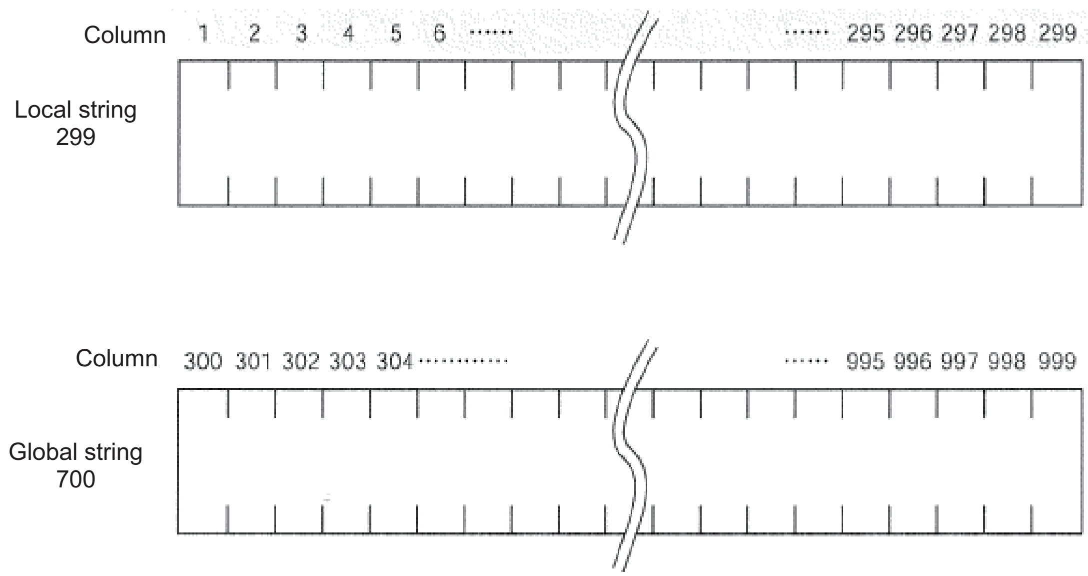
[2] Explanation of transmission format

Basically communication using this system is implemented in the form of exchanging character strings. Specific operations are assigned to these character strings in advance, so that the receiving side can recognize each character string and perform the corresponding operation.
A combination of character strings and characters indicating the end of a character string is called "transmission format," and the user can determine a desired transmission format.
For example, the user can specify a four-character string "HOME" to indicate a home return command. Although the user can also determine a desired character to indicate the end of a character string, the characters specified on the PC side, such as "CR" and "LF," must be followed instead.

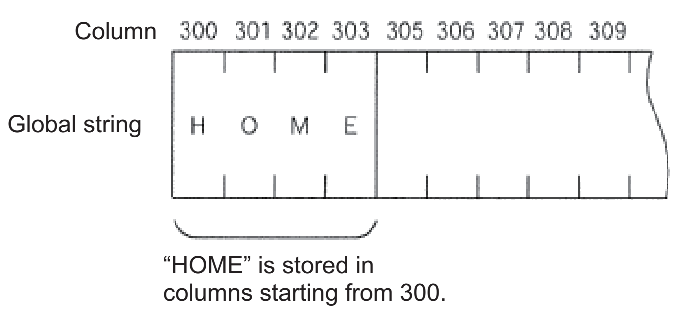
Example of transmission format



[3] Explanation of strings
Characters sent per the aforementioned transmission format are stored in a “string,” which, simply put, is a dedicated container for characters.
Strings are divided into global strings that can be read or written in all programs, and local strings that can be read or written only in each program in which the applicable string is specified. For differentiation, both strings are assigned a column number in a different range.



One character is stored in each column comprising a string.
Positions of fields in a string are indicated by column numbers, and which columns are used to store a given set of characters can be set freely using a command.
For example, if a character string “HOME” indicating a home return command is to be sent from the PC for use in multiple programs, “HOME” must be specified for storage in columns starting from 300.



[4] Determination of transmission format
In this example of application program, three types of transmission formats are used including home return command, movement command and movement completion. These formats are determined as specified below.
Take note that these are only examples and the user can determine each format freely.

A. Home return command format
This format is used to command the controller, from the PC, to perform home return.

H	O	M	E	CR	LF

B. Movement command format
This format is used to command the controller, from the PC, to move axes.

	Speed	Axis 1 position	Axis 2 position		
M O V E	9 9 9	9 9 9 . 9 9 9	9 9 9 . 9 9 9	CR	LF

C. Movement completion format
This format is sent from the controller to the PC when the specified home return or movement has completed.

O	K	CR	LF

[5] Processing procedure
The processing procedure to be followed when programming this application example is explained below:
A. Set “LF” as a character indicating the end of a character string (terminator character).
B. Open channel 1 of the RS232 unit so that this channel can be used.
C. Data sent to channel 1 is received into a local string starting from column 1.
D. If the received data was “MOVE,” the speed data is converted to a binary value and the converted value is set in variable 10, while the position data is also converted to a binary value and the converted value is set in position No. 1. Thereafter, the movement is carried out and after the movement has completed, “OK” is sent.

[6] Application program

STEP	No.	N	OP-CODE	OPRND1	OPRND2	POST	Comment
1			SCHA	10			Set LF as a terminator character.
2			OPEN	1			Open SIO channel 1.
3			TAG	1			
4			READ	1	1		Read SIO1 columns from 1.
5							
6			ISEQ	1	'HOME'		Home return command
7			HOME	11			Perform home return.
8			EXSR	1			Send “OK.”
9			EDIF				
10							
11			ISEQ	1	'MOVE'		If the received data was a movement command:
12			SLEN	3			Set the length to 3 digits.
13			VAL	10	5		Speed → Variable 10
14			VEL	*10			Set the speed.
15							
16			PCLR	1	1		Clear position 1.
17			SLEN	3.3			
18			VAL	199	8		Axis 1 position → Variable 199
19			PPUT	1	1		Set the axis 1 data.
20							
21			VAL	199	15		Axis 2 position → Variable 199
22			PPUT	2	1		Set the axis 2 data.
23			MOVL	1			Carry out the movement.
24			EXSR	1			Send “OK.”
25			EDIF				
26							
27			GOTO	1			
28							-----------
29			BGSR	1			OK send subroutine
30			SCPY	1	'OK'		Set “OK.”
31			SPUT	3	13		Set “CR.”
32			SPUT	4	10		Set “LF.”
33			WRIT	1	1		Send.
34			EDSR				

⊙ List of Parameters

If you have any question regarding changing the parameters, please contact IAI's Sales Engineering Section.
After changing a parameter, record the new and old parameter settings.

If you have purchased the PC software, we recommend that you back up the parameters immediately after the controller is delivered and when the system incorporating the controller is started. Since a number of customizing settings use parameters, you should back up the parameters regularly as you back up the programs.
To make the new parameters effective, write them to the flash ROM and then execute a software reset or reconnect the power.
The lists below are examples of default values displayed on the PC software. The default parameter settings vary depending on the operating condition and actuators used.

The values in the "Input range" column represent input limitations on the teaching pendant or in PC software. For the actual settings, enter the values defined in the "Remarks" column.
Values other than those defined in the "Remarks" column are for future expansion, even when they are inside the input range.
Therefore, do not enter values other than those defined in the "Remarks" column.

1. I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
1	I/O port assignment type	1	0 to 20		0: Fixed assignment 1: Automatic assignment (Priority: Network I/F module → Slot 1 (standard I/O) ~; * Ports are assigned only for the installed adjoining slots, starting from slot 1 = For safety reasons)
2	Input port start number with fixed standard I/O assignments (I/O1)	000	-1 to 599		0 + (Multiple of 8) (Invalid if a negative value is set)
3	Output port start number with fixed standard I/O assignments (I/O1)	300	-1 to 599		300 + (Multiple of 8) (Invalid if a negative value is set)
4	Input port start number with fixed expanded I/O1 assignments (I/O2)	-1	-1 to 599		0 + (Multiple of 8) (Invalid if a negative value is set) (Slot next to the standard I/O slot)
5	Output port start number with fixed expanded I/O1 assignments (I/O2)	-1	-1 to 599		300 + (Multiple of 8) (Invalid if a negative value is set)
6	Input port start number with fixed expanded I/O2 assignments (I/O3)	-1	-1 to 599		0 + (Multiple of 8) (Invalid if a negative value is set)
7	Output port start number with fixed expanded I/O2 assignments (I/O3)	-1	-1 to 599		300 + (Multiple of 8) (Invalid if a negative value is set)
8	Input port start number with fixed expanded I/O3 assignments (I/O4)	-1	-1 to 599		0 + (Multiple of 8) (Invalid if a negative value is set)
9	Output port start number with fixed expanded I/O3 assignments (I/O4)	-1	-1 to 599		300 + (Multiple of 8) (Invalid if a negative value is set)
10	Standard I/O error monitor (I/O1)	1	0 to 5		0: Do not monitor 1: Monitor 2: Monitor (Do not monitor errors relating to 24-V I/O power source) 3: Monitor (Monitor only errors relating to 24-V I/O power source) * Some exceptions apply.
11	Expanded I/O1 error monitor (I/O2)	1	0 to 5		0: Do not monitor 1: Monitor 2: Monitor (Do not monitor errors relating to 24-V I/O power source) 3: Monitor (Monitor only errors relating to 24-V I/O power source) * Some exceptions apply. (Slot next to the standard I/O slot) * If 0 (= Do not monitor) or 2 (= Monitor (Monitor only errors relating to 24-V I/O power source)) is selected, a system error will not generate even when an abnormality relating to the 24-V I/O power source occurs. However, all subsequent actual outputs from the digital I/O board will be cut off by a circuit to protect the controller.
12	Expanded I/O2 error monitor (I/O3)	1	0 to 5		0: Do not monitor 1: Monitor 2: Monitor (Do not monitor errors relating to 24-V I/O power source) 3: Monitor (Monitor only errors relating to 24-V I/O power source) * Some exceptions apply. * If 0 (= Do not monitor) or 2 (= Monitor (Monitor only errors relating to 24-V I/O power source)) is selected, a system error will not generate even when an abnormality relating to the 24-V I/O power source occurs. However, all subsequent actual outputs from the digital I/O board will be cut off by a circuit to protect the controller.

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
13	Expanded I/O3 error monitor (I/O4)	1	0 to 5		0: Do not monitor 1: Monitor 2: Monitor (Do not monitor errors relating to 24-V I/O power source) 3: Monitor (Monitor only errors relating to 24-V I/O power source) * Some exceptions apply. * If 0 (= Do not monitor) or 2 (= Monitor (Monitor only errors relating to 24-V I/O power source)) is selected, a system error will not generate even when an abnormality relating to the 24-V I/O power source occurs. However, all subsequent actual outputs from the digital I/O board will be cut off by a circuit to protect the controller.
14	Number of network I/F module remote input ports used	0	0 to 256		Multiple of 8
15	Number of network I/F module remote output ports used	0	0 to 256		Multiple of 8
16	Starting input port number based on fixed network I/F module assignments	-1	-1 to 599		0 + (Multiple of 8) (Invalid if a negative value is set)
17	Starting output port number based on fixed network I/F module assignments	-1	-1 to 599		300 + (Multiple of 8) (Invalid if a negative value is set)
18	Network I/F module error monitor	1	0 to 5		0: Do not monitor 1: Monitor * Some exceptions apply.
19	(For expansion)	0			
20	Input filtering periods	2	1 to 9	msec	Input signal is recognized when the status is held for twice the period set by this parameter.
21	For future expansion (change prohibited)	0	1 to 9		
22	Remote-I/O-card fieldbus ready timeout value	2000	0 to 99999	msec	Timeout check is not performed if “0” is set.
23	Overcurrent/power-supply error detection input specification for multi-point DIO external terminal block	0H	0H to FFFFFFFFH		Bits 0 to 3: Standard I/O (I/O1) input specification Bits 4 to 7: Expanded I/O1 (I/O2) input specification Bits 8 to 11: Expanded I/O2 (I/O3) input specification Bits 12 to 15: Expanded I/O3 (I/O4) input specification (0: Do not use error detection input 1: Use error detection input = IN023 on card 2: Use error detection input = IN047 on card 3: Use error detection input = IN023/47 on card) * Determine an appropriate setting after checking the specification of the multi-point DIO terminal block unit to be connected. * The input port used for the error detection input cannot be used as a general-purpose input port.
24	I/O setting bit pattern 1 (global specification)	10000H	0H to FFFFFFFFH		Bits 0 to 3: RDY OUT function selection (System IO) (0: SYSRDY (Software = PIO trigger program can be run) and hardware is normal (emergency stop has not been actuated and hardware error is not present) 1: Error of operation-cancellation level or higher is not present 2: Error of cold-start level or higher is not present) Bits 4 to 7: RDY LED function selection (0: Program can be run 1: Error of operation-cancellation level or higher is not present 2: Error of cold-start level or higher is not present) Bits 8 to 11: DET (MELT) (drive-source cutoff relay fused) signal enable/disable selection (0: Disable, 1: Enable) Bits 12 to 15: Drive-source cutoff relay DET (MELT) error level (when voltage drop cannot be checked) (0: Cold start, 1: Message) Bits 16 to 19: Drive-source cutoff relay DET (MELT) error level (when voltage drop is checked) (0: Cold start, 1: Message)

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
25	I/O setting bit pattern 2 (global specification)	0H	0H to FFFFFFFFH		Bits 0 to 3: For future expansion Bits 4 to 7: For future expansion
26 to 27	(For expansion)	0			
28	I/O ready output port number	0	0 to 6999		Output port ON when I/O is ready (invalid, if 0) (Main application version 0.66 or later/F-ROM 32-Mbit version only)
29	Drive-source cutoff (SDN) notification physical output port number	0	0 to 6999		Output port OFF at drive-source cutoff (* Important: This output is used only for notification by software) (Invalid if "0" is set) (Main application version 0.13 or later) * Note: Enter a hexadecimal value if a tool (PC/TP) of a version in which "h" is displayed in the input area is used. * With the F-ROM 16-Mbit version, only output port Nos. 300 to 599 are valid.
30	Input function selection 000	1	0 to 5		0: General-purpose input 1: Program start signal (ON edge) (Input ports 007 to 013, BCD-specified program number) 2: Program start signal (ON edge) (Input ports 007 to 013, binary-specified program number) 3: Program start signal (ON edge) (Input port Nos. 008 to 014, BCD-specified program number) (Main application version 0.39 or later) Note: The function of "I/O parameter No. 44, Input function selection 014" (relating to drive-source cutoff reset) is assigned to "I/O parameter No. 37, Input function selection 007," while the function of "I/O parameter No. 43, Input function selection 013" (error reset, program number specified for program start) is assigned to "I/O parameter No. 44, Input function selection 014." To specify a program number of 7 bit long, "1: Program number specified for program start" must be set for "I/O parameter No. 38, Input function selection 008" through "I/O parameter No. 44, "Input function selection 014." 4: Program start signal (ON edge) (Input port Nos. 008 to 014, binary-specified program number) (Main application version 0.39 or later) Note: The function of "I/O parameter No. 44, Input function selection 014" (relating to drive-source cutoff reset) is assigned to "I/O parameter No. 37, Input function selection 007," while the function of "I/O parameter No. 43, Input function selection 013" (error reset, program number specified for program start) is assigned to "I/O parameter No. 44, Input function selection 014." To specify a program number of 7 bit long, "1: Program number specified for program start" must be set for "I/O parameter No. 38, Input function selection 008" through "I/O parameter No. 44, "Input function selection 014." * When using this signal to start a program, make sure the signal remains ON for 100 msec or longer so that the program will start without fail. * With the F-ROM 32-Mbit version, only BCD-specified program Nos. 1 to 79 or binary-specified program Nos. 1 to 127 can be started. Program No. 128 cannot be started using this signal. Note: The port number assigned to this function can be changed using I/O parameter No. 283, "Port number assigned to input function selection 000." (Main application version 0.64 or later/F-ROM 32-Mbit version only)

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
31	Input function selection 001	0	0 to 5		0: General-purpose input 1: Software reset signal (1secON) * If continued operation is specified as the action upon emergency stop, enable the software reset signal (to provide a means of canceling the operation). Note: The port number assigned to this function can be changed using I/O parameter No. 284, "Port number assigned to input function selection 001." (Main application version 0.64 or later/F-ROM 32-Mbit version only)
32	Input function selection 002	0	0 to 5		0: General-purpose input 1: Servo ON * ON edge: Equivalent to the all-valid-axis servo ON command, OFF edge: Equivalent to the all-valid-axis servo OFF command (A minimum interval of 1.5 seconds is required) (Must be executed in non-operating condition) Note: The port number assigned to this function can be changed using I/O parameter No. 285, "Port number assigned to input function selection 002." (Main application version 0.64 or later/F-ROM 32-Mbit version only)
33	Input function selection 003	1	0 to 5		0: General-purpose input 1: General-purpose input (Start the auto-start program upon power-ON reset/software reset in the AUTO mode) 2: Auto-start program start signal (ON edge: Start, OFF edge: Abort all operations/programs (excluding the I/O processing program at operation/program abort)) * If this parameter is used as an auto-start program start signal, turn ON the signal for at least 100 msec so that the program will start without fail. Note: The port number assigned to this function can be changed using I/O parameter No. 286, "Port number assigned to input function selection 003." (Main application version 0.64 or later/F-ROM 32-Mbit version only)
34	Input function selection 004	0	0 to 5		0: General-purpose input 1: All servo axis soft interlock (OFF level) (Valid for all commands other than the servo OFF command) (Operation is held upon interlock actuation during automatic operation; operation is terminated upon interlock in non-AUTO mode) Note: The port number assigned to this function can be changed using I/O parameter No. 287, "Port number assigned to input function selection 004." (Main application version 0.64 or later/F-ROM 32-Mbit version only)
35	Input function selection 005	0	0 to 5		0: General-purpose input, 1: Operation-pause reset signal (ON edge) Note: The port number assigned to this function can be changed using I/O parameter No. 288, "Port number assigned to input function selection 005." (Main application version 0.64 or later/F-ROM 32-Mbit version only)
36	Input function selection 006	0	0 to 5		0: General-purpose input 1: Operation-pause reset signal (OFF level) (Valid only during automatic operation) * Cancel pause when an operation-pause reset signal is received. Note: The port number assigned to this function can be changed using I/O parameter No. 289, "Port number assigned to input function selection 006." (Main application version 0.64 or later/F-ROM 32-Mbit version only)
37	Input function selection 007	1	0 to 5		0: General-purpose input, 1: Program number specified for program start (least significant bit) Note: The assignment changes depending on the value set in "I/O parameter No. 30, Input function selection 000." (Main application version 0.39 or later) Note: The port number assigned to this function can be changed using I/O parameter No. 290, "Port number assigned to input function selection 007." (Main application version 0.64 or later/F-ROM 32-Mbit version only)

Appendix

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
38	Input function selection 008	1	0 to 5		0: General-purpose input, 1: Program number specified for program start Note: The assignment changes depending on the value set in "I/O parameter No. 30, Input function selection 000." (Main application version 0.39 or later) Note: The port number assigned to this function can be changed using I/O parameter No. 291, "Port number assigned to input function selection 008." (Main application version 0.64 or later/F-ROM 32-Mbit version only)
39	Input function selection 009	1	0 to 5		0: General-purpose input, 1: Program number specified for program start Note: The assignment changes depending on the value set in "I/O parameter No. 30, Input function selection 000." (Main application version 0.39 or later) Note: The port number assigned to this function can be changed using I/O parameter No. 292, "Port number assigned to input function selection 009." (Main application version 0.64 or later/F-ROM 32-Mbit version only)
40	Input function selection 010	1	0 to 5		0: General-purpose input, 1: Program number specified for program start Note: The assignment changes depending on the value set in "I/O parameter No. 30, Input function selection 000." (Main application version 0.39 or later) Note: The port number assigned to this function can be changed using I/O parameter No. 293, "Port number assigned to input function selection 010." (Main application version 0.64 or later/F-ROM 32-Mbit version only)
41	Input function selection 011	1	0 to 5		0: General-purpose input, 1: Program number specified for program start Note: The assignment changes depending on the value set in "I/O parameter No. 30, Input function selection 000." (Main application version 0.39 or later) Note: The port number assigned to this function can be changed using I/O parameter No. 294, "Port number assigned to input function selection 011." (Main application version 0.64 or later/F-ROM 32-Mbit version only)
42	Input function selection 012	1	0 to 5		0: General-purpose input, 1: Program number specified for program start Note: The assignment changes depending on the value set in "I/O parameter No. 30, Input function selection 000." (Main application version 0.39 or later) Note: The port number assigned to this function can be changed using I/O parameter No. 295, "Port number assigned to input function selection 012." (Main application version 0.64 or later/F-ROM 32-Mbit version only)
43	Input function selection 013	1	0 to 5		0: General-purpose input 1: Program number specified for program start 2: Error reset (ON edge) Note: The assignment changes depending on the value set in "I/O parameter No. 30, Input function selection 000." (Main application version 0.39 or later) Note: The port number assigned to this function can be changed using I/O parameter No. 296, "Port number assigned to input function selection 013." (Main application version 0.64 or later/F-ROM 32-Mbit version only)
44	Input function selection 014	0	0 to 5		0: General-purpose input (Cancel cutoff when the drive-source cutoff factor is removed) 1: Drive-source cutoff reset input (ON edge) (Valid when the factor has been removed) * Drive-source cutoff reset control is not available for axes whose motor-drive power unit is not housed inside this controller or whose drive-source cutoff circuit is not controlled by this controller. Note: The assignment changes depending on the value set in "I/O parameter No. 30, Input function selection 000." (Main application version 0.39 or later) Note: The port number assigned to this function can be changed using I/O parameter No. 297, "Port number assigned to input function selection 014." (Main application version 0.64 or later/F-ROM 32-Mbit version only)

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
45	Input function selection 015	0	0 to 5		0: General-purpose input 1: Home return of all valid axes (ON edge) (Servo ON must be executed first = I/O parameter No. 32, Axis-specific parameter No. 13) 2: Home return of all valid incremental axes (ON edge) (Servo ON must be executed first = I/O parameter No. 32, Axis-specific parameter No. 13) Note: The port number assigned to this function can be changed using I/O parameter No. 298, “Port number assigned to input function selection 015.” (Main application version 0.64 or later/F-ROM 32-Mbit version only)
46	Output function selection 300	2	0 to 20		0: General-purpose output 1: Output error of operation-cancellation level or higher (ON) 2: Output error of operation-cancellation level or higher (OFF) 3: Output error of operation-cancellation level or higher + emergency stop (ON) 4: Output error of operation-cancellation level or higher + emergency stop (OFF) Note: The port number assigned to this function can be changed using I/O parameter No. 299, “Port number assigned to output function selection 300.” (Main application version 0.64 or later/F-ROM 32-Mbit version only)
47	Output function selection 301	3	0 to 20		0: General-purpose output 1: READY output (PIO trigger program can be run) 2: READY output (PIO trigger program can be run and error of operation-cancellation level or higher is not present) 3: READY output (PIO trigger program can be run and error of cold-start level or higher is not present) Note: The port number assigned to this function can be changed using I/O parameter No. 300, “Port number assigned to output function selection 301.” (Main application version 0.64 or later/F-ROM 32-Mbit version only)
48	Output function selection 302	2	0 to 20		0: General-purpose output 1: Emergency-stop output (ON) 2: Emergency-stop output (OFF) Note: The port number assigned to this function can be changed using I/O parameter No. 301, “Port number assigned to output function selection 302.” (Main application version 0.64 or later/F-ROM 32-Mbit version only)
49	Output function selection 303	0	0 to 5		0: General-purpose output 1: AUTO mode output 2: Output during automatic operation (Other parameter No. 12) Note: The port number assigned to this function can be changed using I/O parameter No. 302, “Port number assigned to output function selection 303.” (Main application version 0.64 or later/F-ROM 32-Mbit version only)
50	Output function selection 304	0	0 to 5		0: General-purpose output 1: Output if all valid axes are at home (= 0) 2: Output if all valid axes completed home return (coordinates are confirmed) 3: Output if all valid axes are at preset home coordinates * To move an absolute-encoder axis to coordinates 0 or the preset home coordinates, use a MOVP command instead of a HOME command. Note: The port number assigned to this function can be changed using I/O parameter No. 303, “Port number assigned to output function selection 304.” (Main application version 0.64 or later/F-ROM 32-Mbit version only)

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
51	Output function selection 305	0	0 to 5		0: General-purpose output 1: Axis 1 in-position output (OFF if the work part is missed during push-motion operation) 2: Output when axis-1 servo is ON (System monitor task output) 3: For future expansion Note: The port number assigned to this function can be changed using I/O parameter No. 304, "Port number assigned to output function selection 305." (Main application version 0.64 or later/F-ROM 32-Mbit version only)
52	Output function selection 306	0	0 to 5		0: General-purpose output 1: Axis 2 in-position output (OFF if the work part is missed during push-motion operation) 2: Output when axis-2 servo is ON (System monitor task output) 3: For future expansion Note: The port number assigned to this function can be changed using I/O parameter No. 305, "Port number assigned to output function selection 306." (Main application version 0.64 or later/F-ROM 32-Mbit version only)
53	Output function selection 307	0	0 to 5		0: General-purpose output 1: Axis 3 in-position output (OFF if the work part is missed during push-motion operation) 2: Output when axis-3 servo is ON (System monitor task output) 3: For future expansion Note: The port number assigned to this function can be changed using I/O parameter No. 306, "Port number assigned to output function selection 307." (Main application version 0.64 or later/F-ROM 32-Mbit version only)
54	Output function selection 308	0	0 to 5		0: General-purpose output 1: Axis 4 in-position output (OFF if the work part is missed during push-motion operation) 2: Output when axis-4 servo is ON (System monitor task output) 3: For future expansion Note: The port number assigned to this function can be changed using I/O parameter No. 307, "Port number assigned to output function selection 308." (Main application version 0.64 or later/F-ROM 32-Mbit version only)
55	Output function selection 309	0	0 to 5		0: General-purpose output 1: Axis 5 in-position output (OFF if the work part is missed during push-motion operation) 2: Output when axis-5 servo is ON (System monitor task output) 3: For future expansion Note: The port number assigned to this function can be changed using I/O parameter No. 308, "Port number assigned to output function selection 309." (Main application version 0.64 or later/F-ROM 32-Mbit version only)
56	Output function selection 310	0	0 to 5		0: General-purpose output 1: Axis 6 in-position output (OFF if the work part is missed during push-motion operation) 2: Output when axis-6 servo is ON (System monitor task output) 3: For future expansion Note: The port number assigned to this function can be changed using I/O parameter No. 309, "Port number assigned to output function selection 310." (Main application version 0.64 or later/F-ROM 32-Mbit version only)
57	Output function selection 311	0	0 to 5		0: General-purpose output, 1 to 3: For future expansion Note: The port number assigned to this function can be changed using I/O parameter No. 310, "Port number assigned to output function selection 311." (Main application version 0.64 or later/F-ROM 32-Mbit version only)
58	Output function selection 312	0	0 to 5		0: General-purpose output, 1 to 3: For future expansion Note: The port number assigned to this function can be changed using I/O parameter No. 311, "Port number assigned to output function selection 312." (Main application version 0.64 or later/F-ROM 32-Mbit version only)

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
59	Output function selection 313	0	0 to 5		0: General-purpose output 1: System-memory backup battery voltage-low warning level or lower Note: The port number assigned to this function can be changed using I/O parameter No. 312, "Port number assigned to output function selection 313." (Main application version 0.64 or later/F-ROM 32-Mbit version only)
60	Output function selection 314	0	0 to 5		0: General-purpose output 1: Absolute-data backup battery voltage-low warning level or lower (OR check of all axes. Upon detection of abnormal level, the output will be latched until a power-ON reset or software reset is executed.) Note: The port number assigned to this function can be changed using I/O parameter No. 313, "Port number assigned to output function selection 314." (Main application version 0.64 or later/F-ROM 32-Mbit version only)
61	Output function selection 315	0	0 to 5		0: General-purpose output Note: The port number assigned to this function can be changed using I/O parameter No. 314, "Port number assigned to output function selection 315." (Main application version 0.64 or later/F-ROM 32-Mbit version only)
62	Physical input port number for axis-1 brake forced release	0	0 to 3999		Forcibly unlock the brake when the applicable port is ON (be aware of a falling load). * Invalid if "0" is set (Invalid if input port No. 0 is specified) * The synchro slave axis will follow the synchro master axis. * With the F-ROM 16-Mbit version, only output port Nos. 000 to 299 are valid.
63	Physical input port number for axis-2 brake forced release	0	0 to 3999		Forcibly unlock the brake when the applicable port is ON (be aware of a falling load). * Invalid if "0" is set (Invalid if input port No. 0 is specified) * The synchro slave axis will follow the synchro master axis. * With the F-ROM 16-Mbit version, only output port Nos. 000 to 299 are valid.
64	Physical input port number for axis-3 brake forced release	0	0 to 3999		Forcibly unlock the brake when the applicable port is ON (be aware of a falling load). * Invalid if "0" is set (Invalid if input port No. 0 is specified) * The synchro slave axis will follow the synchro master axis. * With the F-ROM 16-Mbit version, only output port Nos. 000 to 299 are valid.
65	Physical input port number for axis-4 brake forced release	0	0 to 3999		Forcibly unlock the brake when the applicable port is ON (be aware of a falling load). * Invalid if "0" is set (Invalid if input port No. 0 is specified) * The synchro slave axis will follow the synchro master axis. * With the F-ROM 16-Mbit version, only output port Nos. 000 to 299 are valid.
66	Physical input port number for axis-5 brake forced release	0	0 to 3999		Forcibly unlock the brake when the applicable port is ON (be aware of a falling load). * Invalid if "0" is set (Invalid if input port No. 0 is specified) * The synchro slave axis will follow the synchro master axis. * Valid only when the controller supports up to 6 axes. * With the F-ROM 16-Mbit version, only output port Nos. 000 to 299 are valid.
67	Physical input port number for axis-6 brake forced release	0	0 to 3999		Forcibly unlock the brake when the applicable port is ON (be aware of a falling load). * Invalid if "0" is set (Invalid if input port No. 0 is specified) * The synchro slave axis will follow the synchro master axis. * Valid only when the controller supports up to 6 axes. * With the F-ROM 16-Mbit version, only output port Nos. 000 to 299 are valid.
68 to 69	(For expansion)	0			(For future expansion)
70	Unaffected general-purpose output area number (MIN) when all operations/programs are aborted	0	0 to 6999		* Important: Outputs in this area must be operated under the responsibility of user programs including the "I/O processing program at operation/program abort." Outputs outside this area will be forcibly turned OFF. (Invalid if "0" is set) * With the F-ROM 16-Mbit version, only output port Nos. 300 to 599 are valid.
71	Unaffected general-purpose output area number (MAX) when all operations/ programs are aborted	0	0 to 6999		

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
72	Unaffected general-purpose output area number (MIN) when all operations are paused (servo-axis soft interlock + output-port soft interlock)	300	0 to 6999		* Important: Outputs in this area must be operated (including recovery) under the responsibility of user programs including the "I/O processing program at all operations pause." Outputs outside this area will be forcibly turned OFF, reflecting/holding the results of operations performed while all operation pause is effective (only during automatic operation). (Invalid if "0" is set) * With the F-ROM 16-Mbit version, only output port Nos. 300 to 599 are valid.
73	Unaffected general-purpose output area number (MAX) when all operations are paused (servo-axis soft interlock + output-port soft interlock)	599	0 to 6999		
74	Number of PC/TP user output ports used (hand, etc.)	0	0 to 8		Referenced by PC/TP. (Invalid if "0" is set)
75	PC/TP user output port start number (hand, etc.)	0	0 to 7599		Referenced by PC/TP.
76	AUTO mode physical output port number	0	0 to 6999		(Invalid if "0" is set) * With the F-ROM 16-Mbit version, only output port Nos. 300 to 599 are valid.
77	Input port number permitted to receive PC/TP servo movement command	0	0 to 3999		* Important: Invalid once operation is started. (Invalid if "0" is set)
78	Axis pattern permitted to receive PC/TP servo movement command for	0	0B to 11111111 B		
79	Input port number for remote mode control	0	0 to 3999		System mode = MANU if specified DI = ON or AUTO/MANU-SW = MANU. (Invalid if "0" is set) * Debug filter is invalid for the remote-mode control input port * With the F-ROM 16-Mbit version, only output port Nos. 000 to 299 are valid.
80	(PC/TP SIO usage)	1	1 to 1		Switching of DIP switches
81	(PC/TP SIO station code)	153	153 to 153		Fixed to 153 (99H).
82 to 89	(PC/TP SIO reservation)	0			
90	Usage of SIO channel 0 opened to user (AUTO mode)	0	0 to 9		0: Open SEL program 1: Open SEL program (Connect PC/TP when both devices are closed = Used exclusively by the manufacturer) 2: IAI protocol B (Slave)
91	Station code of SIO channel 0 opened to user	153	0 to 255		Valid only with IAI protocol.
92	Baud rate type of SIO channel 0 opened to user	0	0 to 5		0: 9.6, 1: 19.2, 2: 38.4, 3: 57.6, 4: 76.8, 5: 115.2 kbps
93	Data length of SIO channel 0 opened to user	8	7 to 8		
94	Stop bit length of SIO channel 0 opened to user	1	1 to 2		
95	Parity type of SIO channel 0 opened to user	0	0 to 2		0: None 1: Odd 2: Even
96	Receive operation type of SIO channel 0 opened to user	0	0 to 1		0: Forcibly enable receive after send 1: Do not forcibly enable receive at send
97	IAI-protocol minimum response delay for SIO channel 0 opened to user	0	0 to 999	msec	Valid only with IAI protocol.
98	(Reservation of SIO channel 0 opened to user)	0			
99	(Reservation of SIO channel 0 opened to user)	0			

PC: PC software
TP: Teaching pendant

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
100	SIO system use (SP3) (expanded)	28100010H	0H to FFFFFFFFH		Bits 28 to 31: Baud rate type (0: 9.6, 1: 19.2, 2: 38.4, 3: 57.6, 4: 76.8, 5: 115.2 kbps) Bits 24 to 27: Data length (7 or 8) Bits 20 to 23: Stop bit length (1 or 2) Bits 16 to 19: Parity type (0: None, 1: Odd, 2: Even) Bits 12 to 15: Communication mode (0: RS232C, 1: RS422, 2: RS485) * Only “0” can be selected for board channels other than Nos. 1 and 2 Bits 8 to 11: Receive operation type (0: RS485 = Forcibly enable receive immediately after send, RS232C/RS422 = Forcibly enable receive immediately before send 1: Do not forcibly enable receive at send) Bits 4 to 7: Board channel assignment number (1: D-sub upper, 2: D-sub lower, 3: Flat connector upper, 4: Flat connector lower) Bits 0 to 3: Expanded I/O slot assignment number (Expanded I/O slots 1 to 3 from the slot next to the standard IO (I/O1) slot. * “0” means no slots are used)
101	(Reservation of SIO (SP3) (expanded))	0	0H to FFFFFFFFH		
102	SIO system use (SP4) (expanded)	28100020H	0H to FFFFFFFFH		(Same as with I/O parameter No. 100)
103	(Reservation of SIO (SP4) (expanded))	0	0H to FFFFFFFFH		
104	SIO system use (SP5) (expanded)	28100010H	0H to FFFFFFFFH		(Same as with I/O parameter No. 100)
105	(Reservation of SIO (SP5) (expanded))	0	0H to FFFFFFFFH		
106	SIO system use (SP6) (expanded)	28100020H	0H to FFFFFFFFH		(Same as with I/O parameter No. 100)
107	(Reservation of SIO (SP6) (expanded))	0	0H to FFFFFFFFH		
108	SIO system use (SP7) (expanded)	28100010H	0H to FFFFFFFFH		(Same as with I/O parameter No. 100)
109	(Reservation of SIO (SP7) (expanded))	0	0H to FFFFFFFFH		
110	SIO system use (SP8) (expanded)	28100020H	0H to FFFFFFFFH		(Same as with I/O parameter No. 100)
111	(Reservation of SIO (SP8) (expanded))	0	0H to FFFFFFFFH		
112	SIO system use (SP9) (expanded)	28100030H	0H to FFFFFFFFH		(Same as with I/O parameter No. 100)
113	(SIO system reserve (SP9)) (expanded)	0	0H to FFFFFFFFH		
114	SIO system use (SP10) (expanded)	28100040H	0H to FFFFFFFFH		(Same as with I/O parameter No. 100)
115	(SIO system reserve (SP10)) (expanded)	0	0H to FFFFFFFFH		
116 to 119	(For expansion)	0			

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
120	Network attribute 1	1H	0H to FFFFFFFFH		Bits 0 to 3: CC-Link remote register area H/L byte swap selection (0: Do not swap, 1: Swap) * The number of used ports and number of occupied stations in I/O parameter Nos. 14 and 15 must match. Bits 4 to 11: Network link error check timer value (10msec) (Main application ver. 1.39 or later, F-ROM32bit version only)
121	Network attribute 2	0	0H to FFFFFFFFH		
122	Network attribute 3	0	0H to FFFFFFFFH		
123	Network attribute 4	0H	0H to FFFFFFFFH		Bits 0 to 3: Ethernet TCP/IP message communication Selection whether to permit 0.0.0.0 (IP address of connection destination can be ignored) as IP address of connection destination on server (0: Do not permit 1: Permit (not recommended)) * Note: Number of clients that can be connected simultaneously to one server port channel = 1
124	Network attribute 5	0H	0H to FFFFFFFFH		Ethernet TCP/IP message communication attribute Ethernet client/server type (0: Not in use 1: Client (Automatic assignment of own port number) (2: Client (Specification of own port number) → This setting is not recommended because of device limitations, such as an error generation when the port is opened for approx. 10 minutes after disablement of close response check due to a power failure at the connection destination, etc.) 3: Server (Specification of own port number)) * Note: Number of clients that can be connected simultaneously to one server port channel = 1 Bits 0 to 3: IAI protocol B/TCP (MANU mode) * PC software can be connected only in the case of a client. Bits 4 to 7: IAI protocol B/TCP (AUTO mode) * PC software can be connected only in the case of a client. Bits 8 to 11: Channel 31 opened to user Bits 12 to 15: Channel 32 opened to user Bits 16 to 19: Channel 33 opened to user Bits 20 to 23: Channel 34 opened to user * If the parameter settings for own port number, client/server type, IP address of connection destination and port number of connection destination do not match completely between the IAI protocol B/TCP MANU and AUTO modes, the connection will be cut off when the MANU/AUTO mode is switched.
125	Network attribute 6	31E32h	0H to FFFFFFFFH		Bits 0 to 7: Module-initialization check timer setting when Ethernet is used (100 msec) Bits 8 to 15: Module-initialization check timer setting when Ethernet is not used (100 msec) Bits 16 to 23: Increment of “PC/TP reconnection delay at software reset” when Ethernet is used (sec)

PC: PC software
TP: Teaching pendant

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
126	Network attribute 7	7D007D0H	0H to FFFFFFFFH		Ethernet TCP/IP message communication attribute Bits 0 to 15: Min timeout value (msec) Bits 16 to 31: Mout timeout value (msec)
127	Network attribute 8	5050214H	0H to FFFFFFFFH		Ethernet TCP/IP message communication attribute Bits 0 to 7: CONNECT_TIMEOUT (Change is prohibited) (Setting of “0” is prohibited) (sec) Bits 8 to 15: Connection retry interval (IAI protocol B/TCP) (sec) Bits 16 to 23: Send timeout value (sec) Bits 24 to 31: IAI protocol B-SIO non-communication check timer setting (sec) (IAI protocol B/TCP connection trigger)
128	Network attribute 9	0H	0H to FFFFFFFFH		Ethernet TCP/IP message communication attribute Bits 0 to 15: SEL server open timeout value (sec) (No timeout check when “0” is set)
129	Network attribute 10	0H	0H to FFFFFFFFH		Ethernet operation requirement Bits 0 to 3: Remote I/O 0: Not in use 1: Use Modbus/TCP (Disable EXCEPTION status) 2: Use Modbus/TCP (Enable EXCEPTION status (upper two digits of error number)) * Refer to the explanation of error levels in the operation manual and perform processing appropriate for each error level. 3: EtherNet/IP (Main application version 1.05 or later) Bits 4 to 7: TCP/IP message communication (0: Not in use, 1: Use) Bits 8 to 31: Reserved (Operation requirement)
130	Own MAC address (H)	0H	Reference only (HEX)		Only lower two bytes are valid.
131	Own MAC address (L)	0H	Reference only (HEX)		
132	Own IP address (H)	192	1 to 255		*Setting of “0” and “127” is prohibited.
133	Own IP address (MH)	168	0 to 255		
134	Own IP address (ML)	0	0 to 255		
135	Own IP address (L)	1	1 to 254		*Setting of “0” and “255” is prohibited.
136	Subnet mask (H)	255	0 to 255		
137	Subnet mask (MH)	255	0 to 255		
138	Subnet mask (ML)	255	0 to 255		
139	Subnet mask (L)	0	0 to 255		
140	Default gateway (H)	0	0 to 255		
141	Default gateway (MH)	0	0 to 255		
142	Default gateway (ML)	0	0 to 255		
143	Default gateway (L)	0	0 to 255		

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
144	IAI protocol B/TCP: Own port number (MANU mode)	64511	1025 to 65535		* Important note: Always set a unique number for each port number. (Duplication of port numbers is permitted only in the IAI protocol B/TCP MANU/AUTO modes.)
145	Channel 31 opened to user (TCP/IP): Own port number	64512	1025 to 65535		
146	Channel 32 opened to user (TCP/IP): Own port number	64513	1025 to 65535		
147	Channel 33 opened to user (TCP/IP): Own port number	64514	1025 to 65535		
148	Channel 34 opened to user (TCP/IP): Own port number	64515	1025 to 65535		
149	IAI protocol B/TCP: IP address of connection destination (MANU mode) (H)	192	0 to 255		* Setting of “0” and “127” is prohibited.
150	IAI protocol B/TCP: IP address of connection destination (MANU mode) (MH)	168	0 to 255		
151	IAI protocol B/TCP: IP address of connection destination (MANU mode) (ML)	0	0 to 255		
152	IAI protocol B/TCP: IP address of connection destination (MANU mode) (L)	100	0 to 254		* Setting of “0” and “255” is prohibited.
153	IAI protocol B/TCP: Port number of connection destination (MANU mode)	64611	0 to 65535		* “0” can be set in the case of a server. 0 = Port number of connection destination is ignored (only the IP address is checked) * “0” cannot be set in the case of a client.
154	IAI protocol B/TCP: IP address of connection destination (AUTO mode) (H)	192	0 to 255		* Setting of “0” and “127” is prohibited.
155	IAI protocol B/TCP: IP address of connection destination (AUTO mode) (MH)	168	0 to 255		
156	IAI protocol B/TCP: IP address of connection destination (AUTO mode) (ML)	0	0 to 255		
157	IAI protocol B/TCP: IP address of connection destination (AUTO mode) (L)	100	0 to 254		* Setting of “0” and “255” is prohibited.
158	IAI protocol B/TCP: Port number of connection destination (AUTO mode)	64611	0 to 65535		* “0” can be set in the case of a server. 0 = Port number of connection destination is ignored (only the IP address is checked) * “0” cannot be set in the case of a client.
159	IAI protocol B/TCP: Own port number (AUTO mode)	64516	1025 to 65535		* Important note: Always set a unique number for each port number. (Duplication of port numbers is permitted only in the IAI protocol B/TCP MANU/AUTO modes.)
160 to 169	(For network expansion)	0			
170 to 200	(For expansion)	0			

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
201	Attribute 1 of SIO channel 1 opened to user (standard mount)	28100001H	0H to FFFFFFFFH		Bits 28 to 31: Baud rate type (0: 9.6, 1: 19.2, 2: 38.4, 3: 57.6, 4: 76.8, 5: 115.2 kbps) * If flow control is performed, select 38.4 kbps or below. Use of a higher baud rate may generate an overrun error, etc. Bits 24 to 27 Data length (7 or 8) Bits 20 to 23: Stop bit length (1 or 2) Bits 16 to 19: Parity type (0: None, 1: Odd, 2: Even) Bits 12 to 15: For future expansion Bits 8 to 11: For future expansion Bits 4 to 7: For future expansion Bits 0 to 3: Use selection (0: Do not use, 1: Use) * Used on the application level.
202	Attribute 2 of SIO channel 1 opened to user (standard mount)	00000001H	0H to FFFFFFFFH		Bits 28 to 31: For future expansion Bits 24 to 27: For future expansion Bits 20 to 23: For future expansion Bits 16 to 19: Character transmission interval (msec) Bits 12 to 15: Communication method (0: Full-duplex, 1: Half-duplex) Bits 8 to 11: Send operation type in half-duplex communication (0: Do not check CTS-ON at send 1: Check CTS-ON at send) Bits 0 to 7: Minimum Receive → Send switching delay in half-duplex communication (msec)
203	Attribute 3 of SIO channel 1 opened to user (standard mount)	01118040H	0H to FFFFFFFFH		Bits 28 to 31: Flow control type (0: None, 1: Xon/Xoff, 2: Hardware) * Valid only in full-duplex communication. * If flow control is performed, select 38.4 kbps or below. Use of a higher baud rate may generate an overrun error, etc. Bits 24 to 27: Xon send selection when send is enabled after SIO-CPU reset (0: Do not send, 1: Send) * Valid only in full-duplex communication with Xon/Xoff flow control Bits 20 to 23: Send enable/disable selection at port open (0: Disable, 1: Enable) * Valid only in full-duplex communication with Xon/Xoff flow control. Bits 16 to 19: Xon/Xoff send selection at port close (0: Do not send, 1: Send Xon, 2: Send Xoff) * Valid only in full-duplex communication with Xon/Xoff flow control. Bits 8 to 15: Flow control high limit (bytes) Bits 0 to 7: Flow control low limit (bytes) * If values are set to a magnitude correlation of "Flow control low limit ≥ SCI receive buffer size – Flow control high limit," both the flow control high/low limits will be converted to a value corresponding to one-fourth the SCI receive buffer size. (SCI Receiving Buffer Size＝192 bytes) .

Appendix

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
204	Attribute 4 of SIO channel 1 opened to user (standard mount)	00000000H	0H to FFFFFFFFH		
205	Attribute 5 of SIO channel 1 opened to user (standard mount)	00000000H	0H to FFFFFFFFH		
206	Attribute 6 of SIO channel 1 opened to user (standard mount)	00000000H	0H to FFFFFFFFH		
207	Attribute 7 of SIO channel 1 opened to user (standard mount)	00000000H	0H to FFFFFFFFH		
208	Attribute 8 of SIO channel 1 opened to user (standard mount)	00000000H	0H to FFFFFFFFH		
209	Attribute 9 of SIO channel 1 opened to user (standard mount)	00000000H	0H to FFFFFFFFH		
210	Attribute 10 of SIO channel 1 opened to user (standard mount)	00000000H	0H to FFFFFFFFH		
211	Attribute 11 of SIO channel 1 opened to user (standard mount)	00000000H	0H to FFFFFFFFH		
212	Attribute 12 of SIO channel 1 opened to user (standard mount)	00000000H	0H to FFFFFFFFH		
213	Attribute 1 of SIO channel 2 opened to user (standard mount)	28100001H	0H to FFFFFFFFH		Bits 28 to 31: Baud rate type (0: 9.6, 1: 19.2, 2: 38.4, 3: 57.6, 4: 76.8, 5: 115.2 kbps) * If flow control is performed, select 38.4 kbps or below. Use of a higher baud rate may generate an overrun error, etc. Bits 24 to 27 Data length (7 or 8) Bits 20 to 23: Stop bit length (1 or 2) Bits 16 to 19: Parity type (0: None, 1: Odd, 2: Even) Bits 12 to 15: Communication mode (0: RS232C, 1: RC gateway) * The RC gateway mode is valid only for channel 2. (Main application version 0.65 or later/controller with expanded memory (with gateway function) only) Bits 8 to 11: For future expansion Bits 4 to 7: For future expansion Bits 0 to 3: Use selection (0: Do not use, 1: Use) * Used on the application level.
214	Attribute 2 of SIO channel 2 opened to user (standard mount)	00000001H	0H to FFFFFFFFH		Bits 28 to 31: For future expansion Bits 24 to 27: For future expansion Bits 20 to 23: For future expansion Bits 16 to 19: Character transmission interval (msec) Bits 12 to 15: Communication method (0: Full-duplex, 1: Half-duplex) Bits 8 to 11: Send operation type in half-duplex communication (0: Do not check CTS-ON at send 1: Check CTS-ON at send) Bits 0 to 7: Minimum Receive → Send switching delay in half-duplex communication (msec)

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
215	Attribute 3 of SIO channel 2 opened to user (standard mount)	01118040H	0H to FFFFFFFFH		Bits 28 to 31: Flow control type (0: None, 1: Xon/Xoff, 2: Hardware) * Valid only in full-duplex communication. * If flow control is performed, select 38.4 kbps or below. Use of a higher baud rate may generate an overrun error, etc. Bits 24 to 27: Xon send selection when send is enabled after SIO-CPU reset (0: Do not send, 1: Send) * Valid only in full-duplex communication with Xon/Xoff flow control. Bits 20 to 23: Send enable/disable selection at port open (0: Disable, 1: Enable) * Valid only in full-duplex communication with Xon/Xoff flow control. Bits 16 to 19: Xon/Xoff send selection at port close (0: Do not send, 1: Send Xon, 2: Send Xoff) * Valid only in full-duplex communication with Xon/Xoff flow control. Bits 8 to 15: Flow control high limit (bytes) Bits 0 to 7: Flow control low limit (bytes) * If values are set to a magnitude correlation of “Flow control low limit ≥ SCI receive buffer size – Flow control high limit,” both the flow control high/low limits will be converted to a value corresponding to one-fourth the SCI receive buffer size. (SCI Receiving Buffer Size＝192 bytes)
216	Attribute 4 of SIO channel 2 opened to user (standard mount)	00000000H	0H to FFFFFFFFH		* This parameter is valid only in the RC gateway mode. Bits 28 to 31: EMG operation type (0: No processing, 1: Decelerate all axes to a stop, 2: Turn all axis servos OFF) Bits 24 to 27: (Reserved) Bits 20 to 23: Control type (0: SEL) Bits 12 to 19: (Reserved) Bits 0 to 11: I/O pattern (Main application version 0.65 or later/controller with expanded memory (with gateway function) only)
217	Attribute 5 of SIO channel 2 opened to user (standard mount)	00000000H	0H to FFFFFFFFH		RC gateway link axis pattern (Axis Nos. 15 to 8) (Main application version 0.65 or later/controller with expanded memory (with gateway function) only)
218	Attribute 6 of SIO channel 2 opened to user (standard mount)	00000000H	0H to FFFFFFFFH		RC gateway link axis pattern (Axis Nos. 7 to 0) (Main application version 0.65 or later/controller with expanded memory (with gateway function) only)
219	Attribute 7 of SIO channel 2 opened to user (standard mount)	00000000H	0H to FFFFFFFFH		
220	Attribute 8 of SIO channel 2 opened to user (standard mount)	00000000H	0H to FFFFFFFFH		
221	Attribute 9 of SIO channel 2 opened to user (standard mount)	00000000H	0H to FFFFFFFFH		
222	Attribute 10 of SIO channel 2 opened to user (standard mount)	00000000H	0H to FFFFFFFFH		

Appendix

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
223	Attribute 11 of SIO channel 2 opened to user (standard mount)	00000000H	0H to FFFFFFFF H		
224	Attribute 12 of SIO channel 2 opened to user (standard mount)	00000000H	0H to FFFFFFFF H		
225 to 282	(For expansion)	0			
283	Port number assigned to input function selection 000	-1	-1 to 3999		Specify the port number to be assigned to the function of I/O parameter No. 30, “Input function selection 000.” * If a negative value is set, the function will be assigned to input port No. 0. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
284	Port number assigned to input function selection 001	-1	-1 to 3999		Specify the port number to be assigned to the function of I/O parameter No. 31, “Input function selection 001.” * If a negative value is set, the function will be assigned to input port No. 1. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
285	Port number assigned to input function selection 002	-1	-1 to 3999		Specify the port number to be assigned to the function of I/O parameter No. 32, “Input function selection 002.” * If a negative value is set, the function will be assigned to input port No. 2. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
286	Port number assigned to input function selection 003	-1	-1 to 3999		Specify the port number to be assigned to the function of I/O parameter No. 33, “Input function selection 003.” * If a negative value is set, the function will be assigned to input port No. 3. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
287	Port number assigned to input function selection 004	-1	-1 to 3999		Specify the port number to be assigned to the function of I/O parameter No. 34, “Input function selection 004.” * If a negative value is set, the function will be assigned to input port No. 4. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
288	Port number assigned to input function selection 005	-1	-1 to 3999		Specify the port number to be assigned to the function of I/O parameter No. 35, “Input function selection 005.” * If a negative value is set, the function will be assigned to input port No. 5. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
289	Port number assigned to input function selection 006	-1	-1 to 3999		Specify the port number to be assigned to the function of I/O parameter No. 36, “Input function selection 006.” * If a negative value is set, the function will be assigned to input port No. 6. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
290	Port number assigned to input function selection 007	-1	-1 to 3999		Specify the port number to be assigned to the function of I/O parameter No. 37, “Input function selection 007.” * If a negative value is set, the function will be assigned to input port No. 7. * If “Program number specified for program start” has been specified for input function selection 007, specify in this parameter an input port number whose LSB contains the next higher value to the LSB of the program number specified for program start. (Related information: I/O parameter No. 30, “Input function selection 000”) (Main application version 0.64 or later/F-ROM 32-Mbit version only)
291	Port number assigned to input function selection 008	-1	-1 to 3999		Specify the port number to be assigned to the function of I/O parameter No. 38, “Input function selection 008.” * If a negative value is set, the function will be assigned to input port No. 8. * If “Program number specified for program start” has been specified for input function selection 008, specify in this parameter an input port number whose LSB contains the next higher value to the LSB of the program number specified for program start. (Main application version 0.64 or later/F-ROM 32-Mbit version only)

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
292	Port number assigned to input function selection 009	-1	-1 to 3999		Specify the port number to be assigned to the function of I/O parameter No. 39, "Input function selection 009." * If a negative value is set, the function will be assigned to input port No. 9. * If "Program number specified for program start" has been specified for input function selection 009, specify in this parameter an input port number whose LSB contains the next higher value to the LSB of the program number specified for program start. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
293	Port number assigned to input function selection 010	-1	-1 to 3999		Specify the port number to be assigned to the function of I/O parameter No. 40, "Input function selection 010." * If a negative value is set, the function will be assigned to input port No. 10. * If "Program number specified for program start" has been specified for input function selection 010, specify in this parameter an input port number whose LSB contains the next higher value to the LSB of the program number specified for program start. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
294	Port number assigned to input function selection 011	-1	-1 to 3999		Specify the port number to be assigned to the function of I/O parameter No. 41, "Input function selection 011." * If a negative value is set, the function will be assigned to input port No. 11. * If "Program number specified for program start" has been specified for input function selection 011, specify in this parameter an input port number whose LSB contains the next higher value to the LSB of the program number specified for program start. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
295	Port number assigned to input function selection 0122	-1	-1 to 3999		Specify the port number to be assigned to the function of I/O parameter No. 42, "Input function selection 012." * If a negative value is set, the function will be assigned to input port No. 12. * If "Program number specified for program start" has been specified for input function selection 012, specify in this parameter an input port number whose LSB contains the next higher value to the LSB of the program number specified for program start. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
296	Port number assigned to input function selection 013	-1	-1 to 3999		Specify the port number to be assigned to the function of I/O parameter No. 43, "Input function selection 013." * If a negative value is set, the function will be assigned to input port No. 13. * If "Program number specified for program start" has been specified for input function selection 013, specify in this parameter an input port number whose LSB contains the next higher value to the LSB of the program number specified for program start. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
297	Port number assigned to input function selection 014	-1	-1 to 3999		Specify the port number to be assigned to the function of I/O parameter No. 44, "Input function selection 014." * If a negative value is set, the function will be assigned to input port No. 14. * If "Program number specified for program start" has been specified for input function selection 014, specify in this parameter an input port number whose LSB contains the next higher value to the LSB of the program number specified for program start. (Related information: I/O parameter No. 30, "Input function selection 000") (Main application version 0.64 or later/F-ROM 32-Mbit version only)
298	Port number assigned to input function selection 015	-1	-1 to 3999		Specify the port number to be assigned to the function of I/O parameter No. 45, "Input function selection 015." * If a negative value is set, the function will be assigned to input port No. 15. (Main application version 0.64 or later/F-ROM 32-Mbit version only)

Appendix

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
299	Port number assigned to output function selection 300	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 46, "Output function selection 300." * If 0 is set, the function will be assigned to output port No. 300. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
300	Port number assigned to output function selection 301	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 47, "Output function selection 301." * If 0 is set, the function will be assigned to output port No. 301. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
301	Port number assigned to output function selection 302	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 48, "Output function selection 302." * If 0 is set, the function will be assigned to output port No. 302. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
302	Port number assigned to output function selection 303	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 49, "Output function selection 303." * If 0 is set, the function will be assigned to output port No. 303. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
303	Port number assigned to output function selection 304	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 50, "Output function selection 304." * If 0 is set, the function will be assigned to output port No. 304. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
304	Port number assigned to output function selection 305	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 51, "Output function selection 305." * If 0 is set, the function will be assigned to output port No. 305. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
305	Port number assigned to output function selection 306	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 52, "Output function selection 306." * If 0 is set, the function will be assigned to output port No. 306. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
306	Port number assigned to output function selection 307	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 53, "Output function selection 307." * If 0 is set, the function will be assigned to output port No. 307. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
307	Port number assigned to output function selection 308	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 54, "Output function selection 308." * If 0 is set, the function will be assigned to output port No. 308. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
308	Port number assigned to output function selection 309	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 55, "Output function selection 309." * If 0 is set, the function will be assigned to output port No. 309. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
309	Port number assigned to output function selection 310	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 56, "Output function selection 310." * If 0 is set, the function will be assigned to output port No. 310. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
310	Port number assigned to output function selection 311	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 57, "Output function selection 311." * If 0 is set, the function will be assigned to output port No. 311. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
311	Port number assigned to output function selection 312	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 58, "Output function selection 312." * If 0 is set, the function will be assigned to output port No. 312. (Main application version 0.64 or later/F-ROM 32-Mbit version only)

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
312	Port number assigned to output function selection 313	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 59, “Output function selection 313.” * If 0 is set, the function will be assigned to output port No. 313. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
313	Port number assigned to output function selection 314	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 60, “Output function selection 314.” * If 0 is set, the function will be assigned to output port No. 314. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
314	Port number assigned to output function selection 315	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 61, “Output function selection 315.” * If 0 is set, the function will be assigned to output port No. 315. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
315	Port number assigned to output function selection 300 (area 2)	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 331, “Output function selection 300 (area 2).” * If 0 is set, the function will not be assigned to any port. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
316	Port number assigned to output function selection 301 (area 2)	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 332, “Output function selection 301 (area 2).” * If 0 is set, the function will not be assigned to any port. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
317	Port number assigned to output function selection 302 (area 2)	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 333, “Output function selection 302 (area 2).” * If 0 is set, the function will not be assigned to any port. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
318	Port number assigned to output function selection 303 (area 2)	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 334, “Output function selection 303 (area 2).” * If 0 is set, the function will not be assigned to any port. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
319	Port number assigned to output function selection 304 (area 2)	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 335, “Output function selection 304 (area 2).” * If 0 is set, the function will not be assigned to any port. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
320	Port number assigned to output function selection 305 (area 2)	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 336, “Output function selection 305 (area 2).” * If 0 is set, the function will not be assigned to any port. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
321	Port number assigned to output function selection 306 (area 2)	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 337, “Output function selection 306 (area 2).” * If 0 is set, the function will not be assigned to any port. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
322	Port number assigned to output function selection 307 (area 2)	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 338, “Output function selection 307 (area 2).” * If 0 is set, the function will not be assigned to any port. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
323	Port number assigned to output function selection 308 (area 2)	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 339, “Output function selection 308 (area 2).” * If 0 is set, the function will not be assigned to any port. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
324	Port number assigned to output function selection 309 (area 2)	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 340, “Output function selection 309 (area 2).” * If 0 is set, the function will not be assigned to any port. (Main application version 0.64 or later/F-ROM 32-Mbit version only)

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
325	Port number assigned to output function selection 310 (area 2)	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 341, “Output function selection 310 (area 2).” * If 0 is set, the function will not be assigned to any port. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
326	Port number assigned to output function selection 311 (area 2)	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 342, “Output function selection 311 (area 2).” * If 0 is set, the function will not be assigned to any port. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
327	Port number assigned to output function selection 312 (area 2)	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 343, “Output function selection 312 (area 2).” * If 0 is set, the function will not be assigned to any port. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
328	Port number assigned to output function selection 313 (area 2)	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 344, “Output function selection 313 (area 2).” * If 0 is set, the function will not be assigned to any port. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
329	Port number assigned to output function selection 314 (area 2)	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 345, “Output function selection 314 (area 2).” * If 0 is set, the function will not be assigned to any port. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
330	Port number assigned to output function selection 315 (area 2)	0	0 to 6999		Specify the port number to be assigned to the function of I/O parameter No. 346, “Output function selection 315 (area 2).” * If 0 is set, the function will not be assigned to any port. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
331	Output function selection 300 (area 2)	0	0 to 20		0: General-purpose output 1: Output of operation-cancellation level or higher error (ON) 2: Output of operation-cancellation level or higher error (OFF) 3: Output of operation-cancellation level or higher error + emergency stop (ON) 4: Output of operation-cancellation level or higher error + emergency stop (OFF) (Main application version 0.64 or later/F-ROM 32-Mbit version only)
332	Output function selection 301 (area 2)	0	0 to 20		0: General-purpose output 1: READY output (PIO trigger program can be run) 2: READY output (PIO trigger program can be run and error of operation-cancellation level or higher is not present) 3: READY output (PIO trigger program can be run and error of cold-start level or higher is not present) (Main application version 0.64 or later/F-ROM 32-Mbit version only)
333	Output function selection 302 (area 2)	0	0 to 20		0: General-purpose output 1: Emergency stop output (ON) 2: Emergency stop output (OFF) (Main application version 0.64 or later/F-ROM 32-Mbit version only)
334	Output function selection 303 (area 2)	0	0 to 5		0: General-purpose output 1: AUTO mode output 2. Automatic operation in-progress output (other parameter No. 12) (Main application version 0.64 or later/F-ROM 32-Mbit version only)
335	Output function selection 304 (area 2)	0	0 to 5		0: General-purpose output, 1: Output at home return of all valid axes (= 0) 2: Output at completion of home return of all valid axes (coordinates conformed) 3: Output when all valid axes at home preset coordinates * To move an ABS encoder axis to coordinate 0 or to the home preset coordinate, use a MOVP command instead of a HOME command. (Main application version 0.64 or later/F-ROM 32-Mbit version only)

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
336	Output function selection 305 (area 2)	0	0 to 5		0: General-purpose output 1: Axis 1 in-position output (OFF if the work part is missed during push-motion operation) 2: Axis 1 servo currently-ON output (system-monitored task output) 3: Reserved by the system. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
337	Output function selection 306 (area 2)	0	0 to 5		0: General-purpose output 1: Axis 2 in-position output (OFF if the work part is missed during push-motion operation) 2: Axis 2 servo currently-ON output (system-monitored task output) 3: Reserved by the system. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
338	Output function selection 307 (area 2)	0	0 to 5		0: General-purpose output 1: Axis 3 in-position output (OFF if the work part is missed during push-motion operation) 2: Axis 3 servo currently-ON output (system-monitored task output) 3: Reserved by the system. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
339	Output function selection 308 (area 2)	0	0 to 5		0: General-purpose output 1: Axis 4 in-position output (OFF if the work part is missed during push-motion operation) 2: Axis 4 servo currently-ON output (system-monitored task output) 3: Reserved by the system. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
340	Output function selection 309 (area 2)	0	0 to 5		0: General-purpose output 1: Axis 5 in-position output (OFF if the work part is missed during push-motion operation) 2: Axis 5 servo currently-ON output (system-monitored task output) 3: Reserved by the system. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
341	Output function selection 310 (area 2)	0	0 to 5		0: General-purpose output 1: Axis 6 in-position output (OFF if the work part is missed during push-motion operation) 2: Axis 6 servo currently-ON output (system-monitored task output) 3: Reserved by the system. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
342	Output function selection 311 (area 2)	0	0 to 5		0: General-purpose output 1 to 3: Reserved by the system for expansion. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
343	Output function selection 312 (area 2)	0	0 to 5		0: General-purpose output 1 to 3: Reserved by the system for expansion. (Main application version 0.64 or later/F-ROM 32-Mbit version only)
344	Output function selection 313 (area 2)	0	0 to 5		0: General-purpose output 1: System-memory backup battery voltage at low-voltage warning level or below (Main application version 0.64 or later/F-ROM 32-Mbit version only)
345	Output function selection 314 (area 2)	0	0 to 5		0: General-purpose output 1: Absolute-data backup battery voltage at low-voltage warning level or below (All axes are checked based on the OR gate. If an abnormal level is detected, the system will be latched until a power-ON reset or software reset is performed.) (Main application version 0.64 or later/F-ROM 32-Mbit version only)
346	Output function selection 315 (area 2)	0	0 to 5		0: General-purpose output (Main application version 0.64 or later/F-ROM 32-Mbit version only)
347 to 379	(For expansion)	0			
380	Unaffected general-purpose output area 2 number (MIN) when all operations/programs are aborted	0	0 to 6999		(Same as I/O parameter No. 70) (Main application version 0.64 or later/F-ROM 32-Mbit version only)

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
381	Unaffected general-purpose output area 2 number (MAX) when all operations/programs are aborted	0	0 to 6999		(Main application version 0.64 or later/F-ROM 32-Mbit version only)
382	Unaffected general-purpose output area 3 number (MIN) when all operations/programs are aborted	0	0 to 6999		(Same as I/O parameter No. 70) (Main application version 0.64 or later/F-ROM 32-Mbit version only)
383	Unaffected general-purpose output area 3 number (MAX) when all operations/programs are aborted	0	0 to 6999		(Main application version 0.64 or later/F-ROM 32-Mbit version only)
384	Unaffected general-purpose output area 4 number (MIN) when all operations/programs are aborted	0	0 to 6999		(Same as I/O parameter No. 70) (Main application version 0.64 or later/F-ROM 32-Mbit version only)
385	Unaffected general-purpose output area 4 number (MAX) when all operations/programs are aborted	0	0 to 6999		(Main application version 0.64 or later/F-ROM 32-Mbit version only)
386 to 389	(For expansion)	0			
390	Unaffected general-purpose output area 2 number (MIN) when all operations are paused (servo-axis soft interlock + output-port soft interlock)	4000	0 to 6999		(Same as I/O parameter No. 72) (Main application version 0.64 or later/F-ROM 32-Mbit version only)
391	Unaffected general-purpose output area 2 number (MAX) when all operations are paused (servo-axis soft interlock + output-port soft interlock)	6999	0 to 6999		(Main application version 0.64 or later/F-ROM 32-Mbit version only)
392	Unaffected general-purpose output area 3 number (MIN) when all operations are paused (servo-axis soft interlock + output-port soft interlock)	0	0 to 6999		(Same as I/O parameter No. 72) (Main application version 0.64 or later/F-ROM 32-Mbit version only)
393	Unaffected general-purpose output area 3 number (MAX) when all operations are paused (servo-axis soft interlock + output-port soft interlock)	0	0 to 6999		(Main application version 0.64 or later/F-ROM 32-Mbit version only)
394	Unaffected general-purpose output area 4 number (MIN) when all operations are paused (servo-axis soft interlock + output-port soft interlock)	0	0 to 6999		(Same as I/O parameter No. 72) (Main application version 0.64 or later/F-ROM 32-Mbit version only)
395	Unaffected general-purpose output area 4 number (MAX) when all operations are paused (servo-axis soft interlock + output-port soft interlock)	0	0 to 6999		(Main application version 0.64 or later/F-ROM 32-Mbit version only)
396 to 399	(For expansion)	0			
400	(For expansion)	1			

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
401 to 404	(For expansion)	0			
405 to 406	(For expansion)	512			
407	(For expansion)	1000			
408	(For expansion)	4000			
409	(For expansion)	1			
410	(For expansion)	0			
411	(For expansion)	1256			
412	(For expansion)	4256			
413 to 414	(For expansion)	0			
415 to 416	(For expansion)	-1			
417 to 419	(For expansion)	0			
420	(For expansion)	0H			
421	(For expansion)	1003000H			
422	(For expansion)	FF007530H			
423	(For expansion)	2H			
424 to 429	(For expansion)	0H			
430	(For expansion)	4000			
432 to 500	(For expansion)	0			
501	Number of RC-gateway position data points	128	0 to 512		Number of position data used in the RC position data mode within the XSEL. (Main application version 0.65 or later/F-ROM 32-Mbit version only)
502	Maximum axis number for definition of RC-gateway position data	0	0 to 15		Maximum axis number used for reserving RC-axis position data areas in the user-data backup memory (Main application version 0.65 or later/F-ROM 32-Mbit version only)
503	Number of position data points for definition of RC-gateway position data	0	0 to 512		Number of position data points used for reserving RC-axis position data areas in the user-data backup memory * If 0, no areas are reserved. * If a value other than 0 is set, areas will be reserved regardless of whether the RC gateway function is enabled or disabled. (Main application version 0.65 or later/F-ROM 32-Mbit version only)
504	Port number of first shared output port occupied in RC-gateway PLC through mode	1000	1000 to 3999		1000 + (multiple of 16) (Main application version 0.65 or later/F-ROM 32-Mbit version only)
505	Port number of first shared output port occupied in RC-gateway PLC through mode	4000	4000 to 6999		4000 + (multiple of 16) (Main application version 0.65 or later/F-ROM 32-Mbit version only)
506	Communication timeout period for PC software connection for RC gateway RC	3000	0 to 99999		Set a timeout period that applies when connecting to the PC software for RC. (Main application version 0.65 or later/F-ROM 32-Mbit version only)
507 to 510	(For expansion)	0			
511	Input port number for forced release of RC axis 0 brake	0	0 to 3999		When the applicable port turns ON, the brake will be released forcibly. (Beware of dropping axis.) * Invalid, if 0. (Specification of input port No. 0 is invalid.) (Main application version 0.65 or later/F-ROM 32-Mbit version only)

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
512	Input port number for forced release of RC axis 1 brake	0	0 to 3999		When the applicable port turns ON, the brake will be released forcibly. (Beware of dropping axis.) * Invalid, if 0. (Specification of input port No. 0 is invalid.) (Main application version 0.65 or later/F-ROM 32-Mbit version only)
513	Input port number for forced release of RC axis 2 brake	0	0 to 3999		When the applicable port turns ON, the brake will be released forcibly. (Beware of dropping axis.) * Invalid, if 0. (Specification of input port No. 0 is invalid.) (Main application version 0.65 or later/F-ROM 32-Mbit version only)
514	Input port number for forced release of RC axis 3 brake	0	0 to 3999		When the applicable port turns ON, the brake will be released forcibly. (Beware of dropping axis.) * Invalid, if 0. (Specification of input port No. 0 is invalid.) (Main application version 0.65 or later/F-ROM 32-Mbit version only)
515	Input port number for forced release of RC axis 4 brake	0	0 to 3999		When the applicable port turns ON, the brake will be released forcibly. (Beware of dropping axis.) * Invalid, if 0. (Specification of input port No. 0 is invalid.) (Main application version 0.65 or later/F-ROM 32-Mbit version only)
516	Input port number for forced release of RC axis 5 brake	0	0 to 3999		When the applicable port turns ON, the brake will be released forcibly. (Beware of dropping axis.) * Invalid, if 0. (Specification of input port No. 0 is invalid.) (Main application version 0.65 or later/F-ROM 32-Mbit version only)
517	Input port number for forced release of RC axis 6 brake	0	0 to 3999		When the applicable port turns ON, the brake will be released forcibly. (Beware of dropping axis.) * Invalid, if 0. (Specification of input port No. 0 is invalid.) (Main application version 0.65 or later/F-ROM 32-Mbit version only)
518	Input port number for forced release of RC axis 7 brake	0	0 to 3999		When the applicable port turns ON, the brake will be released forcibly. (Beware of dropping axis.) * Invalid, if 0. (Specification of input port No. 0 is invalid.) (Main application version 0.65 or later/F-ROM 32-Mbit version only)
519	Input port number for forced release of RC axis 8 brake	0	0 to 3999		When the applicable port turns ON, the brake will be released forcibly. (Beware of dropping axis.) * Invalid, if 0. (Specification of input port No. 0 is invalid.) (Main application version 0.65 or later/F-ROM 32-Mbit version only)
520	Input port number for forced release of RC axis 9 brake	0	0 to 3999		When the applicable port turns ON, the brake will be released forcibly. (Beware of dropping axis.) * Invalid, if 0. (Specification of input port No. 0 is invalid.) (Main application version 0.65 or later/F-ROM 32-Mbit version only)
521	Input port number for forced release of RC axis 10 brake	0	0 to 3999		When the applicable port turns ON, the brake will be released forcibly. (Beware of dropping axis.) * Invalid, if 0. (Specification of input port No. 0 is invalid.) (Main application version 0.65 or later/F-ROM 32-Mbit version only)
522	Input port number for forced release of RC axis 11 brake	0	0 to 3999		When the applicable port turns ON, the brake will be released forcibly. (Beware of dropping axis.) * Invalid, if 0. (Specification of input port No. 0 is invalid.) (Main application version 0.65 or later/F-ROM 32-Mbit version only)
526	Input port number for forced release of RC axis 12 brake	0	0 to 3999		When the applicable port turns ON, the brake will be released forcibly. (Beware of dropping axis.) * Invalid, if 0. (Specification of input port No. 0 is invalid.) (Main application version 0.65 or later/F-ROM 32-Mbit version only)
524	Input port number for forced release of RC axis 13 brake	0	0 to 3999		When the applicable port turns ON, the brake will be released forcibly. (Beware of dropping axis.) * Invalid, if 0. (Specification of input port No. 0 is invalid.) (Main application version 0.65 or later/F-ROM 32-Mbit version only)
525	Input port number for forced release of RC axis 14 brake	0	0 to 3999		When the applicable port turns ON, the brake will be released forcibly. (Beware of dropping axis.) * Invalid, if 0. (Specification of input port No. 0 is invalid.) (Main application version 0.65 or later/F-ROM 32-Mbit version only)
526	Input port number for forced release of RC axis 15 brake	0	0 to 3999		When the applicable port turns ON, the brake will be released forcibly. (Beware of dropping axis.) * Invalid, if 0. (Specification of input port No. 0 is invalid.) (Main application version 0.65 or later/F-ROM 32-Mbit version only)
527 to 529	(For expansion)	0			
530	Pulse I/O board position data count	128	0 to 512		Maximum number of position data points used (Main application version 0.93 or later/F-ROM 32-Mbit version only)

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
531	Maximum axis No. for pulse I/O board position data definition	0	0 to 15		Maximum axis number for allocating the axis position data area for pulse I/O board in the user data memory (Main application version 0.93 or later/F-ROM 32-Mbit version only)
532	Position data count for pulse I/O board position data definition	0	0 to 512		Number of position data points for allocating the axis position data area for pulse I/O board in the user data memory * If 0, no area is allocated. * If a value other than 0 is set, this area is allocated regardless of whether or not the pulse I/O board is installed. (Main application version 0.93 or later/F-ROM 32-Mbit version only)
533	Pulse I/O board synchronous main CPU control master axis position type	00000000H	0H~FFFFFFFFH		Specify the synchronization position type for primary axes (axes 1 to 6) controlled by the main CPU (0: Current command position, 1: Current position) Bits 0 to 3: Axis 1 synchronization position type Bits 4 to 7: Axis 2 synchronization position type Bits 8 to 11: Axis 3 synchronization position type Bits 12 to 15: Axis 4 synchronization position type Bits 16 to 19: Axis 5 synchronization position type Bits 20 to 23: Axis 6 synchronization position type Bits 24 to 31: (Reserved) (Main application version 0.93 or later/F-ROM 32-Mbit version only)
534	Pulse I/O board position axis 0 control attributes	0	0 to 10		0: Invalid assignment (Control I/O board not used) 1: A/PCON type assignment Input port No. n: Servo ON signal Input port No. n+1: Positioning complete signal Input port No. n+2: Home return complete signal Input port No. n+3: Alarm signal Output port No. m: Servo ON command signal Output port No. m+1: Home return command signal Output port No. m+2: Alarm reset command signal 2: SCON type assignment Input port No. n: Servo ON signal Input port No. n+1: Positioning complete signal Input port No. n+2: Home return complete signal Input port No. n+3: Alarm signal Input port No. n+4: Operation mode status signal Output port No. m: Servo ON command signal Output port No. m+1: Home return command signal Output port No. m+2: Alarm reset command signal * n: Value set in I/O parameter No. 535, “First port number among pulse I/O board axis 0 control input ports” * m: Value set in I/O parameter No. 536, “First port number among pulse I/O board axis 0 control output ports” (Main application version 0.93 or later/F-ROM 32-Mbit version only)
535	Pulse I/O board axis 0 control output port head No.	0	0 to 299		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
536	Pulse I/O board axis 0 control output port head No.	0	0 to 599		(Main application version 0.93 or later/F-ROM 32-Mbit version only)

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
537	Pulse I/O board position axis 1 control attributes	0	0 to 10		(*Same as I/O parameter No. 534.) (Main application version 0.93 or later/F-ROM 32-Mbit version only)
538	Pulse I/O board axis 1 control input port head No.	0	0 to 299		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
539	Pulse I/O board axis 1 control output port head No..	0	0 to 599		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
540	Pulse I/O board axis 2 control attribute	0	0 to 10		(*Same as I/O parameter No. 534.) (Main application version 0.93 or later/F-ROM 32-Mbit version only)
541	Pulse I/O board axis 2 control input port head No.	0	0 to 299		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
542	Pulse I/O board axis 2 control output port head No.	0	0 to 599		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
543	Pulse I/O board axis 3 control attribute	0	0 to 10		(*Same as I/O parameter No. 534.) (Main application version 0.93 or later/F-ROM 32-Mbit version only)
544	Pulse I/O board axis 3 control input port head No.	0	0 to 299		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
545	Pulse I/O board axis 3 control output port head No.	0	0 to 599		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
546	Pulse I/O board axis 4 control attribute	0	0 to 10		(*Same as I/O parameter No. 534.) (Main application version 0.93 or later/F-ROM 32-Mbit version only)
547	Pulse I/O board axis 4 control input port head No.	0	0 to 299		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
548	Pulse I/O board axis 4 control output port head No.	0	0 to 599		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
549	Pulse I/O board axis 5 control attribute	0	0 to 10		(*Same as I/O parameter No. 534.) (Main application version 0.93 or later/F-ROM 32-Mbit version only)
550	Pulse I/O board axis 5 control input port head No.	0	0 to 299		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
551	Pulse I/O board axis 5 control output port head No.	0	0 to 599		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
552	Pulse I/O board axis 6 control attribute	0	0 to 10		(*Same as I/O parameter No. 534.) (Main application version 0.93 or later/F-ROM 32-Mbit version only)
553	Pulse I/O board axis 6 control input port head No.	0	0 to 299		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
554	Pulse I/O board axis 6 control output port head No.	0	0 to 599		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
555	Pulse I/O board axis 7 control attribute	0	0 to 10		(*Same as I/O parameter No. 534.) (Main application version 0.93 or later/F-ROM 32-Mbit version only)
556	Pulse I/O board axis 7 control input port head No.	0	0 to 299		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
557	Pulse I/O board axis 7 control output port head No.	0	0 to 599		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
558	Pulse I/O board axis 8 control attribute	0	0 to 10		(*Same as I/O parameter No. 534.) (Main application version 0.93 or later/F-ROM 32-Mbit version only)
559	Pulse I/O board axis 8 control input port head No.	0	0 to 299		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
560	Pulse I/O board axis 8 control output port head No.	0	0 to 599		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
561	Pulse I/O board axis 9 control attribute	0	0 to 10		(*Same as I/O parameter No. 534.) (Main application version 0.93 or later/F-ROM 32-Mbit version only)

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
562	Pulse I/O board axis 9 control input port head No.	0	0 to 299		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
563	Pulse I/O board axis 9 control output port head No.	0	0 to 599		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
564	Pulse I/O board axis 10 control attribute	0	0 to 10		(*Same as I/O parameter No. 534.) (Main application version 0.93 or later/F-ROM 32-Mbit version only)
565	Pulse I/O board axis 10 control input port head No.	0	0 to 299		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
566	Pulse I/O board axis 10 control output port head No.	0	0 to 599		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
567	Pulse I/O board axis 11 control attribute	0	0 to 10		(*Same as I/O parameter No. 534.) (Main application version 0.93 or later/F-ROM 32-Mbit version only)
568	Pulse I/O board axis 11 control input port head No.	0	0 to 299		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
569	Pulse I/O board axis 11 control output port head No.	0	0 to 599		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
570	Pulse I/O board axis 12 control attribute	0	0 to 10		(*Same as I/O parameter No. 534.) (Main application version 0.93 or later/F-ROM 32-Mbit version only)
571	Pulse I/O board axis 12 control input port head No.	0	0 to 299		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
572	Pulse I/O board axis 12 control output port head No.	0	0 to 599		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
573	Pulse I/O board axis 13 control attribute	0	0 to 10		(*Same as I/O parameter No. 534.) (Main application version 0.93 or later/F-ROM 32-Mbit version only)
574	Pulse I/O board axis 13 control input port head No.	0	0 to 299		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
575	Pulse I/O board axis 13 control output port head No.	0	0 to 599		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
576	Pulse I/O board axis 14 control attribute	0	0 to 10		(*Same as I/O parameter No. 534.) (Main application version 0.93 or later/F-ROM 32-Mbit version only)
577	Pulse I/O board axis 14 control input port head No.	0	0 to 299		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
578	Pulse I/O board axis 14 control output port head No.	0	0 to 599		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
579	Pulse I/O board axis 15 control attribute	0	0 to 10		(*Same as I/O parameter No. 534.) (Main application version 0.93 or later/F-ROM 32-Mbit version only)
580	Pulse I/O board axis 15 control input port head No.	0	0 to 299		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
581	Pulse I/O board axis 15 control output port head No		0 to 599		(Main application version 0.93 or later/F-ROM 32-Mbit version only)
582 ~ 600	(For extension)	0			

2. Parameters Common to All Axes

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
1	Valid axis pattern	0000B	00B to 11111111B		An OFF bit indicates that no driver is installed.
2	Default override	100	1 to 100		Used if not specified in program. (Invalid for SIO operation)
3 to 8	(For expansion)	0	to		
9	Physical axis pattern for which enable switch (deadman switch/safety gate) is effective	11111111B	00B to 11111111B		Not affected by a BASE command. (To make the enable switch effective for all axes (= it must be effective for all axes, as a rule), always specify "11111111." Only when "11111111" is set will the enable switch be included in the drive-source cutoff factor. If a value other than "11111111" is set, the drive source will not be cut off and only the servo of the specified axis will be turned off.) * All axes are specified if "Other parameter No. 11: Deadman switch/safety-gate open recovery type" is set to 1 (Reset required for recovery). * The drive-source cannot be cut off for axes whose motor-drive power unit is not housed inside this controller or whose drivesource cutoff circuit is not controlled by this controller. If an optional (custom-order) specification is used, the optional (custom-order) specification is given priority over the physical axis for which the deadman switch is effective, drive-source cutoff specification, servo-off specification, 7-segment display specification, etc.
10	(For expansion)	0	0H to FFFFFFFFH		
11	Default acceleration	30	1 to 200	0.01 G	Used if not specified in position data, program or SIO message, etc.
12	Default acceleration	30	1 to 200	0.01 G	Used if not specified in position data, program or SIO message, etc.
13	Default speed	30	1 to 200	mm/s	Used if not specified in SIO message or position data, when movement is to be continued, etc.
14	Valid selection when operation point data deceleration is 0	0	0 to 5		0: "Deceleration = Acceleration" when the deceleration in the operation point data is "0" 1: "Deceleration = 0" when the deceleration in the operation point data is "0"
15	Maximum jog speed when home return is incomplete	30	1 to 250	mm/s	
16 to 17	(For expansion)	0	~		
18	Maximum operation acceleration/deceleration check timing	0	0 to 1		0: Check at input PC/TP checks the input in All Axes Parameter No.22 "Maximum Acceleration" and "No.23 "Maximum Deceleration". 1: Check at operation * If it is set to the check at operation, the distributed acceleration/ deceleration (CP) of the indicated acceleration and deceleration or the indicated acceleration and deceleration (PTP) are checked and compared with the maximum parameter of the operational acceleration and deceleration of ach axis, and clamped to the available acceleration and deceleration. Therefore, the maximum performance of the system corresponding to the operation command can be obtained, but a complete check cannot be made at the input (because the start position of command or operation is not constant). Also, in CP, the acceleration/ deceleration speed varies depending on the operation start position if CP is conducted from unspecific position (in such cases as the first point movement) since the distributed acceleration/deceleration speed varies depending on the operation start position. (XSEL-P/Q/PCT/QCT main application Ver. 1.15 or later)
19	(For expansion)	0	~		
20	Maximum operating speed check timing	1	0 to 1		0: Check at input 1: Check at operation * If "Check at operation" is selected, the distribution speed (CP) of specified speed or the specified speed (PTP) will be compared against the maximum operating speed of each axis and clamped at the allowable speed. Accordingly, the system can achieve its maximum performance in accordance with the operation command. However, complete check cannot be performed at input (since the command/ operation start position is indeterminable). In the case of CP, the distribution speed will vary depending on the operation start position. Therefore, specifying CP at an unspecified position (first point movement, etc.) will cause the speed to fluctuate depending on where the operation is started.
21	Maximum operating speed for input value check	1000	1 to 9999	mm/s	If "Input" is selected as the maximum speed check timing, this parameter will be used to check for input error.
22	Maximum acceleration	200	1 to 999	0.01 G	Restriction is made for each axis with the setting values above if Each Axis Parameter No.134 "Maximum Operation Acceleration for Each Axis" is valid.
23	Maximum deceleration	200	1 to 999	0.01 G	Restriction is made for each axis with the setting values above if Each Axis Parameter No.135 "Maximum Operation Deceleration for Each Axis" is valid.

Parameters Common to All Axes

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
24	Minimum emergency deceleration	30	1 to 300	0.01 G	Restriction is made for each axis with the setting values above if Each Axis Parameter No.136 “Minimum Emergency Deceleration for Each Axis” is valid.
25	(Acceleration/deceler ation at home return (old))	30	1 to 300	0.01 G	(Invalid)
26	Acceleration/decelera tion specification type	0	Reference only		0: T system, 1: P, M system
27	Master axis type	0	Reference only		0: T system, 1: P system
28	Selection of inching jog auto-switching prohibition	0	Reference only		0: Execute auto-switching (Continuous button ON timer), 1: Prohibited * Referenced by the PC/TP (no handy terminal auto-switching function)
29	All-axis setting bit pattern 1	0	0H to FFFFFFFFH		Bits 0 to 3: Selection of use of last PC/TP inching distance (0: Do not use, 1: Use) * Referenced by the PC/TP (Excluding ANSI-compatible TP) Bits 4 to 7: Overrun (servo) error level (0: Operation-cancellation level, 1: Cold-start level, 2: Operationcancellation level at reset, thereafter cold-start level) Bits 8 to 11: “Actual-position soft limit over (servo)” error level (0: Operationcancellation level, 1: Cold-start level, 2: Operation-cancellation level at reset, thereafter cold-start level) Bits 12 to 15: For future expansion Bits 16 to 19: Abnormal absolute-data backup battery voltage error level (0: Operation-cancellation level, 1: Message level) (Main application version 0.37 or later)
30	Default division angle	150	0 to 1200	0.1 degree	(“0” can be input in PC software version 1.1.1.0 or later or TP application version 1.06 or later)
31	Default division distance	0	0 to 10000	mm	
32	Arch-trigger start-point check type	0	0 to 5		0: Check operation amount and actual position, 1: Check operation amount only
33	Safety speed in manual mode	250	1 to 250	mm/s	* This parameter is treated as a value equivalent to or below the minimum value set in “Axis-specific parameter No. 29, VLMX speed” for all valid axes.
34 to 60	(For expansion)	0	~		
61	Reserved by system	1300H	0H to FFFFFFFFH		
62	Reserved by system	3C000D00H	0H to FFFFFFFFH		
63	Reserved by system	10550FAH	0H to FFFFFFFFH		
64	Reserved by system	A0505H	0H to FFFFFFFFH		
65	Reserved by system	-34000	-9999999 to 9999999	0.001 mm	
66	Reserved by system	360000	-9999999 to 9999999	0.001 mm	
67	Reserved by system	340000	-9999999 to 9999999	0.001 mm	
68	Reserved by system	360000	-9999999 to 9999999	0.001 mm	
69	Reserved by system	30379	-9999999 to 9999999	Pulse	
70	Reserved by system	3	0~999	mm/sec	
71	Reserved by system	1000	-9999999 to 9999999	msec	
72	Reserved by system	30	0 to 9999	mm/sec	
73	Reserved by system	0	0 to 299		
74	Reserved by system	100000	1 to 999999999	0.001 mm	
75	Reserved by system	400000	1 to 999999999	0.001 mm	
76	Reserved by system	3333	-99999 to 99999	0.001 mm	
77	Reserved by system	0	0 to 999		
78	Reserved by system	0	0 to 150		
79	Reserved by system	0	0 to 999		

PC:PC software
TP:Teaching pendant

Appendix

Parameters Common to All Axes

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
80	(For expansion)	0	~		
81	Reserved by system	15	1 to 999	0.01 G	
82	Reserved by system	30	1 to 999	0.01 G	
83	Reserved by system	1500	1 to 9999	mm/sec	
84	Reserved by system	1000	1 to 999999	0.001 mm/sec	
85	Reserved by system	1000	1 to 99999	0.001 mm	
86	Reserved by system	100	1 to 9999	msec	
87	Reserved by system	0	-360000 to 360000	0.001 deg	
88	Reserved by system	0	0 to 299		
89	Reserved by system	0	0 to 599		
90	Reserved by system	0	-9999999 to 9999999	0.001 mm	
91	Reserved by system	0	-9999999 to 9999999	0.001 mm	
92	Reserved by system	0	-299 to 299		
93	Reserved by system	0	0 to 98, 1001 to 1099		
94	(For expansion)	0	0 to 999999		
95	(For expansion)	0	0 to 999999		
96	Reserved by system	100	0 to 9999	mm/sec	
97	Reserved by system	0	-99999 to 99999	0.001 mm	
98	Reserved by system	0	-99999 to 99999	0.001 mm	
99	Reserved by system	0	-9999999 to 9999999	0.001 mm	
100	(For expansion)	0	~		
101	Driver/encoder communication line channel setting (axes 1 to 4)	0H	Reference only		Bits 0 to 7: Driver/encoder communication line channel number of axis 1 Bits 8 to 15: Driver/encoder communication line channel number of axis 2 Bits 16 to 23: Driver/encoder communication line channel number of axis 3 Bits 24 to 31: Driver/encoder communication line channel number of axis 4 (Invalid if "FFh" is set (driver board not installed)) * The channel number corresponds to the number assigned internally to the hardware (0 ~).
102	Driver/encoder communication line channel setting (axes 5 and 6)	0H	Reference only		Bits 0 to 7: Driver/encoder communication line channel number of axis 5 Bits 8 to 15: Driver/encoder communication line channel number of axis 6 Bits 16 to 23: For future expansion Bits 24 to 31: For future expansion (Invalid if "FFh" is set (driver board not installed)) * The channel number corresponds to the number assigned internally to the hardware (0 ~).
103	Driver initialization communication type setting (axes 1 to 4)	0H	Reference only		Bits 0 to 7: Driver initialization communication type of axis 1 Bits 8 to 15: Driver initialization communication type of axis 2 Bits 16 to 23: Driver initialization communication type of axis 3 Bits 24 to 31: Driver initialization communication type of axis 4 (FFh: Perform initialization communication (data of the applicable axis only) 0: Do not perform initialization communication 1 to 6: Perform initialization communication (data of the applicable axis + data of other axes in which the same driver board is installed) * The parameter value indicates the axis number of other axis in which the same driver board is installed.)
104	Driver initialization communication type setting (axes 5 and 6)	0H	Reference only		Bits 0 to 7: Driver initialization communication type of axis 5 Bits 8 to 15: Driver initialization communication type of axis 6 Bits 16 to 23: For future expansion Bits 24 to 31: For future expansion (FFh: Perform initialization communication (data of the applicable axis only) 0: Do not perform initialization communication 1 to 6: Perform initialization communication (data of the applicable axis + data of other axes in which the same driver board is installed) * The parameter value indicates the axis number of other axis in which the same driver board is installed.)

PC:PC software
TP:Teaching pendant

Parameters Common to All Axes

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
105 to 109	(For expansion)	0	~		
110	Reserved by system	4321H	0H to FFFFFFFFH		
111	Reserved by system	543103H	0H to FFFFFFFFH		
112	Reserved by system	0	0 ~ 2		
113	Reserved by system	0	-9999999 to 9999999	0.001 mm	
114	Reserved by system	0	-9999999 to 9999999	0.001 mm	
115	Reserved by system	0H	-9999999 to 9999999	0.001 deg	
116 to 120	(For expansion)	0	~		
121	Vision System I/F 1 Coordinate Axes Definition	4321H	0H to FFFFFFFFH		Bit 0-3: X-direction Axis Number Bit 4-7: Y-direction Axis Number Bit 8-11: Z-direction Axis Number Bit 12-15: R-direction Axis Number Bit 16-31: Reserved (Main application version 1.00 or later/F-ROM 32-Mbit version only)
122	Vision System I/F 1 Coordinate Datum Point Offset X	0	-99999999 to 99999999	0.001 mm	Robot coordinate X at vision system I/F 1 coordinates (X = 0, Y = 0) * Setting is established in vision system I/F adjustment. (Main application version 1.00 or later/F-ROM 32-Mbit version only)
123	Vision System I/F 1 Coordinate Datum Point Offset Y	0	-99999999 to 99999999	0.001 mm	Robot coordinate Y at vision system I/F 1 coordinates (X = 0, Y = 0) * Setting is established in vision system I/F adjustment. (Main application version 1.00 or later/F-ROM 32-Mbit version only)
124	Vision System I/F 1 Coordinate Offset Angle	0	-99999999 to 99999999	0.001 deg	Rotation angle of vision system I/F 1 coordinate with robot coordinate as the datum Setting is established in vision system I/F adjustment. (Main application version 1.00 or later/F-ROM 32-Mbit version only)
125	Vision System I/F 1 Z Axis Direction Vision System Position Identification Datum	0	-99999999 to 99999999	0.001 mm	(Related information: Parameters Common to All Axes No. 130, "Vision System I/F 1 control 2") (Main application version 1.00 or later/F-ROM 32-Mbit version only)
126	Vision System I/F 1 X Axis (GTVD Acquirement Data) Correction Offset	0	-99999 to 99999	0.001 mm	(Main application version 1.00 or later/F-ROM 32-Mbit version only)
127	Vision System I/F 1 Y Axis (GTVD Acquirement Data) Correction Offset	0	-99999 to 99999	0.001 mm	(Main application version 1.00 or later/F-ROM 32-Mbit version only)
128	Vision System I/F 1 R Axis (GTVD Acquirement Data) Correction Offset	0	-360000 to 360000	0.001 deg	(Main application version 1.00 or later/F-ROM 32-Mbit version only)
129	Vision System I/F 1 control 1	0	0H to FFFFFFFFH		Bit 0-3: System reservation Bit 4-11: System reservation Bit 12-19: System reservation Bit 20-23: R axis correction positive sign reverse 0: not to reverse sign, 1: reverse sign Bit 24-31: Reserved (Main application version 1.00 or later/F-ROM 32-Mbit version only)
130	Vision System I/F 1 control 2	0	0H to FFFFFFFFH		Bit 0-7: Z axis direction position identification datum distance [0.1mm] Invalid when installed on robot and at 0 Bit 8-11: Vision installation type 0: fixed installation (not on robot), 1: installed on robot * Setting is established in vision system I/F adjustment. Bit 12-31: Reserved (Main application version 1.00 or later/F-ROM 32-Mbit version only)
131 to 400	(For expansion)	0	~		(Main application version 0.52 or later/F-ROM 32-Mbit version only)

PC:PC software
TP:Teaching pendant

3. Axis-Specific Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
1	Axis operation ty	0	0 to 1		0: Linear movement axis, 1: Rotational movement axis (Angle control)
2	ACMX + acceleration 1	30	1 to 999	0.01G	Acceleration speed when ACMX Command is executed. • Acceleration of movement in positive direction of the cooperate system • Deceleration of movement in negative direction of the cooperate system Setting is established based on transported weight, installation condition, etc. (XSEL-P/Q/PCT/QCT main application Ver. 1.15 or later)
3	ACMX - acceleration 1	30	1 to 999	0.01G	Acceleration speed when ACMX Command is executed. • Acceleration of movement in negative direction of the cooperate system • Deceleration of movement in positive direction of the cooperate system Setting is established based on transported weight, installation condition, etc. (XSEL-P/Q/PCT/QCT main application Ver. 1.15 or later)
4	ACMX + acceleration 2	30	1 to 999	0.01G	Same as Each Axis Parameter No.2
5	ACMX - acceleration 2	30	1 to 999	0.01G	Same as Each Axis Parameter No.3
6	Coordinate/physicaloperation direction selection	1	0 to 1		0: Motor CCW Positive direction on the coordinate system 1: Motor CCW Negative direction on the coordinate system
7	Soft limit +	50000	-99999999 to 99999999	0.001 mm	Fixed to 359.999 degrees internally in the index mode. Invalid in the infinite-stroke mode.
8	Soft limit –	0	-99999999 to 99999999	0.001 mm	Fixed to 0 degree internally in the index mode. Invalid in the infinite-stroke mode.
9	Soft-limit actual position margin	2000	0 to 9999	0.001 mm	Actual position margin in the positioning boundary critical zone in the infinite-stroke mode
10	Home-return method	0	0 to 5		0: earch Z-phase after end search 1: Current position 0 home (This parameter can be specified only with an incremental encoder. Pay attention to contact.) 2: Current position = Preset home (This parameter can be specified only with an incremental encoder. Pay attention to contact.) 3: Automatically refresh home preset value and move to reference coordinate after end search * Valid only for ball-screw spline linear movement axes. * Related information: Axis-specific parameter Nos. 10, 12, 141 (Main application version 0.82 or later)
11	Home-return end-search direction selection	0	0 to 1		0: Negative end of the coordinate system 1: Positive end of the coordinate system
12	Home preset value	0	-99999999 to 99999999	0.001 mm	(Refer to axis-specific parameter No. 76)
13	SIO/PIO home-return order	0	0 to 16		Executed from the smallest one.
14	Home-sensor input polarity	0	0 to 2		0: Do not use, 1: Contact a, 2: Contact b
15	Overrun-sensor input polarity	0	0 to 2		0: Do not use, 1: Contact a, 2: Contact b
16	Creep-sensor input polarity	0	0 to 2		0: Do not use, 1: Contact a, 2: Contact b
17	Initial home-sensor pull-out speed at home return	10	1 to 100	mm/sec	
18	Creep speed at home return	100	1 to 500	mm/sec	End search speed in the creep-sensor non-detection section, if a creep sensor is used
19	End search speed at home return	20	1 to 100	mm/sec	
20	Phase-Z search speed at home return	3	1 to 10	mm/sec	Exercise caution, since limitations apply depending on the read/encoder pulse count.
21	Offset travel distance at home return	1000	-99999999 to 99999999	0.001 mm	Offset travel distance from the ideal phase-Z position (Positive value = Applied in the direction of moving away from the end) (Refer to axis-specific parameter No. 76) * Note when an absolute encoder is used If a value near an integer multiple of the phase-Z distance (including an offset travel of 0) is set in this parameter, the servo will lock above Z-phase when an ABS reset is performed, in which case the coordinate may deviate by the number of phase-Z pulses. Never set a value near an integer multiple of the phase-Z distance. (Provide a sufficient margin relative to the amplitude of the servo system.)
22	Allowable phase-Z position error check value at home return	500	0 to 99999999	0.001 mm	Minimum allowable distance between the end (mechanical or LS) and Z-phase in a rotary encoder specification. Phase-Z search limit in a linear encoder specification.
23	Phase-Z count per encoder revolution	1	1 to 8		Only “1” can be set, in the case of an absolute encoder. Invalid in the case of a linear encoder.
24	Push stop check time at home return	700	1 to 5000	msec	
25	Push stop check time at positioning	500	1 to 5000	msec	

Axis-Specific Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
26	(Phase-Z evacuation distance at absolute home return (old))	1000	0 to 99999	0.001 mm	Evacuation distance from the actual phase-Z position (Positive value = Applied in the direction of moving away from the end) (Phase-shift prevention margin) (Refer to axis-specific parameter No. 76)
27	Maximum motor speed	5000	Reference only	rpm, mm/sec	In rpm when a rotary encoder is used, or in mm/sec when a linear encoder is used (cannot be changed).
28	Maximum operating speed of each axis	1000	1 to 9999	mm/s	
29	VLMX speed	1000	1 to 9999	mm/s	During VLMX operation, the maximum operating speed of each axis or VLMX speed, whichever is lower, is used as the maximum speed of the applicable axis.
30	Servo ON check time	150	0 to 5000		Brake equipped: Time after receiving a servo-ON start response until start of brake unlocking Brake not equipped: Time after receiving a servo ON start response until transition to an operation-enabled status
31	Offset travel speed at home return	3	1 to 500	mm/sec	
32	Actual distance between Zphase and end	-1	-1 to 99999	0.001 mm	Acquire / maintain the distance between the mechanical end (for sensor type, sensor detection position) and the home position. To acquire, set -1 to return home and then complete. [Refer to 12. Use Examples of Key Parameters.]
33	Ideal distance between Zphase and end	0	0 to 99999	0.001 mm	It is a parameter to store the acquired value in Each Axis Parameter No. 32. Have a manual operation for rewriting.
34	Brake equipment specification	0	0 to 1		0: Not equipped, 1: Equipped *Effective when Each Axis Parameter No. 103 = 0
35	Brake unlock check time	150	0 to 3000	msec	Time after receiving a brake-unlock start response until transition to an operation-enabled status
36	Brake lock check time	300	0 to 1000	msec	Time after receiving a brake-lock start response until start of servo OFF
37	Encoder linear/rotary type	0	0 to 1		0: Rotary encoder 1: Linear encoder
38	Encoder ABS/INC type	0	0 to 1		0: INC, 1: ABS
39	Magnetic-pole sensor equipment specification (For future expansion = Change prohibited)	1	0 to 1		0: Not equipped, 1: Equipped
40	For future expansion (change prohibited)	0	0 to 1		
41	For future expansion (change prohibited)	25	1 to 100	DRVVR	
42	Encoder resolution	131072	0 to 99999999	Pulse/rev, 0.001 mm/pulse	Pulses (before division)/rev, in the case of a rotary encoder. 0.001 mm/pulse (before division), in the case of a linear encoder.
43	Encoder division ratio	3	-7 to 7		Pulses are multiplied by ("n"th power of 1/2).
44	Length measurement correction	0	-99999999 to 99999999	0.001 mm/1m	Effective when linear axis and also rotary encoder (Coordinates other than the encoder reference Z point will change proportionally.)
45	Input polarity of broken-belt detection sensor	0	0 to 2		0: Do not use, 1: Contact a, 2: Contact b (Main application version 0.71 or later)
46	(For expansion)	0			
47	Screw lead	20000	1 to 99999999	0.001 mm	Valid only for linear movement axes. Invalid in the case of a linear encoder.
48 to 49	(For expansion)	0			
50	Gear ratio numerator	1	1 to 99999999		Invalid in the case of a linear encoder.
51	Gear ratio denominator	1	1 to 99999999		Invalid in the case of a linear encoder.

Axis-Specific Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
52	Synchro setting bit pattern 1	0	0H to FFFFFFFFH		* Effective only when specified for the synchro slave axis. (Main application version 0.62 or later) Bits 8 to 11: Selection of use of Z-phase of the synchro slave axis during home return of the incremental encoder (INC-INC control) (0: Do not use Z-phase of the slave axis 1: Use not use Z-phase of the slave axis) * If Z-phase of the slave axis is used, the following parameters of the slave axis will become effective: “Axis-specific parameter No. 21, Offset travel distance at home return” “Axis-specific parameter No. 12, Home preset value” * Adjustment method when Z-phase of the slave axis is used [1] Complete a home return in the synchronized mode. • Ignore the “Error No. D0A, Driver overload error” that generates upon completion of home return. • If an “Error No. C9C, Defective phase-Z position error” generates, the relationship of the installed positions of both synchro axes must be adjusted. • If an “Error No. C72/D6B, Overrun error” generates, adjust the relationship of the installed positions of both synchro axes or set “Axis-specific parameter No. 15, Overrun-sensor input polarity” to “0 (Do not use)” and stop using the overrun sensor. [2] Turn the servo OFF by actuating an emergency stop. [3] Align the physical position relationship of the synchro master axis and slave axis and then read off their present position coordinates. [4] Calculate the value of “present position coordinates of synchro slave axis – present position coordinates of synchro master axis” and set the calculated value in “Axis-specific parameter No. 21, Offset travel distance at home return” for the synchro slave axis (Exercise caution that unit conversion is required in the above calculation.) [5] Write the data to the flash ROM, and then execute a software reset or power ON reset of the controller. * Effective only when specified for the synchro slave axis. (Main application version 0.63 or later)
53	Setting bit pattern 1 of each axis	0	0H to FFFFFFFFH		
54	Travel distance for push stop detection at home return	20	1 to 99999	0.001 mm	Used to confirm pushing action at the time of home return.
55	Travel distance for push stop detection at positioning	30	1 to 99999	0.001 mm	Used to confirm pushing action according to the PUSH command.
56	Push-abort deviation ratio at home return	2000	1 to 99999		Deviation is compared against “Steady-state deviation of push speed + Push-speed pulse speed x Abort deviation ratio.”
57	Push-abort deviation ratio at positioning	5000	1 to 99999		Deviation is compared against “Steady-state deviation of push speed + Push-speed pulse speed x Abort deviation ratio.”
58	Positioning band	100	1 to 9999	0.001 mm	* Related information: Axis-specific parameter No. 52
59	Allowable deviation error ratio (Maximum speed pulse ratio)	27	1 to 99		Deviation is compared against “Steady-state deviation of maximum operating speed of each axis + Pulse speed of maximum operating speed of each axis x Allowable deviation error ratio.”
60	Position gain	30	1 to 9999	/s	
61	FAG	0	0 to 99		
62	Synchro FB gain	77	0 to 1000		
63	Stop special output range	1	0 to 9999	Pulse	Invalid if “0” is set.
64	Stop special output value	1	0 to 999	DRVVR	
65	Mating synchro-axis number	0	0 to 8		Must be input for both axes. (Of the axis pair, the axis with the smaller axis number becomes the master axis. Both axes must have the same resolution characteristics. Commands cannot be issued to the slave axis.) * The actuators must be installed by physically aligning the “positions at the end of home return” of the synchro master and slave axes. (Invalid if “0” is set)
66	Mode selection for rotational movement axis	0	0 to 5		0: Normal, 1: Index mode
67	Short-cut control selection for rotational movement axis	0	0 to 5		0: Do not select, 1: Select (Valid only in the index mode AND when an incremental encoder is used)
68	Mode selection for linear movement axis	0	0 to 5		0: Normal, 1: Infinite-stroke mode (Note: Positioning boundary applies. This setting can be specified only when an incremental encoder is used.)
69	Torque limit upon stopping of synchro slave axis	0	0 to 70	%	Not limited, if “0.” Effective only when specified for the synchro slave axis. * Related information: Axis-specific parameter No. 52 (Main application version 0.59 or later)
70	For future expansion	0	Reference only		
71	For future expansion	0	Reference only		

Axis-Specific Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
72	DRVVR + offset	0	Reference only	DRVVR	(Change prohibited) To maintain symmetry of the positive and negative sides.
73	DRVVR – offset	0	Reference only	DRVVR	(Change prohibited) To maintain symmetry of the positive and negative sides.
74	For future expansion	0	Reference only		
75	For future expansion	0	Reference only		
76	Home-adjustment parameter set selection	1	Reference only		(Change prohibited) 0: P21 = Phase-Z evacuation distance at INC home return P12 = Ideal phase-Z position coordinate 1: P32 is read automatically even when P33 = 0. P33 = 0 indicates "actual distance." P21 = Offset travel at home return P12 = Coordinate achieved by offset travel at home return P26 = Invalid (To facilitate adjustment)
77	Synchro S pulse	3	0 to 99999	Pulse	* Related information: Axis-specific parameter No. 52
78	Maximum takeoff command amount	0	-3000 to 3000	0.001 mm	Maximum lift command amount before brake unlock (Input with sign) (Suppression of momentary drop upon servo ON when a heavy object is placed) * Important: Input using the same sign as the rising coordinate direction. (0.100 mm to 0.500 mm in absolute value as a guideline) * The servo-ON check time (axis-specific parameter No. 30) must also be extended (approx. 1000 to 1500 msec) to provide a sufficient time for rise-direction torque to follow. (Valid only when installation of brake is specified.)
79	Actual takeoff check distance	5	0 to 3000	0.001 mm	Absolute value input
80	Maximum forced-feed range	0	0 to 9999	0.001 mm	For reduction of settling time. (Invalid range if "0" is set) (Approx. 1.000 mm as a guideline)
81	Minimum forced-feed range	200	0 to 9999	0.001 mm	
82	Medium forced-feed range	600	0 to 9999	0.001 mm	
83	Absolute synchro slave-axis initialization cancellation	0	0 to 5		Valid only with a synchro slave axis.
84	Maximum synchronization correction speed of synchro slave axis	5	0 to 100	mm/sec	Maximum travel speed for synchronization position correction of slave axis. Valid only with a synchro slave axis. * Note: Not limited by the safety speed.
85	Home-return acceleration/ deceleration	15	1 to 300	0.01 G	
86	Zone 1 MAX	0	-99999999 to 99999999	0.001 mm	Valid only when MAX > MIN. * Must be inside the range for at least 3 msec.
87	Zone 1 MIN	0	-99999999 to 99999999	0.001 mm	Valid only when MAX > MIN. * Must be inside the range for at least 3 msec.
88	Zone 1 output number	0	0 to 899		Physical output port or global flag (Output is invalid if "0" is input; multiple specification is invalid)
89	Zone 2 MAX	0	-99999999 to 99999999	0.001 mm	Valid only when MAX > MIN. * Must be inside the range for at least 3 msec.
90	Zone 2 MIN	0	-99999999 to 99999999	0.001 mm	Valid only when MAX > MIN. * Must be inside the range for at least 3 msec.
91	Zone 2 output number	0	0 to 899		Physical output port or global flag (Output is invalid if "0" is input; multiple specification is invalid)
92	Zone 3 MAX	0	-99999999 to 99999999	0.001 mm	Valid only when MAX > MIN. * Must be inside the range for at least 3 msec.
93	Zone 3 MIN	0	-99999999 to 99999999	0.001 mm	Valid only when MAX > MIN. * Must be inside the range for at least 3 msec.
94	Zone 3 output number	0	0 to 899		Physical output port or global flag (Output is invalid if "0" is input; multiple specification is invalid)
95	Zone 4 MAX	0	-99999999 to 99999999	0.001 mm	Valid only when MAX > MIN. * Must be inside the range for at least 3 msec.
96	Zone 4 MIN	0	-99999999 to 99999999	0.001 mm	Valid only when MAX > MIN. * Must be inside the range for at least 3 msec.
97	Zone 4 output number	0	0 to 899		Physical output port or global flag (Output is invalid if "0" is input; multiple specification is invalid)
98 to 100	(For expansion)	0	~		
101	Allowable time for exceeding continuous-operation enable torque	0	0 to 300	S	If 0, the allowable time for exceeding continuous-operation enable torque is not monitored. (Main application version 0.71 or later)

Appendix

Axis-Specific Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
102	Synchronizing on/off Switchover Mating Axis Number	0	0 to 8		Mutual input necessary (smaller axis number is to be the master axis in a pair.) Only resolution related same characteristic axes can be selected. It is invalid to issue a command to a slave axis. (Ineffective at 0) It is necessary to set the actuators with the synchronizing master and slave axes matched physically at "home-return end position". (Related information: Axis-specific parameter No. 65) (Main application version 1.17 or later)
103	Brake output control method select	0	0 ~ 1		0: System Brake Control (for brake control by the system when Each Axis Parameter No. 34 "Brake Installation Indication" = 1) 1: User Control (User control available in Virtual Output Port No. 7301 to 7306
104	Target axis specification for multiple-slider near-miss detection	0H	0H to FFFFFFFFH		Bits 0 to 3: Mating axis number of near-miss detection target (on the positive side of the coordinate system of the target axis) Bits 4 to 7: Mating axis number of near-miss detection target (on the negative side of the coordinate system of the target axis) * The mating axis must be entered for each axis. (Of the pair, the axis with the smaller axis number becomes the main axis for the sake of convenience.) * For each axis, only an axis whose resolution and other related characteristics are the same can be specified as a mating axis. * In the case of synchro axes, always specify the synchro master axis. (Specification of the synchro slave axis is prohibited.) * Specify "0" if no adjacent slider is present on the applicable side of the coordinate system of the target axis. (Main application version 0.51 or later)
105	Effective stroke of multiple sliders	0	0 to 99999999	0.001 mm	Set the result of [Inter-slider distance at the farthest position allowed] – [Inter-slider distance at the closest position allowed] when both axes subject to multiple-slider near-miss detection are inside the range of operation. (This parameter is valid only for the master axis between the multiple-slider axes.) (Main application version 0.51 or later)
106	Emergency deceleration margin upon multiple-slider near-miss detection	5	0 to 999	0.01 G	(Main application version 0.51 or later)
107	Multiple-slider setting: Bit pattern 1	12H	0H to FFFFFFFFH		Bits 0 to 3: Margin for multiple-slider actual position near-miss detection (mm) (Of the multiple sliders, only the parameter for the master axis is valid.) (Main application version 0.51 or later) Bits 4 to 7: Margin for multiple-slider command position nearmiss detection (mm) (Of the multiple sliders, only the parameter for the master axis is valid.) (Main application version 0.51 or later)
108	Positioning control switching band for synchro slave axis	5000	1 to 99999	0.001 mm	Effective only when specified for the synchro slave axis. * Related information: Axis-specific parameter No. 52 (Main application version 0.62 or later)
109	Specification of mating axis for ball-screw spline correction (linear movement axis + rotational movement axis)	0	0 to 8		This parameter must be entered for both axes. 0: Invalid 1 to 8: Mating axis number * Related information: Axis-specific parameter No. 1 (Main application version 0.82 or later)
110 to 118	(For expansion)	0	~		
119	FSG	0	0 to 100		
120	FFF	10	0 to 100		* Change is prohibited unless instructed by the manufacturer.
121 to 133	(For expansion)	0	~		
134	Maximum Operation Speed for Each Axis	0	0 to 999	0.01G	Ineffective when set to 0 or below. Restriction is to be made regarding All Axes Parameter No.22 "Maximum Acceleration". (XSEL-P/Q/PCT/QCT main application Ver. 1.15 or later)
135	Maximum Operation Deceleration for Each Axis	0	0 to 999	0.01G	Ineffective when set to 0 or below. Restriction is to be made regarding All Axes Parameter No.23 "Maximum Deceleration". (XSEL-P/Q/PCT/QCT main application Ver. 1.15 or later)
136	Minimum Emergency Deceleration for Each Axis	0	0 to 999	0.01G	0Ineffective when set to 0 or below. Restriction is to be made regarding All Axes Parameter No.24 "Minimum Emergency Deceleration". (XSEL-P/Q/pCT/QCT main application Ver. 1.15 or later)
137 to 140	(For expansion)	0	~		
141	Reference coordinate after automatic refresh of home preset value	0	-99999999 to 99999999	0.001 mm 0.001 deg	* Valid only for ball-screw spline axes. * Related information: Axis-specific parameter Nos. 10, 12, 144 (Main application version 0.82 or later)

Axis-Specific Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
142	Coordinate direction selection for rotational movement axis linear movement axis ballscrew spline correction (linear movement axis + rotational movement axis)	0	0 to 1		0: Positive coordinate direction of rotational movement axis Positive coordinate direction of linear movement axis 1: Positive coordinate direction of rotational movement axis Negative coordinate direction of linear movement axis * Valid only for ball-screw spline linear movement axes. (Main application version 0.82 or later)
143	(For expansion)	0	~		
144	End offset travel when standing by at reference coordinate after automatic refresh of home preset value	5500	-99999999 to 99999999	0.001 mm	(Positive value = Direction of moving away from the end) (If "3" is specified in axis-specific parameter No. 10, "Home return method," the actuator will move by the value set in this parameter (distance) following an end search.) * Valid only for ball-screw spline linear movement axes. * Related information: Axis-specific parameter Nos. 10, 12, 141 (Main application version 0.82 or later)
145 to 150	(For expansion)	0	~		
151	Attenuation characteristic coefficent 1 (Parameter set 1)	10	0 to 1000	1/1000 Rate	For anti-vibration control (Indicates width of notch filter attenuation) (Main application version 0.84 or later)
152	Attenuation characteristic coefficent 2 (Parameter set 1)	1000	0 to 1000	1/1000 Rate	For anti-vibration control (Indicates depth of notch filter attenuation) (Main application version 0.84 or later)
153	Natural vibration frequency (Parameter set 1)	10000	500 to 100000	1/1000 Hz	For anti-vibration control (Main application version 0.84 or later)
154	Notch filter gain (Parameter set 1)	9950	1 to 20000	1/10000 Rate	For anti-vibration control (Indicates ratio of output of notch filter attenuation) (Main application version 0.84 or later)
155	System reservation	0	~		
156	Attenuation characteristic coefficent 1 (Parameter set 2)	10	0 to 1000	1/1000 Rate	For anti-vibration control (Indicates width of notch filter attenuation) (Main application version 0.84 or later)
157	Attenuation characteristic coefficent 2 (Parameter set 2)	1000	0 to 1000	1/1000 Rate	For anti-vibration control (Indicates depth of notch filter attenuation) (Main application version 0.84 or later)
158	Natural vibration frequency (Parameter set 2)	10000	500 to 100000	1/1000 Hz	For anti-vibration control (Main application version 0.84 or later)
159	Notch filter gain (Parameter set 2)	9950	1 to 20000	1/10000 Rate	For anti-vibration control (Indicates ratio of output of notch filter attenuation) (Main application version 0.84 or later)
160	System reservation	0	~		
161	Attenuation characteristic coefficent 1 (Parameter set 3)	10	0 to 1000	1/1000 Rate	For anti-vibration control (Indicates width of notch filter attenuation) (Main application version 0.84 or later)
162	Attenuation characteristic coefficent 2 (Parameter set 3)	1000	0 to 1000	1/1000 Rate	For anti-vibration control (Indicates depth of notch filter attenuation) (Main application version 0.84 or later)
163	Natural vibration frequency (Parameter set 3)	10000	500 to 100000	1/1000 Hz	For anti-vibration control (Main application version 0.84 or later)
164	Notch filter gain (Parameter set 3)	9950	1 to 20000	1/10000 Rate	For anti-vibration control (Indicates ratio of output of notch filter attenuation) (Main application version 0.84 or later)
166	Drive disable specification (Main application version 0.98 or later)	0	0 to 1	-	0: Enable drive, 1: Disable drive
167	Slave operation command source unit type (Main application version 0.98 or later)	0	0 to 10	-	0: None, 1: Pulse I/O board axis
168	Slave operation command source device number (Main application version 0.98 or later)	0	0 to 99999999	-	Specify an axis number from 0 to 15 when pulse I/O board axis slave operation is performed.
169 to 193	(For expansion)	0	~		
194	ACMX + acceleration 3	30	1 to 999	0.01G	Same as Each Axis Parameter No.2
195	ACMX - acceleration 3	30	1 to 999	0.01G	Same as Each Axis Parameter No.3
196	ACMX + acceleration 4	30	1 to 999	0.01G	Same as Each Axis Parameter No.2
197	ACMX - acceleration 4	30	1 to 999	0.01G	Same as Each Axis Parameter No.3
198 to 200	(For expansion)	0	~		
201 to 250	(For expansion)	0	~		(Main application version 0.52 or later/F-ROM 32-Mbit version only)

4. Driver Card Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
1	Type (upper) (Manufacturing information)	Space	Reference only		For adjustment by the manufacturer
2	Type (middle) (Manufacturing information)	Space	Reference only		For adjustment by the manufacturer
3	Type (lower) (Manufacturing information)	Space	Reference only		For adjustment by the manufacturer
4	Manufacturing data (Manufacturing information)	Space	Reference only		For adjustment by the manufacturer
5	Manufacturing data (Manufacturing information)	Space	Reference only		For adjustment by the manufacturer
6	Manufacturing data (Manufacturing information)	Space	Reference only		For adjustment by the manufacturer
7	Manufacturing data (Manufacturing information)	Space	Reference only		For adjustment by the manufacturer
8	Board type (Function information)	31	Reference only		For adjustment by the manufacturer
9	Installation type word 1 (Function information)	0101H	Reference only		For adjustment by the manufacturer
10	Installation type word 2 (Function information)	0000H	Reference only		For adjustment by the manufacturer
11	(Function information)	0000H	Reference only		
12	Software version (Function information)	0000H	Reference only		For adjustment by the manufacturer
13	Maximum supported motor ID number (Function information)	0000H	Reference only		For adjustment by the manufacturer
14	Motor control data use selection (Function information)	0000H	Reference only		For adjustment by the manufacturer
15	(Function information)	0000H	Reference only		For adjustment by the manufacturer
16	(Function information)	0000H	Reference only		For adjustment by the manufacturer
17	(Function information)	0000H	Reference only		For adjustment by the manufacturer
18	(Function information)	0000H	Reference only		For adjustment by the manufacturer
19	(Function information)	0000H	Reference only		For adjustment by the manufacturer
20	(Function information)	0000H	Reference only		For adjustment by the manufacturer
21	(Function information)	0000H	Reference only		For adjustment by the manufacturer
22	(Function information)	0000H	Reference only		For adjustment by the manufacturer
23	(Configuration information)	0000H	Reference only		For adjustment by the manufacturer
24	Configuration capacity (rated motor output) (compatible with E, priority on E) (configuration information)	003CH	Reference only		For adjustment by the manufacturer
25	Configuration voltage (motor voltage) (compatible with E, priority on E) (configuration information)	00C8H	Reference only		For adjustment by the manufacturer
26	Motor/encoder configuration information (compatible with E, priority on E) (configuration information)	0000H	Reference only		For adjustment by the manufacturer
27	(Configuration information)	0000H	Reference only		For adjustment by the manufacturer
28	(Configuration information)	0000H	Reference only		For adjustment by the manufacturer

Driver Card Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
29	Motor/encoder characteristic word (compatible with E, priority on E) (configuration information)	0004H	Reference only		For adjustment by the manufacturer
30	Motor/encoder control word 1 (compatible with E, priority on E) (configuration information)	5000	Reference only		For adjustment by the manufacturer
31	Motor/encoder control word 2 (compatible with E, priority on E) (configuration information)	0000H	Reference only		For adjustment by the manufacturer
32	Motor/encoder control word 3 (configuration information) (Encoder cable length) [m]	2	Reference only		Encoder cable length (m) * Be sure to change this parameter after retrofitting.
33	Motor/encoder control word 4 (configuration information)	14H	Reference only		For adjustment by the manufacturer
34	Motor/encoder control word 5 (configuration information)	0000H	Reference only		For adjustment by the manufacturer
35	(Configuration information)	0000H	Reference only		For adjustment by the manufacturer
36	(Configuration information)	0000H	Reference only		For adjustment by the manufacturer
37	Pressing torque limit max in positioning	70	0 to 300	%	(Main application Ver. 0.71 or later)
38	Push torque limit at positioning	70	0 to 300	%	
39	Push torque limit at home return	100	0 to 150	%	
40	Maximum torque limit	300	10 to 400	%	* The maximum value that can be set varies depending on the motor, etc.
41	Dynamic brake operation specification	0	0 to 1		0: Disable, 1: Enable
42	Software DB operation specification	0	0 to 1		0: Enable, 1: Disable
43	Speed loop gain	500	1 to 32767		Proportional gain
44	Speed loop integration time constant	30	0 to 1000		Integral gain
45	Torque filter time constant	0	0 to 2500		
46	Current control band number	4	0 to 4		
47 to 52	(For expansion)	0H	0000H to FFFFH		
53	Current control word 1	0H	Reference only		For adjustment by the manufacturer
54	Current control word 2	0H	Reference only		For adjustment by the manufacturer
55	Current control word 3	0H	Reference only		For adjustment by the manufacturer
56	Current control word 4	0H	Reference only		For adjustment by the manufacturer
57	Current control word 5	0H	Reference only		For adjustment by the manufacturer
58	Current control word 6	0H	Reference only		For adjustment by the manufacturer
59	Current control word 7	0H	0000H to FFFFH		For adjustment by the manufacturer
60	Current control word 8	0H	0000H to FFFFH		For adjustment by the manufacturer

Driver Card Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
61 to 67	(For expansion)	0H	0000H to FFFFH		
68	Current control query information 01	0H	Reference only		For adjustment by the manufacturer
69	Current control query information 02	0H	Reference only		For adjustment by the manufacturer
70	Current control query information 03	0H	Reference only		For adjustment by the manufacturer
71	Current control query information 04	0H	Reference only		For adjustment by the manufacturer
72	Current control query information 05	0H	Reference only		For adjustment by the manufacturer
73	Current control query information 06	0H	Reference only		For adjustment by the manufacturer
74	Current control query information 07	0H	Reference only		For adjustment by the manufacturer
75	Current control query information 08	0H	Reference only		For adjustment by the manufacturer
76	Current control query information 09	0H	Reference only		For adjustment by the manufacturer
77	Current control query information 10	0H	Reference only		For adjustment by the manufacturer
78	Current control query information 11	0H	Reference only		For adjustment by the manufacturer
79	Current control query information 12	0H	Reference only		For adjustment by the manufacturer
80	Current control query information 13	0H	Reference only		For adjustment by the manufacturer
81	Current control query information 14	0H	Reference only		For adjustment by the manufacturer
82	Current control query information 15	0H	Reference only		For adjustment by the manufacturer
83	Current control query information 16	0H	Reference only		For adjustment by the manufacturer
84	Current control query information 17	0H	Reference only		For adjustment by the manufacturer
85	Current control query information 18	0H	Reference only		For adjustment by the manufacturer
86	Current control query information 19	0H	Reference only		For adjustment by the manufacturer
87	Current control query information 20	0H	Reference only		For adjustment by the manufacturer
88	Current control query information 21	0H	Reference only		For adjustment by the manufacturer
89	Current control query information 22	0H	Reference only		For adjustment by the manufacturer
90	Current control query information 23	0H	Reference only		For adjustment by the manufacturer
91	Current control query information 24	0H	Reference only		For adjustment by the manufacturer
92	Current control query information 25	0H	Reference only		For adjustment by the manufacturer
93	Current control query information 26	0H	Reference only		For adjustment by the manufacturer
94	Current control query information 27	0H	Reference only		For adjustment by the manufacturer
95	Current control query information 28	0H	Reference only		For adjustment by the manufacturer
96	Current control query information 29	0H	Reference only		For adjustment by the manufacturer
97	Current control query information 30	0H	Reference only		For adjustment by the manufacturer

5. Encoder Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
1	Type (upper) (Manufacturing information)	Space	Reference only		
2	Type (middle) (Manufacturing information)	Space	Reference only		
3	Type (lower) (Manufacturing information)	Space	Reference only		
4	Manufacturing data (Manufacturing information)	Space	Reference only		
5	Manufacturing data (Manufacturing information)	Space	Reference only		
6	Manufacturing data (Manufacturing information)	Space	Reference only		
7	Manufacturing data (Manufacturing information)	Space	Reference only		
8	Board type (Function information)	80	Reference only		
9	Configuration capacity (rated motor output) (compatible with X/E) (function information)	003CH	Reference only		For adjustment by the manufacturer
10	Configuration voltage (motor voltage) (compatible with X/E) (function information)	00C8H	Reference only		For adjustment by the manufacturer
11	Motor/encoder configuration information (compatible with X/E) (function information)	0000H	Reference only		For adjustment by the manufacturer
12	Encoder resolution (upper word) (compatible with X/E) (function information)	0002H	Reference only		For adjustment by the manufacturer
13	Encoder resolution (lower word) (compatible with X/E) (function information)	0000H	Reference only		For adjustment by the manufacturer
14	Motor/encoder characteristic word (compatible with X/E) (function information)	0004H	Reference only		For adjustment by the manufacturer
15	Motor/encoder control word 1 (function information)	3834	Reference only	0.1 K (Kelvin = temperature unit)	For adjustment by the manufacturer
16	Motor/encoder control word 2 (function information)	0000H	Reference only		For adjustment by the manufacturer
17	Motor/encoder control word 3 (function information)	0000H	Reference only		For adjustment by the manufacturer
18	Motor/encoder control word 4 (function information)	0001H	Reference only		For adjustment by the manufacturer
19	(Function information)	0000H	Reference only		For adjustment by the manufacturer
20	(Function information)	0000H	Reference only		For adjustment by the manufacturer
21	(Function information)	0000H	Reference only		For adjustment by the manufacturer
22	(Function information)	0000H	Reference only		For adjustment by the manufacturer
23 to 30	Card parameter (by board type)	0000H	Reference only		For adjustment by the manufacturer

6. I/O Devices

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
1	Type (upper) (Manufacturing information)	Space	Reference only		For adjustment by the manufacturer
2	Type (middle) (Manufacturing information)	Space	Reference only		For adjustment by the manufacturer
3	Type (lower) (Manufacturing information)	Space	Reference only		For adjustment by the manufacturer
4	Manufacturing data (Manufacturing information)	Space	Reference only		For adjustment by the manufacturer
5	Manufacturing data (Manufacturing information)	Space	Reference only		For adjustment by the manufacturer
6	Manufacturing data (Manufacturing information)	Space	Reference only		For adjustment by the manufacturer
7	Manufacturing data (Manufacturing information)	Space	Reference only		For adjustment by the manufacturer
8	Board type (Function information)	0	Reference only		For adjustment by the manufacturer
9	Function information 01 (by board type)	0000H	Reference only		For adjustment by the manufacturer
10	Function information 02 (by board type)	0000H	Reference only		For adjustment by the manufacturer
11	Function information 03 (by board type)	0000H	Reference only		For adjustment by the manufacturer
12	Function information 04 (by board type)	0000H	Reference only		For adjustment by the manufacturer
13	Function information 05 (by board type)	0000H	Reference only		For adjustment by the manufacturer
14	Function information 06 (by board type)	0000H	Reference only		For adjustment by the manufacturer
15	Function information 07 (by board type)	0000H	Reference only		For adjustment by the manufacturer
16	Function information 08 (by board type)	0000H	Reference only		For adjustment by the manufacturer
17	Function information 09 (by board type)	0000H	Reference only		For adjustment by the manufacturer
18	Function information 10 (by board type)	0000H	Reference only		For adjustment by the manufacturer
19	Function information 11 (by board type)	0000H	Reference only		For adjustment by the manufacturer
20	Function information 12 (by board type)	0000H	Reference only		For adjustment by the manufacturer
21	Function information 13 (by board type)	0000H	Reference only		For adjustment by the manufacturer
22	Function information 14 (by board type)	0000H	Reference only		For adjustment by the manufacturer
23 to 52	Device parameter (by board type)	0000H	Reference only		For adjustment by the manufacturer
53 to 82	Query information 01 to 30 (by board type)	0000H	Reference only		For adjustment by the manufacturer

7. Other Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
1	Auto-start program number	0	0 to 64 (F-ROM 16-Mbit version) 0 to 128 (Main application version 0.52 or later/F-ROM 32-Mbit version only)		(Invalid if "0" is set)
2	I/O processing program number at operation/program abort	0	0 to 64 (F-ROM 16-Mbit version) 0 to 128 (Main application version 0.52 or later/F-ROM 32-Mbit version only)		The start trigger is determined from the "I/O processing program start type at operation/program abort." (Note: This program will be started before confirming an abort of other programs.) (Invalid if "0" is set) * If the setting is valid, the number of user program tasks that can be used will decrease by 1.
3	I/O processing program number at all operation pause	0	0 to 64 (F-ROM 16-Mbit version) 0 to 128 (Main application version 0.52 or later/F-ROM 32-Mbit version only)		This program will be started when an all-operation-pause command is issued due to an all-operation-pause factor. (Only when a program is running) (Invalid if "0" is set) * If the setting is valid, the number of user program tasks that can be used will decrease by 1.
4	Program abort type at error	0	0 to 5		0: Cancel only the program in which an error of operation-cancellation level or higher has generated. (If the error requires the drive source to be cut off or a servo-OFF or all-axis servo-OFF request to be issued, all programs other than the "I/O processing program at operation/program abort" will be cancelled.) 1: Cancel all programs other than the "I/O processing program at operation/program abort" when an error of operation-cancellation level or higher has generated.
5	I/O processing program start type at operation/program abort	0	0 to 5		0: When all-operation-cancellation factor has generated (Only when a program is running) 1: When all-operation-cancellation factor has generated (Always) 2: All-operation-cancellation factor + Error of operation-cancellation level or higher ("Other parameter No. 4 = 0" is considered) (Only when a program is running) 3: All-operation-cancellation factor + Error of operation-cancellation level or higher ("Other parameter No. 4 = 0" is considered) (Always)
6	PC/TP reconnection delay at software reset	14000	1 to 99999	msec	* The setting will become effective after the controller, PC or TP is restarted.
7 to 8	(For expansion)	0			
9	For future expansion (change prohibited)	0	0 to 2		
10	Emergency-stop recovery type	0	0 to 4		0: Abort operations/programs 1: Recovery after reset 2: Operation continued (Only during automatic operation. * Operation commands from the PC/TP will be aborted on the PC/TP side.) 3: Abort operations/programs (Software reset when the emergency stop is reset. The home-return completion status of incremental-encoder axes will be reset (EG approximation swap).) 4: Abort operations/programs (Error reset (only with an error of operation-cancellation level or lower) and auto-start program start (only if AUTO mode AND I/O parameter No. 33 = 1 AND I/O parameter No. 44 ≠ 1 AND all-operation-cancellation factor is not present) when the emergency stop is reset). There must be a minimum interval of 1 second after an emergency stop is actuated before it is reset. The home-return completion status of incremental-encoder axes will be retained.

PC: PC software
TP: Teaching pendant

Other Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
11	Enable switch (deadman/enable switch) recovery type	0	0 to 2		0: Abort operations/programs 1: Recovery after reset 2: Operation continued (Only during automatic operation. * Operation commands from the PC/TP will be aborted on the PC/TP side.)
12	Automatic operation recognition type	0	0 to 3		0: Program is running AND all-operation-cancellation factor is not present 1: [Program is running OR in AUTO mode] AND all-operation-cancellation factor is not present
13 to 19	(For expansion)	0			
20	System-memory backup battery installation function type	2	0 to 2		0: Not installed (SEL global data/error lists cannot be recovered from the flash ROM) 1: Not installed (SEL global data/error lists can be recovered from the flash ROM) 2: Installed * When the power is turned on without battery installed, point data can be copied from the flash ROM. * Use of setting “1” will be prohibited for the time being due to limitations. * When point data is lost due to a battery error, the point data valid before the flash ROM was written can be restored → Input “0” (not installed) and transfer the setting to the controller, and then perform a software reset without writing the flash ROM. The point data last written to the flash ROM will be restored. Thereafter, reset this parameter to the original value. (No remedy is available for recovery of SEL global data/error lists.)
21	Manual mode type	0	0 to 5		0: Always enable edit and SIO/PIO start (Initial condition after connection = With safety speed) 1: Select edit and start (with password) (EU, etc.) 2: Always enable edit and SIO/PIO start (Initial condition after connection = Without safety speed (cancellation)) * Referenced by the PC/TP.
22	Control use region	0	0 to 99		0: J, 1: E, 2: EU
23	PSIZ command function type	0	0 to 5		0: Maximum number of point data areas 1: Number of point data used
24	Local variable number for storing SEL communication command return code	99	1 to 99 1001 to 1099		
25 to 29	(For expansion)	0			
30	Option Password 00	0H	0H to FFFFFFFFH		HOME command option (Change prohibited) * Change is prohibited unless instructed by the manufacturer.
31	Option Password 01	0H	0H to FFFFFFFFH		Reserved (Change prohibited) * Change is prohibited unless instructed by the manufacturer.
32	Option Password 02	0H	0H to FFFFFFFFH		Reserved (Change prohibited) * Change is prohibited unless instructed by the manufacturer.
33 to 35	(For expansion)	0	0H to FFFFFFFFH		

Other Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
36	PC/TP data protect setting (Program)	0H	0H to FFFFFFFFH		Bits 0 to 3: Protect type (0: Read/write, 1: Read only, 2: No read/write) Bits 4 to 7: Protect release method (0: Special operation) Bits 8 to 11: Protect range maximum number (1's place, BCD) Bits 12 to 15: Protect range maximum number (10's place, BCD) Bits 16 to 19: Protect range minimum number (1's place, BCD) Bits 20 to 23: Protect range minimum number (10's place, BCD) * Referenced by the PC/TP * With the F-ROM 32-Mbit version, data cannot be protected for program Nos. 100 to 128 which are outside the allowable setting range (these programs are not covered by the data protection specification.)
37	PC/TP data protect setting (Position)	0H	0H to FFFFFFFFH		Bits 0 to 3: Protect type (0: Read/write, 1: Read only, 2: No read/write) Bits 4 to 7: Protect release method (0: Special operation) Bits 8 to 11: Protect range maximum number (10's place, BCD) Bits 12 to 15: Protect range maximum number (100's place, BCD) Bits 16 to 19: Protect range maximum number (1000's place, BCD) Bits 20 to 23: Protect range minimum number (10's place, BCD) Bits 24 to 27: Protect range minimum number (100's place, BCD) Bits 28 to 31: Protect range minimum number (1000's place, BCD) * The value in the 1's place is considered "0" for both the protect range maximum/minimum numbers. * Referenced by the PC/TP * With the F-ROM 32-Mbit version, data cannot be protected for program Nos. 9991 to 20000 which are outside the allowable setting range (these programs are not covered by the data protection specification.)

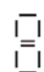
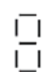
Other Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
38	PC/TP data protect setting (Symbol, parameter)	0H	0H to FFFFFFFF H		Bits 0 to 3: Protect type (Parameter) (0: Read/write, 1: Read only, 2: No read/write) Bits 4 to 7: Protect release method (Parameter) (0: Special operation) Bits 8 to 11: Protect type (Symbol) (0: Read/write, 1: Read only, 2: No read/write) Bits 12 to 15: Protect release method (Symbol) (0: Special operation) * Referenced by the PC/TP
39	(For future expansion)	0H	0H to FFFFFFFF H		
40	EEPROM information check type	83H	Reference only		0: Disable checksum, 1: Enable checksum Bit 0 = Driver Bit 1 = Encoder Bit 2 = I/O board Bits 3 to 6 = (For future expansion) Bit 7 = Power device 0: Do not use EEPROM, 1: Use EEPROM Bits 16 to 17 = (For future expansion) Bit 18 = I/O board Bits 19 to 23 = (For future expansion) (Bits 16 to 23: Main application version 0.21 or later)
41	Hardware information check type	0H	Reference only		Bits 0 to 7 = (For future expansion)
42	Hardware test type	6H	Reference only		0: Do not perform test, 1: Perform test Bit 0 = For future expansion Bit 1 = I/O slot I/F register write-read test Bit 2 = Driver ready check at reset
43	For future expansion	0H	0H to FFFFFFFF H		
44	(For expansion)	0			
45	Special start condition setting	0	0H to FFFFFFFF H		Bits 0 to 3: Enable start from PC/TP in AUTO mode = Used exclusively by the manufacturer (0: Do not enable, 1: Enable) Bits 4 to 7: PIO program start (Input port 000) Single start selection (0: Normal, 1: Single start) * When single start is selected, the next PIO program start (input port 000) will not be accepted as long as a program with the same program number as the one started by the last PIO program start (input port 000) is running. Bits 8 to 11: Permission of auto program start when all-operation-cancellation factor is present (0: Do not permit, 1: Permit) Bits 12 to 15: Permission of ON edge acceptance for PIO program start (input port 000) when all-operation-cancellation factor is present (0: Do not permit, 1: Permit) * This parameter specifies an ON-edge acceptance condition. If the starting condition is not satisfied, an “Error No. A1E: Start condition non-satisfaction error” will generate.

Other Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
46	Other setting bit pattern 1	2001H	0H to FFFFFFFFH		Bits 0 to 3: Variable-value format type in response message to real-number/variable query (0: Big endian with four upper/lower binaryconverted bytes reversed, 1: Big endian) Bits 4 to 7: Decimal-place rounding selection for real-number integer-variable assignment in LET/TRAN commands (0: Do not round, 1: Round) Bits 8 to 11: For future expansion * Change strictly prohibited unless specified by the manufacturer. Bits 12 to 15: Selection of processing to be performed when subroutine first step input condition is not specified when TPCD command = 1 (0: Do not execute, 1: Execute, 2: Error) Bits 16 to 19: For future expansion Bits 20 to 23: Continuous recovery movement/operation resumption timing type (0: Resume operation after completion of continuous recovery movement of all axes using the same task (same as before), 1: Hold resumption of operation while any axis is performing continuous recovery operation (This does not mean the system will wait for completion of continuous recovery movement.)) (Main application version 0.47 or later) Bits 28 to 31: Data operation type upon occurrence of backup RAM data assurance mark non-confirmation error 0: Do not clear the backup RAM data 1: Clear the backup RAM data (Main application version 0.94 or later)
47	Other setting bit pattern 2	0H	0H to FFFFFFFFH		Bits 0 to 7: System Reservation Bits 8 to 11: Whether to use servo monitoring IO monitor function (0: Not to use, 1: Use) (XSEL-P/Q/PCT/QCT main application Ver. 1.15 or later) Bits 12 to 31: For expansion
48	(For expansion)	0			

Other Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
49	Panel 7-segment display data type	0	0 to 9		0: Display controller status 1: Display motor current indicator The current pattern of each axis is displayed instead of “ready status” or “program run number.” “Minimum indicator-displayed axis number” (far-right column) is specified by “Other parameter No. 50.” (Main application version 0.09 or later)  0 < Motor current to rating ratio (%) ≤ 25  25 < Motor current to rating ratio (%) ≤ 50  50 < Motor current to rating ratio (%) ≤ 75  75 < Motor current to rating ratio (%) ≤ 100  100 < Motor current to rating ratio (%) ≤ 150  150 < Motor current to rating ratio (%) ≤ 200  200 < Motor current to rating ratio (%) 2: Display user information number (U001 to U999) The user information number is displayed instead of “ready status” or “program run number” only when the user information number is not “0.” “Global integer variable number for specifying user information number” is specified by “Other parameter No. 50.” (Main application version 0.09 or later)
50	Auxiliary specification for panel 7-segment display data type	0	-99999999 to 99999999		* Refer to the Remarks field for “Other parameter No. 49.”
51 to 100	(For expansion)	0			(Main application version 0.52 or later/F-ROM 32-Mbit version only)
101 to 200	(For expansion)	0			(Main application version 0.52 or later/F-ROM 32-Mbit version only)

8. Pulse I/O Board Common Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
1	(For expansion)	00000000H	0H to FFFFFFFFH		
2	Electronic cam table area assignment	32013201H	0H to FFFFFFFFH		Bits 24 to 31: Number of bank 0 tables (0 to 64) (BCD) Bits 16 to 23: Bank 0 table size (1 to 64) (BCD) Bits 8 to15: Number of bank 1 tables (0 to 64) (BCD) Bits 0 to 7: Bank 1 table size (1 to 64) (BCD) * Set this parameter so that “[Number of bank 0 tables] x [Bank 0 table size] + [Number of bank 1 tables] x [Bank 1 table size]” will become 64 or less.
3	Minimum emergency deceleration	30	1 to 999	0.01 G	
4	Maximum JOG speed when home return is not yet complete	30	1 to 250	mm/s	
5	Reserved by system	0	0 to 9		
6 to 20	(For expansion)	00000000H	0H to FFFFFFFFH		
21	Reserved by system	00000000H	0H to FFFFFFFFH		
22	Reserved by system	00000000H	0H to FFFFFFFFH		
23 to 30	(For expansion)	00000000H	0H to FFFFFFFFH		
31	Reserved by system	20000	1 to 999999		
32	Reserved by system	10000	0 to 999999		
33	Reserved by system	700	1 to 2000		
34	Reserved by system	1	1 to 5		
35	Reserved by system	-4	-10 to 7		
36	Reserved by system	100	0 to 99999999		
37	Reserved by system	10	1 to 100		
37	Reserved by system	100000	0 to 50000		
39 to 100	(For expansion)	00000000H	0H to FFFFFFFFH		

9. Pulse I/O Board Input Channel Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
1	Channel use method	0	0 to 2		0: Not used 1: Command pulse input during synchronized operation 2: General-purpose pulse input
2	Pulse input mode	0	0 to 2		0: Phase A/B pulse train 1: Pulse train + sign 2: Forward/reverse pulse train
3	Reserved by system	1	1 to 1	0.01 G	
4 to 100	(For expansion)	00000000H	0H to FFFFFFFFH	mm/s	

10. Pulse I/O Board Output Channel Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
1	Channel use method	0	0 to 1		0: Not used 1: Pulse-train driver control 2: Main CPU axis control
2	Pulse output mode	0 to 2	0 to 2		0: Phase A/B pulse train 1: Pulse train + sign 2: Forward/reverse pulse train
3	Pulse output mode polarity	0 to 1	0 to 1		0: Positive logic 1: Negative logic
4	(For expansion)	00000000H	0H to FFFFFFFFH		
5	Number of pulses per encoder rotation	16384	1 to 99999999	pluse	Number of pulses per encoder rotation
6	Screwlead	10000	-99999999 to 99999999	0.001 mm	Travel per motor revolution
7	Soft limit +	1000	-99999999 to 99999999	0.001 mm	
8	Soft limit -	0	-99999999 to 99999999	0.001 mm	
9	Soft limit margin	300	0 ~ 9999	0.001 mm	Soft limit margin during synchronized operation
10	Electronic gear numerator	1	1 to 99999999		
11	Electronic gear denominator	1	1 to 99999999		
12	Maximum speed	100	1 to 9999	mm/sec	
13	Maximum acceleration	30	1 to 300	0.01 G	
14	Maximum deceleration	30	1 to 300	0.01 G	
15	Deceleration at end of synchronized operation	30	1 to 30	0.01 G	Deceleration at the end of synchronized operation (electronic cams, electronic shafts)
16	VLMX speed	100	1 to 9999	mm/sec	
17	Reserved by system	500	1 to 99999999		
18	Control device number	0	0 to 6		Specify an axis from 1 to 6 when output channel parameter No. 1, "Channel use method" is set to 2 (Main CPU axis control).
19 to 30	(For expansion)	00000000H	0H to FFFFFFFFH		
31	Pulse-train driver servo ON completion confirmation time	150	1 to 999	100 msec	
32	Pulse-train driver home return completion confirmation time	150	1 to 9999	sec	
33	Pulse-train driver positioning completion confirmation time	10	1 to 999	100 msec	Time after sending of a pulse-train command is complete until the positioning complete status signal turns ON.
34	Delay time for pulse-train driver servo OFF error during servo ON	100	1 to 5000	msec	
35	Pulse-train driver home return completion status OFF wait time	50	1 to 99	msec	
36	Pulse-train driver alarm reset signal output time	10	1 to 99	msec	
37	Reserved by system	100	1 to 999		
38	Reserved by system	0	0 to 1		
39 to 100	(For expansion)	00000000H	0H to FFFFFFFFH		

11. Manual Operation Types

The selectable operation types will vary depending on the setting of the “Manual operation type” parameter (Other parameter No. 21).

(1) PC software

1. Setting = 0 (Always enable edit and SIO/PIO start)

Operation type	Password	Functions				
		Edit	Safety speed	Jog, move, continuous move	SIO program start	PIO program start
With safety speed	Not required.	○	○	○	○	○
Without safety speed	Not required.	○		○	○	○

2. Setting = 1 (Select edit and start (with password))

Operation type	Password	Functions				
		Edit	Safety speed	Jog, move, continuous move	SIO program start	PIO program start
Edit and jog	Not required.	○	○	○		
SIO start and jog (safety speed)	1817 (*1)		○	○	○	
SIO start and jog	1818 (*1)			○	○	
SIO/PIO start and jog	1819 (*1)			○	○	○

(*1) PC software version 0.0.6.0 or later (“0000” in versions 0.0.0.0 through 0.0.5.x)

(2) Teaching pendant

1. Setting = 0 (Always enable edit and SIO/PIO start)

Safety-speed enable selection	Password	Functions				
		Edit	Safety speed	Jog, move, continuous move	SIO program start	PIO program start
Enable	Not required.	○	○	○	○	○
Disable	Not required.	○		○	○	○

2. Setting = 1 (Select edit and start (with password))

Safety-speed enable selection	Password	Functions					
		Edit	Safety speed	Jog, move, continuous move	SIO program start	PIO program start	*2
Enable	Not required.	○	○	○	○	(*3)	
Disable	1818 (*1)	○		○	○	(*3)	

PIO start prohibition selection	Password	Functions					
		Edit	Safety speed	Jog, move, continuous move	SIO program start	PIO program start	*2
Prohibit	Not required.	○	(*4)	○	○		
Enable	1819 (*1)	○	(*4)	○	○	○	

(*1) Teaching pendant application version 0.02 or later (not supported by version 0.01 or earlier)
(*2) PIO program start is enabled only in modes other than the edit mode.
(*3) In accordance with the “PIO start prohibition selection” setting.
(*4) In accordance with the “Safety-speed enable” setting.

12. Use Examples of Key Parameters

You can add functions to those available under the factory settings or set dedicated functions to I/O ports, by changing the parameter values.
Before changing a parameter, be sure to read the corresponding section in the List of Parameters.

Description	Action	Parameter setting	Manipulation/operation
Want to prevent errors relating to the standard I/O board and optional boards (DeviceNet, CC-Link, etc.). (Want to perform trial operation when boards are not wired, etc.)	I/O-board error monitor can be disabled to prevent errors from occurring.	Set “0” in the I/O parameter corresponding to the I/O board whose error monitor you wish to disable. Standard I/O (I/O1): I/O parameter No. 10 = 0 Expanded I/O1 (I/O2): I/O parameter No. 11 = 0 Expanded I/O2 (I/O3): I/O parameter No. 12 = 0 Expanded I/O3 (I/O4): I/O parameter No. 13 = 0	Set “0” in I/O parameter Nos. 10 and 11 to disable error monitor for the standard I/O (I/O1) and expanded I/O1 (I/O2) boards, respectively. Note: To operate a disabled I/O board, be sure to revert the parameter setting to “1.”
Want to execute restart (software reset) using an external input signal.	Input port No. 1 can be set as a restart input.	I/O parameter No. 31 = 1	Turning ON input port No. 1 for at least 1 second will execute restart.
Want to execute servo ON using an external input signal.	Input port No. 2 can be set as a servo ON input.	I/O parameter No. 32 = 1	Servo ON will be executed at the ON edge of input port No. 2. Servo OFF will be executed at the OFF edge.
Want to execute auto program start using an external input signal. (Under the default setting, the specified program will restart upon power ON or restart (software reset) in the AUTO mode.) (More steps will be required to execute auto program start.)	Input port No. 3 can be set as an auto program start input.	I/O parameter No. 33 = 2	The specified program will start at the ON edge of input port No.3. The program will be aborted at the OFF edge.
Want to execute pause using an external input signal.	Input port No. 6 can be set as a pause input. Input port No. 5 can be set as a pause reset input.	I/O parameter No. 36 = 1 I/O parameter No. 35 = 1	Turning OFF input port No. 6 will execute pause. Pause will be reset at the ON edge of input port No. 5 after turning ON input port No. 6. (Input port No. 6 is always ON.)
Want to reset errors using an external input signal (errors of operation-cancellation level or lower).	Input port No. 13 can be set as an error reset input.	I/O parameter No. 43 = 2	Errors will be reset at the ON edge of input port No 13.

Description	Action	Parameter setting	Manipulation/operation
Want to execute home return using an external input signal.	Input port No. 15 can be used as an home return input.	I/O parameter No. 45 = 1	Home return will be executed at the ON edge of input port No. 15. (Servo ON must be executed beforehand.)
Want to input program numbers from input ports in binary. (The default setting is BCD input.)	Program numbers can be input from input port Nos. 7 to 13 in binary.	I/O parameter No. 30 = 2	
Want to check the level of the present error from an output port. Want to check for emergency stop status from an output port.	Error level can be checked from the ON/OFF combination of output port Nos. 300 and 301. Emergency stop status can be checked from ON/OFF of output port No. 302.	I/O parameter No. 46 = 2 I/O parameter No. 47 = 3 I/O parameter No. 48 = 2 (Parameter settings at shipment)	ON/OFF of output port Nos. 300 and 301 and corresponding error levels (300 / 301) Message level or lower: ○ / ○ Operation-cancellation level: ● / ○ Cold-start level: ● / ● ○: ON ●: OFF Output port No. 302 being OFF indicates an emergency stop status. (302) Emergency stop actuated: ● Emergency stop not actuated: ○ Note) Parameter settings at shipment
Want to output signal during the AUTO mode.	Output port No. 303 can be set as an AUTO mode output signal.	I/O parameter No. 49 = 1	Output port No. 303 will turn ON during the AUTO mode.
Want to output signal during automatic operation.	Output port No. 303 can be set as an automatic operation output.	I/O parameter No. 49 = 2	Output port No. 303 will turn ON during automatic operation.
Recognition of automatic operation: Recognition of automatic operation can be changed using the setting of other parameter No. 12.	• Recognize automatic operation if a program is running (either in the MANU or AUTO mode). • Recognize automatic operation if a program is running OR in the AUTO mode (regardless of whether or not a program is running). In either case, all-operation-cancellation factor must not be present. One of the conditions is recognized as automatic operation.	• Other parameter No. 12 = 0 Recognize automatic operation if a program is running. • Other parameter No. 12 = 1 Recognize automatic operation if a program is running OR in the AUTO mode. • “All-operation-cancellation factor is not present” means errors of operation-cancellation level or higher are not present AND emergency-stop signal is not input AND safety-gate signal is not input AND deadman switch is ON (teaching-pendant option).	

Description	Action	Parameter setting	Manipulation/operation
Want to output signal when all valid axes are at their home.	Output port No. 304 can be set as a signal indicating that all valid axes are at their home. Note: Do not use a HOME command when the controller is of the absolute specification.	I/O parameter No. 50 = 1	Output port No. 304 will turn ON when all valid axes are at their home.
Want to output signal when all valid axes have completed home return.	Output port No. 304 can be set as a signal indicating that all valid axes have completed home return.	I/O parameter No. 50 = 2	Output port No. 304 will turn ON when all valid axes have completed home return.
Want to output warning signal when the system-memory backup battery voltage is low.	Output port No. 313 can be set as a signal warning that the system-memory backup battery voltage is low.	I/O parameter No. 59 = 1	Output port No. 313 will turn ON when the system-memory backup battery voltage is low.
Want to output warning signal when the absolute-encoder backup battery voltage is low.	Output port No. 314 can be set as a signal warning that the absolute-encoder backup battery voltage is low. (This function is not supported on early units. The main application version must be 0.28 or later.)	I/O parameter No. 60 = 1	Output port No. 314 will turn ON when the absolute-encoder backup battery voltage is low. The output will remain ON until the power is reconnected or controller is restarted.
Want to release brake using an external input signal.	A general-purpose input port can be set as a brake forced-release input (dedicated input). Set a desired input port number in the applicable parameter.	Set a desired input port number in the I/O parameter corresponding to the target axis number. Correspondence of brake-releasing axis number and parameter number: Axis 1: I/O parameter No. 62 Axis 2: I/O parameter No. 63 Axis 3: I/O parameter No. 64 Axis 4: I/O parameter No. 65 Setting example) To set input port No. 12 as the brake forced-release input for axis 3, set as follows: I/O parameter No. 64 = 12	Brake will be forcibly released when the applicable port turns ON. ← Brake of axis 3 will be forcibly released when input port No. 12 turns ON.
Want to retain output status while emergency-stop signal is input or the safety gate is open.	Minimum and maximum port numbers indicating the output ports you wish to retain can be set.	I/O parameter No. 70 = Output port number MIN I/O parameter No. 71 = Output port number MAX Setting example) To retain output ports from port Nos. 303 through 315, set as follows: I/O parameter No. 70 = 303 I/O parameter No. 71 = 315	← The status of output port Nos. 303 through 315 will be retained while emergency-stop signal is input or the safety gate is open.

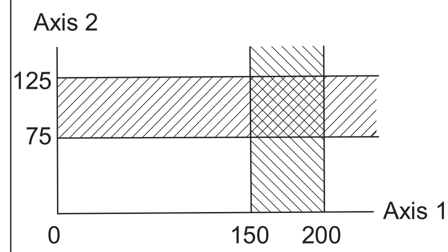
Description	Action	Parameter setting	Manipulation/operation
Want to start programs while emergency-stop signal is input or the safety gate is open. Programs to be started are I/O processing or calculation programs that do not command actuator operation (PIO processing programs).	A PIO processing program to start can be set. Set in the applicable parameters a desired PIO processing program as well as minimum and maximum port numbers indicating the output ports at which the program will be processed.	Other parameter No. 2 = PIO processing program number I/O parameter No. 70 = Output port number MIN I/O parameter No. 71 = Output port number MAX Setting example) To start program No. 5 that involves processing at output port Nos. 303 through 315, set as follows: Other parameter No. 2 = 5 I/O parameter No. 70 = 303 I/O parameter No. 71 = 315	← Program No. 5 will start while emergency-stop signal is input or the safety gate is open. Output port Nos. 303 through 315 can be used for processing.
Want to switch between AUTO and MANU modes using an input port.	A general-purpose input port can be set as a mode switching input (dedicated input). Set a desired input port number in I/O parameter No. 79.	I/O parameter No. 79 = Input port number	Set the mode switch to the AUTO side. The AUTO mode will be enabled when the specified input port turns OFF, and the MANU mode will be enabled when the input port turns ON. If the mode switch is set to the MANU side, the MANU mode will be enabled regardless of ON/OFF of this input port. This function is available on controllers shipped in or after 2003.
Want to automatically execute restart (software reset) after the emergency stop is reset, and start the auto-start program.	The emergency-stop recovery type can be set to “Abort operations/programs (Software reset when the emergency stop is reset).”	Other parameter No. 10 = 3 I/O parameter No. 33 = 1	After the emergency-stop button is released, the system will automatically execute restart (software reset) and start the auto-start program.
Want to automatically execute error reset after the emergency stop is reset, and start the auto-start program.	The emergency-stop recovery type can be set to “Abort operations/programs (Error reset and auto program start when the emergency stop is reset).”	Other parameter No. 10 = 4 I/O parameter No. 33 = 1 I/O parameter No. 44 ≠ 1	After the emergency-stop button is released, the system will automatically execute error reset and start the auto-start program.

Description	Action	Parameter setting	Manipulation/operation
Want to continue actuator operation after the emergency stop is reset (want to resume actuator operation from the part stopped due to emergency stop input). Programs other than the one commanding actuator operation remain running while emergency-stop signal is input. (Programs not commanding actuator operation remain running while emergency-stop signal is input. The program commanding actuator operation will remain running until the execution step reaches an operation command.)	The emergency-stop recovery type can be set to "Operation continued."	Other parameter No. 10 = 2 I/O parameter No. 35 = 1 (Input port No. 5 is set as a pause reset input.) I/O parameter No. 31 = 1 (Input port No. 1 is set as a restart input. This is to provide a means of canceling the operation.)	After the emergency-stop button is released, actuator operation will continue at the ON edge of input port No. 5. To discontinue the operation, turn ON input port No. 1 for at least 1 second to execute restart, without executing ON-edge input to input port No. 5.
Do not want to use a system-memory backup battery.	The controller can be used without installing a system-memory backup battery.	Other parameter No. 20 = 0	In this setting, SEL global data will be cleared when the main power is turned off. In addition, even after running a program that rewrites position data, the previous position data will be restored once the main power is turned off or the application is restarted (software reset). To retain the new position data, the data must be written to the flash ROM in the MANU mode before turning off the main power or restarting the application. Be sure to refer to 2, "When the system-memory backup battery is not used," in Chapter 1 of Part 3.

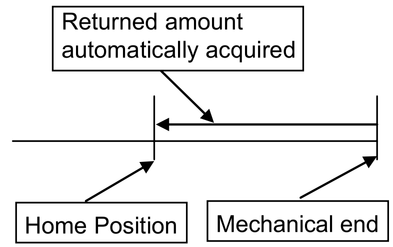
<table>
<tr><th>Description</th><th>Action</th><th>Parameter setting</th><th>Manipulation/operation</th></tr>
<tr>
<td>Want to output signal when the actuator enters a specified area (zone).</td>
<td>A desired actuator zone can be set for each axis. A desired output port to turn ON when the axis enters the zone can be set for each axis. A maximum of four zones can be set (zones 1 to 4).
Max. value of zone 1:
Axis-specific parameter No. 86
Min. value of zone 1:
Axis-specific parameter No. 87
Zone 1 output port number:
Axis-specific parameter No. 88

Max. value of zone 2:
Axis-specific parameter No. 89
Min. value of zone 2:
Axis-specific parameter No. 90
Zone 2 output port number:
Axis-specific parameter No. 91

Max. value of zone 3:
Axis-specific parameter No. 92
Min. value of zone 3:
Axis-specific parameter No. 93
Zone 3 output port number:
Axis-specific parameter No. 94

Max. value of zone 4:
Axis-specific parameter No. 95
Min. value of zone 4:
Axis-specific parameter No. 96
Zone 4 output port number:
Axis-specific parameter No. 97</td>
<td>Setting example) Set the area illustrated below as zone 1:
Axis 1: Output port No. 311 will turn ON when the axis enters the area between 150 and 200 mm.
Axis 2: Output port No. 312 will turn ON when the axis enters the area between 75 and 125 mm.

<table><tr><th></th><th>Axis 1</th><th>Axis 2</th><th></th></tr><tr><td>Axis-specific parameter No. 86</td><td>200000</td><td>125000</td><td>*</td></tr><tr><td>Axis-specific parameter No. 87</td><td>150000</td><td>75000</td><td>*</td></tr><tr><td>Axis-specific parameter No. 88</td><td>311</td><td>312</td><td></td></tr></table>*: Max. and min. values are input in units of 0.001 mm.</td>
<td>For the output signal to be processed, the axes must stay for at least 3 msec in the zone. Duplicate output port numbers cannot be specified.

← : Output port No. 311 turns ON.
← : Output port No. 312 turns ON.</td>
</tr>
</table>

Description	Action	Parameter setting	Manipulation/operation
Want to check if any misalignment to home position	The system measures the amount to return from the mechanical end to the home position and compare with the stored initial value.	To acquire the distance from the current mechanical end, set -1 in Each Axis Parameter No. 32 to return home.  Each Parameter No. 33 is a section to store the value of No. 32. If the value in No. 32 is overwritten, change the value manually and save it.	1) The current value in Each Axis Parameter No. 32 gets recorded. Also, if the value in Each Axis Parameter No. 33 differs from that in No. 32, the value in No. 32 is set to No. 33. 2) Set to -1 in No. 32 to return home. 3) After home-return, compare the value in No. 32 with the value recorded in Step (1). There is no misalignment if the values match with each other.

Before changing a parameter, be sure to read the corresponding section in the List of Parameters.

⊙ Combination Table of XSEL Linear/Rotary Control Parameters

Axis-specific parameter No. 1, Axis operation type	Axis-specific parameter No. 68, Mode selection for linear movement axis	Axis-specific parameter No. 66, Mode selection for rotational movement axis	Axis-specific parameter No. 67, Short-cut control selection for rotational movement axis	Permitted encoder processing method			Expression of current position (approx.)	Axis-specific parameter No. 7, Soft limit +	Axis-specific parameter No. 8, Soft limit -	Axis-specific parameter No. 44, Length measurement correction	Axis-specific parameter No. 47, Screw lead	Axis-specific parameter No. 50, Gear ratio numerator	Axis-specific parameter No. 51, Gear ratio denominator	Input unit
				ABS	Simulated INC	INC								
0 (Linear movement axis)	0 (Normal mode)	Invalid	Invalid	○	○	○	Counter range	Valid	Valid	Valid	Valid	Valid	Valid	• Distance mm • Speed mm/sec • Acceleration/ deceleration G
	1 (Infinite-stroke mode) * Duty cycle timeout check must be reviewed.			X	○	○	-10000 to 9999.999 (rotary)	Invalid (Note)	Invalid (Note)					
1 (Rotational movement axis)	Invalid	0 (Normal mode)	0 (Short-cut control not selected) * "0" must be specified if the normal mode is selected.	○	○	○	Counter range	Valid	Valid	Invalid	Invalid	Valid	Valid	• Angle mm → deg • Angular speed mm/sec → deg/sec • Angular acceleration/deceleration G = 9807 mm/sec2 → 9807 deg/sec2 = 9807 x 2 π/360 rad/sec2 * A "deg" value indicates the angle of the rotating body at the end.
		1 (Index mode)	0 (Short-cut control not selected)	○	○	○	Counter range	Invalid (fixed to 359.999 internally)	Invalid (fixed to 0 internally)					
			1 (Short-cut control selected)	x	○	○	0 to 359.999 (rotary)							

(Note): Any positioning command other than "JXWX" exceeding a coordinate range from approx. –9990 to 9990 will generate an "Error No. CBC, Target-locus data boundary over error."
Executing any positioning command other than "JXWX" outside a coordinate range from approx. –9990 to 9990 will generate an "Error No. CC5, Positioning boundary pull-out error."
[Refer to caution in J□W□ (JOG operation) in Chapter 4 Command Language]

⦿ Error Level Control

Error level	System error assignment source	Error No. (HEX)	Display (7-segment display, etc.)	Error list (Application only)	Error LED output (MAIN only)	Program run (Application only): Other parameter No. 4 = 0	Program run (Application only): Other parameter No. 4 = 1	Error reset (Application only)	Remarks
Secret level	MAIN application	800 to 88F		○					Special error level provided for maintenance purposes
	MAIN core	890 to 8AF							
	PC	8B0 to 8DF							
	TP	8E0 to 8FF							
Message level	MAIN application		○	△ (Battery and fieldbus errors will be registered in an error list.)				Enabled.	Status display, input error, etc.
	MAIN core	-							
	PC								
	PC (Update tool)								
	TP								
	MAIN application	200 to 24F							
	MAIN core	-							
	PC	250 to 29F							
	PC (Update tool)	2A0 to 2CF							
	TP	2D0 to 2FF							
	MAIN application	900 to 93F							
	MAIN core	940 to 97F							
	PC	980 to 9AF							
	PC (Update tool)	9B0 to 9BF							
	TP	9C0 to 9FF							
	MAIN application	A00 to A6F							
	MAIN core	A70 to A9F							
	PC	AA0 to ACF							
	TP	AD0 to AFF							
Operation-cancellation level	MAIN application		○	○		The program in which the error generated will be cancelled. (Except for axis errors, a cancellation factor is present only for the moment the error occurs.) * However, in the case of an error requiring servo OFF or all-axis servo OFF, all programs other than the "I/O processing program at operation/program abort" will be cancelled.	All programs other than the "I/O processing program at operation/program abort" will be cancelled. (Except for axis errors, a cancellation factor is present only for the moment the error occurs.)	Enabled.	Errors affecting operation. The system will attempt to reset minor errors below this level using an auto-reset function via external active command (SIO/PIO) (application only).
	MAIN core	-							
	PC								
	PC (Update tool)								
	TP								
	MAIN application	400 to 4CF							
	MAIN core	-							
	PC	4D0 to 4DF							
	PC (Update tool)	4E0 to 4EF							
	TP	4F0 to 4FF							

Error level	System error assignment source	Error No. (HEX)	Display (7-segment display, etc.)	Error list (Application only)	Error LED output (MAIN only)	Program run (Application only): Other parameter No. 4 = 0	Program run (Application only): Other parameter No. 4 = 1	Error reset (Application only)	Remarks
Operation-cancellation level	MAIN application	B00 to B9F	○	○		The program in which the error generated will be cancelled. (Except for axis errors, a cancellation factor is present only for the moment the error occurs.) * However, in the case of an error requiring servo OFF or all-axis servo OFF, all programs other than the "I/O processing program at operation/program abort" will be cancelled.	All programs other than the "I/O processing program at operation/program abort" will be cancelled. (Except for axis errors, a cancellation factor is present only for the moment the error occurs.)	Enabled.	Errors affecting operation. The system will attempt to reset minor errors below this level using an auto-reset function via external active command (SIO/PIO) (application only).
	MAIN core	BA0 to BBF							
	PC	BC0 to BDF							
	TP	BE0 to BFF							
	MAIN application	C00 to CCF							
	MAIN core	CD0 to CDF							
	PC	CE0 to CEF							
	TP	CF0 to CFF							
Cold-start level	MAIN application		○	○	○ (Core only)	The program in which the error generated will be cancelled. * However, in the case of an error requiring drive-source cutoff, servo OFF or all-axis servo OFF (initialization error, power error, etc.), all programs other than the "I/O processing program at operation/program abort" will be cancelled.	All programs other than the "I/O processing program at operation/program abort" will be cancelled.	Not enabled.	The controller power must be reconnected (MAIN only). (The CPU and OS will run properly.)
	MAIN core	-							
	PC								
	PC (Update tool)								
	TP								
	MAIN application	600 to 6CF							
	MAIN core	-							
	PC	6D0 to 6DF							
	PC (Update tool)	6E0 to 6EF							
	TP	6F0 to 6FF							
	MAIN application	D00 to D8F							
	MAIN core	D90 to DAF							
	PC	DB0 to DCF							
	PC (Update tool)	DD0 to DDF							
	TP	DE0 to DFF							
	MAIN application	E00 to E8F							
	MAIN core	E90 to EBF							
	PC	EC0 to EDF							
	TP	EE0 to EFF							
System-down level	MAIN application		○	○	○	All programs will be cancelled.		Not enabled.	The controller power must be reconnected (MAIN only). (The CPU and OS will not run.)
	MAIN core	-							
	PC								
	PC (Update tool)								
	TP								
	MAIN application	FF0 to FBF							
	MAIN core	FC0 to FCF							
	PC	FD0 to FDF							
	TP	FE0 to FEF							

Note) Secret-level errors are not actual errors. Internal statuses are registered in an error list as secret-level errors, when deemed necessary, in order to facilitate error analysis.
PC: PC software TP: Teaching pendant

⦿ Error List

(MAIN application) (In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
200	Encoder parameter data version mismatch warning	The version of encoder parameter data is not supported by this controller. Update the encoder parameters.
201	EMG logic error	A broken pin in the controller is suspected
202	ENB logic error	A broken pin in the controller is suspected
203	Drive-source cutoff relay DET (MELT) error	The drive-source cutoff relay may have fused.
206	Updating system mode error (IAI protocol)	An update command was received other than in the update mode.
207	Update file name error (IAI protocol)	The name of the update program file selected in the update mode is invalid. Select the correct file and repeat the updating procedure from the beginning.
208	Time data error	The time data is invalid. Check the data.
209	Unsupported control constant table ID error	The control constant table ID is not supported. Check the data.
20A	Control constant table change/query error	The message of the control constant table change/query command contains error. Check the message that has been sent.
20B	Control constant table write data type specification error	The specified control constant table write data type is invalid. Check the message that has been sent.
20C	Control constant table management information mismatch error	The management information regarding the control constant table is invalid. Confirm that the control constant table is supported by the controller.
20D	Flash busy reset timeout error	Error erasing/writing the flash ROM
20E	Motorola S-byte count error	The update program file is invalid. Check the file.
20F	Updating target specification error (Received by the application)	The system application received an updating target specification command. To update the program, restart the controller and repeat the updating procedure from the beginning.
218	Driver Overload Warning	The power input to the motor has exceeded the overload warning load level.
21D	PLC board interface online reset error	The PLC board was reset due to a reset operation from the loader too.
220	RC-axis multiple use error (SIO)	Acquirement of the authority to use was tried on the RC axis which has already been occupied. → Confirm that use of RC axis is not duplicated in several programs.
221	RC-axis right-to-use acquisition error (SIO)	There is no space in the RC axis use authority administration area. → Please contact IAI.
223	RC-gateway operation mode error (SIO)	Operation cannot be made in the current RC gateway use method. → Check the bits 0 to 11 in I/O Parameter No. 216.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
224	RC-gateway status command error	Operation cannot be made in the current RC gateway condition. About RC gateway condition • Gateway condition: condition to have a normal operation • PC software connection condition: Condition to have RC PC software connected via X-SEL Operation commands from X-SEL such as SEL commands for RC gateway will be forbidden. This error would occur in such a case. To switch the condition, have “GW” and “RC” buttons on the menu bar in the X-SEL PC software. → Press “GW” button in X-SEL PC software when operation of RC axis is to be made from X-SEL.
225	RC-axis number error	There is a mistake in the RC axis number indication. → Check the RC axis number.
226	RC-position number error	There is a mistake in the RC axis number indication. → Check the RC position number.
227	Rejection error during program run	An attempt was made to perform an all error reset or single-rotation data/multi-rotation data reset on an encoder for which an all error reset or single-rotation data/multi-rotation data reset is not permitted while a program is running.
22C	RC Gateway Communication Type Error (SIO)	Operation cannot be made with the current communication type. → RC button in X-SEL PC software cannot be used in FB Type. Connect the RC PC software directly to RC controller.
400	Mounted-SIO unopen error (S)	An attempt was made to use a channel that is not open.
401	Mounted-SIO in-use error	An attempt was made to open a channel that has already been opened by other task.
402	Mounted-SIO unopen error (M)	An attempt was made to use a channel not opened by the applicable task.
403	Mounted-SIO duplicate WRIT execution error	WRIT commands were executed simultaneously by multiple tasks for the same channel.
404	Mounted-SIO unused channel selection error	An attempt was made to use a channel specified as “not used” by a parameter. Check I/O parameter Nos. 201, 213, etc.
405	RC Gateway Communication Type Error (SEL)	Operation cannot be made with the current RC gateway communication type. → Example: RMPI or RMDI cannot be used in FB Type.
406	Flash busy reset timeout	Error erasing/writing the flash ROM
407	Control constant table management information mismatch error	The management information regarding the control constant table is invalid. If this error occurs when the controller is started, the control constant table may need to be updated.
408	Control constant table ID error	The control constant table ID is invalid.
409	Encoder control constant error (power-source voltage control)	An encoder control constant relating to power-source voltage control is invalid. The encoder power-source voltage cannot be adjusted (the encoder power will be supplied without voltage adjustment).

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
40A	Encoder power-source voltage calculation error	The encoder power-source voltage cannot be adjusted (the encoder power will be supplied without voltage adjustment). Check the “motor/encoder configuration information” in driver parameter No. 26 and encoder parameter No. 11.
40B	Speed control parameter calculation error	Check driver parameter Nos. 38, 39, 40, 43, 44, 45, etc.
40C	Vision system initialization incomplete error	The vision system is not yet initialized. Among others, check the input port number setting in all-axis parameter No. 88 and if the vision system has been initialized.
40D	Vision system response timeout error	No communication response from the vision system can be confirmed. Among others, check the settings of bits 4 to 7 of I/O parameter No. 129, I/O parameter Nos. 160 to 164 and all-axis parameter Nos. 62, 63, 89, and if the vision system is sending data in response to image capture commands.
40E	Tracking parameter error	Invalid tracking parameter. Check if the tracking parameters such as all-axis parameter Nos. 61 to 95 are set correctly, If conveyor tracking adjustment is not yet performed correctly, perform conveyor tracking adjustment first.
40F	Tracking work part coordinate system error	The current definition data of work part coordinate system is different from the definition data of work part coordinate system for conveyor tracking adjustment. Before performing any tracking action, select an appropriate work part coordinate system for conveyor tracking adjustment.
410	Tracking system initialization incomplete error	The vision system is not yet initialized. Check if the tracking system type in all-axis parameter No. 61 is set to “not use the system.”
411	Tracking system “in-use by other task” error	The tracking system is already in use by other task. Use the tracking system in the same task.
412	Exclusive mode specification error	Modes that cannot be specified simultaneously have been specified. Among others, check if the quick return mode and tracking mode are specified simultaneously.
413	Prohibited command execution error during tracking operation	An attempt was made to execute a command which is prohibited during tracking operation. End the tracking operation with a TRAC command and then execute the command.
414	Allowable number of retained detected loads over error	The number of loads awaiting tracking operation that have been detected between the camera (vision system) and robot or between the work part detection sensor and robot (number of loads awaiting TRAC command execution) exceeded the number that can be retained. Reduce the number of loads on the conveyor, shorten the distance from the sensor (vision sensor or photoelectric sensor) to the tracking operation starting position, shorten the tracking operation time or otherwise reduce the number of retained loads. This error will also generate if a TRAC command is not executed promptly after a work part has been detected.
415	Unsupported identification code reception error (Tracking vision system IF data communication)	An unsupported identification code was received from the vision system. Check the data sent.
416	Received tracking message error (Tracking vision system IF data communication)	Invalid data was received from the vision system. Among others, check if the data sent does not match the format.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
417	Received tracking work part number error (Tracking vision system IF data communication)	The number of loads received from the vision system exceeds the maximum limit of loads permitted in a single image capture. Increase the work part pitch on the conveyor or otherwise prevent the maximum limit from being exceeded.
418	Tracking work part information handling busy error	Internal tracking processing error. Processing cannot be continued because the tracking work part information handling process is busy. Error No. 419 may also be present.
419	Tracking work part information handling timeout error	Internal tracking processing error. A timeout occurred while handling tracking work part information
41A	Invalid control system switching command error	[1] A command to switch to closed-loop position control was issued when vibration control was active. [2] A command to switch to vibration control was issued when closed-loop position control was active.
41F	RC Axis MANU Mode Detection	It was detected that the operation mode status signal of the RC axis (such for SCON) has turned to MANU Mode. → Check such as the mode switch on the RC controller and turn to AUTO Mode.
420	Steady-state (non-push motion) torque limit over error	Current command value control status continued by constant (non-pressing) torque control value. Unexpected load or finish of operation can be considered. It may also be detected in a motor control error due to malfunction of motor, motor cable, motor drive circuit and so on.
422	Multiple-slider command position near-miss error	The sum of distances traveled by both sliders in near-miss directions, as calculated from their estimate stopped positions after decelerating at the multiple-slider emergency deceleration margin (axis-specific parameter No. 106) from the speed corresponding to the command value, exceeds the sum of values specified in axis-specific parameter Nos. 105 and 107.
423	Multiple-slider actual position near-miss error	Both sliders are stopped in positions too close to each other.
424	Size over error of point number data in response message	The expanded point number in the received command is not supported, so a response cannot be sent successfully. The connected PC software, TP, etc., may not support the expanded data. Among others, check if the version of the connected PC software or TP supports the controller.
425	Mounted-SIO communication mode error	It is a communication mode error. Example: Communication command (OPEN, CLOS, READ or WRIT) has been executed to a channel which the RC Gateway Function is in use. → (SIO Type) Communication SEL command cannot be used to Channel 2 when RC Gateway is activated.
426	Vision system image-capture command send retry count over error	The retry count set in bits 0 to 7, “Tracking vision system image-capture command send retry count” in all-axis parameter No. 111 was exceeded. A communication fault or reception of excessive data from an external device is a possibility. Check for noise or shorted or broken communication cable, and also check the connected equipment and communication settings.
42F	Home confirmation positioning timeout error	With a linear semi-absolute actuator, positioning for the purpose of confirming the home did not complete. The servo gain may not be adjusted properly or atuator may have been contacted during confirmation of home.

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Error No.	Error name	Description, action, etc.
430	UBM management area checksum error	Corrupted flash ROM data. Save the user-data backup memory to the flash ROM.
431	UBM data checksum error	Corrupted flash ROM data. Save the user-data backup memory to the flash ROM.
432	UBM SRAM data corruption error	Corrupted data backed up in the user-data backup memory. Check the battery.
433	RC-gateway minor fault error	The RC gateway generated a minor fault.
434	RC-gateway RC-axis detachment detection error	A detached RC-axis was detected. Check the cable connection.
435	RC Gateway RC Axis Operation Invalid Error	Operation invalid alarm has been generated on the RC axis. Example: • An RC position number out of the range has been indicated. (RC position data in RC indication method) → Check the program. • An RC position number, velocity or acceleration/deceleration out of the range has been indicated. (X-SEL position data in RC indication method) → Check the program and RC positions. Refer to the following data which is stored in the error detail information. Info 1: RC axis number which an error has occurred Info 2: RC axis status (Contents are the same as the status acquired by RCST Command) Info 3: RC axis alarm code Refer to the instruction manual of each RC controller for details.
436	RC-gateway command alarm generation	An error has occurred in gateway command. → Please contact IAI.
437	RC-axis number error	There is a mistake in the indication of RC axis number. → Check the RC axis number.
438	RC-position number error	There is a mistake in the indication of RC position number. → Check the RC position number.
439	RC-gateway operation mode error	Operation cannot be made in the current RC position data use method. An invalid SEL command is been executed. → Check in the program language list and bits 0 to 11 in I/O Parameter No. 216.

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Error No.	Error name	Description, action, etc.
43A	RC-gateway status command error	Operation cannot be made in the current RC gateway condition. About RC gateway condition • Gateway condition: condition to have a normal operation • PC software connection condition: Condition to have RC PC software connected via X-SEL Operation commands from X-SEL such as SEL commands for RC gateway will be forbidden. This error would occur in such a case. To switch the condition, have “GW” and “RC” buttons on the menu bar in the X-SEL PC software. → Press “GW” button in X-SEL PC software when operation of RC axis is to be made from X-SEL.
43B	RC-axis pattern not-set error	The RC-axis pattern is not yet set. Issue a RAXS command.
43C	RC-axis in-use servo OFF error	The servo has been turned off on the RC axis in use (in process). → Confirm that use of RC axis is not duplicated in several programs.
43D	RC-axis multiple use error	Acquirement of the authority to use was tried on the RC axis which has already been occupied. → Confirm that use of RC axis is not duplicated in several programs.
43E	Error RC-axis use error	Use of RC axis was tried on which is in an error. → Cancel the error on X-SEL controller and the RC controller which is currently generating the error. Refer to the instruction manual of each RC controller for how to cancel an error.
43F	RC-axis right-to-use acquisition error	There is no space in the RC axis use authority administration area. → Please contact IAI.
440	Servo-OFF RC-axis use error	Use of RC axis was tried on which the servo is turned off. → Turn the servo ON.
441	RC-axis home return incomplete error	Home-return operation of the RC axis is incomplete. → Have a home-return operation completed. (Execute RHOM Command)
442	Inappropriate RC-axis completed position error	The finish position of the RC axis is not appropriate to the position commanded in X-SEL at the finish of RC axis positioning. (for RC position data indication in RC only)
444	Pulse I/O board axis No. error	There are errors in pulse I/O board axis No. specification.
445	No pulse I/O board axis pattern setting error	No axis patterns were set. Execute the XAXS command.
446	Pulse I/O board axis position No. error	There are errors in pulse I/O board axis position No specification.

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Error No.	Error name	Description, action, etc.
447	No position data generation pulse I/O board axis specification error	Pulse I/O board axes for which position data area has not been generated were specified. Check if the specified axis is defined by I/O parameter No. 531, and errors related to position data generation or UBM have occurred.
448	Pulse I/O board servo OFF axis use error	It was attempted to use pulse I/O board axes while the servo is turned OFF.
449	Pulse I/O board axis duplication error	It was attempted to acquire usage right of pulse I/O board axes that are already in use.
44A	Pulse I/O board axis-control-right acquisition error	There are no vacancies in pulse I/O board axis-control area.
44B	Pulse I/O board axis-control-right duplicate-acquisition error (new acquisition failure)	It was attempted to acquire the right anew when pulse I/O board axis-control-right has already been acquired.
44C	No pulse I/O board axis-control-right error (continuous acquisition failure)	Continuous acquisition of pulse I/O board axis-control-right failed.
44D	Pulse I/O board axis home return incomplete error	Home return of pulse I/O board axes has not completed.
44E	Pulse I/O board axis operation command error at servo OFF (main CPU detection)	A gateway command generated an alarm.
44F	RC-axis number error	The specified RC-axis number is invalid.
450	RC-position number error	The servo of pulse I/O board axes being used (processing) was turned off.
451	Pulse I/O board direct command type error	Processing logic error.
452	Pulse train driver alarm detection	The power supply to the RC controller was turned on after the XSEL controller (the XSEL controller launched before the RC controller). Alarm signal OFF (negative logic) of pulse train drivers (SCON, ACON, PCON, etc.) used by pulse I/O boards was detected. Causes can be that any alarm occurred in pulse train drivers, the power is not turned on, cables are disconnected, etc. Check the pulse train drivers or cables.
453	Pulse I/O board axis home return completion timeout error	The home return completion status of pulse train driver could not be confirmed. Check for cable disconnection, pulse train driver movement mode (prohibited to start
454	Pulse I/O board axis position complete timeout error	The positioning complete status of pulse train driver could not be confirmed. Check for cable disconnection, pulse train driver operation mode (prohibited to start PIO), etc.
455	Extension motion board synchronization electronic CAM movement setting error	Synchronization electronic CAM movement settings specified in operand 2 of the XCAS command are invalid.
456	Extension motion board individual electronic CAM movement setting error	Individual electronic CAM movement settings specified in operand 2 of the XCTM command are invalid.
457	Extension motion board electronic shaft movement setting error	Electronic shaft movement settings specified in operand 2 of the XSFS command are invalid.
458	Pulse train driver servo OFF error during pulse I/O board axis servo ON	The servo ON status signal OFF was detected in pulse train drivers (SCON, ACON, PCON, etc.) during controlling pulse I/O board axis servo ON. Check cable disconnection, etc. This error also occurs if only pulse train driver entered the emergency stop status, the servo is turned OFF from pulse train driver support tool while XSEL is commanding servo ON, etc.
459	Pulse train driver MANU mode detection during pulse I/O board axis servo ON	It was detected that the operation mode status signal of pulse train drivers (SCON, etc.) entered the MANU mode during controlling pulse I/O board axis servo ON. Check mode switch and so on.

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Error No.	Error name	Description, action, etc.
45A	Pulse I/O board input channel No. error	Specification of input channels of pulse I/O boards is invalid. Check for channel No. outside the range, channels set as “not used” in parameter settings and so on.
45B	Input channel counter clear error during pulse I/O board synchronous movement	It was attempted to clear the counter of pulse I/O board input channels performing synchronous movement.
45C	Error pulse I/O board input channels use error	It was attempted to use pulse I/O board input channels currently generating error.
45D	Pulse I/O board synchronization slave axis program end detection	A slave axis movement program was ended during pulse I/O board synchronous movement. This error also occurs if errors not related to axes occur during synchronous movement and the slave axis movement program is cancelled. If the master and slave axes move using different programs, it is not allowed to end the slave axis movement program only during synchronous movement. End the synchronous movement first and then end the program. If the program is closed from the PC Software or teaching pendant, cancel all movements or close the master axis movement program, etc.
45E	Pulse I/O board synchronization master axis program end detection	A master axis movement program was ended during pulse I/O board synchronous movement. If a value other than 11111111 is set for all-axis parameter No. 9 “enable switch (deadman switch/safety gate) enable physical axis pattern,” slave axes of the master axis for which the enable switch is enabled must be moved using the same program as the master axis.
460	Pulse I/O board synchronization master error detection	It was attempted to start pulse I/O board synchronous movement using an axis currently generating error as the master axis. Check the error generating in the master axis.
461	Pulse I/O board synchronization master axis servo OFF error	The servo of the master axis was turned OFF during pulse I/O board synchronous movement. The servo of the master axis must not be turned OFF during synchronous movement. End the synchronous movement first and then turn the servo OFF.
462	Pulse I/O board synchronization slave axis restart error	It was attempted to cancel pause during synchronous movement using a pulse I/O board input channel as the master axis. During synchronous movement using an input axis as the master channel, it is not allowed to cancel pause and restart the movement.
463	Pulse I/O board individual electronic CAM movement axis restart error	It was attempted to cancel pause during pulse I/O board individual electronic CAM movement. During individual electronic CAM movement, it is not allowed to cancel pause and restart the movement.
464	Pulse I/O board serial bus command code error	An error occurred at controller internal communication. The following causes can be considered: [1] Communication failures (controller internal communication failures) due to noise, short-circuit, circuit failures, etc. [2] The main CPU application firmware version and the pulse I/O board application firmware version are not consistent (wrong combination).
465	Pulse I/O board duplicate flash write command refusal error	While writing to the flash ROM, a writing command was issued again. Issue the next write command after the completion of writing.
466	Pulse I/O board flash ROM deletion count over error	The number of deletion times of flash ROM of pulse I/O boards exceeded the allowable value.
467	Pulse I/O board flash ROM write error	An error occurred during writing to the flash ROM of pulse I/O boards.

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Error No.	Error name	Description, action, etc.
468	Operation command error at pulse I/O board servo OFF (slave CPU detection)	A movement command was issued to axes in servo-OFF status. Issue movement commands to axes in servo-ON status.
469	Pulse I/O board servo non-definition command detection error	An error occurred at controller internal communication. The following causes can be considered: [1] Communication failures (controller internal communication failures) due to noise, short-circuit, circuit failures, etc. [2] The main CPU application firmware version and the pulse I/O board application firmware version are not consistent (wrong combination).
46A	Pulse I/O board servo unsupported function error	An error occurred at controller internal communication. The following causes can be considered: [1] Communication failures (controller internal communication failures) due to noise, short-circuit, circuit failures, etc. [2] The main CPU application firmware version and the pulse I/O board application firmware version are not consistent.
46B	Pulse I/O board speed change condition error	It was attempted to change the speed of pulse I/O board control axes whose speed cannot be changed (movement axes using S motion etc.)
46C	Pulse I/O board speed specification error	The speed specification is invalid.
46D	Pulse I/O board target value rate data boundary over error	The target position or moving trajectory exceeds positioning boundary.
46E	Pulse I/O board target value data software limit over error	The target position or moving trajectory exceeds the software limit.
46F	Pulse I/O board packet command operand error	An error occurred at controller internal communication. The following causes can be considered: [1] Communication failures (controller internal communication failures) due to noise, short-circuit, circuit failures, etc. [2] The main CPU application firmware version and the pulse I/O board application firmware version are not consistent.
470	Pulse I/O board servo invalid acceleration/deceleration error	The internal servo acceleration/deceleration is invalid.
471	Pulse I/O board excessive command speed error	The following causes can be considered: [1] The axis speed exceeded the maximum speed set by parameters during execution of synchronous movement. [2] The speed exceeded the safety speed in the manual mode when safety speed is enabled. Check the moving speed of the synchronization master axis, electronic CAM table shape, etc.
472	Pulse I/O board excessive command acceleration/deceleration error	The acceleration/deceleration exceeded the maximum acceleration/deceleration set by parameters during execution of synchronous movement. Check the moving speed and acceleration/deceleration of the synchronization master axis, electronic CAM table shape, etc.
473	Pulse I/O board servo command position software limit over error	An axis arrived at a position where it is not possible to stop within the software limit with the specified deceleration during execution of synchronous movement. Check the moving speed and acceleration/deceleration of the synchronization master axis, electronic CAM table shape, etc.

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Error No.	Error name	Description, action, etc.
474	Pulse I/O board invalid axis use error (slave CPU detection)	A movement was commanded to an invalid axis.
475	Data error at pulse I/O board electronic CAM table execution	The following errors were found in electronic CAM table data. [1] The maximum phase is zero. [2] The number of displacement data items is less than 2 or exceeds the maximum number. [3] Non existing table No. was specified. [4] The phase of start point is not zero. Check electronic CAM table data.
476	Pulse I/O board acceleration/deceleration specification error	The acceleration/deceleration specification is invalid.
477	Synchronization start error during pulse I/O board master axis home return	It was attempted to start synchronous movement while the master axis is returning home when the master axis is a main CPU control axis.
479	Pulse I/O board synchronization master axis home return execution error	The master axis attempted to start home return during pulse I/O board synchronous movement.
47A	Pulse I/O board synchronization master axis push-motion execution error	The master axis attempted to start push-motion during pulse I/O board synchronous movement.
47B	Slave communication error	An error occurred in slave communication processing. If other errors related to slave communication occurred in the error list, the cause can be communication failure due to noise, short-cut, circuit failure, etc. Check the slave cards.
47C	Pulse I/O board synchronous movement axis setting error	There are errors in axis settings for pulse I/O board synchronous movement. When setting the master axis of synchronous electronic CAM and electronic shaft synchronous movement is set as a slave axis as well, axis setting where the correspondence of slave axis to master axis closes in ring shape is not allowed.
47D	Pulse train driver home return completion signal OFF error	Home return completion status signal OFF of pulse train driver (SCON, ACON, PCON, etc.) was detected. Check for cable disconnection and so on.
47E	Synchronization start error during pulse I/O board input channel counter clear	It was attempted to start synchronous movement while the counter is being cleared when the master axis is a pulse I/O board input channel.
47F	Pulse I/O board synchronization axis error detection	An error occurred in connected axes in synchronization during pulse I/O board synchronous movement. Check errors occurring in slave axes, master axis, and axes moving with the same command as the master axis, or lower-level slave axes connected in synchronization.
497	Servo slave axis movement command speed over error	The command from a unit commanding slave axis movement exceeded the maximum speed. In case of pulse I/O board slave axis movement, check if the setting value of pulse I/O board output channel parameter No. 12 exceeds the values of parameters for individual axes No. 27 and 28, etc.
498	Servo slave axis movement command origin stop check timeout error	It is not possible to confirm if the slave axis operation command is stopped.
49A	Pulse I/O board command pulse counter over error	The counter value of command pulse input channels exceeded the range from -2,147,482,624 to 2,147,482,623 during synchronous movement. Use the boards such that the input pulse remains within the range above if an input channel is used as the synchronization master axis.

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Error No.	Error name	Description, action, etc.
500	Slave board flash ROM write error	Writing to the flash ROM of a slave board failed. Failure of slave board and similar can be the cause. Check the installed slave boards.
501	Slave board flash ROM write completion check timeout error	Completion of writing to the flash ROM of a slave board could not be confirmed. Failure of slave board and similar can be the cause. Check the installed slave boards. Moreover, this error can occur when error No. 6BE, 6BF, 6C0, 6C4, 6C5, etc. occur at the same time.
502	Slave transmission data generation logic error	Slave transmission data generation error
503	Pulse I/O board ready check timeout error	Normal startup of pulse I/O boards could not be confirmed. Check installed pulse I/O boards.
504	Pulse I/O board target information initialization error	Initialization sequence of pulse I/O board information was not normally completed. Check installed pulse I/O boards.
505	Pulse I/O board axis control I/O port assignment parameter error	Setting values of parameters related to pulse I/O board axis control I/O port assignment are invalid. Check I/O parameter Nos. 534 to 581 for invalid port No., duplicated specification with other system I/O ports and so on.
506	Emergency stop/enable switch recovery type parameter error	Setting values of emergency stop/enable switch recovery type parameters are invalid. If pulse I/O boards are installed, it is not allowed to specify to recover while continuing movement. Check miscellaneous parameters No. 10 and 11.
507	Pulse I/O board axis position data setting error	Position data settings for pulse I/O board axes are invalid. Check I/O parameters No. 530, 531, and 532.
508	Pulse I/O board axis position data valid address error	It is attempted to access valid position data of pulse I/O board axes.
509	Pulse I/O board DPRAM access right timeout error	Unable to acquire DPRAM access right for a specified time or longer.
50A	Pulse I/O board DPRAM access logic error (main CPU detection)	An error in DPRAM access right control was detected.
50B	Pulse I/O board non-definition DPRAM format ID error (main CPU detection)	An error occurred during controller internal communication. The following causes can be considered: [1] Communication failures (controller internal communication failures) due to noise, short-circuit, circuit failures, etc. [2] The main CPU application firmware version and the pulse I/O board application firmware version are not consistent (wrong combination).
50C	Pulse I/O board DPRAM data sum check error (main CPU detection)	A DPRAM data sum check error was detected. Failures of pulse I/O boards, etc. can be considered to be the cause. Check installed pulse I/O boards.
50D	Pulse I/O board fatal failure error	A fatal failure error occurred in pulse I/O boards (SLVALM).
50E	Pulse I/O board CPU ready OFF error	CPU ready of pulse I/O boards was turned off.
50F	Pulse I/O board slave CPU servo underrun detection error (main CPU detection)	A servo control underrun error was detected in pulse I/O boards. It is necessary to turn the power supply on again.

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Error No.	Error name	Description, action, etc.
510	Pulse I/O board error	An error occurred in pulse I/O boards. This error occurs if the main CPU board software does not support error codes of pulse I/O boards. Take actions according to the error list. • If Info.2 of the error list is 76h: The same error as error No. 49A occurred in pulse I/O boards. Refer to the item explaining the corresponding error No. In other cases, contact us and report the description of the error list.
511	Pulse I/O board axis servo ON/OFF timeout error	It is not possible to confirm servo ON/OFF. Check I/O parameter No. 535 and pulse I/O board start No. assignment. Check connection, etc. of servo ON status input signal. This error may occur when pulse train driver's movement mode is set to PIO start prohibition.
512	Pulse I/O board axis stop command completion check timeout error	It is not possible to check if pulse I/O board axis stop command is completed.
513	Pulse I/O board axis stop cancellation completion check timeout error	It is not possible to check if pulse I/O board axis stop cancellation command is completed.
514	Pulse I/O board input channel error	An error occurred in a pulse I/O board input channel. Check if input channel parameters are correctly set and so on.
515	Pulse I/O board input channel disconnection error	Disconnection was detected in a pulse I/O board input channel. Check the cables and so on. It is necessary to turn the power supply on again.
516	Pulse I/O board axis control logic error (main CPU detection)	Axis control logic error
517	Pulse I/O board parameter checksum error	Parameter data in the flash ROM may be destroyed. If the error is not solved even after writing parameter data in the flash ROM and resetting the software, there is a possibility of hardware failure.
518	Pulse I/O board electronic CAM table checksum error	Electronic CAM table data in the flash ROM may be destroyed. If the error is not solved even after writing electronic CAM table data in the flash ROM and resetting the software, there is a possibility of hardware failure.
519	Pulse I/O board parameter flash ROM status error	There is a possibility that data is not correctly in the flash ROM or data is written in incompatible old version. If the error is not solved even after writing parameters in the flash ROM and resetting the software, there is a possibility of hardware failure.
51A	Pulse I/O board electronic CAM table flash ROM status error	There is a possibility that data is not correctly in the flash ROM or data is written in incompatible old version. If the error is not solved even after writing electronic CAM table data in the flash ROM and resetting the software, there is a possibility of hardware failure.

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Error No.	Error name	Description, action, etc.
51B	Pulse I/O board FPGA register read/write error	Data read from the FPGA register on pulse I/O boards is invalid. The following causes can be considered: [1] Communication failures (controller internal communication failures) due to noise, short-circuit, circuit failures, etc. [2] The main CPU application firmware version and the pulse I/O board application firmware version are not consistent.
51C	Pulse I/O board electronic CAM table size inconsistent error	The electronic CAM table size assigned by a parameter and the actual electronic CAM table size do not match. This error occurs when the setting value of pulse I/O board common parameter No. 2 “electronic CAM table area assignment” is changed and similar. Write electronic CAM table data to the flash ROM and reset the software.
51D	Pulse I/O board servo control logic error	A servo control logic error occurred.
51E	Pulse I/O board output channel parameter error	There are errors in output channel parameter setting values of pulse I/O boards. Check setting values of output channel parameters No. 5 to 12 and so on.
51F	Pulse I/O board positioning distance overflow error	The positioning distance is too large.
520	Pulse I/O board undefined DPRAM format ID error (slave CPU detection)	An error occurred at controller internal communication. The following causes can be considered: [1] Communication failures (controller internal communication failures) due to noise, short-circuit, circuit failures, etc. [2] The main CPU application firmware version and the pulse I/O board application firmware version are not consistent (wrong combination).
521	Pulse I/O board packet command handshake logic error	An error occurred at controller internal communication. The following causes can be considered: [1] Communication failures (controller internal communication failures) due to noise, short-circuit, circuit failures, etc. [2] The main CPU application firmware version and the pulse I/O board application firmware version are not consistent (wrong combination).
522	Pulse I/O board DPRAM handshake logic error (slave CPU detection)	An error occurred at controller internal communication. The following causes can be considered: [1] Communication failures (controller internal communication failures) due to noise, short-circuit, circuit failures, etc. [2] The main CPU application firmware version and the pulse I/O board application firmware version are not consistent (wrong combination).
523	Pulse I/O board DPRAM read/write error (slave CPU detection)	An error was detected at hardware check at starting up the board. The following causes can be considered. [1] Communication failures (controller internal communication failures) due to noise, short-circuit, circuit failures, etc. [2] The main CPU application firmware version and the pulse I/O board application firmware version are not consistent (wrong combination).

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Error No.	Error name	Description, action, etc.
524	Pulse I/O board unsupported packet command error	An error occurred at controller internal communication. The following causes can be considered: [1] Communication failures (controller internal communication failures) due to noise, short-circuit, circuit failures, etc. [2] The main CPU application firmware version and the pulse I/O board application firmware version are not consistent (wrong combination).
525	Pulse I/O board main CPU servo underrun detection error (slave CPU detection)	A servo control underrun error was detected in the main CPU board while using pulse I/O boards. It is necessary to turn the power supply on again.
526	Pulse I/O board pulse input setting parameter error	There are errors in input channel parameter setting values of pulse I/O boards. Check the setting values of input channel parameters No. 1 and 2.
527	Pulse I/O board pulse output setting parameter error	There are errors in output channel parameter setting values of pulse I/O boards. Check the setting values of output channel parameters No. 1 to 3.
528	Pulse I/O board main CPU emergency stop signal detection error	An emergency stop signal from the main CPU was detected.
529	Pulse I/O board non-definition main axis type error	The axis type of the main CPU control master axis is invalid. The main CPU application firmware version and the pulse I/O board application firmware version may not be consistent (wrong combination).
52A	Pulse I/O board electronic CAM table area assignment parameter error	The setting value of pulse I/O board common parameter No. 2 "electronic CAM table area assignment" is invalid. The following causes can be considered: [1] The total number of tables exceeds 64. [2] The total table size exceeds 64.
52B	Pulse I/O board function unsupported error	The pulse I/O board does not support functions required for the usage. Check pulse I/O board firmware version, etc. to see the functions to be used are supported.
52D	Pulse I/O board main CPU axis control parameter error	There are errors in parameter settings for controlling main CPU axes with pulse I/O boards. Check if the main CPU axis No. set for pulse I/O board output channel parameter No. 18 is invalid, the main CPU axis side is not specified to perform slave axis operation (parameters for individual axes No. 167 and 168), the main CPU axis side and parameters related to resolution do not match (pulse I/O board output channel parameters No. 5, 6, 10, 11) and so on.
52F	Pulse I/O board slave monitor data register sum check error	A slave monitor data register sum check error was detected. Communication failures (controller internal communication failure) due to noise, short-circuit, circuit failure, etc. can be considered to be the causes. Check installed pulse I/O boards.
530	Pulse I/O board pulse cable disconnection detection	Pulse disconnection was detected. Check cables, etc.

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Error No.	Error name	Description, action, etc.
531	Slave movement parameter error	There are errors in parameter settings (parameters for individual axes No. 167 and 168) specifying slave movement. The following factors can be considered to be the causes in case units specifying slave movement perform pulse I/O board axis slave movements. • Movement conditions do now allow specification of slave movements (selection of rotation move axis short-cut control, linear move axis infinite stroke mode, synchronization, ZR unit, etc.). • No pulse I/O boards are installed. • Device No. that specified slave movement is invalid. • Pulse I/O board output channel that specified slave movement does not control main CPU axes.
532	Drive invalid specification parameter error	There are errors in parameter settings (parameter for individual axes No. 166) that specifies drive invalid. The following causes can be considered. • Parameter for individual axes No. 38 = 1 (ABS) • Specifications by parameters related to resolution and maximum speed (parameters for individual axes No. 28, 42, 43, 44, 47, 50, 51) are outside the range. • Movement conditions do not allow specifying drive invalid (synchronization, ZR unit, etc.).
533	Extension Motion Control Board Coordinate System Data Transfer Error	The data transfer of the coordinate system to the extension motion control board has failed. It is an error of the internal communication in the controller. Following causes may be concerned: 1) Communication fault due to noise, short-circuit or circuit fault (controller internal communication fault) 2) The firmware version of the application part on the main CPU and that of the application part on the extension motion control board do not match with each other (combination is inappropriate).

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Error No.	Error name	Description, action, etc.
601	EMG logic error	A broken pin in the controller is suspected
602	ENB logic error	A broken pin in the controller is suspected
603	Drive-source cutoff relay DET (MELT) error	The drive-source cutoff relay may have fused.
604	Power-supply board CPU ready OFF error	A ready status of the power-supply board cannot be confirmed.
605	Forced discharge error	Abnormal forced discharge. The drive-source cutoff relay may be abnormal. The power must be reconnected.
606	Regenerative discharge error	Abnormal regenerative discharge. The power must be reconnected.
607	Motor power-source voltage low error	Low voltage was detected in the motor power circuit.
608	Power-supply board FRCDCSTR-ON timeout error	Power-supply board FRCDCSTR-ON could not be confirmed within the specified time.
609	Power-supply board RBONSTR-ON timeout error	Power-supply board RBONSTR-ON could not be confirmed within the specified time.
60A	Power-supply board RBONSTR-OFF timeout error	Power-supply board RBONSTR-OFF could not be confirmed within the specified time.
60B	Power-supply board FRCDCSTR-OFF timeout error	Power-supply board FRCDCSTR-OFF could not be confirmed within the specified time.
60C	Power-system overheat error	An overheated power-supply board, regenerative resistor, etc., was detected. The power must be reconnected.
60D	Slave board CPU ready OFF error (other than power supply)	A ready status of the driver board, etc. (other than power-supply board) cannot be confirmed.
60E	Dynamic brake ON/OFF timeout error	Dynamic brake ON/OFF cannot be confirmed within the specified time.
60F	Power-supply board synchronous send timing error 1 (CPSDBSYER)	A communication failure occurred between the power-supply board and FPGA (main).
610	Power-supply board synchronous send timing error 2 (CPCLKER)	A communication failure occurred between the power-supply board and FPGA (main).
611	Power-supply board synchronous communication LRC error	A communication failure occurred between the power-supply board and FPGA (main).
612	Power-supply board synchronous communication timeout error	A communication failure occurred between the power-supply board and FPGA (main).
613	Driver synchronous communication driver read error	A communication failure occurred between the driver board and FPGA (main).
614	Driver synchronous communication LRC error	A communication failure occurred between the driver board and FPGA (main).
615	Driver synchronous communication toggle error	A communication failure occurred between the driver board and FPGA (main).
61A	Mounted-SIO watchdog timer error	The mounted-SIO CPU system is abnormal.
61B	Mounted-SIO parameter data error	There is an invalid mounted-SIO parameter. Check I/O parameter Nos. 201 to 224.
61C	Mounted-SIO parameter transfer format error	The mounted-SIO parameter transfer format is invalid.
61D	Mounted-SIO other slave error	An error occurred in the mounted-SIO CPU. Record or save the detailed information of the error list.
61E	Mounted-SIO F-send/receive queue overflow error (M)	An overflow was detected in the FIFO (FPGA) for main CPU-mounted-SIO communication.
61F	Mounted-SIO control command PUT disable error	FIFO (FPGA)-FULL was detected at mounted-SIO control command PUT.
620	Mounted-SIO control command completion timeout error	Completion of the mounted-SIO control command cannot be confirmed after the specified time.
621	Mounted-SIO logic error	A logic error in mounted-SIO control.

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Error No.	Error name	Description, action, etc.
622	Mounted-SIO undefined control command receive error	An undefined control command was received from the mounted-SIO.
623	Driver error detail code acquisition error	A driver error occurred, but an error detail code could not be acquired.
624	Undefined driver error	A driver error occurred.
625	Driver-side detection synchronous communication error	A communication failure occurred between the driver board and FPGA (main).
626	Driver IPM15V voltage low error	A low voltage was detected in the driver IPM15V circuit.
627	Driver current detection A/D offset over error	A driver current detection A/D offset error was detected.
628	Driver error	(Driver error for future expansion)
629	Driver error	(Driver error for future expansion)
62A	Driver error	(Driver error for future expansion)
62B	Driver error	(Driver error for future expansion)
62C	Driver error	(Driver error for future expansion)
62D	Driver error	(Driver error for future expansion)
62E	Driver error	(Driver error for future expansion)
62F	Driver error	(Driver error for future expansion)
630	Updating system code error (Application detection)	The updating system code is invalid.
631	Updating unit code error (Application detection)	The updating unit code is invalid.
632	Updating device number error (Application detection)	The updating device number is invalid.
633	Feedback pulse synchronization error (Detected in the speed loop)	Abnormal feedback pulse synchronization (detected in the speed loop).
634	Feedback pulse synchronization error (Detected in the position loop)	Abnormal feedback pulse synchronization (detected in the position loop).
635	Deadman/enable switch requiring reset recovery open	Reset the deadman/enable switch, and then reconnect the power.
636	Serial encoder command busy error	The system was busy when the serial encoder command was issued.
637	Serial encoder command timeout error	Completion of the serial encoder command cannot be confirmed after the specified time.
638	Speed control parameter setting command busy error	The system was busy when the speed control parameter setting command was issued.
639	Speed control parameter setting command timeout error	Completion of the speed control parameter setting command cannot be confirmed after the specified time.
63A	ABZ encoder logic error	An encoder phase-A/B electrical level pattern error was detected. The power must be reconnected.
63B	Encoder/motor control constant table flash ROM status error	Data is not written correctly to the flash ROM, or the data is of an old, incompatible version.
63C	Encoder/motor control constant table checksum error	The flash ROM data is corrupted.
63D	ABZ encoder specification error	An ABZ encoder cannot be installed for this axis. Check the “motor/encoder configuration information” in driver parameter No. 26 and encoder parameter No. 11.

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Error No.	Error name	Description, action, etc.
63E	ABZ encoder magnetic-pole sensor signal logic error	Check if the encoder cable is connected.
63F	Encoder control constant error	The encoder control constant is invalid.
640	Motor control constant error	The motor control constant is invalid.
641	Encoder power-source voltage control parameter error	Check driver parameter Nos. 32, 33, etc.
642	Speed loop parameter error	Check driver parameter Nos. 43, 44, 45, etc.
643	Encoder resolution division error	Check “Axis-specific parameter No. 43: Encoder division ratio.”
644	Encoder/motor combination mismatch error (encoder resolution)	Check driver parameter No. 26, encoder parameter No. 11.
645	DAC transfer completion check timeout error when encoder power was supplied	A timeout occurred during DAC transfer when the encoder power was supplied.
646	Encoder EEPROM read busy error	The encoder is faulty or an encoder communication failure occurred.
647	Encoder EEPROM write address mismatch error	The encoder is faulty or an encoder communication failure occurred.
648	Encoder EEPROM read address mismatch error	The encoder is faulty or an encoder communication failure occurred.
649	Undefined serial encoder installation error	Installation of serial encoder is not defined. Check the “motor/encoder configuration information” in driver parameter No. 26 and encoder parameter No. 11.
64A	Undefined serial encoder command error	The serial encoder command is not defined.
64B	Serial encoder command packet error	The serial encoder command packet is invalid.
64C	1-revolution data reset error at servo ON (serial encoder command)	A 1-revolution data reset was commanded when the servo was ON. Turn OFF the servo.
64D	Encoder reset command timeout error (serial encoder command)	An encoder communication failure.
64E	ABS data query command timeout error (serial encoder command)	An encoder communication failure.
64F	Encoder error reset error at servo ON (serial encoder command)	Turn OFF the servo before resetting an encoder error.
650	Encoder receive timeout error (during initialization communication)	An encoder communication failure.
651	Speed control interruption control job error	The speed control interruption error job is invalid.
652	Serial encoder command control job error	The serial encoder command control job is invalid.
653	Encoder control job logic error	The encoder control job logic is invalid.
654		
655	Encoder receive timeout error at serial encoder command issuance	An encoder communication failure.
656	Torque limit logic error	The torque limit logic is invalid.
657	Torque limit parameter error	Check driver parameter Nos. 38, 39, 40, etc.
658	Movement error during ABZ encoder counter initialization	Axis movement was detected while initializing the ABZ encoder counter following power on. The power may have been turned on or a software reset executed while the actuator was moving due to external force such as reactive force of a self-supported cable or while the installation location was vibrating.

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Error No.	Error name	Description, action, etc.
65A	Unsupported encoder ID error	The encoder is not supported. No encoder control constant record is available that corresponds to the encoder ID. Check the installed encoder.
65B	Unsupported encoder error (main information)	The encoder is not supported. No encoder control constant record is available that corresponds to the encoder ID, or the record is invalid. Check the “motor/encoder configuration information” in driver parameter No. 26 and encoder parameter No. 11.
65C	Unsupported motor error (main information)	The motor is not supported. No motor control constant record is available that corresponds to the motor ID, or the record is invalid. Check the “motor/encoder configuration information” in driver parameter No. 26 and encoder parameter No. 11.
65D	Unsupported motor error (driver information)	The motor is not supported. The motor ID bit number is outside the range of “maximum supported motor ID number” when the driver parameter, “Use motor control data in driver flash ROM” is specified. Check the “motor/encoder configuration information” in driver parameter No. 26 and encoder parameter No. 11.
65E	Current detection circuit type mismatch error	The motor control constant, “Current detection circuit specification” does not match the driver parameter, “Installation type word 1, current detection circuit type.” Check the “motor/encoder configuration information” in driver parameter No. 26 and encoder parameter No. 11.
65F	Main/driver motor control data mismatch error	A motor control constant does not match the corresponding driver parameter (rated speed, maximum speed, rated current, maximum current number of pole pairs, linear motor lead, linear motor specification). Check the “motor/encoder configuration information” in driver parameter No. 26 and encoder parameter No. 11.
660	Maximum motor speed mismatch error	The axis-specific parameter, “Maximum motor speed” does not match the motor control constant, “Maximum speed.” Check the “motor/encoder configuration information” in driver parameter No. 26 and encoder parameter No. 11.
661	Encoder/motor combination mismatch error (linear/rotary type)	The linear/rotary type does not match between the encoder and motor. Check the “motor/encoder configuration information” in driver parameter No. 26 and encoder parameter No. 11.
662	Mechanical angle 360-degree pulse count calculation error	The calculated pulse count based on 360 mechanical angle degrees is invalid. (The calculated value is “0,” or in the case of a linear encoder, the calculated value has fraction.)
663	Software DB specification error	The value in the driver parameter, “Software DB specification” is invalid.
664	Current control band number specification error	The value in the driver parameter, “Current control band number” is invalid.
665	Driver/encoder communication line channel number specification error	All-axis parameter No. 101 or 102, “Driver/encoder communication line channel setting” is invalid (invalid value, duplicate specifications).
666	Driver initialization communication type specification error	All-axis parameter No. 103 or 104, “Driver initialization communication type setting” is invalid (invalid value, duplicate specifications, mismatch).

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Error No.	Error name	Description, action, etc.
667	Invalid driver initialization communication line specification error at specification of valid axis	Initialization communication line channel number is not specified for a valid axis. Check all-axis parameter No. 1, “Valid axis pattern,” Nos. 101 and 102, “Driver/encoder communication line channel setting” and Nos. 103 and 104, “Driver initialization communication type setting.”
668	Driver target information initialization error	The initialization sequence of driver target information did not complete successfully. Check the installed driver board. Check all-axis parameter Nos. 101, 102, 103 and 104, or driver parameter No. 26, encoder parameter No. 11.
669	Encoder target information initialization error	The initialization sequence of encoder target information did not complete successfully. Check the installed encoder. Check all-axis parameter Nos. 101, 102, 103 and 104, or driver parameter No. 26, encoder parameter No. 11.
66A	Power-system target information initialization error	The initialization sequence of power-system target information did not complete successfully. Check the installed power-supply board. Check the power-supply board parameters.
66B	Slave communication error response error	An error response was received during slave communication.
66C	SCI LRC error (slave communication)	The message LRC of slave communication is invalid.
66D	Slave communication target ID error	The target ID of slave communication is invalid.
66E	Slave communication block number error	The block number of slave communication is invalid.
66F	Target specification error due to no axis number	The specified target of slave communication (driver or encoder) is invalid (no axis number is assigned for the target ID, or an internal driver board axis is specified).
670	Target board type error	The target board type is invalid.
671	Encoder control data error	The encoder control data is invalid or cannot be acquired. Take the same actions specified for error Nos. 65A, 65B and 669.
672	Motor control data error	The motor control data is invalid or cannot be acquired. Take the same actions as specified for error Nos. 65C, 65D, 668 and 669.
673	Tracking encoder axis specification error	The specified tracking encoder axis is invalid. Check the setting of axis parameter No. 61 to see if the specified axis can be used as a tracking encoder axis.
674	Tracking encoder open error	The tracking encoder cable is broken. The power must be reconnected.
675	Tracking ABZ encoder logic error	An error was detected in the electrical level pattern of tracking encoder phase A/B. The power must be reconnected.
676	ABZ encoder magnetic-pole sensor signal read error	Check if the encoder cable is connected.
677	ABZ encoder phase-Z clear position error	Check if the encoder cable is connected.

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Error No.	Error name	Description, action, etc.
684	Expanded data access error (Upon reception under IAI protocol)	An attempt was made to read data which cannot be read (expanded position data, expanded program number, expanded step number, etc.). The connected PC software, TP, etc., may not support the expanded data. Among others, check if the version of the connected PC software or TP supports the controller.
685	I/O function selection port number error	Invalid setting of I/O port number specified for I/O function selection. Check the settings of I/O parameter Nos. 62 to 65, 76, 77, 283 to 330, etc.
68D	ABZ encoder power-ON check timeout error	The ABZ encoder may not be running.
68E	Backup RAM data (SBM) assurance mark non-confirmation error	The backup SRAM data (SBM) assurance mark could not be confirmed. Reconnect the power or reset the software.
68F	Backup RAM data (UBM) assurance mark non-confirmation error	The backup SRAM data (UBM) assurance mark could not be confirmed. Reconnect the power or reset the software.
6A0	UBM flash ROM status error	The user-data backup memory may not have been written to the flash ROM correctly or the data was written in an old incompatible version.
6A1	UBM data structure change error	The data structure in the user-data backup memory was changed. Initialize the memory.
6A2	UBM data size overflow error	The settings exceed the user-data backup memory size. • There are too many RC-gateway position points.
6A3	UBM use function over error	There are too many functions that use the user-data backup memory. Make sure no more than eight functions are used.
6A4	RC-axis position data setting error	Invalid setting of RC-axis position data. Example: • The value of other parameter No. 501 is greater than the value of other parameter No. 503. • An axis outside the range set in other parameter No. 502 is set as being valid.
6A5	RC-axis position data effective address error	An attempt was made to access invalid RC-axis position data.
6A6	RC-gateway DPRAM access error (Main)	An illegal DPRAM access error occurred between the main and SIO boards (main CPU side).
6A7	RC-gateway DPRAM access error (Mounted SIO)	An illegal DPRAM access error occurred between the main and SIO boards (mounted SIO side).

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Error No.	Error name	Description, action, etc.
6A8	RC-gateway major fault error	The mounted-SIO generated a major fault. Example: • All valid RC-axis have detached (unconnected or broken cable, etc.). • The power supply switch on the main CPU board has a voltage of 0 V. • The mounted SIO could not obtain the DPRAM access permission for the specified time or longer. • The mounted SIO generated a CPU error or other major error.
6A9	RC-gateway link initialization timeout error	A timeout occurred while initializing the RC-axis link.
6AA	RC-gateway DPRAM access permission timeout error	The DPRAM access permission could not be obtained for the specified time or longer.
6AB	RC-gateway command issue timeout error	A gateway command cannot be issued.
6AC	RC-axis control job logic error	The logic of the RC-axis control job is invalid.
6AD	RC-axis control command logic error	Invalid RC-axis control logic
6AE	Mounted-SIO operation mode specification error	An invalid operation mode was set for the mounted SIO.
6AF	Mounted-SIO RC-gateway function selection parameter error	Invalid RC-gateway parameter setting
6B0	Mounted-SIO RC-gateway logic error	Invalid logic during RC gateway initialization
6B1	RC-gateway unsupported error (Mounted SIO)	The configuration of the RC gateway system is invalid.
6B2	RC-gateway I/O assignment parameter error	I/O assignment setting error is occurred in the RC gateway. [SIO type] → Check the settings in I/O Parameter No. 504, 505 and so on. [Fieldbus type] There is an error in the node address setting. → Check the settings in I/O Parameter No. 217, 218 and 432 to 447.
6B3	RC-axis control job timeout error	No response was returned from the RC-axis within the specified time.
6B4	RC-gateway emergency stop mismatch error	The emergency stop status of the XSEL controller does not match the emergency stop status of the RC controller. Check the connection.
6B5	Broken belt error	The drive belt in the actuator became broken.
6B6	Allowable time for exceeding continuous-operation enable torque over error	The torque command has exceeded the “Continuous-operation enable torque” for the “Allowable time for exceeding continuous-operation enable torque” or longer.
6B7	Hardware-unsupported encoder error	The FPGA of the encoder is not supported. Check the versions whose FPGA is supported.
6B8	Driver-unsupported encoder error	The driver of the encoder is not supported. Check the versions whose driver is supported.
6B9	Servo ON error at encoder multi-rotation data reset	An attempt was made to perform a multi-rotation data reset on an encoder for which a multi-rotation data reset is not permitted while the servo is ON.
6BA	Encoder-count indetermination factor detection error	An error was detected that makes the encoder count indeterminable.

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Error No.	Error name	Description, action, etc.
6BB	Deviation overflow error (Before completion of home return)	The command cannot be executed. Check if the operation is locked and also check the wiring, encoder, motor, etc. There is a possibility of mismatched electrical angle. If it occurs frequently, there is a concern of malfunction of the controller (IPM on power stage board).
6BC	Standstill deviation overflow error (Before completion of home return)	While at standstill the axis may have moved due to an external force, or its operation may have been locked during deceleration. This error may also generate when the operation is locked during jogging (due to contact with an obstruction, contact with a mechanical end while jogging before home return, etc.) or upon detection of abnormal wiring, encoder failure or motor and controller (IPM of power stage board) failure during deceleration. There is a possibility of mismatched electrical angle.
6CA	Fieldbus Master Parameter Error	There is an error in the fieldbus master parameter error. Example: • There is an error in the fieldbus master installation parameter settings. → Check in I/O No. 225. • The total of the I/O size for the connected slave exceeds the upper limit that the fieldbus master is able to manage. → Check in I/O Parameter No. 432 to 447.
6CB	Fieldbus Master Link Error	An error has occurred in the network connection between the fieldbus master and all the slaves. Check the status of the monitoring LED lamps on the front panel of the board. Example: • It can be considered the cable is not connected, broke, communication power supply is not turned on or a terminal resistor is not mounted. • Node address is duplicated.
6CC	RC Gateway Simultaneous Use Error	SIO Type and Fieldbus Type are both turned valid at the same time. → Check in I/O Parameter No. 213, 225 and 431, and set only one of SIO Type or Fieldbus Type valid.
6CD	RC Gateway Use Method Logic Error	It is a RC gateway use method logic error. → Please contact IAI.
801	SCIF overrun status (IAI protocol reception)	Communication failure. Check for noise, connected equipment and communication setting.
802	SCIF receive ER status (IAI protocol reception)	Communication failure. Check for noise, shorted/disconnected communication cable, connected equipment and communication setting. This error will also occur when establishing communication with the PC/TP wrongly connected to SIO-CH1 being opened to the user.
803	Receive timeout status (IAI protocol reception)	The transfer interval after the first received byte is too long. Possible causes include disconnected communication cable and error in the connected equipment.
804	SCIF overrun status (SEL reception)	Communication failure. Check for noise, connected equipment and communication setting.
805	SCIF receive ER status (SEL reception)	Communication failure. Check for noise, shorted/disconnected communication cable, connected equipment and communication setting.
806	SCIF receive ER status due to other factor (SEL reception)	Communication failure. Take the same action specified for error No. 804 or 805.
807	Drive-source cutoff relay ER status	The motor-drive power ON status remains ON even when the drive source is cut off. The drive-source cut-off relay contacts may have been melted.
808	Power OFF status during slave parameter write	The power was turned off while writing slave parameters. (This error can be detected only when a backup battery is used.)

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Error No.	Error name	Description, action, etc.
809	Power OFF status during data write to flash ROM	The power was turned off while writing data to the flash ROM. (This error can be detected only when a backup battery is used.)
80A	Expanded-SIO overrun status (SEL reception)	Communication failure. Check for noise, connected equipment and communication setting.
80B	Expanded-SIO parity ER status (SEL reception)	Communication failure. Check for noise, shorted/disconnected communication cable, connected equipment and communication setting.
80C	Expanded-SIO framing ER status (SEL reception)	Communication failure. Check for noise, shorted/disconnected communication cable, connected equipment and communication setting.
80D	Expanded-SIO receive ER status due to other factor (SEL reception)	Communication failure. Take the same action specified for error No. 80A, 80B or 80C.
80E	Expanded-SIO receive buffer overflow status (SEL reception)	The receive buffer overflowed. Excessive data was received from outside.
80F	Ethernet control status 1	Ethernet control information (for analysis)
810	Ethernet control status 2	Ethernet control information (for analysis)
811	Maintenance information 1	Maintenance information (for analysis)
812	Maintenance information 2	Maintenance information (for analysis)
813	Maintenance information 3	Maintenance information (for analysis)
814	Maintenance information 4	Maintenance information (for analysis)
815	Maintenance information 5	Maintenance information (for analysis)
81A	Mounted-SIO overrun status (SEL reception)	Communication failure. Check for noise, connected equipment and communication setting.
81B	Mounted-SIO parity ER status (SEL reception)	Communication failure. Check for noise, shorted/disconnected communication cable, connected equipment and communication setting.
81C	Mounted-SIO framing ER status (SEL reception)	Communication failure. Check for noise, shorted/disconnected communication cable, connected equipment and communication setting.
81D	Mounted-SIO S-receive queue overflow status (SEL reception)	The receive queue in the mounted-SIO CPU overflowed. Excessive data was received from outside.
81E	Mounted-SIO M-receive temporary queue overflow status (SEL reception)	The temporary receive queue in the main CPU overflowed. Excessive data was received from outside.
81F	Mounted-SIO M-receive buffer overflow status (SEL reception)	The receive buffer overflowed. Excessive data was received from outside.
820	DRV status 820 (TO_SELECTEDDATA)	(This is not an error, but maintenance information.)
822	RC-gateway Modbus communication retry status	Modbus communication was retried. (This is not an error.)
823	Power OFF status when writing slave data flash ROM	The power was turned off while the data flash ROM on the pulse I/O board or other slave board was being written. (This error can be detected only when the backup battery is used.)

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Error No.	Error name	Description, action, etc.
900	Blank step shortage error	There are not enough blank steps to save step data. Provide enough blank steps needed to save step data.
901	Step number error	The step number is invalid.
902	Symbol-definition table number error	The symbol-definition table number is invalid.
903	Point number error	The point number is invalid.
904	Variable number error	The variable number is invalid.
905	Flag number error	The flag number is invalid.
906	I/O port/flag number error	The I/O port/flag number is invalid.
910	Command error (IAI protocol HT reception)	The command ID is not supported or invalid. (For future expansion)
911	Message conversion error (IAI protocol HT reception)	The transmitted message does not match the message format or contains invalid data. (For future expansion)
912	PC/TP servo-movement command acceptance-enable input OFF error	Any axis movement command issued to the axis specified in I/O parameter No. 78 from the PC/TP will not be accepted while the input port specified in I/O parameter No. 77 is OFF. (Important: The acceptance-enable input port will become invalid once the operation is started.)
913	Multiple-program simultaneous start prohibition error	Starting of multiple programs is prohibited.
914	Abnormal absolute-data backup battery voltage	Check/replace the absolute-data backup battery and check the encoder cable connection, and then perform an absolute reset.
915	Board type error	The specified board type is invalid.
916	Non-installed device specification error	The specified device is not installed.
917	Slave write data type specification error	The specified slave write data type is invalid.
918	Slave parameter count error	The specified number of slave parameters is invalid.
919	Flash write refused during operation	A command to write the flash ROM of the pulse I/O board, etc., was issued during axis operation.
91A	Electronic cam table section definition data count error (Detected by the main CPU)	The specified number of electronic cam table section definition data is invalid.
91B	Electronic cam table displacement data count error (Detected by the main CPU)	The specified number of electronic cam table displacement data is invalid.
91C	Pulse I/O board axis multiplex-use error (SIO/PIO)	An attempt was made to acquire the right to use a pulse I/O board axis already in use.
91D	Pulse IO board axis use right acquisition error (SIO/PIO)	There is no available space in the pulse I/O board axis use management area.
91E	Pulse I/O board axis use right already acquired (New acquisition failed) (SIO/PIO)	An attempt was made to acquire the right to use a pulse I/O board axis whose use right has already been acquired.
91F	Pulse I/O board axis use right not yet acquired (Continuous acquisition failed) (SIO/PIO)	An attempt to continue to acquire the right to use a pulse I/O board axis failed.
920	Pulse I/O board axis number error	The specified pulse I/O board axis number is wrong.
921	Pulse I/O board axis position number error	The specified pulse I/O board axis position number is wrong.
922	Pulse I/O board parameter type specification error	An invalid parameter type was specified when reading or writing a parameter from/to the pulse I/O board.

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Error No.	Error name	Description, action, etc.
923	Pulse I/O board parameter number specification error	An invalid parameter number was specified when reading or writing a parameter from/to the pulse I/O board.
924	Pulse I/O board parameter count specification error	An invalid parameter count was specified when reading or writing a parameter from/to the pulse I/O board.
925	Pulse I/O board device number specification error	An invalid device number was specified when reading or writing a parameter from/to the pulse I/O board.
926	Pulse I/O board FROM write command type error	An invalid command type was specified when writing the flash ROM of the pulse I/O board.
927	Pulse I/O board electronic cam table number specification error	An invalid table number was specified when reading, writing or clearing electronic cam table data.
928	Pulse I/O board electronic cam table section definition data number specification error	An invalid section definition data number was specified when reading or writing electronic cam table data.
929	Pulse I/O board electronic cam table section definition data count specification error (Detected by the slave CPU)	An invalid section definition data count was specified when reading or writing electronic cam table data.
92A	Pulse I/O board electronic cam table displacement data number specification error	An invalid displacement data number was specified when reading or writing electronic cam table data.
92B	Pulse I/O board electronic cam table displacement data count specification error (Detected by the slave CPU)	An invalid displacement data count was specified when reading or writing electronic cam table data.
92C	FROM write command refused when pulse I/O board axis in use	A command to write the flash ROM was issued when a pulse I/O board-controlled axis was operating. Confirm that all pulse I/O board controlled-axes are stopped (not used), and then try writing the flash ROM again.
92D	Electronic cam table write command refused when pulse I/O board axis in use	A command to write electronic cam table data was issued when a pulse I/O board-controlled axis was operating. Confirm that all pulse I/O board controlled-axes are stopped (not used), and then try writing again.
92E	Pulse I/O board electronic cam table count specification error	An invalid table count was specified when reading, writing or clearing electronic cam table data.
92F	Pulse I/O board memory initialization data type specification error	An invalid data type was specified when initializing the pulse I/O board memory.

Error No.	Error name	Description, action, etc.
A01	System-memory backup battery voltage-low warning	The voltage of the system-memory backup battery is low. Replace the battery. (Above the minimum data-backup voltage)
A02	Abnormal system-memory backup battery voltage	The voltage of the system-memory backup battery is low. Replace the battery. (Below the minimum data-backup voltage)
A03	Absolute-data backup battery voltage-low warning (Driver analysis)	The voltage of the absolute-data backup battery is low. Check the battery connection or replace the battery.
A04	System mode error at core update	An update command was received when the system was not in the core update mode. Before updating the core, confirm that a chip resistance for setting core update mode is provided on the board. (For maintenance)
A05	Motorola S record format error	The update program file is invalid. Check the file.
A06	Motorola S checksum error	The update program file is invalid. Check the file.
A07	Motorola S load address error	The update program file is invalid. Check the file.
A08	Motorola S write address over error	The update program file is invalid. Check the file.
A09	Flash-ROM timing limit over error (Write)	Error writing the flash ROM
A0A	Flash-ROM timing limit over error (Erase)	Error erasing the flash ROM
A0B	Flash-ROM verify error	Error erasing/writing the flash ROM
A0C	Flash-ROM ACK timeout	Error erasing/writing the flash ROM
A0D	Head sector number specification error	Error erasing the flash ROM
A0E	Sector count specification error	Error erasing the flash ROM
A0F	Write-destination offset address error (Odd-numbered address)	Error writing the flash ROM
A10	Write-source data buffer address error (Odd-numbered address)	Error writing the flash ROM
A11	Invalid core-code sector block ID error	The core program already written to the flash ROM is invalid.
A12	Core-code sector block ID erase count over	The number of times the flash ROM can be erased was exceeded.
A13	Flash-ROM write request error when erase is incomplete	When updating, a flash-ROM write command was received before a flash-ROM erase command. Check the update program file and perform update again.
A14	Busy-status reset timeout error at EEPROM write	A busy-status reset timeout occurred after executing EEPROM write.
A15	EEPROM write request error due to no-EEPROM in target	An EEPROM write request was received for a driver or other unit with CPU not equipped with EEPROM.
A16	EEPROM read request error due to no-EEPROM in target	An EEPROM read request was received for a driver or other unit with CPU not equipped with EEPROM.
A17	Message checksum error (IAI protocol reception)	The checksum in the received message is invalid.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
A18	Message header error (IAI protocol reception)	The header in the received message is invalid. Invalid header position (message is 9 bytes or less) is suspected, among other reasons.
A19	Message station number error (IAI protocol reception)	The station number in the received message is invalid.
A1A	Message ID error (IAI protocol reception)	The ID in the received message is invalid.
A1C	Message conversion error	The transmitted message does not match the message format or contains invalid data. Check the transmitted message.
A1D	Start mode error	A start not permitted in the current mode (MANU/AUTO) was attempted.
A1E	Start condition non-satisfaction error	Start was attempted when the start condition was not satisfied, such as when an all-operation-cancellation factor (see the 7-segment display: Drive-source cutoff, mode switching, error, auto-start switch OFF edge, deadman switch, safety gate, emergency stop, etc.) was present or the flash ROM was being written.
A1F	Axis duplication error (SIO · PIO)	The applicable axis is currently in use.
A20	Servo-control-right acquisition error (SIO · PIO)	The servo control right is not available.
A21	Servo-control-right duplicate-acquisition error (SIO · PIO)	The servo control right has already been acquired.
A22	Servo-control-right non-acquisition error (SIO · PIO)	An attempt to retain the servo control right has failed.
A23	Absolute-data backup battery voltage-low warning (Main analysis)	The voltage of the absolute-data backup battery is low. Check the battery connection or replace the battery.
A25	Step count specification error	The specified number of steps is invalid.
A26	Program count specification error	The specified number of programs is invalid.
A27	Program non-registration error	The applicable program is not registered.
A28	Reorganization disable error during program run	A program-area reorganization operation was attempted while a program was running. End all active programs first.
A29	Active-program edit disable error	An edit operation was attempted to a program currently not running. End the applicable program first.
A2A	Program inactive error	The specified program is not running.
A2B	Program-run command refusal error in AUTO mode	Programs cannot be run from the TP/PC software connector in the AUTO mode.
A2C	Program number error	The program number is invalid.
A2D	Inactive program resumption error	A resumption request was received for a program currently not running.
A2E	Inactive program pause error	A pause request was received for a program currently not running.
A2F	Breakpoint error	The step number specified as a breakpoint is invalid.
A30	Breakpoint setting-count specification error	The number of breakpoints to be set exceeds the limit value.
A31	Parameter change value error	The value of parameter changed is invalid.
A32	Parameter type error	The parameter type is invalid.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
A33	Parameter number error	The parameter number is invalid.
A34	Card-parameter buffer read error	Error reading the card-parameter buffer
A35	Card-parameter buffer write error	Error writing the card-parameter buffer
A36	Parameter change refusal error during operation	Parameters cannot be changed during operation (program is running, servo is in use, etc.).
A37	Card manufacturing/function information change refusal error	The card manufacturing/function information cannot be changed.
A38	Parameter change refusal error during servo ON	An attempt was made to change a parameter whose change is not permitted while the servo is ON.
A39	Non-acquired card parameter change error	An attempt was made to change a parameter for a card not recognized at reset.
A3A	Device number error	The device number is invalid.
A3C	Memory initialization type specification error	The specified memory initialization type is invalid.
A3D	Unit type error	The unit type is invalid.
A3E	SEL write data type specification error	The specified SEL write data type is invalid.
A3F	Flash-ROM write refusal error during program run	The flash ROM cannot be written while a program is running.
A40	Data change refusal error during flash ROM write	Data cannot be changed while the flash ROM is being written.
A41	Duplicate flash-ROM write commands refusal error	Another flash-ROM write command was received while the flash ROM was being written.
A42	Direct monitor prohibition error during flash ROM write	Direct monitor is prohibited while the flash ROM is being written.
A43	P0/P3-area direct monitor prohibition error	Direct monitor in the P0/P3 areas is prohibited.
A44	Point-data count specification error	The specified number of point data is invalid.
A45	Symbol-record count specification error	The specified number of symbol records is invalid.
A46	Variable-data count specification error	The specified number of variable data is invalid.
A48	Error-detail query type 1 error	Error-detail query type 1 is invalid.
A49	Error-detail query type 2 error	Error-detail query type 2 is invalid.
A4A	Monitoring data type error	The data type for monitoring data query is invalid.
A4B	Monitoring-record count specification error	The specified number of records for monitoring data query is invalid.
A4C	Monitoring-operation special command register busy error	The driver special command ACK generated a timeout during monitoring operation.
A4E	Parameter register busy error at issuance of slave command	The driver special command ACK generated a timeout at issuance of a slave command.
A4F	Software reset refusal error during operation	Software reset (SIO) is prohibited during operation (program is running, servo is in use, etc.).
A50	Drive-source recovery request refusal error	The drive-source cutoff factor (error, deadman switch, safety gate, emergency stop, etc.) has not been removed.
A51	Operation-pause reset request refusal error	The all-operation-pause factor (drive-source cutoff, operation-pause signal, deadman switch, safety gate, emergency stop, etc.) has not been removed.

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Error No.	Error name	Description, action, etc.
A53	Refusal error due to servo ON	A processing not permitted during servo ON was attempted.
A54	Refusal error due to unsupported function	The function is not supported.
A55	Refusal error due to exclusive manufacturer function	A processing not opened to users other than the manufacturer was attempted.
A56	Refusal error due to invalid data	The data is invalid.
A57	Program start duplication error	An attempt was made to start a program currently running.
A58	BCD error warning	The BCD value being read may be invalid, or the value being written (variable 99) may be a negative value, among other reasons.
A59	IN/OUT command port flag error warning	The number of I/O ports (flags) may have exceeded 32, among other reasons. Check the I/O port (flag) specifications.
A5B	Character-string → value conversion error warning	The specified number of converting characters is invalid or characters that cannot be converted to value are included.
A5C	Copying-character count error warning with SCPY command	The specified number of copying characters is invalid.
A5D	SCIF open error in non-AUTO mode	The channel was opened in a non-AUTO mode. In the MANU mode, the PC/TP connection must be forcibly disconnected before opening the serial channel opened to the user. Exercise caution.
A5E	I/O-port/flag count specification error	The specified number of I/O ports/flags is invalid.
A5F	Fieldbus error (LERROR-ON)	A LERROR-ON was detected.
A60	Fieldbus error (LERROR-BLINK)	A LERROR-BLINK was detected.
A61	Fieldbus error (HERROR-ON)	A HERROR-ON was detected.
A62	Fieldbus error (HERROR-BLINK)	A HERROR-BLINK was detected.
A63	Fieldbus not ready	Fieldbus ready cannot be confirmed.
A64	SCIF overrun error (SIO bridge)	Communication failure. Check for noise, connected equipment and communication setting.
A65	SCIF receive error (SIO bridge)	Communication failure. Check for noise, shorted/disconnected communication cable, connected equipment and communication setting.
A66	SCI overrun error (SIO bridge)	Communication failure. Check for noise, circuit failure and slave card.
A67	SCI framing error (SIO bridge)	Communication failure. Check for noise, shorting, circuit failure and slave card.
A68	SCI parity error (SIO bridge)	Communication failure. Check for noise, shorting, circuit failure and slave card.
A69	Data change refusal error during operation	An attempt was made to change data whose change is prohibited during operation (program is running, servo is in use, etc.).
A6A	Software reset refusal error during write	Software reset is prohibited while data is being written to the flash ROM or slave parameters are being written.
A6B	Fieldbus error (FBRS link error)	A FBRS link error was detected.
A6C	PC/TP start command refusal error in AUTO mode	Starting from the PC software/TP connector is prohibited in the AUTO mode.
A6D	P0/P3/FROM-area direct write prohibition error	Direct write to the P0/P3/FROM areas is prohibited.
A6E	Refusal error during write	A processing not permitted while data is being written to the flash ROM or slave parameters are being written was attempted.

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Error No.	Error name	Description, action, etc.
A6F	Driver monitor type mismatch error	The monitor type supported by the standard DIO board or based on the capacity of FROM on the main CPU board does not match the monitor type on the PC software side (selected on the monitor screen).
A8E	Unit type error (Core detection)	The unit type specified in the received command message is invalid or not supported.

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Error No.	Error name	Description, action, etc.
B00	SCHA setting error	The setting of SCHA command is invalid.
B01	TPCD setting error	The setting of TPCD command is invalid.
B02	SLEN setting error	The setting of SLEN command is invalid.
B03	Home-return method error	The setting of “Axis-specific parameter No. 10, Home-return method” is invalid. (Not incremental encoder AND current position 0 home is specified, etc.) When the ZR unit is used, the value set in axis-specific parameter No. 13, “SIO/PIO home return order” is wrong. Specify the same value (order) for the linear movement axis (Z-axis) and rotational movement axis (R-axis).
B04	1-shot-pulse output excessive simultaneous use error	The number of BTPN and BTPF timers operating in one program simultaneously exceeds the upper limit (16).
B05	Estimate-stroke over error at home return	The operation at home return exceeded the estimate stroke. The home sensor or creep sensor may be faulty, among other reasons.
B06	Expanded-SIO in-use error	An attempt was made to open a channel already opened by other task.
B07	Expanded-SIO unopen error	An attempt was made to use a channel not opened by own task.
B08	Expanded-SIO duplicate WRIT execution error	WRIT commands were executed simultaneously by multiple tasks for the same channel.
B09	Expanded-SIO RS485 WRIT/READ simultaneous execution error	WRIT and READ commands were executed simultaneously in the RS485 mode.
B0A	Expanded-SIO unassigned-channel use error	An attempt was made to use a channel not assigned properly. Check I/O parameter Nos. 100 to 111 and the statuses of I/O slots.
B0B	Pressing Release WAIT Timeout Error	Allowed pressing time has passed without receiving a command to release the pressing from the host during acquirement of the stopper pressing position or pressing at stopper pressing type absolute reset. Disconnection of the PC software is concerned due to such as communication fault. Reconnect the PC software, and redo the steps from the first.
B0C	Pressing Release Movement Condition Unestablished Error	It is in a condition that the pressing release movement cannot be made during acquirement of the stopper pressing position or pressing at stopper pressing type absolute reset. Pressing operation gets cancelled for such reasons as an error generation or emergency stop. Redo the steps from the first.
B0D	Stopper Pressing Operation Start Position Error	The start position for the stopper pressing movement during acquirement of the stopper pressing position or pressing at stopper pressing type absolute reset is too close to the stopper. Set the start position further from the stopper and execute again.
B10	Phase-Z search timeout error	Z-phase cannot be detected. Check for operation restriction, wiring, encoder, motor, etc.
B11	Home-sensor pull-out timeout error	Pull-out from the home sensor cannot be confirmed. Check for operation restriction, wiring, motor, home sensor, etc.
B12	Storage variable number error for SEL command return code	The variable number specified for storing SEL command’s return code is invalid.

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Error No.	Error name	Description, action, etc.
B13	Backup SRAM data checksum error	The backup SRAM data has been destroyed. Check the battery.
B14	Flash-ROM, 8-Mbit version unsupported function error	An attempt was made to use a function not supported in the flash-ROM, 8-Mbit board environment. (HT connection specification, etc.)
B15	Input-port debug filter type error	The setting of input-port debug filter type is invalid.
B16	SEL operand specification error	The operand specification of SEL command is invalid.
B17	Parameter register busy error at issuance of slave command	The driver special command ACK generated a timeout at issuance of a slave command.
B18	Device number error	The device number is invalid.
B19	Unit type error	The unit type is invalid
B1A	Absolute reset specification error	The specification for absolute reset using an optional function, etc., is invalid. (Two or more axes are specified simultaneously, non-absolute-encoder axis is specified, etc.)
B1B	Ethernet non-closed socket open error	An attempt was made to open a socket without closing it first.
B1C	Ethernet in-use-by-other-task error	An attempt was made to open a channel already opened by other task.
B1D	Ethernet non-open error	An attempt was made to use a channel not opened by own task.
B1E	Ethernet multiple WRIT execution error	WRIT commands were executed simultaneously by multiple tasks for the same channel, or a WRIT command that had failed once (due to a communication error, etc.) was executed again without first executing a CLOS command followed by an OPEN command.
B1F	Ethernet job busy error	An attempt was made to start a new process when the Ethernet mailbox control job was busy.
B20	Ethernet non-initialization device use error	An attempt was made to use the Ethernet system when Ethernet device initialization was not yet complete. Check I/O parameter Nos. 123 to 159, 14, 15, etc., depending on the purpose of use.
B21	Ethernet IP address error	An error will generate under the following conditions during normal use. When IP address (H) (first octet) through IP address (L) (fourth octet) are given as IP_H, IP_MH, IP_ML and IP_L, the error conditions are described as follows: IP_H ≤ 0 or IP_H = 127 or IP_H > 255 or IP_MH < 0 or IP_MH > 255 or IP_ML < 0 or IP_ML > 255 or IP_L ≤ 0 or IP_L ≥ 255 Check I/O parameter Nos. 132 to 135, 149 to 152, and 154 to 157, the IP address of connection destination specified by an IPCN command in an integer variable, or the like.

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Error No.	Error name	Description, action, etc.
B22	Ethernet port number error	An error will generate if own port number < 1025, or own port number > 65535, or own port number duplication, or connection-destination port number for client ≤ 0, or connection-destination port number for client > 65535, or connection-destination port number for server < 0, or connection-destination port number for server > 65535 is satisfied. Check I/O parameter Nos. 144 to 148, 159, 153, and 158, the port number of connection destination specified by an IPCN command in an integer variable, or the like.
B26	Ethernet communication mode error	A communication mode error.
B27	Vision system specification error	The vision system I/F to be used is different from the vision system I/F currently in use. Release the vision system I/F currently in use (SLVS command operation 1 [0]), and then specify the vision system I/F to be used.
B28	Vision system I/F initialization incomplete error	Initialization of the vision system I/F is not yet complete. Check I/O parameter Nos. 165 to 169, 351 to 367, all-axis parameter Nos. 121, 141, etc.
B29	Vision system I/F in use by other task	The specified vision system I/F is currently in use by other task.
B2A	Vision system I/F imaging position problem error	The Z-axis position was found abnormal when the GTVD command was executed. Check all-axis parameter Nos. 125,130, 145 and 150.
B86	SEL PTRQ command preprocessing error	The PTRQ command setting is abnormal. Check the setting for abnormality, such as deviation from the allowable range.
C02	Executable program count over error	Execution requests were received for programs exceeding the number that can be executed simultaneously.
C03	Non-registered program specification error	A number not yet registered among program Nos. 1 to 64 was specified via an I/O or in a program.
C04	Program entry point non-detection error	A request was made to execute a program number for which no program steps are registered.
C05	Program first-step BGSR error	The program specified for execution starts with BGSR.
C06	Executable step non-detection error	The program specified for execution does not contain executable program steps.

Appendix

(In the panel window, the three digits after "E" indicate an error number.)

Error No.	Error name	Description, action, etc.
C07	Subroutine non-definition error	The subroutine specified for call is not defined.
C08	Subroutine duplicate-definition error	The same subroutine number is defined at multiple locations.
C0A	Tag duplicate-definition error	The same tag number is defined at multiple locations.
C0B	Tag non-definition error	The tag specified as the jump destination of a GOTO statement is not defined.
C0C	DW/IF/IS/SL pair-end mismatch error	The branching command syntax is invalid. Correspondence with the last appearing branching command is invalid when EDIF, EDDO or EDSL is used. Check the correspondence between IF/IS command and EDIF, DO command and EDDO or SLCT command and EDSL.
C0D	DW/IF/IS/SL no pair-end error	EDIF, EDDO or EDSL is not found. Check the correspondence between IF/IS command and EDIF, DO command and EDDO or SLCT command and EDSL.
C0E	BGSR no pair-end error	There is no EDSR for BGSR, or no BGSR for EDSR. Check the correspondence between BGSR and EDSR.
C0F	DO/IF/IS over-nesting error	The number of nests in a DO or IF/IS command exceeds the limit value. Check for excessive nesting or branching out of or into the syntax using a GOTO command.
C10	SLCT over-nesting error	The number of nests in a SLCT command exceeds the limit value. Check for excessive nesting or branching out of or into the syntax using a GOTO command.
C11	Subroutine over-nesting error	The number of nests in a subroutine exceeds the limit value. Check for excessive nesting or branching out of or into the syntax using a GOTO command.
C12	DO/IF/IS under-nesting error	The EDIF or EDDO position is invalid. Check the correspondence between IF/IS command and EDIF or DO command and EDDO, or branching out of or into the syntax using a GOTO command.
C13	SLCT under-nesting error	The EDSL position is invalid. Check the correspondence between SLCT and EDSR, or branching out of or into the syntax using a GOTO command.
C14	Subroutine under-nesting error	The EDSR position is invalid. Check the correspondence between BGSR and EDSR, or branching out of or into the syntax using a GOTO command.
C15	SLCT next-step command code error	The program step next to SLCT must be WHEQ, WHNE, WHGT, WHGE, WHLT, WHLE, WSEQ, WSNE, OTHE or EDSL.
C16	Create stack failed	Initialization of the input-condition-status storage stack has failed.
C17	Expansion-condition code error	Input program step error. The expansion condition code is invalid.
C18	Expansion-condition LD simultaneous processing over error	The number of LDs processed simultaneously exceeds the limit value.
C19	Expansion-condition LD shortage error 1	There is not enough LD when expansion condition A or O is used.
C1A	Expansion-condition LD shortage error 2	There is not enough LD when expansion condition AB or OB is used.
C1C	Unused-LD detection error	An attempt was made to execute a command based on multiple LD condition that has been saved, without using it in expansion condition AB or OB.

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Error No.	Error name	Description, action, etc.
C1F	Input-condition CND shortage error	The necessary input condition is not found when an expansion condition is used.
C21	Input-condition use error with input-condition prohibited command	Input-condition prohibited commands prohibit the use of input conditions.
C22	Invalid command position error with input-condition prohibited command	A command for which input condition is prohibited cannot be included in an input condition nest.
C23	Invalid operand error	Program step error. The necessary operand data is invalid.
C24	Operand type error	Program step error. The operand data type is invalid.
C25	Actuator control declaration error	The setting of actuator control declaration command is invalid.
C26	Timer setting-range over error	The timer setting is invalid.
C27	Timeout setting-range over error during wait	The timeout setting is invalid.
C28	Tick count setting-range error	The Tick count setting is invalid.
C29	DIV command divisor 0 error	“0” was specified as the divisor in the DIV command.
C2A	SQR command range error	The operand value in the SQR command is invalid. Input a value larger than “0” as data in a SQR command.
C2B	BCD display digit range error	The specified number of BCD display digits is invalid. Specify a value between 1 and 8.
C2C	Program number error	A number not yet registered among program Nos. 1 to 64 was specified.
C2D	Step number error	The step number is invalid.
C2E	Blank step shortage error	There are not enough blank steps to save step data. Provide enough blank steps needed to save step data.
C2F	Axis number error	The axis number is invalid.
C30	Axis pattern error	The axis pattern is invalid.
C32	Operating-axis addition error during command execution	An operating axis for point data was added during continuous point movement or push-motion movement calculation.
C33	Base axis number error	The base axis number is invalid.
C34	Zone number error	The zone number is invalid.
C35	Point number error	The point number is invalid.
C36	I/O port/flag number error	The I/O port/flag number is invalid.
C37	Flag number error	The flag number is invalid.
C38	Tag number error	The tag number is invalid.
C39	Subroutine number error	The subroutine number is invalid.
C3A	User-open communication channel number error	The channel number of the communication channel opened to the user is invalid.
C3B	Parameter number error	The parameter number is invalid.
C3C	Variable number error	The variable number is invalid.
C3D	String number error	The string number is invalid.
C3E	String-variable data count specification error	The specified number of string variables exceeds the area, etc.

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Error No.	Error name	Description, action, etc.
C40	String-variable delimiter non-detection error	Delimiter cannot be detected in the string variable.
C41	String-variable copy size over error	The copy size of string variable is too large.
C42	Character count non-detection error during string processing	The character-string length is not defined in string processing. Execute a string processing command after defining the length with a SLEN command.
C43	Character-string length error during string processing	The character-string length used in string processing is invalid. Check the value of character-string length defined by a SLEN command.
C45	Symbol definition table number error	The symbol definition table number is invalid.
C46	Blank area shortage error with source-symbol storage table	There is not enough area to store the source symbols. Check the number of times source symbol can be used.
C47	Symbol search error	Definitions are not found for the symbols used in the program steps.
C48	SIO-message continuous conversion error	The transmitted SIO message does not match the message format or contains invalid data. Check the transmitted message.
C49	SEL-SIO in-use error	The SIO is being used by other interpreter task.
C4A	SCIF unopen error	Serial channel 1 opened to the user is not opened in the target task. Open the channel using an OPEN command first.
C4B	Delimiter non-definition error	An end character is not defined. Set an end character using a SCHA command first.
C4E	SIO1 invalid usage OPEN error	The usage of serial channel opened to the user does not match the parameter. Check “I/O parameter No. 90, Usage of SIO channel opened to user.”
C4F	SEL program/source symbol checksum error	The flash ROM data has been destroyed.
C50	Symbol definition table checksum error	The flash ROM data has been destroyed.
C51	Point data checksum error	The flash ROM data has been destroyed.
C52	Backup SRAM data destruction error	The backup SRAM data has been destroyed. Check the battery.
C53	Invalid flash-ROM SEL global data/error list error	The SEL global data/error lists in the flash ROM are invalid.
C54	Flash-ROM SEL global data/error list duplication error	The SEL global data/error lists in the flash ROM are duplicated.
C55	Flash-ROM erase count over error for SEL global data/error lists	The number of time the flash ROM containing SEL global data/error lists can be erased was exceeded.
C56	Timing limit over error (Flash ROM erase)	Error erasing the flash ROM
C57	Flash-ROM verify error (Flash ROM erase)	Error erasing the flash ROM
C58	Flash-ROM ACK timeout error (Flash ROM erase)	Error erasing the flash ROM
C59	Head sector number specification error (Flash ROM erase)	Error erasing the flash ROM
C5A	Sector count specification error (Flash ROM erase)	Error erasing the flash ROM

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Error No.	Error name	Description, action, etc.
C5B	Timing limit over error (Flash ROM write)	Error writing the flash ROM
C5C	Flash-ROM verify error (Flash ROM write)	Error writing the flash ROM
C5D	Flash-ROM ACK timeout error (Flash ROM write)	Error writing the flash ROM
C5E	Write-destination offset address error (Flash ROM write)	Error writing the flash ROM
C5F	Write-source data buffer address error (Flash ROM write)	Error writing the flash ROM
C60	No SEL global data/error list write area error	There is no area to write the erased SEL global data/error lists.
C61	SEL-data flash-ROM erase count over error	The number of times the flash ROM containing SEL data can be erased was exceeded.
C62	Operation command error at servo OFF	An attempt was made to execute an operation command when the servo was OFF.
C63	Servo operation condition error	The servo is not in an operation-enabled condition.
C64	Invalid servo acceleration/deceleration error	The internal servo acceleration/deceleration is invalid.
C65	Servo ON/OFF logic error	The servo ON/OFF logic between the main and driver is invalid.
C66	Axis duplication error	An attempt was made to acquire the control right to an axis already in use.
C67	Servo-control-right acquisition error	There is no space in the servo user management area.
C68	Servo-control-right duplicate-acquisition error	The servo control right has already been acquired.
C69	Servo-control-right non-acquisition error	A user who doesn’t have the servo control right attempted to retain the control right.
C6A	Push-motion flag logic error	The internal logic for push-motion processing is invalid.
C6B	Deviation overflow error	The command cannot be followed. Check for operation restriction, wiring, encoder, motor, etc. If it occurs frequently, there is a concern of malfunction of the controller (IPM on power stage board).
C6C	Movement error during absolute data acquisition	Axis movement was detected while acquiring absolute encoder data after the power was turned on. The power may have been turned or a software reset executed while the actuator was moving due to external force such as reactive force of a self-supported cable or while the installation location was vibrating. Or, a software reset may have been executed. Absolute coordinates cannot be confirmed in this condition.
C6D	Maximum installable axes over error	The specified number of axes exceeded the number of installable axes as a result of axis shift with a base command.
C6E	Servo-OFF axis use error	An attempt was made to use an axis whose servo is OFF.
C6F	Home-return incomplete error	Home return has not completed yet. This error may also occur if operation is performed immediately after changing an encoder parameter, performing an absolute encoder reset or resetting an encoder error, without first executing a software reset or reconnecting the power.
C70	Absolute coordinate non-confirmation error	Absolute coordinates have not been confirmed. The power must be reconnected. This error may also occur if operation is performed immediately after changing an encoder parameter, performing an absolute encoder reset or resetting an encoder error, without first executing a software reset or reconnecting the power.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
C71	Synchro slave-axis command error	A command was issued to the synchro slave axis.
C72	Overrun error	The overrun sensor was actuated.
C73	Target-locus soft limit over error	The target position or movement locus exceeds a soft limit. * In the case of a SCARA specification, position data may not exist for the applicable axis.
C74	Actual-position soft limit over error	The actual position exceeds a soft limit by the “soft limit/actual position margin” or more.
C75	Motion-data-packet generation logic error	The motion-data-packet generation logic is invalid.
C76	Movement-point count over error	Too many packets are generated simultaneously.
C77	Handling-packet overflow error	The servo handling packets overflowed.
C78	Motion-data-packet overflow error	The servo motion data packets overflowed.
C79	Pole sense operation error	Operation is disabled in the pole sense mode.
C7A	Servo unsupported function error	An attempt was made to use an unsupported function.
C7B	Odd-pulse slide error	Internal servo calculation error
C7C	Odd-pulse processing logic error	Internal servo calculation error
C7D	Packet pulse shortage error	Internal servo calculation error
C7E	Quadratic equation solution error	An error was detected while calculating a quadratic equation solution.
C7F	No valid specified axis error	No valid axes are specified.
C80	Servo-packet calculation logic error	Internal servo calculation error If the controller is of absolute-encoder specification and an “Error No. C74, Actual-position soft limit over error” is also present, an absolute reset may not have been executed correctly and consequently a servo packet calculation overflow occurred due to a current position error. If this is the case, perform an absolute reset again by following the procedure specified in the operation manual. (Performing an “encoder error reset” operation in the absolute reset window alone does not allow the controller to recognize the current position correctly. Always perform an absolute reset by strictly following the specified procedure.)
C81	Operation-amount logic during servo ON	Servo processing logic error
C82	Servo direct command type error	Servo processing logic error
C83	Servo calculation method type error	The servo calculation method type is invalid.
C84	In-use axis servo OFF error	The servo of an axis currently in use (being processed) was turned off.
C85	Non-installed driver error	Driver is not installed for the applicable axis.
C86	Driver servo ready OFF error	The ready signal for the driver of the applicable axis is OFF.
C87	SEL unsupported function error	An attempt was made to use a function not supported by SEL.
C88	Speed specification error	The specified speed is invalid.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
C89	Acceleration/deceleration specification error	The specified acceleration/deceleration is invalid.
C8B	Circle/arc calculation logic error	The arc calculation logic is invalid.
C8D	Circle/arc calculation error	Position data that cannot be used in arc movement was specified. Check the position data.
C8E	Point deletion error during command execution	The final point data was deleted while continuous point movement was being calculated.
C8F	Axis operation type error	The axis operation type is invalid. Check “Axis-specific parameter No. 1, Axis operation type” and perform operation appropriate for the operation type specified.
C90	Spline calculation logic error	The spline processing logic is invalid.
C91	Push-motion axis multiple specification error	Two or more push-motion axes were specified.
C92	Push-motion approach distance/speed specification error	The specified push-motion approach distance/speed is invalid.
C93	System output operation error	The user attempted a system output operation (through the port specified by I/O parameter for output function selection or the zone output port specified by axis-specific parameter).
C94	PIO program number error	The program number specified by the PIO is outside the range of 1 to 64.
C95	AUTO program number error	The setting of “Other parameter No. 1, Auto-start program number” is invalid.
C96	Start error from operation-abort program	(This error should not occur now that the specification has been changed.)
C97	Program number error for I/O processing program at operation/program abort	The setting of “Other parameter No. 2, I/O processing program number at operation/program abort” is invalid.
C98	Program number error for I/O processing program at operation pause	The setting of “Other parameter No. 3, I/O processing program number at all operation pause” is invalid.
C99	Home sensor non-detection error	The home sensor cannot be detected. Check the wiring and sensor.
C9A	Creep sensor non-detection error	The creep sensor cannot be detected. Check the wiring and sensor.
C9B	Z-phase non-detection error	Z-phase cannot be detected. Check the wiring and encoder.
C9C	Defective phase-Z position error	The phase-Z position is defective. Normal wear and tear of the mechanical ends and home sensor may also be a reason. Readjustment is necessary.
C9D	Card parameter write error	Error writing card parameters
C9E	Servo calculation overflow error	Internal servo calculation error
CA1	Abnormal absolute-data backup battery voltage (Driver analysis)	Check the connection of the absolute-data backup battery/replace the battery and/or check the encoder cable connection, and then perform an absolute reset.
CA2	Abnormal absolute-data backup battery voltage (Main analysis)	Check the connection of the absolute-data backup battery/replace the battery and/or check the encoder cable connection, and then perform an absolute reset.
CA3	Slave setting data out-of-range error	The data set to the slave is outside the allowable range.
CA4	Slave error response	An error response was returned from the slave.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
CA5	Stop deviation overflow error	Movement may have occurred during stopping due to external force or operation may have been restricted during deceleration. This error may also generate when jog operation is restricted (due to contact with an obstacle, contact with a mechanical end before home return, etc.) or when wiring error, faulty encoder or faulty motor and controller (IPM of power stage board) is detected during deceleration.
CA6	Palletizing number error	The specified palletizing number is invalid.
CA7	Setting error of even-numbered row count for palletizing zigzag	The set even-numbered row count for palletizing zigzag is invalid.
CA8	Setting error of palletizing pitches	The set palletizing pitches are abnormal.
CA9	Setting error of placement points in palletizing-axis directions	The set X/Y-axis direction counts for palletizing are invalid.
CAA	Palletizing PASE/PAPS non-declaration error	Neither PASE nor PAPS palletizing-setting command is set. Set either command.
CAB	Palletizing position number error	The specified palletizing position number is invalid.
CAC	Palletizing position number setting over	The specified palletizing position number exceeds the position number range calculated for the current palletizing setting.
CAD	Palletizing PX/PY/PZ-axis duplication error	Any two of the specified PX, PY and PZ-axes for palletizing are the same axis.
CAE	Insufficient valid axes for palletizing 3-point teaching data	There are not enough valid axes in the point data for palletizing 3-point teaching. Axes to comprise the palletizing PX/PY planes cannot be specified.
CAF	Excessive valid axes for palletizing 3-point teaching data	There are too many valid axes in the point data for palletizing 3-point teaching. Axes to comprise the palletizing PX/PY planes cannot be specified.
CB0	Mismatched valid axes for palletizing 3-point teaching data	The valid axis pattern in the point data for palletizing 3-point teaching does not match.
CB1	Offset setting error at palletizing 3-point teaching	Zigzag offset (not zero) cannot be set in palletizing 3-point teaching, if the reference point is the same as the end point of the PX-axis.
CB2	BGPA/EDPA pair-end mismatch error	The BGPA/EDPA syntax is invalid. EDPA was declared before BGPA, or another BGPA was declared after BGPA without first declaring EDPA.
CB4	Arch-motion Z-axis non-declaration error	Z-axis has not been declared by PCHZ or ACHZ.
CB5	BGPA non-declaration error during palletizing setting	Palletizing setting cannot be performed without first declaring BGPA. Declare BGPA.
CB6	Palletizing point error	The palletizing points are invalid (non-Z-axis components for arch-motion movement are absent, etc.).
CB7	Arch-trigger non-declaration error	Declare arch triggers using PTRG or ATRG.
CB8	No 3-point teaching setting error at palletizing angle acquisition	The palletizing angle cannot be acquired until setting by palletizing 3-point teaching is complete.
CB9	PX/PY-axis indeterminable error at palletizing angle acquisition	Angle cannot be calculated because there are too many valid axes in the 3-point teaching data and thus PX/PY-axes cannot be specified.
CBA	Reference-axis/PY/PY-axis mismatch error at palletizing angle acquisition	Angle cannot be calculated because the reference axis for angle calculation is neither of the axes comprising the PX/PY-axes as set by 3-point teaching.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
CBB	Reference-point/PX-axis end-point duplication error at palletizing angle acquisition	Angle cannot be calculated because the reference point of 3-point teaching is the same as the PX-axis end-point data other than the PZ-axis component and thus arc tangent cannot be calculated.
CBC	Palletizing motion calculation error	Trapezoid control calculation error for palletizing motion
CBD	MOD command divisor 0 error	“0” was specified as the divisor in the MOD command.
CBE	Target-locus boundary over error	The target position or movement locus exceeded the positioning boundary in the infinite-stroke mode.
CBF	Positioning distance overflow error	The positioning distance is too large. If the controller is of absolute-encoder specification and an “Error No. C74, Actual-position soft limit over error” is also present, an absolute reset may not have been executed correctly and consequently a servo packet calculation overflow occurred due to a current position error. If this is the case, perform an absolute reset again by following the procedure specified in the operation manual. (Performing an “encoder error reset” operation in the absolute reset window alone does not allow the controller to recognize the current position correctly. Always perform an absolute reset by strictly following the specified procedure.)
CC0	Axis mode error	The axis mode is invalid.
CC1	Speed change condition error	An attempt was made to change the speed of an axis whose speed cannot be changed (axis operating in S-motion, etc.).
CC2	Driver parameter list number error	The driver parameter list number is invalid.
CC3	Angle error	The angle is invalid.
CC4	SEL data error	The SEL data is invalid.
CC5	Positioning boundary pull-out error	An attempt was made to execute a command not permitted outside the positioning boundary.
CC6	Driver error primary detection	A driver error was found by primary detection.
CC7	Palletizing movement PZ-axis pattern non-detection error	PZ-axis component is not found in the axis pattern during palletizing movement.
CC8	Arch top Z-axis pattern non-detection error	Z-axis component relating to the highest point of arch motion is not found in the axis pattern during arch motion operation.
CC9	Arch trigger Z-axis pattern non-detection error	Z-axis component relating to arch motion is not found in the axis pattern of the arch-trigger declaration point data.
CCA	Arch top/end-point reversing error	The coordinates of highest point and end point are reversed during arch motion operation.
CCB	Arch start-point/trigger reversing error	The coordinates of start point and start-point arch trigger are reversed during arch motion operation.
CCC	Arch end-point/trigger reversing error	The coordinates of end point and end-point arch trigger are reversed during arch motion operation.
CCD	Drive-source cutoff axis use error	An attempt was made to use an axis whose drive source is cut off.
CCE	Error axis use error	An attempt was made to use an axis currently generating an error.
CCF	Palletizing reference-point/valid-axis mismatch error	The PX/PY(/PZ)-axes set by PASE/PCHZ are not valid in the axis pattern of the reference-point data set by PAST.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
D01	Encoder EEPROM-write timeout error	The encoder is faulty or failure occurred in the encoder communication.
D02	Encoder EEPROM-read timeout error	The encoder is faulty or failure occurred in the encoder communication.
D03	Encoder count error	Faulty encoder or defective encoder assembly condition is suspected.
D04	Encoder one-revolution reset error	The encoder is faulty or has turned.
D05	Encoder-EEPROM write acceptance error	The encoder is faulty or failure occurred in the encoder communication.
D06	Encoder received-data error	The encoder is faulty or failure occurred in the encoder communication.
D07	Driver logic error	The driver CPU board is in a condition where it cannot operate normally.
D08	Encoder CRC error	The encoder is faulty or failure occurred in the encoder communication.
D09	Driver overspeed error	The motor speed exceeded the upper limit.
D0A	Driver overload error	The power input to the motor exceeded the upper limit.
D0B	Driver EEPROM data error	Failure during write or EEPROM failure
D0C	Encoder EEPROM data error	Failure during write or EEPROM failure
D0E	Axis sensor error	An error occurred in the axis sensor.
D0F	Power stage temperature error	The power stage board exceeded the upper temperature limit.
D10	IPM error	A failure occurred in the motor drive circuit.
D11	Driver abnormal interruption error	The driver CPU board is in a condition where it cannot operate normally.
D12	Encoder disconnection error	The encoder cable is disconnected. The power must be reconnected.
D13	FPGA watchdog timer error	Failure in the interface with the main CPU
D14	Current loop underrun error	Failure in the interface with the main CPU
D15	Driver-CPU down status error	An error occurred in the driver CPU board.
D17	Main-CPU alarm status error	Failure in the interface with the main CPU
D18	Speed loop underrun error	Failure in the interface with the main CPU
D19	Encoder receive timeout error	The encoder is faulty or failure occurred in the encoder communication.
D1A	Driver command error	An error occurred in the CPU bus command.
D1B	Serial bus receive error	Failure in the interface with the main CPU
D1C	Encoder overspeed error	The motor speed exceeded the upper limit.
D1D	Encoder full-absolute status error	The motor ran at the specified speed or above when the power was turned on.
D1E	Encoder counter overflow error	The encoder rotation counter exceeded the upper limit.
D1F	Encoder rotation error	Faulty encoder or defective encoder assembly condition is suspected.

(In the panel window, the three digits after "E" indicate an error number.)

Error No.	Error name	Description, action, etc.
D20	Driver error	(Refer to error No. CA1.)
D22	Encoder rotation reset error	The encoder is faulty or has turned.
D23	Encoder alarm reset error	Faulty encoder
D24	Encoder ID error	The encoder is faulty or failure occurred in the encoder communication.
D25	Encoder configuration mismatch error	The encoder configuration information is outside the function information range.
D26	Motor configuration mismatch error	The motor configuration information is outside the function information range.
D50	Fieldbus error (FBMIRQ timeout)	A FBMIRQ timeout was detected. Check the statuses of monitor LEDs on the front panel of the board by referring to the operation manual for the field network board.
D51	Fieldbus error (FBMIRQ reset)	A FBMIRQ reset error was detected. Check the statuses of monitor LEDs on the front panel of the board by referring to the operation manual for the field network board.
D52	Fieldbus error (FBMBSY)	A FBMBSY was detected. Check the statuses of monitor LEDs on the front panel of the board by referring to the operation manual for the field network board.
D53	Fieldbus error (BSYERR)	A BSYERR was detected. The power must be reconnected. Check the statuses of monitor LEDs on the front panel of the board by referring to the operation manual for the field network board.
D54	Window lock error (LERR)	A LERR was detected. The power must be reconnected. Check the statuses of monitor LEDs on the front panel of the board by referring to the operation manual for the field network board.
D55	Fieldbus error (Min busy)	A Min busy error was detected. Check the statuses of monitor LEDs on the front panel of the board by referring to the operation manual for the field network board.
D56	Fieldbus error (MinACK timeout)	A Min ACK timeout was detected. Check the statuses of monitor LEDs on the front panel of the board by referring to the operation manual for the field network board.
D57	Fieldbus error (MoutSTB timeout)	A Mout STB timeout was detected. Check the statuses of monitor LEDs on the front panel of the board by referring to the operation manual for the field network board.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
D58	Fieldbus error (INIT timeout)	An INIT timeout was detected. Check the statuses of monitor LEDs on the front panel of the board by referring to the operation manual for the field network board.
D59	Fieldbus error (DPRAM write/read)	A DPRAM write/read error was detected. Check the statuses of monitor LEDs on the front panel of the board by referring to the operation manual for the field network board.
D5A	Fieldbus error (TOGGLE timeout)	A TOGGLE timeout was detected. Check the statuses of monitor LEDs on the front panel of the board by referring to the operation manual for the field network board.
D5B	Fieldbus error (Access-privilege retry over)	An access-privilege retry over error was detected. Check the statuses of monitor LEDs on the front panel of the board by referring to the operation manual for the field network board.
D5C	Fieldbus error (Access-privilege open error)	An access-privilege open error was detected. Check the statuses of monitor LEDs on the front panel of the board by referring to the operation manual for the field network board.
D5D	Fieldbus error (FBRS link error)	A FBRS link error was detected. Check the statuses of monitor LEDs on the front panel of the board by referring to the operation manual for the field network board.
D5E	Fieldbus error (Mailbox response)	A mailbox response error was detected. Check the statuses of monitor LEDs on the front panel of the board by referring to the operation manual for the field network board.
D5F	Network I/F Module Type Mismatch Error	The network I/F module type set in I/O Parameter No. 225 and the network module type actually mounted do not match with each other. → Check the settings such as the value in I/O Parameter No. 225 and the network module actually mounted.
D60	Expanded-SIO 2/4 CH isolation power error	An Expanded-SIO isolation power error was detected.
D61	Expanded-SIO 1/3 CH isolation power error	An Expanded-SIO isolation power error was detected.
D62	Expanded-SIO baud-rate-generator clock oscillation error	An Expanded-SIO clock oscillation error was detected.
D63	Expanded-SIO UART paging error	An Expanded-SIO paging error was detected.
D64	Expanded-SIO assignment error	The “board channel assignment number” or “expanded-I/O slot assignment number” in I/O parameter Nos. 100, 102, 104, 106, 108 or 110 may be outside the input range or duplicated, a serial communication expansion board may not be installed in the specified slot, or a “communication mode” other than RS232C may have been selected when the “board channel assignment number” is other than “1” or “2,” among other reasons.
D67	Motor/encoder configuration information mismatch error	The “motor/encoder configuration information” (motor identification number and encoder identification number) in driver parameter No. 26 does not match the “motor/ encoder configuration information” (motor identification number and encoder identification number) in encoder parameter No. 11. Check the parameter values, encoder cable connection, etc.

(In the panel window, the three digits after "E" indicate an error number.)

Error No.	Error name	Description, action, etc.
D68	No remote-mode control support board error	Hardware supporting remote-mode control is not installed, although remote-mode control (AUTO/MANU) is specified in I/O parameter No. 79.
D69	External terminal block overcurrent or power-supply error	Overcurrent or power-supply error in the external terminal block
D6A	Hardware unsupported function error	An attempt was made to use a function not supported by the hardware.
D6B	Overrun error	The overrun sensor was actuated.
D6C	Actual-position soft limit over error	The actual position exceeded a soft limit by the "soft limit/actual position margin" or more.
D6D	Logic error	A logic error occurred.
D6E	Motor drive-source OFF error (MPONSTR-OFF)	A drive-source OFF (MPONSTR-OFF) signal was detected in a non-shutdown (SHDWNSTR-OFF) mode.
D6F	Optional password error	The optional function specified for use requires an optional password. Check other parameter Nos. 30 to 32, etc., depending on the function to be used.
D70	Optional use permission error	Check if an option is specified in a system program where use of the option is not permitted.
D71	Multi-slider parameter error	An invalid multi-slider parameter setting. Check "Axis-specific parameter No. 104, Target axis specification for multiple-slider near-miss detection," etc. Possible causes include specification of an invalid axis number, specification of unmatched axis numbers for both sliders, specification of an adjacent axis number not physically possible based on linear axis structure, and specification of a synchro slave axis number.
D78	Encoder initialization error	An encoder initialization error generated.
D79	Encoder hardware error	An encoder hardware error generated.
D7A	Encoder ABS detection error	An encoder ABS detection error generated.
D7B	Encoder transducer error	An encoder transducer error generated.
D7C	Encoder signal strength error	An encoder signal strength error generated.
D7D	Encoder signal alarm error	An encoder signal alarm error generated.
D7E	Encoder thermal alarm error	An encoder thermal alarm error generated.
D7F	Ball screw spline axis parameter error	Check the axis-specific parameters Nos. 1, 38, 65, 104 and 109 and all-axes parameter No. 1, etc.
D84	Absolute track switching error	The encoder could not switch to absolute track output. There is a possibility of encoder failure, etc.
D85	Absolute track read error	The absolute track signal has changed at the same position. There is a possibility of encoder failure, broken encoder cable, etc.
D86	Invalid absolute data error	Invalid encoder information. There is a possibility of encoder failure, etc.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
D87	Absolute data parity error	Invalid parity of absolute track signal. There is a possibility of encoder failure, broken encoder cable, etc.
D88	Invalid encoder information error	Invalid information acquired from the encoder. There is a possibility of encoder failure, broken encoder cable, etc.
D8C	Vision System I/F Parameter Error	Invalid parameter setting. Check the I/O parameters Nos. 165 to 169 and 351 to 367 and all-axes parameter No. 61, 112,121 and 141 etc.
D8D	Driver Overload Warning Parameter Error	t can be considered the case that a value other than the output port, global flag and the shared output port number (0 is accepted) is input in Each Axis Parameter No. 114, duplicated number is input, or duplicated to the output function select in I/O Parameter or zone output number.
E01	DMA address error	DMA transfer error
E02	SCIF send-buffer overflow error	The SCIF send buffer overflowed.
E03	SCI send-buffer overflow error	The SCI send buffer overflowed.
E04	SCIF receive-buffer overflow error	The SCIF receive buffer overflowed. Excessive data was received from outside.
E05	SCI receive-buffer overflow error	The SCI receive buffer overflowed. Excessive data was received from the slave.
E06	Receive timeout error (Slave communication)	Response from the slave cannot be recognized.
E07	SCI overrun error (Slave communication)	Communication failure. Check for noise, circuit failure and slave card.
E08	SCI framing error (Slave communication)	Communication failure. Check for noise, shorting, circuit failure and slave card.
E09	SCI parity error (Slave communication)	Communication failure. Check for noise, shorting, circuit failure and slave card.
E0A	SCI CRC error (Slave communication)	The CRC in the message is invalid.
E10	SCIF communication mode error	The communication mode is invalid.
E11	SCI communication mode error	The communication mode is invalid.
E12	SIO-bridge SCIF send-queue overflow error	The send queue overflowed.
E13	SIO-bridge SCI send-queue overflow error	The send queue overflowed.
E14	SCI receive-data-register full wait timeout error	Communication failure. Check for noise, shorting, circuit failure and slave card.
E15	SCI overrun error	Communication failure. Check for noise, shorting, circuit failure and slave card.
E16	Program end confirmation timeout error	The program cannot be ended.
E17	I/O-processing-program start logic error	The I/O-processing-program start logic is invalid.
E18	Task ID error	The task ID is invalid.
E19	WAIT factor error	The WAIT factor is invalid.
E1A	WAIT logic error	The WAIT logic is invalid.
E1B	Point-data valid address error	Point-data valid address is not set.
E1C	Source data error	The source data is invalid.

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Error No.	Error name	Description, action, etc.
E1D	Unaffected output number error	The unaffected output number is invalid. A value other than an output port number (“0” is acceptable) may be input in I/O parameter Nos. 70 to 73.
E1E	Zone parameter error	A value other than an output port/global flag number (“0” is acceptable) or duplicate numbers may be input in axis-specific parameter Nos. 88, 91, 94 and 97, or the output number specified as system output in the I/O parameter for output function selection may be duplicated, among other reasons.
E1F	I/O assignment parameter error	A value other than an I/O port number (“-1” is acceptable) or other than an I/O head port number + [multiple of 8] may be input in I/O parameter Nos. 2 to 9, or a value other than a [multiple of 8] may be input in I/O parameter Nos. 14 to 17.
E20	I/O assignment duplication error	I/O assignments are duplicated. Check I/O parameter Nos. 2 to 9 and 14 to 17 and the I/O slot card type (number of I/Os), etc.
E21	I/O assignment count over error	The I/O assignments exceed the specified range. Check I/O parameter Nos. 2 to 9 and 14 to 17 and the I/O slot card type (number of I/Os).
E22	Header error (Slave communication)	The header in the message received from the slave card is invalid.
E23	Card ID error (Slave communication)	The card ID in the message received from the slave card is invalid.
E24	Response type error (Slave communication)	The response type in the message received from the slave card is invalid.
E25	Command type error (Slave communication)	The command type of the transmitting command is invalid.
E26	Target type error	The target type is invalid.
E27	No target error	Target (driver card, I/O card, encoder or other slave card) is not installed.
E29	EEPROM error (EWEN/EWDS not permitted)	EEPROM access error (when writing)
E2A	Read compare mismatch error during EEPROM write	EEPROM access error (when writing)
E2B	Abnormal response error when sending EEPROM information acquisition command	An abnormal response was received when a slave-EEPROM information acquisition command was sent.
E2C	Maximum receive size over error when sending EEPROM information acquisition command	The maximum receive size exceeds the limit value when a slave-EEPROM information acquisition command is sent.
E2D	Receive-data checksum error when sending EEPROM information acquisition command	The checksum of receive data is invalid when a slave-EEPROM information acquisition command is sent.
E2E	No required power stage error	The required power stage is not installed for the valid axes.
E2F	No required regenerative resistance error	The required regenerative resistance is not installed for the valid axes.
E30	No required motor-drive power error	The required motor-drive power is not installed for the valid axes.
E31	No standard I/O slot error	Standard I/O unit is not installed.
E32	No control power error	Control power unit is not installed.
E33	Slave response logic error	The slave response logic is invalid.
E34	Slave block number out of range	The slave block number is out of range.
E37	Slave data setting prohibited	Setting of slave data is prohibited.
E38	Faulty slave EEPROM	The slave EEPROM is faulty.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
E39	No encoder EEPROM error	The encoder is not equipped with EEPROM.
E3A	Absolute encoder error	Absolute encoder is specified illegally.
E3C	Undefined slave-command error code detected	An undefined slave-command error code was detected.
E3D	SEL program/point/parameter flash ROM status error	Data is not written to the flash ROM correctly or written in an old, incompatible application version.
E3E	Parameter checksum error	The flash ROM data has been destroyed.
E3F	Gain parameter error	The setting of “Axis-specific parameter No. 60, Position gain,” etc., is invalid.
E40	Rotational-movement axis parameter error	Check axis-specific parameter Nos. 67, 66, 38, 37, 1, etc.
E41	Servo-motion data packet shortage error	There are not enough servo-motion data packets.
E42	Servo job error	The servo job is invalid.
E45	Servo undefined command detection error	An undefined command was detected during servo processing.
E46	Maximum receive size over error at absolute-data acquisition	The receive size is too large when acquiring absolute data.
E47	No normal response error at absolute-data acquisition	Normal response is not received when acquiring absolute data.
E49	Encoder rotation error	An encoder rotation error was detected.
E4A	Encoder rotation counter overflow error	An encoder rotation counter overflow error was detected.
E4B	Encoder count error	An encoder count error was detected.
E4C	Encoder overspeed error	An encoder overspeed error was detected.
E4D	Driver phase-Z detection logic error	A phase-Z detection completion status was notified from the driver in a mode other than the phase-Z detection operation mode.
E4E	Phase-Z count parameter error	Check axis-specific parameter Nos. 23, 38, 37, etc.
E4F	Synchro parameter error	Check axis-specific parameter Nos. 65, 39, all-axis parameter No. 1, etc.
E50	Driver special command ACK-timeout error	ACK cannot be detected for the driver special command.
E51	Drive unit error (DRVESR)	Error notification from the driver
E52	Encoder error (DRVESR)	Error notification from the driver
E53	Driver CPU error (DRVESR)	Error notification from the driver
E54	Servo control error (DRVESR)	Error notification from the driver
E55	Command error (DRVESR)	Error notification from the driver
E56	Motor temperature error (DRVESR)	Error notification from the driver
E58	Servo ON/OFF timeout error	Servo ON/OFF cannot be confirmed.
E59	Brake ON/OFF timeout error	Brake ON/OFF cannot be confirmed.
E5A	Pole sense non-detection error	Motor magnetic pole cannot be detected.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
E5B	Detection OFF error upon pole sense completion	The motor-magnetic-pole detection status bit (Psenex) is turned OFF after completion of pole sense.
E5C	Hold-at-stop servo job error	The servo job is invalid.
E5D	Servo packet error	The servo packets are invalid.
E5E	Servo-control-right management array number error	The servo-control-right management array number is invalid.
E5F	Length conversion parameter error	Check axis-specific parameter Nos. 47, 50, 51, 42, 1, etc.
E60	Slave maximum receive size over error	The slave receive size is too large.
E61	Slave no normal response reception error	Normal response cannot be received from the slave.
E62	Sending-slave CPU type error	The CPU type of the sending slave is invalid.
E63	Message-buffer information type error	The message-buffer information type is invalid.
E64	Abnormal standby power detection error	Abnormal standby power was detected.
E65	Regenerative resistance temperature error	A regenerative resistance temperature error was detected.
E66	AC-power overvoltage error	An AC-power overvoltage error was detected.
E67	Motor-power overvoltage error	A motor-power overvoltage error was detected.
E68	Emergency-stop status requiring reset recovery (not error)	Reset the emergency stop and then reconnect the power.
E69	Abnormal 24-V I/O power source	The 24-V I/O power source is abnormal. (Turn on the 24-V power before turning on the control power.)
E6A	Safety-gate open status requiring reset recovery (not error)	Close the safety gate and then reconnect the power.
E6B	Shutdown factor indeterminable error	Shutdown factor cannot be determined.
E6C	DO output current error	The DO output current is abnormal.
E6D	Drive-source cutoff relay error	The drive-source cutoff relay may have been melted. When turning on the power to a Q/QCT type controller, turn on the control power first, confirm that the SDN contacts are closed, and then turn on the drive power. (This error generates when the control power and drive power have been turned on simultaneously.)
E6E	Power-stage rating (W) mismatch error	A power stage with inappropriate rated capacity (W) is installed.
E6F	Power-stage rating (V) mismatch error	A power stage with inappropriate rated voltage (V) is installed.
E70	Motor-drive power rating (V) mismatch error	A motor-drive power source with inappropriate rated voltage (V) is installed.
E71	Encoder configuration information outside supported function information range	An encoder whose configuration information is outside the range supported by the driver unit is installed.
E72	Motor configuration information outside supported function information range	A motor whose configuration information is outside the range supported by the driver unit is installed.
E73	Encoder resolution mismatch error	The encoder resolution in the system’s axis-specific parameter and that of the installed encoder do not match.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
E74	Encoder division ratio mismatch error	The encoder division ratio in the system’s axis-specific parameter and that of the installed encoder do not match.
E75	Encoder linear/rotary type mismatch error	The encoder linear/rotary type in the system’s axis-specific parameter and that of the installed encoder do not match.
E76	Encoder ABS/INC type mismatch error	The encoder ABS/INC type in the system’s axis-specific parameter and that of the installed encoder do not match.
E77	Magnetic-pole sensor installation specification mismatch error	The magnetic-sensor installation specification in the system’s axis-specific parameter and that of the installed encoder do not match.
E78	Brake installation specification mismatch error	The followings are concerned as the cause; 1)Brake mount indication does not match between each axis parameter in the system and the encoder actually mounted. 2)There is an error in the setting of the brake output control method. Check the settings in Each Axis Parameter No. 34, 103 and so on.
E79	Abnormal response error when sending EEPROM-data setting slave command	An abnormal response was received when an EEPROM-data setting slave command was sent.
E7A	Maximum receive size over error when sending EEPROM-data setting slave command	The receive size exceeded the limit value when an EEPROM-data setting slave command was sent.
E7B	Motor-drive power ON timeout error	Abnormal current flow from the motor-drive power source
E7C	Register read/write test error	Error reading/writing the register
E7D	Linear-movement axis parameter error	Check axis-specific parameter Nos. 38, 68, 1, etc.
E7E	Parameter error	The parameter is invalid.
E7F	Stroke parameter error	Check axis-specific parameter Nos. 7, 8, 1, etc.
E80	Unsupported card error	An unsupported card is installed in an I/O slot.
E81	Priority auto-assignment card non-detection error	Priority auto-assignment card cannot be detected.
E82	Card mismatch error	The combination or positioning of I/O slot cards has a problem.
E83	I/O slot card error	The I/O slot card is invalid.
E84	Resolution parameter error	Check axis-specific parameter Nos. 47, 50, 51, 44, 42, 43, 1, 37, etc.
E85	Driver ready OFF factor indeterminable error	Driver ready OFF factor cannot be determined.
E86	Fieldbus error (FBVCCER)	A fieldbus error (FBVCCER) was detected.
E87	Fieldbus error (FBPOWER)	A fieldbus error (FBPOWER) was detected.
E88	Power error (Other)	A power error (Other) was detected. This error also generates when the power OFF → ON interval is short. After the power has been turned off, be sure to wait for at least 5 seconds before turning it back on. Abnormal regenerative resistance temperature is also suspected.
E89	SCIF open error in non-AUTO mode (Servo in use)	In a mode other than AUTO, opening of the serial 1 channel (also used by the PC software/TP port) from a SEL program is prohibited while the servo is in use (to ensure safety).

(In the panel window, the three digits after "E" indicate an error number.)

Error No.	Error name	Description, action, etc.
E8A	SEL program flash-ROM status error	Data is not written to the flash ROM correctly or written in an old, incompatible application version.
E8B	Symbol definition table flash-ROM status error	Data is not written to the flash ROM correctly or written in an old, incompatible application version.
E8C	Point data flash-ROM status error	Data is not written to the flash ROM correctly or written in an old, incompatible application version.
E8D	Parameter flash-ROM status error	Data is not written to the flash ROM correctly or written in an old, incompatible application version.
EB2	Flash busy reset timeout (Core detection)	Flash ROM operation error. The flash ROM cannot be reset and remains busy.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
FF0 to F00	Shutdown error (hi_sysdwn () definition)	A shutdown error (hi_sysdwn () definition) was detected.
F03 to F58	Shutdown error (OS call error)	A shutdown error (OS call error) was detected.
F60	System-down level error-call procedure error	A system-down level error-call procedure error was detected.
F61	Interpreter-task end task ID error	An interpreter-task end task ID error was detected.
F62	Abnormal standby power detection error	Abnormal standby power was detected.
F63	Regenerative resistance temperature error	A regenerative resistance temperature error was detected.
F64	AC-power overvoltage error	An AC-power overvoltage error was detected.
F65	Motor-power overvoltage error	A motor-power overvoltage error was detected.
F66	Servo control underrun error	A servo control underrun error was detected.
F67	FROM-write bus width error	A write operation other than 32-bit long word access was detected while writing the flash ROM.
F68	FROM write protect error	Write operation to a write-protected flash ROM area (FRMWE bit in DEVCTR = 1) was detected.
F69	Boot watchdog error	A FPGA boot watchdog was detected. The core program may not be running properly.
F6A to FA0	Undefined exception/interruption error	An undefined exception/interruption occurred.
FB0	TMU0 interruption error	A TMU0 interruption error was detected.
FB1	Application code SDRAM copy error (Checksum)	The sum of 4 bytes does not match between the corresponding sections after FROM → SDRAM program copy.
FB2	Installed flash ROM type mismatch (Application)	The flash ROM type anticipated in the software does not match the flash ROM type actually installed. Check the combination of software and hardware.
FB8	Undefined NMI error	An undefined NMI interruption occurred.
FF0 to FFF	Shutdown error (hi_sysdwn() definition)	A shutdown error (hi_sysdwn() definition) was detected.

⊙ Error List

(MAIN core) (In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
A70	SCIF overrun error	Communication error. Check for noise, connected equipment and communication setting. (When updating the application, connect to a PC and use IAI’s update tool.)
A71	SCIF framing error	Communication error. Check for noise, shorted/disconnected communication cable, connected equipment and communication setting. (When updating the application, connect to a PC and use IAI’s update tool.)
A72	SCIF parity error	Communication error. Check for noise, shorted/disconnected communication cable, connected equipment and communication setting. (When updating the application, connect to a PC and use IAI’s update tool.)
A73	IAI protocol header error	Communication protocol error. Check for noise and connected equipment. (When updating the application, connect to a PC and use IAI’s update tool.)
A74	IAI protocol terminal ID error	Communication protocol error. Check for noise and connected equipment. (When updating the application, connect to a PC and use IAI’s update tool.)
A75	IAI protocol command ID error	Communication protocol error. Check for noise and connected equipment. (When updating the application, connect to a PC and use IAI’s update tool.)
A76	IAI protocol checksum error	Communication protocol error. Check for noise and connected equipment. (When updating the application, connect to a PC and use IAI’s update tool.)
A77	Motorola S record type error	The update program file is invalid. Check the file.
A78	Motorola S checksum error	The update program file is invalid. Check the file.
A79	Motorola S load address error	The update program file is invalid. Check the file.
A7A	Motorola S write address over error	The update program file is invalid. Check the file.
A7B	Flash timing limit over error (Write)	Error writing the flash ROM (When updating)
A7C	Flash timing limit over error (Erase)	Error erasing the flash ROM (When updating)
A7D	Flash verify error	Error erasing/writing the flash ROM (When updating)
A7E	Flash ACK timeout	Error erasing/writing the flash ROM (When updating)
A7F	Head sector number specification error	Error erasing the flash ROM (When updating)
A80	Sector count specification error	Error erasing the flash ROM (When updating)
A81	Write-destination offset address error (Odd-numbered address)	The address written during flash ROM write (when updating) is invalid. Check the update program file.
A82	Write-source data buffer address error (Odd-numbered address)	Error writing the flash ROM (When updating)
A83	Invalid code sector block ID error	The flash ROM is new, or the program currently written to the flash ROM is invalid because the last update was aborted. The ROM can be updated without problem.
A84	Code sector block ID erase count over	The number of times the flash ROM was erased exceeded the allowable count.

(In the panel window, the three digits after "E" indicate an error number.)

Error No.	Error name	Description, action, etc.
A85	FROM write request error before erase is complete	When updating, a flash-ROM write command was received before a flash-ROM erase command. Confirm that the update program file is valid and then perform update again.
A86	Absolute-encoder backup battery voltage-low warning (Driver detection)	The voltage of the absolute-data backup battery is low. Check the battery connection or replace the battery.
A87	Motorola S-byte count error (Core detection)	The update program file is invalid. Check the file.
A88	Message conversion error (Core detection)	The received message does not conform to the message format or contains invalid data. Check the message sent from the host communication device.
A89	Updating target non-specification error (Core detection)	During update, an update command was received before the updating target was specified properly. Check if an appropriate updating PC tool is used and the target specification and other settings in the updating PC tool are correct.
A8A	Updating system code error (Core detection)	The system code in the message received with the updating target specification command does not match the controller system. Check the target specification and other settings in the updating PC tool.
A8B	Updating unit code error (Core detection)	The unit code in the message received with the updating target specification command does not match any updatable unit in the controller. Check the target specification and other settings in the updating PC tool.
A8C	Updating device number error (Core detection)	The specified device number in the message received with the updating target specification command is not appropriate. Check the target specification and other settings in the updating PC tool.
A8D	Flash busy reset timeout (Core detection)	Error erasing/writing the flash ROM
CD0	Drive error (Driver detection)	Error notification from the driver
CD1	Encoder error (Driver detection)	Error notification from the driver
CD2	Driver CPU error (Driver detection)	Error notification from the driver
CD3	Servo control error (Driver detection)	Error notification from the driver
CD4	Command error (Driver detection)	Error notification from the driver
CD5	Motor temperature error (Driver detection)	Error notification from the driver

* If "XSEL only" or "SCARA only" is not specified in the "Description, action, etc." field, basically the error is common to both specifications.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
E90	Core code flash-ROM status error	The core program is invalid. Contact the manufacturer.
E91	Application code flash-ROM status error	The application program is invalid. Contact the manufacturer.
E92	Core code sum error	The core program is invalid. Contact the manufacturer.
E93	Application code sum error	The application program is invalid. Contact the manufacturer.
E94	Timing limit over error (Flash erase)	Error erasing the flash ROM
E95	Flash verify error (Flash erase)	Error erasing the flash ROM
E96	Flash ACK timeout (Flash erase)	Error erasing the flash ROM
E97	Head sector number specification error (Flash erase)	Error erasing the flash ROM
E98	Sector count specification error (Flash erase)	Error erasing the flash ROM
E99	Timing limit over error (Flash write)	Error writing the flash ROM
E9A	Flash verify error (Flash write)	Error writing the flash ROM
E9B	Flash ACK timeout (Flash write)	Error writing the flash ROM
E9C	Write-destination offset address error (Flash write)	Error writing the flash ROM
E9D	Write-source data buffer address error (Flash write)	Error writing the flash ROM
E9E	Watchdog reset occurrence error	A WDT (watchdog timer) was manually reset (error detection).
E9F	Exception occurrence error while BL = 1 (NMI)	An exception occurred while the block bit in the CPU status register was “1.” (NMI)
EA0	Exception occurrence error while BL = 1 (Other than NMI)	An exception occurred while the block bit in the CPU status register was “1.” (Other than NMI)
EA1	Bit exception reset due to command/data TLB duplication	This reset occurs when there are multiple TLB entries corresponding to the virtual address.
EA2	Undefined exception/interruption error	An undefined exception/interruption occurred.
EA3	AC-power cutoff detection error	An AC-power cutoff was detected.
EA4	Abnormal standby power detection error	Abnormal standby power was detected.
EA5	Regenerative resistance temperature error	A regenerative resistance temperature error was detected.
EA6	AC-power overvoltage error	An AC-power overvoltage error was detected.
EA7	Motor-power overvoltage error	A motor-power overvoltage error was detected.
EA8	FROM-write bus width error	A write operation other than 32-bit long word access was detected while writing the flash ROM.
EA9	FROM write protect error	Write operation to a write-protected flash ROM area (FRMWE bit in DEVCTR = 1) was detected.
EAA	SDRAM write/read test error	The SDRAM is faulty. Contact the manufacturer.
EAB	Application-update SCIF send-queue overflow error	An overflow occurred in the send queue.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
EAC	Servo control underrun error	A servo control underrun error was detected.
EAD	Boot error	A FPGA boot watchdog was detected. The core program may not be running properly.
EAE	Application-update SCIF receive-queue overflow error	Excessive data is received from outside. (Confirm that a PC and IAI’s update tool are used to update the application.)
EAF	Installed flash ROM type mismatch (Core)	The flash ROM type anticipated in the software does not match the flash ROM type actually installed. Check the combination of software and hardware.
EB0	Undefined NMI error (Core)	An undefined NMI interruption occurred.

* If “XSEL only” or “SCARA only” is not specified in the “Description, action, etc.” field, basically the error is common to both specifications.

⦿ Troubleshooting of XSEL Controller

The XSEL Controller has a panel window on its front face.
Error numbers will be displayed in this panel window.
When the power is turned on, normally “rdy” or “Ardy” will be displayed. “P01” or other code will be displayed while a program is running.
When an error generates, the panel window will show “EA1D” or other code starting with “E.” (Some errors do not begin with “E.”)

Status	Panel window display
After turning on the power	rdy, Ardy
Program is running	P01, P64, etc.
Error has generated	EA1D, ED03, etc.

* Among the alphabets, B and D are shown in lower case.

Depending on the error number, it may be possible to reset the error after removing the cause of the error, or the power must be reconnected to reset the error.
Also, some error numbers are output to the LED display in the panel window, while others are not.
For details, see “⦿ Error Level Control.”

Troubleshooting (Causes and Countermeasures for Key Errors)

Error No.	Error name	Cause	Countermeasure
ACF	AC power cutoff	Momentary power failure has occurred or the voltage has dropped. 100 V is input while the controller's voltage specification is 200 V.	Check the power-source voltage. If the last digit of the controller's model number is "-1," the power specification is 100 V. If the last digit is "-2," the power specification is 200 V.
ErG	Emergency stop (This is not an error.)	Emergency-stop signal is input.	Emergency-stop signal is input in the following condition: 1. The emergency-stop button on the teaching pendant is pressed. 2. The applicable input terminal in the system connector is turned ON. 3. The port switch on the front panel is set to the manual side. (The teaching-pendant/PC-software connector is not connected.) 4. The actuator is of sensor specification and the slider is stopped on either end of the slider.
oPG	Safety gate open	The safety gate is open.	Check the system connector wiring.
dSF	Deadman switch OFF	The switch is set to the manual side even when the teaching connector or other connector is not connected.	Set the switch to the auto side when the teaching connector or other connector is not connected.
C9C	Defective phase-Z position error	The phase-Z position is defective or the reversing amount at home return is small.	Check to see if foreign object has entered the actuator. Check to see if the mounting bolts are contacting the slider. * Change axis-specific parameter No. 22 to "100"

Error No.	Error name	Cause	Countermeasure
914 CA2	Abnormal absolute-data backup battery voltage	The PG cable was disconnected from the controller. Absolute reset has not been executed after the initial setup. The voltage of the absolute-data backup battery has dropped.	Connect the PG cable to the controller and execute an absolute reset. Replace the absolute-data backup battery and execute an absolute reset.
CA5	Stop deviation overflow error	Operation is mechanically disabled. If there is no problem in the mechanical function, the power stage board is faulty.	Check to see if the actuator mounting bolts are contacting inside the axes, or if the slider attachment is contacting any surrounding mechanical parts. Replace the Power Stage Board.
C6b	Deviation overflow error	Operation is mechanically disabled. If there is no problem in the mechanical function, the power stage board(IPM) is faulty.	Check to see if the actuator mounting bolts are contacting inside the axes, or if the slider attachment is contacting any surrounding mechanical parts. Replace the Power Stage Board.
d03	Faulty encoder or attachment of dust	The encoder is faulty or dust is attached.	Remove the motor cover and apply cleaning air spray for OA equipment, etc., over the cord wheel. If the problem persists, replace/readjust the encoder.
d06	Encoder received-data error	The encoder cable is disconnected.	Replace the encoder cable.
d10	IPM error	The motor coil is damaged.	Measure relative resistance among phases U/V/W. If the resistance values are different, the coil has been burned. Replace the motor. If the resistance values are almost the same, the coil has not been burned.
		If the motor coil is not damaged, the power stage board (to which the motor power cable is connected) is faulty.	Replace the board.
d19	Encoder receive timeout error	The encoder cable is disconnected.	Replace the encoder cable.

Error No.	Error name	Cause	Countermeasure
d18	Speed loop underrun error	The driver CPU board was damaged due to noise in the encoder cable.	Replace the board and implement noise control measures.
807	Shutdown relay ER status	The transistor on the power-supply board (to which the power cable is connected) is damaged.	Replace the board.

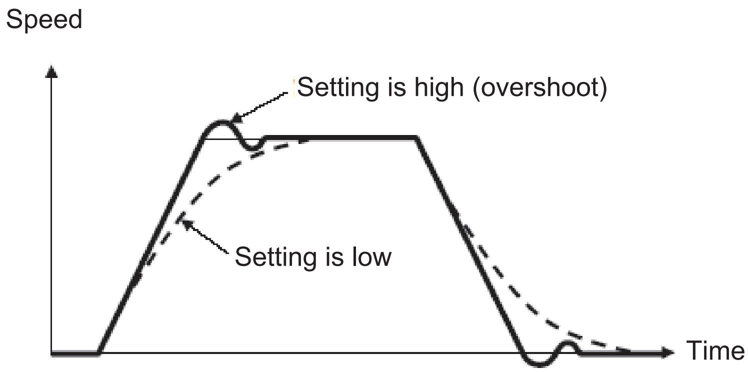
Servo Gain Adjustment

Since the servo has been adjusted at the factory in accordance with the standard specification of the actuator, the servo gain need not be changed in normal conditions of use.
However, vibration or noise may occur depending on how the actuator is affixed, specific load condition, and so on, and therefore the parameters relating to servo adjustment are disclosed to allow the customer to take quick actions should adjustment become necessary.
Particularly with custom models (whose ball screw lead or stroke is longer than that of the standard model), vibration/noise may occur due to external conditions.
In these cases, the parameters shown below must be changed. Contact IAI for details.

● Position Gain

Axis-specific parameter number	Unit	Input range	Default (reference)
60	/ sec	0 to 9999	30

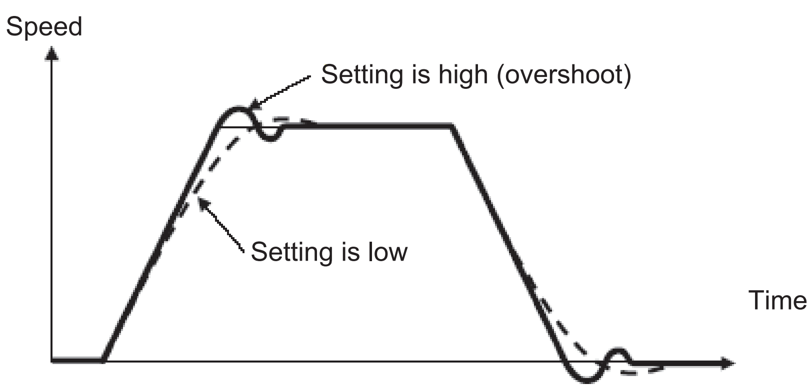
This parameter determines the level of response with respect to a position control loop.
Increasing the setting improves compliance with the position command.
However, increasing the setting too much increases the tendency of the actuator to overshoot.
If the setting is low, compliance with the position command drops and the positioning time increases as a result.



● Speed Loop Gain (Parameter List 1)

Driver card parameter number	Unit	Input range	Default (reference)
43	-	1 to 32767	500

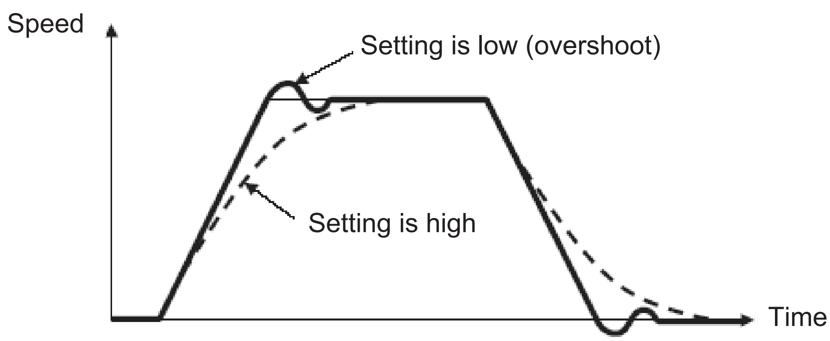
This parameter determines the level of response with respect to a speed control loop.
Increasing the setting improves compliance with the speed command (i.e., servo rigidity increases).
The greater the load inertia, the higher the setting should be.
However, increasing the setting too much increases the tendency of the actuator to overshoot or oscillate, resulting in increased mechanical vibration.



● Speed Loop Integral Time Constant (Parameter List 1)

Driver card parameter number	Unit	Input range	Default (reference)
44	-	1 to 1000	30

This parameter determines the level of response with respect to a speed control loop.
Increasing the setting too much results in lower response with the speed command and decreases the reactive force upon load change. If the setting is low, compliance with the position command also drops and the positioning time increases as a result.
Decreasing the setting too much increases the tendency of the actuator to overshoot or oscillate, resulting in increased mechanical vibration.



● Current Loop Control Band Number

Driver card parameter number	Unit	Input range	Default (reference)
46	-	0 to 4	4

This parameter is used to set the control band of the PI current control system.
Normally this parameter need not be changed. If the parameter is changed carelessly, stability of the control system may be affected and a very dangerous situation may occur.
However, changing this parameter may be effective in certain situations, such as when you want to suppress resonance.
If you wish to change this parameter, contact IAI.

● Torque Filter Time Constant (Parameter List 1)

Driver card parameter number	Unit	Input range	Default (reference)
45	-	1 to 2500	0

This parameter determines the filter time constant applicable to the torque command.
If the mechanical resonance frequency is equal to or lower than the servo loop response frequency, the motor will vibrate.
This mechanical resonance can be suppressed by increasing the setting of this parameter.
It should be noted, however, that increasing the setting too much may affect the stability of the control system.

Trouble Report Sheet

Trouble Report Sheet				Date:	
Company name		Department		Reported by	
TEL	(Ext)	FAX			
IAI agent		Purchase date			
Serial number		Manufacture date			

[1] Number of axes ☐ axis(es)

Type

1 = ____________ 2 = ____________
3 = ____________ 4 = ____________
5 = ____________ 6 = ____________
7 = ____________ 8 = ____________

[2] Type of problem

1. Disabled operation 2. Position deviation 3. Runaway machine
4. Error Error code = ☐☐☐
5. Other ( )

[3] Problem frequency and condition

Frequency =

Condition ____
____
____
____
____

[4] When did the problem occur?

1. Right after the system was set up
2. After operating for a while (Operating hours: ________ year(s) and ________ month(s))

[5] Operating direction

1. Horizontal 2. Horizontal + Vertical

[6] Load condition

1. Load transfer 2. Push-motion operation 3. Load: Approx. ________ kg
4. Speed: Approx. _________ mm/sec

[7] Special specification (option, etc.)

Change History

Revision Date	Description of Revision
December 2010	Ninth edition ▪ P.1: Added G (Quasi-absolute) to the encoder type in the type specification table.
December 2010	Tenth edition ▪ P.8: Changed the contents of "Circuit breaker" and "Earth leakage breaker." ▪ P.217, P.363: Added a note regarding the home return operation of the linear servo actuator LSAS-N10/N15 of quasi-absolute type.
April 2011	Eleventh edition ▪ Swapped over the page for CE Marking
January 2012	Twelfth edition ▪ Important note added for re-execution of absolute reset in synchronizing process
March 2012	Thirteenth edition ▪ P.70: Warning note added to tell the internal components of XSEL-Q/QCT controller may burn if the enclosed cable CB-ST-E1MW050 (black) is used.
March 2012	Fourteenth edition ▪ P.1 to 7: Contents added and changed in Safety Guide ▪ Cautions added regarding use of PC cables (Related pages: P.20, 21, 35, 53, 56, 59, 70) ▪ P.207: GRP command table revised
June 2012	Fifteenth edition ▪ Contents changed in Warranty ▪ ACMX commands and related parameters added ▪ Change made in SCRV specifications ▪ Statement of PCT/QCT added
December 2013	Sixteenth edition ▪ Note added in the caution in the beginning telling about frequency of power supply/shutoff ▪ Correction made to other indicated items
February 2014	Seventeenth edition ▪ Connector name changed

Revision Date	Description of Revision
May 2014	Eighteenth edition Applied for CT4 Pick & Rotary Axis
September 2014	Nineteenth edition Caution added to MVPI and MVLI Commands, etc.

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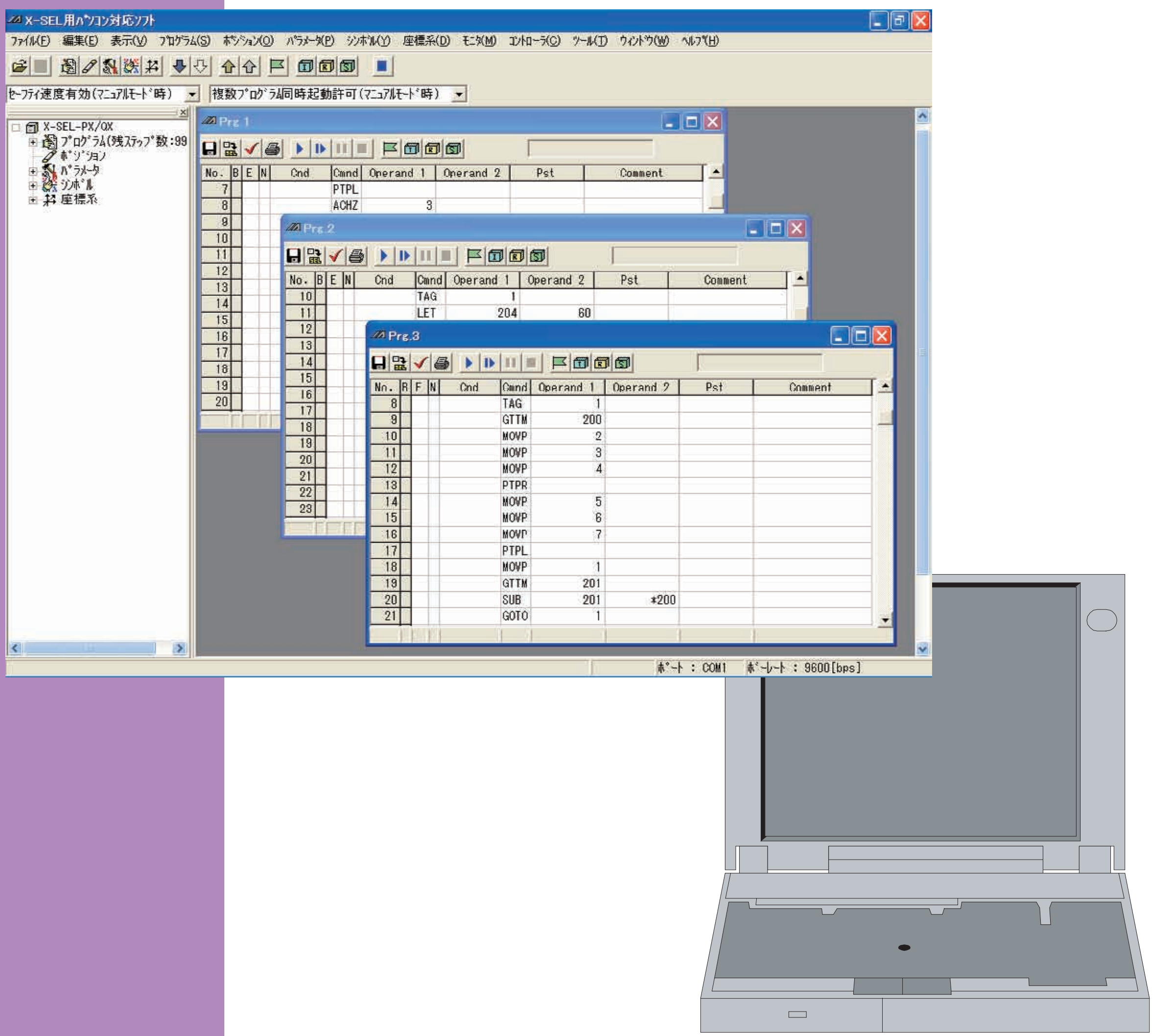
INTELLIGENT ACTUATOR

SEL Language Programming Manual

Eighth Edition



IAI America, Inc.

INTELLIGENT ACTUATOR

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.
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Some commands cannot be used depending on the actuator. For details, refer to individual commands.

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Command	Function	XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -JX/KX	XSEL -PX/QX	XSEL -R/S	XSEL -RX/SX/ RXD/SXD	ASEL PSEL	SSEL	MSEL	TT/TTA	Page
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Command	Function	XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -JX/KX	XSEL -PX/QX	XSEL -R/S	XSEL -RX/SX/ RXD/SXD	ASEL PSEL	SSEL	MSEL	TT/TTA	Page
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J□W□	Jog [FN, FF, BN, BF]	○	○		○	○	○	○	○	○	○	359
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Command	Function	XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -JX/KX	XSEL -PX/QX	XSEL -R/S	XSEL -RX/SX/ RXD/SXD	ASEL PSEL	SSEL	MSEL	TT/TTA	Page
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Command	Function	XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -JX/KX	XSEL -PX/QX	XSEL -R/S	XSEL -RX/SX/ RXD/SXD	ASEL PSEL	SSEL	MSEL	TT/TTA	Page
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Command	Function	XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -JX/KX	XSEL -PX/QX	XSEL -R/S	XSEL -RX/SX/ RXD/SXD	ASEL PSEL	SSEL	MSEL	TT/TTA	Page
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Command	Function	XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -JX/KX	XSEL -PX/QX	XSEL -R/S	XSEL -RX/SX/ RXD/SXD	ASEL PSEL	SSEL	MSEL	TT/TTA	Page
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Command	Function	XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -JX/KX	XSEL -PX/QX	XSEL -R/S	XSEL -RX/SX/ RXD/SXD	ASEL PSEL	SSEL	MSEL	TT/TTA	Page
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VEL	Set speed	○	○	○	○	○	○	○	○	○	○	291
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XCRP	Clear input counter record for extension motion control board axis		○			○						498
XCTM	Move extension motion control board axis individual electronic cam (indicating time)		○			○						534
XGAC	Read extension motion control board axis acceleration data		○			○						511
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Command	Function	XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -JX/KX	XSEL -PX/QX	XSEL -R/S	XSEL -RX/SX/ RXD/SXD	ASEL PSEL	SSEL	MSEL	TT/TTA	Page
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XGVL	Read extension motion control board axis speed data		○			○						510
XHOM	Return extension motion control board axis to home position		○			○						517
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XMDI	Move extension motion control board axis to directly indicated relative position		○			○						523
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Command	Function	XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -JX/KX	XSEL -PX/QX	XSEL -R/S	XSEL -RX/SX/ RXD/SXD	ASEL PSEL	SSEL	MSEL	TT/TTA	Page
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	Clear position data	PCLR	○	○	○	○	○	○	○	○	○	○	276
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	Read current axis position	PRED	○	○	○	○	○	○	○	○	○	○	278
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Category	Function	Command	XSEL -J/K/ KE/KT/KET	XSEL -P/Q/ PCT/QCT	XSEL -JX/KX/ KETX	XSEL -PX/QX	XSEL -R/S	XSEL -RX/SX/ RXD/SXD	ASEL PSEL	SSEL	MSEL	TT/TTA	Page
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	Set offset	OFST	○	○	○	○	○	○	○	○	○	○	302
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Category	Function	Command	XSEL -J/K/ KE/KT/KET	XSEL -P/Q/ PCT/QCT	XSEL -JX/KX/ KETX	XSEL -PX/QX	XSEL -R/S	XSEL -RX/SX/ RXD/SXD	ASEL PSEL	SSEL	MSEL	TT/TTA	Page
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Category	Function	Command	XSEL -J/K/ KE/KT/KET	XSEL -P/Q/ PCT/QCT	XSEL -JX/KX/ KETX	XSEL -PX/QX	XSEL -R/S	XSEL -RX/SX/ RXD/SXD	ASEL PSEL	SSEL	MSEL	TT/TTA	Page
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Category	Function	Command	XSEL -J/K/ KE/KT/KET	XSEL -P/Q/ PCT/QCT	XSEL -JX/KX/ KETX	XSEL -PX/QX	XSEL -R/S	XSEL -RX/SX/ RXD/SXD	ASEL PSEL	SSEL	MSEL	TT/TTA	Page
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	Set palletizing Z-axis offset	OFPZ	○	○	○	○	○	○			○	○	447
	Set palletizing counts	PAPI	○	○	○	○	○	○	○	○	○	○	435
	Set palletizing pattern	PAPN	○	○	○	○	○	○	○	○	○	○	436
Palletizing definition	Set palletizing points for 3-point or 4-point teaching	PAPS	○	○	○	○	○	○	○	○	○	○	440
	Set palletizing pitches	PAPT	○	○	○	○	○	○	○	○	○	○	438
	Set palletizing axes	PASE	○	○	○	○	○	○	○	○	○	○	437
	Set palletizing reference point	PAST	○	○	○	○	○	○	○	○	○	○	439
	Set palletizing Z-axis	PCHZ	○	○	○	○	○	○			○	○	444
	Set palletizing composition	PEXT	○	○	○	○	○	○			○	○	446
	Set zigzag	PSLI	○	○	○	○	○	○	○	○	○	○	443
	Set palletizing arch triggers	PTRG	○	○	○	○	○	○			○	○	445
Palletizing operation	Get palletizing calculation data	PAPG	○	○	○	○	○	○	○	○	○	○	453
	Get palletizing angle	PARG	○	○	○	○	○	○	○	○	○	○	452
	Decrement palletizing position number by 1	PDEC	○	○	○	○	○	○	○	○	○	○	450
	Increment palletizing position number by 1	PINC	○	○	○	○	○	○	○	○	○	○	449
	Set palletizing position number directly	PSET	○	○	○	○	○	○	○	○	○	○	451
	Get palletizing position number	PTNG	○	○	○	○	○	○	○	○	○	○	448

Category	Function	Command	XSEL -J/K/ KE/KT/KET	XSEL -P/Q/ PCT/QCT	XSEL -JX/KX/ KETX	XSEL -PX/QX	XSEL -R/S	XSEL -RX/SX/ RXD/SXD	ASEL PSEL	SSEL	MSEL	TT/TTA	Page
Palletizing movement	Palletizing-point arch motion	PACH	○	○	○	○	○	○			○	○	456
	Move to palletizing points via interpolation	PMVL	○	○		○	○	○	○	○	○ (PC/PG only)	○	455
	Move to palletizing points via PTP	PMVP	○	○	○	○	○	○	○	○	○	○	454
Building of pseudo-ladder task	Change task level	CHPR	○	○	○	○	○	○	○	○	○	○	458
	Output relay for ladder	OUTR	○	○	○	○	○	○	○	○	○	○	152
	Timer relay for ladder	TIMR	○	○	○	○	○	○	○	○	○	○	152
	Specify processing to be performed when input condition is not specified	TPCD	○	○	○	○	○	○	○	○	○	○	459
	Task sleep	TSLP	○	○	○	○	○	○	○	○	○	○	460
Extended commands	Get motor current value	ECMD1		○		○	○	○	○	○			461
	Get home sensor status	ECMD2		○			○	○					462
	Get overrun sensor status	ECMD3		○			○	○					463
	Get creep sensor status	ECMD4		○			○	○					464
	Get axis operation status	ECMD5		○			○	○	○	○	○		465
	Current position acquirement on each axis system	ECMD6				○					○ (PCX/PGX only)		466
	Get parameter	ECMD 20		○			○	○	○	○	○		467
	Set torque limit/detection time for torque limit over error	ECMD 250		○		○	○	○					469
Vision System I/F Related	Declare use of Vision System	SLVS		○			○				○ (PC/PG only)		545
	Image Caputure command	GTVD		○			○				○ (PC/PG only)		547
Conveyor Tracking Related	Declare use of Conveyor Tracking	TRMD		○		○	○	○					541
	Image capturing and tracking command	TRAC		○			○	○					542
Anti-Vibration Control Related	Anti-Vibration Control Parameter Set Select	NTCH		○			○	○					549

RC Gateway Function Commands (Controllers with Gateway Function Only)

Category	Function	Command	XSEL -J/K/ KE/KT/KET	XSEL -P/Q/ PCT/QCT	XSEL -JX/KX/ KETX	XSEL -PX/QX	XSEL -R/S	XSEL -RX/SX/ RXD/SXD	ASEL PSEL	SSEL	MSEL	TT/TTA	Page
RC axis position operation	Assign RC axis position to variable 199	RPGT		○		○	○	○					472
	Assign variable 199 to RC axis position	RPPT		○		○	○	○					473
	Clear RC axis position data	RPCR		○		○	○	○					474
	Copy RC axis position data	RPCP		○		○	○	○					475
	Read current RC axis position	RPRD		○		○	○	○					476
	Read current RC axis position (1 axis, direct)	RPRQ		○		○	○	○					477
	Assign variable 199 to RC axis position speed	RPVL		○		○	○	○					478
	Assign variable 199 to RC axis position acceleration/ deceleration	RPAD		○		○	○	○					479
	Assign variable 199 to RC axis position positioning width	RPIP		○		○	○	○					480
	Assign variable 199 to RC axis position current-limiting value	RPTQ		○		○	○	○					481
	Assign RC axis position speed to variable 199	RGVL		○		○	○	○					482
	Assign RC axis position acceleration/ deceleration to variable 199	RGAD		○		○	○	○					483
	Assign RC axis position positioning width to variable 199	RGIP		○		○	○	○					484
	Assign RC axis position current-limiting value to variable 199	RGTQ		○		○	○	○					485

Category	Function	Command	XSEL -J/K/ KE/KT/KET	XSEL -P/Q/ PCT/QCT	XSEL -JX/KX/ KETX	XSEL -PX/QX	XSEL -R/S	XSEL -RX/SX/ RXD/SXD	ASEL PSEL	SSEL	MSEL	TT/TTA	Page
RC actuator control command	Set RC axis pattern	RAXS		○		○	○	○					486
	Turn RC axis servo ON	RSON		○		○	○	○					487
	Turn RC axis servo OFF	RSOF		○		○	○	○					488
	Return RC axis to its home	RHOM		○		○	○	○					489
	Move by RC axis position specification	RMVP		○		○	○	○					490
	Incremental move by RC axis position specification	RMPI		○		○	○	○					491
	Move by RC axis direct specification	RMVD		○		○	○	○					492
	Incremental move by RC axis direct specification	RMDI		○		○	○	○					493
	Move by RC axis push-motion operation	RPUS		○		○	○	○					494
	Decelerate RC axis to stop	RSTP		○		○	○	○					495
RC axis information acquisition	Get RC axis status	RCST		○		○	○	○					496

Electronic Cam Control System Related Commands

Category	Function	Command	XSEL -J/K/ KE/KT/KET	XSEL -P/Q/ PCT/QCT	XSEL -JX/KX/ KETX	XSEL -PX/QX	XSEL -R/S	XSEL -RX/SX/ RXD/SXD	ASEL PSEL	SSEL	MSEL	TT/TTA	Page
Extension motion control board input operations	Clear input counter record for extension motion control board	XCRP		○			○						498
	Acquire current record of extension motion control board input counter	XGTP		○			○						499
Extension motion control board axis position operations	Read extension motion control board axis position data	XPGT		○			○						500
	Write extension motion control board axis position data	XPPT		○			○						501
	Erase extension motion control board axis position data	XPCR		○			○						502
	Copy extension motion control board axis position data	XPCP		○			○						503
	Read extension motion control board axis current command position	XPRD		○			○						504
	Read extension motion control board axis current command position (single-axis direct)	XPRQ		○			○						505
	Write extension motion control board axis speed data	XPVL		○			○						506
	Write extension motion control board axis acceleration data	XPAC		○			○						507
	Write extension motion control board axis deceleration data	XPDC		○			○						508
	Write extension motion control board axis positioning complete width data	XPIP		○			○						509
	Read extension motion control board axis speed data	XGVL		○			○						510
	Read extension motion control board axis acceleration data	XGAC		○			○						511
	Read extension motion control board axis deceleration data	XGDC		○			○						512
	Read extension motion control board axis positioning width data	XGIP		○			○						513

Category	Function	Command	XSEL -J/K/ KE/KT/KET	XSEL -P/Q/ PCT/QCT	XSEL -JX/KX/ KETX	XSEL -PX/QX	XSEL -R/S	XSEL -RX/SX/ RXD/SXD	ASEL PSEL	SSEL	MSEL	TT/TTA	Page
Extension motion control board axis actuator control declarations	Set extension motion control board axis patterns	XAXS		○			○						514
Extension motion control board axis actuator control commands	Extension motion control board axis servo ON	XSON		○			○						515
	Extension motion control board axis servo OFF	XSOF		○			○						516
	Return extension motion control board axis to home position	XHOM		○			○						517
	Move extension motion control board axis to indicated position	XMVP		○			○						518
	Perform extension motion control board axis position relative movement	XMPI		○			○						519
	Move extension motion control board axis for position indicated interpolation	XMVL		○			○						520
	Move extension motion control board axis for position relative interpolation	XMLI		○			○						521
	Move extension motion control board axis to directly indicated absolute position	XMVD		○			○						522
	Move extension motion control board axis to directly indicated relative position	XMDI		○			○						523
	Perform extension motion control board axis jog operation	XJ☐☐		○			○						524
	Waiting for extension motion control board axis to finish positioning operation of axis used by self-program	XPED		○			○						525
	Cancel operation of extension motion control board axis	XSTP		○			○						526
	Waiting for extension motion control board axis positioning complete signal to be turned ON	XWIP		○			○						527
	Start synchronizing extension motion control board axis electronic cam (indicating main axis)	XCAS		○			○						529

Category	Function	Command	XSEL -J/K/ KE/KT/KET	XSEL -P/Q/ PCT/QCT	XSEL -JX/KX/ KETX	XSEL -PX/QX	XSEL -R/S	XSEL -RX/SX/ RXD/SXD	ASEL PSEL	SSEL	MSEL	TT/TTA	Page
Extension motion control board axis actuator control commands	Move extension motion control board axis individual electronic cam (indicating time)	XCTM		○			○						534
	Start synchronizing of extension motion control board axis electronic shaft	XSFS		○			○						536
	Cancel operation of extension motion control board axis	XSYE		○			○						538
Extension motion control board axis status acquirement	Acquire extension motion control board axis status (0 to 15 axis)	XAST		○			○						540

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	Description
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 the product outside the specifications. Failure to do so may considerably shorten the life of the product. ● 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 ● For an actuator used in vertical orientation, select a model which is equipped with a brake. If selecting a model with no brake, the moving part may drop when the power is turned OFF and may cause an accident such as an injury or damage on the work piece.

No.	Operation Description	Description
2	Transportation	● When carrying a heavy object, do the work with two or more persons or utilize equipment such as crane. ● 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 in transportation, consider well about the positions to hold, weight and weight balance and pay special attention to the carried object so it would not get hit or dropped. ● Transport it using an appropriate transportation measure. The actuators available for transportation with a crane have eyebolts attached or there are tapped holes to attach bolts. Follow the instructions in the instruction manual for each model. ● 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.
3	Storage and Preservation	● The storage and preservation environment conforms to the installation environment. However, especially give consideration to the prevention of condensation. ● Store the products with a consideration not to fall them over or drop due to an act of God such as earthquake.
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. Also, be equipped for a fall-over or drop due to an act of God such as earthquake. ● 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

No.	Operation Description	Description
4	Installation and Start	(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 ● 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. ● For the ground terminal on the AC power cable of the controller and the grounding plate in the control panel, make sure to use a twisted pair cable with wire thickness $0.5mm^2$ (AWG20 or equivalent) or more for grounding work. For security grounding, it is necessary to select an appropriate wire thickness suitable for the load. Perform wiring that satisfies the specifications (electrical equipment technical standards). ● Perform Class D Grounding (former Class 3 Grounding with ground resistance 100Ω or below).

No.	Operation Description	Description
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	Description
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	● Check before starting the automatic operation or rebooting after operation stop that there is nobody in the safety protection fence. ● Before starting automatic operation, make sure that all peripheral equipment is in an automatic-operation-ready state and there is no alarm indication. ● Make sure to operate automatic operation start from outside 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.

No.	Operation Description	Description
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. ● The slider or rod may get misaligned OFF the stop position if the servo is turned OFF. Be careful not to get injured or damaged due to an unnecessary operation. ● Pay attention not to lose the cover or untightened screws, and make sure to put the product back to the original condition after maintenance and inspection works. Use in incomplete condition may cause damage to the product or an injury. * Safety protection Fence : In the case that there is no safety protection fence, the movable range should be indicated.
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. ● When removing the actuator for disposal, pay attention to drop of components when detaching screws. ● Do not put the product in a fire when disposing of it. The product may burst or generate toxic gases.
11	Other	● Do not come close to the product or the harnesses if you are a person who requires a support of medical devices such as a pacemaker. Doing so may affect the performance of your medical device. ● See Overseas Specifications Compliance Manual to check whether complies if necessary. ● For the handling of actuators and controllers, follow the dedicated instruction manual of each unit to ensure the safety.

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

1. Preparation in Advance

SEL language is the simplest type of language in many existing robot languages.
Even though SEL language is an interpreter program, it enables to perform high level controls in simple expression ways.
In this manual, describes how to use SEL language, explanations of command language, examples of how to create programs for each actuator, etc.

In this section, explains what are needed to be prepared beforehand to start programming, or the things that you need to know for programming.

1.1 Related Manuals

Please make sure to refer also to the instruction manuals for the controller and accessories that you intend to use. Listed below are the related instruction manuals.

No.	Name	Manual No.
1	XSEL-J/K Controller Instruction Manual	ME0116
2	XSEL-KT Controller Instruction Manual	ME0134
3	XSEL-JX/KX Controller Instruction Manual	ME0119
4	XSEL-P/Q/PCT/QCT Controller Instruction Manual	ME0148
5	XSEL-PX/QX Controller Instruction Manual	ME0152
6	PSEL Controller Instruction Manual	ME0172
7	ASEL Controller Instruction Manual	ME0165
8	SSEL Controller Instruction Manual	ME0154
9	TT Controller	ME0149
10	PC Software IA-101-X-MW/IA-101-X-USBMW	ME0154
11	Teaching Pendant SEL-T/TD/TG	ME0183
12	Teaching Pendant IA-T-X/XD	ME0160
13	DeviceNet Instruction Manual	ME0124
14	CC-Link Instruction Manual	ME0123
15	PROFIBUS Instruction Manual	ME0153
16	XSEL Ethernet Instruction Manual	ME0140
17	XSEL Controller RC Gateway Function Instruction Manual	ME0188
18	XSEL-P/Q/PCT/QCT Controller Electronic Cam Function Instruction Manual	ME0246
19	OMRON Vision Sensor Tracking Instruction Manual	ME0237
20	Keyence Vision Sensor Tracking Instruction Manual	ME0238
21	Cognex Vision Sensor Tracking Instruction Manual	ME0239
22	XSEL-P/Q/PCT/QCT Controller Vision System I/F Function Instruction Manual	ME0264
23	XSEL-R/S/RX/SX/RXD/SXD Controller Instruction Manual	ME0308
24	Tabletop Robot TTA Instruction Manual	ME0320
25	MSEL Instruction Manual	ME0336

1.2 Programming Tool

To create a program with SEL language, it is necessary to prepare a dedicated teaching pendant or PC software provided by IAI.
Please confirm in the table below that the controller you intend to use complies with the programming tool that you have.

No.	Item	Controller Model / Model Code of Programming Tool	XSEL-J/K/KE/KT/KET	XSEL-P/PCT/R	XSEL-Q/QCT/S	XSEL-JX/KX/KETX	XSEL-PX/RX/RXD	XSEL-QX/SX/SXD	ASEL	PSEL	SSEL	TT/TTA	MSEL
1	PC software (with RS232C cable + emergency stop box)	IA-101-X-MW	○	○	○	○	○	○				○	
2	PC software (with USB conversion adapter + RS232C cable + emergency stop box)	IA-101-X-USBMW	○	○	○	○	○	○				○	
3	PC software (with RS232C cable + emergency stop box + connector conversion cable)	IA-101-X-MW-J							○	○	○		○
4	PC software (with USB cable + dummy plug)	IA-101-X-USB							○	○	○		○
5	PC software (with safety category 4 cable + emergency stop box)	IA-101-XA-MW			○			○					
6	Teaching pendant	SEL-T	○ (J is excluded)	○	○	○	○	○	○	○	○	○	
7	Teaching pendant (with deadman switch)	SEL-TD	○ (J is excluded)	○	○	○	○	○	○	○	○	○	
8	Teaching pendant (with TP adapter for Safety Categories)	SEL-TG	○	○	○	○	○	○	○	○	○	○	
9	Teaching pendant	IA-T-X	○	○ (Q is excluded)	○	○	○	○ (QX is excluded)	○	○	○	○	
10	Teaching pendant (with deadman switch)	IA-T-XD	○	○ (Q is excluded)	○	○	○	○ (QX is excluded)	○	○	○	○	
11	Touch panel teaching	TB-01	○	○	○	○	○	○	○	○	○	○	○
12	Touch panel teaching (with deadman switch)	TB-01D	○	○	○	○	○	○	○	○	○	○	○

○: Applicable, Blank: Not applicable

1.3 PC Operational Environment

If you use the PC software, make sure your PC meets the following specifications before installing the software. [Refer to PC Software Instruction Manual for how to install it.]
Also, confirm in the next section that it is applicable for the controller that you intend to use.

1) Operating System (OS)
   Windows 2000 SP4 or later, Windows XP SP2 or later, Windows Vista, Windows 7
2) Main Memory
   It should possess memory capacity necessary to operate Windows®.
3) Display Monitor
   XGA or more.
4) Hard Disk
   Hard disk with free space of 20MB or more
   (This software is to be used with being installed in the hard disk.)
5) Serial Port
   There should be 1 unit of RS232C port that is capable for the communication speed setting of 9600bps or more.
   (Note) This is for the case the model code of PC software is IA-101-*-MW.
6) USB Port
   There should be 1 unit of USB port with its version 1.1 or more.
   (Note) This is for the case the model code of PC software is IA-101-*-USBMW.
7) Keyboard
   It should comply with the PC main unit. (PC/AT compatible keyboard)
8) Pointing Device
   It should be operated in Windows® OS.
9) Drive Device
   The PC should possess a CD-ROM drive device that complies with the PC or a compatible drive device that can read CD-ROM.

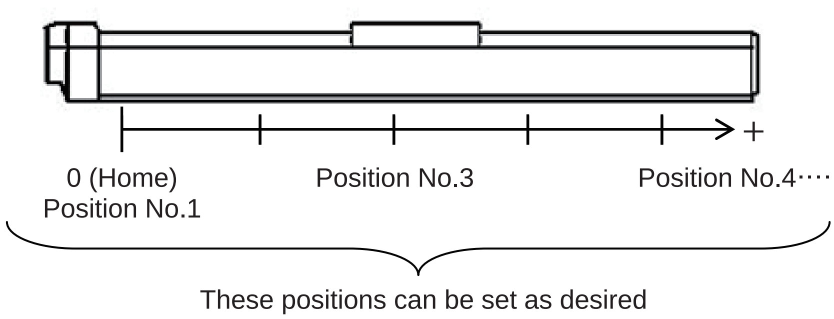
* SEL language is available on the following controllers.
   1) XSEL (all types)
   2) ASEL
   3) PSEL
   4) SSEL
   5) TT/TTA
   6) MSEL

1.4 Axes on Each Actuator and Precautions

In this section, explains the construction of axis number of each actuator on the 3-dimensional coordinate system, X, Y and Z.

1.4.1 Single-Direction Axis

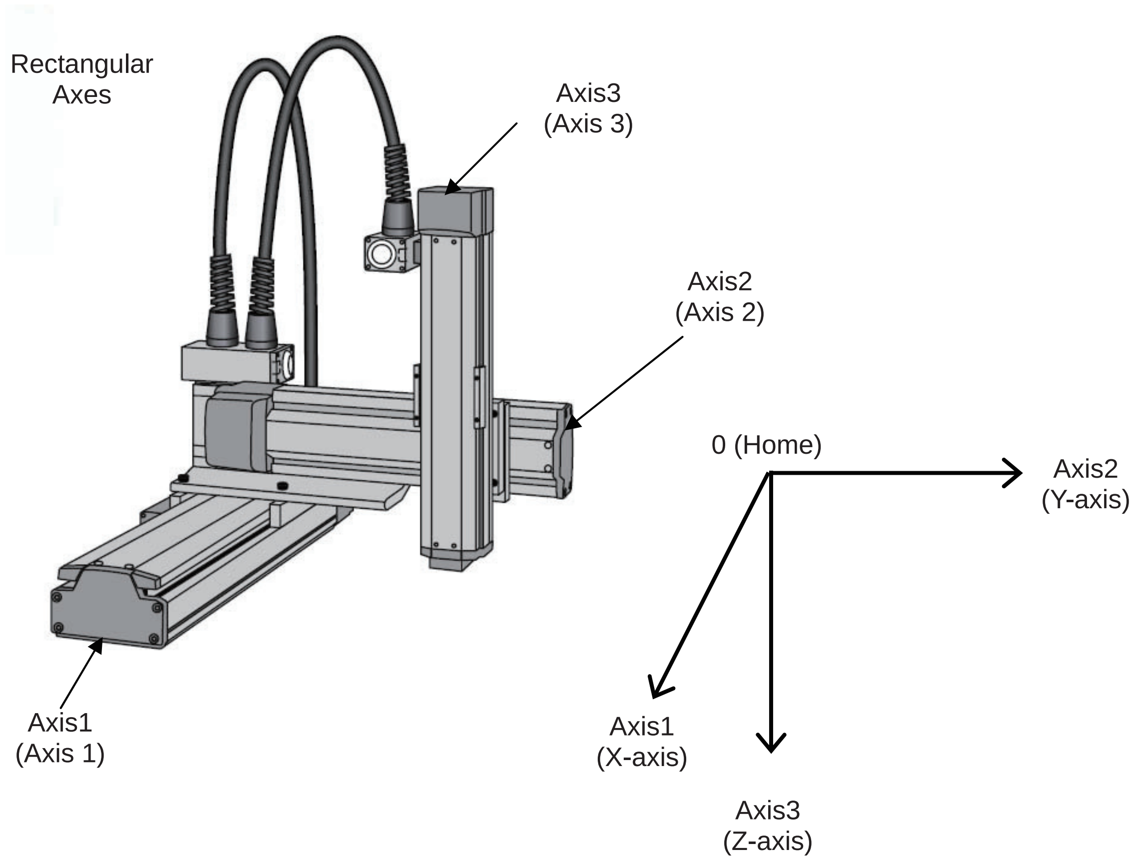
The coordinate value from the home corresponds to 0mm in position data.
Positions from the home represent position data.
The direction is reversed if the actuator is of reversed-home specification.



Axis Number of the position table will be that of the connector that is connected physically to the actuator motor and encoder cable. [Refer to the instruction manual of the controller for the details.]

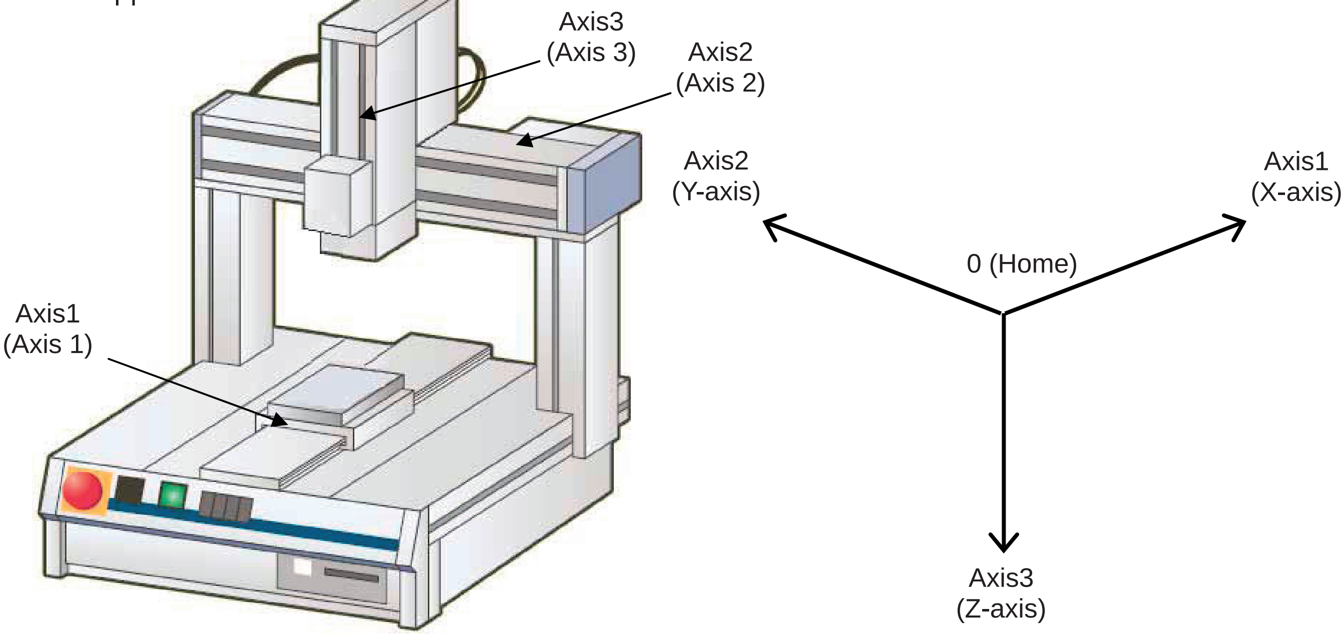
1.4.2 Rectangular Axes, TT*

The coordinate value from the home of each axis corresponds to 0mm in position data.
With each axis, positions from the home represent position data.



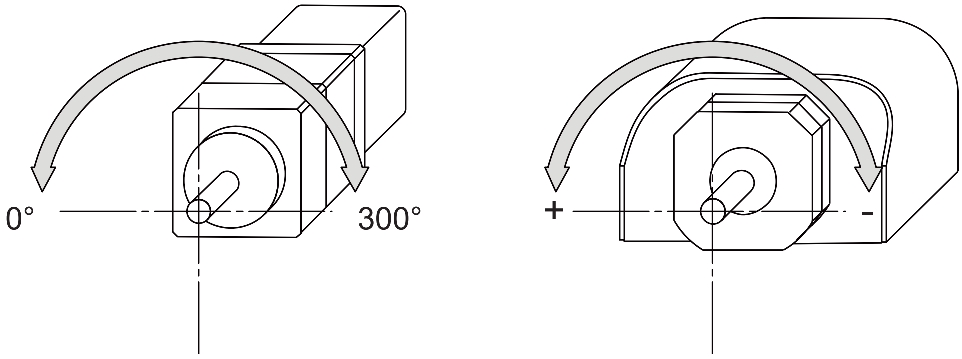
Axis Number is that the actuator motor and encoder cable is connected physically.
The coordinate system shown in the figure below is when each actuator motor and encoder cable is connected to the Axis Number in bracket.
Refer to the instruction manual of each controller for the details.

TT



1.4.3 Rotational Axis

The coordinate value from the home corresponds to 0° in position data.
Rotational angles from the home represent position data.

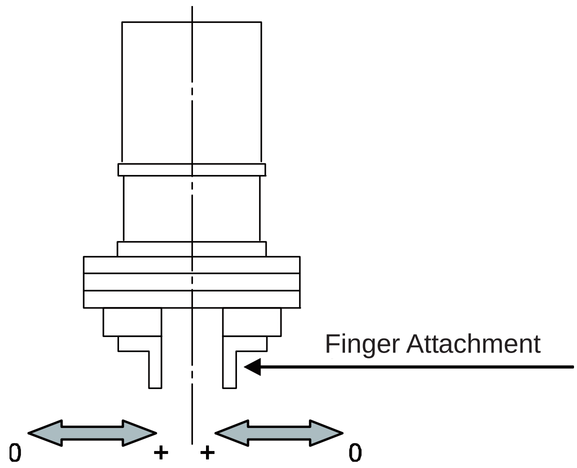


To the rotation axes, there is the finite stroke type that operates within the established angular range and the infinite stroke type that can rotate for a number of times in the indicated direction.
Refer to the instruction manual of each actuator for the details.

1.4.4 Gripper

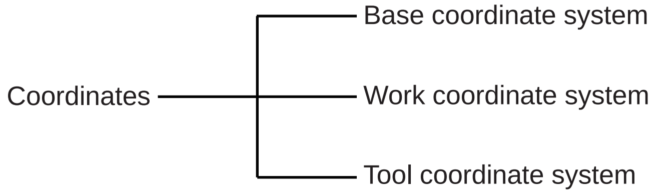
The coordinate value (opening side) from the home corresponds to 0mm in position data.
1/2 stroke*1 from the home represent position data.

*1 Stroke : Distance between both grippers

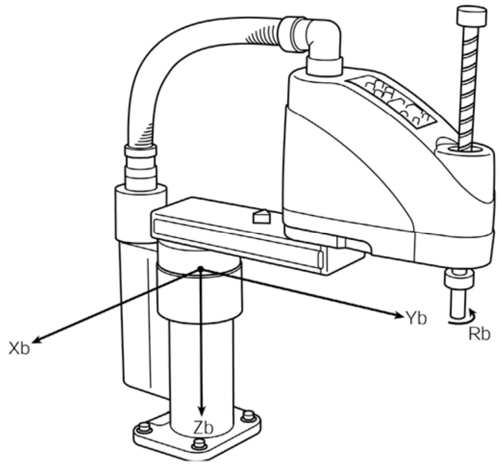


1.4.5 SCARA Robot

[1] Coordinates
A horizontal articulated (SCARA) robot has three coordinate systems including the base coordinate system, work coordinate system and tool coordinate system.

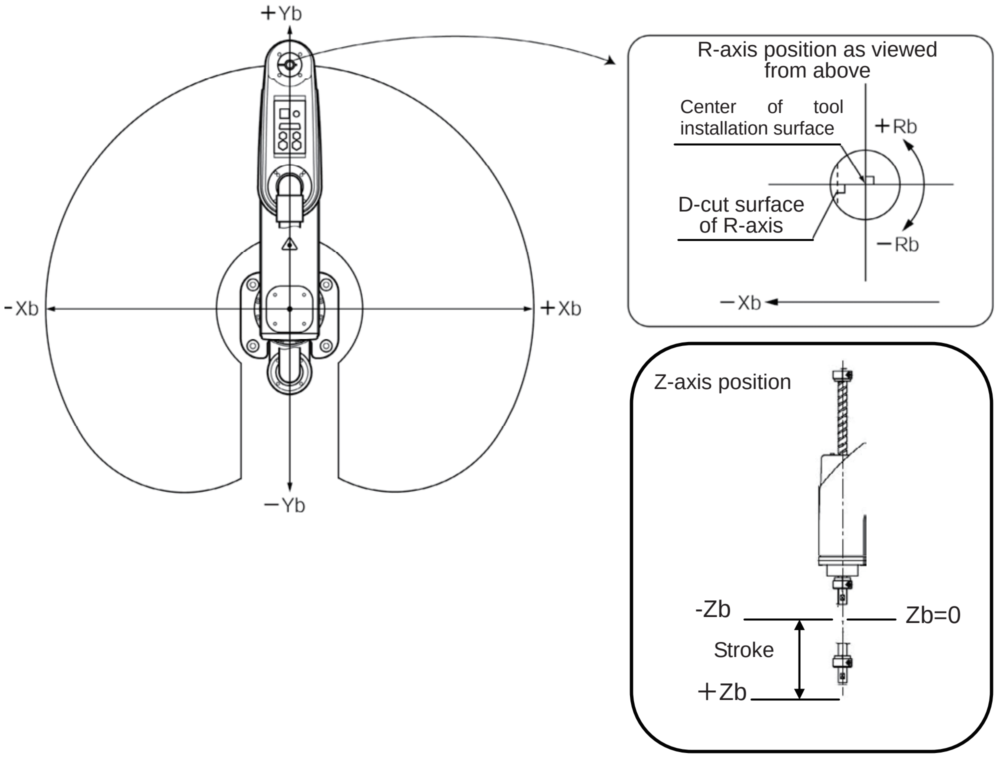


(1) Base coordinate system (= Work Coordinate System No. 0)
This is a combination of three-dimensional rectangular coordinates and rotational axis coordinates defined in the robot prior to shipment.
Work Coordinate System No. 0 (= 0 work coordinate system offsets) = Base coordinate system.

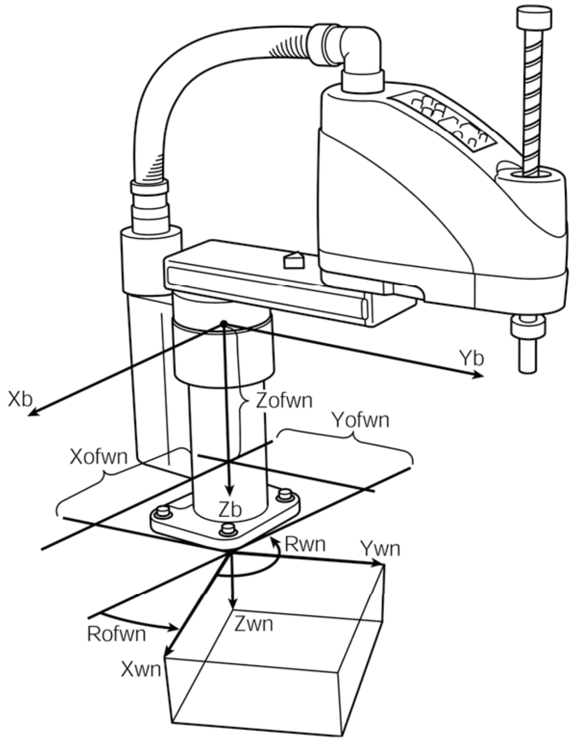


* There is no rotary axis on Three-Axis Type SCARA ROBOT (IXP-3N****). (Xb, Yb and Zb) are available to indicate as the target position.

The XY-axis home is the center of the base (center of rotation of arm 1).
The Z-axis home is the top edge of the effective Z-axis stroke.
The R-axis home is where the D-cut surface faces the -Xb direction.
The X-axis, Y-axis, Z-axis and R-axis on the base coordinate system are indicated as Xb, Yb, Zb and Rb, respectively.



(2) Work coordinate system
This is a combination of 32 types of three-dimensional rectangular coordinates and rotational axis coordinates defined by the offset of each axis relative to the base coordinate system. Note that Work Coordinate System No. 0 is reserved as the base coordinate (= 0 work coordinate system offset) by the system.



Xofwn: X work coordinate offset
Yofwn: Y work coordinate offset
Zofwn: Z work coordinate offset
Rofwn: R work coordinate offset

Xwn: Work coordinate system, X-axis
Ywn: Work coordinate system, Y-axis
Zwn: Work coordinate system, Z-axis
Rwn: Work coordinate system, R-axis

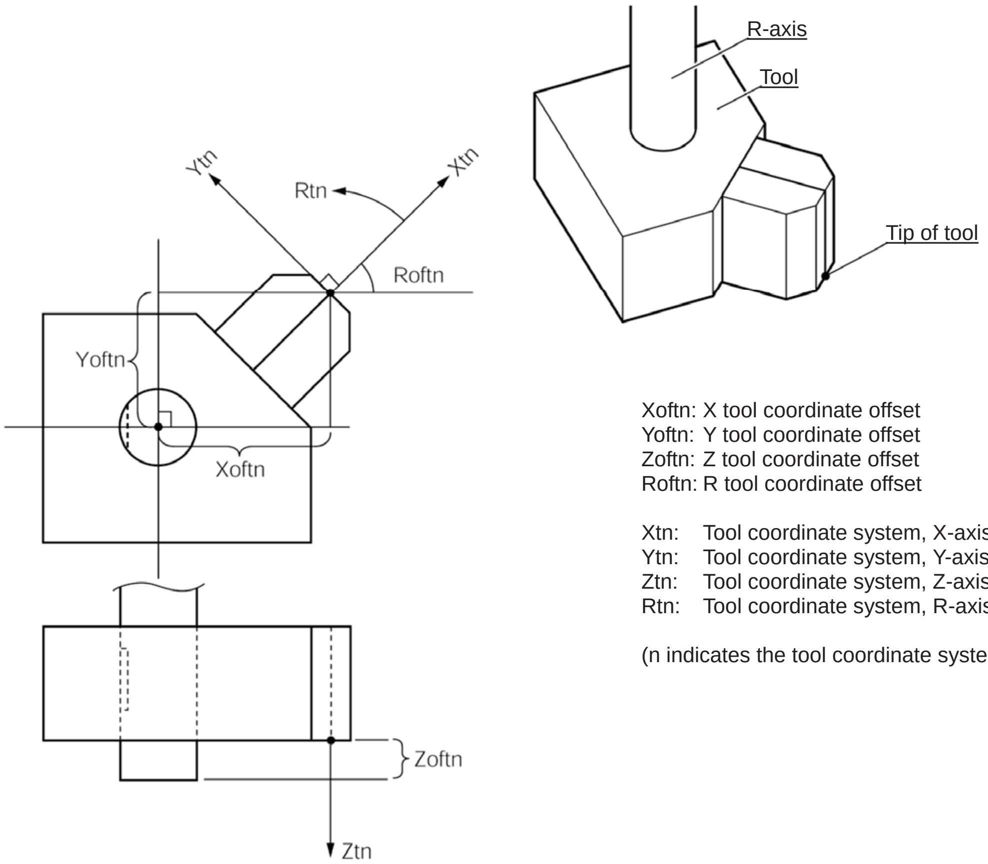
(n indicates the work coordinate system number.)

* R work coordinate offset is valid also on Three-Axis Type SCARA ROBOT (IXP-3N****).

(3) Tool coordinate system

This is a combination of 128 types of three-dimensional rectangular coordinates and rotational axis coordinates defined by the dimension (offset) of the tool (hand, etc.) installed on the tool installation surface. Note that Tool Coordinate System No. 0 is reserved as one with 0 tool coordinate system offset by the system.

When a defined tool coordinate system number is selected, the robot uses the tip of the tool, not the center of the tool installation surface, as the point to reach by positioning.

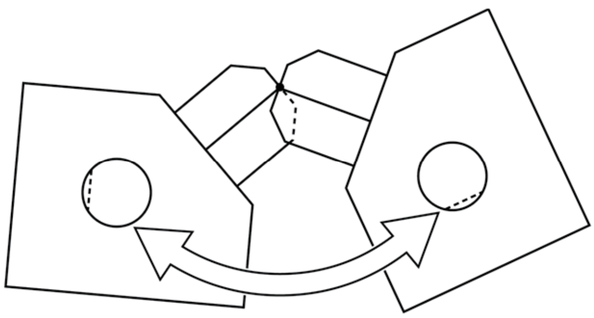


Xoftn: X tool coordinate offset
Yoftn: Y tool coordinate offset
Zoftn: Z tool coordinate offset
Roftn: R tool coordinate offset

Xtn: Tool coordinate system, X-axis
Ytn: Tool coordinate system, Y-axis
Ztn: Tool coordinate system, Z-axis
Rtn: Tool coordinate system, R-axis

(n indicates the tool coordinate system number.)

When a defined tool coordinate system is elected and the R-axis is jogged, the axis operates as shown below.



The orientation of the tool coordinate system axis is always the same as the orientation of the base coordinate system axis on Three-Axis Type SCARA ROBOT (IXP-3N****). As there is no R axis, the control of the orientation (posture) of the tool cannot be conducted. Therefore, there may be a case the tool end may not be the reachable point at positioning. Also, the setting of the tool coordinate system offset on the R axis will be ignored.

[2] CP Operation and PTP Operation

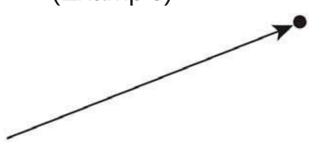
How CP operation and PTP operation differ as they pertain to SCARA robots is explained.

(1) CP operation

1) Path

The axes move to the target position while interpolating with one another. The path of the tip of movement can be specified by a command (linear, circle, arc, path movement, etc.).

(Example)



Position No. 1

MOVL 1

Move from the current position to position No. 1 along a straight line.

The arm system does not change during CP operation.

CP operation commands: MOVL MVLI TMLI PATH PSPL PUSH CIR2 ARC2 ARCD ARCC CIRS ARCS CIR ARC

For details on these commands, refer to “Explanation of Each Command”

2) Setting of speed and acceleration/deceleration for CP operation

In CP operation, the speed and acceleration/deceleration are set beforehand in the program using a control declaration command.

Speed setting command “VEL” unit [mm/sec]

Acceleration setting command “ACC” unit [G]

Deceleration setting command “DCL” unit [G]

(Example)

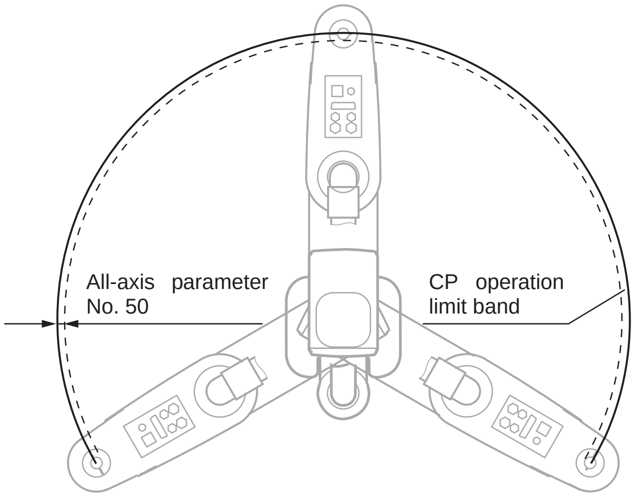
ACC	0.5	Set the acceleration for CP operation to 0.5G.
DCL	0.5	Set the deceleration for CP operation to 0.5G.
VEL	500	Set the speed for CP operation to 500mm/sec.
MOVL	2	Move to position No. 2 along a straight line.

The speed and acceleration/deceleration for CP operation can also be set in the VEL, ACC and DCL fields of the position data table.

To set these items as part of position data, do so for each position number. If the VEL, ACC and DCL fields of the position data table contain settings for a given position number, they are given priority over the “VEL”, “ACC” and “DCL” commands in the program when moving to the applicable position number.

3) Notes on CP operation

The singular point is where both arms 1 and 2 extend straight.
If the actuator moves near the singular point via CP operation, poor path precision, vibration (abnormal noise) or error may occur. The following errors may generate: "D09: Driver overspeed error", "B91: Main overspeed error", "C64: Abnormal servo acceleration/deceleration error", "B74: CP operation limit band entry error", "CB6: Deviation overflow error", etc.
These errors may be avoided by lowering the speed and/or acceleration/deceleration.



With the area inside for the amount of either All Axes Parameter No. 50 or No. 227 from the singularity defined as the CP operation limit band, the CP operation is limited within this area. (In the figure on the left, the area between the solid line and dotted line is the CP operation limit band.)

The controller generates an error upon detecting an entry of the target path or actual movement path into the CP operation limit band as a result of path calculation. If the target movement path enters the CP operation band as a result of path calculation, "B7C: Target path in CP operation limit band error (PTP/jotting of axis permitted)" occurs.

If the actual movement path enters the CP operation limit band, on the other hand, "B74: CP operation limit band entry error (PTP/jogging of axis permitted)" or "C74: Actual position soft limit over error" occurs.
The width of the CP operation limit band (distance between the solid line and dotted line) varies depending on the arm length of the robot.
(If the arm length is 500 or 600, this width becomes approx. 0.5mm (All Axes Parameter No. 50 or No. 227, "Width of CP operation limit band around point directly above Arm 1/2").)

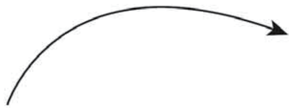
Avoid writing programs that cause the actuator to pass the CP operation limit band via CP operation.
The actuator cannot pull out from the CP operation limit band by means of CP operation. In this case, move the actuator in PTP operation. Exercise caution in situations where the condition of each arm is not recognized, such as when the program is started, etc.
With CP operation, conduct test operation at low speed at first and confirm absence of problems, and then gradually raise the speed to an appropriate level.

(2) PTP operation

1) Movement path

Each axis moves to the target position at the specified speed. The path of the tip of movement cannot be specified by a command.

(Example)



Position No. 1

MOVP 1

Move from the current position to position No. 1 via PTP operation.

The arm system may change during movement depending on the operation area and arm system control command.
PTP operation commands: MOVP MVPI TMPI PACH PMVP ARCH
For details on these commands, refer to “Explanation of Each Command”

2) Setting of speed and acceleration/deceleration for PTP operation

In PTP operation, the speed and acceleration/deceleration are set beforehand in the program using a control declaration command.
Speed setting command “VELS”, unit [% (percentage relative to the maximum PTP speed (SCARA axis) set in axis-parameter No. 28)]
Acceleration setting command “ACCS”, unit [% (percentage relative to the maximum PTP acceleration for SCARA axis set in axis-parameter No. 134)]
Deceleration setting command “DCLS”, unit [% (percentage relative to the maximum PTP deceleration for SCARA axis set in axis-parameter No. 135)]

(Example)

ACCS	50	Set the acceleration for PTP operation to 50% of the maximum PTP acceleration.
DCLS	50	Set the deceleration for PTP operation to 50% of the maximum PTP deceleration.
VELS	50	Set the speed for PTP operation to 50% of the maximum PTP speed.
MOVP	2	Move to position 2 via PTP operation.

3) Note on PTP operation

The arm system may change during an operation depending on the operation area, arm system control command or position data arm system.
Refer to “[4] Arm System”.

[3] Settings of Each Axis

(1) Base coordinate system

1) Positioning on Base Coordinate System

To select a work coordinate system number in the SEL program, use a SLWK command. The work coordinate system selection number that has been set will remain effective even after the program ends or after the system-memory backup battery has been set and power has been reconnected. (For XSEL-RX/SX/RXD/SXD, battery is not necessary.)

The figure below shows a part of the position edit screen in the PC software for horizontal articulated robot.

In this example, the following teaching settings are assumed:

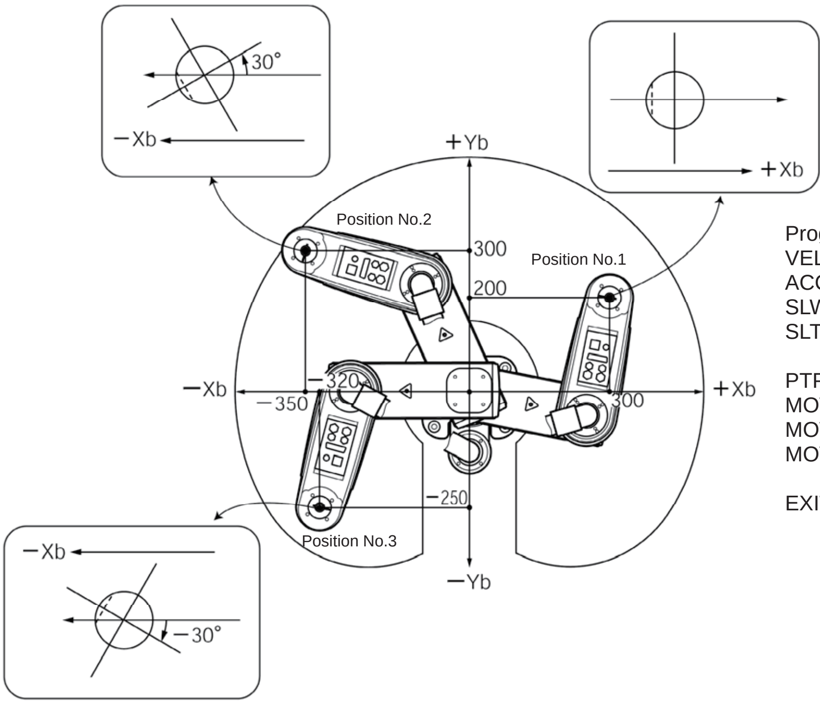
Position data for Position No. 1: X = 300, Y = 200, Z = 0, R = 0
Position data for Position No. 2: X = -350, Y = 300, Z = 50, R = 30
Position data for Position No. 3: X = -320, Y = -250, Z = 100, R = -30

The selected work coordinate system number is displayed.
Work Coordinate System No. 0 = Base coordinate system

No.(Name)	Axis1	Axis2	Axis3	Axis4	Vel	Acc	Dcl
1( )	300.000	200.000	0.000	0.000			
2( )	-350.000	300.000	50.000	30.000			
3( )	-320.000	-250.000	100.000	-30.000			
4( )							
5( )							

The selected tool coordinate system number is displayed. In the case of Tool Coordinate System No. 0, the center of the tool installation surface is positioned.

2) Position to the position data shown above via PTP operation.



Program example

```
VELS   50
ACCS   50
SLWK   0     Select Work Coordinate System No. 0
SLTL   0     Select Tool Coordinate System No. 0

PTPR         Specify right arm of PTP target arm system
MOVP   1
MOVP   2
MOVP   3

EXIT
```

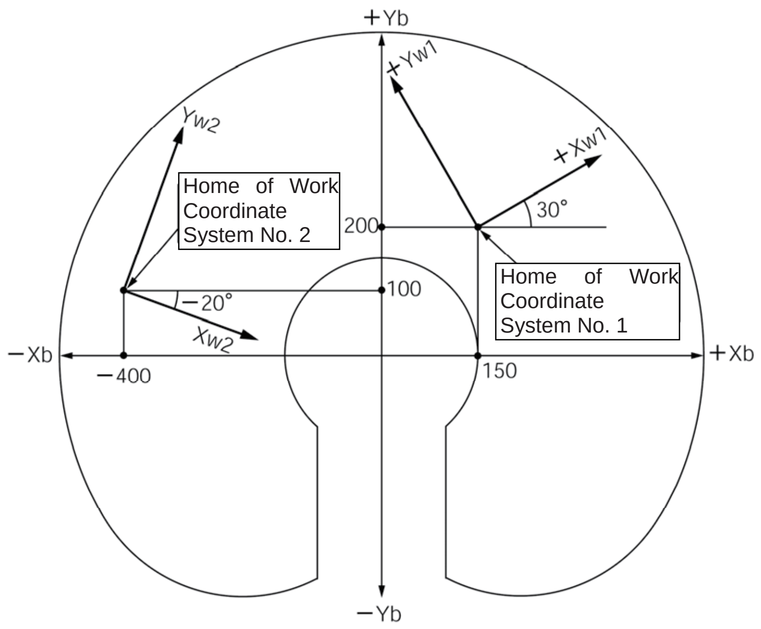
(2) Work coordinate system

1) Setting of Work Coordinate System

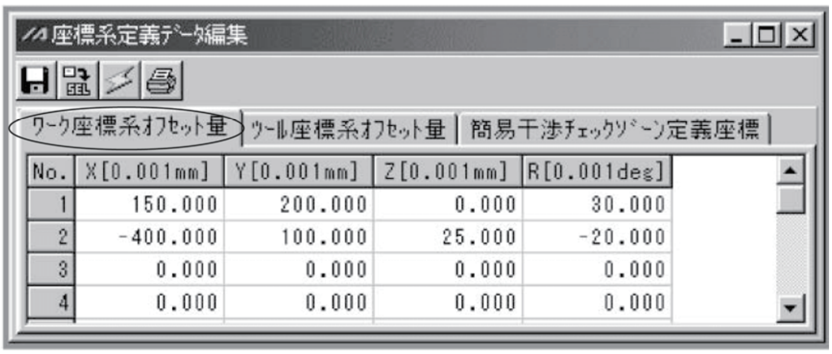
Set the offset relative to the base coordinate system.

(Example) Setting example of work coordinate system

Define Work Coordinate System No. 1 and No. 2 as shown below.



For the offset of Work Coordinate System No. 1, set Xofw1 = 150, Yofw1 = 200, Zofw1 = 0 and Rofw1 = 30.
For the offset of Work Coordinate System No. 2, set Xofw2 = -400, Yofw2 = 100, Zofw2 = 25 and Rofw2 = -20.
Shown below is the edit screen for work coordinate system definition data in the PC software for horizontal articulated robot, where Work Coordinate System No. 1 and No. 2 have been set.

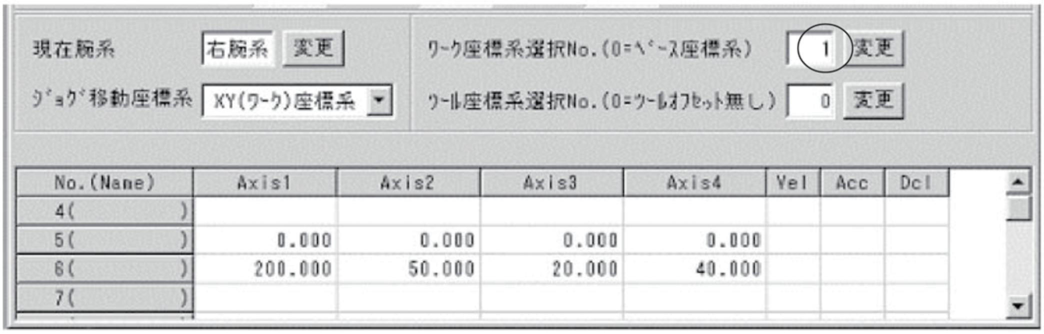


No.	X[0.001mm]	Y[0.001mm]	Z[0.001mm]	R[0.001deg]
1	150.000	200.000	0.000	30.000
2	-400.000	100.000	25.000	-20.000
3	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000

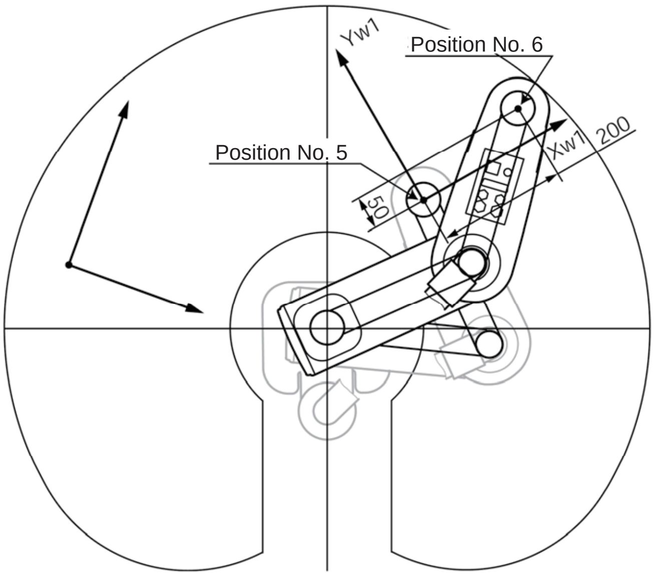
* To set a work coordinate system offset in the SEL program, use a DFWK command.

2) Positioning on Work Coordinate System
Perform positioning after selecting the work coordinate system you want to use.
To select a work coordinate system number in the SEL program, use a SLWK command.
The work coordinate system selection number that has been selected will remain effective even after the program ends or after the system-memory backup battery has been set and power has been reconnected.

(Example 1) Position to Position No. 5 and No. 6 via PTP operation on Work Coordinate System No. 1.

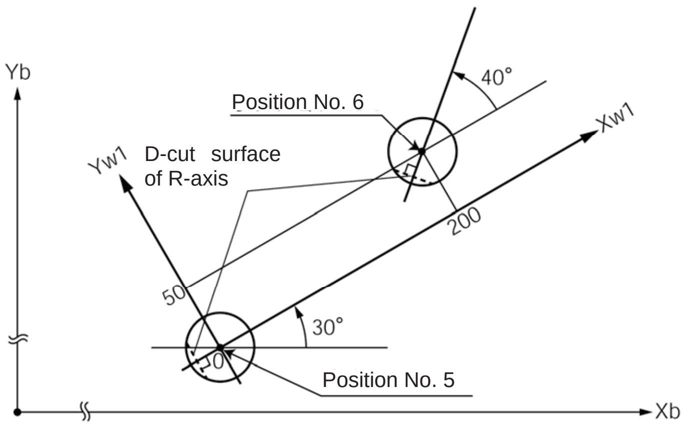


No.(Name)	Axis1	Axis2	Axis3	Axis4	Vel	Acc	Dcl
4( )							
5( )	0.000	0.000	0.000	0.000			
6( )	200.000	50.000	20.000	40.000			
7( )							



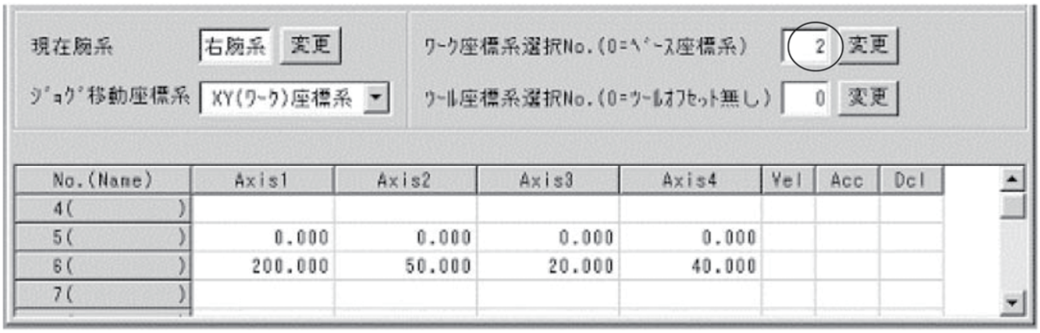
Program example

```
  :
  :
  :
SLWK   1   Select Work Coordinate System No. 1
SLTL   0   Select Tool Coordinate System No. 0
PTPR       Specify right arm of PTP target arm system
MOVP   5   Move to Position No. 5.
MOVP   6   Move to Position No. 6.
  :
  :
  :
```

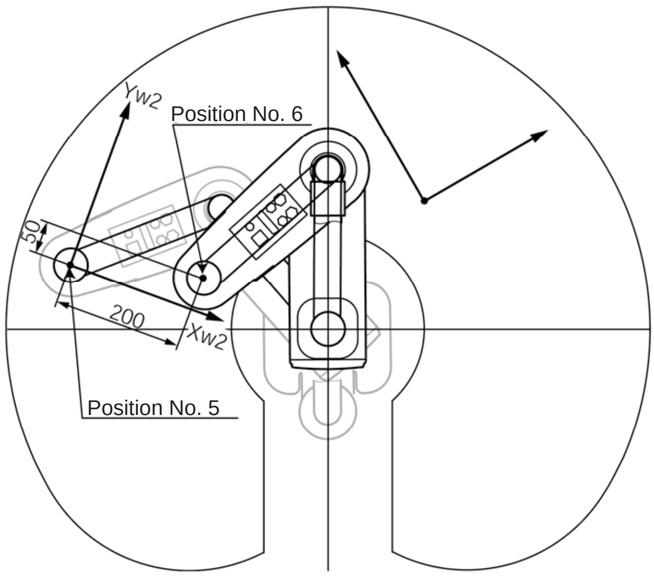


The R-axis position is shown to the left (viewed from above).
The Z-axis position is as follows:
Position No. 5 Zb = 0
Position No. 6 Zb = 20

(Example 2) Position to Position No. 5 and No. 6 via PTP operation on Work Coordinate System No. 2.

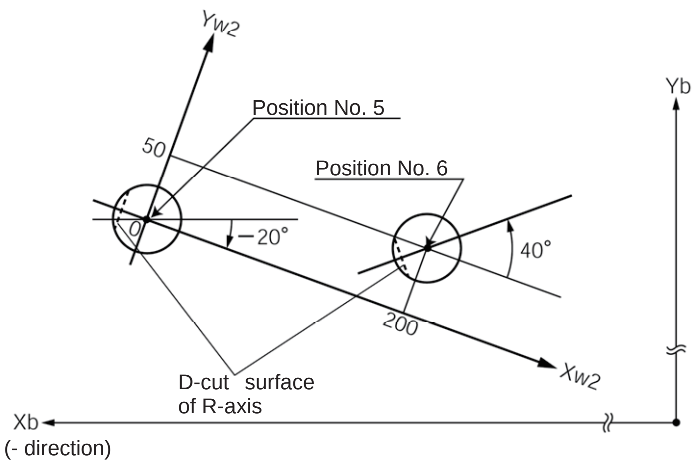


No.(Name)	Axis1	Axis2	Axis3	Axis4	Vel	Acc	Dcl
4( )							
5( )	0.000	0.000	0.000	0.000			
6( )	200.000	50.000	20.000	40.000			
7( )							



Program example

```
    :
    :
    :
SLWK    2    Select Work Coordinate System No. 2
SLTL    0    Select Tool Coordinate System No. 0
PTPR         Specify right arm of PTP target arm system
MOVP    5    Move to Position No. 5.
MOVP    6    Move to Position No. 6.
    :
    :
    :
```



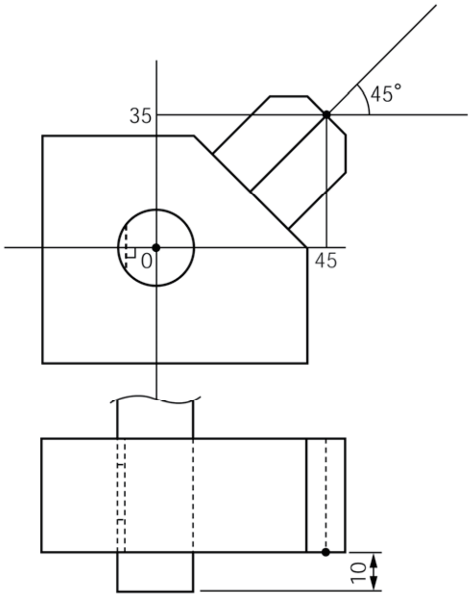
The R-axis position is shown to the left (viewed from above).
The Z-axis position is as follows:
Position No. 5 Zb = 25
Position No. 6 Zb = 45

(3) Tool coordinate system

1) Setting of Tool Coordinate System

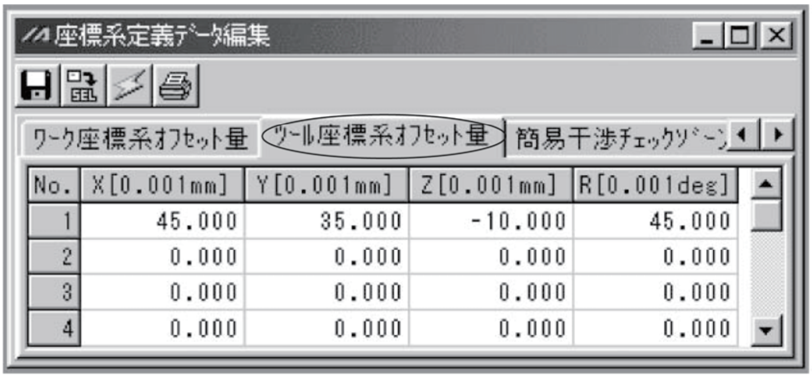
Set the offset from the center of the tool installation surface to tip of the tool.

(Example) Setting example of tool coordinate system
Define Tool Coordinate System No. 1 as shown below.



Offsets under Tool Coordinate System No. 1: Xoft1 = 45, Yoft1 = 35, Zoft1 = -10, Roft1 = 45

Shown below is the edit screen for tool coordinate system definition data in the PC software for horizontal articulated robot, where Tool Coordinate System No. 1 has been set.



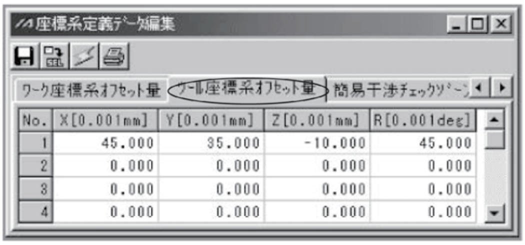
No.	X[0.001mm]	Y[0.001mm]	Z[0.001mm]	R[0.001deg]
1	45.000	35.000	-10.000	45.000
2	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000

* To set a tool coordinate system offset in the SEL program, use a DFTL command.

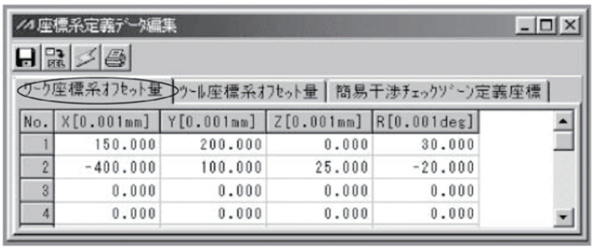
2) Positioning Using Tool Coordinate System Offset
Perform positioning after selecting the tool coordinate system you want to use.
To use a tool coordinate system number in the SEL program, use a SLTL command.
The tool coordinate system selection number that has been selected will remain effective even after the program ends or after the system-memory backup battery has been set and power has been reconnected. (For XSEL-RX/SX/RXD/SXD, battery is not necessary.)

> The orientation of the tool coordinate system axis is always the same as the orientation of the base coordinate system axis on Three-Axis Type SCARA ROBOT (IXP-3N****). As there is no R axis, the control of the orientation (posture) of the tool cannot be conducted. Therefore, there may be a case the tool end may not be the reachable point at positioning. Also, the setting of the tool coordinate system offset on the R axis will be ignored.

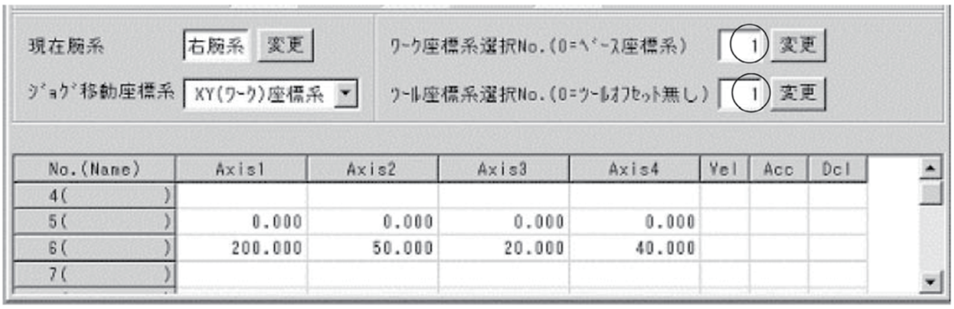
(Example 1) Position the tip of the tool on Tool Coordinate System No. 1 to Position No. 5 and No. 6 on Work Coordinate System No. 1 via PTP operation.



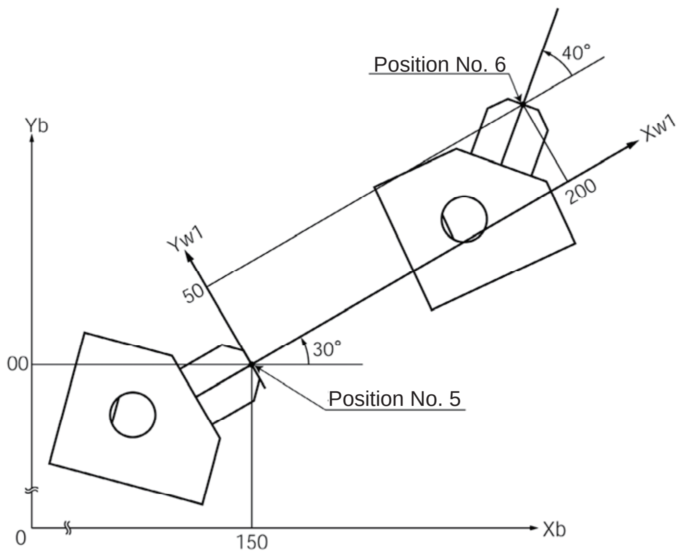
No.	X[0.001mm]	Y[0.001mm]	Z[0.001mm]	R[0.001deg]
1	45.000	35.000	-10.000	45.000
2	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000



No.	X[0.001mm]	Y[0.001mm]	Z[0.001mm]	R[0.001deg]
1	150.000	200.000	0.000	30.000
2	-400.000	100.000	25.000	-20.000
3	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000



No.(Name)	Axis1	Axis2	Axis3	Axis4	Vel	Acc	Dcl
4( )							
5( )	0.000	0.000	0.000	0.000			
6( )	200.000	50.000	20.000	40.000			
7( )							

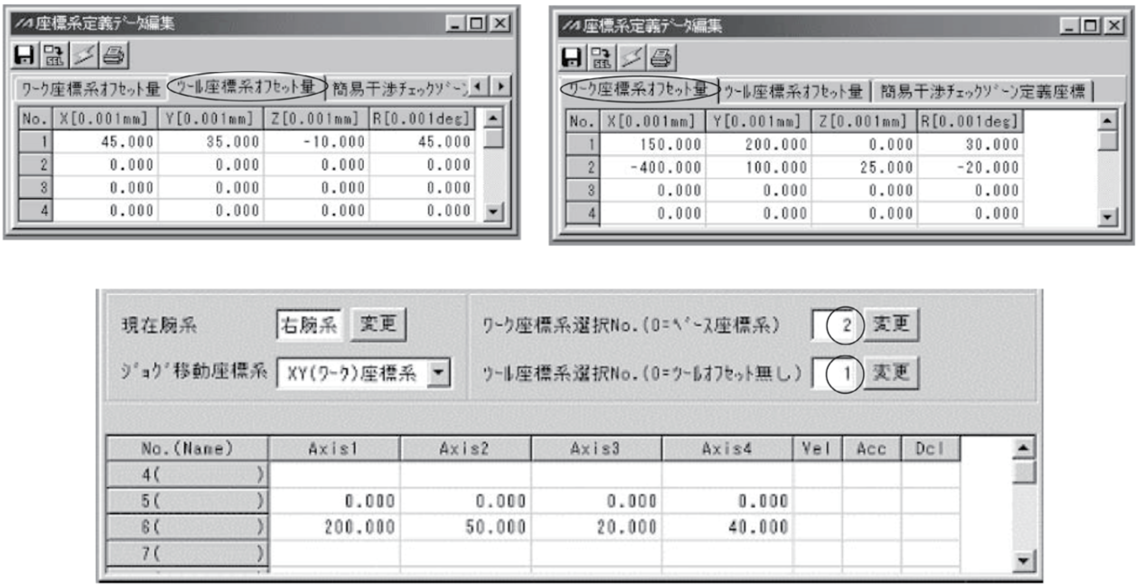


Program example

```
    :
    :
SLWK    1    Select Work Coordinate System No. 1
SLTL    1    Select Tool Coordinate System No. 1
PTPR         Specify right arm of PTP target arm system
MOVP    5    Move to Position No. 5.
MOVP    6    Move to Position No. 6.
    :
    :
```

The Z-axis position at the tip of the tool is as follows:
Position No. 5 Zb = 0
Position No. 6 Zb = 20
The figure on the left is viewed from above.

(Example 2) Position the tip of the tool on Tool Coordinate System No. 1 to Position No. 5 and No. 6 on Work Coordinate System No. 2 via PTP operation.



座標系定義データ編集 — ツール座標系オフセット量

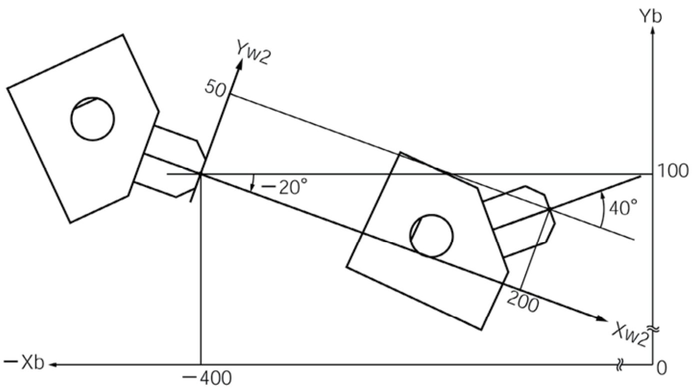
No.	X[0.001mm]	Y[0.001mm]	Z[0.001mm]	R[0.001deg]
1	45.000	35.000	-10.000	45.000
2	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000

座標系定義データ編集 — ワーク座標系オフセット量

No.	X[0.001mm]	Y[0.001mm]	Z[0.001mm]	R[0.001deg]
1	150.000	200.000	0.000	30.000
2	-400.000	100.000	25.000	-20.000
3	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000

現在腕系 右腕系 変更　ワーク座標系選択No.(0=ベース座標系) 2 変更
ジョグ移動座標系 XY(ワーク)座標系　ツール座標系選択No.(0=ツールオフセット無し) 1 変更

No.(Name)	Axis1	Axis2	Axis3	Axis4	Vel	Acc	Dcl
4( )							
5( )	0.000	0.000	0.000	0.000			
6( )	200.000	50.000	20.000	40.000			
7( )							



Program example

⋮

SLWK	2	Select Work Coordinate System No. 2
SLTL	1	Select Tool Coordinate System No. 1
PTPR		Specify right arm of PTP target arm system
MOVP	5	Move to Position No. 5.
MOVP	6	Move to Position No. 6.

⋮

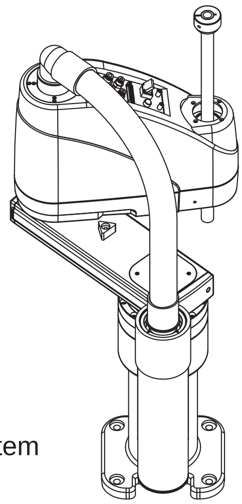
The Z-axis position at the tip of the tool is as follows:
Position No. 5 Zb = 25
Position No. 6 Zb = 45

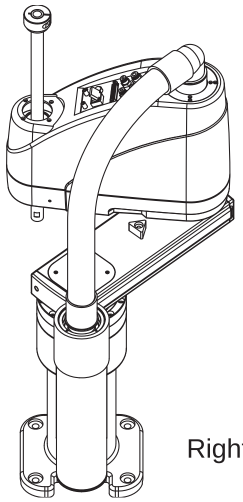
[4] Arm System

(1) Right arm system/left arm system

Robot postures are classified into two types: right arm system and left arm system.

Left arm system

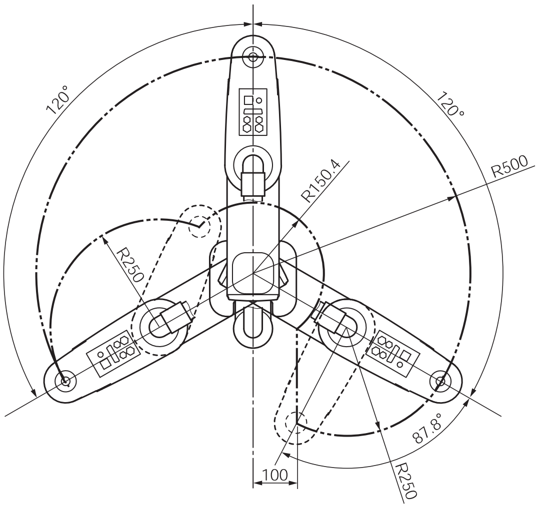




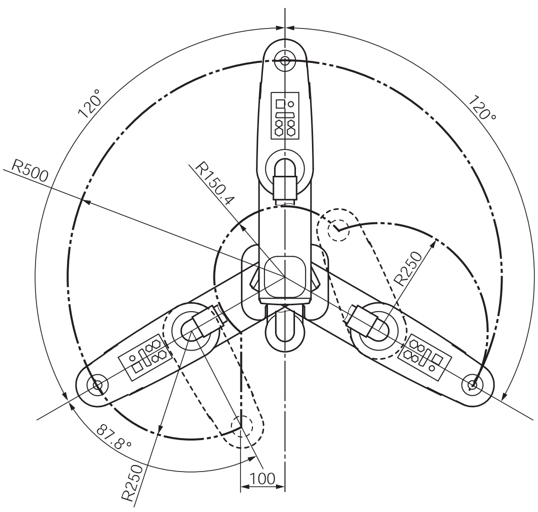
Right arm system

Right arm system : Condition where arms 1 and 2 extend straight and arm 2 is positioned in the CCW direction.
Left arm system : Condition where arms 1 and 2 extend straight and arm 2 is positioned in the CW direction.
The conditions of robot arms are expressed by assuming them as human arms.

The operation area is different between the right arm system and left arm system.
The figure below shows the operation area of each arm system of a robot whose arm length is 500mm.



Operation area of left arm system



Operation area of right arm system

(2) Arm control commands (dedicated SCARA commands)

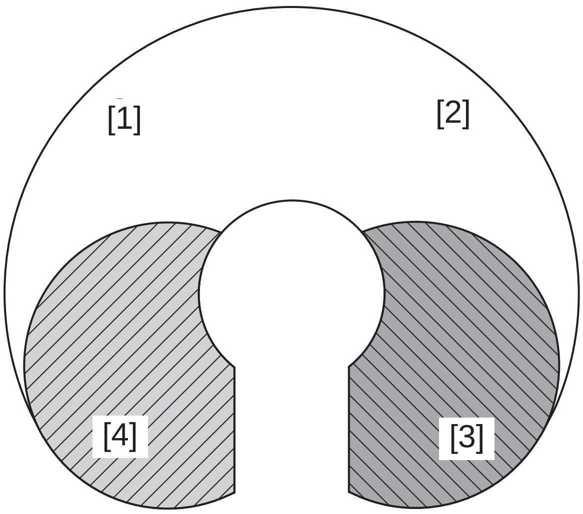
The left arm system is defined as “opposite arm system” of the right arm system, and vice versa.
The actual arm system currently used is defined as “current arm system”.
The arm system scheduled to be used for positioning to the target under a movement command is defined as “target arm system”.

Commands that are used to control the robot arm system include PTPD, PTPE, PTPR, PTPL, RIGH and LEFT.
PTPD, PTPE, PTPR and PTPL are control declarations for the target arm system of PTP operation, so they remain valid throughout the program once declared. In the case of CP operation where the arm system does not change, operation is performed based on the current arm system without being affected by the above commands.
Only one of PTPD, PTPE, PTPR and PTPL, whichever is executed last, remains valid.
RIGH and LEFT are control commands for the current arm system.

(3) Arm system control commands and arm system changes

Arm system commands and how the arm system changes during PTP operation as a result of their declaration are explained.

Set position No. 1 to 4 as shown below ([1] to [4]).
Try moving the actuator using a MOVP command (PTP operation) in the order of 1 → 2 → 3 → 2 → 1 → 4.
Move the robot while it is positioned at position No. 1.
Position No. 3 is inside the limited area for left arm system (positioning to this position is not possible if the right arm system is used).
Position No. 4 is inside the limited area for right arm system (positioning to this position is not possible if the left arm system is used).




```
:
:
:
Arm system control command
MOVP    2
MOVP    3
MOVP    2
MOVP    1
MOVP    4
EXIT
```

: Limited area for right arm system

: Limited area for left arm system

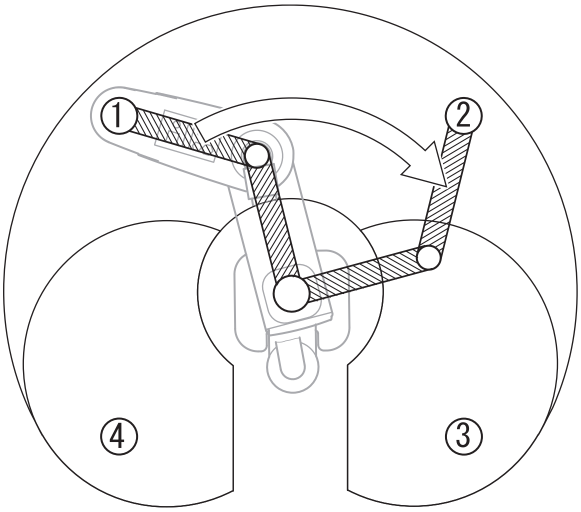
How the arm system changes with an arm system control command is explained for each command.

In the figure, the black arrows indicate movements where the arm system changes.
White arrows indicate movements where the arm system does not change.
The shaded arm represents the right arm system. The unshaded arm represents the left arm system.

[PTPD]

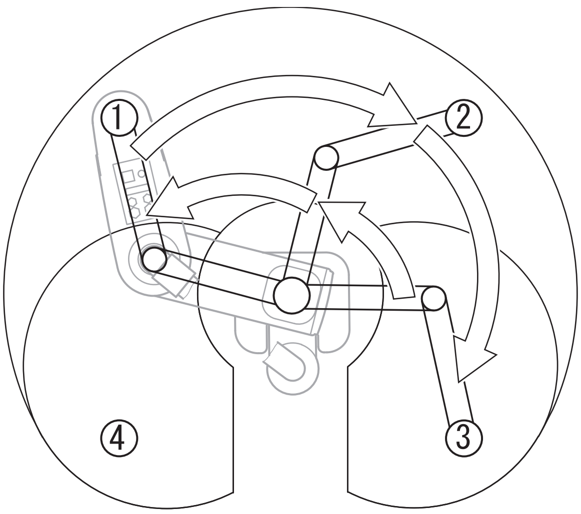
Following the execution of a PTPD command, the robot performs positioning by moving according to the current arm system. The PTPD command prohibits situations where the current arm system is opposite the target arm system. An attempt to move to an area to which positioning is impossible without changing to the opposite arm system generates an error "C73: Target path soft limit over error". Even when a PTPD command is not executed, this command is already effective on the robot when the program is started.

1) Starting from right arm system




```
   :
   :
   :
PTPD
MOVP    2
MOVP    3 ⇒ C73 error occurs.
```

2) Starting from left arm system

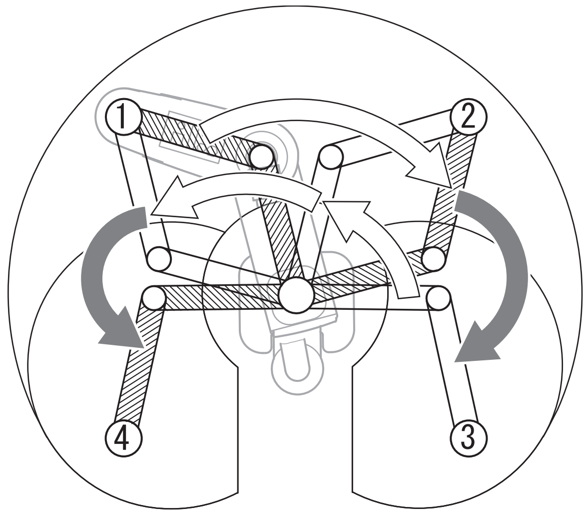



```
   :
   :
   :
PTPD
MOVP    2
MOVP    3
MOVP    2
MOVP    1
MOVP    4 ⇒ C73 error occurs.
```

[PTPE]

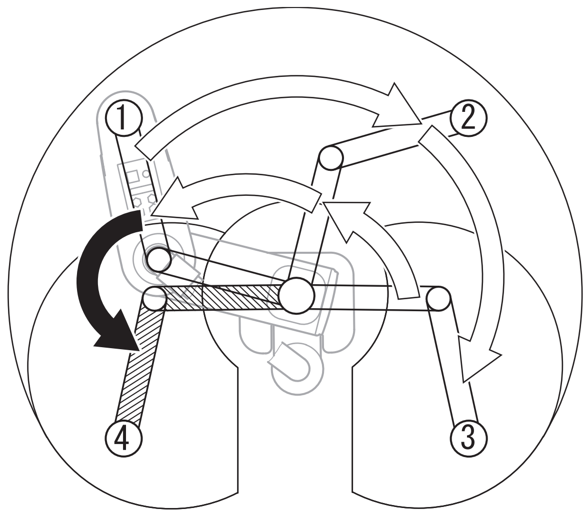
Following the execution of a PTPE command, the robot gives priority to the current arm system for movement and positioning. The PTPE command permits situations where the current arm system is opposite the target arm system. Therefore, it is permitted to move to an area to which positioning is impossible without changing to the opposite arm system.
To prohibit moving to the area for opposite arm system after permitting such movement, execute a PTPD command.

1) Starting from right arm system




```
  :
  :
  :
PTPE
MOVP   2
MOVP   3
MOVP   2
MOVP   1
MOVP   4
EXIT
```

2) Starting from left arm system

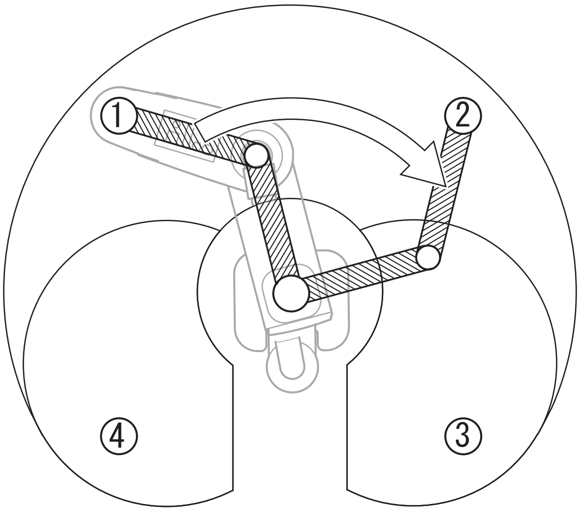



```
  :
  :
  :
PTPE
MOVP   2
MOVP   3
MOVP   2
MOVP   1
MOVP   4
EXIT
```

[PTPR]

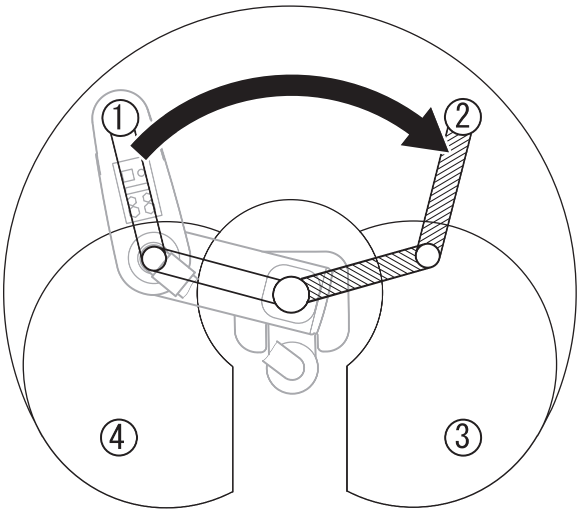
Following the execution of a PTPR command, the robot performs positioning according to the right arm system. The PTPR command limits the target arm system to the right arm system. Therefore, an attempt to move to an area to which positioning is impossible without changing to the left arm system generates a “C73: Target path soft limit over error”.
Executing a PTPR command alone does not initiate any arm movement.
When a PTP movement command is executed following the execution of a PTPR command and while the current arm system is the left arm system, the robot moves as it changes from the left arm system to right arm system and performs positioning according to the right arm system.

1) Starting from right arm system




```
:
:
:
PTPR
MOVP    2
MOVP    3 ⇒ C73 error occurs.
```

2) Starting from left arm system

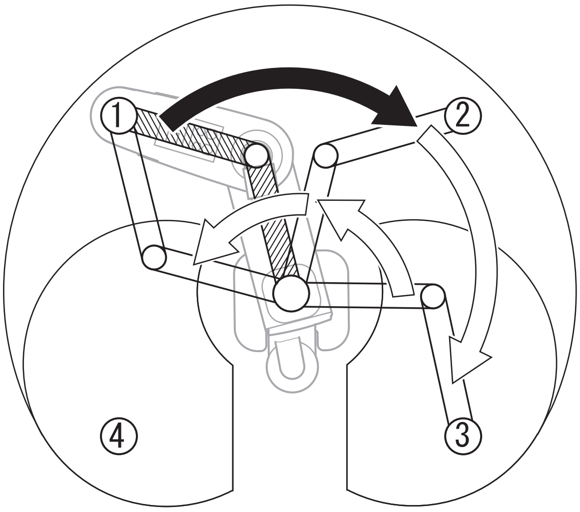



```
:
:
:
PTPR
MOVP    2
MOVP    3 ⇒ C73 error occurs.
```

[PTPL]

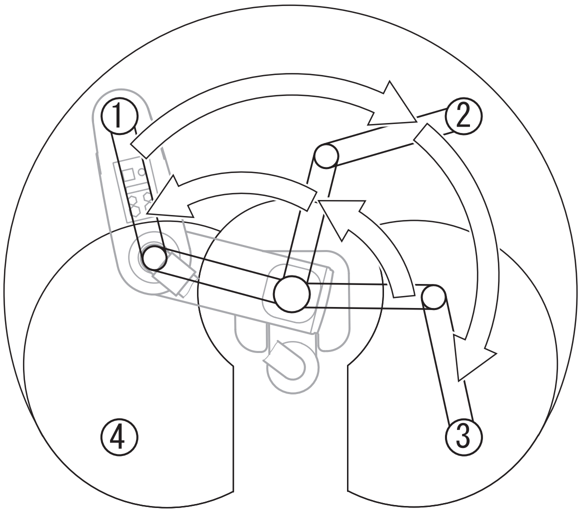
Following the execution of a PTPL command, the robot performs positioning according to the left arm system. The PTPL command limits the target arm system to the left arm system. Therefore, an attempt to move to an area to which positioning is impossible without changing to the right arm system generates a “C73: Target path soft limit over error”.
Executing a PTPL command alone does not initiate any arm movement.
When a PTP movement command is executed following the execution of a PTPL command and while the current arm system is the right arm system, the robot moves as it changes from the right arm system to left arm system and performs positioning according to the left arm system.

1) Starting from right arm system




```
:
:
:
PTPL
MOVP    2
MOVP    3
MOVP    2
MOVP    1
MOVP    4 ⇒ C73 error occurs.
```

2) Starting from left arm system

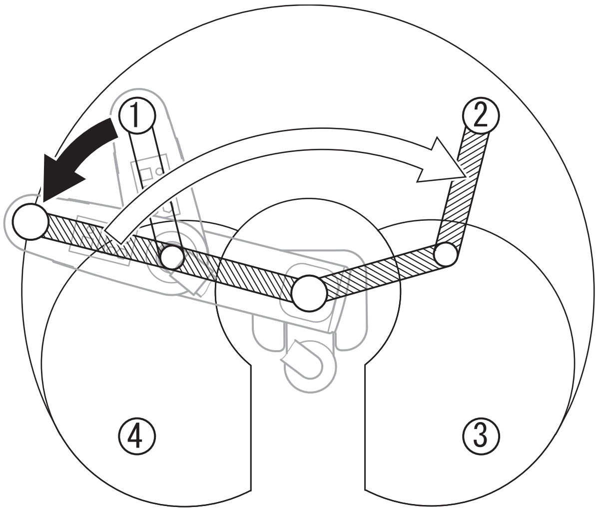



```
:
:
:
PTPL
MOVP    2
MOVP    3
MOVP    2
MOVP    1
MOVP    4 ⇒ C73 error occurs.
```

[RIGH]

The RIGH command changes the current arm system to the right arm system.
When a RIGH command is executed while the current arm system is the left arm system, arm 2 operates in such a way that both arms 1 and 2 form a straight line.
Executing a RIGH command while the current arm system is the right arm system does not initiate any arm movement.

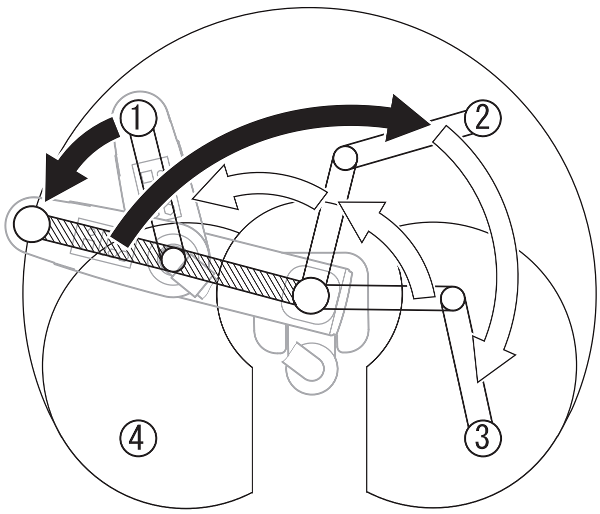
1) Starting from left arm system




```
:
:
:
RIGH
MOVP    2
MOVP    3 ⇒ C73 error occurs.
```

In the above example, the PTPD command is effective because no arm system control command other than RIGH is set.
The RIGH command only controls the current arm system. It does not limit positioning via PTP operation to the right arm system. The arm system used for positioning varies depending on the control declaration of target arm system (PTPD, PTPE, PTPR, PTPL).
Accordingly, the specific operation that takes place after the execution of a RIGH command varies depending on the control declaration of target arm system which is currently effective.

2) RIGH command at PTPL command execution

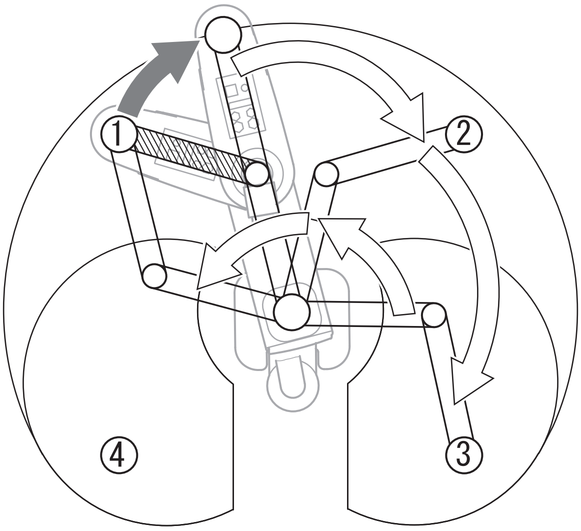



```
:
:
:
PTPL
:
:
:
RIGH
MOVP    2
MOVP    3
MOVP    2
MOVP    1
MOVP    4 ⇒ C73 error occurs.
```

[LEFT]

The LEFT command changes the current arm system to the left arm system.
When a LEFT command is executed while the current arm system is the right arm system, arm 2 operates in such a way that both arms 1 and 2 form a straight line.
Executing a LEFT command while the current arm system is the left arm system does not initiate any arm movement.

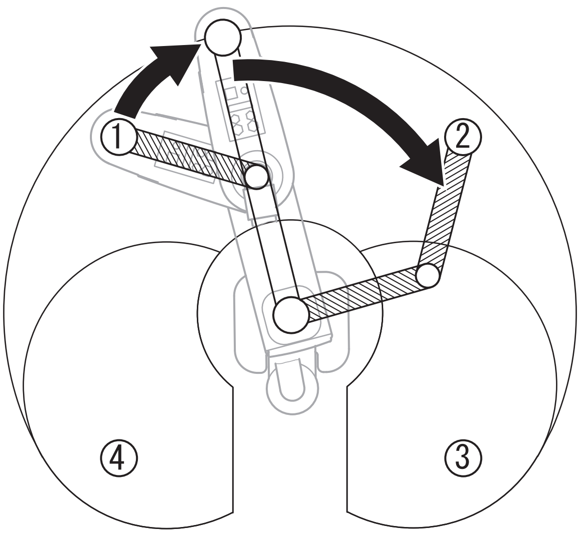
1) Starting from right arm system



:
:
:
LEFT
MOVP 2
MOVP 3
MOVP 2
MOVP 1
MOVP 4 ⇒ C73 error occurs.

In the above example, the PTPD command is effective because no arm system control command other than LEFT is set.
The LEFT command only controls the current arm system. It does not limit positioning via PTP operation to the left arm system. The arm system used for positioning varies depending on the control declaration of target arm system (PTPD, PTPE, PTPR, PTPL).
Accordingly, the specific operation that takes place after the execution of a LEFT command varies depending on the control declaration of target arm system which is currently effective.

2) LEFT command at PTPR command execution



:
:
:
PTPR
:
:
:
LEFT
MOVP 2
MOVP 3 ⇒ C73 error occurs.

[4] PTP Acceleration/Deceleration Optimization Function

IX-***H Type and IXP Type operates in the optimum acceleration / deceleration speed during the PTP operation.

(Note) Those such as IX-NNN5020 do not operate in the optimum acceleration/deceleration speed during the PTP operation. For those models, the maximum acceleration/deceleration speed during the PTP operation relies on the values set in Axis Parameters No. 134 “Maximum PTP acceleration for SCARA axis” and No. 135 “Maximum PTP deceleration for SCARA axis”.
The acceleration for PTP operation corresponds to the ratio (%) set according to the ACCS command and DCLS command.

(1) Function overview
PTP optimum acceleration/deceleration is the automatic adjustment function to obtain the optimized acceleration and deceleration responding to the conditions of such facts as the tip load. In PTP optimum acceleration/deceleration, it is necessary to set the tip load mass with the WGHT Command as well as the acceleration and deceleration ratios with ACCS and DCLS Commands set for the existing models. Set an appropriate load mass according to the load to be transported, etc.
The calculation formats of PTP acceleration and deceleration in PTP optimum acceleration/deceleration are as shown below:

- PTP acceleration = Maximum acceleration determined by the load mass, etc. × ACCS command [%]
- PTP deceleration = Maximum deceleration determined by the load mass, etc. × DCLS command [%]

* The WGHT command is supported by controllers of main application Ver.0.45 or later. This command can be input in PC software of Ver.7.5.0.0 or later or on teaching pendants of Ver.1.11 or later.

⚠ Caution

- PTP optimum acceleration/deceleration would not work with the ideal acceleration or deceleration unless the setting of the WGHT Command according the actual robot tip load is conducted. Make sure to setup the tip load mass setting in the WGHT Command.
- PTP optimum acceleration/deceleration function is effective only for the PTP operation. It cannot be operated with the optimized acceleration or deceleration for CP operation or direct-movement axis.
- If an overload error occurs, lower the acceleration setting and/or deceleration setting as deemed appropriate or make other adjustment such as providing a stopping time after acceleration/deceleration to prevent an overload error from occurring.

[5] Horizontal Movement Optimizing Function responding to Z-axis position

SCARA Robot (IX-***H) can utilize the horizontal movement optimizing function.

(Note) Note that the horizontal movement Z-position optimization function is not available for those such as IX-NNN5020. (Using this function would generate a "D8A: Internal parameter error for acceleration/deceleration optimization or horizontal movement Z-position optimization function".)

(1) Function overview

Horizontal movement optimizing function by Z-axis is the function to optimize the horizontal movement condition based on Z-axis position and the tip load mass.
This function can be set effective/ineffective in the all axes parameter No. 51. When a parameter setting change is made, make sure to reset the software or reboot the system after the flash ROM writing is complete.
The tip load mass setting by the WGHT Command is required while the SCARA Z-axis position and horizontal movement optimizing function are effective. Set the load mass setting accordingly following the transporting work figure.

● All-axis common parameters

No.	Parameter name	Default value (reference)	Input range	Unit	Access privilege	Remarks
51	SCARA-axis control 1	0H	0H to FFFFFFFFH		F	Bits 8 to 11: Z-axis Position -> horizontal movement optimized (PTP) (0: Disable, 1: Enable) (Available only on high-speed SCARA robots with main application Ver.0.45 or later) Bits 12 to 15: Z-axis Position -> horizontal movement optimized (CP) (0: Disable, 1: Enable) * Disabling this function is recommended if the CP operation requires constant speed, path precision and attainment of specified speed. (Available only on high-speed SCARA robots with main application Ver.0.45 or later)

* The WGHT command is supported by controllers of main application Ver.0.45 or later. This command can be input in PC software of Ver.7.5.0.0 or later or on teaching pendants of Ver.1.11 or later.

Caution

- It is necessary to set the tip load mass with the WGHT Command while the horizontal movement optimizing function by Z position is activated. An appropriate result could not be gained unless the mass setting according the actual robot tip load is conducted.

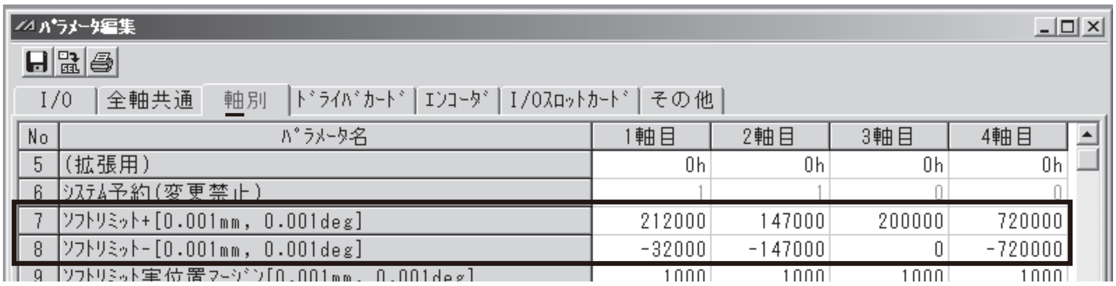
- When the horizontal movement optimizing function by Z position is activated, the speed may not reach the set speed due to the robot load mass or movement position. Make the horizontal movement optimization function invalid if it is required to reach the set speed.
  * When also it is indicated the Operation 1 = 0 (prioritized to reach set speed automatic division) for DIS (divide distance setting for spline movement) and DIG (arc angle setting), the horizontal movement optimization function should be prioritized and may not reach the set speed.

- When operating individually with the PATH, CIR, ARC, CIRS, ARCS or PSPL Command while the horizontal movement optimization (CP) by Z position is activated, the movement speed during the command may vary due to the robot load mass or the movement position. In a continuous operation with the continuous operation related commands (PATH, PSPL, CIR2, ARC2, CIRS, ARCS, CIRS, ARCD, ARCC, CIR, ARC Commands, etc.), the movement speed between the commands may vary due to the operational condition. Make the horizontal movement optimization (CP) invalid if an evenly paced speed is required.

- When the horizontal movement optimization (CP) by Z axis is activated, the track of CP operation may slightly vary due to the robot load mass and movement position.
  If accuracy in the track is required, make the horizontal movement optimization (CP) invalid.

[6] Soft Limit

The soft limit is set in axis-specific parameter No. 7 and 8. Below is an example of a screen showing the soft limits for IX5020 (arm length 500mm, Z-axis 200mm).


ﾊﾟﾗﾒｰﾀ編集

I/O | 全軸共通 | 軸別 | ﾄﾞﾗｲﾊﾞｶｰﾄﾞ | ｴﾝｺｰﾀﾞ | I/Oｽﾛｯﾄｶｰﾄﾞ | その他

No	ﾊﾟﾗﾒｰﾀ名	1軸目	2軸目	3軸目	4軸目
5	(拡張用)	0h	0h	0h	0h
6	ｼｽﾃﾑ予約(変更禁止)	1	1	0	0
7	ｿﾌﾄﾘﾐｯﾄ+[0.001mm, 0.001deg]	212000	147000	200000	720000
8	ｿﾌﾄﾘﾐｯﾄ-[0.001mm, 0.001deg]	-32000	-147000	0	-720000
9	ｿﾌﾄﾘﾐｯﾄ実位置ﾏｰｼﾞﾝ[0.001mm, 0.001deg]	1000	1000	1000	1000

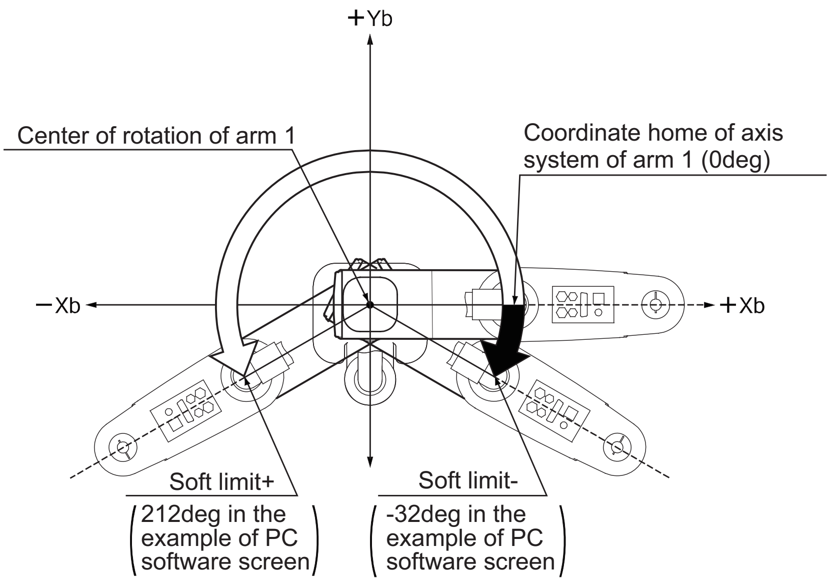
The soft limit parameters are set by coordinate values according to each axis system.
Axis 1 corresponds to arm 1, axis 2 corresponds to arm 2, axis 3 corresponds to Z-axis, and axis 4 corresponds to R-axis.
The setting units is [0.001deg] for arm 1, arm 2 and R-axis (rotational axis). The setting unit for Z-axis is [0.001mm].
The soft limits are used to limit the range of operation of arm 1, arm 2, Z-axis or R-axis from the coordinate home of each axis system. It is not affected by the work coordinates system or tool coordinate systems.

(Note) These parameters have been set to the maximum limits of range of operation at the factory. Do not set values that would enlarge the range of operation.

(1) Coordinates on each axis system and soft limits

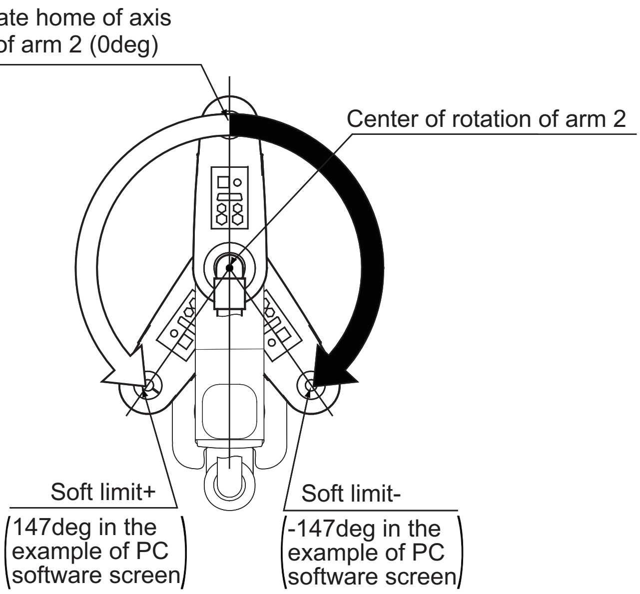
[Soft limits for arm 1]

The arm 1 position at which the arm faces the +Xb direction defines the coordinate home of the axis system of arm 1 (0deg).
This position is not affected by the arm 2 position.
Operating angles in the counterclockwise direction (positive direction) from this coordinate home of axis system are limited by the soft limit+ (axis 1 of axis-specific parameter No. 7).
Operating angles in the clockwise direction (negative direction) are limited by the soft limit- (axis 1 of axis-specific parameter No. 8).



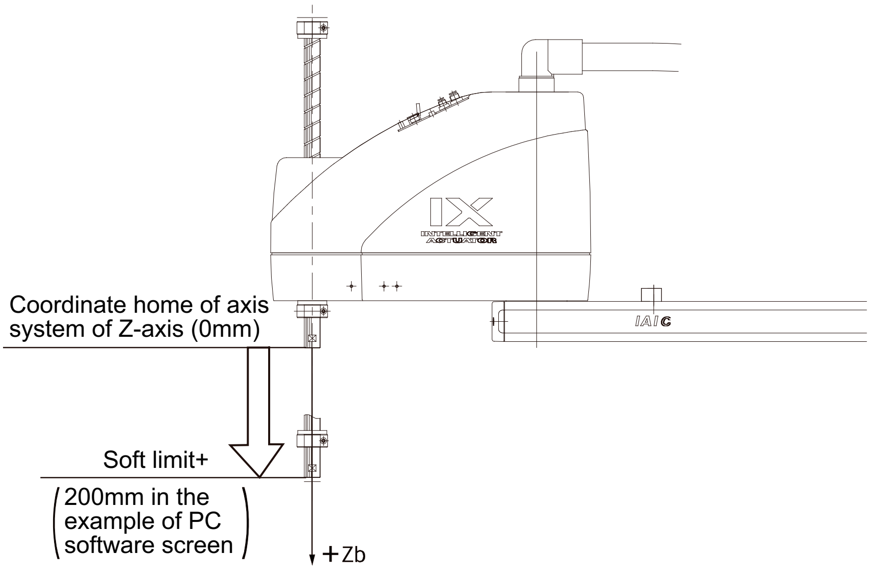
[Soft limits for arm 2]

The arm 2 position at which the arm forms a straight line with arm 1 defines the coordinate home of the axis system of arm 2 (0deg).
This position is not affected by the arm 1 position.
Operating angles in the counterclockwise direction (positive direction) from this coordinate home of axis system are limited by the soft limit+ (axis 2 of axis-specific parameter No. 7).
Operating angles in the clockwise direction (negative direction) are limited by the soft limit- (axis 2 of axis-specific parameter No. 8).



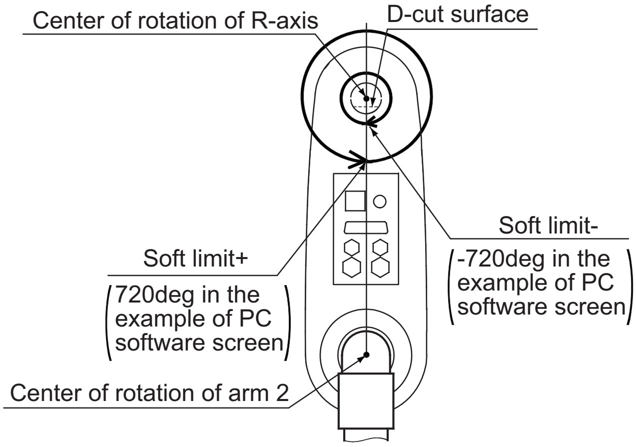
[Soft limits for Z-axis]

The Z-axis position at which the mechanical stopper attached to the Z-axis is approx. 5mm below the mechanical end at the bottom of arm 2 defines the coordinate home of the axis system of Z-axis (0mm). This position is the same as the Axis 3 = 0mm position on the base coordinate system. (On actuators of clean-room specification and dust-proof/splash-proof specification, this mechanical stopper is not visible because it is located inside bellows.)
Movements in the downward direction (positive direction) from this coordinate home of axis system are limited by the soft limit+ (axis 3 of axis-specific parameter No. 7). Movements in the upward direction (negative direction) from this coordinate home of axis system are limited by the soft limit- (axis 3 of axis-specific parameter No. 8). (The relationship is reversed on actuators of inverse specification.)



[Soft limits for R-axis]

The R-axis position at which the D-cut surface at the tip of the axis faces the center of rotation of arm 2 defines the coordinate home of the axis system of R-axis (0deg). This position is not affected by the arm 1 or arm 2 position.



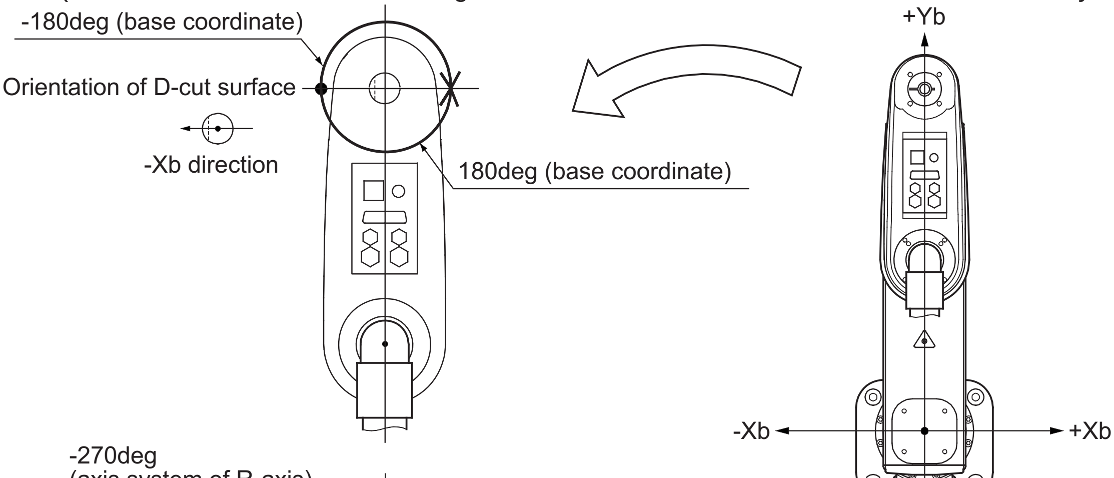
Operating angles in the counterclockwise direction (positive direction) from this coordinate home of axis system are limited by the soft limit+ (axis 4 of axis-specific parameter No. 7). Operating angles in the clockwise direction (negative direction) are limited by the soft limit- (axis 4 of axis-specific parameter No. 8).

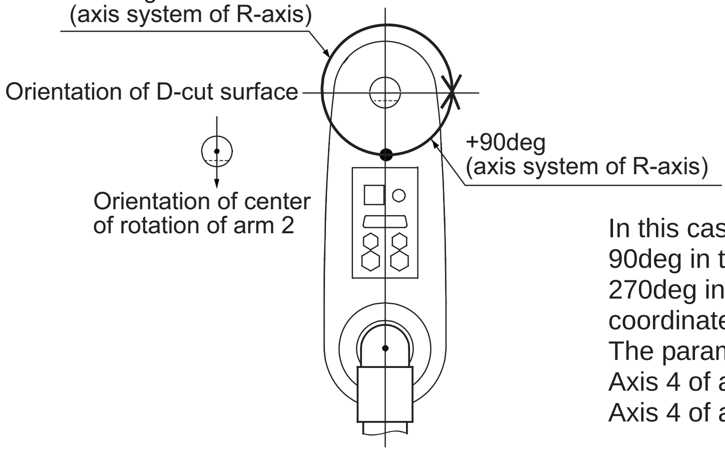
When limiting the operating range of the R-axis, you must pay attention to the difference between the base coordinate system and this axis system.

(Example)

Limit the range of operation of the R-axis to ±180 from the position shown below.

(Limit the R-axis to within ±180deg in the Axis 4 = 0 condition on the base coordinate system.)





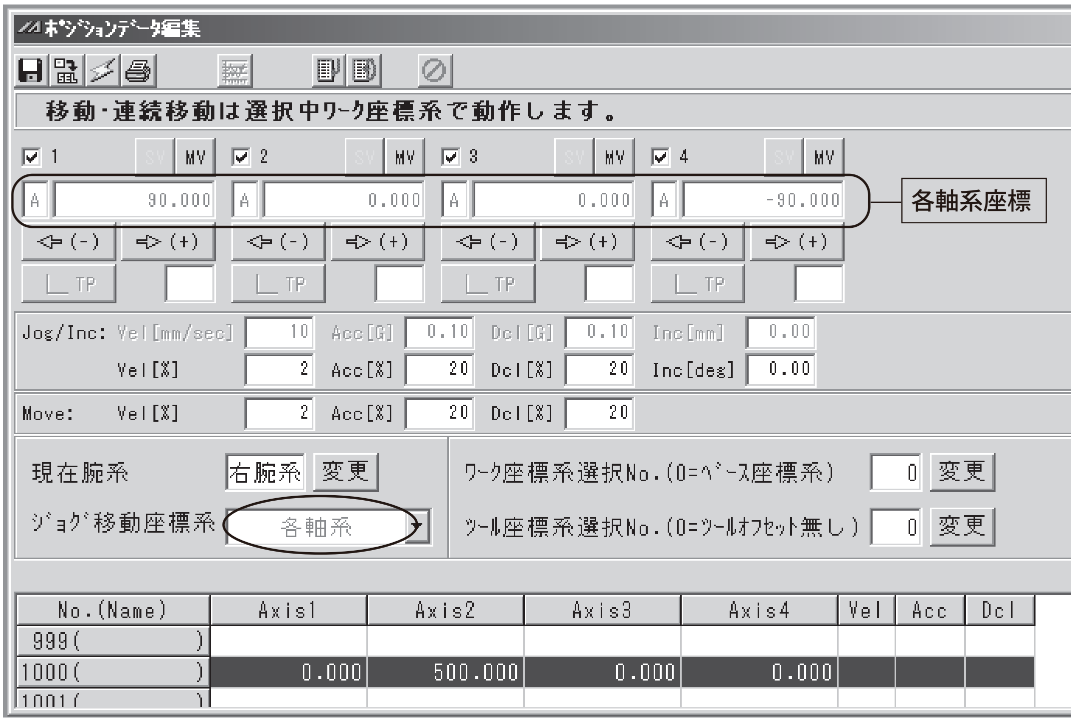
In this case, the R-axis is limited to within 90deg in the positive direction and within 270deg in the negative direction from the coordinate home of the axis system of R-axis. The parameters below are set as follows:

Axis 4 of axis-specific parameter No. 7 = 90000

Axis 4 of axis-specific parameter No. 8 = -270000

(2) Monitoring of axis system coordinates

You can use the PC software or teaching pendant to monitor axis system coordinates. Shown below is an example of a PC software screen. When the jog movement coordinate system is selected for each axis system in the position data edit window, the currently displayed position switch to a coordinate based on the selected axis system.



(An IX5020 (arm length 500mm, Z-axis 200mm) is located at the position of Axis 1 = 0, Axis 2 = 500, Axis 3 = 0, Axis 4 = 0 on the base coordinate system.)

(Note) Position data cannot be loaded in each axis system.

[For details on the specific operating procedure, refer to the Instruction Manual for your PC software or teaching pendant.]

[7] Simple Contact Check Zone

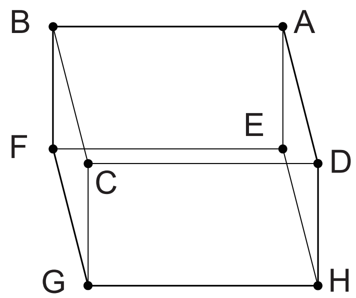
The simple contact check zone is an area you must set when checking for contact between the robot and nearby equipment.
When tool coordinate system No. 0 (= tool coordinate system offset 0) is selected, you can detect an entry into the simple contact check zone by the center position of the tool mounting surface. When any one of tool coordinate system No. 1 to 127 (= tool coordinate system offset enabled) is selected, you can detect a similar entry by the tool tip position.

[Notes on use of simple contact check zone]

- An entry into the simple contact check zone by the center position of the tool mounting surface (when tool coordinate system No. 0 is selected) or tool tip position (when any one of tool coordinate system No. 1 to 127 is selected) is detected. An entry by the outer periphery of the R-axis or any part of the tool other than its tip is not detected.
- This function does not prevent an entry into the simple contact check zone. It only detects an entry after it has occurred.
- An entry cannot be detected reliably unless the applicable position remains inside the simple contact check zone for 5msec or more. This function is intended to provide a means for simple check by low-speed operation.
- The path changes between high-speed operation (actual operation) and low-speed operation. Ensure a sufficient margin to avoid contact. (The robot tends to pass on the inner side of the path during high-speed operation compared to low-speed operation.)
- The coordinates defining the simple contact check zone are always recognized as data of the base coordinate system (work coordinate system selection No. 0). Take note that changing the work coordinate system does not change the position of the simple contact check zone.
  If the coordinates defining the simple contact check zone are changed, it will take 5msec before the check result according to the new coordinates is reflected.
- In PTP operation, the robot does not move along a fixed path. Conduct test operation at low speed to confirm absence of contact near an obstacle (including a part of the robot), and then gradually raise the speed to an appropriate level.
- If physical output port numbers or global flag numbers are duplicated, chattering occurs and operation results become unstable. Do not specify duplicate numbers.
- Use of the simple contact check zone consumes significant CPU power. When this function is not used, disable the function by setting 0 for the applicable “physical output port number/global flag number” and “error type”.
- The simple interference check zone becomes available after the home-operation complete or the absolute coordinate confirmation. Note that interference check cannot be held when home-return operation is incomplete or the absolute coordinate is unconfirmed.
- In Physical Output Port Number and Global Flag Number of Simple Interference Check Zone Definition, numbers to duplicate with those set in System Output Port / Flag Numbers (Output Function Select, Linear Axis Zone, etc.) Error No. 906 “Input and Output Port / Flag Number Error” generates if any duplicated number is indicated.

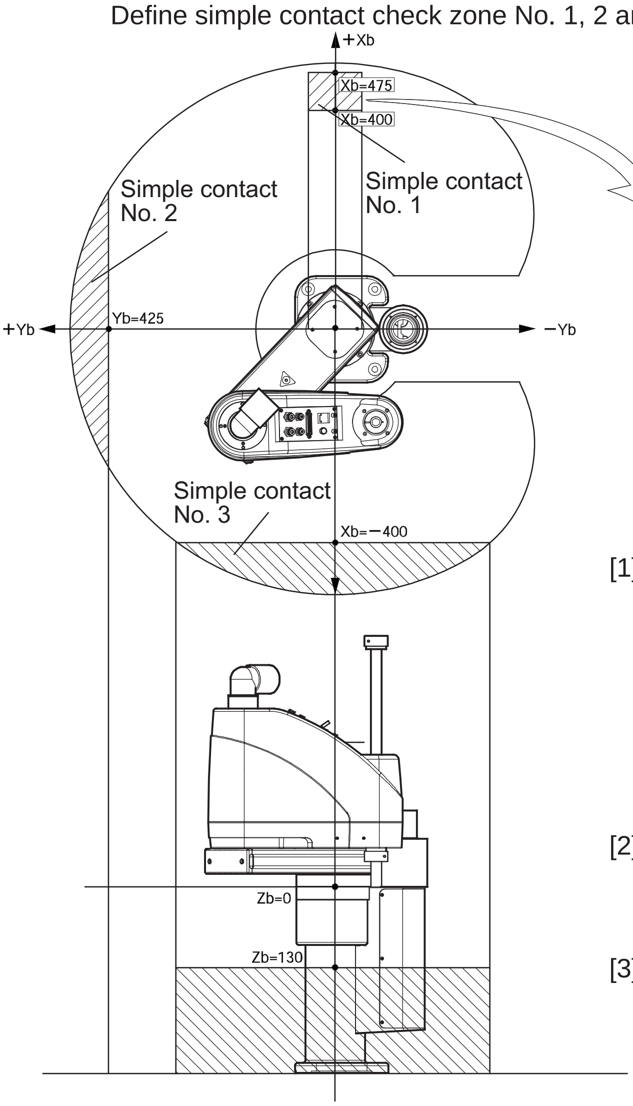
[Setting of simple contact check zone]

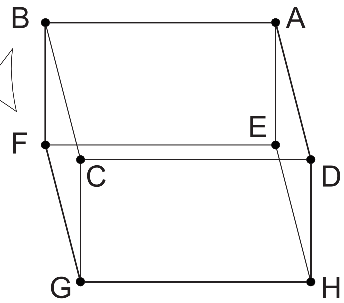
Set the simple contact check zone using position data of the base coordinate system.
Enter the maximum and minimum coordinate values of the simple contact check zone.
Set the boundary surfaces of the simple contact check zone in parallel with the base coordinate axes.



To set a rectangular solid like the one shown to the left as the simple contact check zone, enter the coordinate values of two points according to a combination of A-G, B-H, C-E or D-F.

(Example) Setting example of simple contact check zones
Define simple contact check zone No. 1, 2 and 3 as shown below.



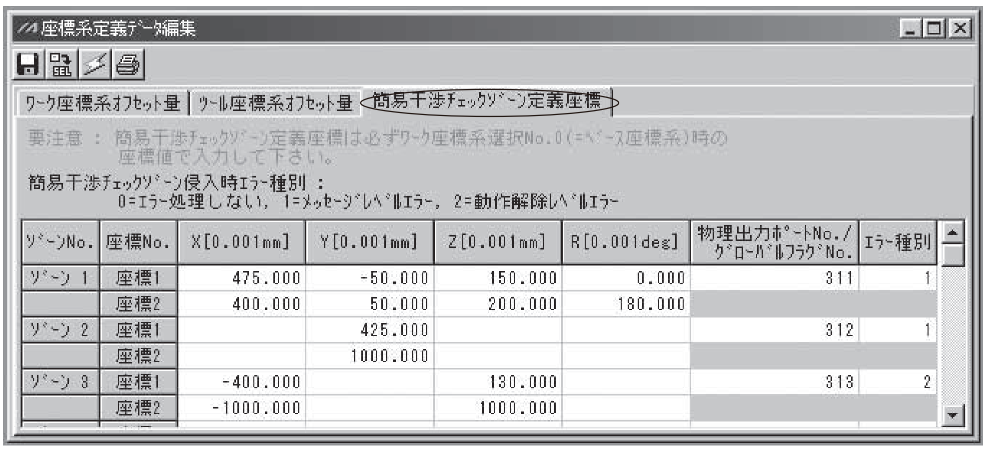


[1] For simple contact check zone No. 1, set a rectangular solid as the simple contact check zone.
A : Xb = 475, Yb = -50, Zb = 150, Rb = 0
G : Xb = 400, Yb = 50, Zb = 200, Rb = 180
An entry into this rectangular solid is not detected if Rb is outside the range of 0 to 180°.

[2] For simple contact check zone No. 2, set an area where Yb is 425mm or more as the simple contact check zone.

[3] For simple contact check zone No. 3, set an area where Xb is -400mm or less and Zb is 130mm or more as the simple contact check zone.

Shown below is the screenshot of the edit window for the simple contact check zone definition data in PC software dedicated for SCARA Robot assuming the simple contact check zones No. 1, No. 2 and No. 3 are set.


座標系定義ﾃﾞｰﾀ編集

ﾜｰｸ座標系ｵﾌｾｯﾄ量 | ﾂｰﾙ座標系ｵﾌｾｯﾄ量 | 簡易干渉ﾁｪｯｸｿﾞｰﾝ定義座標

要注意 ： 簡易干渉ﾁｪｯｸｿﾞｰﾝ定義座標は必ずﾜｰｸ座標系選択No.0(=ﾍﾞｰｽ座標系)時の座標値で入力して下さい。

簡易干渉ﾁｪｯｸｿﾞｰﾝ侵入時ｴﾗｰ種別 ：
0=ｴﾗｰ処理しない, 1=ﾒｯｾｰｼﾞﾚﾍﾞﾙｴﾗｰ, 2=動作解除ﾚﾍﾞﾙｴﾗｰ

ｿﾞｰﾝNo.	座標No.	X[0.001mm]	Y[0.001mm]	Z[0.001mm]	R[0.001deg]	物理出力ﾎﾟｰﾄNo./ｸﾞﾛｰﾊﾞﾙﾌﾗｸﾞNo.	ｴﾗｰ種別
ｿﾞｰﾝ 1	座標1	475.000	-50.000	150.000	0.000	311	1
	座標2	400.000	50.000	200.000	180.000		
ｿﾞｰﾝ 2	座標1		425.000			312	1
	座標2		1000.000				
ｿﾞｰﾝ 3	座標1	-400.000		130.000		313	2
	座標2	-1000.000		1000.000			

- As for simple contact check zone No. 1, an entry into this rectangular solid is not detected if the Rb is outside the range of 0 to 180°. To detect an entry into this zone regardless of the R-axis coordinate value, leave the coordinate 1 and 2 fields for zone 1 and R blank.

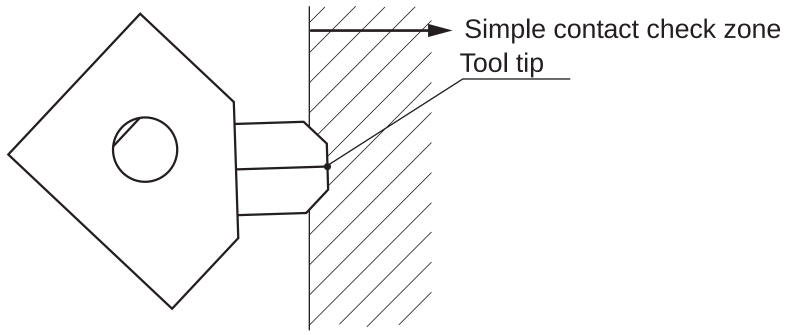
- If either the maximum value or minimum value is not limited, as is the case with simple contact check zone No. 2 and 3, enter a value outside the range of operation (such as 1000 for zone 2, and 1000 or -1000 for zone 3).

- The maximum value and minimum value can be set under either coordinate 1 or 2.

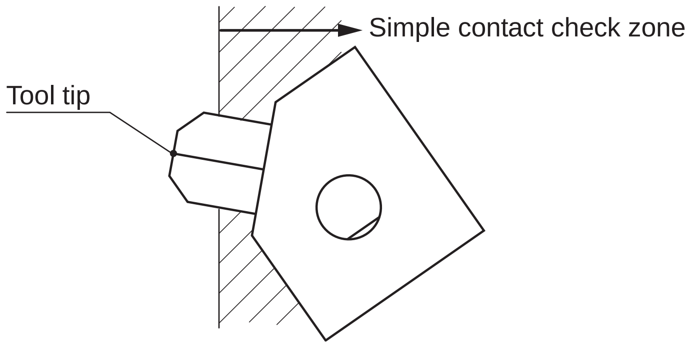
- According to the above settings, output port No. 311 turns ON upon entry into simple contact check zone No. 1, output port No. 312 turns ON upon entry into simple contact check zone No. 2, and output port No. 313 turns ON upon entry into simple contact check zone No. 3.

* Use a DFIF command if you want to set a simple contact check zone within the SEL program.

[Note on detection while tool coordinate system is selected]
While the tool coordinate system is selected, this function detects an entry of the tool tip, not the center of the mounting surface, into the simple contact check zone.



Depending on the movement path, a part of the tool other than its tip may enter the simple contact check zone, as shown below. Exercise due caution because in this case, the entry will not be detected until the tool tip enters the simple contact check zone.



- Caution

In X-SEL-RXD/SXD, the definitions of SCARA axes (Axes 1 to 4) are to be set to Axes 1 to 4 and SCARA axes (Axes 5 to 8) to Axes 5 to 8. SCARA axes (Axes 1 to 4) and SCARA axes (Axes 5 to 8) cannot be set in one zone number at the same time. (10 zone definitions are required in total for 2 units of SCARA.)

Each coordinate axis number expresses the meaning listed below.

- Axis 1: Interference domain data of X-axis for SCARA axes (Axes 1 to 4)
- Axis 2: Interference domain data of Y-axis for SCARA axes (Axes 1 to 4)
- Axis 3: Interference domain data of A-axis for SCARA axes (Axes 1 to 4)
- Axis 4: Interference domain data of R-axis for SCARA axes (Axes 1 to 4)
- Axis 5: Interference domain data of X-axis for SCARA axes (Axes 5 to 8)
- Axis 6: Interference domain data of Y-axis for SCARA axes (Axes 5 to 8)
- Axis 7: Interference domain data of Z-axis for SCARA axes (Axes 5 to 8)
- Axis 8: Interference domain data of R-axis for SCARA axes (Axes 5 to 8)

2. Connection with Host System

When transferring the data between the host system (PLC, etc.), it can be selected from the following methods(Note 1):

1) Use 24V DC I/O.
2) (For XSEL only) Use the serial communication (RS232C).
3) Use the Fieldbus communication(Note 2) (option). … This is able to control like I/O.

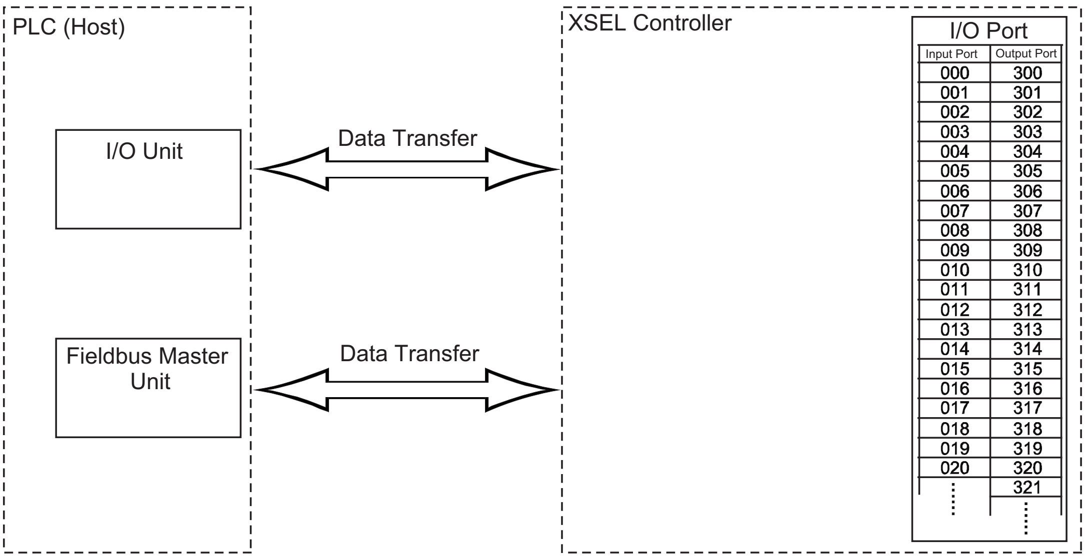
(Note 1) It includes the optional functions.

(Note 2) A dedicated PCB is required separately.
The types of applicable Fieldbus are CC-Link, DeviceNet, PROFIBUS, Ethernet (for XSEL only), EtherNet/IP (for XSEL-R*/S* only) and EtherCAT (for XSEL-R*/S* only).
[For details, refer to the Fieldbus Instruction Manual provided separately and the Instruction Manual for the host system.]

2.1 I/O Signal

There are 2 types of input and output signals as shown below.

1) Input and Output I/O Port
2) Virtual I/O Port



	Port No.	Function		Port No.	Function
Input	000	Program Start	Output	300	Alarm Output
	001	General-purpose Input		301	Ready Output
	002	General-purpose Input		302	Emergency Stop Output
	003	General-purpose Input		303	General-purpose Output
	004	General-purpose Input		304	General-purpose Output
	005	General-purpose Input		305	General-purpose Output
	006	General-purpose Input		306	General-purpose Output
	007	Program Specification (PRG No.1)		307	General-purpose Output
	008	Program Specification (PRG No.2)		308	General-purpose Output
	009	Program Specification (PRG No.4)		309	General-purpose Output
	010	Program Specification (PRG No.8)		310	General-purpose Output
	011	Program Specification (PRG No.10)		311	General-purpose Output
	012	Program Specification (PRG No.20)		312	General-purpose Output
	013	Program Specification (PRG No.40)		313	General-purpose Output
	014	General-purpose Input		314	General-purpose Output
	015	General-purpose Input		315	General-purpose Output
	⋮	⋮		⋮	⋮

(Note) The numbers of I/O ports are:

Input: 000 to 299 (300 points max.)
Output: 300 to 599 (300 points max.)

2.1.1 XSEL-J/K Type Controllers

XSEL-J/K type controllers
- XSEL-J/K/KE/KT/KET
- XSEL-JX/KX/KETX

[1] Input and Output I/O Port

With XSEL-J/K type controllers, the assignments of input and output functions to I/O ports are fixed and cannot be changed.

I/O Signal Table

Input

Pin No.	Wire color	Port No.	Standard (factory) setting Can be changed by I/O parameter	I/O parameter	
1	Brown-1		K, KX types : Cannot be connected. J, JX types : +24V input		
2	Red-1	000	Program start	No. 30	0: General-purpose input 1: Program start (BCD specification) 2: Program start (binary specification)
3	Orange-1	001	General-purpose input	No. 31	0: General-purpose input 1: Soft reset signal
4	Yellow-1	002	General-purpose input	No. 32	0: General-purpose input 1: Servo ON signal
5	Green-1	003	General-purpose input	No. 33	0: General-purpose input 1: Auto program start upon power-ON reset or software reset in AUTO mode 2: Auto program start signal
6	Blue-1	004	General-purpose input	No. 34	0: General-purpose input 1: Software interlock of all servo axes (OFF level)
7	Purple-1	005	General-purpose input	No. 35	0: General-purpose input 1: Operation pause cancellation input (ON edge)
8	Gray-1	006	General-purpose input	No. 36	0: General-purpose input 1: Operation pause signal (OFF level)
9	White-1	007	Program number specification (MSB)	No. 37	0: General-purpose input 1: Program number specification (MSB)
10	Black-1	008	Program number specification (bit 2)	No. 38	0: General-purpose input 1: Program number specification (bit 2)
11	Brown-2	009	Program number specification (bit 3)	No. 39	0: General-purpose input 1: Program number specification (bit 3)
12	Red-2	010	Program number specification (bit 4)	No. 40	0: General-purpose input 1: Program number specification (bit 4)
13	Orange-2	011	Program number specification (bit 5)	No. 41	0: General-purpose input 1: Program number specification (bit 5)
14	Yellow-2	012	Program number specification (bit 6)	No. 42	0: General-purpose input 1: Program number specification (bit 6)
15	Green-2	013	Program number specification (LSB: bit 7)	No. 43	0: General-purpose input 1: Program number specification (LSB: bit 7)
16	Blue-2	014	General-purpose input	No. 44	0: General-purpose input 1: Drive-source cutoff cancellation (ON edge)
17	Purple-2	015	General-purpose input	No. 45	0: General-purpose input The following settings are effective only with XSEL-J/K: 1: Home return of all effective axes (ON edge) 2: Home return of all effective incremental axes (ON edge)
18	Gray-2	016	General-purpose input		
19	White-2	017	General-purpose input		
20	Black-2	018	General-purpose input		
21	Brown-3	019	General-purpose input		
22	Red-3	020	General-purpose input		
23	Orange-3	021	General-purpose input		
24	Yellow-3	022	General-purpose input		
25	Green-3	023	General-purpose input		
26	Blue-3	024	General-purpose input		
27	Purple-3	025	General-purpose input		
28	Gray-3	026	General-purpose input		
29	White-3	027	General-purpose input		
30	Black-3	028	General-purpose input		
31	Brown-4	029	General-purpose input		
32	Red-4	030	General-purpose input		
33	Orange-4	031	General-purpose input		

Output

Pin No.	Wire color	Port No.	Standard (factory) setting Can be changed by I/O parameter	I/O parameter	
34	Yellow-4	300	Output of operation-cancellation level or higher error (OFF)	No. 46	0: General-purpose output 1: Output of operation-cancellation level or higher error (ON) 2: Output of operation-cancellation level or higher error (OFF) 3: Output of operation-cancellation level or higher error + Emergency stop output (ON) 4: Output of operation-cancellation level or higher error + Emergency stop output (OFF)
35	Green-4	301	READY output (PIO-trigger program operation enabled AND no cold-start level or higher error) (Main application version 0.20 or later)	No. 47	0: General-purpose output 1: READY output (PIO-trigger program operation enabled) 2: READY output (PIO-trigger program operation enabled AND no operation-cancellation level or higher error) (Main application Ver.0.20 or later) 3: READY output (PIO-trigger program operation enabled and no cold-start level or higher error) (Main application Ver.0.20 or later)
36	Blue-4	302	Emergency stop output (OFF)	No. 48	0: General-purpose output 2: Emergency stop output (ON) 3: Emergency stop output (OFF)
37	Purple-4	303	General-purpose output	No. 49	0: General-purpose output 1: AUTO mode output 2: Auto operation output (When other parameter No. 12 is set to ‘1’)
38	Gray-4	304	General-purpose output	No. 50	0: General-purpose output The following settings are effective only with XSEL-J/K: 1: Output when all effective axes are home (= 0) 2: Output when all effective axes have completed home return 3: Output when all effective axes are at home preset coordinate (Main application Ver.0.21 or later) * To move an actuator of absolute encoder specification to coordinate 0 or the home preset coordinate, use a MOVP command instead of HOME command.
39	White-4	305	General-purpose output	No. 51	0: General-purpose output 2: Axis 1 servo ON output (Main application Ver.0.44 or later)
40	Black-4	306	General-purpose output	No. 52	0: General-purpose output 2: Axis 2 servo ON output (Main application Ver.0.44 or later)
41	Brown-5	307	General-purpose output	No. 53	0: General-purpose output 2: Axis 3 servo ON output (Main application Ver.0.44 or later)
42	Red-5	308	General-purpose output	No. 54	0: General-purpose output 2: Axis 4 servo ON output (Main application Ver.0.44 or later)
43	Orange-5	309	General-purpose output	No. 55	
44	Yellow-5	310	General-purpose output	No. 56	
45	Green-5	311	General-purpose output	No. 57	
46	Blue-5	312	General-purpose output	No. 58	
47	Purple-5	313	General-purpose output	No. 59	0: General-purpose output 1: System-memory backup battery voltage low alarm level or lower
48	Gray-5	314	General-purpose output	No. 60	0: General-purpose output 1: Absolute-battery backup battery voltage low alarm level or lower (OR check of all axes. If an error level is detected, this output is retained until power-ON reset or software reset.) (Main application Ver.0.28 or later)
49	White-5	315	General-purpose output	No. 61	
50	Black-5		K, KX types : Need not be connected. J, JX types : 0V input		

- By default, the ON/OFF state of an input signal is recognized by the controller when the signal has remained ON/OFF for approx. 4msec or more.
- The setting for this ON/OFF duration can be changed using I/O parameter No. 20, “Input filtering period”.

[2] Virtual I/O Ports

Virtual I/O ports are provided so that the controller can notify internal information. They are used to warn a low power-supply voltage, notify errors, etc. Use these ports as necessary.

XSEL-J/K Virtual Input Ports (Internal Flags)

Port No.	Function
7000	Always OFF
7001	Always ON
7002	Voltage low warning for system-memory backup battery
7003	Abnormal voltage of system-memory backup battery
7004	(For future expansion = Use strictly prohibited)
7005	(For future expansion = Use strictly prohibited)
7006	Top-level system error = Message level error is present
7007	Top-level system error = Operation-cancellation level error is present
7008	Top-level system error = Cold-start level error is present
7009	(For future expansion = Use strictly prohibited)
7010	Drive-source cutoff factor is present (including when waiting for cutoff reset input)
7011	Latch signal indicating that all-operation-cancellation factor is present (latch signal for recognizing 1-shot cancellation factor; latch is cancelled by 7300-ON)
7012	All-operation-pause factor is present (including when waiting for restart switch signal) (Valid only during automatic operation recognition)
7013	All-servo-axis-interlock factor is present (all-operation-pause factor + interlock input-port factor)
7014	(For future expansion = Use strictly prohibited)
7015	Voltage low warning for axis-1 absolute-data backup battery (main application version 0.28 or later)
7016	Abnormal voltage of axis-1 absolute-data backup battery (latched until power-on reset or software reset) (main application version 0.28 or later)
7017	Voltage low warning for axis-2 absolute-data backup battery (main application version 0.28 or later)
7018	Abnormal voltage of axis-2 absolute-data backup battery (latched until power-on reset or software reset) (main application version 0.28 or later)
7019	Voltage low warning for axis-3 absolute-data backup battery (main application version 0.28 or later)
7020	Abnormal voltage of axis-3 absolute-data backup battery (latched until power-on reset or software reset) (main application version 0.28 or later)
7021	Voltage low warning for axis-4 absolute-data backup battery (main application version 0.28 or later)
7022	Abnormal voltage of axis-4 absolute-data backup battery (latched until power-on reset or software reset) (main application version 0.28 or later)
7023 to 7030	For future expansion = Use strictly prohibited
7031	Reading SIO CH1 (standard SIO) (reception ready) (*OFF if used for PC/TP connection) (main application versions 0.41 or later)
7032	Reading SIO CH2 (expanded SIO) (reception ready) (main application versions 0.41 or later)
7033	Reading SIO CH3 (expanded SIO) (reception ready) (main application versions 0.41 or later)
7034	Reading SIO CH4 (expanded SIO) (reception ready) (main application versions 0.41 or later)
7035	Reading SIO CH5 (expanded SIO) (reception ready) (main application versions 0.41 or later)
7036	Reading SIO CH6 (expanded SIO) (reception ready) (main application versions 0.41 or later)
7037	Reading SIO CH7 (expanded SIO) (reception ready) (main application versions 0.41 or later)
7038 to 7040	(For future expansion = Use strictly prohibited)
7041 to 7070	(For future expansion = Use strictly prohibited)
7071	In AUTO mode (main application version 0.87 or later)
7072	During automatic operation (main application version 0.87 or later)
7073 to 7100	(For future expansion = Use strictly prohibited)
7101	Running program No. 01 (including during pause)
~	~
7164	Running program No. 64 (including during pause)
7165 to 7299	(For future expansion = Use strictly prohibited)

XSEL-J/K Virtual Output Ports (Internal Flags)

Port No.	Function
7300	Latch cancellation output for a latch signal indicating that all-operation-cancellation factor is present (7011) (latch is cancelled only when operation-cancellation factor is no longer present) (7300 will be turned OFF following an attempt to cancel latch.)
7301 to 7380	(For future expansion = Use strictly prohibited)
7381 to 7399	(For future expansion = Use strictly prohibited)
7400 to 7599	(For future expansion = Use strictly prohibited)

XSEL-JX/KX Virtual Input Ports (Internal Flags)

Port No.	Function
7000	Always OFF
7001	Always ON
7002	System-memory backup battery voltage low warning
7003	System-memory backup battery voltage error
7004	(Reserved by the system = Use is strictly prohibited)
7005	(Reserved by the system = Use is strictly prohibited)
7006	Critical system error = A message level error is present.
7007	Critical system error = An operation-cancellation level error is present.
7008	Critical system error = A cold-start level error is present.
7009	(Reserved by the system = Use is strictly prohibited)
7010	A cause of drive-source cutoff is present (including a condition waiting for a cutoff cancellation input).
7011	A latch signal indicating that a cause of all-operation cancellation is present. (This latch signal is used to recognize a cause of 1-shot reset. Latch cancellation: 7300-ON)
7012	A cause of all-operation pause is present (including a condition waiting for the restart switch to be pressed). (Effective only in the auto operation recognition mode)
7013	A cause of all-servo-axis interlock is present (cause of all-operation pause + cause of interlock input port)
7014	(Reserved by the system = Use is strictly prohibited)
7015	Axis 1 absolute-data backup battery voltage low warning
7016	Axis 1 absolute-data backup battery voltage error (Latched until power-ON reset or software reset)
7017	Axis 2 absolute-data backup battery voltage low warning
7018	Axis 2 absolute-data backup battery voltage error (Latched until power-ON reset or software reset)
7019	Axis 3 absolute-data backup battery voltage low warning
7020	Axis 3 absolute-data backup battery voltage error (Latched until power-ON reset or software reset)
7021	Axis 4 absolute-data backup battery voltage low warning
7022	Axis 4 absolute-data backup battery voltage error (Latched until power-ON reset or software reset)
7023 to 7030	(For future expansion = Use is strictly prohibited)
7031	Reading SIO CH1 (standard SIO) (Receive ready) (*OFF if a PC/TP is connected)
7032	Reading SIO CH2 (standard SIO) (Receive ready)
7033	Reading SIO CH3 (standard SIO) (Receive ready)
7034	Reading SIO CH4 (standard SIO) (Receive ready)
7035	Reading SIO CH5 (standard SIO) (Receive ready)
7036	Reading SIO CH6 (standard SIO) (Receive ready)
7037	Reading SIO CH7 (standard SIO) (Receive ready)
7038 to 7070	(Reserved by the system = Use is strictly prohibited)
7071	In the AUTO mode (Main application Ver.0.34 or later)
7072	During auto operation (Main application Ver.0.34 or later)
7073 to 7100	(Reserved by the system = Use is strictly prohibited)
7101	Program No. 01 is being executed (or paused).
~	~
7164	Program No. 64 is being executed (or paused).
7165 to 7299	(For future expansion = Use is strictly prohibited)

XSEL-JX/KX Virtual Output Ports (Internal Flags)

Port No.	Function
7300	A latch cancellation signal is output to cancel the latch signal indicating a cause of all-operation cancellation (7011). (Unlatched only when the cause of operation cancellation is no longer present.) (7300 is turned OFF after latch cancellation is attempted.)
7301 to 7380	(For future expansion = Use is strictly prohibited)
7381 to 7399	(Reserved by the system = Use is strictly prohibited)
7400 to 7599	(For future expansion = Use is strictly prohibited)

2.1.2 XSEL-P/Q/PCT/QCT Controllers

[1] Input and Output I/O Port

With XSEL-P/Q/PCT/QCT controllers, input and output functions can be assigned to input and output ports as desired.
For input ports, set input functions using I/O parameters 30 to 45 (input function selections 000 to 015) and then use I/O parameters 283 to 298 to set the port numbers to assign the respective functions to.
For output ports, set output functions using I/O parameters 46 to 61 (output function selections 300 to 315) and then use I/O parameters 299 to 314 to set the port numbers to assign the respective functions to.
You can also use I/O parameters 331 to 346 (output function selections 300 (area 2) to 315 (area 2)) to set output functions and then use I/O parameters 315 to 330 to set the port numbers to assign the respective functions to.

Input

Pin No.	Wire color	Port No.	Standard (factory-set) function
1	Brown-1		+24V input
2	Red-1	000	Program start
3	Orange-1	001	General-purpose input
4	Yellow-1	002	General-purpose input
5	Green-1	003	General-purpose input
6	Blue-1	004	General-purpose input
7	Purple-1	005	General-purpose input
8	Gray-1	006	General-purpose input
9	White-1	007	Program number specification (MSB)
10	Black-1	008	Program number specification (bit 2)
11	Brown-2	009	Program number specification (bit 3)
12	Red-2	010	Program number specification (bit 4)
13	Orange-2	011	Program number specification (bit 5)
14	Yellow-2	012	Program number specification (bit 6)
15	Green-2	013	Program number specification (LSB: bit 7)
16	Blue-2	014	General-purpose input
17	Purple-2	015	General-purpose input
18	Gray-2	016	General-purpose input
19	White-2	017	General-purpose input
20	Black-2	018	General-purpose input
21	Brown-3	019	General-purpose input
22	Red-3	020	General-purpose input
23	Orange-3	021	General-purpose input
24	Yellow-3	022	General-purpose input
25	Green-3	023	General-purpose input
26	Blue-3	024	General-purpose input
27	Purple-3	025	General-purpose input
28	Gray-3	026	General-purpose input
29	White-3	027	General-purpose input
30	Black-3	028	General-purpose input
31	Brown-4	029	General-purpose input
32	Red-4	030	General-purpose input
33	Orange-4	031	General-purpose input

Remarks		
Inputs are set as shown in the table prior to the shipment, but you can change these input functions by setting applicable I/O parameters.		
Parameter No.	Parameter name	Function
No. 30	Input function selection 000	0: General-purpose input 1: Program start (input ports 007 to 013, BCD specification) 2: Program start (input ports 007 to 013, binary specification) 3: Program start (input ports 008 to 014, BCD specification) 4: Program start (input ports 008 to 014, binary specification)
No. 31	Input function selection 001	0: General-purpose input 1: Soft reset signal
No. 32	Input function selection 002	0: General-purpose input 1: Servo ON signal
No. 33	Input function selection 003	0: General-purpose input 1: Auto program start upon power-ON reset or software reset in AUTO mode 2: Auto program start signal
No. 34	Input function selection 004	0: General-purpose input 1: Software interlock of all servo axes (OFF level)
No. 35	Input function selection 005	0: General-purpose input 1: Operation pause cancellation input (ON edge)
No. 36	Input function selection 006	0: General-purpose input 1: Operation pause signal (OFF level)
No. 37	Input function selection 007	0: General-purpose input 1: Program number specification (MSB)
No. 38	Input function selection 008	0: General-purpose input 1: Program number specification (bit 2)
No. 39	Input function selection 009	0: General-purpose input 1: Program number specification (bit 3)
No. 40	Input function selection 010	0: General-purpose input 1: Program number specification (bit 4)
No. 41	Input function selection 011	0: General-purpose input 1: Program number specification (bit 5)
No. 42	Input function selection 012	0: General-purpose input 1: Program number specification (bit 6)
No. 43	Input function selection 013	0: General-purpose input 1: Program number specification (LSB: bit 7)
No. 44	Input function selection 014	0: General-purpose input 1: Drive-source cutoff cancellation (ON edge)
No. 45	Input function selection 015	0: General-purpose input 1: Home return of all effective axes (ON edge) 2: Home return of all effective incremental axes (ON edge)

Output

Pin No.	Wire color	Port No.	Standard Setting (in the delivery) Function	Remarks		
				When the unit is delivered, the output is set as shown in the table. However, the output function can be changed using the I/O parameter setting.		
				Parameter No. *1	Parameter Name	Function
34	YW-4	300	Error Output at the Operation Cancellation Level or more (OFF)	No.46 No.331	Output Function Selection 300 Output Function Selection 300 (Area 2)	0: Universal Output 1: Error Output at the Operation Cancellation Level or more (ON) 2: Error Output at the Operation Cancellation Level or more (OFF) 3: Error Output at the Operation Cancellation Level or more + Emergency-stop output (ON) 4: Error Output at the Operation Cancellation Level or more + Emergency-stop output (OFF)
35	GN-4	301	READY Output (PIO Trigger Program Operation Available and without occurrence of any error at the cold start level or more) (Main Application Ver. 0.20 or later)	No.47 No.332	Output Function Selection 301 Output Function Selection 301 (Area 2)	0: Universal Input 1: READY Output (PIO Trigger Program Operation Available) 2: READY Output (PIO Trigger Program Operation Available)and without occurrence of any error at the operation cancellation level or more 3: READY Output (PIO Trigger Program Operation Available)and READY Output (PIO Trigger Program Operation Available, and without occurrence of any error at the cold start level or more or more level or more
36	BL-4	302	Emergency-stop output (OFF)	No.48 No.333	Output Function Selection 302 Output Function Selection 302 (Area 2)	0: Universal Input 2: Emergency-stop output (ON) 3: Emergency-stop output (OFF)
37	PL-4	303	Universal Output	No.49 No.334	Output Function Selection 303 Output Function Selection 303 (Area 2)	0: Universal Output 1: AUTO Mode Output 2: Output during the Automatic Operation (In addition, when the parameter No. 12 is set to “1”)
38	GY-4	304	Universal Output	No.50 No.335	Output Function Selection 304 Output Function Selection 304 (Area 2)	0: Universal Output 1: Output at the time of “All Effective Axes Homing (=0)” 2: Output when all the effective axes homing is completed 3: Output when all the effective axes home preset coordinates are set * When the actuator applicable to the absolute encoder is moved to the coordinates “0” or home preset coordinates, use “MOVE” order, not “HOME” order.
39	WT-4	305	Universal Output	No.51 No.336	Output Function Selection 305 Output Function Selection 305 (Area 2)	0: Universal Output 1: Axis 1 in-position output (turned OFF when pressing missed) 2: Output during the Axis 1 servo ON
40	BK-4	306	Universal Output	No.52 No.337	Output Function Selection 306 Output Function Selection 306 (Area 2)	0: Universal Output 1: Axis 2 in-position output (turned OFF when pressing missed) 2: Output during the Axis 2 servo ON
41	BR-5	307	Universal Output	No.53 No.338	Output Function Selection 307 Output Function Selection 307 (Area 2)	0: Universal Output 1: Axis 3 in-position output (turned OFF when pressing missed) 2: Output during the Axis 3 servo ON
42	RD-5	308	Universal Output	No.54 No.339	Output Function Selection 308 Output Function Selection 308 (Area 2)	0: Universal Output 1: Axis 4 in-position output (turned OFF when pressing missed) 2: Output during the Axis 4 servo ON
43	OR-5	309	Universal Output	No.55 No.340	Output Function Selection 309 Output Function Selection 309 (Area 2)	0: Universal Output 1: Axis 5 in-position output (turned OFF when pressing missed) 2: Output during the Axis 5 servo ON
44	YW-5	310	Universal Output	No.56 No.341	Output Function Selection 310 Output Function Selection 310 (Area 2)	0: Universal Output 1: Axis 6 in-position output (turned OFF when pressing missed) 2: Output during the Axis 6 servo ON
45	GN-5	311	Universal Output	No.57 No.342	Output Function Selection 311 Output Function Selection 311 (Area 2)	
46	BL-5	312	Universal Output	No.58 No.343	Output Function Selection 312 Output Function Selection 312 (Area 2)	

Pin No.	Wire color	Port No.	Standard Setting (in the delivery) Function
47	PL-5	313	Universal Output
48	GY-5	314	Universal Output
49	WT-5	315	Universal Output
50	BK-5		0V Output

Remarks		
When the unit is delivered, the output is set as shown in the table. However, the output function can be changed using the I/O parameter setting.		
Parameter No. *1	Parameter Name	Function
No.59 No.344	Output Function Selection 313 Output Function Selection 313 (Area 2)	0: Universal Output 1: System Memory Backup Battery Low Voltage Alarm Level or less
No.60 No.345	Output Function Selection 314 Output Function Selection 314 (Area 2)	0: Universal Output 1: Absolute Battery Backup Battery Low Voltage Alarm Level or less (All axes OR check: Error level detection is maintained until power ON reset and software reset)
No.61 No.346	Output Function Selection 315 Output Function Selection 315 (Area 2)	

- By default, the ON/OFF state of an input signal is recognized by the controller when the signal has remained ON/OFF for approx. 4msec or more.
- The setting for this ON/OFF duration can be changed using I/O parameter No. 20, “Input filtering period”.

[2] Virtual I/O Port

Virtual I/O ports are provided so that the controller can notify internal information. They are used to warn a low power-supply voltage, notify errors, etc. Use these ports as necessary.

XSEL-P/Q/PCT/QCT Virtual Input Ports (Internal Flags)

Port No.	Function
7000	Always OFF
7001	Always ON
7002	System-memory backup battery voltage low warning
7003	System-memory backup battery voltage error
7004	(Reserved by the system = Use is strictly prohibited)
7005	(Reserved by the system = Use is strictly prohibited)
7006	Critical system error = A message level error is present.
7007	Critical system error = An operation-cancellation level error is present.
7008	Critical system error = A cold-start level error is present.
7009	(Reserved by the system = Use is strictly prohibited)
7010	A cause of drive-source cutoff is present (including a condition waiting for a cutoff cancellation input).
7011	A latch signal indicating that a cause of all-operation cancellation is present. (This latch signal is used to recognize a cause of 1-shot reset. Latch cancellation: 7300-ON)
7012	A cause of all-operation pause is present (including a condition waiting for the restart switch to be pressed). (Effective only in the auto operation recognition mode)
7013	A cause of all-servo-axis interlock is present (cause of all-operation pause + cause of interlock input port)
7014	(Reserved by the system = Use is strictly prohibited)
7015	Axis 1 absolute-data backup battery voltage low warning
7016	Axis 1 absolute-data backup battery voltage error (Latched until power-ON reset or software reset)
7017	Axis 2 absolute-data backup battery voltage low warning (Main application version 0.28 or later)
7018	Axis 2 absolute-data backup battery voltage error (Latched until power-ON reset or software reset)
7019	Axis 3 absolute-data backup battery voltage low warning
7020	Axis 3 absolute-data backup battery voltage error (Latched until power-ON reset or software reset)
7021	Axis 4 absolute-data backup battery voltage low warning
7022	Axis 4 absolute-data backup battery voltage error (Latched until power-ON reset or software reset)
7023	Axis 5 absolute-data backup battery voltage low warning (Effective only with 6-axis types)
7024	Axis 5 absolute-data backup battery voltage error (Latched until power-ON reset or software reset) (Effective only with 6-axis types)
7025	Axis 6 absolute-data backup battery voltage low warning (Effective only with 6-axis types)
7026	Axis 6 absolute-data backup battery voltage error (Latched until power-ON reset or software reset) (Effective only with 6-axis types)
7027 to 7040	(Reserved by the system = Use is strictly prohibited)
7041, 7042	(For future expansion = Use is strictly prohibited)
7043	Axis 1 home return completion
7044	Axis 2 home return completion
7045	Axis 3 home return completion
7046	Axis 4 home return completion
7047	Axis 5 home return completion
7048	Axis 6 home return completion
7049 to 7070	(For future expansion = Use is strictly prohibited)
7071	In the AUTO mode
7072	During auto operation
7073 to 7100	(Reserved by the system = Use is strictly prohibited)
7101	Program No. 01 is being executed (or paused).
~	~
7164	Program No. 64 is being executed (or paused).

XSEL-P/Q/PCT/QCT Virtual Input Ports (Internal Flags)

Port No.	Function
7165	Program No. 65 is being executed (or paused). (Controller with increased memory capacity (with gateway function) only)
~	~
7228	Program No. 128 is being executed (or paused). (Controller with increased memory capacity (with gateway function) only)
7229 to 7299	(For future expansion = Use is strictly prohibited)

XSEL-P/Q/PCT/QCT Virtual Output Ports (Internal Flags)

Port No.	Function
7300	A latch cancellation signal is output to cancel the latch signal indicating a cause of all-operation cancellation (7011). (Unlatched only when the cause of operation cancellation is no longer present.) (7300 is turned OFF after latch cancellation is attempted.)
7301 to 7380	(For future expansion = Use is strictly prohibited)
7381 to 7399	(Reserved by the system = Use is strictly prohibited)
7400 to 7599	(For future expansion = Use is strictly prohibited)

2.1.3 XSEL-PX/QX Controllers

[1] Input and Output I/O Port

With XSEL-PX/QX type controllers, the assignments of input and output functions to I/O ports are fixed and cannot be changed.

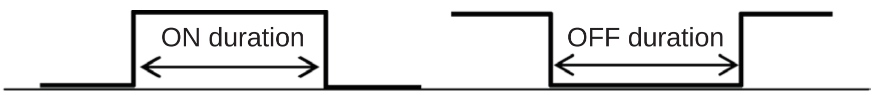
Input

Pin No.	Wire color	Port No.	Standard (factory-set) function	I/O parameter Inputs are set as shown in the table prior to the shipment, but you can change these input functions by setting applicable I/O parameters.	
1	Brown-1		+24V input		
2	Red-1	000	Program start	No. 30	0: General-purpose input 1: Program start (input ports 007 to 013, BCD specification) 2: Program start (input ports 007 to 013, binary specification) 3: Program start (input ports 008 to 014, BCD specification) 4: Program start (input ports 008 to 014, binary specification)
3	Orange-1	001	General-purpose input	No. 31	0: General-purpose input 1: Soft reset signal
4	Yellow-1	002	General-purpose input	No. 32	0: General-purpose input 1: Servo ON signal
5	Green-1	003	General-purpose input	No. 33	0: General-purpose input 1: Auto program start upon power-ON reset or software reset in AUTO mode 2: Auto program start signal
6	Blue-1	004	General-purpose input	No. 34	0: General-purpose input 1: Software interlock of all servo axes (OFF level)
7	Purple-1	005	General-purpose input	No. 35	0: General-purpose input 1: Operation pause cancellation input (ON edge)
8	Gray-1	006	General-purpose input	No. 36	0: General-purpose input 1: Operation pause signal (OFF level)
9	White-1	007	Program number specification (MSB)	No. 37	0: General-purpose input 1: Program number specification (MSB)
10	Black-1	008	Program number specification (bit 2)	No. 38	0: General-purpose input 1: Program number specification (bit 2)
11	Brown-2	009	Program number specification (bit 3)	No. 39	0: General-purpose input 1: Program number specification (bit 3)
12	Red-2	010	Program number specification (bit 4)	No. 40	0: General-purpose input 1: Program number specification (bit 4)
13	Orange-2	011	Program number specification (bit 5)	No. 41	0: General-purpose input 1: Program number specification (bit 5)
14	Yellow-2	012	Program number specification (bit 6)	No. 42	0: General-purpose input 1: Program number specification (bit 6)
15	Green-2	013	Program number specification (LSB: bit 7)	No. 43	0: General-purpose input 1: Program number specification (LSB: bit 7)
16	Blue-2	014	General-purpose input	No. 44	0: General-purpose input 1: Drive-source cutoff cancellation (ON edge)
17	Purple-2	015	General-purpose input	No. 45	0: General-purpose input 1: Home return of all effective axes (ON edge) 2: Home return of all effective incremental axes (ON edge)
18	Gray-2	016	General-purpose input		
19	White-2	017	General-purpose input		
20	Black-2	018	General-purpose input		
21	Brown-3	019	General-purpose input		
22	Red-3	020	General-purpose input		
23	Orange-3	021	General-purpose input		
24	Yellow-3	022	General-purpose input		
25	Green-3	023	General-purpose input		
26	Blue-3	024	General-purpose input		
27	Purple-3	025	General-purpose input		
28	Gray-3	026	General-purpose input		
29	White-3	027	General-purpose input		
30	Black-3	028	General-purpose input		
31	Brown-4	029	General-purpose input		
32	Red-4	030	General-purpose input		
33	Orange-4	031	General-purpose input		

Output

Pin No.	Wire color	Port No.	Standard (factory-set) function		
34	Yellow-4	300	Output of operation-cancellation level or higher error (OFF)	No. 46	0: General-purpose output 1: Output of operation-cancellation level or higher error (ON) 2: Output of operation-cancellation level or higher error (OFF) 3: Output of operation-cancellation level or higher error + Emergency stop output (ON) 4: Output of operation-cancellation level or higher error + Emergency stop output (OFF)
35	Green-4	301	READY output (PIO-trigger program operation enabled AND no cold-start level or higher error) (Main application Ver.0.20 or later)	No. 47	0: General-purpose output 1: READY output (PIO-trigger program operation enabled) 2: READY output (PIO-trigger program operation enabled AND no operation-cancellation level or higher error) 3: READY output (PIO-trigger program operation enabled AND no cold-start level or higher error)
36	Blue-4	302	Emergency stop output (OFF)	No. 48	0: General-purpose output 2: Emergency stop output (ON) 3: Emergency stop output (OFF)
37	Purple-4	303	General-purpose output	No. 49	0: General-purpose output 1: AUTO mode output 2: Auto operation output (When other parameter No. 12 is set to ‘1’)
38	Gray-4	304	General-purpose output	No. 50	0: General-purpose output The following settings are effective only with XSEL-J/K: 1: Output when all effective axes are home (= 0) 2: Output when all effective axes have completed home return 3: Output when all effective axes are at home preset coordinate * To move an actuator of absolute encoder specification to coordinate 0 or the home preset coordinate, use a MOVP command instead of HOME command.
39	White-4	305	General-purpose output	No. 51	0: General-purpose output 2: Axis 1 servo ON output
40	Black-4	306	General-purpose output	No. 52	0: General-purpose output 2: Axis 2 servo ON output
41	Brown-5	307	General-purpose output	No. 53	0: General-purpose output 2: Axis 3 servo ON output
42	Red-5	308	General-purpose output	No. 54	0: General-purpose output 2: Axis 4 servo ON output
43	Orange-5	309	General-purpose output	No. 55	0: General-purpose output 2: Axis 5 servo ON output
44	Yellow-5	310	General-purpose output	No. 56	0: General-purpose output 2: Axis 6 servo ON output
45	Green-5	311	General-purpose output	No. 57	
46	Blue-5	312	General-purpose output	No. 58	
47	Purple-5	313	General-purpose output	No. 59	0: General-purpose output 1: System-memory backup battery voltage low alarm level or lower
48	Gray-5	314	General-purpose output	No. 60	0: General-purpose output 1: Absolute-battery backup battery voltage low alarm level or lower (OR check of all axes. If an error level is detected, this output is retained until power-ON reset or software reset.)
49	White-5	315	General-purpose output	No. 61	
50	Black-5		0V input		

- By default, the ON/OFF state of an input signal is recognized by the controller when the signal has remained ON/OFF for approx. 4msec or more.
- The setting for this ON/OFF duration can be changed using I/O parameter No. 20, “Input filtering period”.



[2] Virtual I/O Port
Should be the same as XSEL-P/Q/PCT/QCT [Refer to 2.1.2 XSEL-P/Q/PCT/QCT]

XSEL-PX/QX Virtual Input Ports (Internal Flags)

Port No.	Function
7000	Always OFF
7001	Always ON
7002	Voltage low warning for system memory backup battery
7003	Abnormal voltage of system memory backup battery
7004	(For future expansion = Use strictly prohibited)
7005	(For future expansion = Use strictly prohibited)
7006	Top level system error = Message level error is present
7007	Top level system error = Operation cancellation level error is present
7008	Top level system error = Cold start level error is present
7009	(For future expansion = Use strictly prohibited)
7010	Drive source cutoff factor is present (including when waiting for cutoff reset input)
7011	Latch signal indicating that all operation cancellation factor is present (latch signal for recognizing 1-shot cancellation factor; latch is cancelled by 7300 being ON)
7012	All operation pause factor is present (including when waiting for restart switch signal. Valid only during automatic operation recognition)
7013	All servo axis interlock factor is present (all operation pause factor + interlock input port factor)
7014	(For future expansion = Use strictly prohibited)
7015	Voltage low warning for axis 1 absolute data backup battery
7016	Abnormal voltage of axis 1 absolute data backup battery (latched until power on reset or software reset)
7017	Voltage low warning for axis 2 absolute data backup battery (main application version 0.28 or later)
7018	Abnormal voltage of axis 2 absolute data backup battery (latched until power on reset or software reset)
7019	Voltage low warning for axis 3 absolute data backup battery
7020	Abnormal voltage of axis 3 absolute data backup battery (latched until power on reset or software reset)
7021	Voltage low warning for axis 4 absolute data backup battery
7022	Abnormal voltage of axis 4 absolute data backup battery (latched until power on reset or software reset)
7023	Voltage low warning for axis 5 absolute data backup battery (valid only when the controller supports up to 6 axes)
7024	Abnormal voltage of axis 5 absolute data backup battery (latched until power on reset or software reset. Valid only when the controller supports up to 6 axes)
7025	Voltage low warning for axis 6 absolute data backup battery (valid only when the controller supports up to 6 axes)
7026	Abnormal voltage of axis 6 absolute data backup battery (latched until power on reset or software reset. Valid only when the controller supports up to 6 axes)
7027 to 7040	(For future expansion = Use strictly prohibited)
7041 to 7070	(For future expansion = Use strictly prohibited)
7071	In AUTO mode
7072	During automatic operation
7073 to 7100	(For future expansion = Use strictly prohibited)
7101	Running program No. 01 (including during pause)
~	~
7164	Running program No. 64 (including during pause)
7165	Running program No. 65 (including during pause) (Controller with increased memory size (with gateway function) only)
~	~
7228	Running program No. 128 (including during pause) (Controller with increased memory size (with gateway function) only)
7229 to 7299	(For future expansion = Use strictly prohibited)

XSEL-PX/QX Virtual Output Ports (Internal Flags)

Port No.	Function
7300	Latch cancellation output for a latch signal indicating that all operation cancellation factor is present (port 7011. The latch is cancelled only when operation cancellation factor is no longer present. 7300 will be turned OFF following an attempt to cancel latch)
7301 to 7380	(For future expansion = Use strictly prohibited)
7381 to 7399	(For future expansion = Use strictly prohibited)
7400 to 7599	(For future expansion = Use strictly prohibited)

2.1.4 XSEL-R/S Controllers

[1] Input and Output I/O Port

With XSEL-R/S controllers, input and output functions can be assigned to input and output ports as desired.
For input ports, set input functions using I/O parameters 30 to 45 (input function selections 000 to 015) and then use I/O parameters 283 to 298 to set the port numbers to assign the respective functions to.
For output ports, set output functions using I/O parameters 46 to 61 (output function selections 300 to 315) and then use I/O parameters 299 to 314 to set the port numbers to assign the respective functions to.
You can also use I/O parameters 331 to 346 (output function selections 300 (area 2) to 315 (area 2)) to set output functions and then use I/O parameters 315 to 330 to set the port numbers to assign the respective functions to.

Input

Pin No.	Wire color	Port No.	Standard (factory-set) function
1	Brown-1		+24V input
2	Red-1	000	Program start
3	Orange-1	001	General-purpose input
4	Yellow-1	002	General-purpose input
5	Green-1	003	General-purpose input
6	Blue-1	004	General-purpose input
7	Purple-1	005	General-purpose input
8	Gray-1	006	General-purpose input
9	White-1	007	Program number specification (MSB)
10	Black-1	008	Program number specification (bit 2)
11	Brown-2	009	Program number specification (bit 3)
12	Red-2	010	Program number specification (bit 4)
13	Orange-2	011	Program number specification (bit 5)
14	Yellow-2	012	Program number specification (bit 6)
15	Green-2	013	Program number specification (LSB: bit 7)
16	Blue-2	014	General-purpose input
17	Purple-2	015	General-purpose input
18	Gray-2	016	General-purpose input
19	White-2	017	General-purpose input
20	Black-2	018	General-purpose input
21	Brown-3	019	General-purpose input
22	Red-3	020	General-purpose input
23	Orange-3	021	General-purpose input
24	Yellow-3	022	General-purpose input
25	Green-3	023	General-purpose input
26	Blue-3	024	General-purpose input
27	Purple-3	025	General-purpose input
28	Gray-3	026	General-purpose input
29	White-3	027	General-purpose input
30	Black-3	028	General-purpose input
31	Brown-4	029	General-purpose input
32	Red-4	030	General-purpose input
33	Orange-4	031	General-purpose input

Remarks		
Inputs are set as shown in the table prior to the shipment, but you can change these input functions by setting applicable I/O parameters.		
Parameter No.	Parameter name	Function
No. 30	Input function selection 000	0: General-purpose input 1: Program start (input ports 007 to 013, BCD specification) 2: Program start (input ports 007 to 013, binary specification) 3: Program start (input ports 008 to 014, BCD specification) 4: Program start (input ports 008 to 014, binary specification)
No. 31	Input function selection 001	0: General-purpose input 1: Soft reset signal
No. 32	Input function selection 002	0: General-purpose input 1: Servo ON signal
No. 33	Input function selection 003	0: General-purpose input 1: Auto program start upon power-ON reset or software reset in AUTO mode 2: Auto program start signal
No. 34	Input function selection 004	0: General-purpose input 1: Software interlock of all servo axes (OFF level)
No. 35	Input function selection 005	0: General-purpose input 1: Operation pause cancellation input (ON edge)
No. 36	Input function selection 006	0: General-purpose input 1: Operation pause signal (OFF level)
No. 37	Input function selection 007	0: General-purpose input 1: Program number specification (MSB)
No. 38	Input function selection 008	0: General-purpose input 1: Program number specification (bit 2)
No. 39	Input function selection 009	0: General-purpose input 1: Program number specification (bit 3)
No. 40	Input function selection 010	0: General-purpose input 1: Program number specification (bit 4)
No. 41	Input function selection 011	0: General-purpose input 1: Program number specification (bit 5)
No. 42	Input function selection 012	0: General-purpose input 1: Program number specification (bit 6)
No. 43	Input function selection 013	0: General-purpose input 1: Program number specification (LSB: bit 7)
No. 44	Input function selection 014	0: General-purpose input 1: Drive-source cutoff cancellation (ON edge)
No. 45	Input function selection 015	0: General-purpose input 1: Home return of all effective axes (ON edge) 2: Home return of all effective incremental axes (ON edge)

Output

Pin No.	Wire color	Port No.	Standard Setting (in the delivery) Function	Remarks		
				When the unit is delivered, the output is set as shown in the table. However, the output function can be changed using the I/O parameter setting.		
				Parameter No. *1	Parameter Name	Function
34	YW-4	300	Error Output at the Operation Cancellation Level or more (OFF)	No.46 No.331	Output Function Selection 300 Output Function Selection 300 (Area 2)	0: Universal Output 1: Error Output at the Operation Cancellation Level or more (ON) 2: Error Output at the Operation Cancellation Level or more (OFF) 3: Error Output at the Operation Cancellation Level or more + Emergency-stop output (ON) 4: Error Output at the Operation Cancellation Level or more + Emergency-stop output (OFF)
35	GN-4	301	READY Output (PIO Trigger Program Operation Available and without occurrence of any error at the cold start level or more) (Main Application Ver. 0.20 or later)	No.47 No.332	Output Function Selection 301 Output Function Selection 301 (Area 2)	0: Universal Input 1: READY Output (PIO Trigger Program Operation Available) 2: READY Output (PIO Trigger Program Operation Available)and without occurrence of any error at the operation cancellation level or more 3: READY Output (PIO Trigger Program Operation Available)and READY Output (PIO Trigger Program Operation Available, and without occurrence of any error at the cold start level or more or more level or more
36	BL-4	302	Emergency-stop output (OFF)	No.48 No.333	Output Function Selection 302 Output Function Selection 302 (Area 2)	0: Universal Input 2: Emergency-stop output (ON) 3: Emergency-stop output (OFF)
37	PL-4	303	Universal Output	No.49 No.334	Output Function Selection 303 Output Function Selection 303 (Area 2)	0: Universal Output 1: AUTO Mode Output 2: Output during the Automatic Operation (In addition, when the parameter No. 12 is set to “1”)
38	GY-4	304	Universal Output	No.50 No.335	Output Function Selection 304 Output Function Selection 304 (Area 2)	0: Universal Output 1: Output at the time of “All Effective Axes Homing (=0)” 2: Output when all the effective axes homing is completed (Coordinates determined) 3: Output when all the effective axes home preset coordinates are set
39	WT-4	305	Universal Output	No.51 No.336	Output Function Selection 305 Output Function Selection 305 (Area 2)	0: Universal Output 1: Axis 1 in-position output (turned OFF when pressing missed) 2: Output during the Axis 1 servo ON
40	BK-4	306	Universal Output	No.52 No.337	Output Function Selection 306 Output Function Selection 306 (Area 2)	0: Universal Output 1: Axis 2 in-position output (turned OFF when pressing missed) 2: Output during the Axis 2 servo ON
41	BR-5	307	Universal Output	No.53 No.338	Output Function Selection 307 Output Function Selection 307 (Area 2)	0: Universal Output 1: Axis 3 in-position output (turned OFF when pressing missed) 2: Output during the Axis 3 servo ON
42	RD-5	308	Universal Output	No.54 No.339	Output Function Selection 308 Output Function Selection 308 (Area 2)	0: Universal Output 1: Axis 4 in-position output (turned OFF when pressing missed) 2: Output during the Axis 4 servo ON
43	OR-5	309	Universal Output	No.55 No.340	Output Function Selection 309 Output Function Selection 309 (Area 2)	0: Universal Output 1: Axis 5 in-position output (turned OFF when pressing missed) 2: Output during the Axis 5 servo ON
44	YW-5	310	Universal Output	No.56 No.341	Output Function Selection 310 Output Function Selection 310 (Area 2)	0: Universal Output 1: Axis 6 in-position output (turned OFF when pressing missed) 2: Output during the Axis 6 servo ON
45	GN-5	311	Universal Output	No.57 No.342	Output Function Selection 311 Output Function Selection 311 (Area 2)	0: Universal Output 1: Axis 7 in-position output (turned OFF when pressing missed) 2: Output during the Axis 7 servo ON (system monitoring task output)
46	BL-5	312	Universal Output	No.58 No.343	Output Function Selection 312 Output Function Selection 312 (Area 2)	0: Universal Output 1: Axis 8 in-position output (turned OFF when pressing missed) 2: Output during the Axis 8 servo ON (system monitoring task output)

Pin No.	Wire color	Port No.	Standard Setting (in the delivery) Function
47	PL-5	313	Universal Output
48	GY-5	314	Universal Output
49	WT-5	315	Universal Output
50	BK-5		0V Output

Remarks		
When the unit is delivered, the output is set as shown in the table. However, the output function can be changed using the I/O parameter setting.		
Parameter No. *1	Parameter Name	Function
No.59 No.344	Output Function Selection 313 Output Function Selection 313 (Area 2)	0: Universal Output 1: System Memory Backup Battery Low Voltage Alarm Level or less
No.60 No.345	Output Function Selection 314 Output Function Selection 314 (Area 2)	0: Universal Output
No.61 No.346	Output Function Selection 315 Output Function Selection 315 (Area 2)	0: Universal Output

- By default, the ON/OFF state of an input signal is recognized by the controller when the signal has remained ON/OFF for approx. 4msec or more.
- The setting for this ON/OFF duration can be changed using I/O parameter No. 20, “Input filtering period”.

[2] Virtual I/O Port

Virtual I/O ports are provided so that the controller can notify internal information. They are used to warn a low power-supply voltage, notify errors, etc. Use these ports as necessary.

XSEL-R/S/RX/SX/RXD/SXD Virtual Input Ports (Internal Flags)

Port No.	Function
7000	Always OFF
7001	Always ON
7002 to 7005	(Reserved by the system = Use is strictly prohibited)
7006	Critical system error = A message level error is present.
7007	Critical system error = An operation-cancellation level error is present.
7008	Critical system error = A cold-start level error is present.
7009	(Reserved by the system = Use is strictly prohibited)
7010	A cause of drive-source cutoff is present (including a condition waiting for a cutoff cancellation input).
7011	A latch signal indicating that a cause of all-operation cancellation is present. (This latch signal is used to recognize a cause of 1-shot reset. Latch cancellation: 7300-ON)
7012	A cause of all-operation pause is present (including a condition waiting for the restart switch to be pressed). (Effective only in the auto operation recognition mode)
7013	A cause of all-servo-axis interlock is present (cause of all-operation pause + cause of interlock input port)
7014	(Reserved by the system = Use is strictly prohibited)
7015	Axis 1 absolute-data backup battery voltage low warning
7016	Axis 1 absolute-data backup battery voltage error (Latched until power-ON reset or software reset)
7017	Axis 2 absolute-data backup battery voltage low warning
7018	Axis 2 absolute-data backup battery voltage error (Latched until power-ON reset or software reset)
7019	Axis 3 absolute-data backup battery voltage low warning
7020	Axis 3 absolute-data backup battery voltage error (Latched until power-ON reset or software reset)
7021	Axis 4 absolute-data backup battery voltage low warning
7022	Axis 4 absolute-data backup battery voltage error (Latched until power-ON reset or software reset)
7023	Axis 5 absolute-data backup battery voltage low warning
7024	Axis 5 absolute-data backup battery voltage error (Latched until power-ON reset or software reset)
7025	Axis 6 absolute-data backup battery voltage low warning
7025	Axis 6 absolute-data backup battery voltage error (Latched until power-ON reset or software reset)
7027	Axis 7 absolute-data backup battery voltage low warning
7028	Axis 7 absolute-data backup battery voltage error (Latched until power-ON reset or software reset)
7029	Axis 8 absolute-data backup battery voltage low warning
7030	Axis 8 absolute-data backup battery voltage error (Latched until power-ON reset or software reset)
7031 to 7040	(Reserved by the system = Use is strictly prohibited)
7041 to 7042	(For future expansion = Use is strictly prohibited)
7043	Axis 1 home return completion
7044	Axis 2 home return completion
~	~
7048	Axis 6 home return completion
7049	Axis 7 home return completion
7050	Axis 8 home return completion
7051 to 7069	(For future expansion = Use is strictly prohibited)
7070	(Reserved by the system = Use is strictly prohibited)
7071	In the AUTO mode
7072	During auto operation
7073 to 7074	(For future expansion = Use is strictly prohibited)
7075	During Tracking Conveyor Speed Drop Detection

XSEL-R/S/RX/SX/RXD/SXD Virtual Input Ports (Internal Flags)

Port No.	Function
7076	Tracking Operation Complete Work Position Arrival Latch Signal (Latches until “TRAC 1 nnn” or “Tracking Operation Execution Program Finish”)
7077	In Tracking Conveyor Tracking Complete Range
7078	Tracking Reversed Operation Detected Work Position Arrival Latch Signal (Latches until “TRAC 1 nnn” or “Tracking Operation Execution Program Finish”)
7079	During Tracking Mode (Work detection valid) (for SCARA controller only)
7080	During Tracking Operation (including a pause in tracking operation)
7081 to 7100	(Reserved by the system = Use is strictly prohibited)
7101	Program No. 01 is being executed (or paused).
7102	Program No. 02 is being executed (or paused).
7103	Program No. 03 is being executed (or paused).
~	~
7227	Program No. 127 is being executed (or paused).
7228	Program No. 128 is being executed (or paused).
7229 to 7299	(Reserved by the system = Use is strictly prohibited)

XSEL-R/S/RX/SX/RXD/SXD Virtual Output Ports (Internal Flags)

Port No.	Function
7300	A latch cancellation signal is output to cancel the latch signal indicating a cause of all-operation cancellation (7011). (Unlatched only when the cause of operation cancellation is no longer present.) (7300 is turned OFF after latch cancellation is attempted.)
7301 to 7380	(For future expansion = Use is strictly prohibited)
7381 to 7399	(Reserved by the system = Use is strictly prohibited)
7400 to 7599	(For future expansion = Use is strictly prohibited)

2.1.5 XSEL-RX/SX/RXD/SXD Controllers

[1] Input and Output I/O Port

With XSEL-RX/SX/RXD/SXD type controllers, the assignments of input and output functions to I/O ports are fixed and cannot be changed.

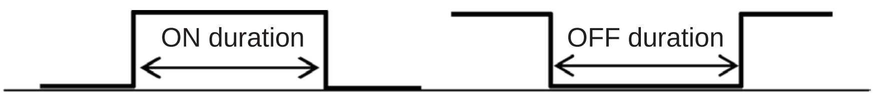
Input

Pin No.	Wire color	Port No.	Standard (factory-set) function	I/O parameter Inputs are set as shown in the table prior to the shipment, but you can change these input functions by setting applicable I/O parameters.	
1	Brown-1		+24V input		
2	Red-1	000	Program start	No. 30	0: General-purpose input 1: Program start (input ports 007 to 013, BCD specification) 2: Program start (input ports 007 to 013, binary specification) 3: Program start (input ports 008 to 014, BCD specification) 4: Program start (input ports 008 to 014, binary specification)
3	Orange-1	001	General-purpose input	No. 31	0: General-purpose input 1: Soft reset signal
4	Yellow-1	002	General-purpose input	No. 32	0: General-purpose input 1: Servo ON signal
5	Green-1	003	General-purpose input	No. 33	0: General-purpose input 1: Auto program start upon power-ON reset or software reset in AUTO mode 2: Auto program start signal
6	Blue-1	004	General-purpose input	No. 34	0: General-purpose input 1: Software interlock of all servo axes (OFF level)
7	Purple-1	005	General-purpose input	No. 35	0: General-purpose input 1: Operation pause cancellation input (ON edge)
8	Gray-1	006	General-purpose input	No. 36	0: General-purpose input 1: Operation pause signal (OFF level)
9	White-1	007	Program number specification (MSB)	No. 37	0: General-purpose input 1: Program number specification (MSB)
10	Black-1	008	Program number specification (bit 2)	No. 38	0: General-purpose input 1: Program number specification (bit 2)
11	Brown-2	009	Program number specification (bit 3)	No. 39	0: General-purpose input 1: Program number specification (bit 3)
12	Red-2	010	Program number specification (bit 4)	No. 40	0: General-purpose input 1: Program number specification (bit 4)
13	Orange-2	011	Program number specification (bit 5)	No. 41	0: General-purpose input 1: Program number specification (bit 5)
14	Yellow-2	012	Program number specification (bit 6)	No. 42	0: General-purpose input 1: Program number specification (bit 6)
15	Green-2	013	Program number specification (LSB: bit 7)	No. 43	0: General-purpose input 1: Program number specification (LSB: bit 7)
16	Blue-2	014	General-purpose input	No. 44	0: General-purpose input 1: Drive-source cutoff cancellation (ON edge)
17	Purple-2	015	General-purpose input	No. 45	0: General-purpose input 1: Home return of all effective axes (ON edge) 2: Home return of all effective incremental axes (ON edge)
18	Gray-2	016	General-purpose input		
19	White-2	017	General-purpose input		
20	Black-2	018	General-purpose input		
21	Brown-3	019	General-purpose input		
22	Red-3	020	General-purpose input		
23	Orange-3	021	General-purpose input		
24	Yellow-3	022	General-purpose input		
25	Green-3	023	General-purpose input		
26	Blue-3	024	General-purpose input		
27	Purple-3	025	General-purpose input		
28	Gray-3	026	General-purpose input		
29	White-3	027	General-purpose input		
30	Black-3	028	General-purpose input		
31	Brown-4	029	General-purpose input		
32	Red-4	030	General-purpose input		
33	Orange-4	031	General-purpose input		

Output

Pin No.	Wire color	Port No.	Standard (factory-set) function		
34	Yellow-4	300	Output of operation-cancellation level or higher error (OFF)	No. 46	0: General-purpose output 1: Output of operation-cancellation level or higher error (ON) 2: Output of operation-cancellation level or higher error (OFF) 3: Output of operation-cancellation level or higher error + Emergency stop output (ON) 4: Output of operation-cancellation level or higher error + Emergency stop output (OFF) 5: Error output of cold start level or more (ON) 6: Error output of cold start level or more (OFF)
35	Green-4	301	READY output (PIO-trigger program operation enabled AND no cold-start level or higher error) (Main application Ver.0.20 or later)	No. 47	0: General-purpose output 1: READY output (PIO-trigger program operation enabled) 2: READY output (PIO-trigger program operation enabled AND no operation-cancellation level or higher error) 3: READY output (PIO-trigger program operation enabled AND no cold-start level or higher error)
36	Blue-4	302	Emergency stop output (OFF)	No. 48	0: General-purpose output 2: Emergency stop output (ON) 3: Emergency stop output (OFF)
37	Purple-4	303	General-purpose output	No. 49	0: General-purpose output 1: AUTO mode output 2: Auto operation output (When other parameter No. 12 is set to ‘1’)
38	Gray-4	304	General-purpose output	No. 50	0: General-purpose output 1: Output at the time of “All Effective Axes Homing (=0)” 2: Output when all effective linear drive axis home-return operation is complete (coordinate is established) 3: Output when all the effective axes home preset coordinates are set * Use MOVP Command, not HOME Command, if moving the ABS encoder axes to the coordinate 0 or home preset coordinate.
39	White-4	305	General-purpose output	No. 51	0: General-purpose output 1: Axis 1 in-position output (turned OFF when pressing missed) 2: Output during the Axis 1 servo ON
40	Black-4	306	General-purpose output	No. 52	0: General-purpose output 1: Axis 2 in-position output (turned OFF when pressing missed) 2: Output during the Axis 2 servo ON
41	Brown-5	307	General-purpose output	No. 53	0: General-purpose output 1: Axis 3 in-position output (turned OFF when pressing missed) 2: Output during the Axis 3 servo ON
42	Red-5	308	General-purpose output	No. 54	0: General-purpose output 1: Axis 4 in-position output (turned OFF when pressing missed) 2: Output during the Axis 4 servo ON
43	Orange-5	309	General-purpose output	No. 55	0: General-purpose output 1: Axis 5 in-position output (turned OFF when pressing missed) 2: Output during the Axis 5 servo ON
44	Yellow-5	310	General-purpose output	No. 56	0: General-purpose output 1: Axis 6 in-position output (turned OFF when pressing missed) 2: Output during the Axis 6 servo ON
45	Green-5	311	General-purpose output	No. 57	0: General-purpose output 1: Axis 7 in-position output (turned OFF when pressing missed) 2: Output during the Axis 7 servo ON (system monitoring task output)
46	Blue-5	312	General-purpose output	No. 58	0: General-purpose output 1: Axis 8 in-position output (turned OFF when pressing missed) 2: Output during the Axis 8 servo ON (system monitoring task output)
47	Purple-5	313	General-purpose output	No. 59	0: General-purpose output 1: System-memory backup battery voltage low alarm level or lower
48	Gray-5	314	General-purpose output	No. 60	0: General-purpose output 1: Absolute-battery backup battery voltage low alarm level or lower (OR check of all axes. If an error level is detected, this output is retained until power-ON reset or software reset.)
49	White-5	315	General-purpose output	No. 61	
50	Black-5		0V input		

- By default, the ON/OFF state of an input signal is recognized by the controller when the signal has remained ON/OFF for approx. 4msec or more.
- The setting for this ON/OFF duration can be changed using I/O parameter No. 20, “Input filtering period”.



[2] Virtual I/O Port

Should be the same as XSEL-R/S. [Refer to 2.1.4 XSEL-R/S]

2.1.6 SSEL, ASEL, PSEL Controllers

[1] Input and Output I/O Port

With SSEL, ASEL and PSEL controllers, input and output functions can be assigned to input and output ports as desired.
For input ports, set input function setting values (0 to 23) in input function selections 000 to 015 (I/O parameters 30 to 45) corresponding to port No. 000 to 015 or input function selections 016 to 023 (I/O parameters 251 to 258) corresponding to port No. 16 to 23, and the set functions will be assigned.
For output ports, set output function setting values (0 to 17, 24, 25) in output function selections 300 to 307 (I/O parameters 46 to 53) corresponding to port No. 300 to 307, and the set functions will be assigned.

Program mode
Input

Pin No.	Wire color	Port No.	Standard (factory-set) function	Parameter No.	Parameter name	Input function setting value (factory setting)
1A	Brown 1	-	I/O power supply +24 V	-	-	-
1B	Red 1	016	Program No. 1 selection (MSB)	251	Input function selection 016	9
2A	Orange 1	017	Program No. 2 selection (bit 2)	252	Input function selection 017	10
2B	Yellow 1	018	Program No. 4 selection (bit 3)	253	Input function selection 018	11
3A	Green 1	019	Program No. 8 selection (bit 4)	254	Input function selection 019	12
3B	Blue 1	020	Program No. 10 selection (bit 5)	255	Input function selection 020	13
4A	Purple 1	021	Program No. 20 selection (bit 6)	256	Input function selection 021	14
4B	Gray 1	022	Program No. 40 selection (LSB: bit 7)	257	Input function selection 022	15
5A	White 1	023	Software reset	258	Input function selection 023	3
5B	Black 1	000	Program start	30	Input function selection 000	1
6A	Brown 2	001	General-purpose input	31	Input function selection 001	0
6B	Red 2	002	General-purpose input	32	Input function selection 002	0
7A	Orange 2	003	General-purpose input	33	Input function selection 003	0
7B	Yellow 2	004	General-purpose input	34	Input function selection 004	0
8A	Green 2	005	General-purpose input	35	Input function selection 005	0
8B	Blue 2	006	General-purpose input	36	Input function selection 006	0
9A	Purple 2	007	General-purpose input	37	Input function selection 007	0
9B	Gray 2	008	General-purpose input	38	Input function selection 008	0
10A	White 2	009	General-purpose input	39	Input function selection 009	0
10B	Black 2	010	General-purpose input	40	Input function selection 010	0
11A	Brown 3	011	General-purpose input	41	Input function selection 011	0
11B	Red 3	012	General-purpose input	42	Input function selection 012	0
12A	Orange 3	013	General-purpose input	43	Input function selection 013	0
12B	Yellow 3	014	General-purpose input	44	Input function selection 014	0
13A	Green 3	015	General-purpose input	45	Input function selection 015	0

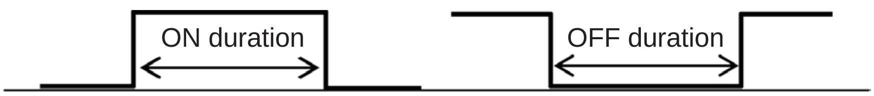
Input function setting value	Function
0	General-purpose input
1	Program start (BCD) (ON edge) signal
2	Program start (BIN) (ON edge) signal
3	Soft reset signal (ON for 1sec)
4	Servo ON signal (ON edge)
5	Auto program start signal (ON edge)
6	All-servo-axis software interlock (OFF level)
7	Operation pause cancellation input (ON edge)
8	Operation pause signal (OFF level)
9	Program number specification (MSB)
10	Program number specification (bit 2)
11	Program number specification (bit 3)
12	Program number specification (bit 4)
13	Program number specification (bit 5)
14	Program number specification (bit 6)
15	Program number specification (LSB: bit 7)
16	Error reset (ON edge)
17	Drive-source cutoff cancellation input (ON edge)
18	All-effective-axis home return command signal (ON edge)
19	All-effective-incremental-axis home return (ON edge)
20	PC/teaching pendant servo movement command acceptance input
21	Remote mode control input
22	Axis 1 forced brake release input
23	Axis 2 forced brake release input
24 to 27	Reserved by the system
24	Program number specification (bit 8)
25	Program number specification (bit 9)

Program mode
Output

Pin No.	Wire color	Port No.	Standard (factory-set) function	Parameter No.	Parameter name	Input function setting value (factory setting)	Input function setting value	Function
13B	Blue 3	300	Alarm output	46	Output function selection 300	2	0	General-purpose input
14A	Purple 3	301	Ready output	47	Output function selection 301	7	1	Output of operation-cancellation level or higher error (ON)
14B	Gray 3	302	General-purpose output	48	Output function selection 302	0	2	Output of operation-cancellation level or higher error (OFF)
15A	White 3	303	General-purpose output	49	Output function selection 303	0	3	Output of operation-cancellation level or higher error + Emergency stop output (ON)
15B	Black 3	304	General-purpose output	50	Output function selection 304	0	4	Output of operation-cancellation level or higher error + Emergency stop output (OFF)
16A	Brown 4	305	General-purpose output	51	Output function selection 305	0	5	READY output (PIO-trigger program operation enabled)
16B	Red 4	306	General-purpose output	52	Output function selection 306	0	6	READY output (PIO-trigger program operation enabled AND no operation-cancellation level or higher error)
17A	Orange 4	307	General-purpose output	53	Output function selection 307	0	7	READY output (PIO-trigger program operation enabled AND no cold-start level or higher error)
17B	Yellow 4	N	I/O power supply 0V	-	-	-	8	Emergency stop output (ON)
							9	Emergency stop output (OFF)
							10	AUTO mode output
							11	Auto operation output
							12	Output when all effective axes are home (= 0)
							13	Output when all effective axes have completed home return
							14	Output when all effective axes are at home preset coordinate
							15	System-memory backup battery (optional) voltage low warning output
							16	Absolute-data backup battery (optional) voltage low warning output
							17	Drive-source cutoff (SDN) notification output
							24	Axis 1 servo ON output
							25	Axis 2 servo ON output

*1 Output function setting values 1, 2, 3 and 4 cannot be assigned at the same time.
*2 Output function setting values 5, 6 and 7 cannot be assigned at the same time.

- By default, the ON/OFF state of an input signal is recognized by the controller when the signal has remained ON/OFF for approx. 4msec or more.
- The setting for this ON/OFF duration can be changed using I/O parameter No. 20, “Input filtering period”.



[2] Virtual I/O Port

Virtual I/O ports are provided so that the controller can notify internal information. They are used to warn a low power-supply voltage, notify errors, etc. Use these ports as necessary.

ASEL/PSEL/SSEL Virtual Input Ports (Internal Flags)

Port No.	Function
7000	Always OFF
7001	Always ON
7002	System-memory backup battery voltage low warning
7003	System-memory backup battery voltage error
7004	(Reserved by the system = Use is strictly prohibited)
7005	(Reserved by the system = Use is strictly prohibited)
7006	Critical system error = A message level error is present.
7007	Critical system error = An operation-cancellation level error is present.
7008	Critical system error = A cold-start level error is present.
7009	(Reserved by the system = Use is strictly prohibited)
7010	A cause of drive-source cutoff is present (including a condition waiting for a cutoff cancellation input).
7011	A latch signal indicating that a cause of all-operation cancellation is present. (This latch signal is used to recognize a cause of 1-shot reset. Latch cancellation: 7300-ON)
7012	A cause of all-operation pause is present (including a condition waiting for the restart switch to be pressed). (Effective only in the auto operation recognition mode)
7013	A cause of all-servo-axis interlock is present (cause of all-operation pause + cause of interlock input port)
7014	(Reserved by the system = Use is strictly prohibited)
7015	Axis 1 absolute-data backup battery voltage low warning
7016	Axis 1 absolute-data backup battery voltage error (Latched until power-ON reset or software reset)
7017	Axis 2 absolute-data backup battery voltage low warning
7018	Axis 2 absolute-data backup battery voltage error (Latched until power-ON reset or software reset)
7019 to 7026	(For future expansion = Use is strictly prohibited)
7027 to 7040	(Reserved by the system = Use is strictly prohibited)
7041, 7042	(For future expansion = Use is strictly prohibited)
7043	Axis 1 home return completion
7044	Axis 2 home return completion
7045 to 7070	(For future expansion = Use is strictly prohibited)
7071	In the AUTO mode
7072	During auto operation
7073 to 7100	(Reserved by the system = Use is strictly prohibited)
7101	Program No. 01 is being executed (or paused).
~	~
7164	Program No. 64 is being executed (or paused).
7165	Program No. 65 is being executed (or paused). ··· Dedicated only for SSEL with expanded memory capacity
~	~
7228	Program No. 128 is being executed (or paused). Dedicated only for SSEL with expanded memory capacity
7229 to 7299	(For future expansion = Use is strictly prohibited)

ASEL/PSEL/SSEL Virtual Output Ports (Internal Flags)

Port No.	Function
7300	A latch cancellation signal is output to cancel the latch signal indicating a cause of all-operation cancellation (7011). (Unlatched only when the cause of operation cancellation is no longer present.) (7300 is turned OFF after latch cancellation is attempted.)
7301 to 7380	(For future expansion = Use is strictly prohibited)
7381 to 7399	(Reserved by the system = Use is strictly prohibited)
7400 to 7599	(For future expansion = Use is strictly prohibited)

2.1.7 Tabletop Robot TT/TTA

[1] Input and Output I/O Port

With the tabletop robot TT, input and output functions can be assigned to input and output ports as desired.
For input ports, set input functions using I/O parameters 30 to 45 (input function selections 000 to 015) and then use I/O parameters 283 to 298 to set the port numbers to assign the respective functions to.
For output ports, set output functions using I/O parameters 46 to 61 (output function selections 300 to 315) and then use I/O parameters 299 to 314 to set the port numbers to assign the respective functions to.
You can also use I/O parameters 331 to 346 (output function selections 300 (area 2) to 315 (area 2)) to set output functions and then use I/O parameters 315 to 330 to set the port numbers to assign the respective functions to.

Input

Pin No.	Wire color	Port No.	Standard (factory-set) function
1	Brown 1	-	I/O power supply +24V
2	Red 1	016	General-purpose input
3	Orange 1	017	General-purpose input
4	Yellow 1	018	General-purpose input
5	Green 1	019	General-purpose input
6	Blue 1	020	General-purpose input
7	Purple 1	021	General-purpose input
8	Gray 1	022	General-purpose input
9	White 1	023	General-purpose input
10	Black 1	024	General-purpose input
11	Brown 2	025	General-purpose input
12	Red 2	026	General-purpose input
13	Orange 2	027	General-purpose input
14	Yellow 2	028	General-purpose input
15	Green 2	029	General-purpose input
16	Blue 2	030	General-purpose input
17	Purple 2	031	General-purpose input

Remarks

Inputs are set as general-purpose inputs, but you can change these input functions by setting applicable I/O parameters.

Parameter No.	Parameter name	Function
30	Input function selection 000*1	1: Program start
31	Input function selection 001	0: General-purpose input 1: Soft reset signal
32	Input function selection 002	0: General-purpose input 1: Soft reset signal
33	Input function selection 003	0: General-purpose input 1: Auto program start upon power-ON reset or software reset in AUTO mode 2: Auto program start signal
34	Input function selection 004	0: General-purpose input 1: Software interlock of all servo axes (OFF level)
35	Input function selection 005	0: General-purpose input 1: Operation pause cancellation input (ON edge)
36	Input function selection 006	0: General-purpose input 1: Operation pause signal (OFF level)
37	Input function selection 007*2	0: General-purpose input 1: Program number specification (LSB)
38	Input function selection 008*2	0: General-purpose input 1: Program number specification (bit 2)
39	Input function selection 009*2	0: General-purpose input 1: Program number specification (bit 3)
40	Input function selection 010*2	0: General-purpose input 1: Program number specification (bit 4)
41	Input function selection 011*2	0: General-purpose input 1: Program number specification (bit 5)
42	Input function selection 012*2	0: General-purpose input 1: Program number specification (bit 6)
43	Input function selection 013*2	0: General-purpose input 1: Program number specification (MSB: bit 7) 2: Error reset (ON edge)
44	Input function selection 014	0: General-purpose input 1: Drive-source cutoff cancellation (ON edge)
45	Input function selection 015	0: General-purpose input 1: Home return of all effective axes (ON edge) 2: Home return of all effective incremental axes (ON edge)

*1 If input function selection 000 (program start) is assigned to a port other than No. 000, the start switch on the front panel is disabled.
*2 If input function selections 007 to 013 (program selection switches) are assigned to ports other than No. 007 to 013, the program selection switches on the front panel are disabled.

Output

Pin No.	Wire color	Port No.	Standard (factory-set) function
18	Gray 2	316	General-purpose output
19	White 2	317	General-purpose output
20	Black 2	318	General-purpose output
21	Brown 3	319	General-purpose output
22	Red 3	320	General-purpose output
23	Orange 3	321	General-purpose output
24	Yellow 3	322	General-purpose output
25	Green 3	323	General-purpose output
26	Blue 3	324	General-purpose output
27	Purple 3	325	General-purpose output
28	Gray 3	326	General-purpose output
29	White 3	327	General-purpose output
30	Black 3	328	General-purpose output
31	Brown 4	329	General-purpose output
32	Red 4	330	General-purpose output
33	Orange 4	331	General-purpose output
34	Yellow 4	-	I/O power supply 0 V

Remarks		
Outputs are set as general-purpose outputs, but you can change these output functions by setting applicable I/O parameters.		
Parameter No.	Parameter name	Function
46 331	Output function selection 300[*3] Output function selection 300 (area 2)	0: General-purpose output 1: Output of operation-cancellation level or higher error (ON) 2: Output of operation-cancellation level or higher error (OFF) 3: Output of operation-cancellation level or higher error + Emergency stop output (ON) 4: Output of operation-cancellation level or higher error + Emergency stop output (OFF)
47 332	Output function selection 301[*3] Output function selection 301 (area 2)	0: General-purpose output 1: READY output (PIO-trigger program operation enabled) 2: READY output (PIO-trigger program operation enabled AND no operation-cancellation level or higher error) 3: READY output (PIO-trigger program operation enabled AND no cold-start level or higher error)
48 333	Output function selection 302[*3] Output function selection 302 (area 2)	0: General-purpose output 1: Emergency stop output (ON) 2: Emergency stop output (OFF)
49 334	Output function selection 303[*3] Output function selection 303 (area 2)	0: General-purpose output 1: AUTO mode output 2: Auto operation output (When other parameter No. 12 is set to '1')
50 335	Output function selection 304[*3] Output function selection 304 (area 2)	0: General-purpose output 1: Output when all effective axes are home (= 0) 2: Output when all effective axes have completed home return 3: Output when all effective axes are at home preset coordinate
51 336	Output function selection 305 Output function selection 305 (area 2)	0: General-purpose output 2: Axis 1 servo ON output
52 337	Output function selection 306 Output function selection 306 (area 2)	0: General-purpose output 2: Axis 2 servo ON output
53 338	Output function selection 307 Output function selection 307 (area 2)	0: General-purpose input 2: Axis 3 servo ON output
54 339	Output function selection 308 Output function selection 308 (area 2)	0: General-purpose output
55 340	Output function selection 309 Output function selection 309 (area 2)	0: General-purpose output
56 341	Output function selection 310 Output function selection 310 (area 2)	0: General-purpose output
57 342	Output function selection 311 Output function selection 311 (area 2)	0: General-purpose output
58 343	Output function selection 312 Output function selection 312 (area 2)	0: General-purpose output
59 344	Output function selection 313 Output function selection 313 (area 2)	0: General-purpose output
60 345	Output function selection 314 Output function selection 314 (area 2)	0: General-purpose output
61 346	Output function selection 315 Output function selection 315 (area 2)	0: General-purpose output

*3 Since output function selections 300 to 304 are assigned to LEDs in the panel window, the LEDs are disabled if parameters 46 to 50 are set as general-purpose outputs or port number assignments are changed using parameters 299 to 303.
If you want to output system signals to the I/O shown in the tables above, use output function selection area 2.

- By default, the ON/OFF state of an input signal is recognized by the controller when the signal has remained ON/OFF for approx. 4msec or more.
- The setting for this ON/OFF duration can be changed using I/O parameter No. 20, "Input filtering period".

[2] Virtual I/O Port

Virtual I/O ports are provided so that the controller can notify internal information. They are used to warn a low power-supply voltage, notify errors, etc. Use these ports as necessary.

TT/TTA Virtual Input Ports (Internal Flags)

Port No.	Function
7000	Always OFF
7001	Always ON
7002	System-memory backup battery voltage low warning (Note TTA is for system reservation)
7003	System-memory backup battery voltage error (Note TTA is for system reservation)
7004	Reserved by the system = Use is prohibited
7005	Reserved by the system = Use is prohibited
7006	Critical system error = A message level error is present.
7007	Critical system error = An operation-cancellation level error is present.
7008	Critical system error = A cold-start level error is present.
7009	Reserved by the system = Use is prohibited
7010	A cause of drive-source cutoff is present (including a condition waiting for a cutoff cancellation input).
7011	A latch signal indicating that a cause of all-operation cancellation is present. (This latch signal is used to recognize a cause of 1-shot reset. Latch cancellation: 7300-ON)
7012	A cause of all-operation pause is present (including a condition waiting for the restart switch to be pressed). (Effective only in the auto operation recognition mode)
7013	A cause of all-servo-axis interlock is present (cause of all-operation pause + cause of interlock input port)
7014 to 7050	Reserved by the system = Use is prohibited
7051 to 7070	For future expansion = Use is prohibited
7071	In the AUTO mode
7072	During auto operation
7073 to 7100	Reserved by the system = Use is prohibited
7101	Program No. 01 is being executed (or paused).
~	~ (Note TTA : Port No.7101 to 7228, program No.1 to 128 are being executed.)
7164	Program No. 64 is being executed (or paused).
7165 to 7299	For future expansion = Use is prohibited

TT Virtual Output Ports (Internal Flags)

Port No.	Function
7300	A latch cancellation signal is output to cancel the latch signal indicating a cause of all-operation cancellation (7011). (Unlatched only when the cause of operation cancellation is no longer present.) (7300 is turned OFF after latch cancellation is attempted.)
7301 to 7380	(For future expansion = Use is strictly prohibited)
7381 to 7399	(Reserved by the system = Use is strictly prohibited)
7400 to 7599	(For future expansion = Use is strictly prohibited) (Note TTA : Port No.7401 to 7527, Program No.129 to 255 are being executed.)

2.1.8 MSEL Controller

[1] Input and Output I/O Port

In Input Function Select No. 000 to 015 and Output Function Select No. 300 to 315, dedicated functions can be set, and they can be assigned to desired input and output ports.
For input ports, set input functions using I/O parameters 30 to 45 (input function selections 000 to 015) and then use I/O parameters 283 to 298 to set the port numbers to assign the respective functions to.
For output ports, set output functions using I/O parameters 46 to 61 (output function selections 300 to 315) and then use I/O parameters 299 to 314 to set the port numbers to assign the respective functions to.
For other I/O port Nos., they can be used freely as the universal I/O port.

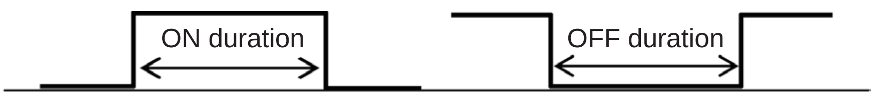
(1) Input Port Function Assignment

Input function selection No.	Parameter No.		Setting values	Input Signal Functions	Setting at delivery
000	No.30		0	General-purpose input	
			1	Program start (Indicated input port = 007 to 014, Start of program number indicated in BCD ... ON edge)	○
			2	Program start (Indicated input port = 007 to 014, Start of program number indicated in binary ... ON edge)	
001	No.31		0	General-purpose input	○
			1	Software reset signal (Kept on continuously for 1sec)	
002	No.32		0	General-purpose input	○
			1	Servo ON signal (Edge input)	
003	No.33		0	General-purpose input	
			1	Indicated program automatically starts by power-on reset / software reset in AUTO Mode	○
			2	Start of Auto Start Program (kept on continuously for 100ms)	
004	No.34		0	General-purpose input	○
			1	Software interlock on all servo axes (level signal with always being on)	
005	No.35		0	General-purpose input	○
			1	Operation pause cancellation input（On-edge process signal）	
006	No.36		0	General-purpose input	○
			1	Operation pause cancellation input（level signal with always being on）	
007	No.37	Independent from value in Input Function Select 000	0	General-purpose input	
		When Input Function Select 000 = 1	1	Program number specification 0 bit	○
		When Input Function Select 000 = 2			
008	No.38	Independent from value in Input Function Select 000	0	General-purpose input	
		When Input Function Select 000 = 1	1	Program number specification 1 bit	○
		When Input Function Select 000 = 2			
009	No.39	Independent from value in Input Function Select 000	0	General-purpose input	
		When Input Function Select 000 = 1	1	Program number specification 2 bit	○
		When Input Function Select 000 = 2			
010	No.40	Independent from value in Input Function Select 000	0	General-purpose input	
		When Input Function Select 000 = 1	1	Program number specification 3 bit	○
		When Input Function Select 000 = 2			
011	No.41	Independent from value in Input Function Select 000	0	General-purpose input	
		When Input Function Select 000 = 1	1	Program number specification 4 bit	○
		When Input Function Select 000 = 2			
012	No.42	Independent from value in Input Function Select 000	0	General-purpose input	
		When Input Function Select 000 = 1	1	Program number specification 5 bit	○
		When Input Function Select 000 = 2			
013	No.43	Independent from value in Input Function Select 000	0	General-purpose input	
		When Input Function Select 000 = 1	1	Program number specification 6 bit	○
		When Input Function Select 000 = 2			
014	No.44	Independent from value in Input Function Select 000	0	General-purpose input	
		When Input Function Select 000 = 1	1	Program number specification 7 bit	○
		When Input Function Select 000 = 2			
015	No.45		0	General-purpose input	○

(2) Output Port Function Assignment

Input function selection No.	Parameter No.	Setting values	Input Signal Functions	Setting at delivery
300	No.46	0	General-purpose output	
		1	Output of operation-cancellation level or higher error (ON)	
		2	Output of operation-cancellation level or higher error (OFF)	○
		3	Output of operation-cancellation level or higher error + Emergency stop output (ON)	
		4	Output of operation-cancellation level or higher error + Emergency stop output (OFF)	
		5	Error output of cold start level or more (ON)	
		6	Error output of cold start level or more (OFF)	
		7	Message level related to maintenance information alarm function (ON) for error output of (Error No. 231 to 232)	
		8	Message level related to maintenance information alarm function (OFF) for error output of (Error No. 231 to 232)	
301	No.47	0	General-purpose output	
		1	READY output (PIO-trigger program operation enabled)	
		2	READY output (PIO-trigger program operation enabled AND no operation-cancellation level or higher error)	
		3	READY output (PIO-trigger program operation enabled AND no cold-start level or higher error)(ON)	○
302	No.48	0	General-purpose output	
		1	Emergency stop output（ON）	
		2	Emergency stop output（OFF）	○
303	No.49	0	General-purpose output	○
304	No.50	0	General-purpose output	○
305	No.51	0	General-purpose output	○
306	No.52	0	General-purpose output	○
307	No.53	0	General-purpose output	○
308	No.54	0	General-purpose output	○
309	No.55	0	General-purpose output	○
310	No.56	0	General-purpose output	○
311	No.57	0	General-purpose output	○
312	No.58	0	General-purpose output	○
313	No.59	0	General-purpose output	○
314	No.60	0	General-purpose output	○
315	No.61	0	General-purpose output	○

- By default, the ON/OFF state of an input signal is recognized by the controller when the signal has remained ON/OFF for approx. 4msec or more.
- The setting for this ON/OFF duration can be changed using I/O parameter No. 20, “Input filtering period”.



[2] Virtual I/O Port

Virtual I/O ports are provided so that the controller can notify internal information. They are used to warn a low power-supply voltage, notify errors, etc. Use these ports as necessary.

MSEL Virtual Input Ports (Internal Flags)

Port No.	Function
7000	Always OFF
7001	Always ON
7002	Reserved by the system
7003	Reserved by the system
7004	Reserved by the system
7005	Reserved by the system
7006	Critical system error = A message level error is present.
7007	Critical system error = An operation-cancellation level error is present.
7008	Critical system error = A cold-start level error is present.
7009	Reserved by the system
7010	A cause of drive-source cutoff is present (including a condition waiting for a cutoff cancellation input).
7011	A latch signal indicating that a cause of all-operation cancellation is present. (This latch signal is used to recognize a cause of 1-shot reset. Latch cancellation: 7300-ON)
7012	A cause of all-operation pause is present (including a condition waiting for the restart switch to be pressed). (Effective only in the auto operation recognition mode)
7013	A cause of all-servo-axis interlock is present (cause of all-operation pause + cause of interlock input port)
7014 to 7050	Reserved by the system
7051 to 7070	For future expansion
7071	In the AUTO mode
7072	During auto operation
7073 to 7100	Reserved by the system
7101	Program No. 01 is being executed (or paused).
~	~
7228	Program No. 128 is being executed (or paused).
7229 to 7299	For future expansion

MSEL Virtual Output Ports (Internal Flags)

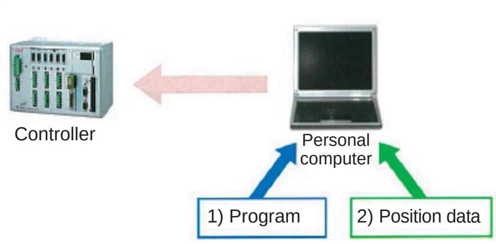
Port No.	Function
7300	A latch cancellation signal is output to cancel the latch signal indicating a cause of all-operation cancellation (7011). (Unlatched only when the cause of operation cancellation is no longer present.) (7300 is turned OFF after latch cancellation is attempted.)
7301 to 7380	For future expansion
7381 to 7399	Reserved by the system
7400	For future expansion
7401	Program No. 129 is being executed (or paused).
~	
7527	Program No. 255 is being executed (or paused).
7528 to 7599	For future expansion

3. Program

3.1 Position Table and Program Format

To run the robot,
- Program
- Position data
  (information of positions for the robot to move)

it is necessary to create 2 types of data as shown below and input them to the controller with using PC.

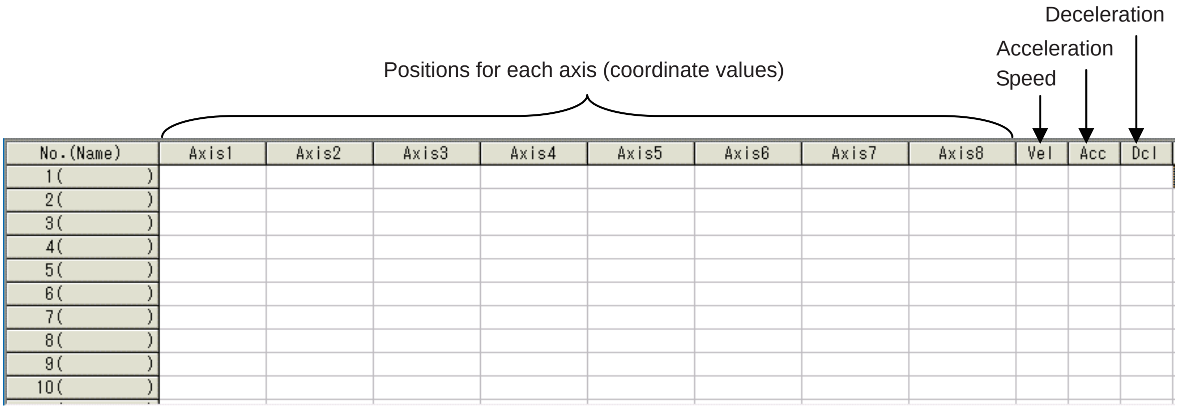


3.1.1 Position Table

The position data is to be input in the position table provided in the PC software.
(Note) • The edit window differs depending on the type of robot.
• The total number of settable positions differ depending on the controller

Controller	Position Total Number
XSEL-P/Q/PCT/QCT, PX/QX	20000
XSEL-R/S/RX/SX/RXD/SXD	53332 (1-axis specification) 40000 (2-axis specification) 32000 (3-axis specification) 26666 (4-axis specification) 22856 (5-axis specification) 20000 (6-axis specification) 17776 (7-axis specification) 16000 (8-axis specification)
XSEL-J/K/KE/KT/KET JX/KX/KETX	3000
SSEL	20000
ASEL/PSEL	1500
TT	3000
TTA	30000
MSEL	30000

[1] Single/rectangular axes, TT robots
Set positions (coordinate values), speeds, accelerations and decelerations in the position table and store the table in the controller.



● Axes 1 to 8: Position (coordinate value)
Set the positions (coordinates) for all the connected axes (8 axes at maximum).
The setting range varies depending on the actuator.
The maximum range is from -99999.999 to 99999.999.

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8
Single/rectangular axes	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8

● Comment Column (shown on the right side of the position data)
- Input is available up to 32 words with half width characters and 16 with full width at the maximum.
- Comment can be added to Positions No. 1 to 10000.
- Comment needs to be written to flash ROM after the data is transferred.

(Note 1) When having the software reset conducted or the power turned OFF without writing the position data to the flash ROM after a change is made to a comment, 22B “Position Data Comment Lost Error” will occur and the comment that a change was made will be deleted.
It is only the comment which is lost, and the program operation is available.

(Note 2) Comment is applicable also for PCLR (Position Data Clear) Command and PCPY (Position Data Copy) Command in SEL Program.
Therefore, in case that the position data with a comment being set is cleared by PCLR Command, or that a copy is made to the position with a comment being set in the area to copy from or area to copy to with PCPY Command, if the software reset is conducted or the power is turned OFF without the position data being written to the flash ROM, 22B “Position Data Comment Lost Error” will occur.
Please understand this well when using PCLR or PCPY.

- Vel (speed), Acc (acceleration), Dcl (deceleration)
  If Vel (speed), Acc (acceleration) and Dcl (deceleration) are set in the position data table, the values set in the position data table are given priority over the corresponding data set in the program.
  To make the Vel (speed), Acc (acceleration) and Dcl (deceleration) settings in the program effective, leave these fields blank.

The effective values of speed and acceleration are determined based on the priorities specified below.

Priority	Speed	Acceleration (Deceleration)
1	Value set in the position data table	Value set in the position data table
2	Value set in the VEL command	Value set in the ACC (DCL) command
3		All-axis parameter No. 11, "Default acceleration" (All-axis parameter No. 12, "Default deceleration")

The setting ranges vary depending on the actuator.

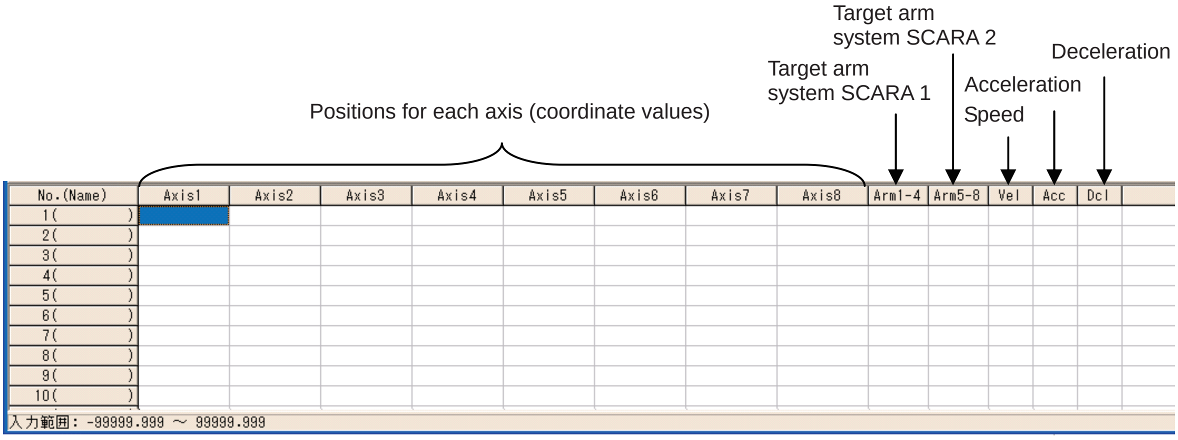
- Speed: 1 to the value of all-axis common parameter No. 21, “Maximum operating speed”
- Acceleration: 0.01 to the value of all-axis common parameter No. 22, “Maximum acceleration”
- Deceleration: 0.01 to the value of all-axis common parameter No. 23, “Maximum deceleration”

With rotational axes, values in mm are handled in degrees.
If Axis-specific parameter No. 1, “Axis operation type” is set to 1 (Rotational movement axis (angle control)), all values indicated in mm (including parameters, etc.) are converted to angles (in degrees).
These angles (in degrees) indicate angles (in degrees) of a rotating body at the end, as long as the gear ratio parameters (Axis-specific parameter No. 50, 51) are set correctly.

Example)	Distance	1mm	→	1deg
	Speed	1mm/sec	→	1deg/sec
	Acceleration/deceleration	1G = 9807mm/sec^2		
			→	9807deg/sec^2

[2] SCARA robots

Set positions (coordinate values), target arm system indications, speeds, accelerations and decelerations in the position table and store the table in the controller.



- Axes 1 to 8: Position (coordinate value)
  Set the positions (coordinates) for all the connected SCARA robots (8 axes at maximum).
  The setting range varies depending on the actuator.
  The maximum range is from -99999.999 to 99999.999.

SCARA robots 1				SCARA robots 2			
Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8
X-axis	Y-axis	Z-axis	R-axis	X-axis	Y-axis	Z-axis	R-axis

- Arm1-4, Arm5-8: Target arm system indications (for XSEL-RX/SX/RXD/SXD, MSEL-PCX/PGX (Arm1-4) only)
  Indicate the arm system at PTP movement. (R: right arm system, L: left arm system)
  The indications become valid when:
  1) an operation is made with “Move” in the position data edit window or “Continuous Move” button, or
  2) when SEL program PTP movement command is executed using the position data

(Note 1) Unless otherwise the target arm system is indicated, the operation will be made with the current arm system.

(Note 2) The priority is put in the order as shown below to the indication of the target arm systems when PTP movement command is executed by SEL program.
1) Position data settings
2) SEL command (Settings for PTPR, PTPL, PTPD and PTPE)

(Note 3) Error No. B4D “Arm System Setting Error” would be issued if the current arm system and the target arm system are different at CP movement.

- Vel (speed), Acc (acceleration), Dcl (deceleration)
  If Vel (speed), Acc (acceleration) and Dcl (deceleration) are set in the position data table, the values set in the position data table are given priority over the corresponding data set in the program.
  To make the Vel (speed), Acc (acceleration) and Dcl (deceleration) settings in the program effective, leave these fields blank.
  Only for CP operation (*1) the speeds, accelerations and decelerations set in the position table become effective.
  (*1) CP operation is a type of operation in which the axes interpolates with one another to move to the target position. CP operation may be performed in the form of linear movement, arc movement, etc. If the axes do not interpolate with one another, such operation is called “PTP operation”.

The effective values of speed and acceleration are determined based on the priorities specified below.

Priority	Speed	Acceleration (Deceleration)
1	Value set in the position data table	Value set in the position data table
2	Value set in the VEL command	Value set in the ACC (DCL) command
3		All-axis parameter No. 11, "Default acceleration" (All-axis parameter No. 12, "Default deceleration")

The setting ranges vary depending on the actuator.

- Speed: 1 to the value of all-axis common parameter No. 21, “Maximum operating speed”
- Acceleration: 0.01 to the value of all-axis common parameter No. 22, “Maximum acceleration”
- Deceleration: 0.01 to the value of all-axis common parameter No. 23, “Maximum deceleration”

With rotational axes, values in mm are handled in degrees.
If Axis-specific parameter No. 1, “Axis operation type” is set to 1 (Rotational movement axis (angle control)), all values indicated in mm (including parameters, etc.) are converted to angles (in degrees).
These angles (in degrees) indicate angles (in degrees) of a rotating body at the end, as long as the gear ratio parameters (Axis-specific parameter No. 50, 51) are set correctly.

Example) Distance 1mm → 1deg
Speed 1mm/sec → 1deg/sec
Acceleration/deceleration 1G = 9807mm/sec^2
→ 9807deg/sec^2

3.2 Program

Create a program using the “SEL Language” which is a proprietary language by IAI.

(Note) The number of programs and total number steps vary depending on the controller.

Controller	Number of programs	Total number of program steps
XSEL-P/Q/PCT/QCT/PX/QX/ R/S/RX/SX/RXD/SXD	128	9999
XSEL-J/K/KE/KT/KET JX/KX/KETX	64	6000
SSEL	128	9999
ASEL/PSEL	64	2000
TT	64	6000
TTA	256	9999
MSEL	256	9999

3.3 Program Format

[1] Program Edit

The program is to be input to the program edit window in the PC software.
The created program is to be transferred to the controller to be activated.

SEL language is translated by a step number (1 line) to another for the operation. Thus, it is unnecessary to compile (translate into the computer language).

No.	B	E	N	Cnd	Cmnd	Operand1	Operand2	Pst	Comment
3					VEL	100			
4					ACC	0.3			
5					TAG	1			
6					EXSR	5			
7					MOVP	10			
8					MOVP	11			
9					TIMW	0.3			
10					EXSR	5			
11					MOVP	15			
12					EXSR	6			
13					TIMW	0.2			
14					MOVP	16			
15					VEL	300			
16					EXSR	1			
17					MOVP	20			

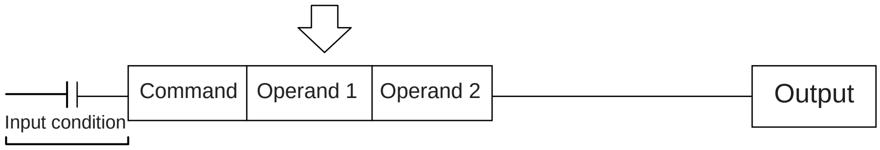
Step No.
Expansion Condition
Input Condition
Input Condition
Command and Declaration
Operand 1
Operand 2
Output

The program edit window is created in a program format (table format) and you are only to input the information for position, command, etc. to the appropriate areas.
In the following, explains about the program format.

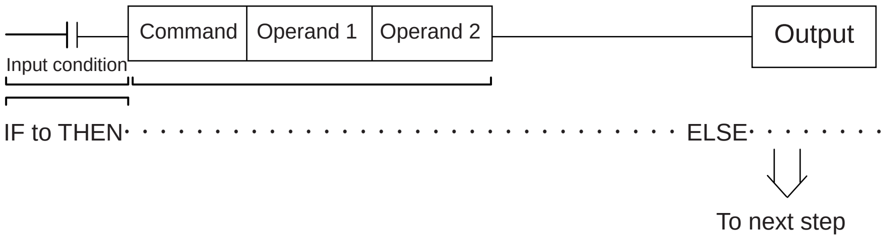
[2] Program Format

Extension condition (AND, OR)	Input condition (I/O, flag)	Command, declaration			Output (Output port, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand1	Operand2	Pst

The above is illustrated as follows in a ladder diagram.

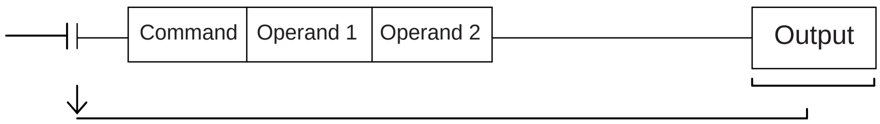


(1) The conditions in front of the command are equivalent to “IF to THEN” for the BASIC language.



1) The command will be executed if the input conditions meet the requirement. If there is an indication for the output, it turns the output port on, and if the input conditions do not meet the requirement, it moves to the next step.
2) If no condition is set, the command is executed unconditionally.
3) To use the condition in reverse (using the so-called contact b logic), add “N” (NOT) to the condition.
4) You can use an input port, output port or flag for the input condition.
5) Operands 1 and 2, and the output, can be specified indirectly.

(2) Operation of the output, specified after the command and operands 1 and 2, is explained below.



1) In the case of an actuator operation control command, etc., the output turns OFF the moment the command execution is started and turns ON when the execution is completed. In the case of a calculation command, etc., the output turns ON when the result becomes a certain value and turns OFF with other values.
2) You can use an output port or flag for the output.

[Application] Extended condition

You can combine extended conditions in a complex manner using the AND gate and OR gate.

(Example)

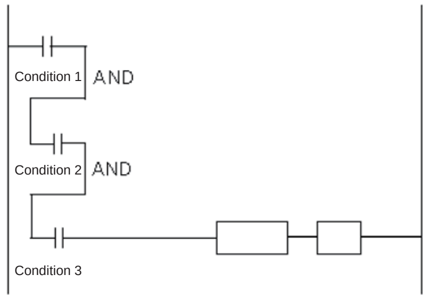
[Extension by AND]

Combination of A (AND) and A (AND)

(SEL language)

Extension condition	Input condition	Command			Output
		Command	Operand 1	Operand 2	
	Condition 1				
A	Condition 2				
A	Condition 3	Command	Operand 1	Operand 2	

(Ladder diagram)



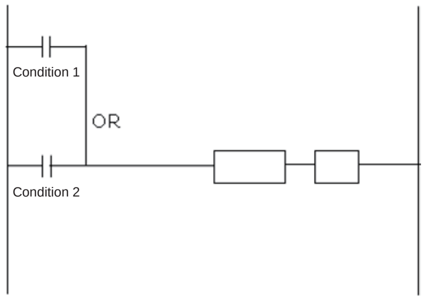
[Extension by OR]

Combination of O (OR) and O (OR)

(SEL language)

Extension condition	Input condition	Command			Output
		Command	Operand 1	Operand 2	
	Condition 1				
○	Condition 2	Command	Operand 1	Operand 2	

(Ladder diagram)



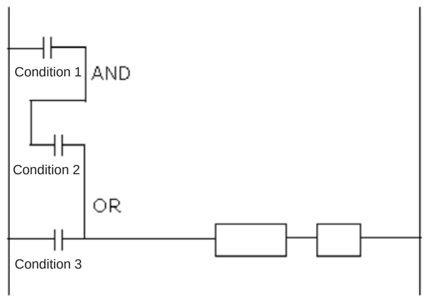
[Extension by AND and OR]

Combination of A (AND) and O (OR)

(SEL language)

Extension condition	Input condition	Command			Output
		Command	Operand 1	Operand 2	
	Condition 1				
A	Condition 2				
○	Condition 3	Command	Operand 1	Operand 2	

(Ladder diagram)



3.4 Relationship of program and position table

In the case of a movement command such as MOVL, set a position number in operand 1. Some commands such as ARCH (arch motion) require a position number to be set in operand 2, as well.
The position corresponding to the position number set in the position table is referenced and the actuator moves to the applicable position.

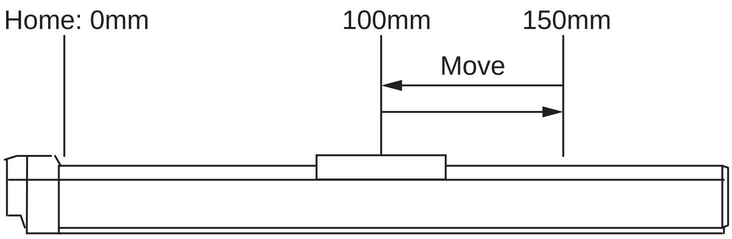
Program format

No.	B	E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
1					HOME	1			原点復帰
2					VEL	100			速度設定100mm/sec
3					TAG	1			
4					MOVL	1			P1移動
5					MOVL	2			P2移動
6					GOTO	1			
7									

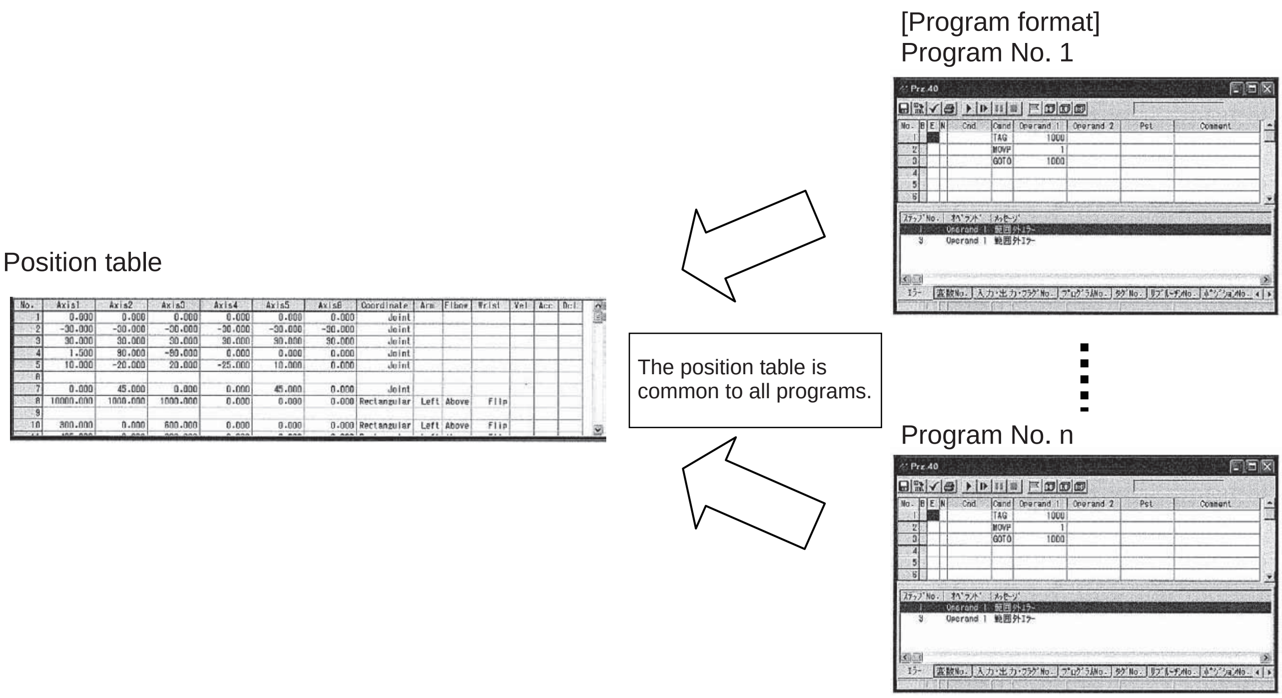
Position table

No.	Axis1
1	100.000
2	150.000
3	
4	
5	
6	
7	

In the above example, the actuator moves to the positions at 100mm corresponding to position No. 1 and 150mm corresponding to position No. 2.



The position table is a single table that can be referenced from all programs. In the example below, the standard position table is used. A different table is used if the controller has a gateway function.
(Note) For RC Gateway Function, a different position table is to be used.
[Refer to the Instruction Manual for XSEL Controller P/Q/PX/QX RC Gateway Function.]



3.5 Basic Stage (Program creation and position table creation)

In this section, explains how to create a program for the basic operation patterns.

3.5.1 Home Return and Home Return Completion Signal

[1] Description

Output a signal to confirm completion of homing (incremental specification).
With the controller, a home return completion signal can be output using an I/O parameter.
However, the following explains how to output a home return completion signal within a program using a general-purpose output.
Once turned ON, a general-purpose output will remain ON even after the current program ends or other program is started. (It will turn OFF upon emergency stop, etc., but the ON status can be maintained using an I/O parameter (I/O parameter No. 70 and 71).)
(Note) SCARA robots do not require home return operation.

[2] Example of Use

a. Output a home return completion signal.

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst
			HOME	11		
			BTON	303		

Execute homing. (1st and 2nd axes)
Output 303 is turned ON when home-return operation is complete

b. Use a home return completion signal to make sure the actuator will not perform homing if it has already been performed.

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst
	N	303	HOME	11		
			BTON	303		

If output 303 is OFF (NOT);

Execute homing if output 303 is OFF.
Home-return complete output
(turn Output 303 ON)

c. Use the output field instead of a BTON command.

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst
	N	303	HOME	11		303

Output section

The same process as Example b. is proceeded.

[3] Reference

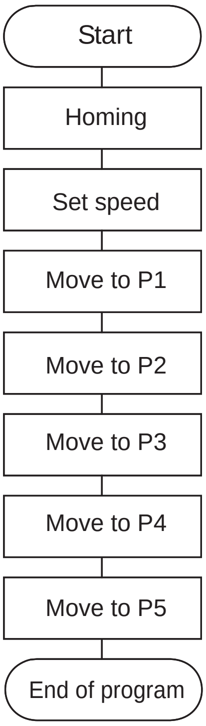
Output port No. 304 can be used as a home return completion output (dedicated output) by setting I/O parameter No. 50 to “2”.

3.5.2 Positioning Operation (Moving position)

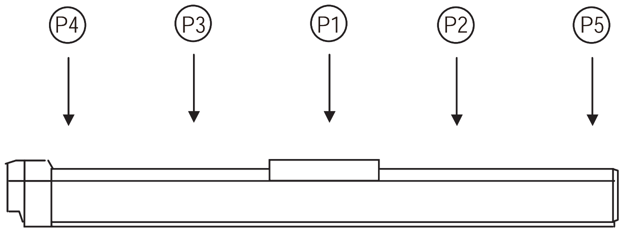
[1] Description
Move the actuator to positions 1 through 5 at a speed of 100mm/sec after homing.

[2] Example of Use

Flowchart



- Homing must be performed and a speed must be set, before the actuator can be operated.
- The actuator moves to the position data coordinates specified by the respective move commands.
- With the absolute specification, homing (HOME command) is not required.



Program (Example)

No.	B	E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
1					HOME	1			1軸原点復帰
2					VEL	100			速度設定100mm/sec
3					MOVL	1			ポジションデータNo.1に移動
4					MOVL	2			ポジションデータNo.2に移動
5					MOVL	3			ポジションデータNo.3に移動
6					MOVL	4			ポジションデータNo.4に移動
7					MOVL	5			ポジションデータNo.5に移動
8					EXIT				ﾌﾟﾛｸﾞﾗﾑ終了
9									

Position data (Example)

No.	Axis1
1	100.000
2	150.000
3	50.000
4	0.000
5	200.000
6	
7	
8	
9	

3. Program

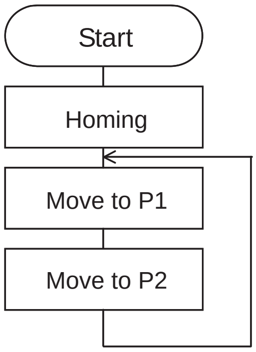
3.5.3 Moving Back and Forth between Two Points

[1] Description

Moves back and forth between two points.

[2] Example of Use

Flowchart



- The actuator moves back and forth between P1 and P2 indefinitely.
- Use of only 1 axis is assumed.
- Enter TAG in the first of the steps to be repeated, and enter GOTO in the last of the steps to be repeated.

Program (Example)

No.	B	E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
1					HOME	1			原点復帰
2					VEL	100			速度設定100mm/sec
3					TAG	1			
4					MOVL	1			ポジションデータNo.1に移動
5					MOVL	2			ポジションデータNo.2に移動
6					GOTO	1			TAG1 にジャンプ
7									

Position data (Example)

No.	Axis1
1	100.000
2	150.000
3	
4	
5	
6	
7	

3.5.4 Repeated Operation

[1] Description

Use GOTO and TAG commands to repeat the same operation within the program or to jump to a desired step if a condition is satisfied. A TAG command can be written in a step either before or after a GOTO command.

[2] Example of Use

Example 1

Repeat the same operation. (Move to Position 1 → to position 2 → to position 1 …)

```
             :
            TAG    1
Repeated.   MOVP   1  } Steps to be repeated
            MOVP   2
            GOTO   1
```

Example 2

Skip steps.

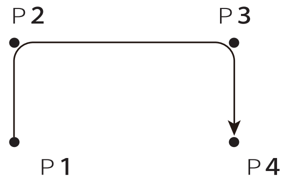
```
             :
            GOTO   2
Jump.       MOVP   1  } Steps to be ignored
            MOVP   2
            TAG    2
```

3.5.5 PATH Operation (Continuous operation among multiple positions)

[1] Description

This function moves the robot continuously among 4 arbitrary points. (PATH movement)

[2] Example of Use



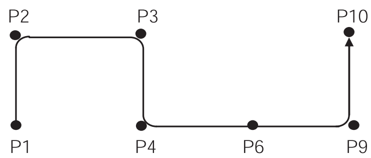
The actuator moves along the path shown at right, without stopping at P2 and P3.
Compared with MOVP and MOVL, this command does not require the actuator to position exactly at P2 and P3, and thus the movement tact time can be reduced.
Assume the following command is executed when the actuator is stopped at P1:

```
PATH  2  4
```

The actuator will move from P1 to P4 by passing points near P2 and P3.

Even if “PATH 2 3” and “PATH 4 4” are input successively, the actuator will still move in the same way as when “PATH 2 4” is input.

If “PATH 4 1” is executed while the actuator is stopped at P4, the actuator will move along the same path in the opposite direction (P4 → P3 → P2 → P1).



It is possible to move through discontinuous positions or move continuously by passing the same position.

```
PATH  1  4
PATH  6  6    discontinuous position
PATH  9  10
```

As shown above, specify the number corresponding to the discontinuous position, or No. 6, for both the start position number and end position number in the PATH command. The actuator moves continuously in the sequence of position Nos. P1 → P2 → P3 → P4 → P6 → P9 → P10.

[3] Example of Use

Refer to the page for “PATH” Command in [12] Actuator Control Command for each command language for the caution in use.

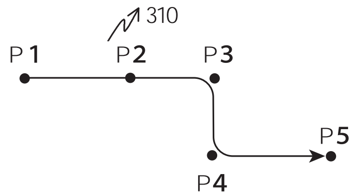
3.5.6 External Signal Output during Path Movement

[1] Description
Output signals while the actuator is moving with a PATH command.

[2] Example of Use
Before executing a PATH command, declare a POTP command to specify signal output during movement.
If a given output or global flag is specified in the output field of the PATH command, the output or flag specified in the output field will turn ON as the actuator approaches, via path movement, the position specified in the PATH command.

Example 1

The actuator moves from P1 to P5 along the positions shown at right, without stopping. As the actuator approaches P2, output port 310 turns ON.



Cmnd	Operand 1	Operand 2	Pst
VEL	100		
POTP	1		
PATH	1	1	
PATH	2	2	310
PATH	3	5	

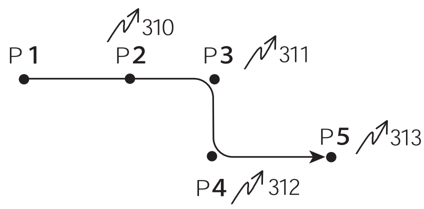
← A declaration command to specify signal output during path movement.
← 310 turns ON when the actuator approaches P2 specified in this step.

Example 2

Outputs 310 to 313 can be turned ON sequentially at the respective points of P2 to P5.

Cmnd	Operand 1	Operand 2	Pst
VEL	100		
POTP	1		
PATH	1	1	
PATH	2	5	310

← A declaration command to specify signal output during path movement.
← 310 to 313 turn ON sequentially at P2 to P5 specified in this step.



(Note) This command is able only to output and to turn the flag ON. The output or flag that was turned ON during path operation must be turned OFF (using a BTOF command) after the operation is completed.

[3] Example of Use
Refer to the page for "PATH" Command in [12] Actuator Control Command for each command language for the caution in use.

3.5.7 Circle/Arc Operation

[1] Description

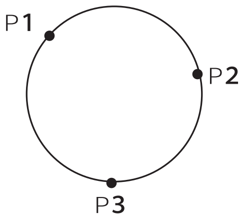
The actuator moves along a two-dimensional circle or arc.

[2] Example of Use

To specify a circle, specify three points the actuator will pass. To specify an arc, specify the starting point, passing point and end point.

Example 1

Circle



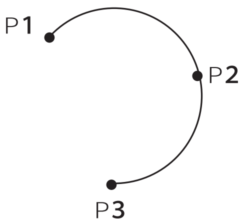
- Specify “CIR2 2 3” after the actuator has moved to P1.
- If “CIR2 2 3” is specified in the figure shown at left, the actuator will move along this circle clockwise.

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst
			VEL	100		
			MOVP	1		
			CIR2	2	3	

- To cause the actuator to move counterclockwise, specify “CIR2 3 2”.

Example 2

Arc



- Specify “ARC2 2 3” after the actuator has moved to P1.

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst
			VEL	100		
			MOVP	1		
			ARC2	2	3	

[3] Reference

1) Some circle and arc commands can be executed not only two-dimensionally (between two actuator axes) but also three dimensionally (among three actuator axes).

CIRS ·········· Move along circle three-dimensionally
ARCS ·········· Move along arc three-dimensionally

2) Refer to the page for “CIR2, ARC2, CIRS, ARCS” Command in [12] Actuator Control Command for each command language for the caution in use.

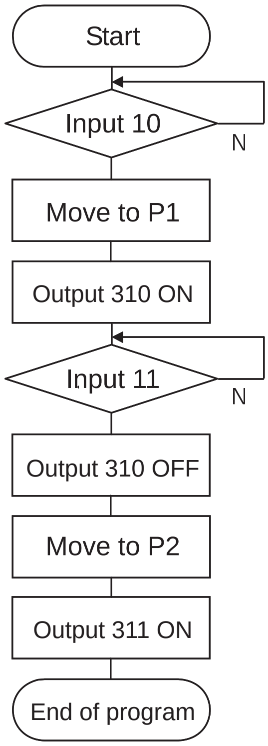
3.5.8 Axis Movement by External Signals and Output of Completion Signal to External Device

[1] Description

This is a function to enable the axes movement with an external signal input and to output the complete signal to an external device.

[2] Example of Use

Flowchart



Wait for the input port (external signal) 10 to turn ON, and then move to P1 (Position Data No. 1).
Wait for the input port (external signal) 11 to turn ON, and then move to P2 (Position Data No. 2).
The movement complete signal for P1 is output to the output port 310, and P2 complete signal to port 311.

Program (Example)

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
			VEL	100			速度100mm/sec設定
			WTON	10			入力10 ON待ち
			MOVP	1			P1移動
			BTON	310			出力310 ON
			WTON	11			入力11 ON待ち
			BTOF	310			出力310 OFF
			MOVP	2			P2移動
			BTON	311			出力311 ON
			EXIT				ﾌﾟﾛｸﾞﾗﾑ終了

3.5.9 Changing the Moving Speed

[1] Description
Change the moving speed.

[2] Example of Use
The speed can be set using the following two methods:
a: Use a VEL command within the program
b: Use a speed setting in the position table

Program (Example)

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst
			MOVP	1		P1移動
			VEL	1000		速度1000mm/sec設定
			MOVP	2		P2移動
			MOVP	3		P3移動
			VEL	50		速度50mm/sec設定
			MOVP	4		P4移動

Position data (Example)

No.	Axis1	Vel	Acc	Dcl
1	100.000	100		
2	200.000	500		
3	300.000			
4	400.000			

Each Position (Position Data No. 1 (P1) to No. 4 (P4))

Moving speeds in the above program
Position at 100mm (P1) … The actuator moves at 100mm/sec.
Position at 200mm (P2) … The actuator moves at 500mm/sec.
Position at 300mm (P3) … The actuator moves at 1000mm/sec.
Position at 400mm (P4) … The actuator moves at 50mm/sec.

If a speed is specified in the position data table, this speed takes precedence over the speed specified in the application program, as shown above.

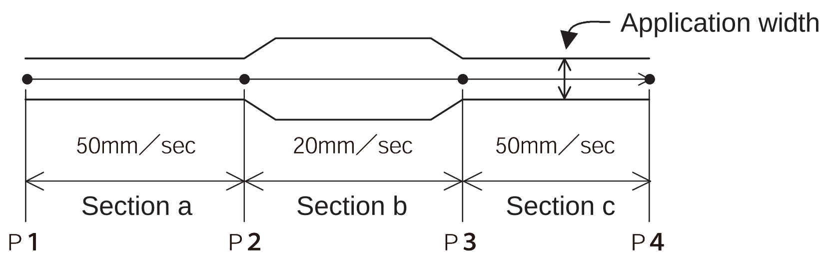
3.5.10 Speed Setting Change during PATH (Continuous) Operation

[1] Description

You can change the speed of the actuator without stopping it, by using a PATH command and VEL fields of the position table.
For example, this command is useful in a paint dispensing application where the application volume changes in the middle.

[2] Example of Use

The actuator moves through linear sections a, b and c at 50mm/sec, 20mm/sec and 50mm/sec, respectively, without stopping (PATH operation).



Position data (Example)

No.	Axis1	Vel	Acc	Dcl
1	0.000	50		
2	100.000	50		
3	200.000	20		
4	300.000	50		

Program (Example)
"PATH 1 4" is the only movement command required.

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst
			PATH	1	4	

[3] Reference

The speed can also be changed from other program using a CHVL (speed change) command.

3.5.11 Variables and Flags [Global/Local]

[1] Description

The internal variables and flags used in the SEL language are classified into local and global types.
The data range used commonly by all programs is called the global range, while the data range used only by each program is called the local range. When multi-tasking programs are run simultaneously, the global range must be used to synchronize the programs and allow cross-referencing of variables among the programs.

[2] Example of Use

Program handshake

Program A

Cmnd	Operand 1	
MOVL	1	Turn ON Output 600 →
BTON	600	
WTON	601	Waiting for Output 601 to turn ON
MOVL	3	

Program B

Cmnd	Operand 1	
WTON	600	Waiting for Output 600 to turn ON
MOVL	2	
BTON	601	Turn ON Output 601

Use of global flags with the above two programs permits handshake between the programs, and the actuator moves per “MOVL 1” in program A, moves per “MOVL 2” in program B, and then move per “MOVL 3” in program A, for example.

Backup in Battery

The XSEL controller (Note 1) has a built-in battery for retaining variables and flags used in the programs. The data is retained in the global domain for both variables and flags even if the power is turned OFF.
The variables and flags in the local range are cleared when the program is started (the variables are reset to “0”, while the flags turn OFF).

Note 1: XSEL-R/S/RX/SX/RXD/SXD do not have a system memory backup battery since they possess the global domain in the non-volatile memory.

The system-memory backup battery is optional for ASEL, PSEL and SSEL controllers.
No system-memory backup battery is available for TT robots.
If the system memory is not backed up with a battery, global areas will be cleared once the power is cut off.

3.5.12 How to Use Subroutines

[1] Description

A subroutine is a group of steps that are called and executed several times within a program. Subroutines are used to reduce the number of program steps and make the program easy to read. Up to 99 subroutines can be used in one program. Up to 15 subroutine calls can be nested.

[2] Example of Use

Declare/call subroutines using the following commands:

EXSR: Call a subroutine
BGSR: Declare the start of a subroutine (start of a group of steps)
EDSR: Declare the end of a subroutine (end of a group of steps)

Cmnd	Operand 1
VEL	100
MOVL	1
BTON	310
WTON	20
BTOF	310
MOVL	2
BTON	310
WTON	20
BTOF	310
MOVL	3
BTON	310
WTON	20
BTOF	310
EXIT	

The same tasks are consolidated into a single location.

Cmnd	Operand 1
VEL	100
MOVL	1
EXSR	1
MOVL	2
EXSR	1
MOVL	3
EXSR	1
EXIT	
BGSR	1
BTON	310
WTON	20
BTOF	310
EDSR	

Subroutine

[3] Note

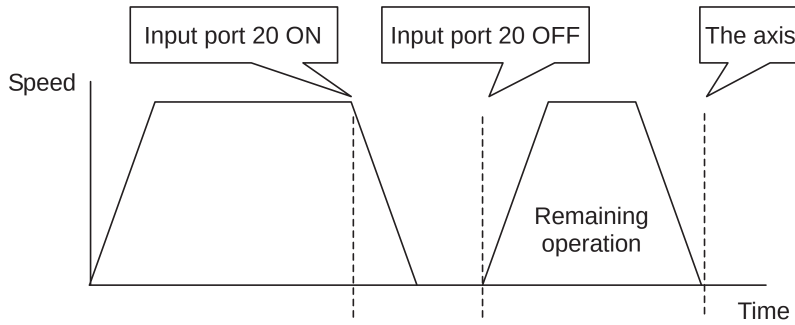
Jumping from within a subroutine to a TAG position outside the subroutine using a GOTO command is prohibited.

3.5.13 Pausing the Operation

[1] Description
Use a declaration command HOLD to pause the moving axis temporarily via external input.

[2] Example of Use
A pause interruption operation can be executed to a moving axis (to decelerate the axis to a stop) by declaring a HOLD command within the program.
While HOLD is input, the actuator pauses (decelerates to a stop, if currently moving) against all moving commands in the same program.

HOLD 20 A declaration to execute pause if general-purpose input 20 turns ON.



Application

You can specify a global flag, instead of an input port, in Operand 1 of the HOLD command.
Use of a global flag allows the actuator to be paused from other program.
The input signal pattern and stop action can be selected using Operand 2.

0 = Contact a (Decelerates to a stop) ⇒ Same as when Operand 2 is not specified.
1 = Contact b (Decelerates to a stop)
2 = Contact b (Decelerates to a stop, and then servo OFF
⇒ The drive power is not cut off.)

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
			HOLD	20	2		SVOF入力20 B接点

[3] Note
If the actuator is paused during homing, it will start the homing sequence from the beginning upon restart.

3.5.14 Canceling the Operation

[1] Description

Use a declaration command CANC to decelerate the moving axis to a stop and cancel the remaining operation.

[2] Example of Use

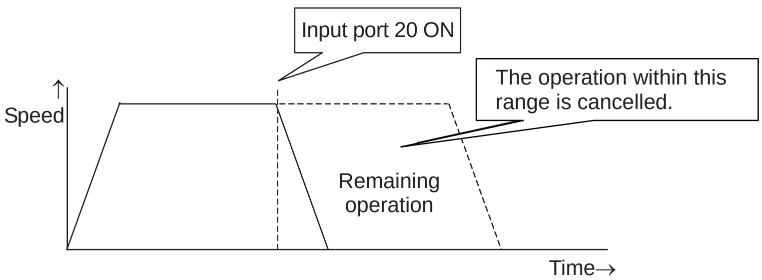
While CANC is input, all movement commands in the same program are cancelled.

CANC command

```
CANC    20    Cancel the movement commands if input port 20 turns ON (declaration).
           :
MOVP     1
MOVP     2
           :
WTON    21
           :
```

* Declare this command in a step before the movement commands you want to cancel.

* While CANC is input, all operation commands are cancelled sequentially, while tasks other than operation commands (such as I/O processing and calculation processing) are executed sequentially.



Application

A desired input signal pattern can be selected for a CANC command using Operand 2.

0 = Contact a (Decelerates to a stop) ⇒ Same as when Operand 2 is not specified.
1 = Contact b (Decelerates to a stop)

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
			CANC	20	1		ｷｬﾝｾﾙ入力20 B接点

[3] Note

It is recommended that you use a WTON command to create an input waiting step, because otherwise you cannot specify which of the program steps the actuator is currently executing.

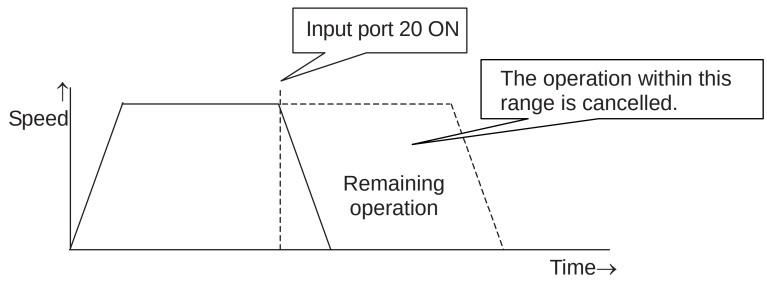
3.5.15 Aborting from Other Program

[1] Description

Decelerate the moving axis to a stop and cancel the remaining operation. (STOP)

[2] Example of Use

Execute a STOP command from other program to forcibly stop the operation (in the multi-tasking mode). Specify the axis you want to stop using an axis pattern.



Example 1

STOP command

Main program			Stop control program		
EXPG	n	The stop program starts.	WTON	20	Wait for stop input.
:			STOP	11	Axes 1 and 2 stop.
MOVL	1				
MOVL	2				
:					

If “STOP 11” is executed while “MOVL 1” is being executed, “MOVL 1” will be cancelled and the actuator will continue its operation from “MOVL 2”.

Example 2

Main program			Stop control program		
EXPG	n	The stop program starts.	WTON	20	Wait for stop input.
:			STOP	10	Axis 2 stops.
MOVP	1				
MOVP	2				
:					

If “STOP 10” is executed while “MOVL 1” is being executed, only the axis 2 part of “MOVL 1” will be cancelled. Both axes 1 and 2 will operate under “MOVL 2”.

[3] Note

If a STOP command is executed during a CP operation (interpolation operation) initiated by MOVL, etc., the operations of all axes will be cancelled regardless of the axis pattern specified in the STOP command.

3.5.16 Operation by Position Number Specification via External Signals and Output of Completion Signal to External Device

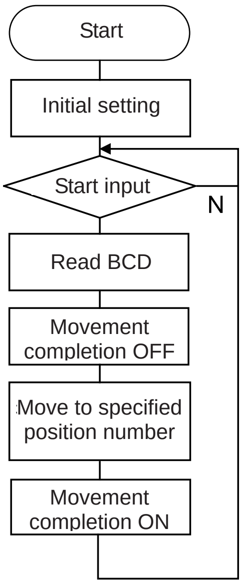
[1] Description

Load externally input BCD codes as position numbers to execute movements.

[2] Example of Use

Use an INB command to load a position number as a BCD code from an input port.
A position number can be specified using a value consisting of up to three digits.

Flowchart



Input assignment*1

Port	Description
1	Start input
15	Position specification 1
16	Position specification 2
17	Position specification 4
18	Position specification 8
19	Position specification 10
20	Position specification 20
21	Position specification 40
22	Position specification 80
23	Position specification 100
24	Position specification 200
25	Position specification 400
26	Position specification 800

Output

303 Movement completion

Program (Example)

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
			VEL	100			速度設定
			TAG	1			GOTOの飛び先
			WTON	1			ｽﾀｰﾄ入力待ち
			INB	15	3		ﾎﾟｼﾞｼｮﾝNo．読取り
			BTOF	303			移動完了信号OFF
			MOVL	*99			ﾎﾟｼﾞｼｮﾝNo．へ移動
			BTON	303			移動完了信号ON
			GOTO	1			TAG1へｼﾞｬﾝﾌﾟ

*1 Shown above is an example of port assignment for XSEL, ASEL, PSEL and SSEL controllers.
An example for TT robots is shown below.

Input assignment

Port	Description
28	Start input
16	Position specification 1
17	Position specification 2
18	Position specification 4
19	Position specification 8
20	Position specification 10
21	Position specification 20
22	Position specification 40
23	Position specification 80
24	Position specification 100
25	Position specification 200
26	Position specification 400
27	Position specification 800

3.5.17 Operation by Coordinate Value Input via External Signals and Output of Completion Signal to External Device

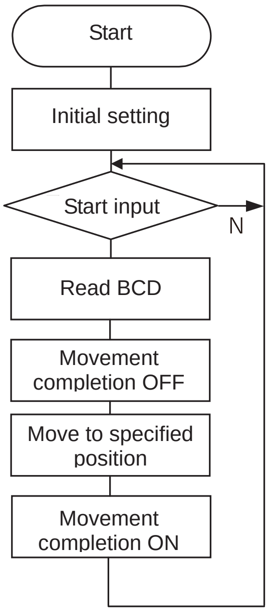
[1] Description

Receive target position data as absolute values from a host device to execute movements.

[2] Example of Use

Use an INB command to load position data as a BCD code from an input port.
Each BCD value should consist of four digits, with the last digit indicating a decimal place.
The moving axis is axis 1.
Example: If a BCD of “1234” is received, the axis will move to the position at 123.4mm.

Flowchart



Input assignment

Port	Description
1	Start input
15	0.1mm
16	0.2mm
17	0.4mm
18	0.8mm
19	1mm
20	2mm
21	4mm
22	8mm
23	10mm
24	20mm
25	40mm
26	80mm
27	100mm
28	200mm
29	400mm
30	800mm

Output

303 Movement completion

Program (Example)

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	コメント
			HOME	11			原点復帰
			VEL	100			速度設定
			TAG	1			GOTOの飛び先
			WTON	1			スタート入力待ち
			INB	15	4		移動位置読み取り
			LET	199	*99		小数点付けの為実数変数にコピー
			DIV	199	10		小数点付けの為10で割る
			PPUT	1	1000		ポジションナンバ1000の1軸目にデータ代入
			BTOF	303			移動完了信号オフ
			MOVL	1000			代入された位置に移動
			BTON	303			移動完了信号オン
			GOTO	1			TAG1にジャンプ

[3] Note

With TT robots, 16 general-purpose inputs from 016 to 0.31 can be input. However, if coordinate values from 400mm [maximum TT stroke] to 0.0mm are inputs in 0.1mm increments and a start signal is used to start the movement, as in the example, all of the 16 general-purpose inputs are used. Take note that in this case you can no longer use general-purpose inputs for other purposes.

3.5.18 Output of Current Position Coordinate Value to External Device

[1] Description

Read the current actuator coordinate in real time and output the coordinate from an output port as BCD data.

[2] Example of Use

Use a PRDQ command to read the current coordinate value of axis 1.
Output the current coordinate data of axis 1 every 0.2sec as BCD output.
The output range is from 0.00 to 999.99mm.

BCD output assignment

Output port No.	Description	Output port No.	Description
324	0.01	337	20
325	0.02	338	40
326	0.04	339	80
327	0.08	340	100
328	0.1	341	200
329	0.2	342	400
330	0.4	343	800
331	0.8		
332	1		
333	2		
334	4		
335	8		

Unit: mm

Program (Example)

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	コメント
			TAG	1			
			PRDQ	1	101		1軸現在位置を変数101へ
			MULT	101	100		少数点以下第三位目以下切り捨て
			LET	99	*101		整数変数にコピー
			OUTB	324	5		BCDで5桁分出力
			TIMW	0.2			サンプリングタイム
			GOTO	1			

* The current position coordinate is written to variable 101 according to the PRDQ command. Since the value that has been read into the variable is in the xxx.xxx format, move the unused digits to below the decimal point so that the result can be output as BCD data.
In this example, the third and subsequent decimal places are not required and thus the value is multiplied by 100 to obtain the data xxxxx.x.
Next, the BCD output data is copied to dedicated variable 99.
The digit below the decimal point is rounded off at this time.
Then, the final value is output to an external device via an OUTB command.
This program is run in the multi-tasking mode as a sub-program.

[3] Note

The unit of output data may have to be changed as deemed appropriate depending on the moving range of the actuator and number of available output ports.
If coordinate values from 0mm to 400mm [maximum TT stroke] are output in 0.01mm increments, as in the example, 19 general-purpose outputs are needed. However, TT robots only have 16 general-purpose outputs of 316 to 331. Accordingly, you must take an appropriate action such as changing the unit of output data to 0.1mm.

3.5.19 Conditional Jump

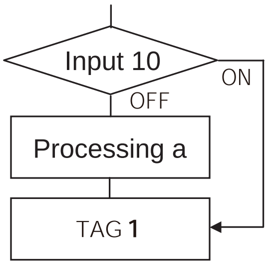
[1] Description

Select the destination to jump to via GOTO using the external input, output and/or internal flag statuses as a condition.
Process is switched over for each input.

[2] Example of Use

Example 1

If input 10 turns ON, the actuator will jump to TAG 1. If it turns OFF, the actuator will proceed to the next processing.



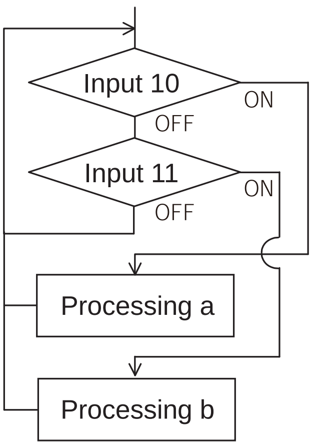
E	N	Cnd	Cmnd	Operand 1
		10	GOTO	1
Processing a				
			TAG	1
Processing b				

Execute GOTO 1 if input 10 turns ON.

* If input 10 turns ON, the actuator will skip processing a and perform processing b.
If input 10 turns OFF, the actuator will perform processing a, and then perform processing b.

Example 2

Wait for the input to the two ports 10 and 11, and if Input 10 becomes ON, proceed to the processing a, and proceed to the processing b if Input 11 becomes ON.



E	N	Cnd	Cmnd	Operand 1
			TAG	1
		10	GOTO	2
		11	GOTO	3
			GOTO	1
			TAG	2
Processing a				
			GOTO	1
			TAG	3
Processing b				
			GOTO	1

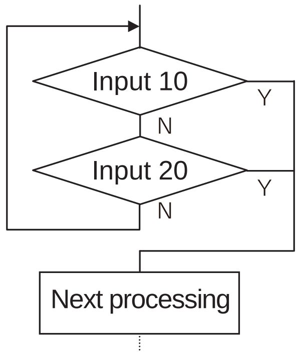
——— No input.
-·-·-· Input 10 turns ON.
······ Input 11 turns ON.

If both inputs 10 and 11 turn ON, the actuator will perform processing a.

3.5.20 How to Pause and Then Resume Program after Output Signal Input

[1] Description
The controller waits for multiple different inputs and performs processing upon reception of any of these inputs.

[2] Example of Use
Inputs 10 and 20 are monitored, and the actuator will proceed to the next step when either input is received (OR logic).



Program a

E	N	Cnd	Cmnd	Operand 1
			TAG	1
		10		
O		20	GOTO	2
			GOTO	1
			TAG	2

Next processing

Program b

E	N	Cnd	Cmnd	Operand 1
			TAG	1
	N	10		
A	N	20	GOTO	1

Next processing

* Both programs a and b perform the same processing.

As shown in the sample, the controller waits for input without using a WTON command.
This method can also be used when multiple input conditions must be combined.

[3] Note
With a WTON command, the program cannot wait for multiple inputs because processing will resume upon receipt of one of the specified inputs.

3.5.21 How to Use Offset

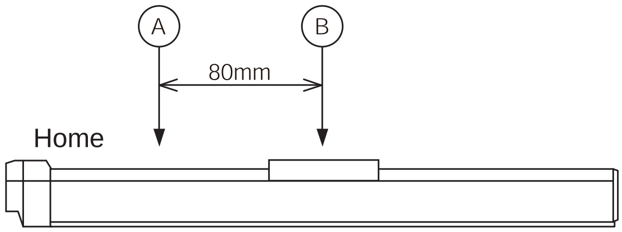
[1] Description

With an OFST command, an offset can be specified for position data when you want to shift (offset) all teaching points by several millimeters because the actuator was not installed exactly in the specified position or for other reasons.

[2] Example of Use

Move the actuator from point A to point B, which is offset by 80mm from point A.

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
			VEL	100			
			MOVP	1			A点へ移動
			OFST	1	80		1軸目80mmｵﾌｾｯﾄ
			MOVP	1			B点へ移動



[3] Note

Once an offset has been set, the offset applies to all movement commands executed thereafter. To cancel the offset, execute an offset command again by specifying 0mm. An offset does not apply to other programs (even in the multi-tasking mode). If a given offset must be applied to all programs, it must be set for all programs individually.

3.5.22 How to Repeat Specified Operation Multiple Times

[1] Description
Execute a specific operation n times.

[2] Example of Use
The actuator moves back and forth between P1 and P2 ten times, and then the program ends.
Use a CPEQ command to compare the number of times the movement has been actually repeated, against 10.
It is assumed that homing has been completed.

Program (Example)

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
			VEL	100			速度設定
			LET	1	0		変数ｸﾘｱ
			TAG	1			
			MOVP	1			P1へ移動
			MOVP	2			P2へ移動
			ADD	1	1		変数1に1加算
			CPEQ	1	10	900	繰返し回数確認
	N	900	GOTO	1			10回未満ならTAG1へ
			EXIT				ﾌﾟﾛｸﾞﾗﾑ終了

[3] Reference
The same operation can also be performed using a DWEQ command.

3.5.23 Constant Feed Operation [Pitch Feed]

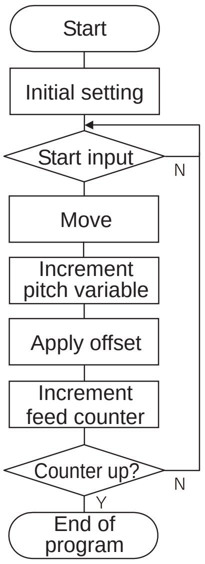
[1] Description

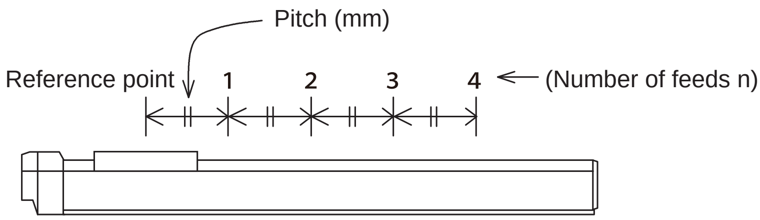
Feed the actuator by a specified pitch n times from a reference point.
The pitch and number of repetitions are specified by variables in advance.

[2] Example of Use

Use an OFST command to perform pitch feed.
The number of times the actuator has been fed is counted by a counter variable.
The X-axis is fed in the positive direction.

Flowchart





Program (Example)

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
			LET	1	4		送り回数(n=4)代入
			LET	100	80		ﾋﾟｯﾁ(80mm)代入
			LET	2	0		変数ｸﾘｱ(ｶｳﾝﾀ)
			LET	101	0		変数ｸﾘｱ(ｵﾌｾｯﾄ値)
			HOME	1			原点復帰
			VEL	100			速度設定
			TAG	1			
			WTON	1			ｽﾀｰﾄ入力待ち
			MOVP	1			移動
			ADD	101	*100		ｵﾌｾｯﾄ値にﾋﾟｯﾁ加算
			OFST	1	*101		X軸ｵﾌｾｯﾄ処理
			ADD	2	1		ｶｳﾝﾀ用変数に＋１
			CPGT	2	*1	900	送り終了確認
	N	900	GOTO	1			未完了なら繰返す
			EXIT				ﾌﾟﾛｸﾞﾗﾑ終了

[3] Note

An OFST command applies to movement commands.
Executing an OFST command alone does not move the axis.

[4] Reference

Pitch feed can also be performed with MVPI and MVLI Commands.

3.5.24 How to JOG via External Signal Input

[1] Description

The slider moves forward or backward while an input is ON or OFF.
Instead of an input, an output or global flag can be used as a cue.
The slider will move directly to the next step if the specified input does not satisfy the condition when the command is executed.
Regardless of the input status, the slider will stop upon reaching the soft limit, and the command in the next step will be executed.

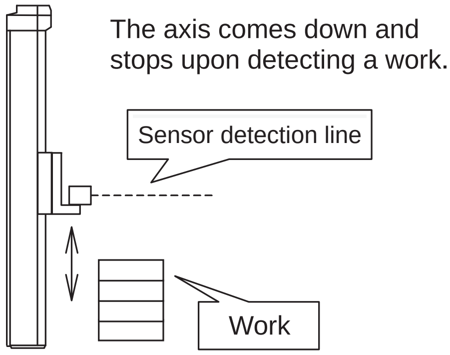
[2] Example of Use

- Explanation of commands

JFWN	1	20	Axis 1 moves forward while input 20 is ON.
JFWF	1	21	Axis 1 moves forward while input 21 is OFF.
JBWN	10	22	Axis 2 moves backward while input 22 is ON.
JBWF	10	23	Axis 2 moves backward while input 23 is OFF.

Example 1

- Stop the axis when a sensor input is received.



:

VEL	50		Specify a low speed.
JFWF	1	20	Move until a sensor input (20) is received.
EXIT			The program ends.

Example 2

- Cause the actuator to jog just like in teaching pendant operation (2 axes are operated).

Program (Example)

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst
			TAG	1		
			JFWN	1	20	
			JBWN	1	21	
			JFWN	10	22	
			JBWN	10	23	
	N	24	GOTO	1		
			EXIT			

[3] Note

HOLD, STOP and CANC commands remain valid while the actuators are jogging.

3.5.25 Switching Programs

[1] Description

Use EXPG/ABPG commands to switch programs using a program.

[2] Example of Use

Example 1

Start program 2 once the processing of program 1 is completed, and then end program 1.

```
Program 1          Program 2
   :                  :
EXPG   2              :
EXIT
```

Example 2

Start a program via an external signal, and then end the other program.

```
Program 1          Program 2
ABPG   2           ABPG   1
   :                  :
```

If program 2 is started while program 1 is running, program 1 will be aborted.
If program 1 is started while program 2 is running, program 2 will be aborted.

Application

If a program number is specified in operand 2, the programs from the one corresponding to the program number in operand 1 to the other corresponding to the program number in operand 2 can be started (EXPG) or ended (ABPG) simultaneously.

[3] Note

- Up to 16 programs (maximum of 8 programs in the case of ASEL/PSEL/SSEL controllers) can be run at the same time. To use other programs when the controller is already running 16 programs, switch programs by closing a program or programs that are not required.
- If an ABPG command was executed to end a program while the program was executing a movement command, the actuator immediately decelerates to a stop.

3.5.26 Aborting a Program

[1] Description

Abort a program currently running.
Execute an ABPG command (command to abort other program) from other program in the multi-tasking mode.

[2] Example of Use

Main program (Prg. 1)

EXPG	n	The abort control program starts.
WTON	10	
MOVP	1	
BTON	303	
:		
:		

Abort control program (Prg. n)

WTON	20	Wait for an abort input.
ABPG	1	Prg. 1 is aborted.
EXIT		The program ends.

[3] Note

If the running program was executing any movement command, the applicable axis immediately decelerates to a stop and then the program ends.

3.5.27 Way to Prevent Duplicated Startup by Program

[1] Description

How to prevent other programs from starting redundantly using virtual I/O port N710☐ (Program No.☐ running) is explained. If a given program is not running as determined by the checking of corresponding virtual I/O port N710☐ (Program No.☐ running), that program is started.

[2] Example of Use

```
   PRG1 (for task management)
   TAG1
N7102   EXPG      2   PRG2 stopped
                            PRG2 running
N7103   EXPG      3   PRG3 stopped
                            PRG3 running
N7104   EXPG      4   PRG4 stopped
                            PRG4 running
        TIMW   0.02   Task open
        GOTO      1
```

```
PRG2 (auto)
ABPG   3   4
   .
   .
```

```
PRG3 (step)
ABPG   2
ABPG   4
   .
   .
```

```
PRG4 (JOG)
ABPG   2   3
   .
   .
```

3.5.28 How to Cause Rotational Axis [Multi-rotation Specification] to Rotate Multiple Times

Regarding the axis operation types and rotation axis modes
(1) Axis-specific parameter No. 1, "Axis operation type"

No.	Parameter name	Default value	Input range	Unit
1	Axis operation type	Varies depending on the actuator.	0 to 1	None

● Explanation
This parameter defines the type of the actuator used. (Set this to 1.)
● Setting values
0: Linear movement axis   Actuator other than rotational axis
1: Rotational movement axis   Rotational axis (RS-30/60, RCS2-RT*/RTC*)

(2) Axis-specific parameter No. 66, "Rotational axis mode selection"

No.	Parameter name	Default value	Input range	Unit
66	Rotational axis mode selection	0	0 to 5	None

● Explanation
This parameter selects a desired rotational axis mode. (Set this to 1.)
Related parameter: Axis-specific No. 7, "Soft limit+"
● Setting values
0: Normal
1: Index mode
* When the index mode is selected, the soft limit is fixed to 359.999mm internally. Short-cut control is enabled while the index mode is selected.
2 to 5: Reserved by the system

⚠Caution: Absolute-specification actuators do not support the following settings:
- If this parameter is set to 0 (Linear movement axis), the infinite stroke mode cannot be set with parameter No. 68.
- If this parameter is set to 1 (Rotational movement axis), short-cut control cannot be selected in parameter No. 67.

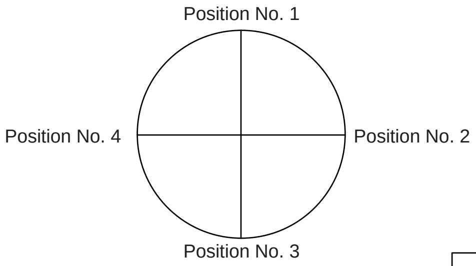
(3) Axis-specific parameter No. 67, “Short-cut control selection for rotational movement axis”

No.	Parameter name	Default value	Input range	Unit
67	Short-cut control selection for rotational movement axis	0	0 to 1	None

- Set this parameter to 1 when the rotation of the rotary axis is required to be in one way.
  Multi-rotation operation can be performed by setting this parameter to 1 (Short-cut control selected) and repeating a movement command in the same rotating direction.
  What is short-cut control?
  A type of operation in which the actuator moves to the closest point in the next move.
  It may shortcut if a far point is indicated. Pay attention to the indication value if the multi-rotation operation is preferred.

- Setting values
  0: Not selected
  1: Selected

Example: Move the actuator through position No. 2 → 3 → 4 → 1 successively based on position No. 1 being the reference point.



Program

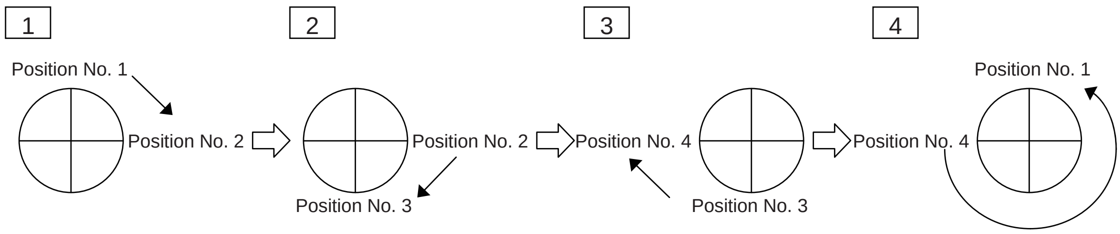
Step No.	Command	Operation
1	MOVP	2
2	MOVP	3
3	MOVP	4
4	MOVP	1

Position

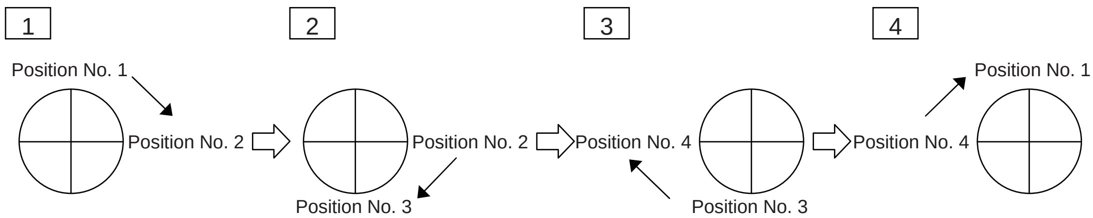
Position No.	Position data
1	0
2	90
3	100
4	270

1° of position data corresponds to 1mm.

Short-cut control not selected



Short-cut control selected



* By selecting short-cut control, you can cause the actuator to rotate in a specific direction.

3.6 For Advanced Operations (program edit)

3.6.1 Handling of Axis Numbers and Patterns

You can specify each axis using an axis number or multiple axes using an axis pattern.

[1] Axis number and indication of axis
Axes are indicated as follows so that multiple axes can be expressed.
To specify only one of multiple axes, specify it by the applicable axis number.

Single axis/rectangular axis

Axis	Axis number
Axis 1	1
Axis 2	2
Axis 3	3
Axis 4	4
Axis 5	5
Axis 6	6
Axis 7	7
Axis 8	8

SSEL, ASEL and PSEL controllers support only up to two axes. TT robots support only up to three axes.

In addition to following the above rule, you can also express axis numbers using symbols.

SCARA robot

Axis	Axis number
X-axis	1
Y-axis	2
Z-axis	3
R-axis	4

(Note) The movements of arms 1 and 2 of a SCARA robot are interlocked. It is not that arm 1 always represents the X-axis and arm 2, Y-axis.
Consider that the X-axis (axis No. 1) moves in the direction of X coordinates, while the Y-axis (axis No. 2) moves in the direction of Y coordinates.
Note that only when an AXST command is issued, the X-axis represents the arm 1 axis, while the Y-axis represents the arm 2 axis.

In addition to following the above rule, you can also express axis numbers using symbols.

[2] Axis pattern

[Single axis/rectangular axis]
Use "1" or "0" to indicate which axis(es) you want to use.

(Higher) (Lower)

Axis	Axis 8	Axis 7	Axis 6	Axis 5	Axis 4	Axis 3	Axis 2	Axis 1
Use	1	1	1	1	1	1	1	1
Do not use	0	0	0	0	0	0	0	0

[Example] Use axes 1 and 2.
Axis 2
↓
You should state 000011… (The 0's at the beginning are not necessary. Take them away and use 11.)
↑
Axis 1

[Example] Use axes 1 and 4.
Axis 4
↓
You should state 1001… (In this case, the 0's are needed to indicate the position of axis 4.)
↑
Axis 1

Specifying an axis pattern indirectly using a variable
Consider an axis pattern as a binary expression and assign a decimal equivalent of it to a variable.

[Example] Axis pattern where home return is performed only for axis 3

```
HOME    100
```

This pattern is specified indirectly as follows:
100 (binary) → 4 (decimal)
Accordingly:

```
LET     6     4
HOME    *6
```

If multiple axes must be specified at the same time, use an axis pattern.

- Commands where an axis pattern is used to specify axes
  OFST, GRP, SVON, SVOF, HOME, JFWN, JFWF, JBWN, JBWF, STOP, PTST, PRED CHVL, PBND, WZNA, WZNO, WZFA, WZFO, PAXS, NBND, PTRQ, MOVD, MVDI, NTCH, RAXS, XAXS, ECMD(250)

[SCARA robot]
Use “1” or “0” to indicate which axis(es) you want to use.

Axis	R-axis (Higher)	Z-axis	Y-axis	X-axis (Lower)
Use	1	1	1	1
Do not use	0	0	0	0

(Note) The movements of arms 1 and 2 of a SCARA robot are interlocked. It is not that arm 1 always represents the X-axis and arm 2, Y-axis.
Consider that the X-axis (axis No. 1) moves in the direction of X coordinates, while the Y-axis (axis No. 2) moves in the direction of Y coordinates.

[Example] Use the X-axis and Y-axis.

Y-axis
↓
You should state 0011… (The 0’s at the beginning are not necessary. Take them away and use 11.)
↑
Axis 1

[Example] Use the X-axis and R-axis.

R-axis
↓
You should state 1001… (In this case, the 0’s are needed to indicate the position of axis R.)
↑
X-axis

Specifying an axis pattern indirectly using a variable
Consider an axis pattern as a binary expression and assign a decimal equivalent of it to a variable.

If multiple axes must be specified at the same time, use an axis pattern.

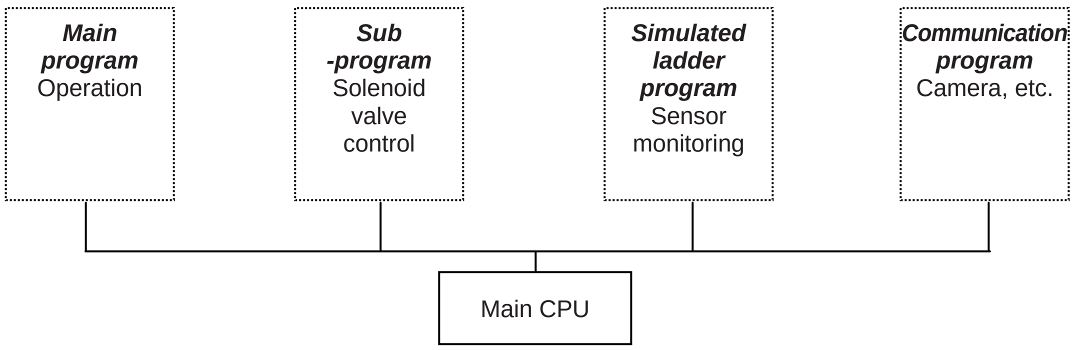
- Commands where an axis pattern is used to specify axes
  OFST, GRP, PTST, PRED, PBND
  (Note) In the case of SVON, SVOF and STOP, all axes are specified regardless of the axis pattern.

3.6.2 Setting of Multi-tasking and Task Level

[1] Multi-tasking

Controllers come standard with the multi-tasking function that allows multiple programs to be run simultaneously, such as moving actuators in one program and turning ON/OFF solenoid valves in another programs.
“Multi-tasking” literally means performing multiple tasks. The main CPU processes each program step by step. If multiple programs are run that contain actuator commands, timer commands, input waiting commands, etc., however, the main CPU uses an idle time while waiting for completion of each commanded task to process different programs.
(If a given program has no idle time, the system forcibly switches to the next program after 1mS based on “task slicing” action.)
XSEL controllers adopt high-speed CPUs, so multi-tasking is also performed at high speed.
Note that this function also supports simulated ladder circuits, which means that as long as your equipment is small enough you can build it as a sequencer.

[Example of multi-tasking (running multiple programs)]

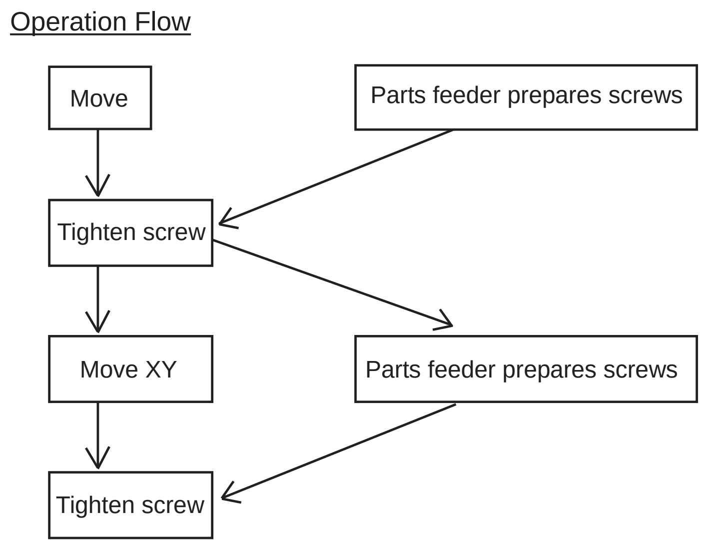


[2] Task level

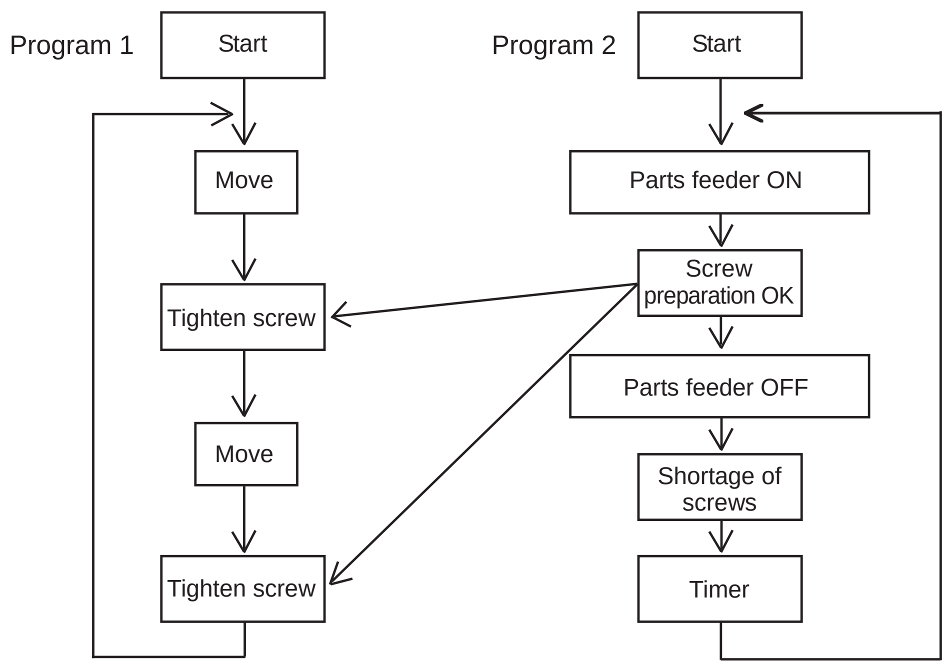
If you want to perform a given task (program) preferentially over other tasks (programs), you can do so with a CHPR command by setting the parameter to “1: HIGH”. If the parameter is set to “0: NORMAL”, no priority is set.
You can also set task levels for simulated ladder programs. [Refer to Section 3.6.3]

[3] Multi-Tasking

Take a screw-tightening robot, for example.
In general, a screw-tightening robot consists of axis 1 and axis 2 actuators and a screw-tightening machine (up/down air cylinder, etc.).



Although the flow chart is simple, the movement of axis 1 and axis 2 actuators and the operation of the parts feeder must take place simultaneously. This requires “multi-tasking” operation.



[4] Program Switching

Various methods are available to switch between programs, depending on the purpose of programs. The representative methods are explained below.

```
                    ┌─ External start
Program switching ──┤
                    └─ Program ─────┬─ Single-tasking -----------EXIT command
                                    └─ Multi-tasking -------------EXPG command
```

There are mainly two ways. One is to conduct with external startup and the other with application program.

(1) External start method ······· Refer to the Instruction Manual for each controller.

(2) Program method

○ Single-tasking

By executing EXIT Command (program finish) at the end of each program, finish the program and put back to the condition when the power is turned off. The home position, however, is remained, thus the next program can be executed with external start input by specifying another program number.

○ Multi-tasking

By creating a program for control and executing EXPG Command (startup of another program) in the program, multiple programs run in parallel one after another.

3.6.3 Pseudo-Ladder Task

A pseudo-ladder task function can be used depending on the command and extension condition.
The input format is shown below. Note that this function must be used by expert engineers with a full knowledge of PLC software design.

[1] Basic Frame

Extension condition	N	Input condition	Command	Operand 1	Operand 2	Output	
E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	
LD		7001	CHPR	1			
			TPCD	1			
			TAG	1			
⋮		⋮	⋮	⋮			Ladder statement field
LD		7001	TSLP	1 to 100			
⋮		⋮	⋮	⋮			Ladder statement field
LD		7001	TSLP	1 to 100			
LD		7001	GOTO	1			
LD		7001	EXIT				

* * Virtual input 7001: “Normally ON” contact

[2] Ladder Statement Field

1) Extension conditions

LD ·······LOAD
A ·······AND
O ·······OR
AB ·······AND BLOCK
OB ·······OR BLOCK

All of the above extension conditions can be used in non-ladder tasks.

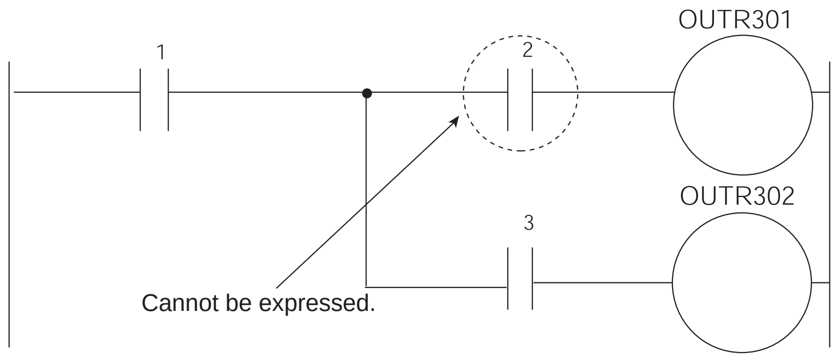
2) Ladder commands

OUTR ·········· Ladder output relay (Operand 1 = Output, flag number)
TIMR ·········· Ladder timer relay
(Operand 1 = Local flag number, Operand 2 = Timer setting (sec))

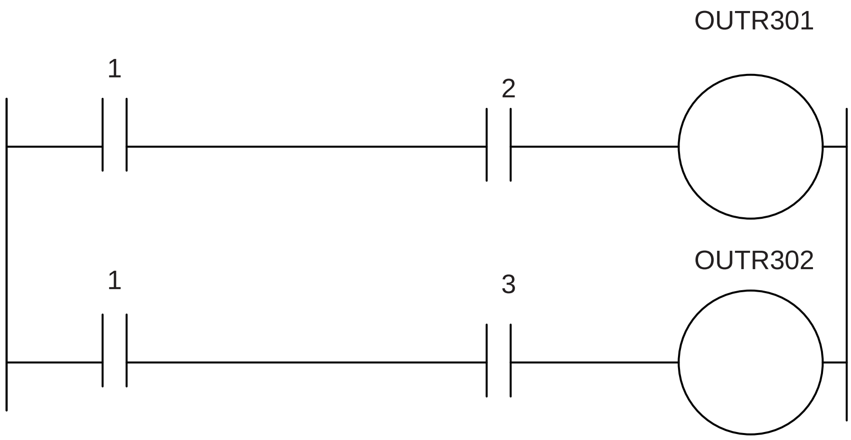
[3] Points to Note

- This system only processes software ladders using an interpreter. Therefore, the processing time is much longer than that of a dedicated commercial sequencer.
  (This system is not suitable for large-scale ladder processing.)
- If an extension condition is not specified for steps in which an input condition is specified, the steps will be treated as LD (LOAD).
- Always specify a “normally ON” contact for those steps that must be processed without fail, such as CHPR, TSLP and GOTO. (LD 7001)
  Virtual input 7001: “Normally ON” contact

- Ladder processing is based on software ladders using an interpreter, you cannot branch an output “1” to produce an input “2” or “3” as shown in the input circuit below.

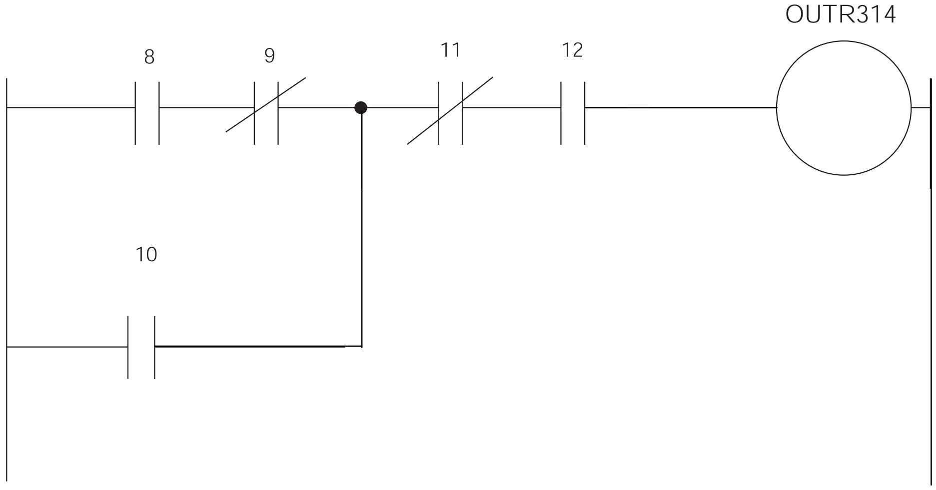


To perform this operation, you can write a ladder as follows, for example.
However, this is conditional upon the output “1” not changing during the output processing at OUTR301 in line 1. Make sure the output “1” does not change due to other programs.



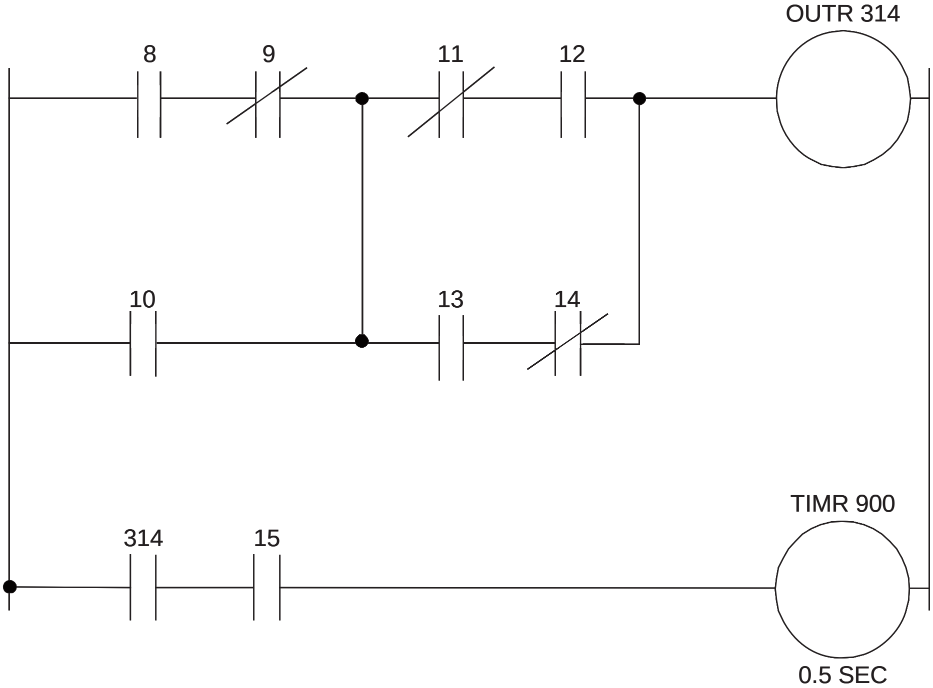
Extension condition	N	Input condition	Command	Operand 1	Operand 2	Operand 3
E	N	Cnd	Cmnd	Operand 1	Operand 2	Operand 3
LD		1				
A		2	OUTR	301		
LD		1				
A		3	OUTR	302		

[4] Program Example



Extension condition	N	Input condition	Command	Operand 1	Operand 2	Output
E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst
LD		7001	CHPR	1		
			TPCD	1		
			TAG	1		
LD		8				
A	N	9				
O		10				
LD	N	11				
A		12				
AB			OUTR	314		
LD		7001	TSLP	3		
LD		7001	GOTO	1		
LD		7001	EXIT			

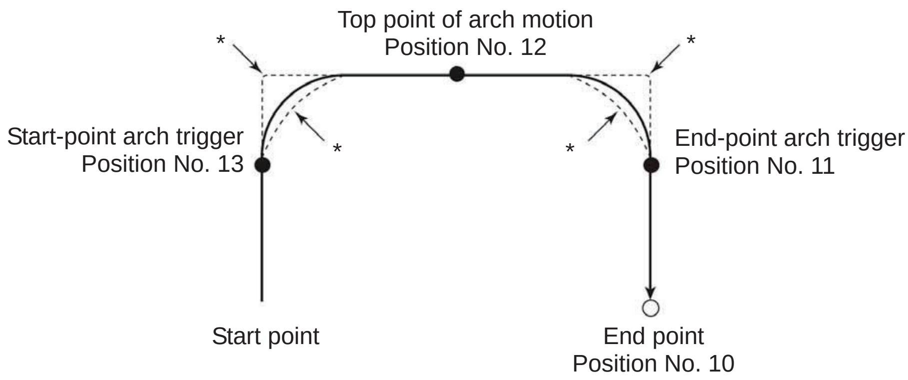
An example where 13, 14, 15 and timer TIMER900 are added further is given below.



Extension condition	N	Input condition	Command	Operand 1	Operand 2	Output
E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst
LD		7001	CHPR	1		
			TPCD	1		
			TAG	1		
LD		8				
A	N	9				
O		10				
LD	N	11				
A		12				
LD		13				
A	N	14				
OB						
AB			OUTR	314		
LD		314				
A		15	OUTR	900	0.5	
LD		7001	TSLP	3		
LD		7001	GOTO	1		
LD		7001	EXIT			

3.6.4 How to Use Arch Motion

Move from the current position to end point via arch motion.



Example of program

```
ACHZ   3                                                                  -------- Declare arch motion Z-axis
ATRG  13 (start-point arch trigger position)  11 (end-point arch trigger position)   -------- Set arch trigger
            :
ARCH  10 (position of end point)         12 (position of top point of arch motion) ------  Arch motion
```

- Use an ACHZ command to specify the arch motion Z-axis. In the case of a SCARA robot, you only need to specify the Z-axis (axis 3) to perform arch motion. (ACHZ 3)
- Use an ATRG command to specify the arch motion trigger.
  After rising up to the start arch trigger from the current position by ARCH Command, a movement in the direction other than Z-axis starts with the arch motion.The actuator passes the top point being the Z point specified in operand 2 and completes the movement in a direction other than that of arch motion Z-axis, after which it passes near the end-point arch trigger and reaches the positions of the specified point.

Note

When operation is resumed after a pause, the transition from rising movement to horizontal movement and transition from horizontal movement to rising movement may follow the paths indicated by * (dotted lines) in the figure. Exercise caution to prevent contact.

- The arch motion Z-axis coordinate at the end point corresponds to the sum of the arch-motion Z-axis component of position data specified in operand 1, if any, and the arch-motion Z-axis offset. If the position data has no arch-motion Z component, the arch motion Z-axis coordinate corresponds to the sum of the arch motion Z-axis coordinate at the start point and the arch motion Z-axis offset. (Normally an offset is added to all positions such as the arch trigger and Z point.)
- If the start-point arch trigger is set below the start point or end-point arch trigger is set below the end point, an error occurs. (Note: The upward and downward directions have nothing to do with + and - of coordinates.)
- The rising direction of the arch motion Z-axis is the direction of moving from the end point to Z point (while the downward direction is the opposite of that direction), and has nothing to do with the magnitude correlation of coordinate values. Accordingly, be sure to check the actual operating direction when using this command.
- As for the data of end-position arch trigger, also start/end the operation at a point above the applicable arch trigger for any effective axis data other than data of the arch motion Z-axis, if available.
- If a composite arch trigger is set and any effective axis data is available other than data of the effective axis at the end point or arch motion Z-axis, the applicable axis also operates. In this case, also start/end the operation at a point above the applicable arch trigger.

3.6.5 How to Use Palletizing Function

The SEL language provides palletizing commands that support palletizing operation. These commands allow simple specification of various palletizing settings and enable arch motion ideal for palletizing. You can also call a subroutine at the palletizing destination to perform palletizing operation.

[1] How to Use

Use palletizing commands in the following steps:

(1) Palletizing setting
Set palletizing positions, arch motion, etc., using palletizing setting commands.

(2) Palletizing calculation
Specify palletizing positions using palletizing calculation commands.

(3) Palletizing movement
Execute motion using palletizing movement commands.

[2] Palletizing Setting

Use the palletizing setting commands to set items necessary for palletizing operation. The setting items include the following:

[Palletizing number setting .... Command: BGPA]

At the beginning of a palletizing setting, determine a palletizing number using a BGPA command to declare the start of palletizing setting.
At the end, declare the end of palletizing setting using an EDPA command.

BGPA	1	Declare the start of setting for palletizing No. 1.
		Set palletizing in these steps.
EDPA		Declare the end of palletizing setting at the end.

A maximum of 10 sets (palletizing No. 1 to 10) of palletizing setting can be specified for each program.

[Palletizing pattern .... Command: PAPN]

Select a pattern indicating the palletizing order.
The two patterns illustrated below are available.
The encircled numbers indicate the order of palletizing and are called “palletizing position numbers”.

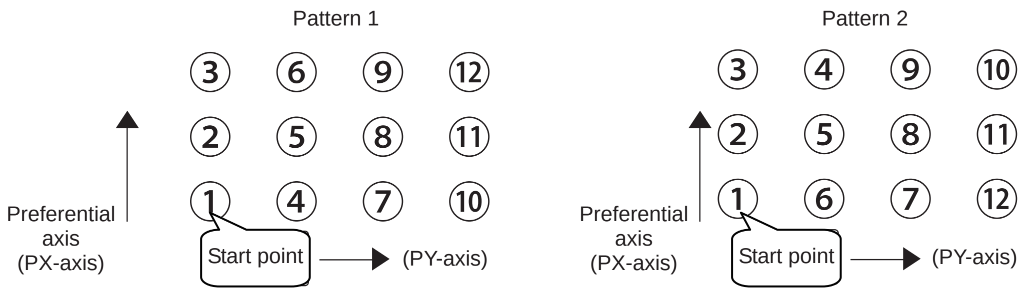


Fig. 1

PAPN	2		When pattern 2 is selected (Setting is not necessary if pattern 1 is selected.)

The row from 1 to 3 to be placed first is called the “preferential axis (PX-axis)”, while the other direction comprising the palletizing plane is called the “PY-axis”.

[Palletizing counts .... Command: PAPI]

Set the palletizing counts.

PAPI	3	4	Count for preferential axis (PX-axis): 3, Count for PY-axis: 4

[Palletizing position setting]

Palletizing position setting is performed mainly by method A or B, as explained below. Set the palletizing positions for each palletizing setting based on method A or B.

	Setting method	Commands
A	[3-point or 4-points teaching method] Set three position-data points or four position-data points specifying the palletizing positions.	PAPS
B	[Method to set palletizing positions in parallel with the actuators (in parallel with an axis on the work coordinate system in the case of a SCARA robot)] Set from the palletizing axes, palletizing reference point and palletizing pitches.	PASE, PAST PAPT

A. 3-point teaching method

To set the palletizing positions by 3-point teaching, store desired positions in position data fields as three continuous position data and then specify the first position number using a PAPS command.
This method allows you to set the PX-axis and PY-axis as three-dimensional axes not parallel with the actuators and not crossing with each other.
In the example shown below, position data [1], [3] and [10] are stored in three continuous position data fields.

When three points are taught from position No. 11

Position No. 11 [1] : Start point (First palletizing position)
Position No. 12 [3] : Palletizing position corresponding to the end point in the PX-axis direction
Position No. 13 [10] : Palletizing position corresponding to the end point in the PY-axis direction

The encircled numbers indicate palletizing position numbers (palletizing order).

Use a PAPS command to specify the position number corresponding to the start point.

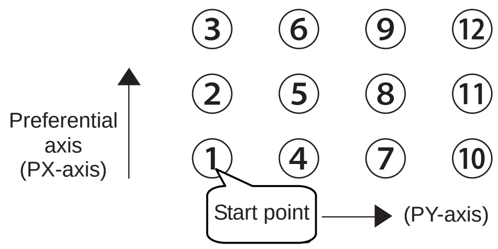


Fig. 1

```
PAPS        11
```

The pitches are calculated automatically from the count set for each axis.
In 3-point teaching, you can specify position data for two axes or three axes. If position data is specified for three axes, the palletizing plane becomes a three-dimensional plane.

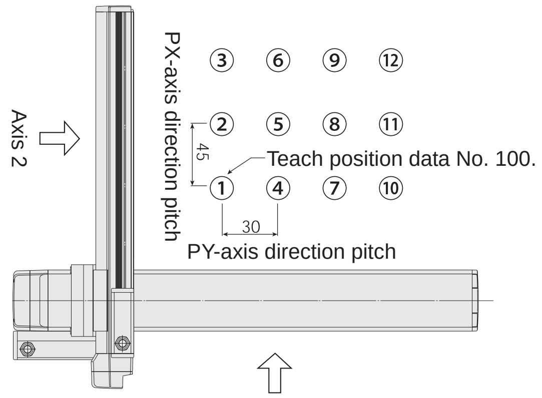
B. Method to set palletizing positions in parallel with the actuators

Palletizing reference point: Store the position data of the start point (palletizing position No. 1) in a position data field and specify the applicable position number using a PAST command, as shown below.

Palletizing pitches: Use a PAPT command to specify the pitches in the PX-axis and PY-axis directions.

Palletizing axes: Use a PASE command to specify the two axes, one representing the PX-axis direction and the other representing the PY-axis direction, to be used in palletizing.

(An actuator axis number parallel with the preferential axis (PX-axis) and another perpendicular to the preferential axis)



PAST	100		Teach position data No. 100 as the start point.
PAPT	45	30	The PX-axis direction pitch is 45mm and the PY-axis direction pitch is 30mm.
PASE	2	1	Set axis 2 as the priority axis (PX-axis) and axis 1 as the rectangular axis and the priority axis.

(Note) When the above palletizing axes, palletizing pitches and palletizing reference point are used, the PX-axis and PY-axis must be parallel with the actuators and crossing with each other.

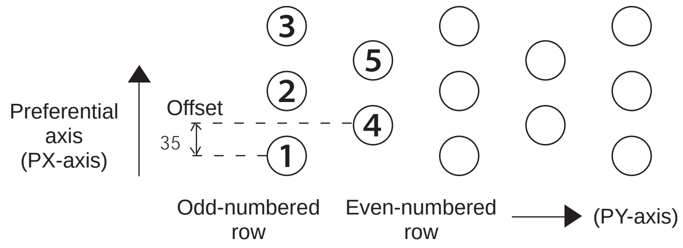
Select either method A or B for each palletizing setting.

[Zigzag setting .... Command: PSLI]

Use a PSLI command to set a zigzag layout as shown below.

Zigzag offset: Offset amount in the preferential-axis direction, which will be applied when even-numbered rows are placed.
"Even-numbered rows" refer to the rows occurring at the even numbers based on the row placed first representing the first row.

Zigzag count: Number in the even-numbered rows. Two in the diagram below.



PSLI 35 2

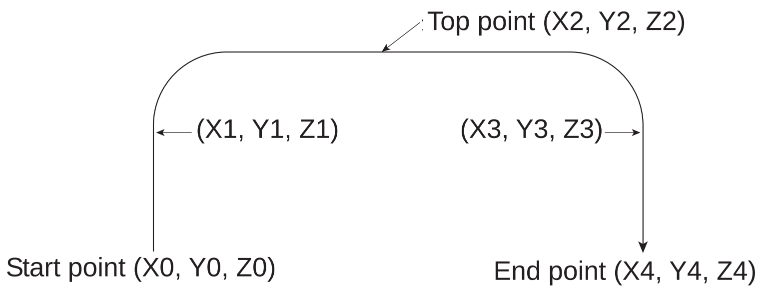
[Arch motion setting]

(a) Arch motion Z-axis No. .... Applicable command: ACHZ
- In the case of a SCARA robot, you only need to specify the Z-axis (axis 3) to perform arch motion.
  ACHZ 3

(b) Arch motion Z-axis offset .... Applicable command: OFAZ

(c) Composite arch motion .... Applicable command: AEXT
Composite arch motion data refers to position data used when you want to cause any axis other than the effective axis at the end point or arch motion Z-axis to perform an additional operation (such as when setting a rotational angle).
Note, however, that any composite axis operation starts and ends at a position above the applicable arch trigger.
Set this composite arch motion setting command by specifying a position number under which composite arch motion data is set.

(d) Arch trigger .... Applicable command: ATRG
The following arch trigger settings are available for arch motion.
Set this arch trigger setting command by specifying a position number under which arch trigger coordinate data is stored.
(d-1) Start-point arch trigger
Specify the position to be reached after the arch motion is started from the start point and the actuator moves in the arch motion Z-axis coordinate direction, after which the actuator will start moving in the direction of other axis. Start-point arch trigger = Z1
(d-2) End-point arch trigger
Specify the position to be reached in the arch-motion Z-axis coordinate direction during the arch motion down movement, after which the actuator will end moving in the direction of other axis. End-point arch trigger = Z3



[Palletizing arch motion setting]

(a) Axis number corresponding to palletizing Z direction...... Applicable command: PCHZ

(b) Palletizing Z-axis offset .... Applicable command: OFPZ

(c) Composite palletizing .... Applicable command: PEXT

Composite palletizing data refers to position data used when you want to cause any axis other than the PX- or PY- (or PZ-) axis to perform an additional operation in a palletizing movement command (such as when setting a rotational angle).

Note, however, that any composite axis operation starts and ends at a position above the applicable palletizing arch trigger.

Set this composite palletizing setting command by specifying a position number under which composite palletizing data is stored.

(d) Palletizing arch trigger .... Applicable command: PTRG

If the end point is the palletizing point, you need palletizing arch triggers just like arch triggers.

Set this palletizing arch trigger setting command by setting a position number under which palletizing arch trigger coordinate data is stored.

(d-1) Palletizing start-point arch trigger

(d-2) Palletizing end-point arch trigger

[3] Palletizing Calculation

The items that can be operated or obtained using palletizing calculation commands are shown below:

[Palletizing position number Commands ...... PSET, PINC, PDEC, PTNG]

Number showing the ordinal number of a palletizing point. (In Fig. 1 for [2] given in the explanation of palletizing pattern, the encircled numbers are palletizing position numbers.)

Always set this command before executing a palletizing movement command --- PSET

For example, executing a palletizing movement command by setting 1 as the palletizing position number will move the axes to the start point. Executing a palletizing movement command by setting 2 as the palletizing position number will move the axes to the point immediately next to the start point in the PX-axis direction.

[Palletizing angle Command .... PARG]

This is the angle formed by the physical axis and the preferential palletizing axis (PX-axis) (θ in the figure below).

θ represents an angle calculated by ignoring the coordinate in palletizing Z-axis direction.

In the figure below, θ will become a negative value if axis 1 is used as the reference for angle calculation.

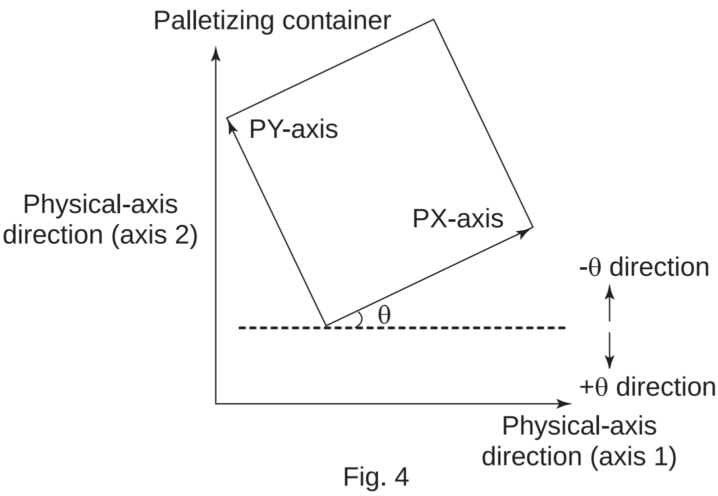


Fig. 4

If the composite axis is a rotating axis, you can obtain the palletizing angle and add it as an offset to the operation of the composite axis in order to correct the composite axis against any position error of the palletizing container.

With XSEL commands, executing a “get palletizing angle” command following a palletizing setting via 3-point teaching will automatically obtain the palletizing angle.

If 3-point teaching is set three-dimensionally, you must specify the palletizing Z-axis.

[Palletizing calculation data Command ..... PAPG]

When a palletizing position number is set, this data refers to the position coordinate data of the palletizing point corresponding to that palletizing position number.

Note, however, that this position coordinate data does not reflect any normal offset or palletizing Z-axis offset.

[4] Palletizing Movement

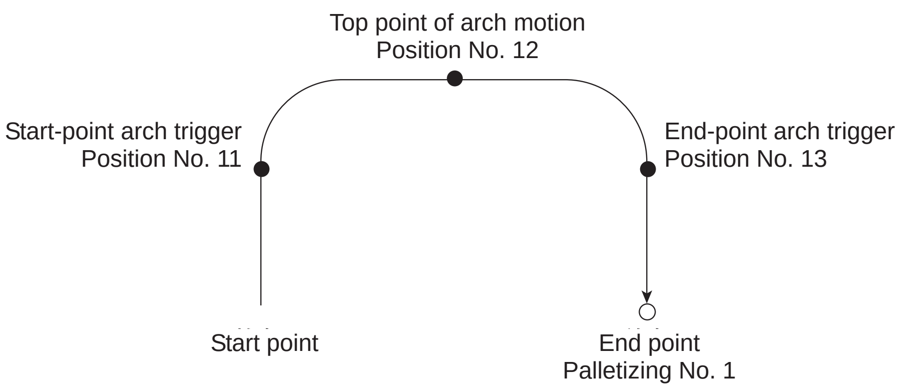
Palletizing movement commands include commands used to move the actuator to palletizing points and other that uses position data to specify the end point.

[Movement commands to palletizing point .... PMVP, PMVL, PACH]

Calculate the position coordinate of a two-dimensionally or three-dimensionally positioned palletizing point and use this coordinate as the end point to move the actuator. (The actuator moves to the palletizing point corresponding to the palletizing position number specified in the command when executed)

You need two actuator axes to constitute a two-dimensional plane. If you need a vertical axis (PZ-axis), you must specify one more axis.

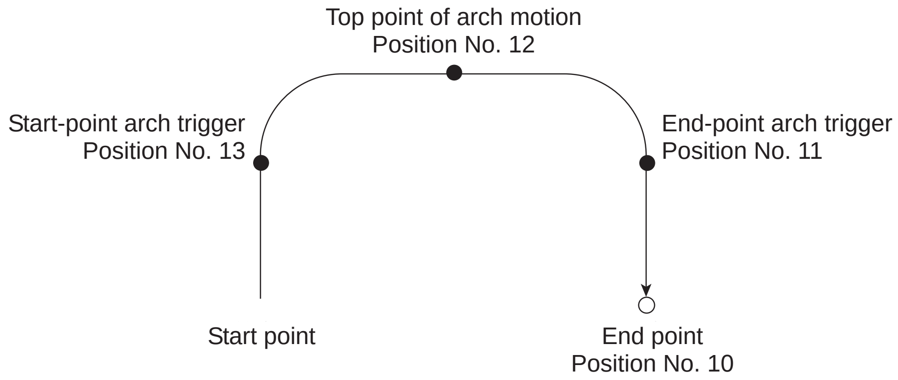
PMVP: Move from the current position to a palletizing point via PTP.
PMVL: Move from the current position to a palletizing point via interpolation.
PACH: Move from the current position to palletizing position via arch motion.
You must set palletizing arch motion based on palletizing setting.




```
PCHZ    3
PTRG    11    13
  :
PACH    1     12
```

[Movement command that uses position data as end point...ARCH]

Arch motion is performed to the end point specified by position data.
If the movement is linear in parallel with the actuator, arch motion operation can be possible by specifying only two axes including the applicable axis and PZ-axis.
Arch motion must be set.



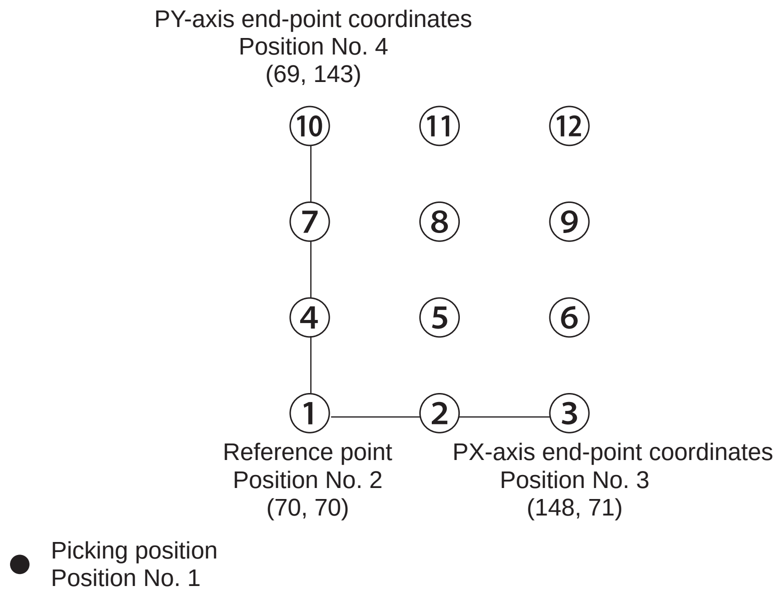

```
ACHZ    3
ATRG    13    11
  ⋮
ARCH    10    12
```

[5] Program Examples

[Simple program example (two-axis specification) using PAPS (set by 3-point teaching)]
The example below specifies movement only and does not cover picking operation.

Step	E	N	Cnd	Cmnd	Operand1	Operand2	Pst	Comment
1				BGPA	1			Start setting palletizing No. 1
2				PAPI	3	4		Number of palletizing points 3 × 4
3				PAPS	2			Set 3-point teaching
4				EDPA				End setting palletizing No. 1
5								
6				VEL	200			Speed 200mm/sec
7				MOVL	1			Move to pick position
8				PSET	1	1		Set palletizing position number to 1
9				TAG	1			
10				PMVL	1			Move to palletizing position via interpolation
11				MOVL	1			Move to pick position via interpolation
12				PINC	1		600	Increment palletizing position number by 1
13			600	GOTO	1			Move to beginning of loop if PINC was successful
14				EXIT				End

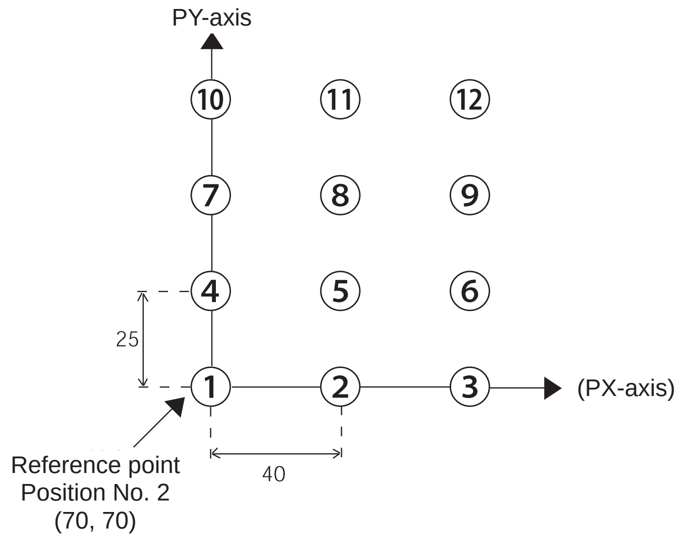
No.	Axis 1	Axis 2	Vel	Acc	Dcl	Remarks
1	10.000	10.000				Pick position
2	70.000	70.000				Position data of reference point
3	148.000	71.000				Position data PX-axis end point
4	69.000	143.000				Position data PY-axis end point



[Simple program example (two-axis specification) using PAPS, PAPT and PAST]
The example below specifies movement only and does not cover picking operation.

Step	E	N	Cnd	Cmnd	Operand1	Operand2	Pst	Comment
1				BGPA	1			Start setting palletizing No. 1
2				PAPI	3	4		Number of palletizing points 3 × 4
3				PASE	1	2		PX-axis = Axis 1, PY-axis = Axis 2
4				PAPS	40	25		Pitch X = 40, Y = 25
5				PAST	2			Position No. 2 = Reference point
6				EDPA				End setting palletizing No. 1
7								
8				VEL	200			Speed 200mm/sec
9				MOVL	1			Move to pick position
10				PSET	1	1		Set palletizing position number to 1
11				TAG	1			
12				PMVL	1			Move to palletizing position via interpolation
13				MOVL	1			Move to pick position via interpolation
14				PINC	1		600	Increment palletizing position number by 1
15			600	GOTO	1			Move to beginning of loop if PINC was successful
16				EXIT				End

No.	Axis 1	Axis 2	Vel	Acc	Dcl	Remarks
1	10.000	10.000				Pick position
2	70.000	70.000				Position data of reference point



Pitch in PX-axis direction: 40
Pitch in PY-axis direction: 25
The PX-axis is parallel with axis 1,
while the PY-axis is parallel with axis 2.

● Picking position
Position No. 1

[Program example using PAPS (set by 3-point teaching)]
The example below specifies movement only and does not cover picking operation.

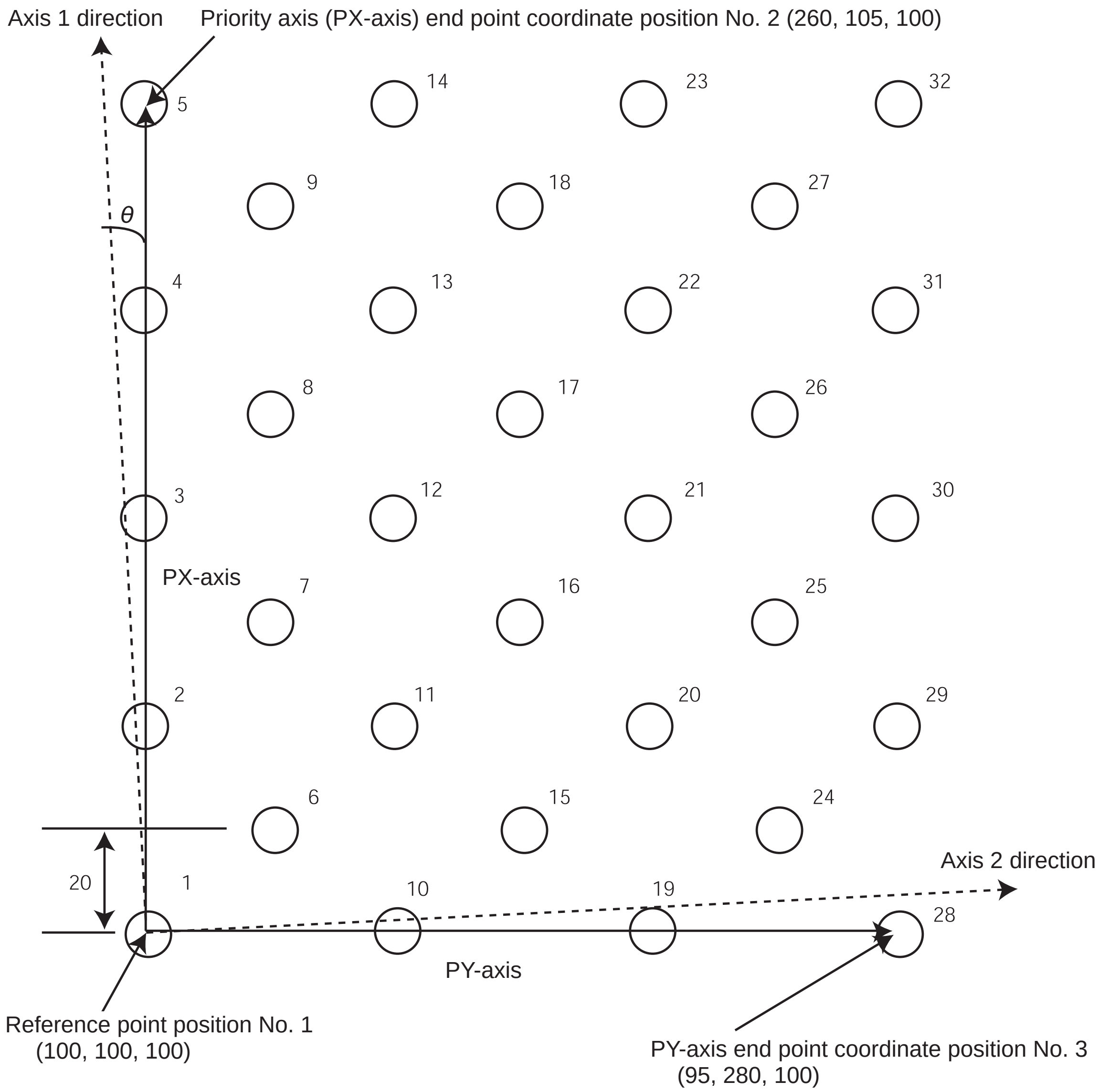
Step	E	N	Cnd	Cmnd	Operand1	Operand2	Pst	Comment
1				BGPA	1			Start setting palletizing No. 1
2								
3				PAPI	5	7		Number of palletizing points 5 × 7
4				PAPN	1			Palletizing pattern 1
5				PAPS	1			Set by 3-point teaching
6								Use data of position No. 1
7				PSLI	20	4		Zigzag offset = 20mm
8				PCHZ	3			Palletizing Z-axis = Axis 3
9				PTRG	4	4		Set palletizing arch trigger
10								Use data of position No. 4
11				OFPZ	100			PZ-axis offset = 100mm
12				PEXT	6			Set composite palletizing
13								Use data of position No. 6
14				EDPA				
15								
16				PARG	1	1		Get palletizing angle
17								The data is stored in variable 199.
18				PPUT	4	6		Store angle data in variable 199 under axis 4 in position No. 6
19								
20	*///							
21								
22				ATRG	4	4		Set arch trigger
23								Use data of position No. 4
24				ACHZ	3			Set arch motion Z-axis
25								
26				ACC	0.3			Acceleration
27				DCL	0.3			Deceleration
28				VLMX				
29								
30				PSET	1	1		Set palletizing position number to 1

Continues to the next page

Step	E	N	Cnd	Cmnd	Operand1	Operand2	Pst	Comment
31				MOVP	8			Move to pick position
32								
33				TAG	1			Beginning of loop process
34				PACH	1	9		Palletizing arch motion
35								Z point specified under position No. 9
36				ARCH	8	9		Arch motion
37								Z point specified under position No. 9
38				PINC	1		600	Increment palletizing position number by 1
39			600	GOTO	1			Move to beginning of loop if PINC was successful
40								
41				EXIT				End task
42								
43								
44								
45								

No.	Axis 1	Axis 2	Axis 3	Axis 4	Remarks
1	100.000	100.000	100.000	*.***	Position data of reference point
2	260.000	105.000	100.000	*.***	Position data PX-axis end point
3	95.000	280.000	100.000	*.***	Position data PY-axis end point
4	*.***	*.***	50.000	*.***	Position data for arch trigger
5	*.***	*.***	*.***	*.***	(Not used)
6	*.***	*.***	*.***	–1.79	Position data for composite palletizing
7	*.***	*.***	*.***	*.***	(Not used)
8	0.000	0.000	100.000	0.000	Position data of pick position
9	*.***	*.***	0.000	*.***	Z position data
10					

Schematic diagram of placement point positions according to the program defined earlier



- The number at the top right of each circle indicates the palletizing position number.
- Number of points in PX-axis direction = 5, Number of points PY-axis direction = 7
- Zigzag offsets: 20
- Number of zigzags: 4
- Pallet angle error θ: -1.79°

[Example of program using PASE, PAPT and PAST]
The following program consists of movements only and does not support pick operation.

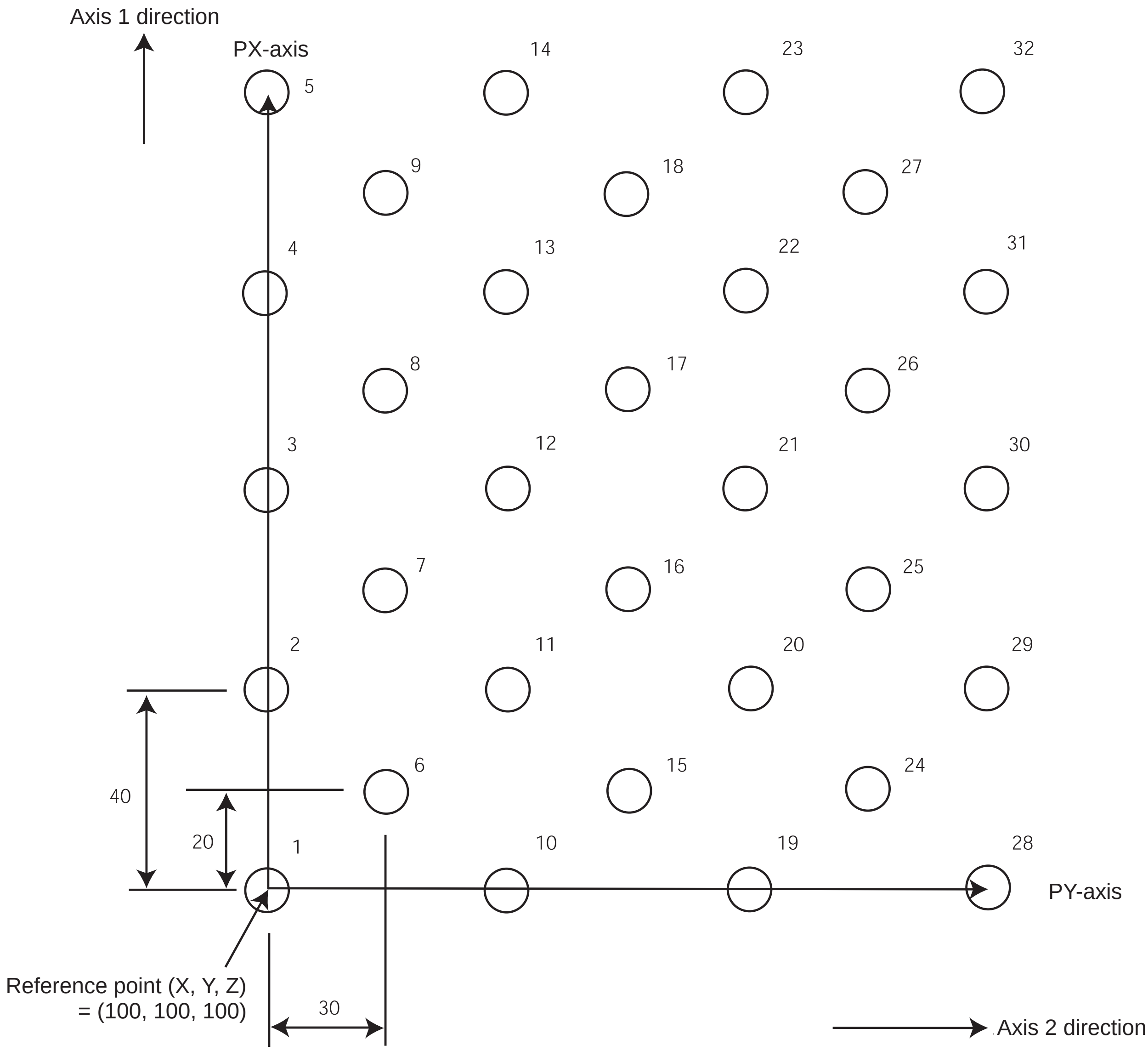
Step	E	N	Cnd	Cmnd	Operand1	Operand2	Pst	Comment
1				BGPA	1			Start setting palletizing No. 1
2								
3				PAPI	5	7		Number of palletizing points 5 × 7
4				PAPN	1			Palletizing pattern 1
5				PASE	1	2		PX-axis = Axis 1, PY-axis = Axis 2
6				PAPT	40	30		Pitch (X = 40, Y = 30mm)
7				PAST	1			Set reference position data
8								Use data of position No. 1
9				PSLI	20	4		Zigzag offset = 20mm
10								Number of zigzags = 4
11				PCHZ	3			Palletizing Z-axis = Axis 3
12				PTRG	4	4		Set palletizing arch trigger
13								Use data of position No. 4
14				OFPZ	100			PZ-axis offset = 100mm
15								
16				EDPA				
17								
18	*///							
19				ATRG	4	4		Set arch trigger
20								Use data of position No. 4
21				ACHZ	3			Set arch motion Z-axis
22								
23				ACC	0.3			Acceleration
24				DCL	0.3			Deceleration
25				VLMX				
26								
27				PSET	1	1		Set palletizing position number
28				MOVP	8			Move to pick position
29	*///							
30								

Continues to the next page

Step	E	N	Cnd	Cmnd	Operand1	Operand2	Pst	Comment
31				TAG	1			Beginning of loop process
32				PACH	1	9		Palletizing arch motion
33								Z point specified under position No. 9
34				ARCH	8	9		Arch motion
35								Z point specified under position No. 9
36				PINC	1		600	Increment palletizing position number by 1
37			600	GOTO	1			Move to beginning of loop if PINC was successful
38								
39				EXIT				End task
40								

No.	Axis 1	Axis 2	Axis 3	Axis 4	Remarks
1	100.000	100.000	100.000	*.***	Position data of reference point
2	*.***	*.***	*.***	*.***	(Not used)
3	*.***	*.***	*.***	*.***	(Not used)
4	*.***	*.***	50.000	*.***	Position data for arch trigger
5	*.***	*.***	*.***	*.***	(Not used)
6	*.***	*.***	*.***	*.***	(Not used)
7	*.***	*.***	*.***	*.***	(Not used)
8	0.000	0.000	100.000	0.000	Position data of pick position
9	*.***	*.***	0.000	*.***	Z position data
10					

Schematic diagram of placement point positions according to the program defined earlier



- The number at the top right of each circle indicates the palletizing position number.
- Number of points in PX-axis direction = 5, Number of points PY-axis direction = 7
- Pitch in PX-axis direction: 40
- Pitch in PY-axis direction: 30
- Zigzag offsets: 20
- Number of zigzags: 4

3.6.6 Handling of WAIT Timers

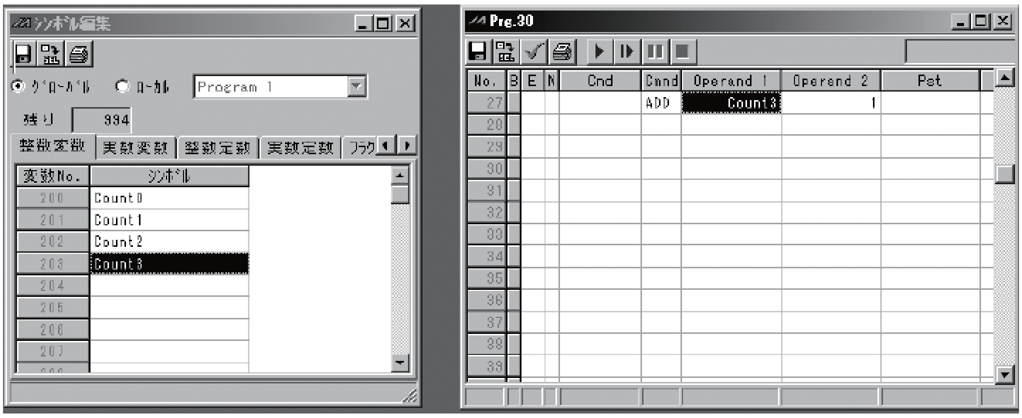
WAIT timers are provided to wait for certain events to occur.
Use a TIMW command to specify waiting.
WAIT timers can be actuated in each program.

3.6.7 Handling of Shot Pulse Timers

Shot pulse timers provide a function to turn ON/OFF an I/O flag for a specified time.
You can use a BTPN command to turn ON an I/O or flag for a specified time.
Similarly, you can use a BTPF command to turn OFF an I/O or flag for a specified time.
The maximum number of shot pulse timers that can be actuated simultaneously in one program is 16 as a total of BTPN and BTPF commands.
Note, however, that there are no limitations to how many times these timers can be used in one program.

3.6.8 Handling of Number of Symbol Definitions

With XSEL controllers, you can create a program with ease by using symbols representing variable numbers, flag numbers, etc.
In the example below, variable No. 203 is defined the symbol “Count3” in the symbol edit screen.
The defined symbol can be used in programs, and each statement of “Count3” in programs indicates variable No. 203.



Symbol edit screen　　　　Program edit screen

For information on how to edit symbols, refer to “Editing Symbols” in the XSEL Teaching Pendant Instruction Manual or “Symbol Edit Window” in the XSEL PC Software Instruction Manual.

[1] Scope of support
The following items support use of symbols:
Variable number, flag number, tag number, subroutine number, program number, position number, input port number, output port number, axis number, constant

[2] Convention of symbol statement
1) Up to nine single-byte alphanumeric or underscore characters, starting from an alphabet. (Note: Up to eight single-byte characters in the case of character string literals)
 * Symbols can also start with an underscore if you are using PC Software Ver.1.1.0.5 or later and Teaching Pendant Ver.1.04 or later.
 * Among the ASCII codes 21h to 7Eh, those single-byte characters that can be entered from the keyboard can be entered as the second and subsequent characters in a symbol, if you are using PC Software Ver.1.1.0.5 or later.
 * Note that same ASCII codes may be expressed differently if the font used on the PC is different from that used on the teaching pendant (the same also applies to character string literals).
  5Ch ····· PC software: Backslash ＼ (overseas specification, etc.)
  Teaching pendant: Yen symbol ¥
  7Eh ····· PC software: ~
  Teaching pendant: Right arrow →
2) Defining symbols of the same name within the same function is prohibited. (Defining local symbols of the same name in different programs is permitted.)
3) Defining symbols of the same name within the flag number group, input port number group or output port number group is prohibited.
(Defining local symbols of the same name in different programs is permitted.)
4) Defining symbols of the same name within the integer variable number group or real variable number group is prohibited.
(Defining local symbols of the same name in different programs is permitted.)
5) Defining symbols of the same name within the integer constant group or real constant group is prohibited.

3.6.9 RS232C Communication

[1] String processing commands

Strings are character strings. Strings used by the controllers covered by this manual include global strings and local strings.
Global strings can be read or written commonly from any program.
Local strings are valid only within each program and cannot be used in other programs.
Global strings and local strings are differentiated by the range to which their number belongs.

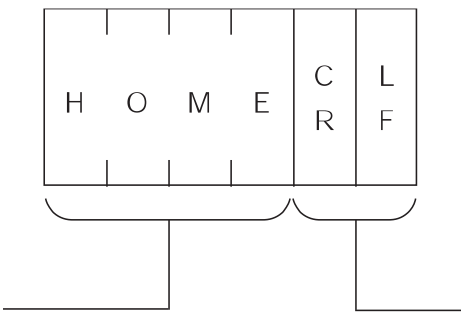
Global areas	300 to 999 (700)
Local areas	1 to 299 (299)

The communication with the external devices requires to be conducted with the serial communication using character lines, thus a use of the string is required.

[2] Explanation of transmission format

Communication performed by the systems covered by this manual is basically exchange of character strings.
Which character strings should be used for which operations is determined beforehand, so that the receiving side can recognize each character string and perform the corresponding operation.
A combination of these strings and characters indicating the end of one character string is called “transmission format”, and the user can determine a desired transmission format freely.
For example, assume a character string consisting of four characters “HOME” which is used as a home return command.
It is determined the character to finish the character line should be either “CR” or “LF” on PC. Therefore, it is necessary to follow this rule.

Example of transmission format

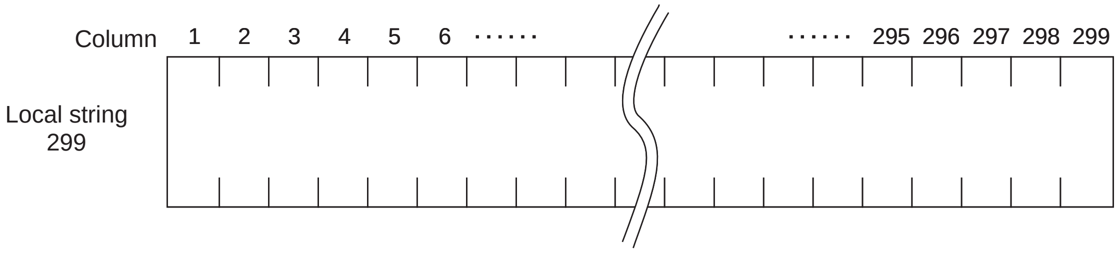


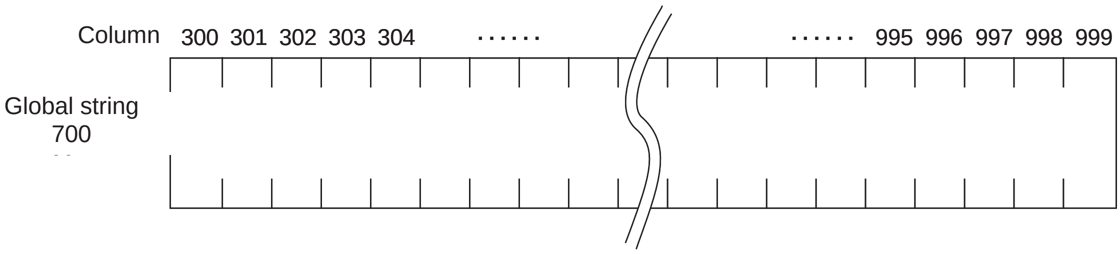
Character string for home return command

Characters indicating the end of the character string

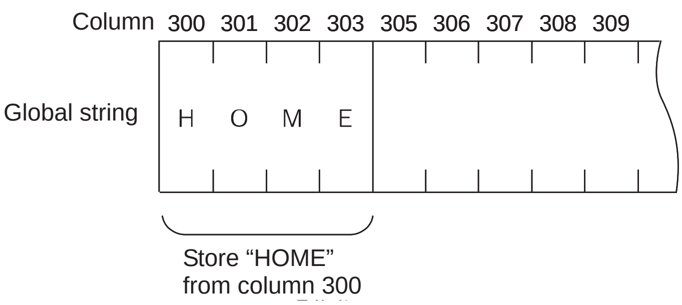
[3] Explanation of string

Strings sent according to the format explained above are stored in boxes designed to contain character strings, so that they can be used freely in the program.
Two types of strings are available: global strings that can be read or written in all programs, and local strings that can be red or written only in each program. Both strings are differentiated by their column numbers.





One character is stored in each of the fields of these strings.
The position of a given field comprising a string is indicated by “column XX” and which column to store can be set freely for each command.
For instance, if a character line “HOME”, which indicates the home-return command, is received, and the character line is desired to be used in several programs, you should save the data to Column 300 in the global string.



[4] Determination of transmission format

In this example of application program, three types of transmission formats are required, or namely transmission formats for home return command, movement command and movement completion. These formats are determined as follows. Note that these are only examples and the user can freely determine each format.

A. Home return command format

This format is used to issue a home return command from the PC to the controller.

H	O	M	E	CR	LF

B. Movement command format

This format is used to issue an axis movement command from the PC to the controller.

M	O	V	E	Speed			Axis 1 position							Axis 2 position							CR	LF
				9	9	9	9	9	9	.	9	9	9	9	9	9	.	9	9	9		

C. Movement completion format

This format is sent from the controller to the PC when the home return or movement is completed.

O	K	CR	LF

[5] Processing procedure

The processing procedure you should follow to program this application example is explained.

A. Set "LF" as characters (terminator characters) indicating the end of a string.
B. Open channel 1 of the RS232 unit to use this channel 1.
C. Program so that any data, if sent through channel 1, is received into columns starting from column 1 for local strings.
D. Program so that if the received data is "MOVE", the applicable speed data is converted to a binary value and the converted binary value is set in variable 10, while the applicable position data is converted to a binary value and the obtained binary value is set in position No. 1, after which the actuator moves and when the movement is completed, "OK" is sent.

[6] Application program

STEP	No.	N	OP-CODE	OPRND1	OPRND2	POST	Comment
1			SCHA	10			Set LF as terminator characters
2			OPEN	1			Open SIO channel 1
3			TAG	1			
4			READ	1	1		Read into columns starting from SIO 1 column 1
5							
6			ISEQ	1	'HOME'		If Home return command
7			HOME	11			Home return
8			EXSR	1			Send OK
9			EDIF				
10							
11			ISEQ	1	'MOVE'		If movement command:
12			SLEN	3			Reading period with three digits
13			VAL	10	5		Set speed in variable 10
14			VEL	*10			Set speed
15							
16			PCLR	1	1		Clear position 1
17			SLEN	3.3			
18			VAL	199	8		Set axis 1 position in variable 199
19			PPUT	1	1		Set axis 1 data
20							
21			VAL	199	15		Set axis 2 position in variable 199
22			PPUT	2	1		Set axis 2 data
23			MOVL	1			Move
24			EXSR	1			Send OK
25			EDIF				
26							
27			GOTO	1			
28							-----------
29			BGSR	1			OK send subroutine
30			SCPY	1	'OK'		Set OK
31			SPUT	3	13		Set CR
32			SPUT	4	10		Set LF
33			WRIT	1	1		Send
34			EDSR				

[7] Number of SIO Channels for each Controller

The channel numbers of SIO channels used in RS232C serial communication are as shown below.
Use OPEN and CLOS commands to specify SIO channel numbers that are used to open and close the RS232C serial communication line.
How many SIO channel numbers are available varies depending on the controller.

Controller	SIO channel number
XSEL-P/Q/PCT/QCT/PX/QX/R/ S/RX/SX/RXD/SXD	1 to 2
XSEL-J/JX TT, TTA, MSEL	1 *1
XSEL-K/KE/KT/KET, KX/KETX	1 *1 *2
SSEL, ASEL, PSEL	0 *1

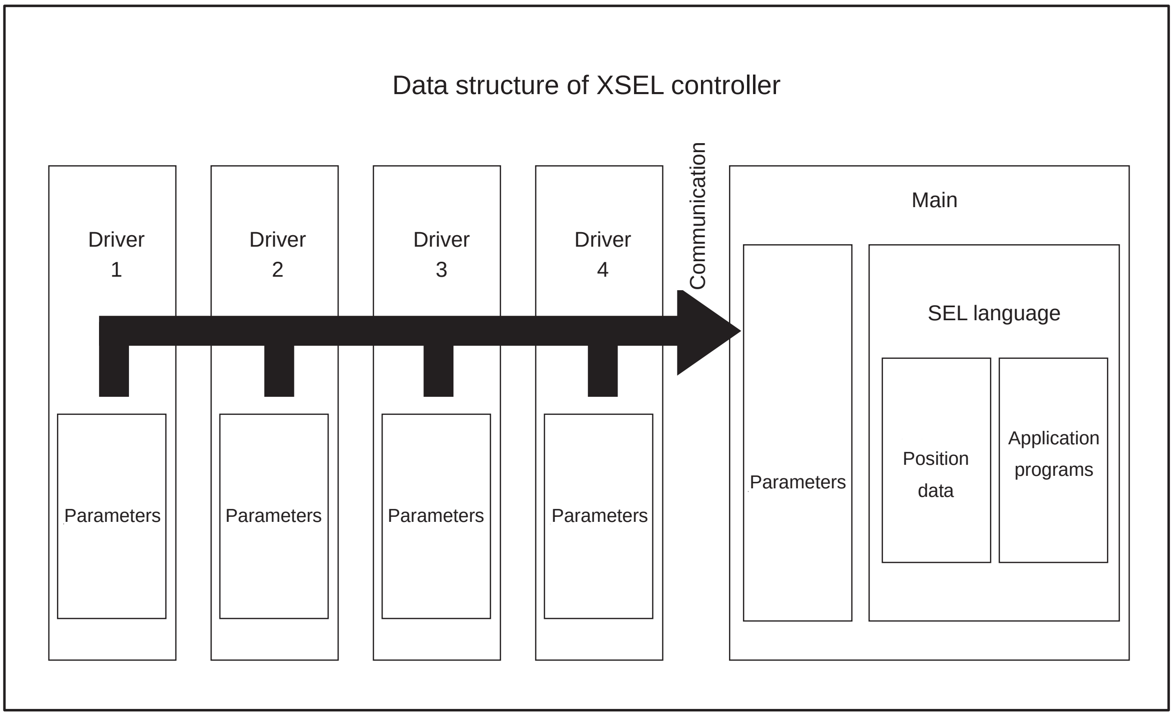
*1 This channel is used as the teaching-pendant connector port.

*2 If an expansion SIO board is installed, No. 2 and subsequent channels can be used.

3.7 Controller Data Structure and Saving of Data

3.7.1 XSEL-J/K/KE/KT/KET, JX/KX/KETX

[1] Data structure
The controller contains parameters as well as position data and application programs used to use the SEL language fully.



The customer must create position data and application programs.
Certain parameters can be changed according to the customer's system.

[2] Saving of data

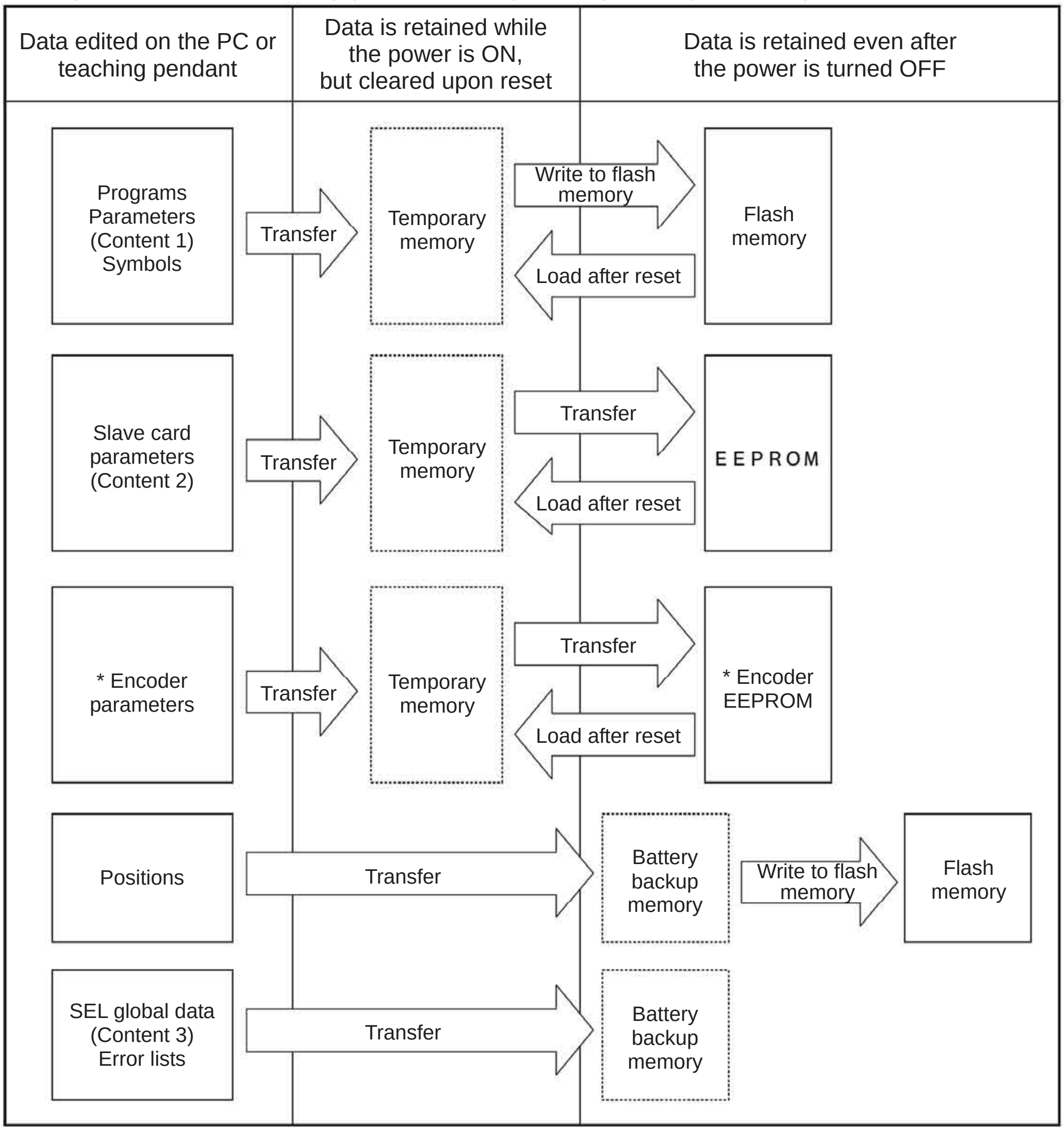
XSEL controllers have areas saved by the backup battery and areas saved by the flash memory.

Also note that even if you transfer data to your controller via the PC software or teaching pendant, the data is only written to the temporary memories and will be cleared once the power is turned OFF or controller is reset, as shown below.

So that your important data is saved without fail, write the data to the flash memory.

[System-memory backup battery is used]

Other parameter No. 20 = 2 (System-memory backup battery installed)



* Encoder parameters are stored not in the controller, but in the EEPROM of the actuator's encoder. Accordingly, they are loaded to the controller when the power is turned on or software is reset.

Since programs, parameters and symbols are loaded from the flash memory upon restart, these data in the temporary memories will return to the conditions before editing unless written to the flash memory. The controller always operates according to the data in each temporary memory (dotted box) (excluding parameters).

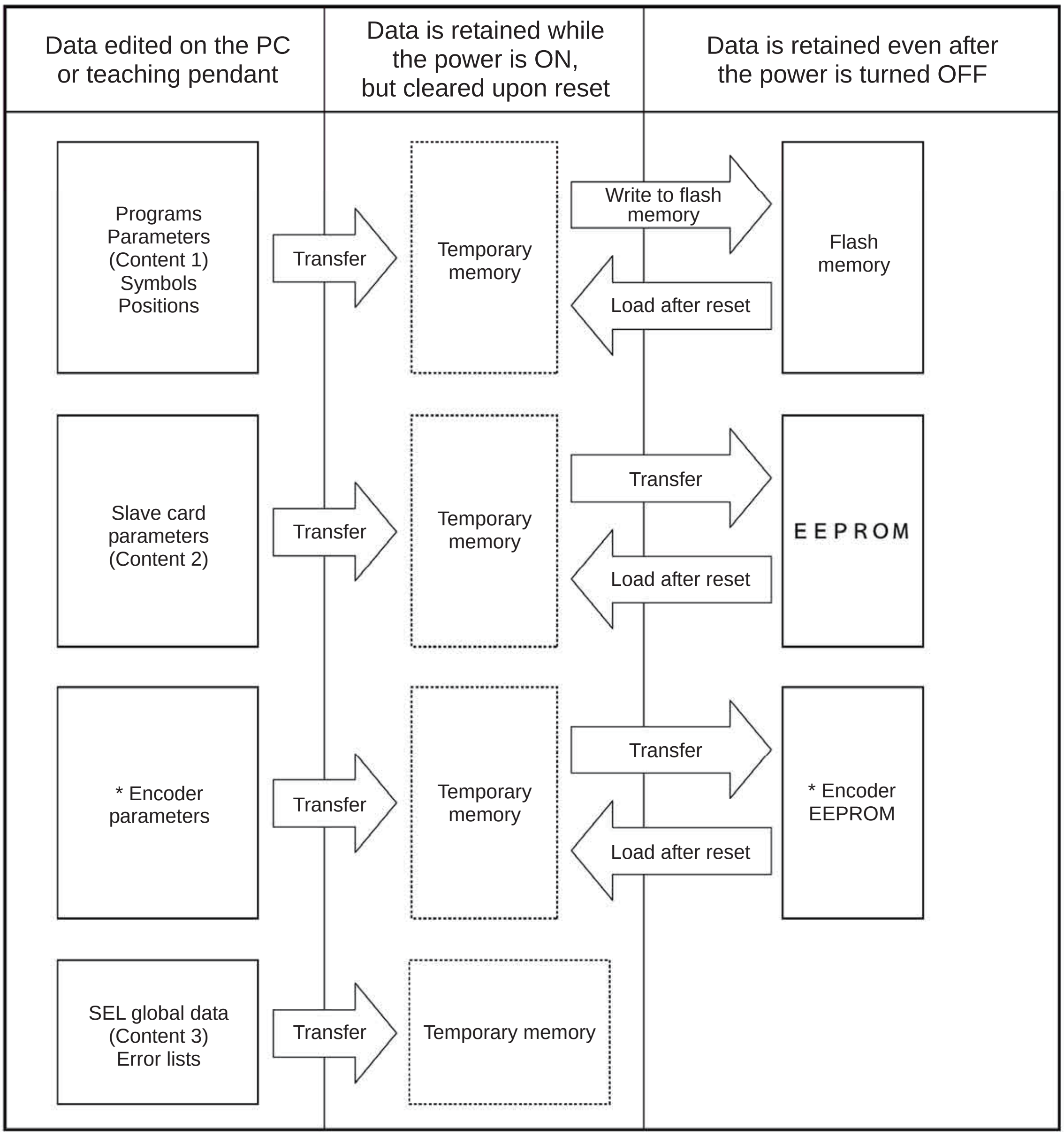
Content 1: Parameters other than those included in Content 2 below and encoder parameters

Content 2: Driver card and I/O slot card (power card) parameters

Content 3: Flags, variables and strings

[System-memory backup battery is not used]

Other parameter No. 20 = 0 (System-memory backup battery not installed)



Since programs, parameters, symbols and positions are loaded from the flash memory upon restart, these data in the temporary memories will return to the conditions before editing unless written to the flash memory. The controller always operates according to the data in each temporary memory (dotted box) (excluding parameters).
Note: SEL global data cannot be retained unless the backup battery is installed.

[3] Notes

⚠ **Caution**

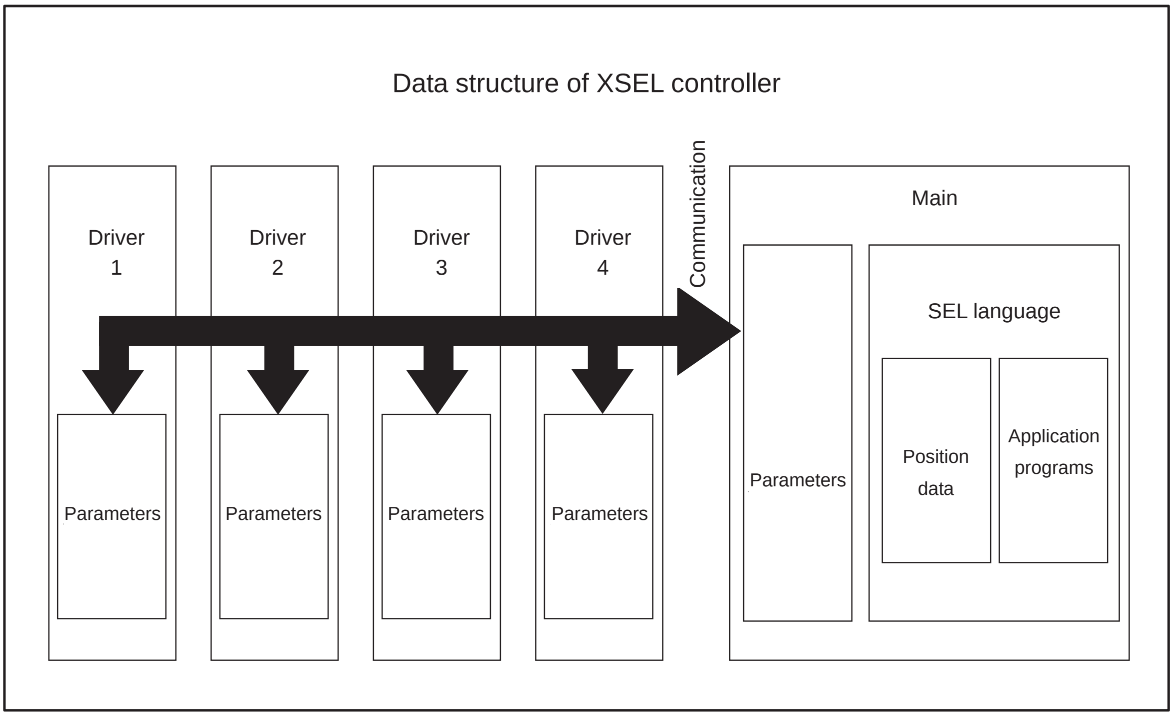
- **Notes on transferring data and writing it to the flash memory**
  Never turn OFF the main power while data is being transferred or written to the flash memory, because data may be lost and the controller will no longer be able to operate.

- **Notes on saving parameters to a file**
  Encoder parameters are stored in the EEPROM of the actuator's encoder. (Unlike parameters of other types, these parameters are not stored in the controller's EEPROM.) When the power is turned on or software is reset, encoder parameters are loaded from the EEPROM to the controller.
  Accordingly, if parameters are saved to a file after the controller power was turned on (or software was reset) while the actuator (encoder) was still not connected, the encoder parameters in this file will become invalid.

- **Notes on transferring a parameter file to the controller**
  When a parameter file is transferred to the controller, encoder parameters are transferred to the encoder's EEPROM (excluding manufacturing information and function information).
  Accordingly, if a parameter file is read and transferred to the controller after the controller power was turned on while the actuator was still not connected, invalid encoder parameters will be written to the encoder's EEPROM (as they are transferred to the controller to which the actuator is connected).
  To save parameters to a file, do so while the actuator is connected.

3.7.2 XSEL-P/Q/PCT/QCT, PX/QX

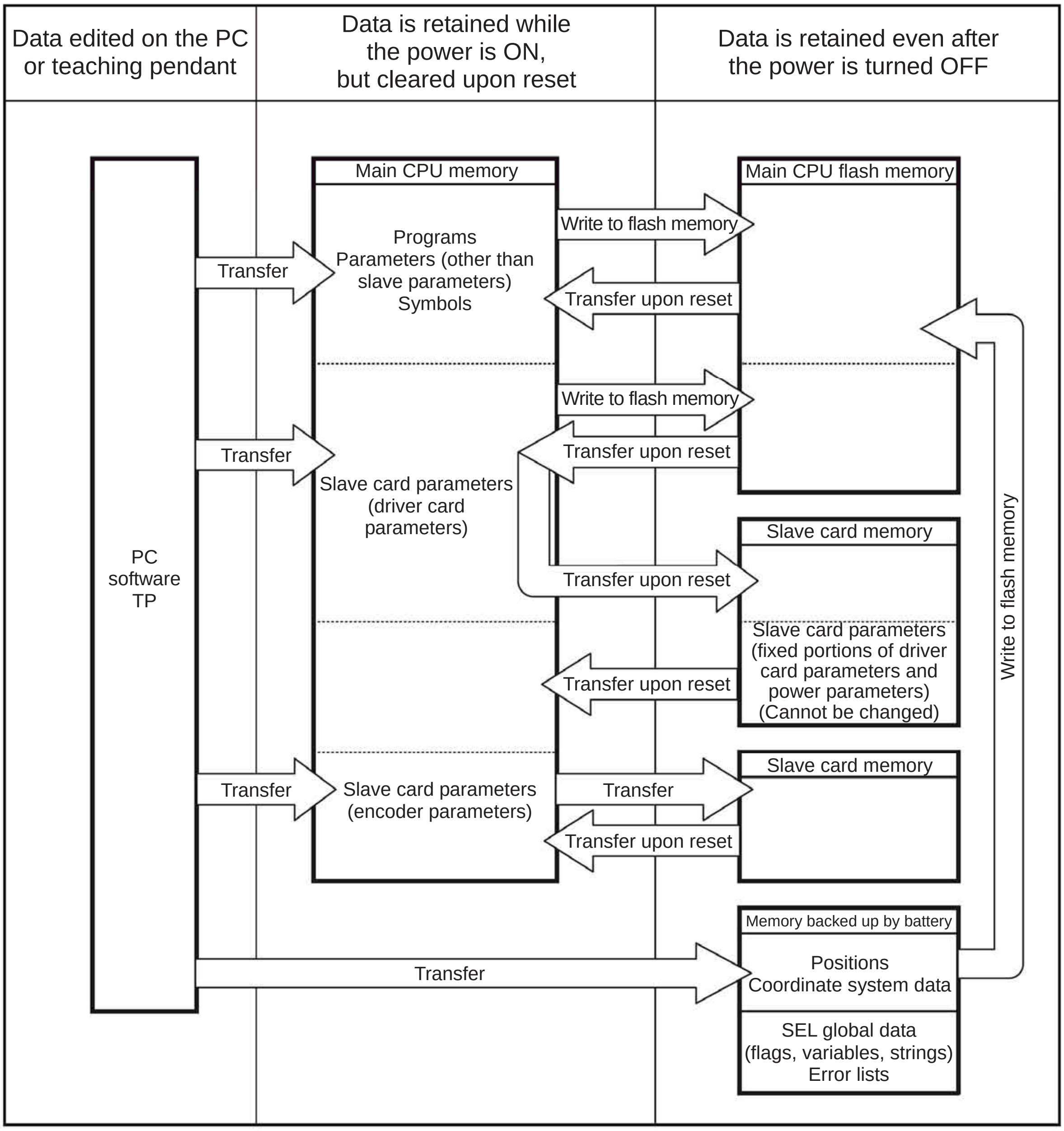
[1] Data structure
The controller contains parameters as well as position data and application programs used to use the SEL language fully.



The customer must create position data and application programs. Certain parameters can be changed according to the customer’s system.

[2] Saving of data
XSEL controllers have areas saved by the backup battery and areas saved by the flash memory.
Also note that even if you transfer data to your controller via the PC software or teaching pendant, the data is only written to the temporary memories and will be cleared once the power is turned OFF or controller is reset, as shown below.
So that your important data is saved without fail, write the data to the flash memory.

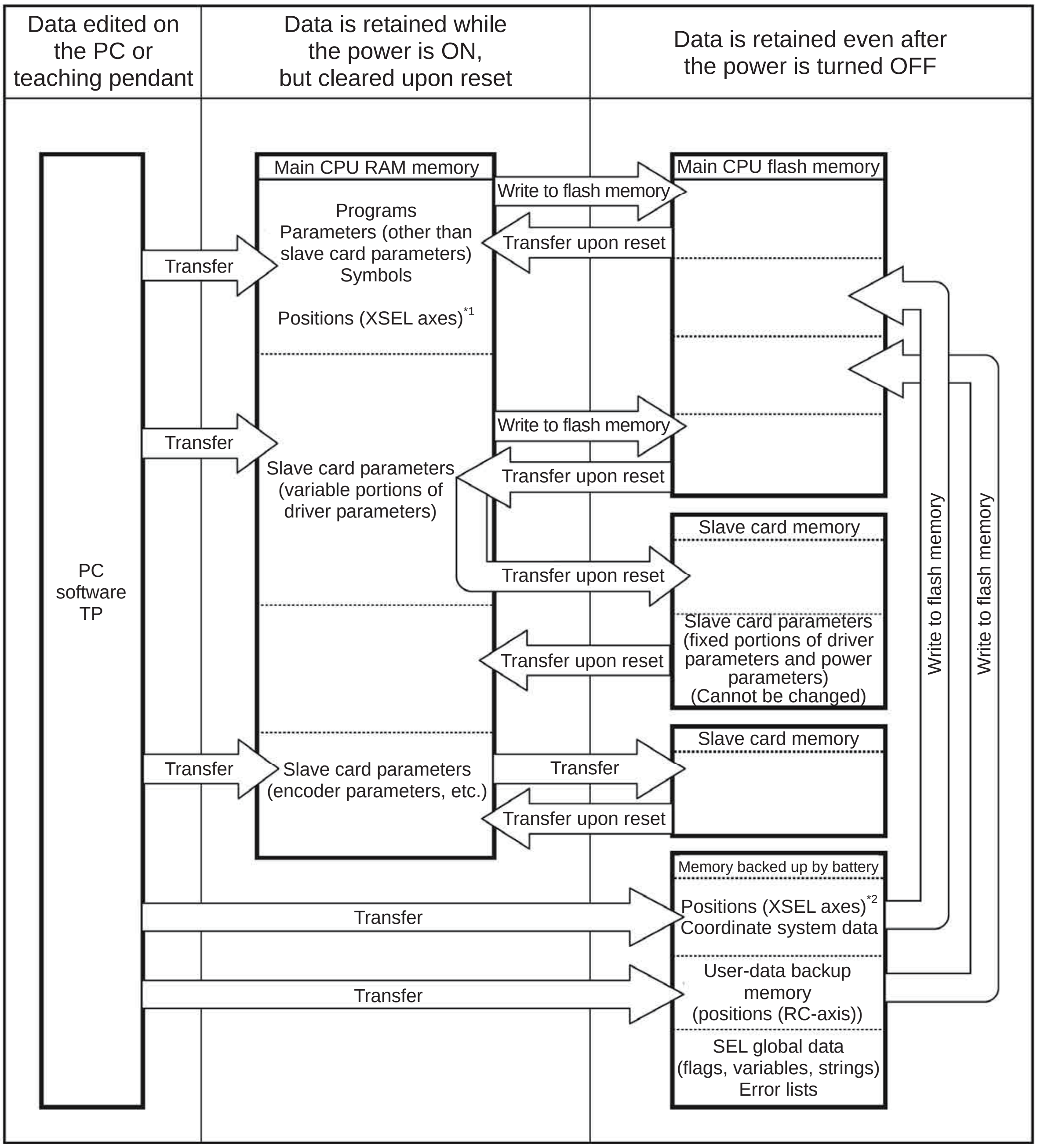
[System-memory backup battery is used]
1) XSEL-P/Q/PCT/QCT, PX/QX
(gateway function + 5V supply switch not available, memory capacity 16M)
Other parameter No. 20 = 2 (System-memory backup battery installed)



Since programs, parameters and symbols are loaded from the flash memory upon restart, these data in the temporary memories will return to the conditions before editing unless written to the flash memory.
The controller always operates according to the data in each temporary memory (excluding parameters).

2) XSEL-P/Q/PCT/QCT, PX/QX
(gateway function + 5V supply switch available, memory capacity 32M)

Other parameter No. 20 = 2 (System-memory backup battery installed)



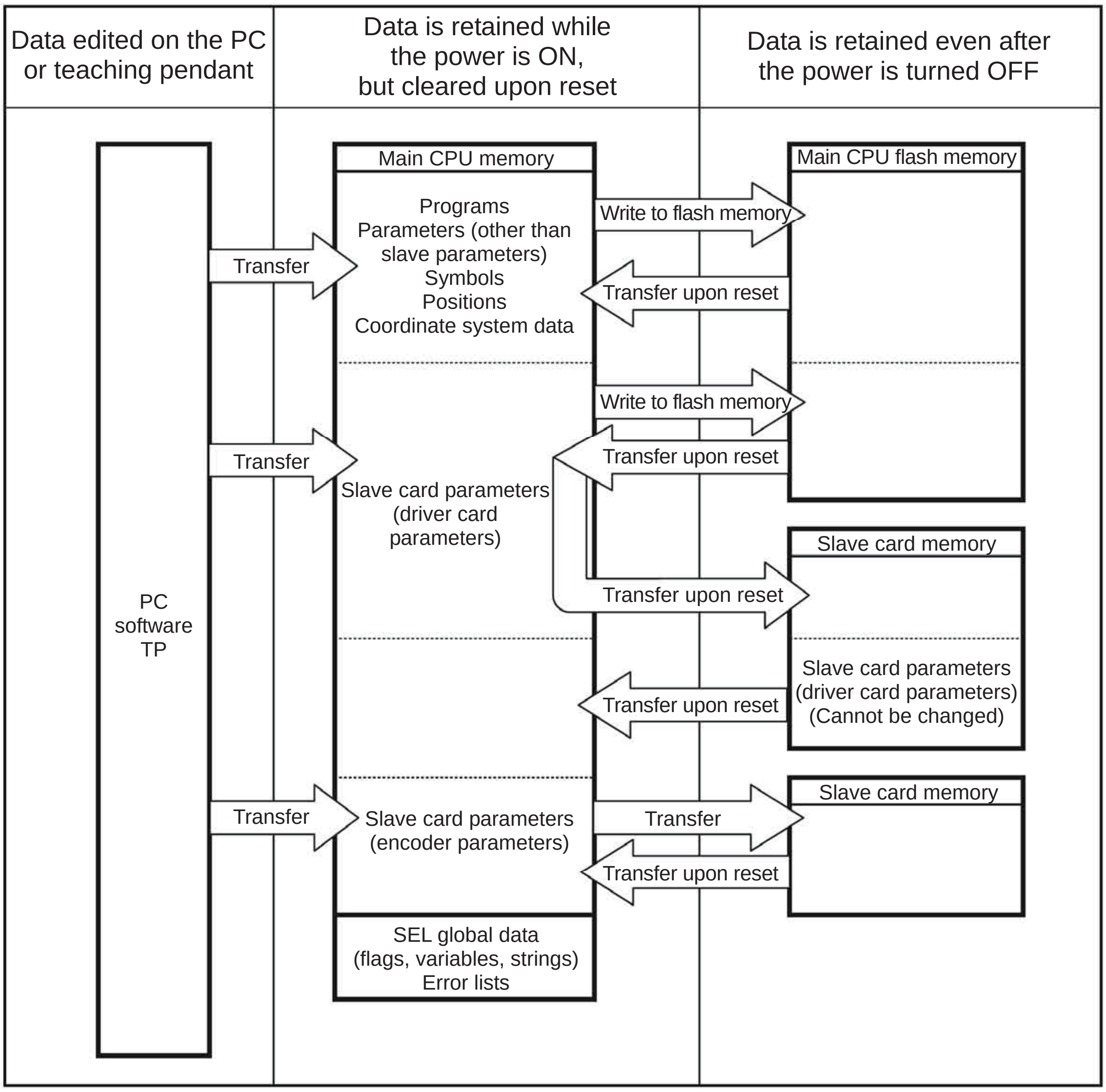
Since programs, parameters and symbols are loaded from the flash memory upon restart, these data in the temporary memories will return to the conditions before editing unless written to the flash memory.
The controller always operates according to the data in each temporary memory (excluding parameters).

*1 XSEL-P/Q/PCT/QCT and PX/QX controllers support No. 10001 to 20000.
*2 XSEL-P/Q/PCT/QCT and PX/QX controllers support No. 1 to 10000.

[System-memory backup battery is not used]

1) XSEL-P/Q/PCT/QCT, PX/QX
(gateway function + 5V supply switch not available, memory capacity 16M)

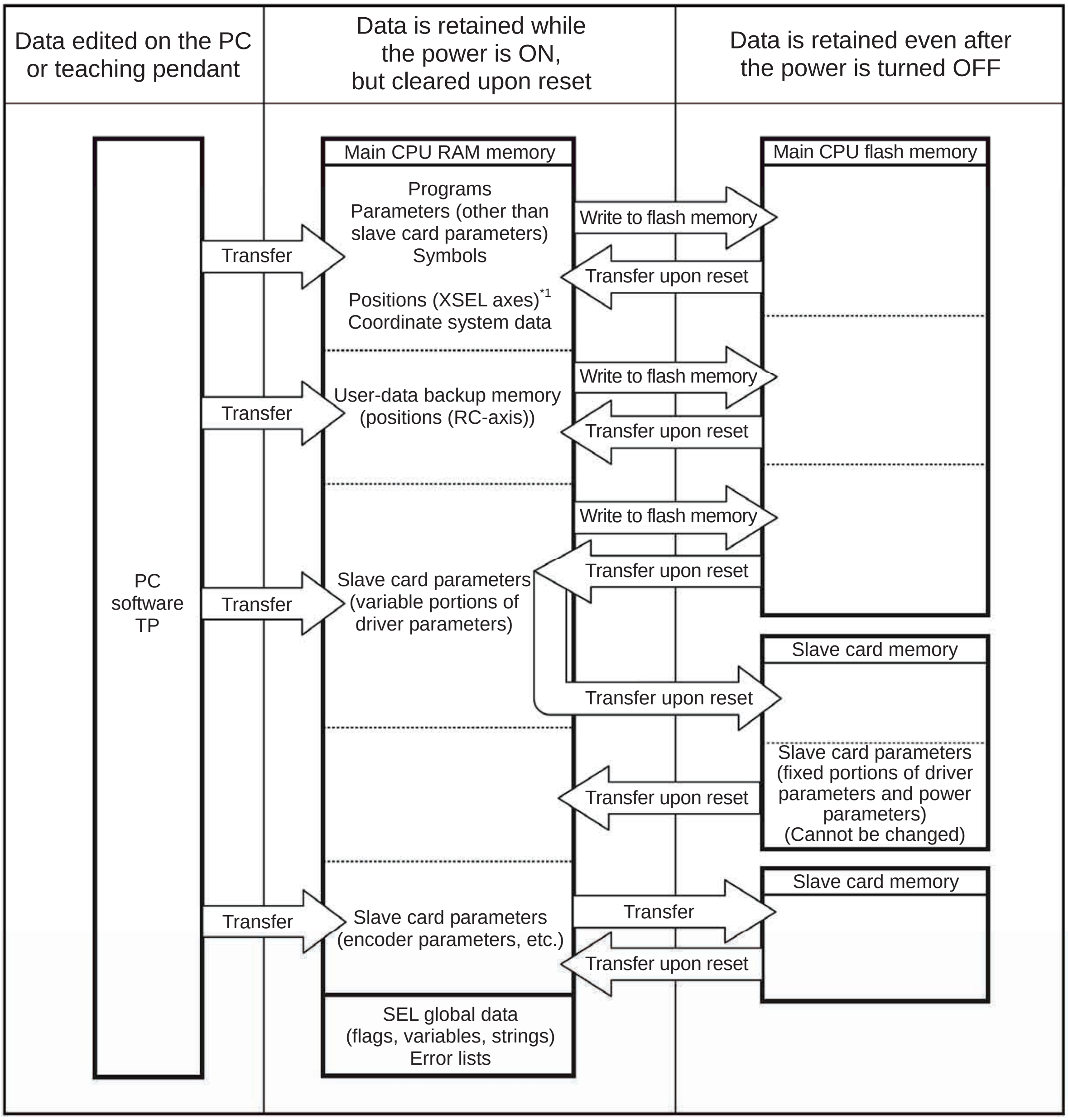
Other parameter No. 20 = 0 (System-memory backup battery not installed)



Since programs, parameters, symbols and positions are loaded from the flash memory upon restart, these data in the temporary memories will return to the conditions before editing unless written to the flash memory. The controller always operates according to the data in the main CPU memory (excluding parameters).
Note: SEL global data cannot be retained unless the backup battery is installed.

2) XSEL-P/Q/PCT/QCT, PX/QX
(gateway function + 5V supply switch available, memory capacity 32M)

Other parameter No. 20 = 0 (System-memory backup battery installed)



Since programs, parameters, symbols, positions and user-data backup memory are loaded from the flash memory upon restart, these data in the temporary memories will return to the conditions before editing unless written to the flash memory. The controller always operates according to the data in the main CPU memory (excluding parameters).
Note: SEL global data cannot be retained unless the backup battery is installed.

*1 XSEL-P/Q/PCT/QCT and PX/QX controllers support No. 1 to 20000.

[3] Notes

⚠ **Caution**

- **Notes on transferring data and writing it to the flash memory**
  Never turn OFF the main power while data is being transferred or written to the flash memory, because data may be lost and the controller will no longer be able to operate.

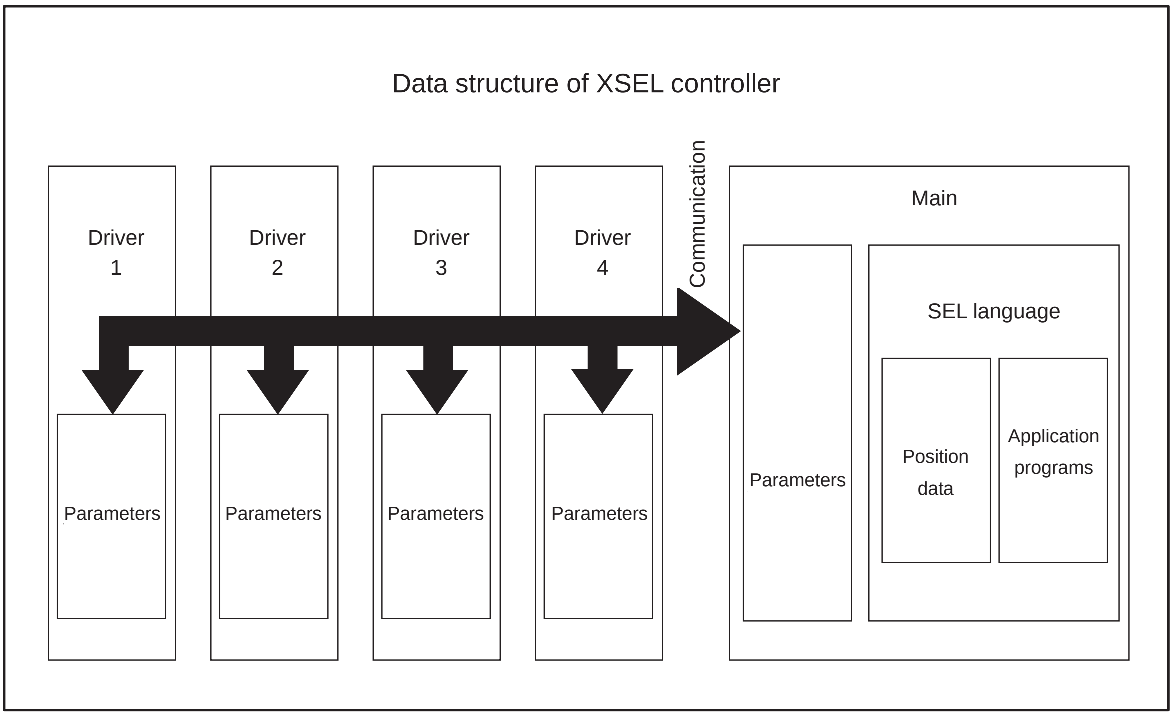
- **Notes on saving parameters to a file**
  Encoder parameters are stored in the EEPROM of the actuator's encoder. (Unlike parameters of other types, these parameters are not stored in the controller's EEPROM.) When the power is turned ON or software is reset, encoder parameters are loaded from the EEPROM to the controller.
  Accordingly, if parameters are saved to a file after the controller power was turned on (or software was reset) while the actuator (encoder) was still not connected, the encoder parameters in this file will become invalid.

- **Notes on transferring a parameter file to the controller**
  When a parameter file is transferred to the controller, encoder parameters are transferred to the encoder's EEPROM (excluding manufacturing information and function information).
  Accordingly, if a parameter file is read and transferred to the controller after the controller power was turned on while the actuator was still not connected, invalid encoder parameters will be written to the encoder's EEPROM (as they are transferred to the controller to which the actuator is connected).
  To save parameters to a file, do so while the actuator is connected.

- **Notes on increased number of positions**
  On controllers with increased memory capacity (with gateway function), the number of position data points has increased to 20000.
  Accordingly, take note of the following points:
  * If the memory backup battery is used (other parameter No. 20 = 2), position data is saved in the memory backup battery for position No. 1 to 10000, and in the main CPU flash ROM for position No. 10001 to 20000. Accordingly, <u>turning OFF the power or resetting the software without writing the position data to the flash ROM will cause the data of position No. 10001 to 20000 to be cleared and the data previously written to the flash ROM will be loaded the next time the controller is started.</u> To retain your data, therefore, make sure you write it to the flash ROM. If the memory backup battery is not used (other parameter No. 20 = 2), all position data of No. 1 to 20000 is saved in the main CPU flash ROM. In this case, again, write your data to the flash ROM to make sure the data is retained.

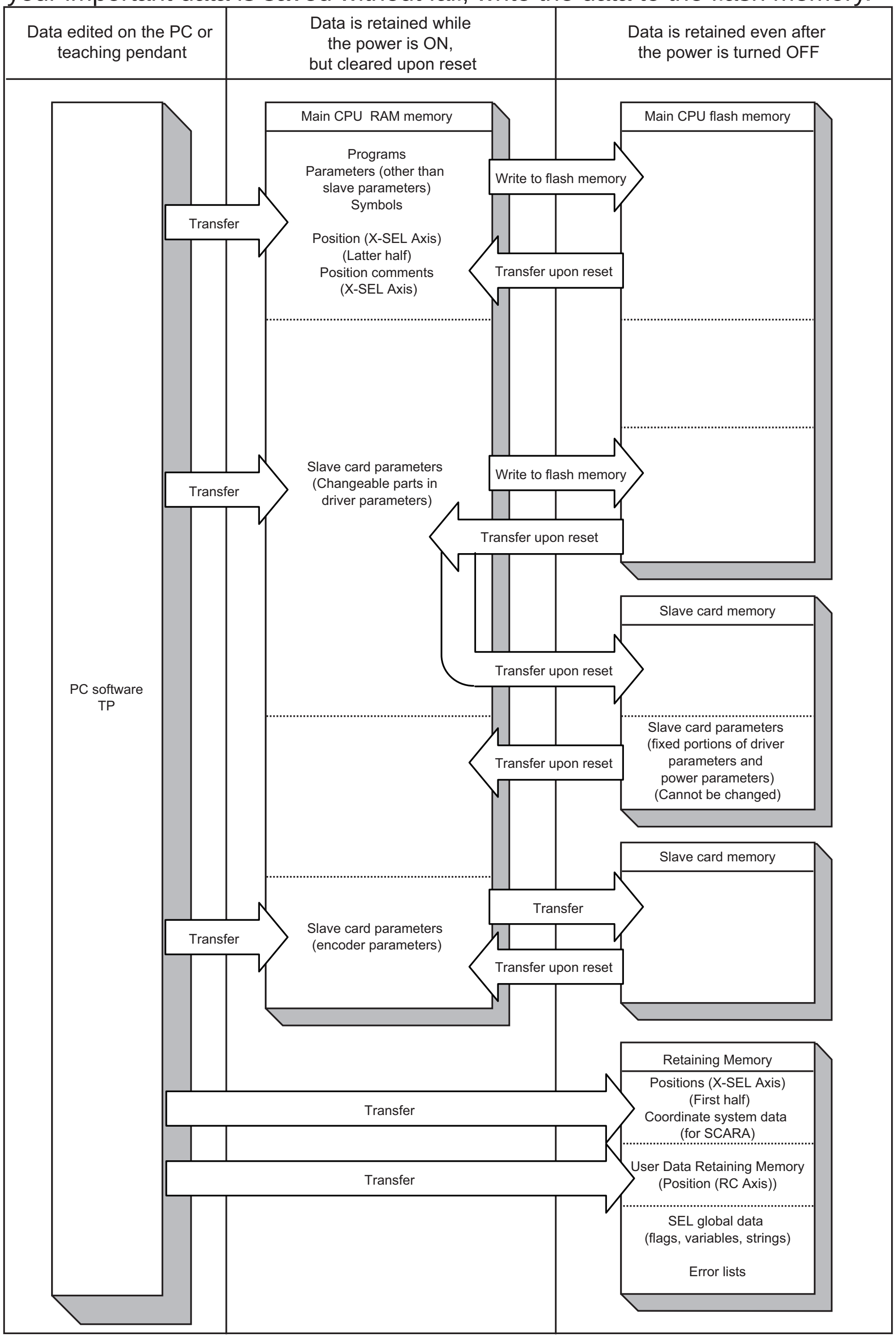
3.7.3 XSEL-R/S/RX/SX/RXD/SXD

[1] Data structure
The controller contains parameters as well as position data and application programs used to use the SEL language fully.



The customer must create position data and application programs. Certain parameters can be changed according to the customer’s system.

[2] Saving of data
In XSEL controller, there is a storage domain with saving memory and a storage domain with flash memory.
Also note that even if you transfer data to your controller via the PC software or teaching pendant, the data is only written to the temporary memories and will be cleared once the power is turned OFF or controller is reset, as shown below.
So that your important data is saved without fail, write the data to the flash memory.



Since programs, parameters and symbols are loaded from the flash memory upon restart, these data in the temporary memories will return to the conditions before editing unless written to the flash memory.
The controller always operates according to the data in each temporary memory (excluding parameters).
Note: The first half of the position data is stored in the saving memory while the second half in flash memory. The comment for each position data can be used in Positions No. 1 to 10000, and it is saved in the flash memory.

[3] Notes

⚠ **Caution**

- **Notes on transferring data and writing it to the flash memory**
  Never turn OFF the main power while data is being transferred or written to the flash memory, because data may be lost and the controller will no longer be able to operate.

- **Notes on saving parameters to a file**
  Encoder parameters are stored in the EEPROM of the actuator's encoder. (Unlike parameters of other types, these parameters are not stored in the controller's EEPROM.) When the power is turned ON or software is reset, encoder parameters are loaded from the EEPROM to the controller.
  Accordingly, if parameters are saved to a file after the controller power was turned on (or software was reset) while the actuator (encoder) was still not connected, the encoder parameters in this file will become invalid.

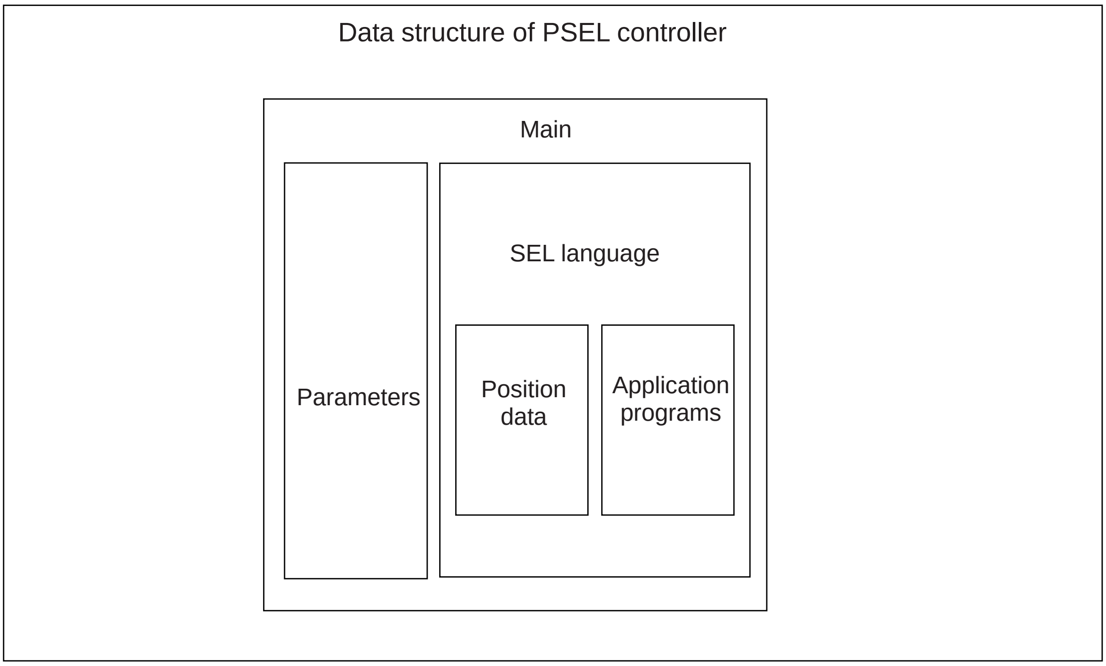
- **Notes on transferring a parameter file to the controller**
  When a parameter file is transferred to the controller, encoder parameters are transferred to the encoder's EEPROM (excluding manufacturing information and function information).
  Accordingly, if a parameter file is read and transferred to the controller after the controller power was turned on while the actuator was still not connected, invalid encoder parameters will be written to the encoder's EEPROM (as they are transferred to the controller to which the actuator is connected).
  To save parameters to a file, do so while the actuator is connected.

- **Regarding Position Data Save**
  The storage domain for the position data is saving memory for the position (first half) and flash ROM of the main CPU for the position (second half). All the position data comment is to be stored in the flash ROM of the main CPU. Therefore, if the power is turned OFF or the software reset is conducted before writing to the flash ROM, the position (second half) and the position comment data are deleted, and the data that was previously written to the flash ROM is read out the next time the system is turned on. Do not fail to conduct the flash ROM writing when data saving is required.

- **About Initializing of Memory**
  Because the position data, maintenance information data and SEL global data will not be initialized (error data remains) even after an error is detected, make sure not to use the data without canceling it. To cancel an error, initialize the memory of the data which an error has been detected.
  For the position data (No. 10001 and after), do not fail to conduct the flash ROM writing at the same time after initializing.
  (Reference) How to Initialize Memory
  - Position Data: Select [Memory Initialization] → [Position Data] Menu in the PC software
  - Coordinate System Data: Select [Memory Initialization] → [Coordinate System Definition Data] Menu in the PC software
  - User Retaining Memory: Select [Memory Initialization] → [User Retaining Memory] Menu in the PC software
  - SEL Global Data: Select [Memory Initialization] → [Global Variables/Flags] Menu in the PC software
  - Maintenance Information Data: Select [Memory Initialization] → [Maintenance Information] in the PC software and select [Information Initialization]
    * Initialization available when Error No. 4A4, 4A5 or 4A6 has occurred

3.7.4 ASEL, PSEL

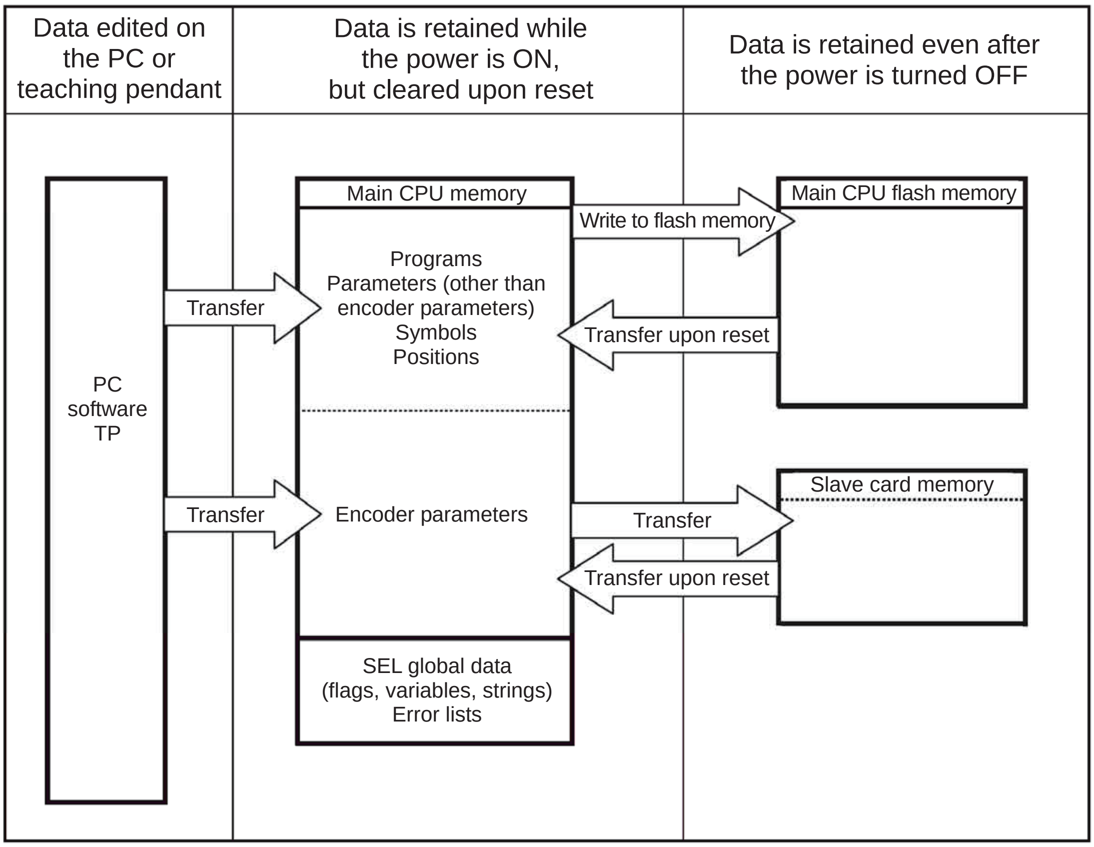
[1] Data structure
The controller contains parameters as well as position data and application programs used to use the SEL language fully.



[2] Saving of data
On ASEL and PSEL controllers, data is saved as shown below.
Even if you transfer data to your controller via the PC software or teaching pendant, the data is only written to the temporary memories and will be cleared once the power is turned OFF or controller is reset, as shown below.
To save the data without fail, be sure to write the data you want to save to the flash ROM.

[System-memory backup battery is not used]

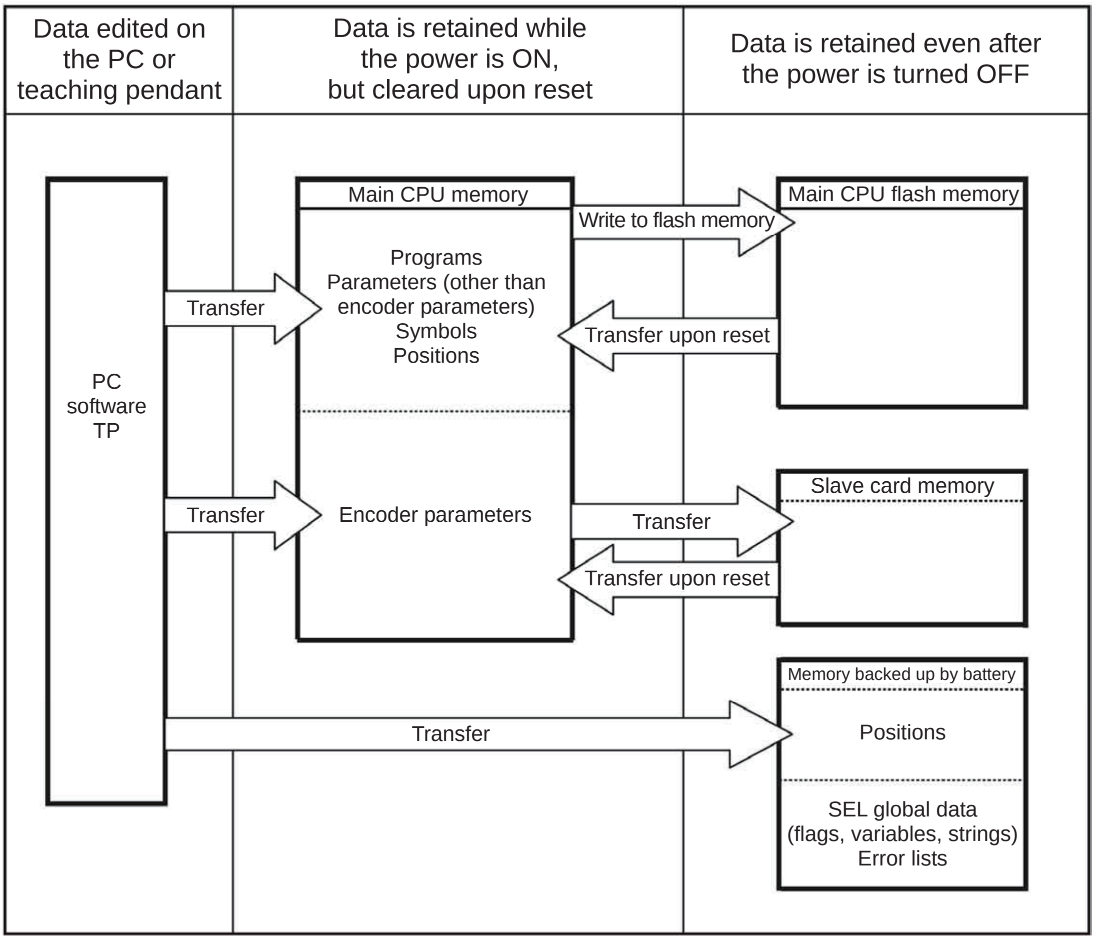
Other parameter No. 20 = 0 (System-memory backup battery not installed)



Since programs, parameters, symbols and positions are loaded from the flash memory upon restart, these data in the temporary memories will return to the conditions before editing unless written to the flash memory. The controller always operates according to the data in the main CPU memory (excluding parameters).
Note: SEL global data cannot be retained unless the backup battery is installed.
SEL global data is cleared once the control power is turned OFF or software is reset.
Error lists are cleared once the control power is turned OFF.

[System-memory backup battery (optional) is used]

The setting of other parameter No. 20 = 2 (System-memory backup battery installed) must be changed.



Since programs, parameters and symbols are loaded from the flash memory upon restart, these data in the temporary memories will return to the conditions before editing unless written to the flash memory.
The controller always operates according to the data in each temporary memory (excluding parameters).

[3] Notes

⚠ **Caution**

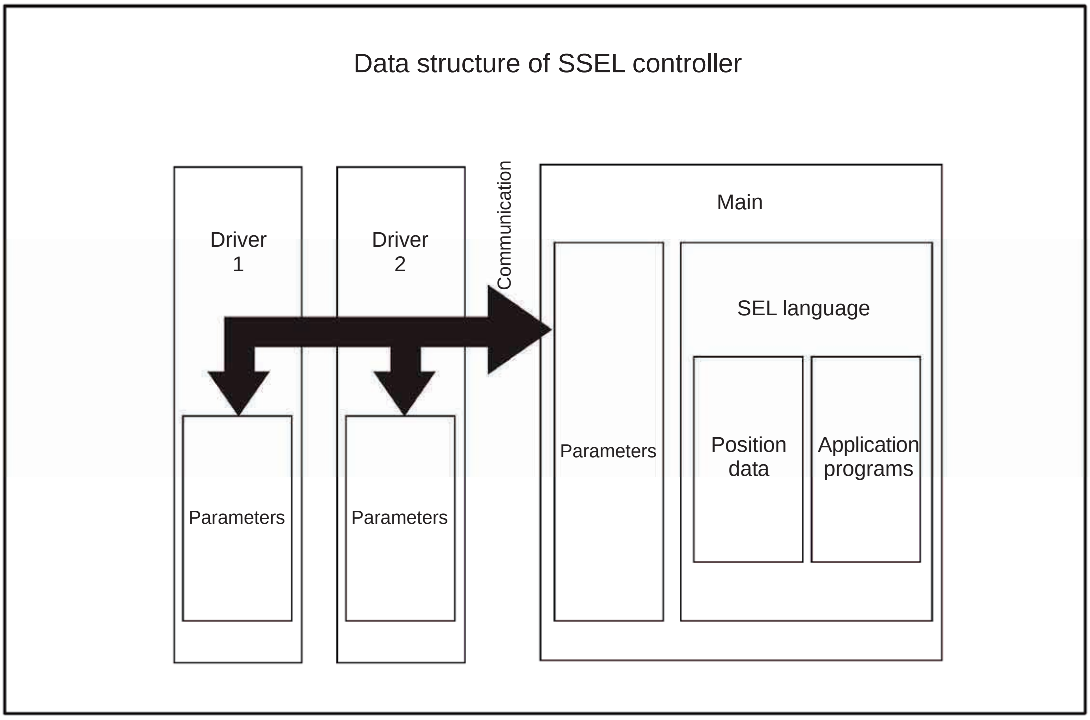
- **Notes on transferring data and writing it to the flash memory**
  Never turn OFF the main power while data is being transferred or written to the flash memory, because data may be lost and the controller will no longer be able to operate.

- **Notes on saving parameters to a file**
  Encoder parameters are stored in the EEPROM of the actuator's encoder. (Unlike parameters of other types, these parameters are not stored in the controller's EEPROM.) When the power is turned ON or software is reset, encoder parameters are loaded from the EEPROM to the controller.
  Accordingly, if parameters are saved to a file after the controller power was turned on (or software was reset) while the actuator (encoder) was still not connected, the encoder parameters in this file will become invalid.

- **Notes on transferring a parameter file to the controller**
  When a parameter file is transferred to the controller, encoder parameters are transferred to the encoder's EEPROM (excluding manufacturing information and function information).
  Accordingly, if a parameter file is read and transferred to the controller after the controller power was turned on while the actuator was still not connected, invalid encoder parameters will be written to the encoder's EEPROM (as they are transferred to the controller to which the actuator is connected).
  To save parameters to a file, do so while the actuator is connected.

3.7.5 SSEL

[1] Data structure
The controller contains parameters as well as position data and application programs used to use the SEL language fully.

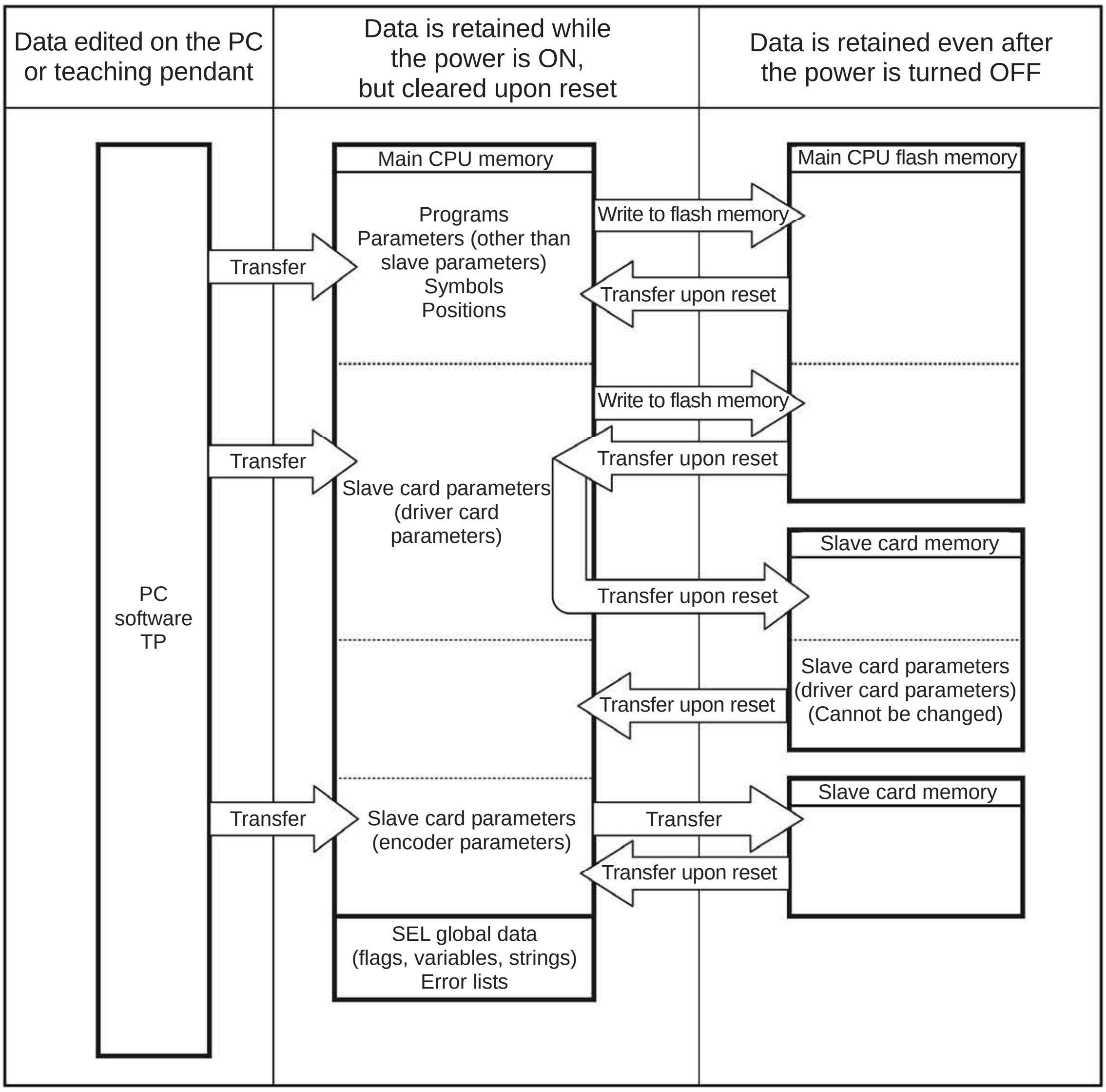


The customer must create position data and application programs.
Certain parameters can be changed according to the customer’s system.

[2] Saving of data
On SSEL controllers, data is saved as shown below.
Even if you transfer data to your controller via the PC software or teaching pendant, the data is only written to the temporary memories and will be cleared once the power is turned OFF or controller is reset, as shown below.
To save the data without fail, be sure to write the data you want to save to the flash ROM.

[System-memory backup battery is not used]

Other parameter No. 20 = 0 (System-memory backup battery not installed)

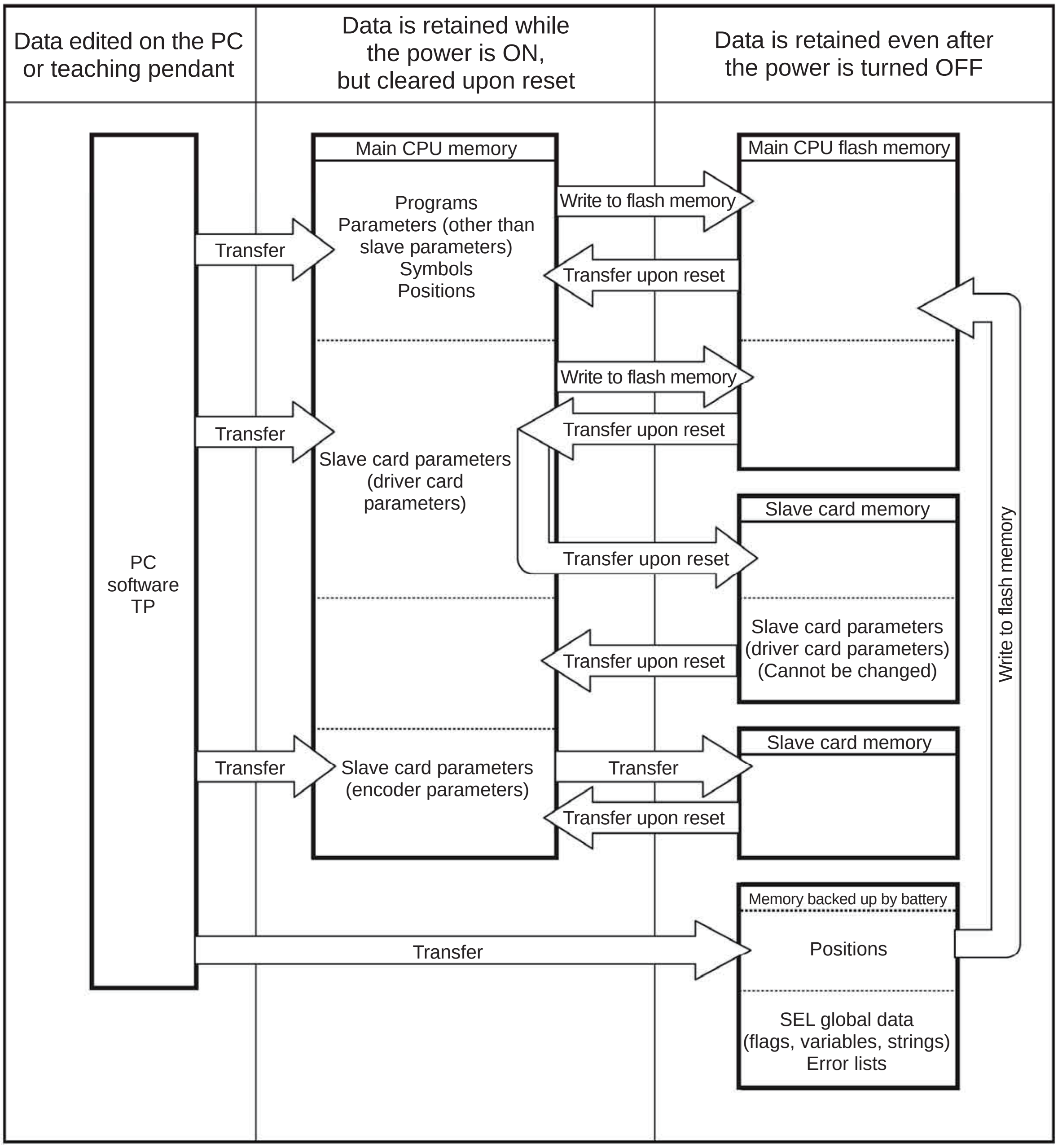


Since programs, parameters, symbols and positions are loaded from the flash memory upon restart, these data in the temporary memories will return to the conditions before editing unless written to the flash memory. The controller always operates according to the data in the main CPU memory (excluding parameters).

Note: SEL global data cannot be retained unless the backup battery is installed.
SEL global data is cleared once the control power is turned OFF or software is reset.
Error lists are cleared once the control power is turned OFF.

[System-memory backup battery (optional) is used]

The setting of other parameter No. 20 = 2 (System-memory backup battery installed) must be changed.



Since programs, parameters and symbols are loaded from the flash memory upon restart, these data in the temporary memories will return to the conditions before editing unless written to the flash memory.
The controller always operates according to the data in each temporary memory (excluding parameters).

[3] Notes

⚠ **Caution**

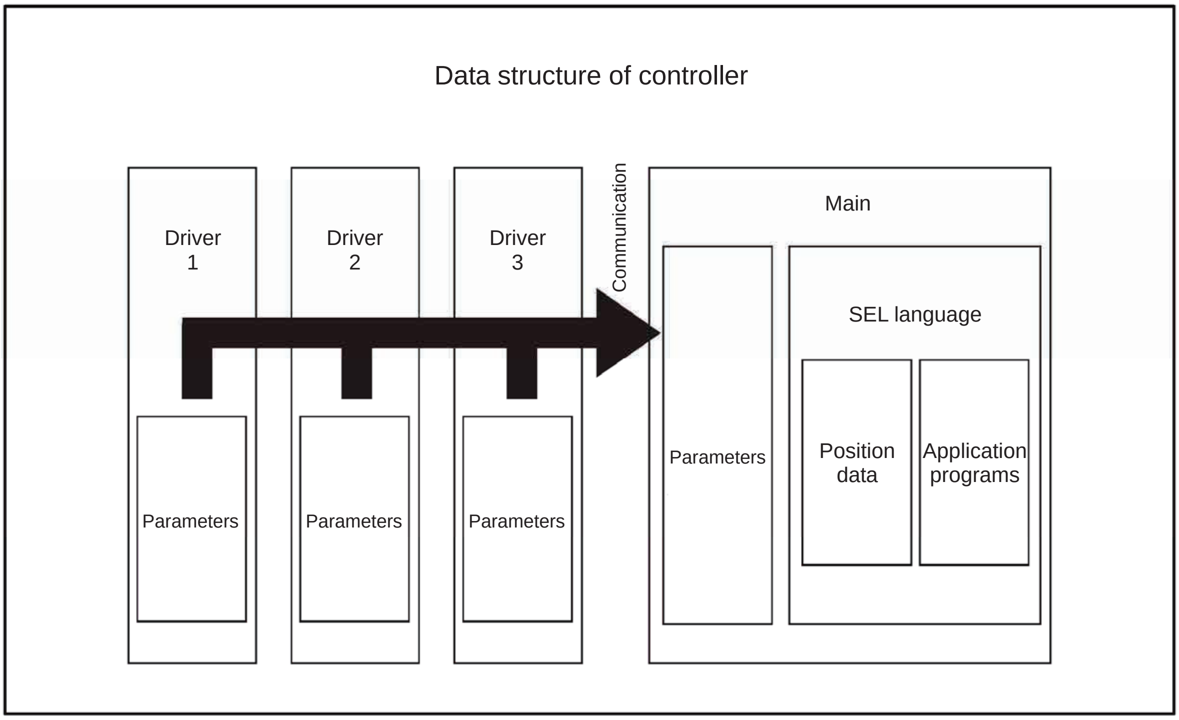
- **Notes on transferring data and writing it to the flash memory**
  Never turn OFF the main power while data is being transferred or written to the flash memory, because data may be lost and the controller will no longer be able to operate.

- **Notes on saving parameters to a file**
  Encoder parameters are stored in the EEPROM of the actuator's encoder. (Unlike parameters of other types, these parameters are not stored in the controller's EEPROM.) When the power is turned ON or software is reset, encoder parameters are loaded from the EEPROM to the controller.
  Accordingly, if parameters are saved to a file after the controller power was turned on (or software was reset) while the actuator (encoder) was still not connected, the encoder parameters in this file will become invalid.

- **Notes on transferring a parameter file to the controller**
  When a parameter file is transferred to the controller, encoder parameters are transferred to the encoder's EEPROM (excluding manufacturing information and function information).
  Accordingly, if a parameter file is read and transferred to the controller after the controller power was turned on while the actuator was still not connected, invalid encoder parameters will be written to the encoder's EEPROM (as they are transferred to the controller to which the actuator is connected).
  To save parameters to a file, do so while the actuator is connected.

3.7.6 TT/TTA

[1] Data structure
The controller module of a tabletop robot contains parameters as well as position data and application programs used to drive the SEL language.



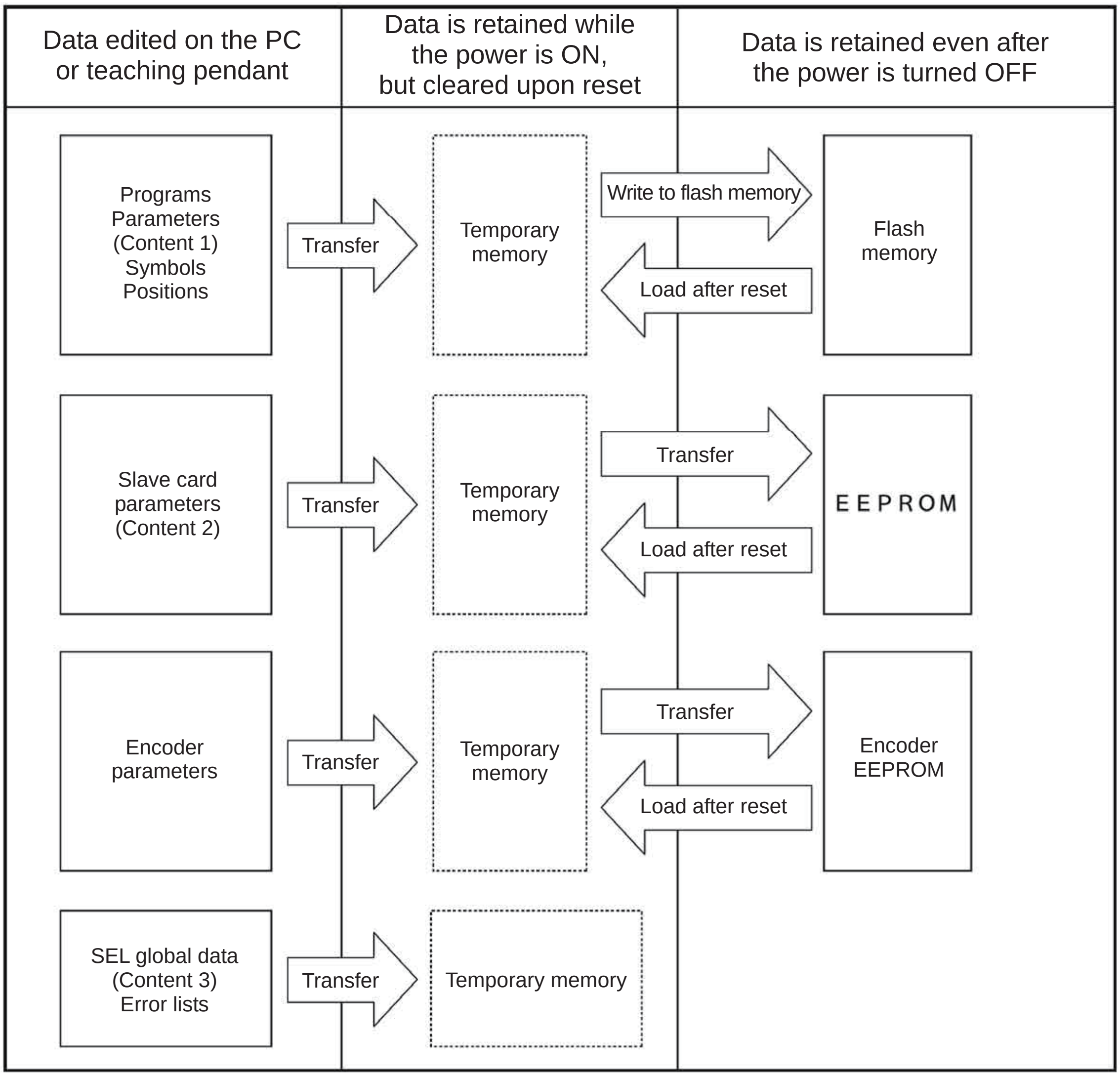
The customer must create position data and application programs.
Certain parameters can be changed according to the customer's system.
[Refer to tabletop robot TT Instruction Manual provided separately.]

[2] Data Saving of TT

When data created/edited using the PC software or teaching pendant is transferred to the controller (by pressing the WRT key if you are using the teaching pendant), the data is temporarily stored in the controller's memories. Accordingly, such data will be cleared once the power is turned off or software is reset (restarted).

If you want your data to be retained, be sure to write it to the flash memory.

Note: Global data (variables, flags, strings) is cleared once the power is turned OFF or software is reset (restarted) (global data cannot be retained after the power is turned OFF). Error lists are retained after the software is reset, but cleared if the power is turned OFF.



Content 1: Parameters other than those included in Content 2 below and encoder parameters
Content 2: Driver card and I/O slot card (power card) parameters
Content 3: Flags, variables and strings

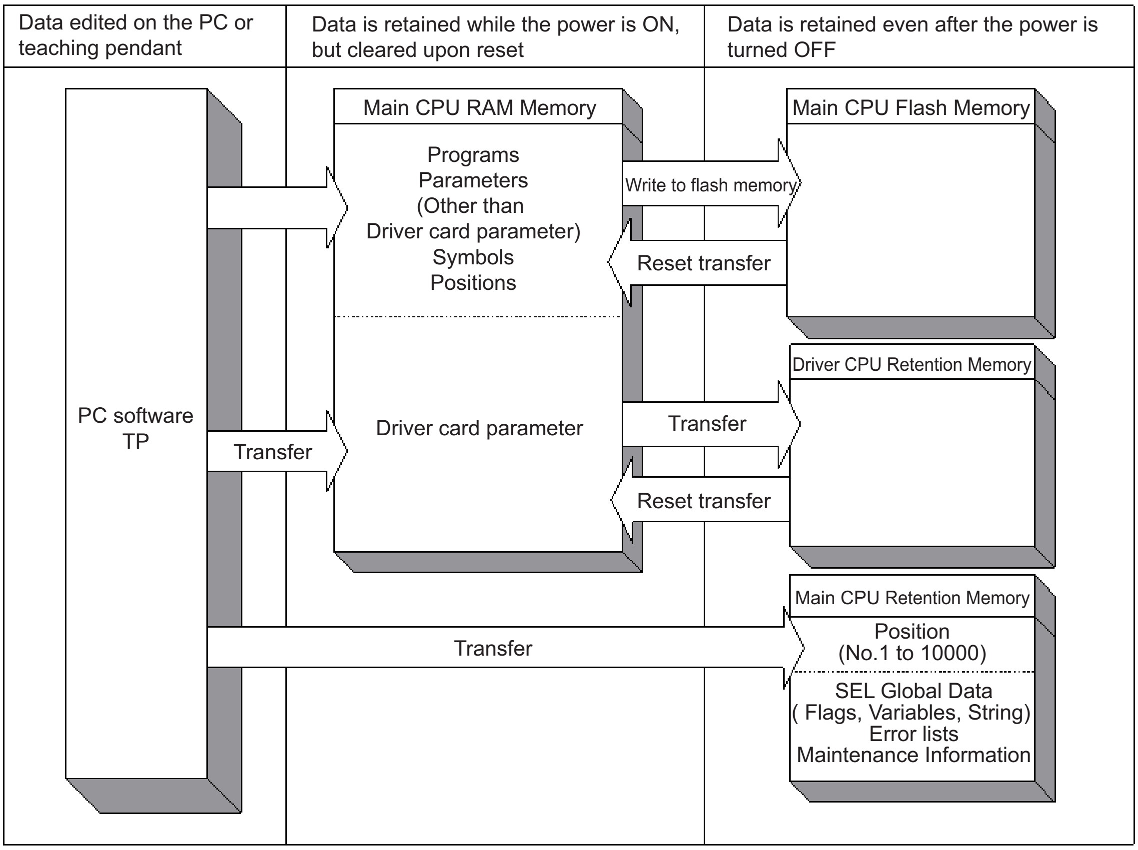
Since programs, parameters, symbols and positions are loaded from the flash memory upon restart, these data in the temporary memories will return to the conditions before editing unless written to the flash memory. The controller always operates according to the data in each temporary memory (dotted box) (excluding parameters).

[3] Notes

> ⚠ **Caution**
> **Notes on transferring data and writing it to the flash memory**
> Never turn OFF the main power while data is being transferred or written to the flash memory, because data may be lost and the controller will no longer be able to operate.

[4] Data Saving of TTA

In the retaining memory (FeRAM), Position data (No. 1 to 10000), SEL global data, error list and maintenance information are stored for backup in standard with no battery.
Position (No. 1 to 10000) is stored only in the retaining memory. (It is not necessary to have the flash ROM writing.)



(Note 1) Do not attempt to turn the power OFF during the memory initialization (position, global variables and flags) or the maintenance information initialization. As the initializing process terminates incomplete, errors described below* may be generated in the next startup. Redo initializing in case the power is turned OFF accidently, and an error is generated. (* Error No. 4A4, 69E, 6C7 or 826)

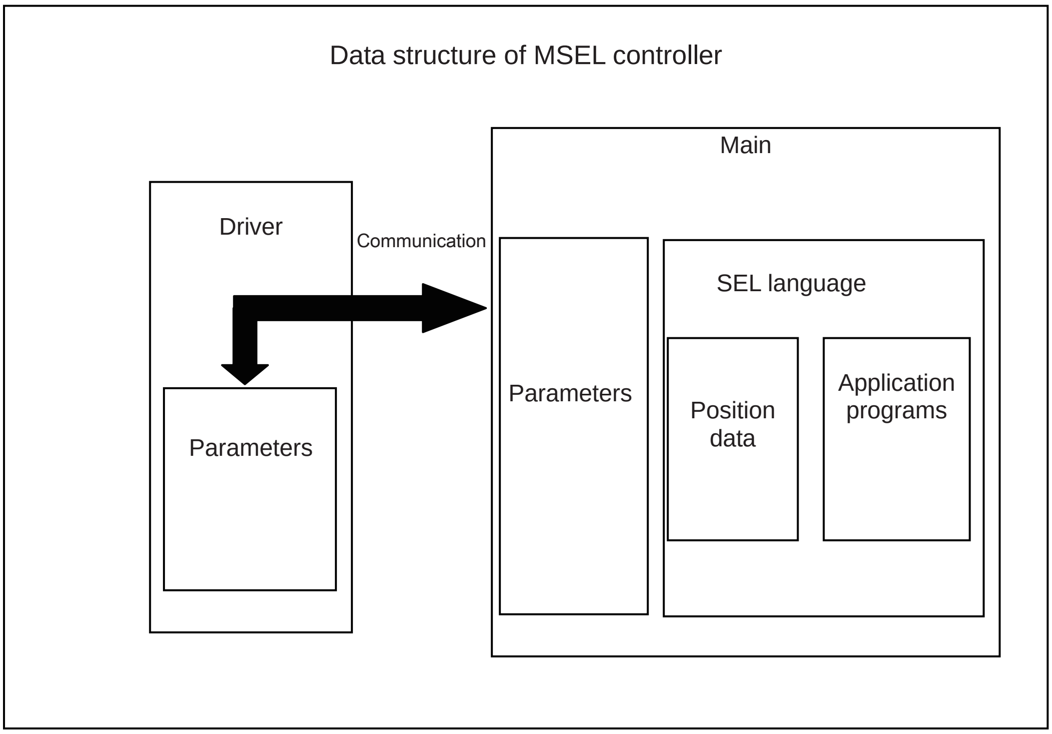
(Note 2) As the position data, maintenance information data and SEL global data will not be initialized even if an error gets detected (error data can be seen as it is), do not attempt to use the data as it is. To cancel the error, initialize the memory in the data the error was detected.
For position data (No. 10001 to 30000), conduct also the flash ROM writing after initializing.

(Reference) How to Initialize Memory

- Position Data: Select [Memory Initialization] → [Position Data] Menu in the PC software
- SEL Global Data: Select [Memory Initialization] → [Global Variables/Flags] Menu in the PC software
- Maintenance Information Data: Select [Memory Initialization] → [Maintenance Information] in the PC software and select [Information Initialization]
  * Initialization available when Error No. 4A4, 4A5 or 4A6 has occurred

3.7.7 MSEL

[1] Data structure
The controller module of a MSEL contains parameters as well as position data and application programs used to drive the SEL language.



The customer must create position data and application programs.
Certain parameters can be changed according to the customer’s system.

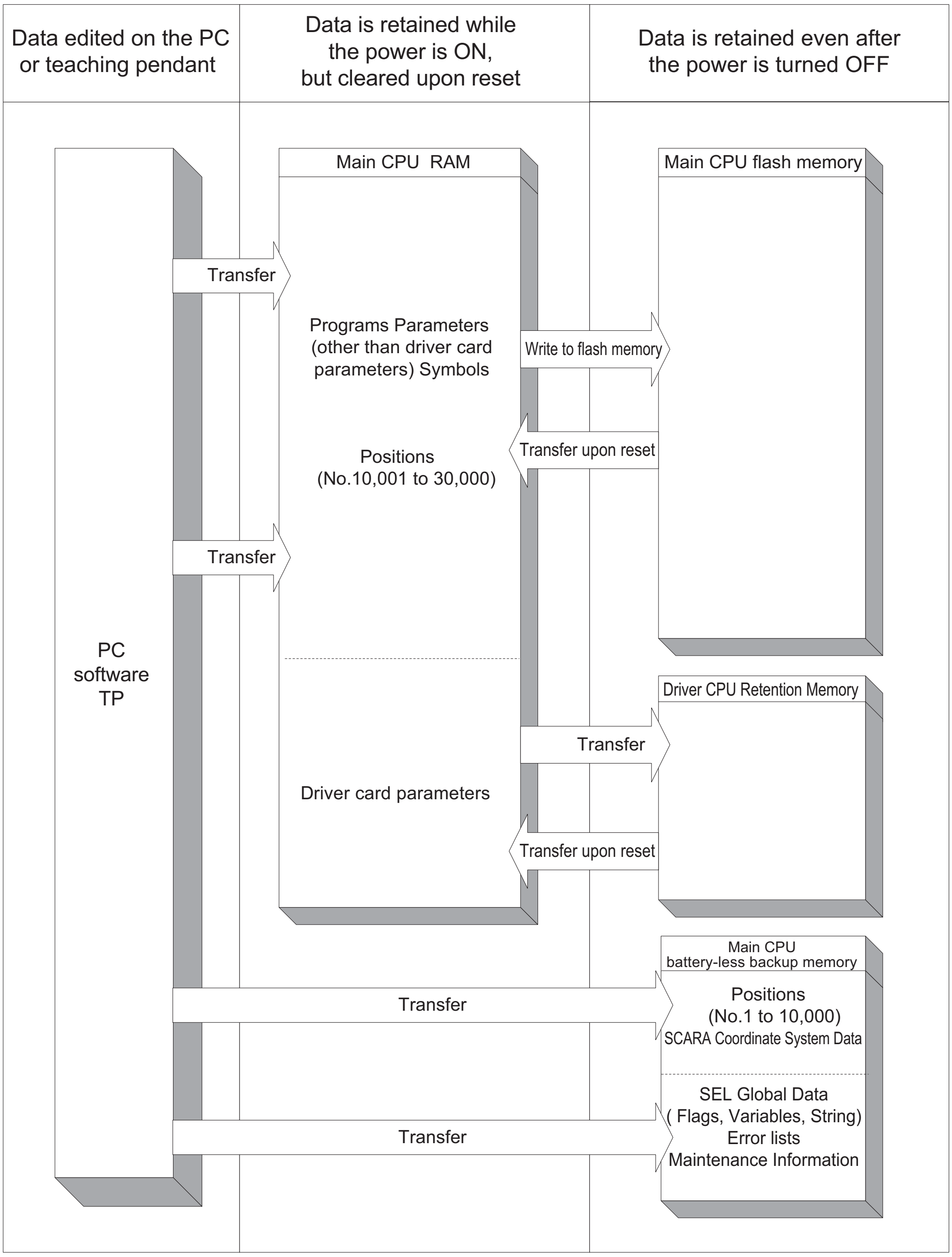
[2] Saving of data

On MSEL controllers, data is saved as shown below.

Even if you transfer data via the PC software or teaching pendant, the data, except for some (Note), is only written to the memories temporarily and will be cleared once the power is turned off or controller is reset.

To save the data without fail, be sure to write the data you want to save to the flash ROM.

(Note) The position data (No. 1 to 10000), SEL global data, error list, maintenance information and SCARA coordinate system data are stored in the battery-less backup memory (FRAM). There is no need of flash ROM writing.



(Note 1) Do not attempt to turn the power off while initializing the memories (position, global variables and flags) or maintenance information. It may cause to generate such as an error* in the next startup due to incomplete of initializing process. Have an initializing process again in case the power is turned off accidently. (* Error No. 4A4, 69E, 6C7, 826)

(Note 2) Because the position data, maintenance information data and SEL global data will not be initialized (error data remains) even after an error is detected, make sure not to use the data without canceling it. To cancel an error, initialize the memory of the data which an error has been detected.
For the position data (No. 10001 to 30000), do not fail to conduct the flash ROM writing at the same time after initializing.

4. Program Edit

4.1 Each Type of Data Available to Handle on the Program and its Range

In SEL language, separate areas are provided for each task such as I/O port, variables, flags, etc.
Some areas are separated to the global area and local area. Data set to the global area can be read and written from multiple programs.
The global domain is backed up in the controller battery for the models except for XSEL-R*/S*.
Data in local area gets cleared each time the program is booted.
In the following, explains about the area and range.

Function	Global area		Local area		Remarks
	Range	Total number	Range	Total number	
Input port	000 to 299	300			
Output port	300 to 599	300			
Extended Input Ports	1000 to 3999	3000			Applied for XSEL-P/Q/PCT/QCT and XSEL-R/S/RX/SX/RXD/SXD
Extended Output Ports	4000 to 6999	3000			
Flag	600 to 899	300	900 to 999	100	
Variable (integer)	200 to 299	100	1 to 99	99	99 is a special variable used in IN, INB, OUT and OUTB Variable (integer) commands, etc.
	1200 to 1299	100	1001 to 1099	99	
Variable (real number)	300 to 399	100	100 to 199	100	199 is a special variable used in PPUT, PGET and PAPG commands, etc.
	1300 to 1399	100	1100 to 1199	100	
String	300 to 999	700	1 to 299	299	
Tag number			1 to 256	256	
Sub routine number			1 to 99	99	
Work coordinate system number	0 to 31	32			For SCARA robots
Tool coordinate system number	0 to 127	128			For SCARA robots
Simple contact check zone number	1 to 10	10			For SCARA robots
Zone number	1 to 4	4			For single-axis/Cartesian robots
Palletizing number			1 to 10	10	
Axis number	1 to 8	8			Varies depending on the controller.
Axis pattern	0 to 11111111				Varies depending on the controller.
Program number (XSEL-P/Q/PX/QX/PCT/QCT, XSEL-R/S/RX/SX/RXD/SXD, SSEL)	1 to 128	128			
Program number (XSEL-J/K/KE/KTKET/JX/KX/KETX, TT, ASEL/PSEL)	1 to 64	64			
Program number (TTA, MSEL)	1 to 256	256			

Function		Global area		Local area		Remarks
		Range	Total number	Range	Total number	
Position number	XSEL-R/S/RX/SX/RXD/ SXD	1 to 53332 (MAX)	53332 (MAX)			Depend on how many axes are to be used
	XSEL-P/Q/PX/QX/PCT/QC T, SSEL	1 to 20000	20000			
	XSEL-J/K/KE/KT/KET/ JX/KX/KETX, TT	1 to 3000	3000			
	ASEL/PSEL	1 to 1500	1500			
	TTA, MSEL	1 to 30000	30000			
Position comments (Half-sized 32 characters)	XSEL-R/S/RX/SX/RXD/ SXD			1 to 10000	10000	
Task level		0: NORMAL/ 1: HIGH	2			Comment can be added only in Positions No. 1 to 10000
SIO channel number	XSEL-P/Q/PCT/QCT/PX/ QX/R/S/RX/SX/RXD/SXD	1 to 2	2			
	XSEL-J/JX, TT	1	1			To be communized with teaching and PC software
	XSEL-K/KE/KT/KET/KX/ KETX	1	1			
	SSEL/ASEL/PSEL	0	1			
WAIT timer				1		TIMW command
1-shot pulse timer				16 (Can be operated simultaneously.)		BTPN, BTPF command
Ladder timer				Use local area flags. 900 to 999	100	TIMR command
Virtual input port (SEL system → SEL user program)		7000 to 7299	300			
Virtual output port (SEL user program → SEL system)		7300 to 7599	300			
Number of symbol definitions	XSEL-P/Q/PCT/QCT/PX/ QX/R/S/RX/SX/RXD/SXD	1000				
	XSEL-J/K/KE/KT/KET/JX/ KX/KETX, TT, TTA, MSEL	1000				
	SSEL/ASEL/PSEL	500				
Number of symbol used in commands	XSEL-P/Q/PCT/QCT/PX/ QX/R/S/RX/SX/RXD/SXD	5000 (including string literals)				
	XSEL-J/K/KE/KT/KET/JX/ KX/KETX, TT, TTA, MSEL	5000 (including string literals)				
	SSEL/ASEL/PSEL	2500 (including string literals)				
Number of recorded history	XSEL-R/S/RX/SX/RXD/ SXD, TTA, MSEL	400				
	XSEL-P/Q/PCT/QCT/PX/ QX	200				
	XSEL-J/K/KE/KT/KET/JX/ KX/KETX, TT	200				
	SSEL/ASEL/PSEL	100				

4.2 Setting of Function and Values

Explanation below shows how you should handle the I/O port and how you should take the variables in your mind when you create a program with SEL language.

4.2.1 Handling of I/O Port

Refer to “2.1 I/O Signal” for I/O ports.

[1] Input ports
These ports are used as input ports for limit switches, sensor switches, etc.

Input number assignment
000 to 031 (standard)

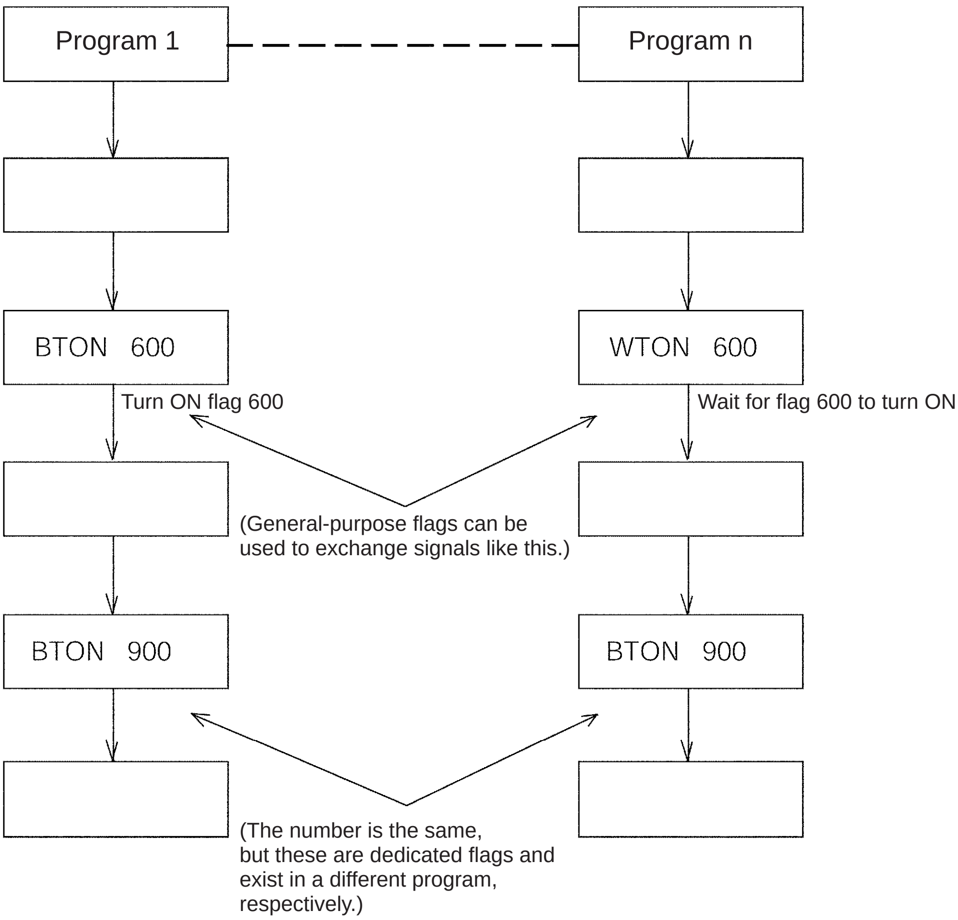
[2] Output ports
These ports are used as various output ports.

Output number assignment
300 to 315 (standard)

4.2.2 Handling (Setting and Resetting) of Flags

Unlike their literal meaning, flags are actually “memories” where data is set and reset. Flags correspond to “auxiliary relays” in sequencers.
Flags are classified into two types: general-purpose flags (global flags) that are assigned numbers from 600 to 899 and usable in all programs, and dedicated flags (local flags) that are assigned numbers from 900 to 999 and usable only in each program.
The general-purposed flags (global flags) can be saved (in the battery backup or saving memory, depends on the models) even after the power is turned OFF.
Dedicated flags (local flags) will be cleared once the power is turned OFF.

Flag No.	600 to 899	Usable in all programs.	"General-purpose flags (global flags)"
Flag No.	900 to 999	Usable only in each program.	"Dedicated flags (local flags)"



4.2.3 How to Deal with Values and Variables

(1) How to Deal with Values

If the last digit of the set value is H, set with hexadecimal number.
Refer to the following.
Input the value of hexadecimal number transformed from the binary number.

●Binary number

Binary number expresses a numeral figure with using 2 numbers, 0 and 1.
The number increases in the order of 0, 1, and then the number of digit increases, and goes 10, 11 …

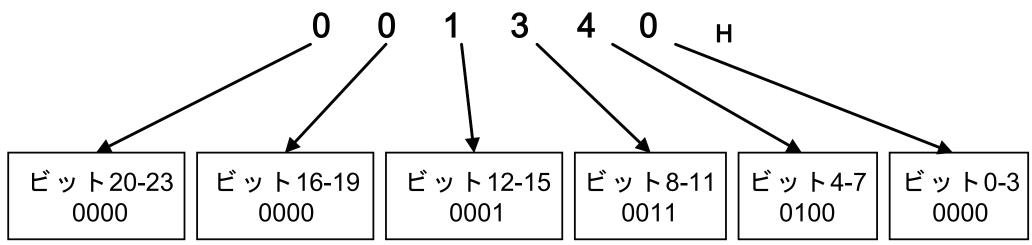
Decimal number	0	1	2	3	4	5	6	7	8	9	10
Binary number	0	1	10	11	100	101	110	111	1000	1001	1010

●Hexadecimal number

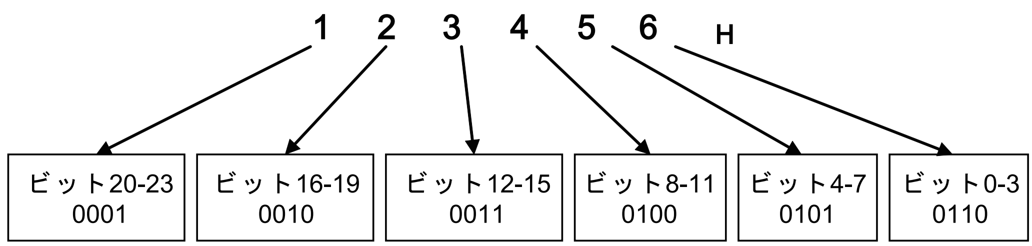
Hexadecimal number expresses a numeral figure with using numbers from 0 to 9 and alphabets from A to F. The number increases in the order of 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B,C, D, E, F, and then the number of digit increases, and goes 10, 11, …

Decimal number	0 to 9 (Same for decimal and hexadecimal numbers)	10	11	12	13	14	15	16
Hexadecimal number		A	B	C	D	E	F	10

Example 1 : 001340_H

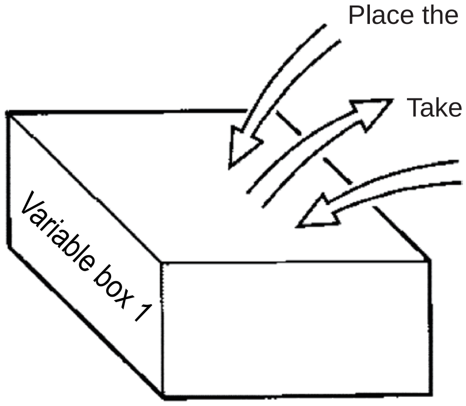


Example 2 : 123456_H



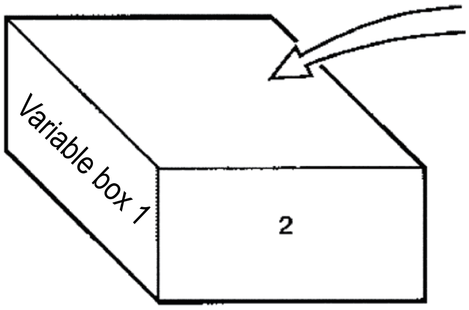
(2) Types and Handling of Variables

1) Meaning of variables
“Variable” is a technical software term. Simply put, a variable is a “container in which a value is placed”. You can use variables in many different ways such as placing a value in a variable, taking a value out of a variable, and adding or subtracting a value to/from a variable, to name a few.



Command	Operand 1	Operand 2
ADD	1	1

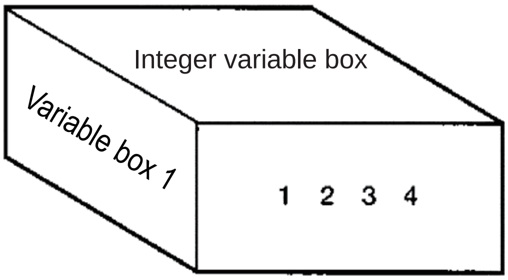
With this command, if 2 is already placed in the box of variable 1 as shown, then 1 is added and the content of variable 1 becomes 3.



(2 is already placed inside.)

2) Types of variables
Variables are classified into two types as explained below.

[Integer variables]
These variables cannot handle decimal points.
[Example] 1234

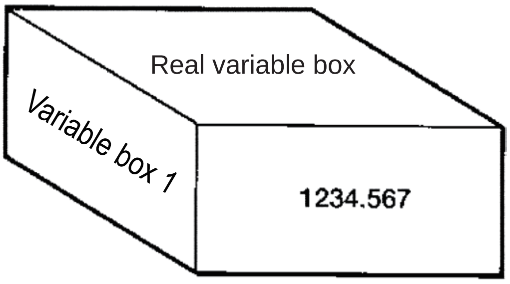


Integer variable No.	200 to 299 1200 to 1299	Usable in all programs.	“Global integer variables”
Integer variable No.	1 to 99 1001 to 1099	Usable only in each program.	“Local integer variables”

Caution

- Values from -9,999,999 to 99,999,999 can be entered in programs.
- Variable 99 is a special register used for integer calculations by the system.

[Real variables]
These variables are actual numbers and can also handle decimal points.
[Example] 1234.567
↑
(decimal point)



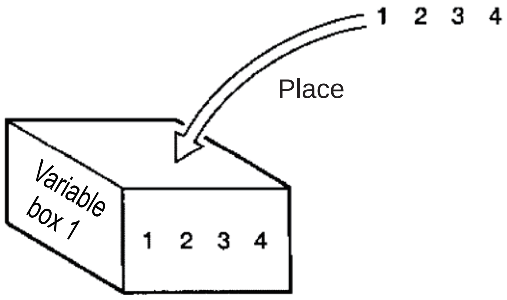
Real variable No.	300 to 399 1300 to 1399	Usable in all programs.	“Global real variables”
Real variable No.	100 to 199 1100 to 1199	Usable only in each program.	“Local real variables”

Caution

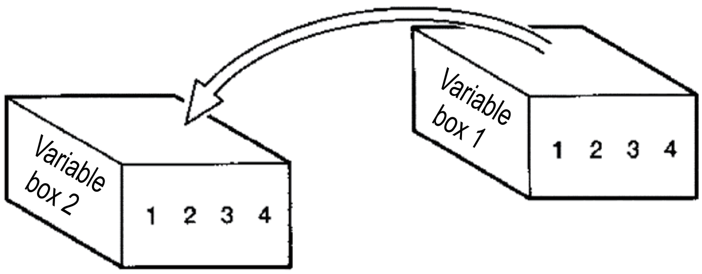
- Values from -99,999.9 to 999,999.9 (up to eight digits including the sign and decimal point) can be entered in programs.
- Variable 199 is a special register used for integer calculations by the system.

[Indirect specification of variables]
Variables are specified with a "*" (asterisk) appended to them.
In the example below, the content of variable box 1 is placed in variable box 2. If "1234" is in variable box 1, "1234" is placed in variable box 2.

Command	Operand 1	Operand 2
LET	1	1234



Command	Operand 1	Operand 2
LET	2	*1



This usage is called "indirect specification".

"*" is to be applied also when making an indirect specification of symbolized variables.

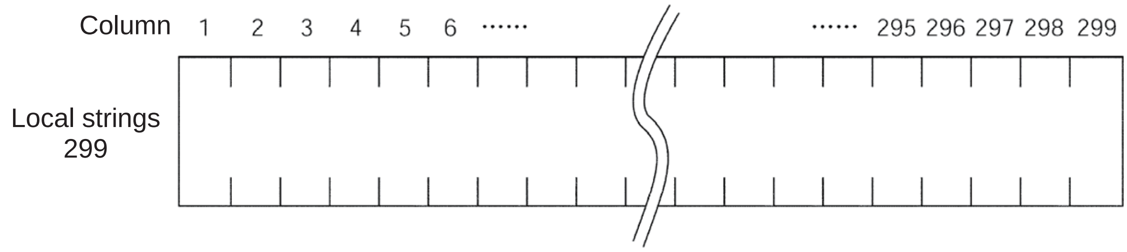
Command	Operand 1	Operand 2
LET	ABC	1
LET	BCD	2
AD	ABC	*BCD

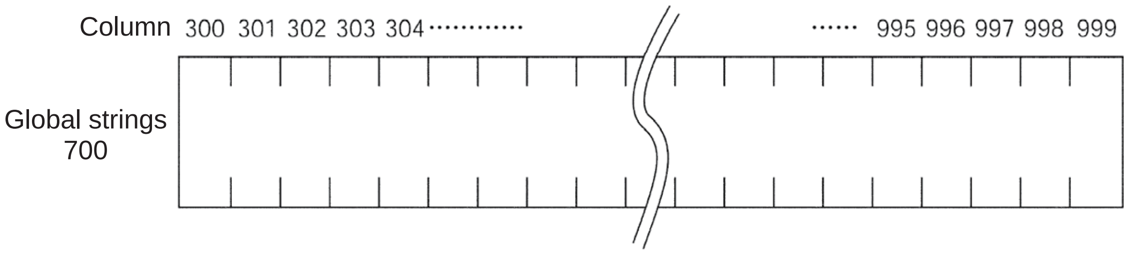
Place 1 in variable ABC.
Place 2 in variable BCD.
Add the content of variable BCD, or 2, to variable ABC.
(The content of variable ABC becomes 3.)

4.2.4 Specification Method for Local String and Global String

RS232C serial communication is implemented basically by means of exchange of character strings.
These character strings are called “string”.
Strings sent in the communication transmission format can be used freely in programs, or specifically they are stored in boxes (columns) in which strings are placed.
These string are classified into global string that can be read or written in all programs, and local string that can be read or written only in each program.
String are differentiated by the range of their number.

	Column number
Global string	300 to 999 (700)
Local string	1 to 299 (299)

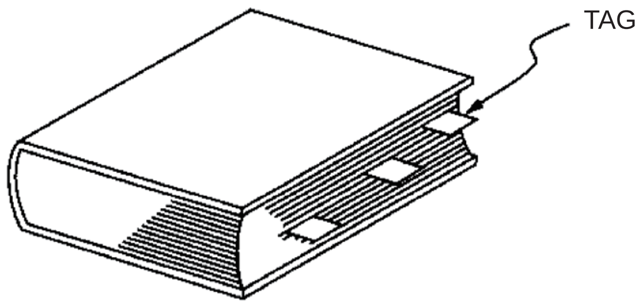




The characters constituting a string are stored one by one in each of these fields.
The position of a given field in a string is expressed by column X, and the column to store each character in can be set freely using a command.

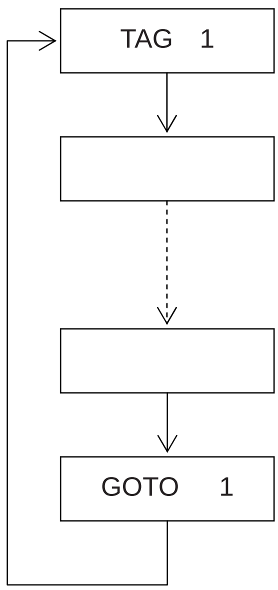
4.2.5 Handling of Tag Numbers

A “TAG” is a “heading”.
You may stick labels on pages you want to read frequently. Tags are used for the same purpose.
The destination to jump to where you specify in the jump command “GOTO” is a “TAG”.



Command	Operand 1
TAG	Tag number (integer of 1 to 256)

Usable only in each program.



5. SEL Commands

5.1 How to Read Explanation of Command

How a command is explained is described using an example of LET command.

● LET (Assign)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	LET	Variable number	Data	ZR

← [1] SEL language structure

Applicable models							
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT
○	○	○	○	○	○	○	○

← [2] Applicable models

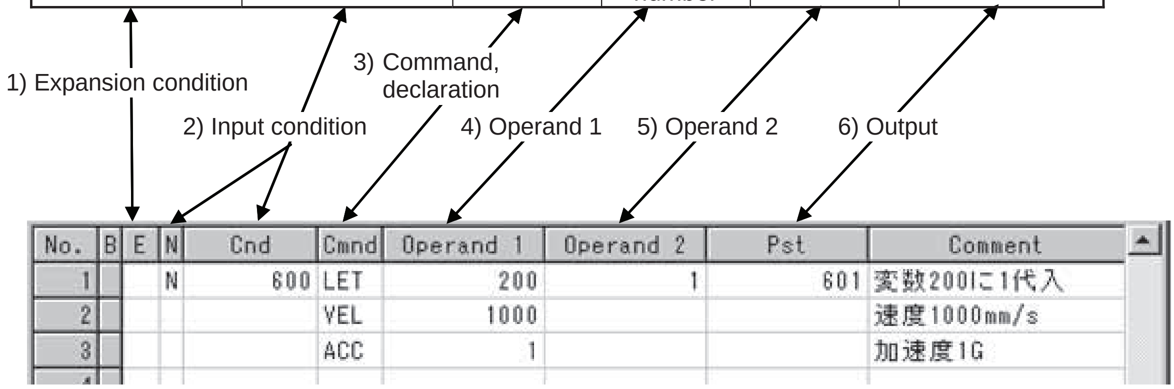
[Function] Assign the value specified in operand 2 to the variable specified in operand 1.
The output will turn ON when 0 is assigned to the variable specified in operand 1.

← [3] Description of Functions

[Example 1]	LET	1	10	Assign 10 to variable 1.
[Example 2]	LET	1	2	Assign 2 to variable 1.
		3	10	Assign 10 to variable 3.
	LET	*1	*3	Assign the content 10 of variable 3 to the variable that corresponds to the content 2 of variable 1.

[1] SEL language structure

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	LET	Variable number	Data	ZR



Program screen

The details of SEL language structure components are explained.

1) Expansion condition (LD, A, O, AB, OB)

Free ······ You can freely set a desired expansion condition for simulated ladder tasks by selecting LD, A, O, AB and OB. This condition can also be set as an expansion condition for tasks other than simulated ladder tasks.

LD : LOAD
A : AND
O : OR
AB : ANDBLOCK
OB : ORBLOCK

2) Input condition (I/O, flag)
Free ⋯⋯ You can freely set a desired input condition by selecting an input port, output port or flag (global area or local area).

3) Command/declaration
State a command/declaration command*1. The command explained in the applicable section is described.

*1 Once executed in the program, "Actuator Control Declaration" Command (VEL command, VELS command, etc.) will remain effective while the program is running, until the command is changed. If you want to change a value (operand 1, operand 2, etc.) previously set by an "Actuator Control Declaration" Command, you must reset (change) the value at the necessary location in the program.

4) Operand 1,
5) Operand 2
What is set in these items varies depending on the command. Set an appropriate item according to each command.

6) Output (output port, flag)
This is where the result of command execution is shown, and the output 6) turns ON and OFF*2. You can freely set an output port or flag (global area or local area) in which to store the condition of this output. What is turned ON/OFF in output varies depending on the command.
In the 6) Output (output port, flag), the following types are to be shown depending on the operational conditions.
(Output operation types)
CC ⋯⋯ Command successful
ZR ⋯⋯ Calculation result zero
PE ⋯⋯ Operation complete
CP ⋯⋯ Command passing
TU ⋯⋯ Timeout
(CP☐☐ comparison command)
EQ ⋯⋯ Operand 1 = Operand 2
NE ⋯⋯ Operand 1 ≅ Operand 2
GT ⋯⋯ Operand 1 > Operand 2
GE ⋯⋯ Operand 1 ≥ Operand 2
LT ⋯⋯ Operand 1 < Operand 2
LE ⋯⋯ Operand 1 ≤ Operand 2

*2 The output turns OFF when the command is executed. After the command has been executed, the output turns ON depending on the condition specified as the output operation type. (If the condition is not met, the output remains OFF.)
Take note that the output of a CP☐☐ comparison command does not turn OFF when the command is executed.

[2] Applicable models

Controllers that support the command are denoted by a "○".
Controllers that do not support the command are denoted by a "×".
The following controllers are applicable when described as "Applicable for all models".

- XSEL-J/K/JX/KX
- XSEL-P/Q/PX/QX/PCT/QCT
- XSEL-R/S/RX/SX/RXD/SXD
- TT/TTA
- ASEL/PSEL/SSEL
- MSEL-PC/PG/PCX/PGX

[3] Description of functions

Explanation of the function is provided for the corresponding command.

5.2 SEL Language Code Table for each Function

For Operand 1, Operand 2 and the output, the variable indirect specification is available.
For the condition, Operand 1, Operand 2 and the output, an input with symbols is available.
Input into ( ) for Operand 1 and Operand 2 is not compulsory.
"Actuator control declaration" command is kept effective though the program run once it is executed during the program. A reconstruction of the settings is required for the appropriate areas in the program if a change to the values (Operand 1, Operand 2, etc.) already set by "actuator control declaration" command is needed. It means that the values set by the executed command in the last operation are effective.
The output section is turned OFF when the command is executed. After the command execution, it may get turned ON depending on the condition of the output section operation type. (It is turned OFF if the condition does not meet the requirement.)

> ⚠ Caution: Comparative command CP☐☐ (CPEQ, CPNE, CPGT, CPGE, CPLT, CPLE) output section does not get turned OFF during the command execution.

Output operation types
CC: Command successful, ZR: Calculation result zero
PE: Operation complete, CP: Command passing, TU: Timeout
EQ: Operand 1 = Operand 2, NE: Operand 1 ≅ Operand 2
GT: Operand 1 > Operand 2, GE: Operand 1 ≥ Operand 2
LT: Operand 1 < Operand 2, LE: Operand 1 ≤ Operand 2

Category	Condition	Command	Operand 1	Operand 2	Output	Function	Page
Variable Assignment	Optional	LET	Variable Assignment	Assignment number	ZR	Assign	231
	Optional	TRAN	Variable to copy data to	Variable to copy data from	ZR	Copy	232
	Optional	CLR	Clear start variable	Clear finish variable	ZR	Clear variable	233
Arithmetic Operation	Optional	ADD	Augend variable	Addend	ZR	Add	234
	Optional	SUB	Minuend variable	Subtrahend	ZR	Subtract	235
	Optional	MULT	Multiplicand variable	Multiplier	ZR	Multiply	236
	Optional	DIV	Dividend variable	Divisor	ZR	Divide	237
	Optional	MOD	Modulus assignment variable	Divisor	ZR	Modulus calculation	238
Function Operation	Optional	SIN	Sine assignment variable	Operant [Radian]	ZR	Sine	239
	Optional	COS	Cosine assignment variable	Operant [Radian]	ZR	Cosine	240
	Optional	TAN	Tangent assignment variable	Operant [Radian]	ZR	Tangent	241
	Optional	ATN	Arc tangent assignment variable	Operant	ZR	Inverse-tangent	242
	Optional	SQR	Square root assignment variable	Operant	ZR	Root	243
Logical Operation	Optional	AND	Logical conjunction variable	Operant	ZR	Logical AND	244
	Optional	OR	Logical disjunction variable	Operant	ZR	Logical OR	245
	Optional	EOR	Logical operation exclusive disjunction	Operant	ZR	Logical exclusive-OR	246
Comparison	Optional	CP☐☐	Comparative variable	Compared number	EQ NE GT GE LT LE	Compare [EQ/NE/GT/GE/LT/LE]	247
Timer	Optional	TIMW	Waiting time [sec]	Prohibited	TU	Wait for certain time	248
	Optional	TIMC	Program No.	Prohibited	CP	Cancel waiting	249
	Optional	GTTM	Time assignment variable	Prohibited	CP	Get time	250
I/O, Flag Operation	Optional	BT☐☐	Start output, Flag	(Complete output, Flag)	CP	Output, flag [ON/OF/NT]	251
	Optional	BTPN	Output port, Flag	Timer setting	CP	Output ON pulse	252
	Optional	BTPF	Output port, Flag	Timer setting	CP	Output OFF pulse	253
	Optional	WT☐☐	I/O, Flag	(Waiting time)	TU	Wait for input and output, flag [ON/OF]	254
	Optional	IN	Head I/O, Flag	Complete input and output, Flag	CC	Input binary number (Max 32 bit)	255
	Optional	INB	Head I/O, Flag	Convertible digits	CC	Input BCD (Max eight digits)	256
	Optional	OUT	Head output, Flag	Complete input and output, Flag	CC	Output binary number (Max 32 bit)	257
	Optional	OTPS	Output port No.	Axis No.	CC	Output current position data	263
	Optional	OUTB	Head output, Flag	Convertible digits	CC	Output BCD (Max eight digits)	258
	Optional	FMIO	Format type	Prohibited	CP	IN (B) OUT (B) command format	259

Output operation types
CC: Command successful, ZR: Calculation result zero
PE: Operation complete, CP: Command passing, TU: Timeout
EQ: Operand 1 = Operand 2, NE: Operand 1 ≅ Operand 2
GT: Operand 1 > Operand 2, GE: Operand 1 ≥ Operand 2
LT: Operand 1 < Operand 2, LE: Operand 1 ≤ Operand 2

Category	Condition	Command	Operand 1	Operand 2	Output	Function	Page
Program Control	Optional	GOTO	Tag No. to jump to	Prohibited	CP	Jump	264
	Prohibited	TAG	Declaration tag No.	Prohibited	CP	Declaration of destination to jump to	265
	Optional	EXSR	Execution sub routine No.	Prohibited	CP	Execute subroutine	266
	Prohibited	BGSR	Declaration sub routine No.	Prohibited	CP	Start subroutine	267
	Prohibited	EDSR	Prohibited	Prohibited	CP	End subroutine	268
Task Management	Optional	EXIT	Prohibited	Prohibited	CP	End program	269
	Optional	EXPG	Execution program No.	(Execution program No.)	CC	Start other program	270
	Optional	ABPG	Termination program No.	(Termination program No.)	CC	Abort other program	271
	Optional	SSPG	Pause program No.	(Pause program No.)	CC	Pause program	272
	Optional	RSPG	Resume program No.	(Resume program No.)	CC	Resume program	273
Position Operation	Optional	PGET	Axis No.	Position No.	CC	Assign position to Variable 199	274
	Optional	PPUT	Axis No.	Position No.	CP	Assign Variable 199 value	275
	Optional	PCLR	Start position No.	Termination position No.	CP	Clear position data	276
	Optional	PCPY	Position No. to copy data to	Position No. to copy data from	CP	Copy position data	277
	Optional	PRED	Axis pattern read	Position No. to save data to	CP	Read current axis position	278
	Optional	PRDQ	Axis No.	Variable No.	CP	Read current axis position (single-axis direct)	279
	Optional	PTST	Axis pattern confirmation	Confirmation position No.	CC	Check position data	281
	Optional	PVEL	Speed [mm/sec]	Position No. to assign to	CP	Assign position speed	282
	Optional	PACC	Acceleration [G]	Position No. to assign to	CP	Assign position acceleration	283
	Optional	PDCL	Deceleration [G]	Position No. to assign to	CP	Assign position deceleration	284
	Optional	PAXS	Axis pattern assignment variable No.	Position No.	CP	Read axis pattern	285
	Optional	PSIZ	Size assignment variable No.	Prohibited	CP	Check position data size	286
	Optional	PTAM	Variable No.	Position No.	CP	Substitution of target arm system data	280
	Optional	GTAM	Variable No.	Position No.	CP	Acquirement of target arm system data	287
	Optional	GVEL	Variable No.	Position No.	CP	Get speed data	288
	Optional	GACC	Variable No.	Position No.	CP	Get acceleration data	289
	Optional	GDCL	Variable No.	Position No.	CP	Get deceleration data	290
Actuator Control Declaration	Optional	VEL	Speed [mm/sec]	Prohibited	CP	Set speed	291
	Optional	OVRD	Speed ratio [%]	Prohibited	CP	Speed coefficient settings	293
	Optional	ACC	Acceleration [G]	Prohibited	CP	Set acceleration	294
	Optional	DCL	Deceleration [G]	Prohibited	CP	Set deceleration	296
	Optional	SCRV	Ratio [%]	Prohibited	CP	Set sigmoid motion ratio	298
	Optional	OFST	Setting axis pattern	Offset value [mm]	CP	Set offset	302
	Optional	DEG	Division angle [deg]	Prohibited	CP	Division angle settings	303
	Optional	BASE	Datum axis No.	Prohibited	CP	Datum axis setting	304
	Optional	GRP	Effective axis pattern	Prohibited	CP	Set group axes	305
	Optional	HOLD	(Pause input port)	(HOLD type)	CP	Declare port to pause	306
	Optional	CANC	(Cancel complete input port)	(CANC type)	CP	Declare port to abort	307
	Optional	VLMX	Prohibited	Prohibited	CP	Specify VLMX speed	311
	Optional	ACMX	ACMX Acceleration No.	Prohibited	CP	Indicate ACMX acceleration	308
	Optional	DIS	Distance	Prohibited	CP	Set division distance at spline movement	312
	Optional	POTP	0 or 1	Prohibited	CP	Set PATH output type	313
	Optional	PAPR	Distance	Speed	CP	PUSH Command distance and speed settings	314
	Optional	QRTN	0 or 1	Prohibited	CP	Set quick-return mode	315
	Optional	ACCS	Ratio	Prohibited	CP	Set acceleration ratio	295
	Optional	DCLS	Ratio	Prohibited	CP	Set deceleration ratio	297
	Optional	DFIF	Contact check zone No.	Position No.	CP	Define simple contact check zone coordinate	336
	Optional	DFTL	Tool coordinate system No.	Position No.	CP	Define tool coordinate system	320

Output operation types
CC: Command successful, ZR: Calculation result zero
PE: Operation complete, CP: Command passing, TU: Timeout
EQ: Operand 1 = Operand 2, NE: Operand 1 ≅ Operand 2
GT: Operand 1 > Operand 2, GE: Operand 1 ≥ Operand 2
LT: Operand 1 < Operand 2, LE: Operand 1 ≤ Operand 2

Category	Condition	Command	Operand 1	Operand 2	Output	Function	Page
Actuator Control Declaration	Optional	DFWK	Work coordinate system No.	Position No.	CP	Define work coordinate system	325
	Optional	GTIF	Contact check zone No.	Position No.	CP	Get simple contact check zone definition coordinate	340
	Optional	GTTL	Tool coordinate system No.	Position No.	CP	Get tool coordinate system definition data	323
	Optional	GTWK	Work coordinate system No.	Position No.	CP	Get work coordinate system definition number	328
	Optional	NBND	Axis pattern	Close distance	CP	Set close distance	345
	Optional	PTPD	Prohibited	Prohibited	CP	Specify PTP target arm system to current arm	334
	Optional	SLTL	Tool coordinate system No.	Prohibited	CP	Select tool coordinate system	322
	Optional	SEIF	Contact check zone No.	0 to 2	CP	Specify type of simple contact check zone	339
	Optional	RIGH	Prohibited	Prohibited	PE	Change current arm system to right arm	330
	Optional	LEFT	Prohibited	Prohibited	PE	Change current arm system to left arm	331
	Optional	PTPR	Prohibited	Prohibited	CP	Specify PTP target arm system to right arm	332
	Optional	PTPE	Prohibited	Prohibited	CP	Specify PTP target arm system to current arm	335
	Optional	WGHT	Mass	(Inertial moment)	CP	Set tip work mass, inertial moment	341
	Optional	WGT2	Mass	(Inertial moment)	CP	Tip load condition setting 2	343
	Optional	VELS	Ratio	Prohibited	CP	Set speed ratio	292
	Optional	SOIF	Contact check zone No.	Output, global flag No.	CP	Specify output for simple contact check zone	338
	Optional	SLWK	Work coordinate system No.	Prohibited	CP	Select work coordinate system	327
	Optional	PTPL	Prohibited	Prohibited	CP	Specify PTP target arm system to left arm	333

Output operation types
CC: Command successful, ZR: Calculation result zero
PE: Operation complete, CP: Command passing, TU: Timeout
EQ: Operand 1 = Operand 2, NE: Operand 1 ≅ Operand 2
GT: Operand 1 > Operand 2, GE: Operand 1 ≥ Operand 2
LT: Operand 1 < Operand 2, LE: Operand 1 ≤ Operand 2

Category	Condition	Command	Operand 1	Operand 2	Output	Function	Page
Actuator Control Command	Optional	SV☐☐	Operation axis pattern	Prohibited	PE	Turn ON/OFF servo	346
	Optional	HOME	Home-return axis pattern	Prohibited	PE	Home return	347
	Optional	MOVP	Position No. to move to	Prohibited	PE	Move by specifying position data	348
	Optional	MOVL	Position No. to move to	Prohibited	PE	Position-indicated interpolation movement	350
	Optional	MVPI	Movement amount position No.	Prohibited	PE	Position-relative movement	352
	Optional	MVLI	Movement amount position No.	Prohibited	PE	Position-relative interpolation movement	354
	Optional	PATH	Start position No.	End position No.	PE	Move along path	358
	Optional	J☐W☐	Drive axis pattern	Start input and output, flag	PE	Jog [FN/FF/BN/BF]	359
	Optional	STOP	Stop axis pattern	Prohibited	CP	Deceleration and stop of axis	361
	Optional	PSPL	Start position No.	End position No.	PE	Move along spline	362
	Optional	PUSH	Target position No.	Prohibited	PE	Move by push motion	363
	Optional	PTRQ	Axis pattern	Ratio [%]	CC	Change push torque limit parameter	365
	Optional	CIR2	Passing position 1 No.	Passing position 2 No.	PE	Circle movement 2 (Arc interpolation)	366
	Optional	ARC2	Passing position No.	End position No.	PE	Arc movement 2 (Arc interpolation)	368
	Optional	CIRS	Passing position 1 No.	Passing position 2 No.	PE	Move along circle three-dimensionally	370
	Optional	ARCS	Passing position No.	End position No.	PE	Move along arc three-dimensionally	372
	Optional	CHVL	Axis pattern	Speed	CP	Change speed	374
	Optional	ARCD	End position No.	Center angle [°(degree)]	PE	Termination position center angle indicated arc movement	376
	Optional	ARCC	Center position No.	Center angle [°(degree)]	PE	Center position center angle indicated arc movement	378
	Optional	PBND	Axis pattern	Distance	CP	Set positioning width	380
	Optional	CIR	Passing position 1 No.	Passing position 2 No.	PE	Circle movement (CIR2 is recommended)	383
	Optional	ARC	Passing position No.	End position No.	PE	Arc movement (ARC2 is recommended)	385
	Optional	PEND	Prohibited	Prohibited	PE	Wait for end of operation by axes currently used by program	387
	Optional	MOVD	Target position	(Axis pattern)	PE	Move via direct value specification	356
	Optional	MVDI	Travel distance	(Axis pattern)	PE	Move relatively via direct value specification	357
	Optional	TMLI	Position No.	Prohibited	PE	Move incrementally to position on tool coordinate system via CP operation	382
	Optional	TMPI	Position No.	Prohibited	PE	Move incrementally to position on tool coordinate system via PTP operation	381
IF structure	Optional	IF☐☐	Comparative variable	Compared No.	CP	Compare [EQ/NE/GT/GE/LT/LE]	388
	Optional	IS☐☐	Column No.	Column No., character literal	CP	Compare strings	389
	Prohibited	ELSE	Prohibited	Prohibited	CP	Declaration of IF Command unsuccessful execution destination	390
	Prohibited	EDIF	Prohibited	Prohibited	CP	IF termination declaration	391
Structural DO	Optional	DW☐☐	Comparative variable	Compared No.	CP	Loop [EQ/NE/GT/GE/LT/LE]	392
	Optional	LEAV	Prohibited	Prohibited	CP	Pull out of DO	393
	Optional	ITER	Prohibited	Prohibited	CP	Repeat of DO	394
	Prohibited	EDDO	Prohibited	Prohibited	CP	DO termination declaration	395
Multi-Branching	Optional	SLCT	Prohibited	Prohibited	CP	Start declaration for multi-branching	396
	Prohibited	WH☐☐	Comparative variable	Compared No.	CP	Branch values [EQ/NE/GT/GE/LT/LE]	397
	Prohibited	WS☐☐	Column No.	Column No., character literal	CP	Branch character line [EQ/NE]	398
	Prohibited	OTHE	Prohibited	Prohibited	CP	Declaration of condition unsuccessful branching destination	399
	Prohibited	EDSL	Prohibited	Prohibited	CP	SLCT termination declaration	400

Output operation types
CC: Command successful, ZR: Calculation result zero
PE: Operation complete, CP: Command passing, TU: Timeout
EQ: Operand 1 = Operand 2, NE: Operand 1 ≅ Operand 2
GT: Operand 1 > Operand 2, GE: Operand 1 ≥ Operand 2
LT: Operand 1 < Operand 2, LE: Operand 1 ≤ Operand 2

Category	Condition	Command	Operand 1	Operand 2	Output	Function	Page
System Information Acquisition	Optional	AXST	Variable No.	Axis No.	CP	Get axis status	401
	Optional	PGST	Variable No.	Program No.	CP	Get program status	402
	Optional	SYST	Variable No.	Prohibited	CP	Get system status	403
	Optional	GARM	Variable No.	Prohibited	CP	Get current arm system	404
Zone	Optional	WZNA	Zone No.	Axis pattern	CP	Wait for zone ON based on AND gate	405
	Optional	WZNO	Zone No.	Axis pattern	CP	Wait for zone ON based on OR gate	406
	Optional	WZFA	Zone No.	Axis pattern	CP	Wait for zone OFF based on AND gate	407
	Optional	WZFO	Zone No.	Axis pattern	CP	Wait for zone OFF based on OR gate	408
Communication	Optional	OPEN	Channel No.	Prohibited	CP	Open channel	409
	Optional	CLOS	Channel No.	Prohibited	CP	Close channel	410
	Optional	READ	Channel No.	Column No.	CC	Input from channel	411
	Optional	TMRW	Read timer setting	(Write timer setting)	CP	Set READ timeout value	415
	Optional	WRIT	Channel No.	Column No.	CC	Output to channel	416
	Optional	SCHA	Character code	Prohibited	CP	Character setting for sending and receiving	417
	Optional	TMRD	Timer period	Prohibited	CP	Set READ timeout value	413
String Operation	Optional	SCPY	Column No.	Column No., character literal	CC	Copy character string	418
	Optional	SCMP	Column No.	Column No., character literal	EQ	Compare character strings	419
	Optional	SGET	Variable No.	Column No., character literal	CP	Get character	420
	Optional	SPUT	Column No.	Data	CP	Set character	421
	Optional	STR	Column No.	Data	CC	Convert character string; decimal	422
	Optional	STRH	Column No.	Data	CC	Convert character string; hexadecimal	423
	Optional	VAL	Variable No.	Column No., character literal	CC	Convert character string data; decimal	424
	Optional	VALH	Variable No.	Column No., character literal	CC	Convert character string data; hexadecimal	425
	Optional	SLEN	Character string length	Prohibited	CP	Set length	426

Output operation types
CC: Command successful, ZR: Calculation result zero
PE: Operation complete, CP: Command passing, TU: Timeout
EQ: Operand 1 = Operand 2, NE: Operand 1 ≅ Operand 2
GT: Operand 1 > Operand 2, GE: Operand 1 ≥ Operand 2
LT: Operand 1 < Operand 2, LE: Operand 1 ≤ Operand 2

Category	Condition	Command	Operand 1	Operand 2	Output	Function	Page
Palletizing Definition	Optional	BGPA	Palletizing No.	Prohibited	CP	Declare start of palletizing setting	433
	Prohibited	EDPA	Prohibited	Prohibited	CP	Declare end of palletizing setting	434
	Optional	PAPI	Count	Count	CP	Set palletizing counts	435
	Optional	PAPN	Pattern No.	Prohibited	CP	Set palletizing pattern	436
	Optional	PASE	Axis No.	Axis No.	CP	Declare palletizing axes	437
	Optional	PAPT	Pitch	Pitch	CP	Set palletizing pitches	438
	Optional	PAST	(Position No.)	Prohibited	CP	Set palletizing reference point	439
	Optional	PAPS	Position No.	Palletizing position setting type	CP	Set palletizing points for 3-point or 4-point teaching	440
	Optional	PSLI	Offset amount	(Count)	CP	Set zigzag	443
	Optional	PCHZ	(Axis No.)	Prohibited	CP	Declare palletizing Z-axis	444
	Optional	PTRG	Position No.	Position No.	CP	Set palletizing arch triggers	445
	Optional	PEXT	(Position No.)	Prohibited	CP	Set composite palletizing	446
	Optional	OFPZ	Offset amount	Prohibited	CP	Set palletizing Z-axis offset	447
	Optional	ACHZ	Axis No.	Prohibited	CP	Declare arch-motion Z-axis	429
	Optional	ATRG	Position No.	Position No.	CP	Set arch triggers	430
	Optional	AEXT	(Position No.)	Prohibited	CP	Set composite arch motion	431
	Optional	OFAZ	Offset amount	Prohibited	CP	Set arch-motion Z-axis offset	432
	Optional	PTNG	Palletizing No.	Variable No.	CP	Get palletizing position number	448
	Optional	PINC	Palletizing No.	Prohibited	CC	Increment palletizing position number by 1	449
	Optional	PDEC	Palletizing No.	Prohibited	CC	Decrement palletizing position number by 1	450
	Optional	PSET	Palletizing No.	Data	CC	Set palletizing position number directly	451
	Optional	PARG	Palletizing No.	Axis No.	CP	Get palletizing angle	452
	Optional	PAPG	Palletizing No.	Position No.	CP	Get palletizing calculation data	453
	Optional	PMVP	Palletizing No.	(Position No.)	PE	Move to palletizing points via PTP	454
	Optional	PMVL	Palletizing No.	(Position No.)	PE	Move to palletizing points via interpolation	455
	Optional	PACH	Palletizing No.	Position No.	PE	Arch motion to palletizing point	456
	Optional	ARCH	Position No.	Position No.	PE	Arch motion	427
Building of Pseudo-Ladder Task	Optional	CHPR	0 or 1	Prohibited	CP	Change task level	458
	Prohibited	TPCD	0 or 1	Prohibited	CP	Specify processing to be performed when input condition is not specified	459
	Prohibited	TSLP	Time	Prohibited	CP	Task sleep	460
	Optional	OUTR	Output, flag No.	Prohibited	CP	Ladder output relay	152
	Optional	TIMR	Local flag No.	Timer setting	CP	Ladder timer relay	152
Extended Command	Optional	ECMD	1	Axis No.	CC	Get motor current value	461
	Optional	ECMD	2	Axis No.	CC	Get home sensor status	462
	Optional	ECMD	3	Axis No.	CC	Get overrun sensor status	463
	Optional	ECMD	4	Axis No.	CC	Get creep sensor status	464
	Optional	ECMD	5	Axis No.	CC	Get axis operation status	465
	Optional	ECMD	6	Axis No.	CC	Current position acquirement on each axis system	466
	Optional	ECMD	20	Axis No.	CC	Get parameter value	467
	Optional	ECMD	250	Axis pattern	CC	Set torque limit/torque limit over detection time	469
Vision System I/F Related	Optional	SLVS	Select using Vision System I/F	(Timeout time)	CC	Select Vision System I/F	545
	Optional	GTVD	Capturing Trigger Classification	Variable No.	CC	Vision System I/F Image-Capture Data Acquirement	547
Conveyor Tracking Related	Optional	TRMD	Select using Tracking Mode	TRAC Command timeout time	CC	Tracking Mode Setting	541
	Optional	TRAC	0 or 1	Position No. to save the work position information	CC	Tracking Operation Setting & Datum Point Position Information Obtainment in Work	542
Anti-Vibration Control Related	Optional	NTCH	Axis pattern	Parameter set number	CC	Anti-Vibration Control Parameter Set Select	549

RC Gateway Function Commands (Controller with Gateway Function Only)

* Refer to “XSEL Controller P/Q/PX/QX RC Gateway Function Instruction Manual” for the commands related to RC gateway functions.

Output operation types
CC: Command successful, ZR: Calculation result zero
PE: Operation complete, CP: Command passing, TU: Timeout
EQ: Operand 1 = Operand 2, NE: Operand 1 ≅ Operand 2
GT: Operand 1 > Operand 2, GE: Operand 1 ≧ Operand 2
LT: Operand 1 < Operand 2, LE: Operand 1 ≦ Operand 2

Category	Condition	Command	RC position-data use mode		Operand 1	Operand 2	Output	Function	Page
			XSEL	RC					
RC axis position operation	Optional	RPGT	○	×	RC-axis No.	Position No.	CC	Assign RC axis position location to Variable 199	472
	Optional	RPPT	○	×	RC-axis No.	Position No.	CP	Assign Variable 199 to RC axis position location	473
	Optional	RPCR	○	×	RC-axis No.	Variable No.	CP	Clear RC-axis position data	474
	Optional	RPCP	○	×	RC-axis No.	Variable No.	CP	Copy RC-axis position data	475
	Optional	RPRD	○	×	Position No.	Prohibited	CP	Read current RC-axis position	476
	Optional	RPRQ	○	○	RC-axis No.	Variable No.	CP	Read current RC-axis position (single-axis direct)	477
	Optional	RPVL	○	×	RC-axis No.	Position No.	CP	Assign Variable 199 to RC axis position speed	478
	Optional	RPAD	○	×	RC-axis No.	Position No.	CP	Assign Variable 199 to RC axis position acceleration/deceleration	479
	Optional	RPIP	○	×	RC-axis No.	Position No.	CP	Assign Variable 199 to RC axis position positioning width	480
	Optional	RPTQ	○	×	RC-axis No.	Position No.	CP	Assign Variable 199 to RC axis position current limitation	481
	Optional	RGVL	○	×	RC-axis No.	Position No.	CP	Assign RC axis position speed to Variable 199	482
	Optional	RGAD	○	×	RC-axis No.	Position No.	CP	Assign RC axis position acceleration/deceleration to Variable 199	483
	Optional	RGIP	○	×	RC-axis No.	Position No.	CP	Assign RC position positioning width to Variable 199	484
	Optional	RGTQ	○	×	RC-axis No.	Position No.	CP	Assign RC position current limitation to Variable 199	485
RC actuator control command	Optional	RAXS	○	○	Axis pattern, upper	Axis pattern, lower	CP	Set axis pattern for RC axis	486
	Optional	RSON	○	○	Prohibited	Prohibited	PE	Turn ON RC-axis servo	487
	Optional	RSOF	○	○	Prohibited	Prohibited	PE	Turn OFF RC-axis servo	488
	Optional	RHOM	○	○	Prohibited	Prohibited	PE	Return RC-axis to home	489
	Optional	RMVP	○	○	Position No.	Prohibited	PE	Move RC-axis by position specification	490
	Optional	RMPI	○	×	Position No.	Prohibited	PE	Move RC-axis incrementally by position specification	491
	Optional	RMVD	○	×	RC-axis No.	Variable No.	PE	Move RC axis with direct specification	492
	Optional	RMDI	○	×	RC-axis No.	Variable No.	PE	Move RC axis to directly specified relative position	493
	Optional	RPUS	○	×	RC-axis No.	Position No.	PE	Move RC-axis via push motion	494
	Optional	RSTP	○	○	Prohibited	Prohibited	PE	Decelerate and stop RC axis	495
RC axis information acquisition	Optional	RCST	○	○	Variable No.	RC-axis No.	PE	Acquire RC axis status	496

Electronic Cam Control System Related Commands (Controller with Electronic Cam Function Only)

* Refer to "XSEL Controller P/Q/PCT/QCT Electronic Cam function Instruction Manual" for the details of the commands related to the electronic cam functions.

Output operation types
CC: Command successful, CP: Command passing
PE: Operation complete

Category	Condition	Command	Operand 1	Operand 2	Output	Function	Page
Extension Motion Control Board Input Operations	Optional	XCRP	Pulse input channel No.	Prohibited	CP	Clear input counter record for extension motion control board	498
	Optional	XGTP	Pulse input channel No.	Prohibited	CP	Acquire current record of extension motion control board input counter	499
Extension Motion Control Board Axis Position Operations	Optional	XPGT	Axis No.	Position No.	CC	Read extension motion control board axis position data	500
	Optional	XPPT	Axis No.	Position No.	CP	Write extension motion control board axis position data	501
	Optional	XPCR	Axis No.	Variable No.	CP	Erase extension motion control board axis position data	502
	Optional	XPCP	Axis No.	Variable No.	CP	Copy extension motion control board axis position data	503
	Optional	XPRD	Position No.	Prohibited	CP	Read extension motion control board axis current command position	504
	Optional	XPRQ	Axis No.	Variable No.	CP	Read extension motion control board axis current command position (single-axis direct)	505
	Optional	XPVL	Axis No.	Position No.	CP	Write extension motion control board axis speed data	506
	Optional	XPAC	Axis No.	Position No.	CP	Write extension motion control board axis acceleration data	507
	Optional	XPDC	Axis No.	Position No.	CP	Write extension motion control board axis deceleration data	508
	Optional	XPIP	Axis No.	Position No.	CP	Write extension motion control board axis positioning complete width data	509
	Optional	XGVL	Axis No.	Position No.	CP	Read extension motion control board axis speed data	510
	Optional	XGAC	Axis No.	Position No.	CP	Read extension motion control board axis acceleration data	511
	Optional	XGDC	Axis No.	Position No.	CP	Read extension motion control board axis deceleration data	512
	Optional	XGIP	Axis No.	Position No.	CP	Read extension motion control board axis positioning complete width data	513
Extension Motion Control Board Axis Actuator Control Declarations	Optional	XAXS	Axis pattern, upper	Axis pattern, lower	CP	Set each pulse I/O board axis pattern (0 to 15 axis)	514
Extension Motion Control Board Axis Actuator Control Commands	Optional	XSON	Prohibited	Prohibited	CP	Extension motion control board axis to servo ON	515
	Optional	XSOF	Prohibited	Prohibited	CP	Extension motion control board axis to servo OFF	516
	Optional	XHOM	Prohibited	Prohibited	PE	Extension motion control board axis to home return	517
	Optional	XMVP	Position No.	Prohibited	PE	Move extension motion control board axis to indicated position	518
	Optional	XMPI	Position No.	Prohibited	PE	Perform extension motion control board axis position relative movement	519
	Optional	XMVL	Position No.	Prohibited	PE	Move extension motion control board axis for position indicated interpolation	520
	Optional	XMLI	Position No.	Prohibited	PE	Move extension motion control board axis for position relative interpolation	521
	Optional	XMVD	Axis No.	Variable No.	PE	Move extension motion control board axis to directly indicated absolute position	522
	Optional	XMDI	Axis No.	Variable No.	PE	Move extension motion control board axis to directly indicated relative position	523
	Optional	XJ□□	Input, output, flag No.	Prohibited	PE	Perform extension motion control board axis jog operation [FN/FF/BN/BF]	524
	Optional	XPED	Prohibited	Prohibited	PE	Waiting for extension motion control board axis to finish positioning operation of axis used by self-program	525

Output operation types
CC: Command successful, CP: Command passing
PE: Operation complete

Category	Condition	Command	Operand 1	Operand 2	Output	Function	Page
Extension Motion Control Board Axis Actuator Control Commands	Optional	XSTP	Prohibited	Prohibited	PE	Cancel operation of extension motion control board axis	526
	Optional	XWIP	Prohibited	Prohibited	CP	Waiting for extension motion control board axis positioning complete signal to be turned ON	527
	Optional	XCAS	Slave Shaft No.	Variable No.	PE	Start synchronizing extension motion control board axis electronic cam (indicating main axis)	529
	Optional	XCTM	Slave Shaft No.	Variable No.	PE	Move extension motion control board axis individual electronic cam (indicating time)	534
	Optional	XSFS	Slave Shaft No.	Variable No.	PE	Start synchronizing of extension motion control board axis electronic shaft	536
	Optional	XSYE	Slave Shaft No.	(Complete Type)	PE	Cancel operation of extension motion control board axis	538
Extension Motion Control Board Axis Status Acquirement	Optional	XAST	Variable No.	Axis No.	CP	Acquire extension motion control board axis status	540

5.3 Explanation of Commands

[1] Variable Assignment

● LET (Assign)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	LET	Variable number	Data	ZR

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Assign the value specified in operand 2 to the variable specified in operand 1. The output will turn ON when 0 is assigned to the variable specified in operand 1.

[Example 1]	LET	1	10	Assign 10 to variable 1.
[Example 2]	LET	1	2	Assign 2 to variable 1.
	LET	3	10	Assign 10 to variable 3.
	LET	*1	*3	Assign the content 10 of variable 3 to the variable that corresponds to the content 2 of variable 1.

● TRAN (Copy)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	TRAN	Variable number	Variable number	ZR

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Assign the content of the variable specified in operand 2 to the variable specified in operand 1.
The output will turn ON when 0 is assigned to the variable specified in operand 1.

[Example 1]	TRAN	1	2	Assign the content of variable 2 to variable 1. The above operation can be performed with a LET command as follows.
	LET	1	*2	
[Example 2]	LET	1	2	Assign 2 to variable 1.
	LET	2	3	Assign 3 to variable 2.
	LET	3	4	Assign 4 to variable 3.
	LET	4	10	Assign 10 to variable 4.
	TRAN	*1	*3	Assign 10 of the content 4 of variable 3 to the variable that corresponds to the content 2 of variable 1.

The variables change as follows.

1	2	3	4		1	2	3	4
2	3	4	10	→	2	10	4	10

● CLR (Clear variable)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	CLR	Variable number	Variable number	ZR

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Clear the variables from the one specified in operand 1 through the other specified in operand 2.
The contents of the variables that have been cleared become 0.
The output will turn ON when 0 is assigned to the variable specified in operand 1.

[Example 1]	CLR	1	5	Clear variables 1 through 5.
[Example 2]	LET	1	10	Assign 10 to variable 1.
	LET	2	20	Assign 20 to variable 2.
	CLR	*1	*2	Clear the variables from the contents 10 in variable 1 through the contents 20 in variable 2.

[2] Arithmetic Operation

● ADD (Add)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	ADD	Variable number	Data	ZR

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Add the content of the variable specified in operand 1 and the value specified in operand 2, and assign the result to the variable specified in operand 1.
The output will turn ON when the operation result becomes 0.

[Example 1]

LET	1	3	Assign 3 to variable 1.
ADD	1	2	Add 2 to the content of variable 1 (3). 5 (3 + 2 = 5) will be stored in variable 1.

[Example 2]

LET	1	2	Assign 2 to variable 1.
LET	2	2	Assign 3 to variable 2.
LET	3	2	Assign 2 to variable 3.
ADD	*1	*3	Add the content of variable 3, or 2, to the variable that corresponds to the content of variable 1, or 2. 3 + 2, or 5, is stored in variable 2.

● SUB (Subtract)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	SUB	Variable number	Data	ZR

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Subtract the value specified in operand 2 from the content of the variable specified in operand 1, and assign the result to the variable specified in operand 1.
The output will turn ON when the operation result becomes 0.

[Example 1]

```
LET   1   3      Assign 3 to variable 1.
SUB   1   2      Subtract 2 from the content of variable 1 (3).
                 1 (3 – 2 = 1) will be stored in variable 1.
```

[Example 2]

```
LET   1   2      Assign 2 to variable 1.
LET   2   3      Assign 3 to variable 2.
LET   3   2      Assign 2 to variable 3.
SUB   *1  *3     Subtract the content of variable 3 (2), from the
                 variable corresponding to the content of variable 1
                 (2). 1 (3 - 2 = 1) will be send in variable 2.
```

● MULT (Multiply)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	MULT	Variable number	Data	ZR

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Multiply the content of the variable specified in operand 1 by the value specified in operand 2, and assign the result to the variable specified in operand 1.
The output will turn ON when the operation result becomes 0.

[Example 1]

LET	1	3	Assign 3 to variable 1.
MULT	1	2	Multiply the content of variable 1 (3) by 2. 3 × 2, or 6, is stored in variable 1.

[Example 2]

LET	1	2	Assign 2 to variable 1.
LET	2	3	Assign 3 to variable 2.
LET	3	2	Assign 2 to variable 3.
MULT	*1	*3	Multiply the variable that corresponds to the content of variable 1, or 2, by the content of variable 3, or 2. 3 × 2, or 6, is stored in variable 2.

● DIV (Divide)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	DIV	Variable number	Data	ZR

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Divide the content of the variable specified in operand 1 by the value specified in operand 2, and assign the result to the variable specified in operand 1.
The output will turn ON when the operation result becomes 0.

(Note) If the variable specified in operand 1 is an integer variable, any decimal places will be rounded off.

[Example 1]

```
LET   1    6     Assign 6 to variable 1.
DIV   1    2     Divide the content of variable 1 (6) by 2.
                 6 / 2, or 3, is stored in variable 1.
```

[Example 2]

```
LET   2    6     Assign 6 to variable 2.
LET   1    2     Assign 2 to variable 1.
LET   3    2     Assign 2 to variable 3.
DIV   *1   *3    Divide the variable that corresponds to the content
                 of variable 1, or 2, by the content of variable 3, or 2.
                 6 / 2, or 3, is stored in variable 2.
```

● MOD (Remainder)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	MOD	Variable number	Data	ZR

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Assign, to the variable specified in 1, the remainder obtained by dividing the content of the variable specified in operand 1 by the value specified in operand 2. The output will turn ON when the operation result becomes 0.

(Note) A MOD command is used with integer variables.

[Example 1]

LET	1	7	Assign 7 to variable 1.
MOD	1	3	Obtain the remainder of dividing the content of variable 1 (7) by 3. The remainder of 7 / 3 = 2, or 1, is assigned to variable 1.

[Example 2]

LET	1	2	Assign 2 to variable 1.
LET	2	7	Assign 7 to variable 2.
LET	3	3	Assign 3 to variable 3.
MOD	*1	*3	Obtain the remainder of dividing the variable that corresponds to the content of variable 1, or 2, by the content of variable 3, or 3. The remainder of 7 / 3 = 2, or 1, is assigned to variable 2.

[3] Function Operation

● SIN (Sine operation)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	SIN	Variable number	Data	ZR

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Assign the sine of the data specified in operand 2 to the variable specified in operand 1.
The output will turn ON when the operation result becomes 0.
The setting in operand 1 must be a real variable in a range of 100 to 199, 1100 to 1199, 300 to 399 or 1300 to 1399.
The unit of data in operand 2 is radian.

(Note 1) Radian = Angle × π / 180

[Example 1]

SIN	100	0.523599	Assign the sine of 0.523599 (0.5) to variable 100.

[Example 2]

LET	1	100	Assign 100 to variable 1.
LET	101	30	30 × π / 180 (radian)
MULT	101	3.141592	(30° is converted to radian and the result is
DIV	101	180	assigned to variable 101.)
SIN	*1	*101	Assign the sine of the content of variable 101, or 0.5, to the variable that corresponds to the content of variable 1, or 100.

● COS (Cosine operation)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	COS	Variable number	Data	ZR

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Assign the cosine of the data specified in operand 2 to the variable specified in operand 1.
The output will turn ON when the operation result becomes 0.
The setting in operand 1 must be a real variable in a range of 100 to 199, 1100 to 1199, 300 to 399 or 1300 to 1399.
The unit of data in operand 2 is radian.

(Note 1) Radian = Angle × π / 180

[Example 1]	COS	100	1.047197	Assign the cosine of 1.047197 (0.5) to variable 100.

[Example 2]	LET	1	100	Assign 100 to variable 1.
	LET	101	60	60 × π / 180 (radian) (60° is converted to radian and the result is assigned to variable 101.)
	MULT	101	3.141592	
	DIV	101	180	
	COS	*1	*101	Assign the sine of the content of variable 101, or 0.5, to the variable that corresponds to the content of variable 1, or 100.

● TAN (Tangent operation)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	TAN	Variable number	Data	ZR

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Assign the tangent of the data specified in operand 2 to the variable specified in operand 1.
The output will turn ON when the operation result becomes 0.
The setting in operand 1 must be a real variable in a range of 100 to 199, 1100 to 1199, 300 to 399 or 1300 to 1399.
The unit of data in operand 2 is radian.

(Note 1) Radian = Angle × π / 180

[Example 1]

TAN	100	0.785398	Assign the tangent of 0.785398 (1) to variable 100.

[Example 2]

LET	1	100	Assign 100 to variable 1.
LET	101	45	45 × π / 180 (radian)
MULT	101	3.141592	(45° is converted to radian and the result is
DIV	101	180	assigned to variable 101.)
TAN	*1	*101	Assign the sine of the content of variable 101, or 1, to the variable that corresponds to the content of variable 1, or 100.

● ATN (Inverse-tangent operation)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	ATN	Variable number	Data	ZR

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Assign the inverse tangent of the data specified in operand 2 to the variable specified in operand 1.
The output will turn ON when the operation result becomes 0.
The setting in operand 1 must be a real variable in a range of 100 to 199, 1100 to 1199, 300 to 399 or 1300 to 1399.
The unit of inverse tangent is radian.

(Note 1) Radian = Angle $\times$ π / 180

[Example 1]	ATN	100	1	Assign the inverse tangent of 1 (0.785398) to variable 100.
[Example 2]	LET	1	100	Assign 100 to variable 1.
	LET	101	1	Assign 1 to variable 101.
	ATN	*1	*101	Assign the inverse arc tangent of the content of variable 101, or 0.785398, to the variable that corresponds to the content of variable 1, or 100.

● SQR (Root operation)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	SQR	Variable number	Data	ZR

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Assign the root of the data specified in operand 2 to the variable specified in operand 1.
The output will turn ON when the operation result becomes 0.

[Example 1]

SQR	1	4	Assign the root of 4 (2) to variable 1.

[Example 2]

LET	1	10	Assign 10 to variable 1.
LET	2	4	Assign 4 to variable 2.
SQR	*1	*2	Assign the square root of the content of variable 2, or 4, to the variable that corresponds to the content of variable 1, or 10.

[4] Logical Operation

● AND (Logical AND)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	AND	Variable number	Data	ZR

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Assign the logical AND operation result of the content of the variable specified in operand 1 and the value specified in operand 2, to the variable specified in operand 1.
The output will turn ON when the operation result becomes 0.

[Example 1]

LET	1	204	Assign 204 to variable 1.
AND	1	170	Assign the logical AND operation result (136) of the content of variable 1 (204) and 170, to variable 1.

[Example 2]

LET	1	2	Assign 2 to variable 1.
LET	2	204	Assign 204 to variable 2.
LET	3	170	Assign 170 to variable 3.
AND	*1	*3	Assign the logical product 136 of the content 204 of the variable that corresponds to the content of variable 1, or 2, and the content of variable 3, or 170, to the variable that corresponds to the content of variable 1, or 2.

Decimal	Binary
204	11001100
AND 170	AND 10101010
136	10001000

● OR (Logical OR)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	OR	Variable number	Data	ZR

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Assign the logical OR operation result of the content of the variable specified in operand 1 and the value specified in operand 2, to the variable specified in operand 1.
The output will turn ON when the operation result becomes 0.

[Example 1]

LET	1	204	Assign 204 to variable 1.
OR	1	170	Assign the logical OR operation result (238) of the content of variable 1 (204) and 170, to variable 1.

[Example 2]

LET	1	2	Assign 2 to variable 1.
LET	2	204	Assign 204 to variable 2.
LET	3	170	Assign 170 to variable 3.
OR	*1	*3	Assign the logical sum 238 of the content 204 of the variable that corresponds to the content of variable 1, or 2, and the content of variable 3, or 170, to the variable that corresponds to the content of variable 1, or 2.

Decimal		Binary	
	204		11001100
OR	170	OR	10101010
	238		11101110

● EOR (Logical exclusive-OR)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	EOR	Variable number	Data	ZR

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Assign the logical exclusive-OR operation result of the content of the variable specified in operand 1 and the value specified in operand 2, to the variable specified in operand 1.
The output will turn ON when the operation result becomes 0.

[Example 1]

LET	1	204	Assign 204 to variable 1.
EOR	1	170	Assign the logical exclusive-OR operation result (102) of the content of variable 1 (204) and 170, to variable 1.

[Example 2]

LET	1	2	Assign 2 to variable 1.
LET	2	204	Assign 204 to variable 2.
LET	3	170	Assign 170 to variable 3.
EOR	*1	*3	Assign the exclusive logical sum 102 of the content 204 of the variable that corresponds to the content of variable 1, or 2, and the content of variable 3, or 170, to the variable that corresponds to the content of variable 1, or 2.

Decimal	Binary
204	11001100
EOR 170	EOR 10101010
102	01100110

[5] Comparison Operation

● CP☐☐ (Compare)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	CP☐☐	Variable number	Data	EQ NE GT GE LT LE

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] The output will be turned ON if the comparison result of the content of the variable specified in operand 1 and the value specified in operand 2 satisfies the condition.
The value in the variable does not change.
The output will be turned OFF if the condition is not satisfied.

(Note) The output will not be turned OFF when the command is executed.

CP☐☐

EQ	....	Operand 1 = Operand 2
NE	....	Operand 1 ≠ Operand 2
GT	....	Operand 1 > Operand 2
GE	....	Operand 1 ≥ Operand 2
LT	....	Operand 1 < Operand 2
LE	....	Operand 1 ≤ Operand 2

[Example 1]

	LET	1	10		Assign 10 to variable 1.
	CPEQ	1	10	600	Turn ON flag 600 if the content of variable 1 is 10.
600	ADD	2	1		Add 1 to variable 2 if flag 600 is ON.

[Example 2]

LET	1	2		Assign 2 to variable 1.
LET	2	10		Assign 10 to variable 2.
LET	3	10		Assign 10 to variable 3.
CPNE	*1	*3	310	Turn ON output 310 if the variable that corresponds to the content of variable 1, or 2, is not equal to the content of variable 3.

[6] Timer

● TIMW (Timer)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	TIMW	Time	Prohibited	TU

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Stop the program and wait for the time specified in operand 1.
The setting range is 0.01 to 99, and the unit is second.
The output will turn ON when the specified time has elapsed and the program proceeds to the next step.

[Example 1] TIMW 1.5 Wait for 1.5sec.

[Example 2]

LET	1	10	Assign 10 to variable 1.
TIMW	*1		Wait for the content of variable 1 (10sec).

● TIMC (Cancel timer)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	TIMC	Program number	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Cancel a timer in other program running in parallel.

(Note) Timers in TIMW, WTON, WTOF and READ commands can be cancelled. In the case of WTON, WTOF and READ commands, even if timeout is not specified it is assumed that an unlimited timer has been specified and the wait time will be cancelled.

[Example 1]

```
TIMC    10            Cancel the wait time in program 10.
```

[Example 2]

```
LET     1     10      Assign 10 to variable 1.
TIMC    *1            Cancel the wait time in the content of variable 1
                      (program 10).
```

[Example 3]

```
Program 1       Program 10

   :               :
   :            WTON 8   20         Program 10 waits for input 8 for 20
   :            (Wait for input 8)  seconds.
TIMC    10      (Wait for input 8)  Cancel the wait time in program 10.
   :               :
```

(Note) The steps shown in the above example represent those executed simultaneously in different programs.

● GTTM (Get time)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	GTTM	Variable number	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Read system time to the variable specified in operand 1. The time is specified in units of 10msec.
The time obtained here has no base number. Therefore, this command is called twice and the difference will be used to calculate the elapsed time.

[Example 1]

```
GTTM   1            Read the reference time to variable 1.
ADD    1    500     Set the ending time to 5sec later.
GTTM   2            Read the current system time to variable 2.
DWLE   2    *1      Proceed to the step next to EDDO when 5sec
  :                 elapsed.
  :                 The above process will be repeated for 5sec.
GTTM   2            Read the current system time to variable 2.
EDDO
```

[Example 2]

```
LET    1    5       Assign 5 to variable 1.
GTTM   *1           Store the current system time in the content of
                    variable 1 (variable 5).
```

[7] I/O, Flag Operation

● BT□□ (Output port, flag operation)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	BT□□	Output, flag	(Output, flag)	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Reverse the ON/OFF status of the output ports or flags from the one specified in operand 1 through the other specified in operand 2.

(Note) Dedicated outputs (system outputs) other than general-purpose outputs cannot be specified for operands 1 and 2.

BT□□
- ON .... Switch the status to ON.
- OF .... Switch the status to OFF.
- NT .... Reverse the status.

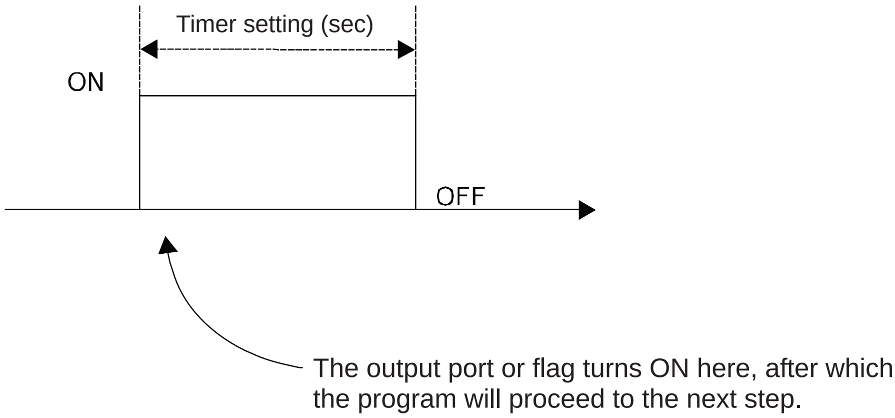
[Example 1]	BTON	300		Turn ON output port 300.
[Example 2]	BTOF	300	307	Turn OFF output ports 300 through 307.
[Example 3]	LET	1	600	Assign 600 to variable 1.
	BTNT	*1		Reverse the content of variable 1 (flag 600).
[Example 4]	LET	1	600	Assign 600 to variable 1.
	LET	2	607	Assign 607 to variable 2.
	BTON	*1	*2	Turn ON the flags from the content of variable 1 (flag 600) through the content of variable 2 (flag 607).

● BTPN (Output ON pulse)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	BTPN	Output port, flag	Timer setting	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Turn ON the specified output port or flag for the specified time.
When this command is executed, the output port or flag specified in operand 1 will be turned ON and then the program will proceed to the next step. The output port or flag will be turned OFF automatically upon elapse of the timer setting specified in operand 2.
The timer is set in a range from 0.01 to 99.00sec (including up to two decimal places).



(Note 1) If this command is executed with respect to an output port or flag already ON, the output port or flag will be turned OFF upon elapse of the timer setting.

(Note 2) If the program ends after the command has been executed but before the timer is up, the output port or flag will not be turned OFF.

(Note 3) This command will not be cancelled by a TIMC command.

(Note 4) A maximum of 16 timers, including BTPN and BTPF, can be operated simultaneously in a single program.
(There is no limitation as to how many times these timers can be used in a single program.)

(Note 5) Dedicated outputs (system outputs) other than general-purpose outputs cannot be specified for operand 1.

(Note 6) If other task interrupts after a port is turned ON until it is subsequently turned OFF, an error will generate in pulse output time, in which case pulse output cannot be used for a specified period.

[Example]

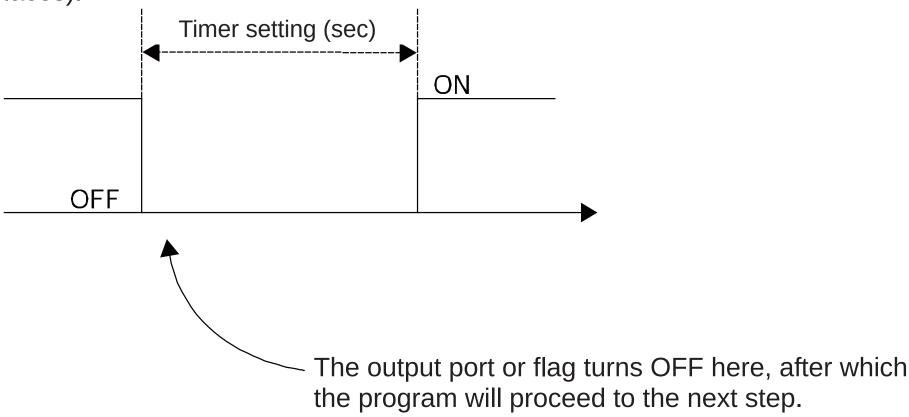
BTPN	300	1	Turn ON output port 300 for 1sec.
BTPN	600	10	Turn ON flag 600 for 10sec.

● BTPF (Output OFF pulse)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	BTPF	Output port, flag	Timer setting	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Turn OFF the specified output port or flag for the specified time.
When this command is executed, the output port or flag specified in operand 1 will be turned OFF and then the program will proceed to the next step. The output port or flag will be turned ON automatically upon elapse of the timer setting specified in operand 2.
The timer is set in a range from 0.01 to 99.00sec (including up to two decimal places).



(Note 1) If this command is executed with respect to an output port or flag already OFF, the output port or flag will be turned ON upon elapse of the timer setting.

(Note 2) If the program ends after the command has been executed but before the timer is up, the output port or flag will not be turned ON.

(Note 3) This command will not be cancelled by a TIMC command.

(Note 4) A maximum of 16 timers, including BTPN and BTPF, can be operated simultaneously in a single program.
(There is no limitation as to how many times these timers can be used in a single program.)

(Note 5) Dedicated outputs (system outputs) other than general-purpose outputs cannot be specified for operand 1.

(Note 6) If other task interrupts after a port is turned ON until it is subsequently turned OFF, an error will generate in pulse output time, in which case pulse output cannot be used for a specified period.

[Example]

BTPF	300	1	Turn OFF output port 300 for 1sec.
BTPF	600	10	Turn OFF flag 600 for 10sec.

● WT□□ (Wait for I/O port, flag)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	WT□□	I/O, flag	(Time)	TU

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Wait for the I/O port or flag specified in operand 1 to turn ON/OFF.
The program can be aborted after the specified time by setting the time in operand 2.
The setting range is 0.01 to 99sec.
The output will turn ON upon elapse of the specified time (only when operand 2 is specified).

(Note) A local flag cannot be entered in operand 1.

WT□□
- ON .... Wait for the applicable I/O port or flag to turn ON.
- OF .... Wait for the applicable I/O port or flag to turn OFF.

[Example 1]	WTON	15		Wait for input port 15 to turn ON.
[Example 2]	WTOF	308	10	Wait for 10sec for output port 308 to turn OFF.
[Example 3]	LET	1	600	Assign 600 to variable 1.
	WTON	*1		Wait for the content of variable 1 (flag 600) to turn ON.
[Example 4]	LET	1	8	Assign 8 to variable 1.
	LET	2	5	Assign 5 to variable 2.
	WTOF	*1	*2	Wait for the content of variable 2 (5sec) for the content of variable 1 (input port 8) to turn OFF.

● IN (Read I/O, flag as binary)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	IN	I/O, flag	I/O, flag	CC

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Read the I/O ports or flags from the one specified in operand 1 through the other specified in operand 2, to variable 99 as a binary.

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	• • • Binary
15	14	13	12	11	10	9	8	• • • Input port number
ON	OFF	OFF	OFF	OFF	ON	OFF	ON	

1	0	0	0	0	1	0	1	• • • Binary

$2^7 + 0 + 0 + 0 + 0 + 2^2 + 0 + 2^0$

$128 + 0 + 0 + 0 + 0 + 4 + 0 + 1 = 133$

$\boxed{133}$ • • • • • • • • • • • • • • • • • Variable 99

(Note 1) A maximum of 32 bits can be input.

(Note 2) When 32 bits have been input and the most significant bit is ON, the value read to variable 99 will be treated as a negative value.

(Note 3) The read data format can be changed using a FMIO command (refer to the section on FMIO command).

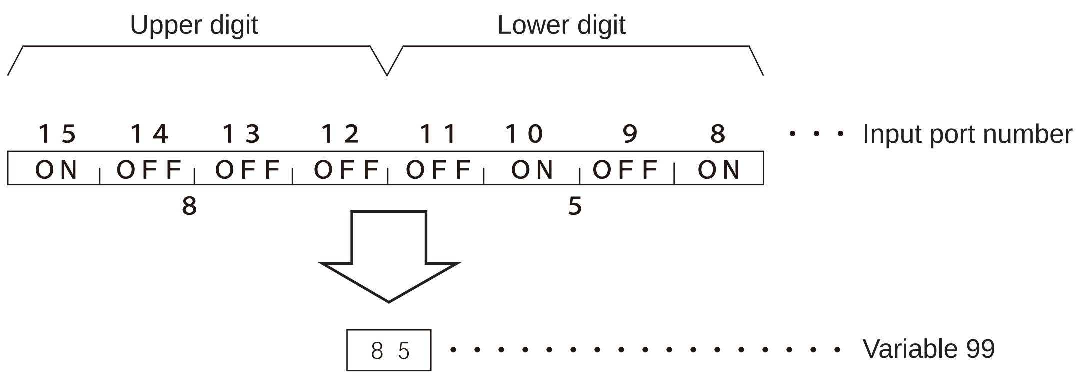
[Example 1]	IN	8	15	Read input ports 8 through 15, to variable 99 as a binary.
[Example 2]	LET	1	8	Assign 8 to variable 1.
	LET	2	15	Assign 15 to variable 2.
	IN	*1	*2	Read the input ports from the content of variable 1 (input port 8) through the content of variable 2 (input port 15), to variable 99 as a binary.

● INB (Read I/O, flag as BCD)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	INB	I/O, flag	BCD digits	CC

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Read the I/O ports or flags from the one specified in operand 1 for the number of digits specified in operand 2, to variable 99 as a BCD.



(Note 1) A maximum of eight digits (32 bits) can be input.

(Note 2) The number of I/O ports and flags that can be used is 4 × n (digits).

(Note 3) The read data format can be changed using a FMIO command (refer to the section on FMIO command).

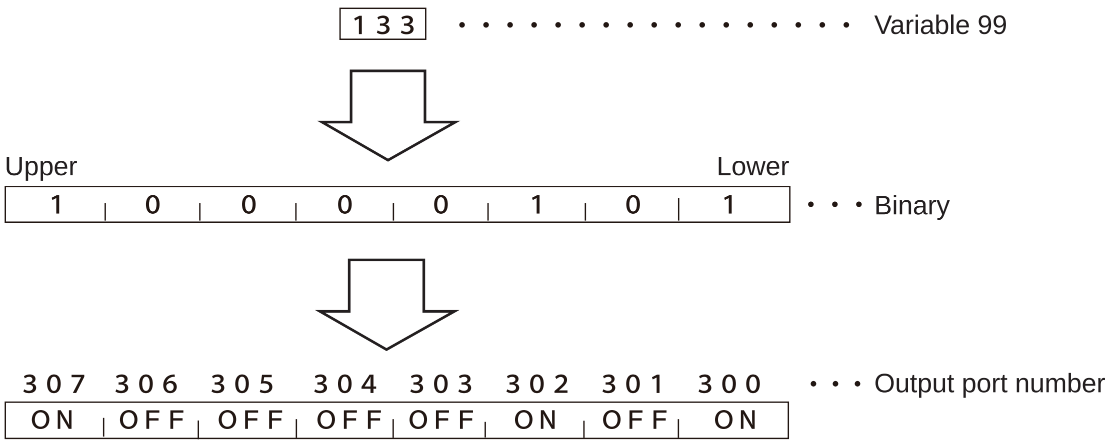
[Example 1]	INB	8	2	Read input ports 8 through 15, to variable 99 as a BCD.
[Example 2]	LET	1	8	Assign 8 to variable 1.
	LET	2	2	Assign 2 to variable 2.
	INB	*1	*2	Read the input ports from the content of variable 1 (input port 8) for the content of variable 2 (two digits) (until input port 15), to variable 99 as a BCD.

● OUT (Write output, flag as binary)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	OUT	Output, flag	Output, flag	CC

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Write the value in variable 99 to the output ports or flags from the one specified in operand 1 through the other specified in operand 2.



(Note 1) A maximum of 32 bits can be output.

(Note 2) The write data format can be changed using a FMIO command (refer to the section on FMIO command).

[Example 1] OUT 300 307 — Write the value in variable 99 to output ports 300 through 307 as a binary.

[Example 2]

LET	1	300	Assign 300 to variable 1.
LET	2	307	Assign 307 to variable 2.
OUT	*1	*2	Write the value in variable 99 to the output ports from the content of variable 1 (output port 300) through the content of variable 2 (output port 307) as a binary.

● OUTB (Write output, flag as BCD)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	OUTB	Output, flag	BCD digits	CC

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Write the value in variable 99 to the output ports or flags from the one specified in operand 1 for the number of digits specified in operand 2 as a BCD.

85 · · · · · · · · · · · · · · · · · · Variable 99

⇩

307	306	305	304	303	302	301	300	· · · Output port number
ON	OFF	OFF	OFF	OFF	ON	OFF	ON	

(Note 1) A maximum of eight digits (32 bits) can be output.

(Note 2) The number of output ports and flags that can be used is 4 × n (digits).

(Note 3) The write data format can be changed using a FMIO command (refer to the section on FMIO command).

[Example 1]	OUTB	300	2	Write the value in variable 99 to the output ports from 300 for two digits (until output port 307) as a BCD.
[Example 2]	LET	1	300	Assign 300 to variable 1.
	LET	2	2	Assign 2 to variable 2.
	OUTB	*1	*2	Write the value in variable 99 to the output ports from the content of variable 1 (output port 300) for the content of variable 2 (two digits) (until output port 307) as a BCD.

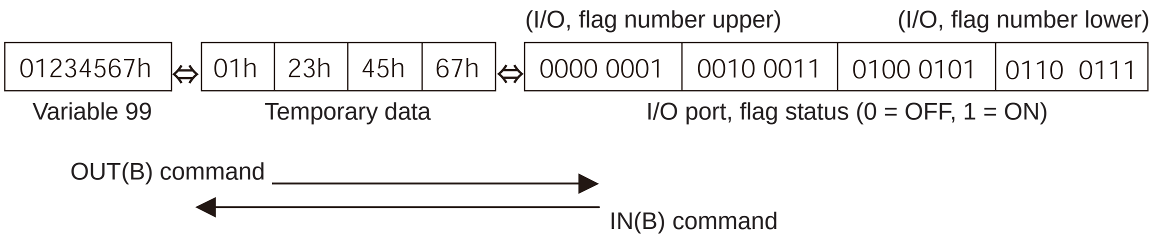
● FMIO (Set IN, INB, OUT, OUTB, OTPS command format)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	FMIO	Format type	Prohibited	CP

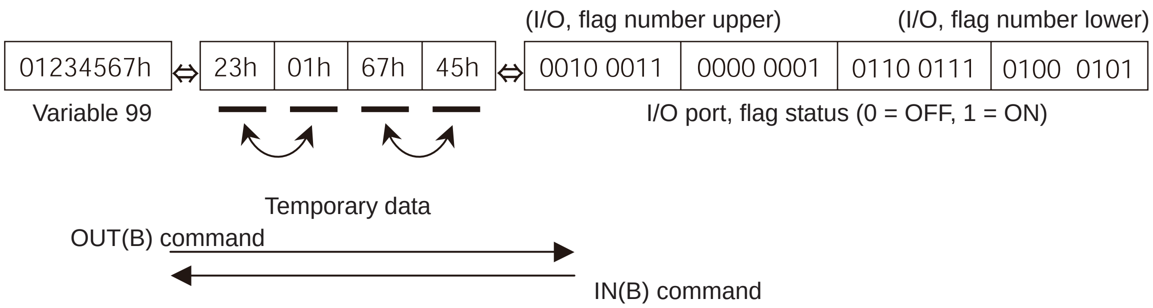
Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Set the data format for reading or writing I/O ports and flags with an IN, INB, OUT OUTB or OTPS command.
Details of data in each format type are shown for the IN, INB, OUT and OUTB commands. Data details of the OTPS command are the same as those of the OUT command, where the only difference is that variable 99 in the OUT command is replaced with current position data in the OTPS command.

1) Operand 1 = 0 (Default status when a FMIO command has not been executed)
Data is read or written without being reversed.



2) Operand 1 = 1
Data is read or written after its upper 8 bits and lower 8 bits are reversed every 16 bits.



3) Operand 1 = 2
   Data is read or written after its upper 16 bits and lower 16 bits are reversed every 32 bits.

(I/O, flag number upper) (I/O, flag number lower)

01234567h	⇔	45h	67h	01h	23h	⇔	0100 0101	0110 0111	0000 0001	0010 0011

Variable 99

I/O port, flag status (0 = OFF, 1 = ON)

Temporary data

OUT(B) command

IN(B) command

4) Operand 1 = 3
   Data is read or written after its upper 16 bits and lower 16 bits are reversed every 32 bits and its upper 8 bits and lower 8 bits are reversed every 16 bits.

(I/O, flag number upper) (I/O, flag number lower)

01234567h	⇔	67h	45h	23h	01h	⇔	0110 0111	0100 0101	0010 0011	0000 0001

Variable 99

I/O port, flag status (0 = OFF, 1 = ON)

Temporary data

OUT(B) command

IN(B) command

(Note) The FMIO command is supported by: Main application Ver.0.56 or later
PC software Ver.2.0.45 or later
Teaching pendant Ver.1.13 or later

[Example 1] Variable 99 = 00123456h (Decimal: 1193046, BCD: 123456)

00123456h ← OUT(B) command / IN(B) command → Variable 99: 1193046 (IN/OUT command), 123456 (INB/OUTB command)

OUT(B) command ↓ ↑ IN(B) command

	Temporary data				⇔	(I/O, flag number upper)			(I/O, flag number lower)
FMIO=0	00h	12h	34h	56h	⇔	0000 0000	0001 0010	0011 0100	0101 0110
FMIO=1	12h	00h	56h	34h	⇔	0001 0010	0000 0000	0101 0110	0011 0100
FMIO=2	34h	56h	00h	12h	⇔	0011 0100	0101 0110	0000 0000	0001 0010
FMIO=3	56h	34h	12h	00h	⇔	0101 0110	0011 0100	0001 0010	0000 0000

Temporary data — OUT(B) command → / ← IN(B) command — I/O port, flag status (0 = OFF, 1 = ON)

[Example 2] Variable 99 = 00001234h (Decimal: 4660, BCD: 1234)

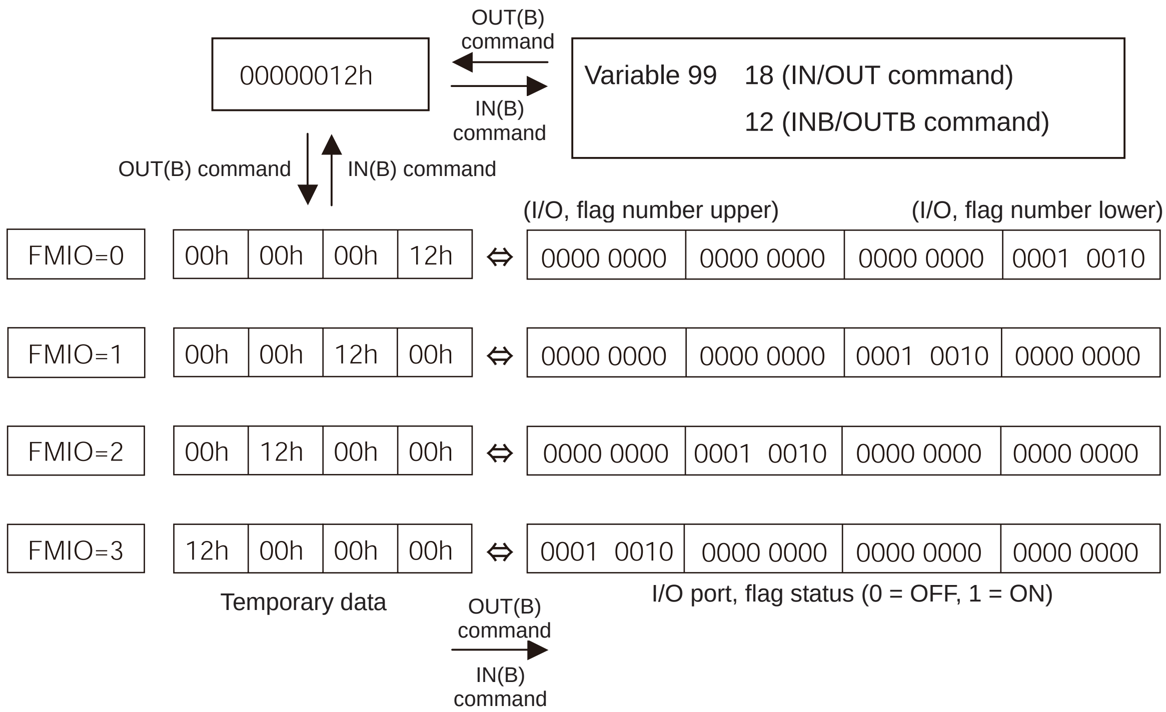
00001234h ← OUT(B) command / IN(B) command → Variable 99: 4660 (IN/OUT command), 1234 (INB/OUTB command)

OUT(B) command ↓ ↑ IN(B) command

	Temporary data				⇔	(I/O, flag number upper)			(I/O, flag number lower)
FMIO=0	00h	00h	12h	34h	⇔	0000 0000	0000 0000	0001 0010	0011 0100
FMIO=1	00h	00h	34h	12h	⇔	0000 0000	0000 0000	0011 0100	0001 0010
FMIO=2	12h	34h	00h	00h	⇔	0001 0010	0011 0100	0000 0000	0000 0000
FMIO=3	34h	12h	00h	00h	⇔	0011 0100	0001 0010	0000 0000	0000 0000

Temporary data — OUT(B) command → / ← IN(B) command — I/O port, flag status (0 = OFF, 1 = ON)

[Example 3] Variable 99 = 00000012h (Decimal: 18, BCD: 12)



● OTPS (Output current position data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	OTPS	Output port number	Axis number	CC

* This command is supported by SSEL controller main application Ver.0.22 or later.

Applicable models
SSEL ○ Other than SSEL ×

[Function]

- Output current position data to an output port.
- The current position data corresponding to the axis number specified in operand 2 is output to 32 bits of ports starting from the output port specified in operand 1.
- If the command is executed with 0 specified in operand 1, the command will become invalid and refreshing of current position data at the specified output will stop.
- When this command is executed, current position data will be refreshed continuously at the specified output port until the program in which this command was input is stopped or otherwise the command becomes invalid.
- 32 bits binary data (extended by sign) is output. The minimum unit is 0.001mm.

(Note)

- Only output ports of No. 300 or higher port numbers (multiples of 8) can be specified in operand 1.
- Only network output ports are supported.
- Even if this command is executed, output data remains indeterminable if home return is not yet completed.
- The output data format can be changed using the FMIO command (refer to the section on "FMIO command"). Note, however, that data is output in the FMIO-specified format when this command is called.

[Example 1]

When OTPS 300 1 is executed:
If the current position is -0.012mm, it is expressed as -12 (decimal) or FFFFFFF4 (binary) in units of 0.001mm.
Accordingly, FFFFFFF4 is output to output port No. 300 onward.

If the current position is 125.305mm, it is expressed as 125305 (decimal) or 0001E979 (binary) in units of 0.001mm.

Accordingly, 0001E979 is output to output port No. 300 onward.
The statuses of output ports are shown below.

307	306	305	304	303	302	301	300
OFF	ON	ON	ON	ON	OFF	OFF	ON
315	314	313	312	311	310	309	308
ON	ON	ON	OFF	ON	OFF	OFF	ON
323	322	321	320	319	318	317	316
OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON
331	330	329	328	327	326	325	324
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFf

[8] Program Control

● GOTO (Jump)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	GOTO	Tag number	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Jump to the position of the tag number specified in operand 1.

(Note 1) A GOTO command is valid only within the same program.
(Note 2) Do not create a program that contains an infinite series of continuous movement commands using TAG-GOTO statements. Doing so will cause coordinate conversion errors to accumulate.

[Example 1]

```
TAG   1    Set a tag.
 :
 :
 :
GOTO  1    Jump to tag 1.
```

Using a GOTO command to branch out of or into any of the syntaxes listed below is prohibited.
Since the maximum number of nests is defined for each conditional branching command or subroutine call, a nest will be infinitely repeated if an ED☐☐ is not passed, and a nest (repetition) overflow error will generate. In the case of palletizing setting, an error will generate if the second BGPA is declared after the first BGPA declaration without passing an EDPA.

(1) IF☐☐ or IS☐☐ and EDIF syntax
(2) DWXX and EDDO syntax
(3) SLCT and EDSL syntax
(4) BGSR and EDSR syntax
(5) BGPA and EDPA syntax

● TAG (Declare tag)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Prohibited	Prohibited	TAG	Tag number	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Set the tag number specified in operand 1.

[Example 1] Refer to the section on GOTO command.

● EXSR (Execute subroutine)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Prohibited	Prohibited	EXSR	Subroutine number	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Execute the subroutine specified in operand 1.
A maximum of 15 nested subroutine calls are supported.

(Note) This command is valid only for subroutines within the same program.

[Example 1]

```
EXSR   1            Execute subroutine 1.
  :
  :
EXIT
BGSR   1            Start subroutine 1.
  :
  :
  :
EDSR                End subroutine 1.
```

[Example 2]

```
LET    1    10      Assign 10 to variable 1.
EXSR   *1           Execute the content of variable 1 (subroutine 10).
```

● BGSR (Start subroutine)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Prohibited	Prohibited	BGSR	Subroutine number	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Declare the start of the subroutine specified in operand 1.

[Example 1] Refer to the section on EXSR command.

(Note) Using a GOTO command to branch out of or into a BGSR-EDSR syntax is prohibited.

● EDSR (End subroutine)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Prohibited	Prohibited	EDSR	Prohibited	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Declare the end of a subroutine.
This command is always required at the end of a subroutine.
Thereafter, the program will proceed to the step next to the EXSR that has been called.

[Example 1] Refer to the section on EXSR command.

[9] Task Management

● EXIT (End program)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	EXIT	Prohibited	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] End the program.
If the last step has been reached without encountering any EXIT command, the program will return to the beginning.

(Note) Status at program end
- Output ports ················Retained
- Local flags···················Cleared
- Local variables············Cleared
- Current values ············Retained
- Global flags·················Retained
- Global variables ··········Retained

● EXPG (Start other program)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	EXPG	Program number	(Program number)	CC

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Start the programs from the one specified in operand 1 through the other specified in operand 2, and run them in parallel. Specification in operand 1 only is allowed.

[Example 1] EXPG 10 12 Start program No. 10, 11 and 12.

Error-generation/output-operation conditions
When one EXPG program is specified (only operand 1 is specified)

Status of the specified program	No program number error *1			Program number error *1
	Program already registered		Program not yet registered	
	Program running	Program not running		
Error	A57 "Multiple program start error"	None	C03 "Non-registered program specification error"	C2C "Program number error"
Output operation	ON	ON	OFF	OFF

* The errors shown in the table represent those that generate in accordance with the status of the specified program. Errors caused by other factors are excluded.

* 1… Program number error indicates specification of a number smaller than 1 or exceeding 64.

When multiple EXPG programs are specified (both operands 1 and 2 are specified)

Status of the specified program	No program number error *2			Program number error *1
	Registered program exists inside the specified range *3		None of programs inside the specified range are registered	
	Running program exists inside the specified range	None of programs inside the specified range are running		
Error	A57 "Multiple program start error"	None	C03 "Non-registered program specification error"	C2C "Program number error"
Output operation	ON	ON	OFF	OFF

* The errors shown in the table represent those that generate in accordance with the status of the specified program. Errors caused by other factors are excluded.

* 2… Program number error indicates specification of a number smaller than 1 or exceeding 64.

* 3… In this case, non-registered programs inside the specified range are not treated as a target of operation. This will not affect error generation or output operation.

● ABPG (Abort other program)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	ABPG	Program number	(Program number)	CC

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Abort other program.

(Note 1) If an ABPG command is issued while a movement command is being executed, the axes will immediately decelerate and stop.

(Note 2) Not only the operation but also the execution of the step itself will be terminated.

[Example 1] ABPG 10 12 End program No. 10, 11 and 12.

Error-generation/output-operation conditions
When one ABPG program is specified (only operand 1 is specified)

Status of the specified program	No program number error *1			Program number error *1
	Program already registered		Program not yet registered	
	Program running	Program not running		
Error	None	None	None	C2C "Program number error"
Output operation	ON (OFF *2)	ON	OFF	OFF

* The errors shown in the table represent those that generate in accordance with the status of the specified program. Errors caused by other factors are excluded.

* 1… Program number error indicates specification of a number smaller than 1 or exceeding 64.

* 2… If an own task (own program) is specified in an ABPG command, the own task will be terminated and then deleted. The output will turn OFF.

When multiple ABPG programs are specified (both operands 1 and 2 are specified)

Status of the specified program	No program number error *3			Program number error *1
	Registered program exists inside the specified range *4		None of programs inside the specified range are registered	
	Running program exists inside the specified range	None of programs inside the specified range are running		
Error	None	None	None	C2C "Program number error"
Output operation	ON (OFF *5)	ON	OFF	OFF

* The errors shown in the table represent those that generate in accordance with the status of the specified program. Errors caused by other factors are excluded.

* 3… Program number error indicates specification of a number smaller than 1 or exceeding 64.

* 4… In this case, non-registered programs inside the specified range are not treated as a target of operation. This will not affect error generation or output operation.

* 5… If an own task (own program) is included in the specified range, the own task will be terminated, upon which the processing of the ABPG command will end. Since the own task will be deleted, the result of ending the processing of specified programs will become indeterminable. Exercise caution. The output will always turn OFF regardless of the result.

● SSPG (Pause program)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	SSPG	Program number	(Program number)	CC

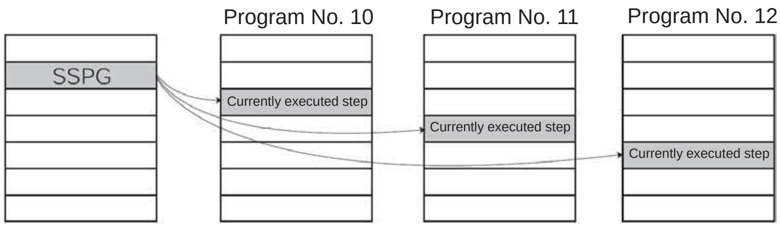
Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Pause the program from the one specified in operand 1 through the other specified in operand 2, at the current step. Specification in operand 1 only is allowed.

(Note 1) Pausing a program will also pause the operation the program has been executing.

(Note 2) Not only the operation but also the execution of the step itself will be paused.

[Example 1] SSPG 10 12 Pause program No. 10, 11 and 12 at the current step.



Error-generation/output-operation conditions

When one SSPG program is specified (only operand 1 is specified)

Status of the specified program	No program number error *1			Program number error *1
	Program already registered		Program not yet registered	
	Program running	Program not running		
Error	None	None	C03 "Non-registered program specification error"	C2C "Program number error"
Output operation	ON	OFF	OFF	OFF

* The errors shown in the table represent those that generate in accordance with the status of the specified program. Errors caused by other factors are excluded.

* 1… Program number error indicates specification of a number smaller than 1 or exceeding 64.

When multiple SSPG programs are specified (both operands 1 and 2 are specified)

Status of the specified program	No program number error *2			Program number error *1
	Registered program exists inside the specified range *3		None of programs inside the specified range are registered	
	Running program exists inside the specified range *4	None of programs inside the specified range are running		
Error	None	None	C03 "Non-registered program specification error"	C2C "Program number error"
Output operation	ON	OFF	OFF	OFF

* The errors shown in the table represent those that generate in accordance with the status of the specified program. Errors caused by other factors are excluded.

* 2… Program number error indicates specification of a number smaller than 1 or exceeding 64.

* 3… In this case, non-registered programs inside the specified range are not treated as a target of operation with EXPG, ABPG, SSPG and PSPG commands. This will not affect error generation or output operation.

* 4… In this case, programs not running (but already registered) inside the specified range are not treated as a target of operation with SSPG and RSPG commands. This will not affect error generation or output operation.

● RSPG (Resume program)

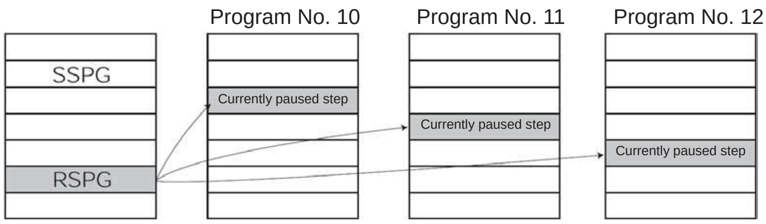
Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RSPG	Program number	(Program number)	CC

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Resume the programs from the one specified in operand 1 through the other specified in operand 2. Specification in operand 1 only is allowed.

(Note 1) Resuming a program will also resume the operation the program had been executing before the pause.

[Example 1] RSPG 10 12 Resume program No. 10, 11 and 12 from the paused step.



Error-generation/output-operation conditions

When one RSPG program is specified (only operand 1 is specified)

Status of the specified program	No program number error *1			Program number error *1
	Program already registered		Program not yet registered	
	Program running	Program not running		
Error	None	None	C03 “Non-registered program specification error”	C2C “Program number error”
Output operation	ON	OFF	OFF	OFF

* The errors shown in the table represent those that generate in accordance with the status of the specified program. Errors caused by other factors are excluded.

* 1… Program number error indicates specification of a number smaller than 1 or exceeding 64.

When multiple RSPG programs are specified (both operands 1 and 2 are specified)

Status of the specified program	No program number error *2			Program number error *1
	Registered program exists inside the specified range *3		None of programs inside the specified range are registered	
	Running program exists inside the specified range *4	None of programs inside the specified range are running		
Error	None	None	C03 “Non-registered program specification error”	C2C “Program number error”
Output operation	ON	OFF	OFF	OFF

* The errors shown in the table represent those that generate in accordance with the status of the specified program. Errors caused by other factors are excluded.

* 2… Program number error indicates specification of a number smaller than 1 or exceeding 64.

* 3… In this case, non-registered programs inside the specified range are not treated as a target of operation. This will not affect error generation or output operation.

* 4… In this case, programs not running (but already registered) inside the specified range are not treated as a target of operation with SSPG and RSPG commands. This will not affect error generation or output operation.

[10] Position Operation

● PGET (Read position data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PGET	Axis number	Position number	CC

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Read to variable 199 the data of the axis number specified in operand 1 in the position data specified in operand 2.
If the position data table contains no data to be loaded (= the position data display on the teaching pendant shows X.XXX or position data display fields in the PC software are blank) when the PGET command is executed, no data will placed in variable 199 (= the PGET command will not be executed).

[Example 1]	PGET	2	3	Read to variable 199 the data of Y-axis (axis 2) at position 3.
[Example 2]	LET	1	2	Assign 2 to variable 1.
	LET	2	3	Assign 3 to variable 2.
	PGET	*1	*2	Read to variable 199 the data of the content Y-axis (axis 2) of variable 1 at the content 3 of variable 2 at the position number.

● PPUT (Write position data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PPUT	Axis number	Position number	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Write the value in variable 199 to the axis number specified in operand 1 in the position data specified in operand 2.

[Example 1]

LET	199	150	Assign 150 to variable 199.
PPUT	2	3	Write the content 150 of variable 199 to Y-axis (axis 2) at position 3.

[Example 2]

LET	199	150	Assign 150 to variable 199.
LET	1	2	Assign 2 to variable 1.
LET	2	3	Assign 3 to variable 2
PPUT	*1	*2	Write the content 150 of variable 199 to the content Y-axis (axis 2) of variable 1 at the content 3 of variable 2 at the position number.

● PCLR (Clear position data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PCLR	Position number	Position number	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Clear the position data from the one specified in operand 1 through the other specified in operand 2.
When data is cleared, the field no longer contains data, which is different from the value of 0.000. The position data display on the teaching pendant changes to ×.××× while position data fields in the PC software become blank.

(Note 1) The comment on each position data are also subject to delete. If the position data with a comment is deleted by PCLR Command and software reset is conducted or the power is turned OFF without flash ROM writing being conducted, 22B "Position Data Comment Lost Error" will occur.

[Example 1]	PCLR	10	20	Clear the data from position No. 10 through 20.
[Example 2]	LET	1	10	Assign 10 to variable 1.
	LET	2	20	Assign 20 to variable 2.
	PCLR	*1	*2	Clear the data of the content of variable 1 (position 10) through the content of variable 2 (position 20).

● PCPY (Copy position data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PCPY	Position number	Position number	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Copy the position data specified in operand 2 to the position number specified in operand 1.

(Note 1) The comment on each position data are also subject to copy. If a change is made to the position data comment of the area to recover at by PCPY Command and software reset is conducted or the power is turned OFF without flash ROM writing being conducted, 22B "Position Data Comment Lost Error" will occur.

[Example 1]	PCPY	20	10	Copy the data of position No. 10 to position No. 20.
[Example 2]	LET	1	20	Assign 20 to variable 1.
	LET	2	10	Assign 10 to variable 2.
	PCPY	*1	*2	Copy the data of the content of variable 2 (position 10) to the content of variable 1 (position 20).

● PRED (Read current position)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PRED	Axis pattern	Position number	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Read the current position of the axis specified in operand 1 to the position specified in operand 2.

[Example 1] PRED 11 10 Read the current positions of X and Y-axis to position No. 10.

[Example 2] The axis pattern can be specified indirectly using a variable. When the command in [Example 1] is rephrased based on indirect specification using a variable:

11 (binary) → 3 (decimal)

```
LET    1    3     Assign 3 to variable 1.
PRED   *1   10
```

[Example 3]

```
LET    1    10    Assign 10 to variable 1.
PRED   11   *1    Read the current positions of X and Y-axis to the
                  content of variable 1 (position 10).
```

● PRDQ (Read current axis position (single-axis direct))

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PRDQ	Axis number	Variable number	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Read the current position of the axis number specified in operand 1 to the variable specified in operand 2.

[Example] PRDQ 2 100 Read the current position of Y-axis (axis) 2 to variable 100.

● PTAM (Substitution of target arm system data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PTAM	Variable No. (Two variables used in a row)	Position number	CP

Applicable models
XSEL-RX/SX/RXD/SXD ○ MSEL-PCX/PGX ○ Other than above ×

[Function] It writes the two types of arm system indications in a row from the variable number indicated in Operand 1 into the position data indicated in Operand 2.

Arm System Indication Type	Operand 1 Variable Setting
Right Arm System Substitution	1
Left Arm System Substitution	-1
Arm System Data Clear	0

Variation No. n in Operand 1 is the target arm system indication of the 1st to 4th axes or 1st to 3rd axes, and variable No. n+1 is that of the 5th to 8th axes. For the type to connect one unit of SCARA, make sure to set 0 to the indicated variable No. n+1.

Variable No.	Description	Setting Range	
		1 unit of SCARA connected	2 units of SCARA connected
n	1st to 4th axes (1st to 3rd axes) SCARA target arm system	-1, 0, 1	-1, 0, 1
n + 1	5th to 8th axes SCARA target arm system	0 (Reserved by the system)	-1, 0, 1

[Example]

LET	20	1	Set right arm system to 1st to 4th axes (1st to 3rd axes)
LET	21	0	Set 0 to 5th to 8th axes (system reservation as it is not connected)
PTAM	20	10	Write the arm system data stored in Variable No. 20 and 21 to Position No. 10.

Variable No.20	1	: Right arm system indicated in 1st to 4th axes (1st to 3rd axes)
Variable No.21	0	: System reserved (not connected) in 5th to 8th axes

No.(Name)	Axis1	Axis2	Axis3	Axis4	Arm1-4	Vel	Acc	Dcl
10( )	250.000	250.000	100.000	0.000	Right			

● PTST (Check position data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PTST	Axis pattern	Position number	CC

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Check if valid data is contained in the axis pattern specified in operand 1 at the position number specified in operand 2.
The output turns ON when the data specified by the axis pattern is not entirely available (= the position data display on the teaching pendant is ×.××× or position data fields in the PC software are blank).
0 is treated as valid data.

[Example 1] PTST 11 10 300 — Turn ON output 300 if there are no valid values of X and Y-axis at position 10.
Output 300 will turn OFF if the position data is given as follows:

[Example 2] The axis pattern can be specified indirectly using a variable. When the command in [Example 1] is rephrased based on indirect specification using a variable:
11 (binary) → 3 (decimal)

LET	1	3		Assign 3 to variable 1.
PTST	*1	10	300	

[Example 3]

LET	1	11		Assign 11 to variable 1.
PTST	1011	*1	600	Turn ON flag 600 if there are no valid values in the data of X, Y and R-axis at the content of variable 1 (position 11). Flag 600 will turn ON if the position data is given as follows:

No.(Name)	Axis1	Axis2	Axis3	Axis4	Vel	Acc	Dcl
9( )							
10( )	200.000	100.000					
11( )			150.000				
12( )							

● PVEL (Assign speed data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PVEL	Speed	Position number	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Write the CP operation speed/linear axis speed specified in operand 1 to the position number specified in operand 2. The unit of operand 1 is [mm/sec].

(Note 1) If a negative value is written in PVEL Command, an alarm will be generated when this position is indicated in a movement.

(Note 2) If 0 is set in Operation 1, the speed setting in the indicated position number is deleted.

[Example 1]

```
PVEL   100   10      Write speed 100mm/s to position No. 10.
```

[Example 2]

```
LET    1     100     Assign 100 to variable 1.
LET    2     10      Assign 10 to variable 2.
PVEL   *1    *2      Write the content of variable 1 (speed 100mm/s) to
                     the content of variable 2 (position 10).
```

● PACC (Assign acceleration data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PACC	Acceleration	Position number	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Write the acceleration in CP operation/acceleration in linear axis operation specified in operand 1 to the position number specified in operand 2. The unit of operand 1 is [G] and the entered value is valid to the second decimal point.

[Example 1]	PACC	0.3	10	Write acceleration 0.3G to position No. 10.
[Example 2]	LET	100	0.3	Assign 0.3 to variable 100.
	LET	2	10	Assign 10 to variable 2.
	PACC	*100	*2	Write the content of variable 100 (acceleration 0.3G) to the content of variable 2 (position 10).

(Note 1) Range check is not performed for a PACC command.
(Note 2) If Operation 1 is set to 0, the acceleration setting on the indicated position number gets deleted.

● PDCL (Assign deceleration data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PDCL	Deceleration	Position number	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Write the CP operation deceleration/linear axis deceleration specified in operand 1, into the position number specified in operand 2.
The unit of operand 1 is [G], and the set value is effective to two decimal points.

[Example 1] PDCL 0.3 3 Assign 0.3 to the deceleration data at position No. 3.

(Note 1) If Operation 1 is set to 0, the deceleration setting on the indicated position number gets deleted.

● PAXS (Read axis pattern)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PAXS	Variable number	Position number	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Store the axis pattern at the position specified in operand 2 to the variable specified in operand 1.

[Example 1]

PAXS	1	98	Read the axis pattern at position 98 to variable 1. If the position is given as follows, “3” (binary 0011) will be read to variable 1.

[Example 2]

LET	1	3	Assign 3 to variable 1.
LET	2	101	Assign 101 to variable 2.
PAXS	*1	*2	Read the axis pattern at the content of variable 2 (position 101) to the content of variable 1 (variable 3). If the point is given as follows, “8” (binary 1000) will be stored in variable 3.

The table below shows different positions and corresponding values stored in a variable.

No.(Name)	Axis1	Axis2	Axis3	Axis4	
98( )	200.000	100.000			0 0 1 1 = 2 + 1 = 3
99( )	350.000		120.000		0 1 0 1 = 4 + 1 = 5
100( )					0
101( )				180.000	1 0 0 0 = 8

● PSIZ (Check position data size)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PSIZ	Variable number	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Set an appropriate value in the variable specified in operand 1 in accordance with the parameter setting.

- When “Other parameter No. 23, PSIZ function type” = 0
  The maximum number of position data that can be stored in the controller will be set.
  (Regardless of whether the data are used or not.)
- When “Other parameter No. 23, PSIZ function type” = 1
  The number of position data used will be set.

[Example]
PSIZ 1
When “Other parameter No. 23, PSIZ function type” = 0
The maximum number of position data that can be stored in variable 1 will be set.
When “Other parameter No. 23, PSIZ function type” = 1
The number of position data currently used will be set in variable 1.

● GTAM (Acquirement of target arm system data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	GTAM	Variable No. (Two variables used in a row)	Position number	CP

Applicable models
XSEL-RX/SX/RXD/SXD ○ MSEL-PCX/PGX ○ Other than above ×

[Function] Acquire the target arm system indication from the position data indicated in Operand 2, and set it in the two variables in a row indicated in Operand 1.

Arm System Indication Type	Operand 1 Variable Setting
Right Arm System Substitution	1
Left Arm System Substitution	-1
Not to be indicated	0

Variation No. n in Operand 1 is the target arm system indication of the 1st to 4th axes or 1st to 3rd axes, and variable No. n+1 is that of the 5th to 8th axes. For the type to connect one unit of SCARA, make sure to set 0 to the indicated variable No. n+1.

Variable No.	Description	Output Range	
		1 unit of SCARA connected	2 units of SCARA connected
n	1st to 4th axes (1st to 3rd axes) SCARA target arm system	-1, 0, 1	-1, 0, 1
n + 1	5th to 8th axes SCARA target arm system	Indefinite	-1, 0, 1

[Example] GTAM 20 10 Set the arm system data in Position No. 10 to Variable No. 20.

No.(Name)	Axis1	Axis2	Axis3	Axis4	Arm1-4	Vel	Acc	Dcl
10( )	250.000	250.000	100.000	0.000	Right			

Variable No.20	1	: 1st to 4th axes (1st to 3rd axes) arm system
Variable No.21	0	: 5th to 8th axes arm system (not connected)

● GVEL (Get speed data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	GVEL	Variable number	Position number	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Obtain speed data from the speed item in the position data specified in operand 2, and set the value in the variable specified in operand 1.

[Example] GVEL 100 10 Set the speed data at position No. 10 in variable 100.

No.(Name)	Axis1	Axis2	Axis3	Axis4	Vel	Acc	Dcl
9( )							
10( )	250.000	100.000	100.000	30.000	100	0.80	0.80
11( )							

If the position data is set as above when the command is executed, 100 will be set in variable 100.

● GACC (Get acceleration data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	GACC	Variable number	Position number	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Obtain acceleration data from the acceleration item in the position data specified in operand 2, and set the value in the variable specified in operand 1.

[Example] GACC 100 10 Set the acceleration data at position No. 10 in variable 100.

No.(Name)	Axis1	Axis2	Axis3	Axis4	Vel	Acc	Dcl
9( )							
10( )	250.000	100.000	100.000	30.000	100	0.80	0.80
11( )							

If the position data is set as above when the command is executed, 0.8 will be set in variable 100.

● GDCL (Get deceleration data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	GDCL	Variable number	Position number	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Obtain deceleration data from the deceleration item in the position data specified in operand 2, and set the value in the variable specified in operand 1.

[Example] GDCL 100 10 Set the deceleration data at position No. 10 in variable 100.

No.(Name)	Axis1	Axis2	Axis3	Axis4	Vel	Acc	Dcl
9( )							
10( )	250.000	100.000	100.000	30.000	100	0.80	0.80
11( )							

If the position data is set as above when the command is executed, 0.8 will be set in variable 100.

[11] Actuator Control Declaration

● VEL (Set speed)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	VEL	Speed	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Set the actuator travel speed in the value specified in operand 1.
In the case of a SCARA, set the operating speed for CP operation.
The unit is [mm/sec].
The maximum speed will vary depending on the model of the actuator connected.
Set a speed not exceeding the applicable maximum speed.

(Note 1) Decimal places cannot be used. An error will generate
(Note 2) The minimum speed is 1mm/sec.

[Example 1]

```
VEL   100      Set the speed to 100mm/sec.
MOVL  1        Move to point 1 at 100mm/sec.
```

[Example 2]

```
VEL   500      Set the speed to 500mm/sec.
MOVL  2        Move to point 2 at 500mm/sec.
```

● VELS (Dedicated SCARA command/Set speed ratio)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	VELS	Ratio	Prohibited	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	○	○	○	×	×	○ (PCX/PGX only)

[Function] Set in operand 1 the moving speed for SCARA PTP operation command (angular speed for all axes other than Z) as a ratio of the maximum PTP speed. Operand 1 must be set with an integer (unit: %).

(Note 1) If a RIGH or LEFT command is used, the speed must be set with VELS even when a SCARA PTP operation command is not used.

[Example 1]

VELS	50	Set the moving speed for PTP operation command to 50% of the maximum value.
MOVP	1	Move to position No. 1 via PTP at 50% of the maximum speed.

● OVRD (Override)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	OVRD	Speed ratio	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Reduce the speed in accordance with the ratio specified in operand 1 (speed coefficient setting). The speed ratio is set in a range from 1 to 100%.
A speed command specifying a speed below 1mm/sec can be generated using OVRD.
Speed-command smoothing limit speed : 1pulse/msec
Speed-command generation limit speed : 1pulse/256msec
(Smoothing in actual operation is not guaranteed. It must be confirmed with the actual equipment.)
1pulse : Lead [mm]/16384 … Standard model with 1 : 1 gear ratio
(The speed set by a PAPR command (push-motion approach speed) is clamped at the lower-limit speed 1mm/sec.)

[Example 1]

VEL	100	Set the speed to 100mm/s.
OVRD	50	Reduce the speed to 50%. As a result, the actual speed will become 50mm/s.

[Example 2: SCARA robot]

VEL	150	Set the SCARA CP operation speed/linear axis speed to 150mm/sec.
VELS	90	Set the SCARA PTP operation speed ratio to 90%.
OVRD	50	Lower the speed to 50%. The SCARA CP operation speed/linear axis speed becomes 75mm/sec, while the SCARA PTP operation speed ratio becomes 45%.

Command limit speed for smooth operation:
Travel distance per encoder pulse [mm/pulse]/time [msec]
Command limit speed that can be generated:
Travel distance per encoder pulse [mm/pulse]/time [msec]
(Smoothness of actual operation cannot be guaranteed. Movement must be checked on the actual machine.)

[Calculation formula of travel distance per encoder pulse]
Rotary encoder
Travel distance per encoder pulse [mm/pulse] = (Screw lead [0.001mm] × Gear ratio numerator)
/ (Encoder resolution [pulses/rev] × Gear ratio denominator
/ (2 ^ Encoder division ratio)
Linear encoder
Travel distance per encoder pulse [mm/pulse] = Encoder resolution (0.001μm/pulse) × 1000
/ (2 ^ Encoder division ratio)

(Reference) Use the values of the following parameters for the above calculation formulas:

Encoder resolution:	Axis-specific parameter No. 42
Encoder division ratio:	Axis-specific parameter No. 43
Screw lead:	Axis-specific parameter No. 47
Gear ratio numerator:	Axis-specific parameter No. 50
Gear ratio denominator:	Axis-specific parameter No. 51

● ACC (Set acceleration)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	ACC	Acceleration	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Set the acceleration for actuator operation in operand 1.
For SCARA robot, the setting is the operational acceleration speed for CP operation.
The unit of operand 1 is [G], and the set value is effective to two decimal points.

(Note) [Other than XSEL-JX/KX/PX/QX/RX/SX/RXD/SXD and MSEL-PCX/PGX]
If no acceleration is set in the position data or by an ACC command when the actuator moves, the actuator uses the default value registered in all-axis parameter No. 11, “Default acceleration”.
[XSEL-JX/KX/PX/QX/RX/SX/RXD/SXD and MSEL-PCX/PGX]
If no acceleration is set in the position data or by an ACC command during CP operation, a SCARA robot uses the default value registered in all-axis parameter No. 11, “Default CP acceleration for SCARA axis”, while a linear axis uses the default value registered in all-axis parameter No. 200, “Default acceleration for linear axis”.

[Example 1] ACC 0.3 Set the acceleration to 0.3G.

(Note) Setting an acceleration exceeding the specified range for the actuator may generate an error. It may also result in a failure or shorter product life.

● ACCS (Dedicated SCARA command/Set acceleration ratio)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	ACCS	Ratio	Prohibited	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	○	○	○	×	×	○ (PCX/PGX only)

[Function] Set in operand 1 the acceleration for movement by SCARA PTP operation command (angular acceleration for all axes other than Z) as a ratio of the maximum PTP acceleration. Operand 1 must be set with an integer (unit: %).

(Note 1) For the acceleration ratio setting, make sure to refer to “Caution for Use” in Vertical Articulated Robot IX Series Instruction Manual provided separately.

[Example] ACCS 50 Set the acceleration for movement by PTP operation command to 50% of the maximum value.

● DCL (Set deceleration)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	DCL	Deceleration	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Set the deceleration for actuator operation in operand 1.
For SCARA robot, the setting is the operational deceleration speed for CP operation.
The unit of operand 1 is [G], and the set value is effective to two decimal points.

(Note) [Other than XSEL- JX/KX/PX/QX/RX/SX/RXD/SXD and MSEL-PCX/PGX]
If the position data contains no deceleration AND deceleration is not set by a DCL command, the actuator will move based on the default value set in “All-axis parameter No. 12, Default deceleration”.
A DCL command cannot be used with CIR and ARC commands.
[XSEL- JX/KX/PX/QX/RX/SX/RXD/SXD and MSEL-PCX/PGX]
If no deceleration is set in the position data or by a DCL command during CP operation, a SCARA robot uses the default value registered in all-axis parameter No. 12, “Default CP deceleration for SCARA”, while a linear axis uses the default value registered in all-axis parameter No. 201, “Default acceleration for linear axis”.
DCL is invalid with respect to a CIR or ARC command.

[Example] DCL 0.3 Set the deceleration to 0.3G.

(Note) Setting a deceleration exceeding the specified range for the actuator may generate an error. It may also result in a failure or shorter product life.

● DCLS (Dedicated SCARA command/Set deceleration ratio)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	DCLS	Ratio	Prohibited	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	○	○	○	×	×	○ (PCX/PGX only)

[Function] Set in operand 1 the deceleration for movement by SCARA PTP operation command (angular deceleration for all axes other than Z) as a ratio of the maximum PTP deceleration. Operand 1 must be set with an integer (unit: %).

(Note 1) For the deceleration ratio setting, make sure to refer to “Caution for Use” in Vertical Articulated Robot IX Series Instruction Manual provided separately.

[Example] DCLS 50 Set the acceleration for movement by PTP operation command to 50% of the maximum value.

● SCRV (Set sigmoid motion ratio) • • • 1/3

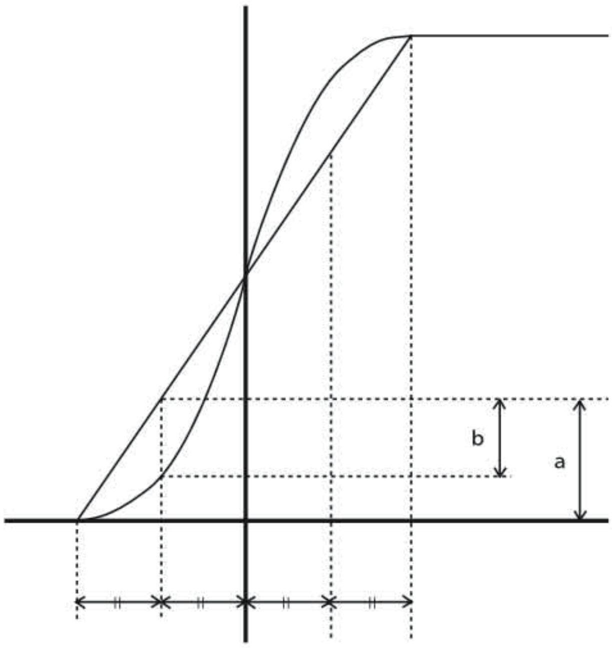
Extension Condition (LD, A, O, AB, OB)	Input condition (I/O flag)	Command,declaration			Output (Output,flag)
		Command, declaration	Operand1	Operand2	
E	N, Cnd	Cmnd	Operand1	Operand2	Pst
Optional	Optional	SCRV	Ratio	Prohibited	CP

Applicable models (Refer to the following pages for the models marked with × in the table below.)								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
○	×	×	○	×	○	○	TT:○, TTA:×	×

[Function] Set the ratio of sigmoid motion control of the actuator in the value specified in operand1.
The ratio is set as integer in a range from 0 to 50(%)

$$\frac{b}{a} \times 100\ (\%)$$

If the ratio is not set using this command or 0% is set,a trapezoid motion will be implemented.
A SCRV command can be used with the following commands：
MOVP, MOVL, MVPI, MVLI, JBWF, JBWN, JFWF, JFWN, TMPI, TMLI, RIGH, LEFT



[Example] SCRV 30 Set the sigmoid motion ratio to 30%

● SCRV (Set sigmoid motion ratio) • • • 2/3

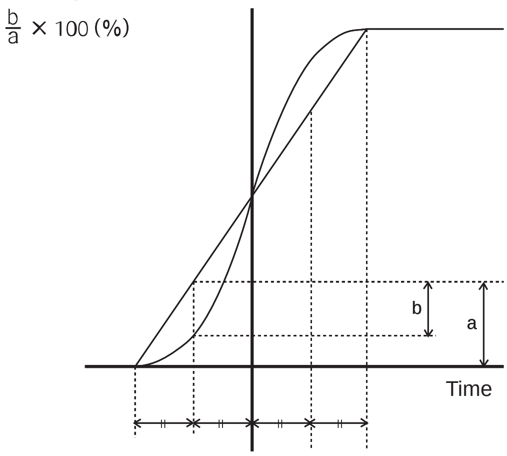
Extension Condition (LD, A, O, AB, OB)	Input condition (I/O flag)	Command,declaration			Output (Output,flag)
		Command, declaration	Operand1	Operand2	
E	N, Cnd	Cmnd	Operand1	Operand2	Pst
Optional	Optional	SCRV	Ratio	(S-motion type)	CP

Applicable models (Refer also to the previous and following pages for the models marked with × in the table below.)								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	○	×	○	○	×	×	×

[Function] Set the ratio of sigmoid motion control of the actuator in the value specified in operand1.
The ratio is set as integer in a range from 0 to 50(%)
If the ratio is not set using this command or 0% is set, a trapezoid motion will be implemented.
A SCRV command can be used with the following commands :
MOVP, MOVL, MVPI, MVLI, JBWF, JBWN, JFWF, JFWN, TMPI, TMLI, RIGH, LEFT

Value set in operand2	Description
0 or no specification	S-motionA
1	S-motionB (Recommended)

- S-motion A (Operand 2 = Not specified or 0)



- S-motion B (Operand 2 = 1)
  If S-motionB is selected,the speed pattern becomes smoother(than the equivalent S-motion control ratio based on S-motionA).(The divergence peak relative to trapezoid motion becase smaller).

[Example] SCRV 30 Set the sigmoid motion ratio to 30%

● SCRV (Set sigmoid motion ratio) • • • 3/3

Extension Condition (LD, A, O, AB, OB)	Input condition (I/O flag)	Command,declaration			Output (Output,flag)
		Command, declaration	Operand1	Operand2	
E	N, Cnd	Cmnd	Operand1	Operand2	Pst
Optional	Optional	SCRV	Ratio	(S-motion type)	CP

Applicable models (Refer to the previous two pages for the models marked with × in the table below.)								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	×	×	×	×	×	○	○

[Function] Set the ratio of sigmoid motion control of the actuator in the value specified in operand1.
The ratio is set as integer in a range from 0 to 50(%)
If the ratio is not set using this command or 0% is set,a trapezoid motion will be implemented.

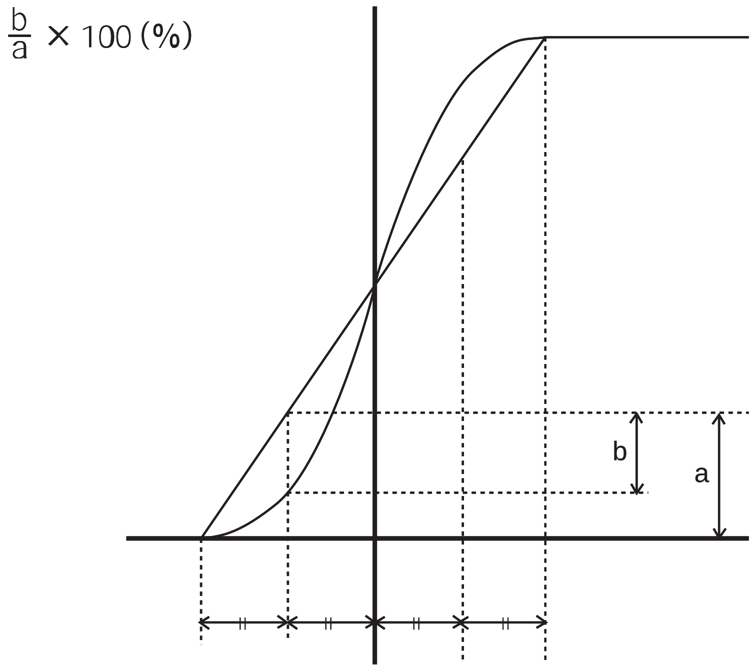
XSEL-P/Q/PCT/QCT are available to select operand2.(S-shaped type).
(Main application Ver.1.25 and later)
Operand 2 can be inputted from IA-T-X(D):Ver.1.52 or subsequent ones after teaching box SEL-T(D):Ver.1.12 after PC software:Ver.7.7.12.0.

Model Name	Setting in Operand 2 (S-shaped Type)	S-shaped Motion Class	S-shaped Motion Effective Command Group (See the table below)
XSEL -P/Q	Not set, 0	A	1)
	1	B	1)
	2	A	2) (Note 2)
	3	B	2) (Note 2)
XSEL -PCT/ QCT	Not set, 0	B (Note 1)	1)
	1		1)
	2		2) (Note 2)
	3		2) (Note 2)

Note 1 The class of S-shaped motion is compulsorily B.
Note 2 S-shaped Motion is effective also at the speed change point (position joint point) during PATH Command. If S-shaped Motion is activated, constant velocity or track could be lost. Use the unit with S-shaped Motion ineffective in such processes as applying paint or glue, in which the constant velocity and track are important.

Effective Command Group	SCRV Effective Command
1)	MOVP, MOVL, MVPI, MVLI, JBWF, JBWN, JFWF, JFWN
2)	MOVP, MOVL, MVPI, MVLI, JBWF, JBWN, JFWF, JFWN, PATH, ARCH, PACH

- S-motion A



- S-motion B
  In this class, operates with a speed pattern smoother than the control of S-shaped Motion Class A. (Estrangement peak with Trapezoid Motion becomes small.)

[Example]SCRV	30	1	Set S-shaped motion ratio 30% and S-shaped motion class A.

● OFST (Set offset)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	OFST	Axis pattern	Offset value	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Add the offset in operand 2 to the target value for the axis pattern specified in operand 1 when the actuator moves, to reset the target value and operate the actuator accordingly.
The offset is set in mm, and the effective resolution is 0.001mm.
A negative offset may be specified as long as the operation range is not exceeded.

(Note) An OFST command cannot be used outside the applicable program. To use OFST in multiple programs, the command must be executed in each program.
An OFST command cannot be used with MVPI, MVTI, TMLI and TMPI commands.

[Example 1] OFST 110 50 Add 50mm to the specified positions of Y-axis and Z-axis.

[Example 2] The axis pattern can be specified indirectly using a variable. When the command in [Example 1] is rephrased based on indirect specification using a variable:
110 (binary) → 6 (decimal)

```
LET    1     6      Assign 6 to variable 1.
OFST   *1    50
```

[Example 3]

```
LET    1     30     Assign 30 to variable 1.
OFST   1000  *1     Add the content of variable 1, or 30°, to the
                    specified position of R-axis.
```

● DEG (Set arc angle)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	DEG	Angle	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Set a division angle for the interpolation implemented by a CIR (move along circle) or ARC (move along arc) command.
When CIR or ARC is executed, a circle will be divided by the angle set here to calculate the passing points.
The angle is set in a range from 0 to 120°.
If the angle is set to “0”, an appropriate division angle will be calculated automatically so that the actuator will operate at the set speed (maximum 180°).
The angle is set in degrees and may include up to one decimal place.

(Note) If a CIR or ARC command is executed without setting an angle with this command, the default value registered in “All-axis parameter No. 30, Default division angle” will be used.

[Example 1] DEG 10 Set the division angle to 10°.

● BASE (Specify axis base)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	BASE	Datum axis number	Prohibited	CP

Applicable models
XSEL-JX/KX × Other than XSEL-JX/KX ○

[Function] Count the axes sequentially based on the axis number specified in operand 1 being the first axis.
BASE Command is available in PRED, PRDQ, AXST, actuator control commands, ARCH, PACH, PMVP, PMVL, zone commands, actuator control declaration commands SLTL, SLWK, WGHT, WGT2, PTPR, PTPL, PTPE, PTPD, RIGH, LEFT and the system information acquirement command GARM. Note that each zone range is assigned to the actuator via parameter.

(Note 1) For XSEL-RX/SX/RXD/SXD, GRP and BASE Commands are available in the actuator control declaration commands SLTL, SLWK, WGHT, WGT2, PTPR, PTPL, PTPE, PTPD, RIGH, LEFT and the system information acquirement command GARM. Refer to the caution note for GRP and BASE Commands.

[Example 1]

BASE	5		Axis 5 is considered the first axis.
HOME	1		Axis 5 returns to the home.
HOME	10		Axis 6 returns to the home.

[Example 2]

LET	1	5	Assign 5 to variable 1.
BASE	*1		The content of variable 1 (axis 5) will be considered as the first axis.

Thereafter, axes 5 and 6 move according to the specifications for axes 1 and 2.

● GRP (Set group axes)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	GRP	Axis pattern	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Allow only the position data of the axis pattern specified in operand 1 to become valid.
The program assumes that there are no data for other axes not specified.
When multiple programs are run simultaneously, assigning axes will allow the same position data to be used effectively among the programs.
GRP Command is available in the operand axis pattern indication SEL commands except for OFST, DFTL, DFWK, DFIF, GTTL, GTWK and GTIF or the servo operation commands to use the position data, actuator control declaration commands SLTL, SLWK, WGHT, WGT2, PTPR, PTPL, PTPE, PTPD, RIGH and LEFT, and the system information acquirement command GARM.
GRP Command activates in the condition before the axis number changed due to BASE Command.

(Note 1) In XSEL-RX/SX/RXD/SXD, GRP and BASE Command are available also in the actuator control declaration commands SLTL, SLWK, WGHT, WGT2, PTPR, PTPL, PTPE, PTPD, RIGH, LEFT and the system information acquirement command GARM. Establish the setting to have all the SCARA axes valid. Error No. C30 “Axis Pattern Error” will occur if even one axis is set invalid by GRP and BASE Commands.

[Example] Express what axis is to be used by using either “1” or “0”.

(Superior) (Inferior)

Axis No.	8-axis	7-axis	6-axis	5-axis	4-axis	3-axis	2-axis	1-axis
Use	1	1	0	1	1	1	1	1
Unused	0	0	1	0	0	0	0	0

● When using 1st and 2nd axes;

2-axis
↓
000011… (0 in front are not necessary. Remove 0 and make it 11.)
↑
1-axis

● When using 1st and 4nd axes;

4-axis
↓
1001… (In this case, 0 are necessary to express the position of the 4th axis.)
↑
1-axis

● HOLD (Hold: Declare axis port to pause)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	HOLD	(Input port, global flag)	(HOLD type)	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Declare an input port or global flag to pause while a servo command is being executed.
When operation is performed on the input port or global flag specified in operand 1, the current servo processing will pause. (If the axes are moving, they will decelerate to a stop.)
If nothing is specified in operand 1, the current pause declaration will become invalid.

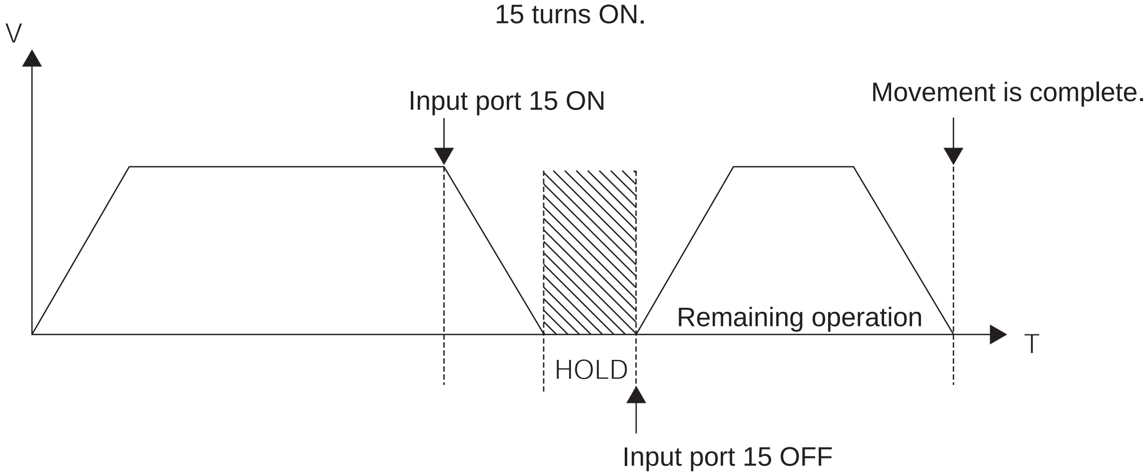
[HOLD type]
0 = Contact a (Deceleration stop)
1 = Contact b (Deceleration stop)
2 = Contact b (Deceleration stop → Servo OFF (The drive source will not be cut off))

The HOLD type is set to "0" (contact a) when the program is started.
If nothing is specified in operand 2, the current HOLD type will be used.
Using other task to issue a servo ON command to any axis currently stopped via a HOLD servo OFF will generate an "Error No. C66, Axis duplication error". If the servo of that axis was ON prior to the HOLD stop, the system will automatically turn on the servo when the HOLD is cancelled. Therefore, do not issue a servo ON command to any axis currently stopped via a HOLD servo OFF.
If any axis currently stopped via a HOLD servo OFF is moved by external force, etc., from the stopped position, and when the servo of that axis was ON prior to the HOLD stop, the axis will move to the original stopped position when the HOLD is cancelled before resuming operation.

(Note 1) The input port or global flag specified by a HOLD declaration will only pause the axes used in the task (program) in which the HOLD is declared. The declaration will not be valid on axes used in different tasks (programs).

(Note 2) An input port or global flag to pause is valid for all active servo commands other than a SVOF command. (A deceleration stop will also be triggered in J☐W☐ and PATH operations.)

[Example] HOLD 15 0 The axes will decelerate to a stop when input port 15 turns ON.



● CANC (Cancel: Declare axis port to abort)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	CANC	(Input port, global flag)	(CANC type)	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Declare an input port or global flag to abort while a servo command is being executed.
When operation is performed on the input port or global flag specified in operand 1, the current servo processing will be aborted. (If the axes are moving, they will decelerate to a stop before the processing is aborted.)
If nothing is specified in operand 1, the current abort declaration will become invalid.

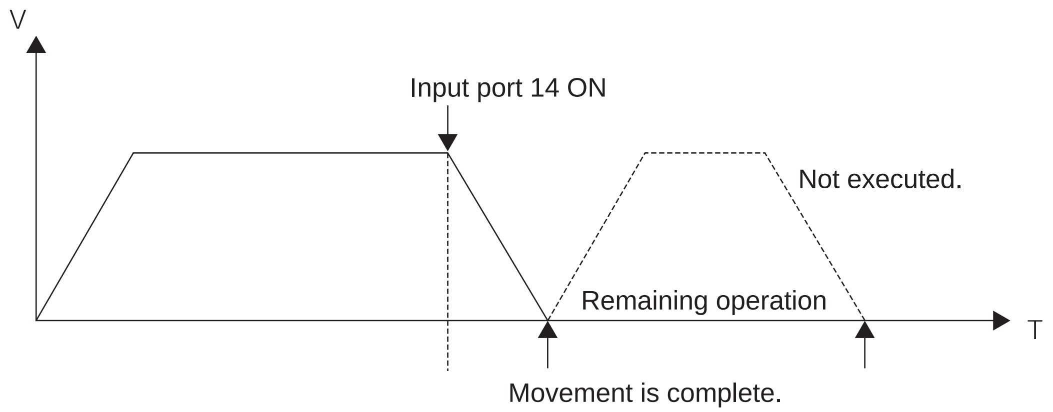
[CANC type]
0 = Contact a (Deceleration stop)
1 = Contact b (Deceleration stop)

The CANC type is set to “0” (contact a) when the program is started.
If nothing is specified in operand 2, the current CANC type will be used.

(Note 1) The input port or global flag specified by a CANC command will only abort the axes used in the task (program) in which the CANC is declared. The declaration will not be valid on axes used in different tasks (programs).

(Note 2) An input port or global flag to pause is valid for all active servo commands other than a SVOF command. (A deceleration stop will also be triggered in JXWX and PATH operations.)

[Example] CANC 14 0 The axes will decelerate to a stop when input port 14 turns ON.



● ACMX (Indicate ACMX acceleration) (Dedicated linear axis command)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	ACMX	ACMX Acceleration No.	Prohibited	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	○	○ (SSEL only)	×	○

[Function] Set the movement acceleration and deceleration of the actuator to the ACMX acceleration of the number indicated in Operand 1. Once ACMX Command is executed, the parameters registered in ACMX Acceleration No. 1 to 4 (Each Axis Parameters No. 2 to 5 and 194 to 197) are set as the movement acceleration and deceleration. It is necessary to set the parameters of ACMX acceleration in advance considering the conditions how to use the actuator (transportation weight, installation condition, etc.).

ACMX Acceleration No.	Moving Direction	Acceleration	Deceleration
1	Positive	Each Axis Parameter No.2 Setting of “ACMX + Acceleration 1”	Each Axis Parameter No.3 Setting of “ACMX - Acceleration 1”
	Negative	Each Axis Parameter No.3 Setting of “ACMX - Acceleration 1”	Each Axis Parameter No.2 Setting of “ACMX + Acceleration 1”
2	Positive	Each Axis Parameter No.4 Setting of “ACMX + Acceleration 2”	Each Axis Parameter No.5 Setting of “ACMX - Acceleration 2”
	Negative	Each Axis Parameter No.5 Setting of “ACMX - Acceleration 1”	Each Axis Parameter No.4 Setting of “ACMX + Acceleration 2”
3	Positive	Each Axis Parameter No.194 Setting of “ACMX + Acceleration 3”	Each Axis Parameter No.195 Setting of “ACMX - Acceleration 3”
	Negative	Each Axis Parameter No.195 Setting of “ACMX - Acceleration 3”	Each Axis Parameter No.194 Setting of “ACMX + Acceleration 3”
4	Positive	Each Axis Parameter No.196 Setting of “ACMX + Acceleration 4”	Each Axis Parameter No.197 Setting of “ACMX - Acceleration 4”
	Negative	Each Axis Parameter No.197 Setting of “ACMX - Acceleration 4”	Each Axis Parameter No.196 Setting of “ACMX + Acceleration 4”

(Note 1) It may generate an error is the acceleration or deceleration is set above the actuator specifications. Also, it cause a malfunction or drop of the production life.

(Note 2) The priority is put to the setting of acceleration and deceleration in the position data indicated with a movement command if there is any.

(Note 3) An operation is made within the range of the maximum acceleration and deceleration that would not exceed the ACMX acceleration/deceleration of each movement axis during the CP operation such as MOVL Command. In case constancy is required in the target acceleration/deceleration, indicate the acceleration and deceleration in ACC, DCL Command and the position data.

(Note 4) Do not attempt to indicate the ACMX acceleration/deceleration to the continuous movement related commands (PATH, PSPL, etc.).
It may cause a big speed drop depending on the direction of the movement position. Indicate the acceleration and deceleration in ACC, DCL Command and the position data.

(Note 5) Do not attempt to indicate the ACMX acceleration/deceleration to the extended motion control board axis movement commands. It would cause Error No. C89 “Acceleration/Deceleration Indication Error”. Indicate the acceleration and deceleration in ACC, DCL Command and the position data.

(Note 6) ACMX Command is a command dedicated for the linear drive axes.

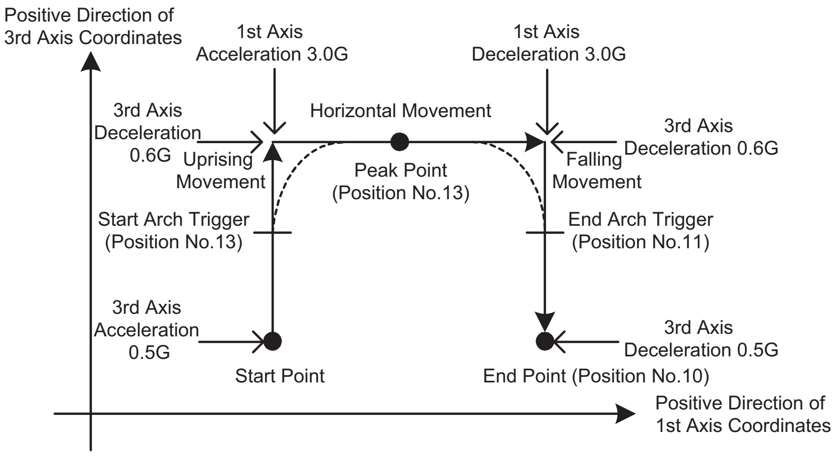
[Example 1] For arch motion movement (vertical axis to move up/down)

VLMX			Set the speed setting in VLMX Speed.
ACMX	1		Set the ACMX acceleration/deceleration of No. 1.
ACHZ	3		Indicate the 3rd axis to Z-axis for arch motion.
ATRG	13	11	
ARCH	10	12	With Position No. 12 as the peak point, move with the arch motion to Position No. 10.

- Setting for Example 1

ACMX Acceleration No.	Each Axis Parameter No.	Parameter Name	Example for Setting	
			1st Axis	3rd Axis
1	2	ACMX + Acceleration 1	300 (3.0G)	50 (0.5G)
	3	ACMX - Acceleration 1	300 (3.0G)	60 (0.6G)

- Operation of Example 1 (Acceleration/Deceleration in Arch Motion Movement)



[11] Actuator Control Declaration

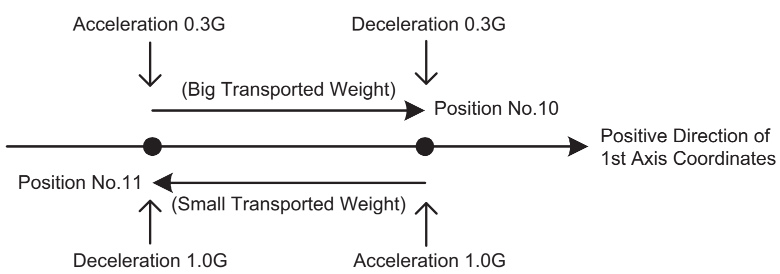
[Example 2] When the transported weight differs for going forward and backward

```
VLMX              Set the speed setting in VLMX Speed.
ACMX   1          Set the ACMX acceleration/deceleration of No. 1.
MOVP   10         PTP movement is made to Position No. 10.
ACMX   2          Set the ACMX acceleration/deceleration of No. 2.
MOVP   11         PTP movement is made to Position No. 11.
```

- Setting for Example 2

ACMX Acceleration No.	Each Axis Parameter No.	Parameter Name	Example for Setting 1st Axis
1	2	ACMX + Acceleration 1	30 (0.3G)
	3	ACMX - Acceleration 1	30 (0.3G)
2	4	ACMX + Acceleration 2	100 (1.0G)
	5	ACMX - Acceleration 2	100 (1.0G)

- Operation of Example 2



● VLMX (Dedicated linear axis command/Specify VLMX speed)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	VLMX	Prohibited	Prohibited	CP

Applicable models
XSEL-JX/KX × Other than XSEL-JX/KX ○

[Function] Set the moving speed of a linear axis to the VLMX speed (normally maximum speed).
Executing a VLMX command will set the value registered in “Axis-specific parameter No. 29, VLMX speed” as the travel speed.

(Note 1) If the VLMX speed is specified for a continuous position movement command (PATH, PSPL), the target speed to each position becomes a composite speed based on the VLMX speed to the extent that each axis does not exceed the value set in axis-specific parameter No. 28, “Maximum PTP speed (SCARA axis)/ axis-specific maximum operating speed (linear axis)”. To keep the target speed constant, you must expressly specify the speed using a VEL command.

(Note 2) Error No. C88 “Velocity Specification Error” will occur if VLMX speed is indicated in case of CP operation held on the liner axes and SCARA axes at the same time. Indicate the speed with VEL Command.

[Example]

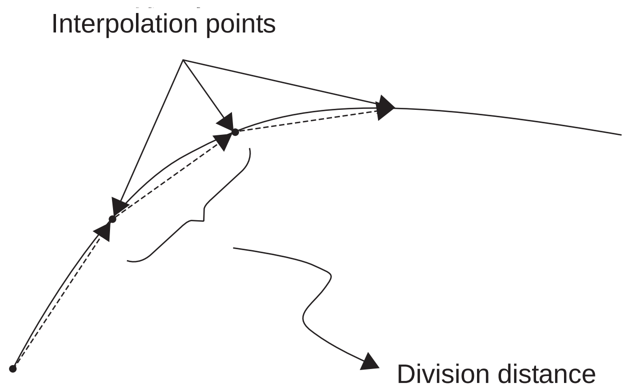
```
VEL     1000 ┐
MOVP    1    │ The speed becomes 1000mm/sec in this section.
MOVP    2    ┘
VLMX         ┐
MOVP    3    │ The speed becomes VLMXmm/sec in this section.
MOVP    4    ┘
```

● DIS (Set division distance at spline movement)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	DIS	Distance	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Set a division distance for the interpolation implemented by a PSPL (move along spline) command.
When a PSPL command is executed, a passing point will be calculated at each distance set here and the calculated passing points will be used as interpolation points.
If the distance is set to “0”, an appropriate division distance will be calculated automatically so that the actuator will operate at the set speed.
The distance is input in mm.



(Note) If a PSPL command is executed without setting a distance with a DIS command, the default value registered in “All-axis parameter No. 31, Default division distance” will be used.

[Example] DIS 10 Set the division distance to 10mm.

● POTP (Set PATH output type)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	POTP	0 or 1	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

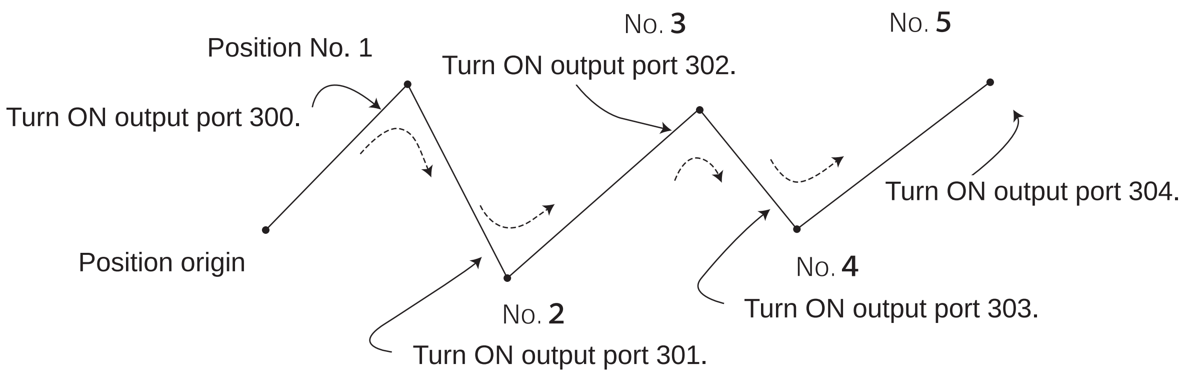
[Function] Set the output type in the output field to be used when a PATH and PSPL command is executed.
When a PATH and PSPL command is executed, the output will operate as follows in accordance with the setting of the POTP command.

1) POTP [Operand 1] = 0 (ON upon completion of operation)
The output port or flag will turn ON upon completion of operation.
2) POTP [Operand 1] = 1 (Increment and output on approaching each position; ON upon completion of operation for the last position)
During PATH or PSPL operation, the output port number or flag number specified in the output field will be incremented and turned ON when each specified position approaches.
At the last position, however, the output will turn ON upon completion of operation. This setting provides a rough guide for output in sequence control.

(Note 1) The default value of POTP, before it is set, is “0”.
(Note 2) If POTP = 1 and there is no valid data at the specified position, the output number will be incremented but the output will not turn ON. (The output number will be incremented regardless of the size of position numbers specified in operands 1 and 2 in a PATH or PSPL command.)

[Example]

POTP	1			
PATH	1	5	300	Turn ON output port No. 300 through 304 sequentially each time a specified position approaches during a pass movement from position No. 1 through 5, starting from the first position.

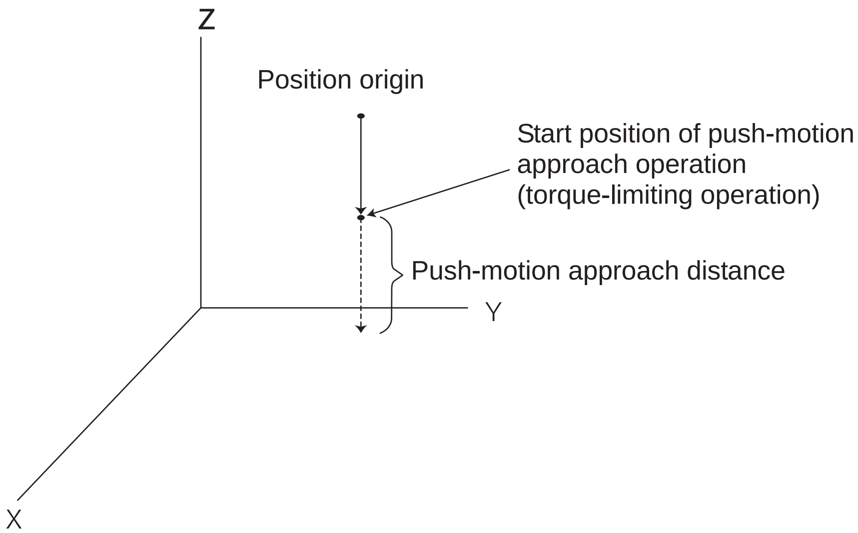


● PAPR (Set push-motion approach distance, speed)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PAPR	Distance	Speed	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Set the operation to be performed when a PUSH command is executed.
Set the distance (push-motion approach distance) over which push-motion approach operation (torque-limiting operation) will be performed in operand 1 (in mm), and set the speed (push-motion approach speed) at which push-motion approach operation (torque-limiting operation) will be performed in operand 2 (in mm/sec).
The push-motion approach distance specified in operand 1 may contain up to three decimal places, while the speed specified in operand 2 cannot contain any decimal place.



[Example]

PAPR	100	30	Set the push-motion approach distance in a PUSH command to 100mm and the push-motion approach speed to 30mm/sec.
MOVP	10		
PUSH	11		

(Note) The push-motion approach speed in an OVRD command will be clamped by the minimum speed of 1mm/sec. (Correct push-motion operation is not guaranteed at the minimum speed. Operation at slow push-motion approach must be checked on the actual machine by considering the effects of mechanical characteristics, etc.)

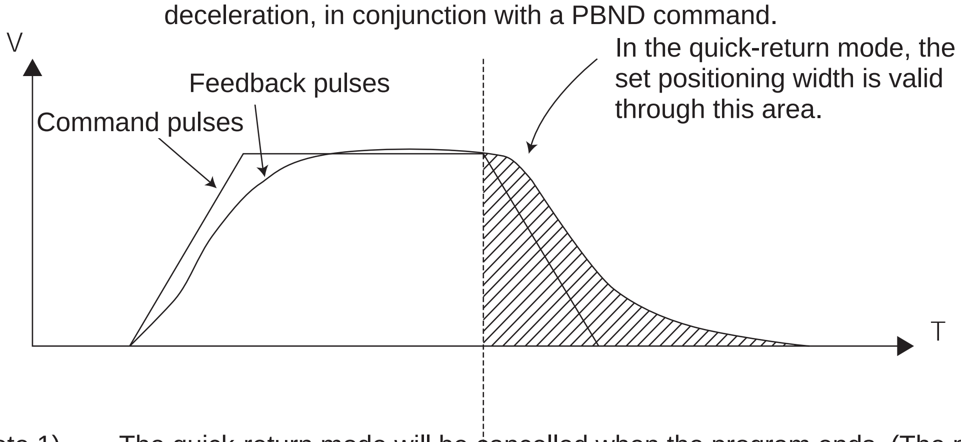
● QRTN (Set quick-return mode)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	QRTN	0 or 1	Prohibited	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
○	○	○	×	×	×	○	○	○ (PC/PG only)

[Function] Set and cancel the quick-return mode.

1) QRTN [Operand 1] = 0 (Normal mode)
   Positioning is deemed complete when all command pulses have been output and the current position is inside the positioning width.
   * If a deceleration command is currently executed in the quick-return mode, the system will wait for all command pulses to be output.
2) QRTN [Operand 1] = 1 (Quick-return mode)
   Positioning is deemed complete when "a normal deceleration command is currently executed (excluding deceleration due to a stop command, etc.) or all command pulses have been output" and "the current position is inside the positioning width". This setting is used to perform other processing during deceleration, in conjunction with a PBND command.



(Note 1) The quick-return mode will be cancelled when the program ends. (The positioning width set by a PBND command will not be cancelled.)

(Note 2) If a given axis is used even once in the quick-return mode, the program will not release the right to use the axis until the QRTN is set to "0" (normal mode) or the program ends. Any attempt to use the axis from other program will generate an "Error No. C66, Axis duplication error".

(Note 3) Following a return from a normal deceleration command in the quick-return mode, the next positioning will start after all command pulses for the previous positioning have been output. Therefore, in the quick-return mode a simple reciprocating operation will require a longer tact time because of the extra completion check. In this sense, this setting should be used only if you wish to reduce the overall tact time by performing other processing during deceleration.

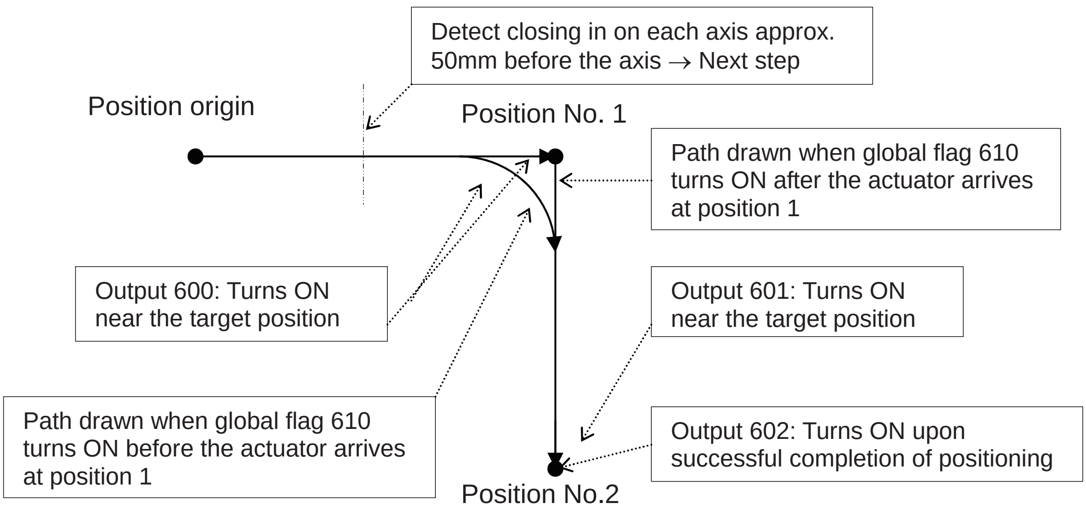
(Note 4) The quick-return mode represents very irregular processing. Therefore, be sure to revert to the normal mode when the overlay processing is completed in the necessary section.

(Note 5) The quick-return mode cannot be used with a push-motion travel command or arc interpolation command.

3) Quick return mode 2 (closeness-detection return target position addition mode)
* XSEL-J/K only
- When a MOVP, MOVL or PATH command (specifying the final moving position) is executed, closeness to the target position is detected when the close distance set by a NBND command is reached (or all command pulses are sent AND the positioning width is reached) while all used axes are positioning in steady state according to the applicable command, after which the command will be reset (quick return) and the SEL command in the next step will be executed.
Set this mode if you want to perform other processing during positioning by using NBND and PEND commands together, or add a target position to operate the actuator continuously.
- If a MOVP, MOVL or PATH command is executed again while the actuator is moving in quick return mode 2, a target position will be added and the actuator will operate continuously.

[Example]

:				
QRTN	2			Set quick return mode to 2
NBND	11	50		Set close position for axes 1 and 2 to 50mm
MOVL	1		600	Move to position 1 (axes 1/2) (Proceed to the next step when each axis reaches approx. 50mm before the position.)
WTON	610			Wait for permission of movement to position 2 (610)
MOVL	2		601	Move to position 2 (axis 3)
PEND			602	Wait for all used axes to end operation
QRTN	0			Set quick return mode to 0
:				



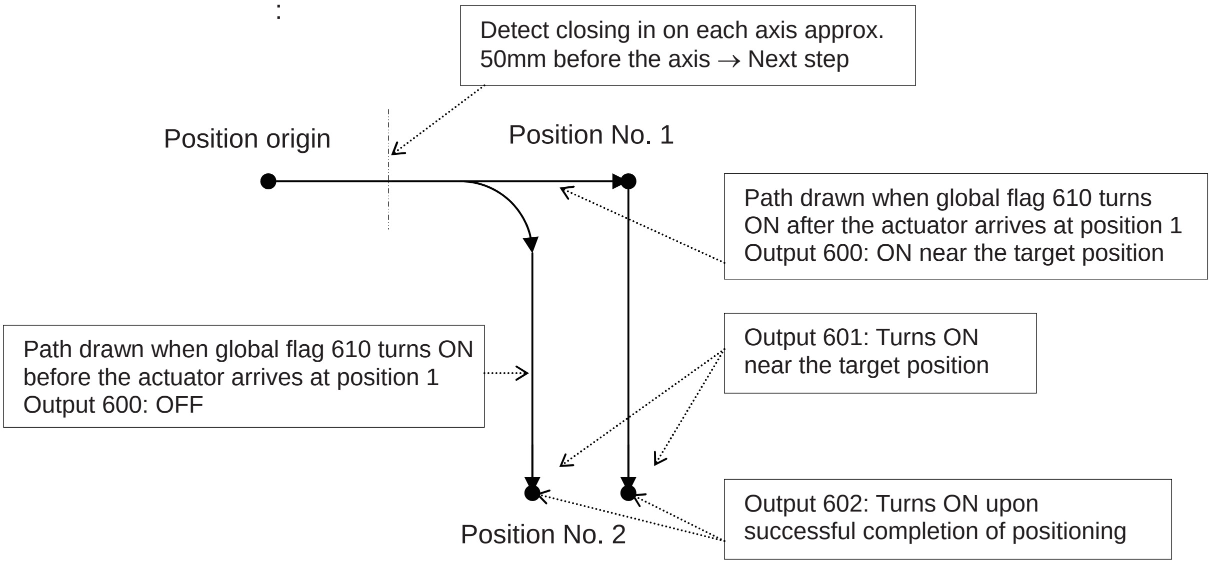
* This mode is invalid with respect to commands other than MOVP, MOVL and PATH.
(With CIR2, ARC2, ARCC, ARCD, CIRS, ARCS, CIR, ARC, PSPL, MVPI and MVLI commands, “Error No. B24: Quick return mode error” occurs (= the command cannot be executed) because an unexpected path may be followed and a dangerous situation may result unless the start point is accurately understood.
* The close distance set by a NBND command must consider an allowance for the processing time in the next step onward following the quick return upon closeness detection (the specific processing time varies depending on the types of commands, number of steps, etc.) (this distance is not intended for use in precise processing).

* Behavior at the connection of movement commands when a new target position is added (when processing under the new movement command can be performed in time)
  If either the previous movement command (quick return) or new movement command is MOVP, the actuator starts moving to the target position under the new movement command simultaneously as the slowest axis starts decelerating under the previous movement command.
  If neither of the commands is MOVP (such as when MOVL and PATH commands are combined), the connection of operations is equivalent to what happens between normal PATH commands.
* During quick return mode 2, the output of a MOVP, MOVL or PATH command turns ON near the target position (regardless of the value set by the NBND command) (the operation is not yet complete). Use the output of a PEND command to check if the operation has completed (positioning has been successful).
* During quick return mode 2, the following tasks apply to all used axes for any operation with a MOVP command (they apply to all used axes even when specified for an individual axis):
  - All stop processing including one by a STOP command
  - Speed change by a CHVL command
* An attempt to switch from quick return mode 2 directly to quick return mode 1 generates “Error No. B24: Quick return mode error”.
* Software versions supporting quick return mode
  - Controller main application: Ver.1.04 or later
    (excluding flash ROM 8Mbit versions)
  - PC software: Ver.7.2.3.0 or later
  - Teaching pendant:
    - IA-T-X (D): Ver.1.44 or later
    - SEL-T (D): Ver.1.02 or later

4) Quick return mode 3 (closeness-detection return target position addition mode)
* XSEL-J/K only
- When a MOVP, MOVL or PATH command (specifying the final moving position) is executed, closeness to the target position is detected when the close distance set by a NBND command is reached (or all command pulses are sent and the positioning width is reached) while all used axes are positioning in steady state according to the applicable command, after which the command will be reset (quick return) and the SEL command in the next step will be executed.
Set this mode if you want to perform other processing during positioning by also using a NBND/PEND command or change the target position without stopping.
- If the MOVP, MOVL or PATH command is executed again while the actuator is still moving as part of quick return in quick return mode 3, the actuator changes the target position (by decelerating to stop at the previous target position to cancel the position and then starting to move to the new target position) without stopping.

[Example]

:				
QRTN	3			Set quick return mode to 3
NBND	11	80		Set close position for axes 1 and 2 to 80mm
MOVL	1		600	Move to position 1 (axes 1/2) (Proceed to the next step when each axis reaches approx. 80mm before the position.)
WTON	610			Wait for permission of movement to position 2 (610)
MOVL	2		601	Move to position 2 (axis 3)
PEND			602	Wait for all used axes to end operation
QRTN	0			Set quick return mode to 0
:				



* This mode is invalid with respect to commands other than MOVP, MOVL and PATH.
(With CIR2, ARC2, ARCC, ARCD, CIRS, ARCS, CIR, ARC, PSPL, MVPI and MVLI commands, “Error No. B24: Quick return mode error” occurs (= the command cannot be executed) because an unexpected path may be followed and a dangerous situation may result unless the start point is accurately understood.
* The close distance set by a NBND command must consider an allowance for the processing time in the next step onward following the quick return upon closeness detection (the specific processing time varies depending on the types of commands, number of steps, etc.) (this distance is not intended for use in precise processing).

* Transition between movement commands upon target position change
  The actuator starts moving to the target position under the new movement command roughly at the same time it starts cancelling the previous movement command via forced deceleration to a stop (there is a delay corresponding to the processing time to recalculate the target position).
* During quick return mode 3, the output of a MOVP, MOVL or PATH command turns ON near the target position (regardless of the value set by the NBND command) (the operation is not yet complete). Use the output of a PEND command to check if the operation has completed (positioning has been successful).
  However, the output is invalid if the target position was changed (cancelled via forced deceleration to a stop) before the start of normal deceleration (during acceleration or constant-speed operation), and so is the S-motion mode during forced deceleration after the target position has been changed.
* During quick return mode 3, the following tasks apply to all used axes for any operation with a MOVP command (they apply to all used axes even when specified for an individual axis):
  All stop processing including one by a STOP command
  Speed change by a CHVL command
* An attempt to switch from quick return mode 3 directly to quick return mode 1 generates “Error No. B24: Quick return mode error”.
* Software versions supporting quick return mode 3
  Controller main application: Ver.1.04 or later
  (excluding flash ROM 8Mbit versions)
  PC software: Ver.7.2.3.0 or later
  Teaching pendant:
  IA-T-X (D): Ver.1.44 or later
  SEL-T (D): Ver.1.02 or later

(Note 1) Following a quick return from a SEL movement command, the right to use the applicable axis is not released in the program even after the command has been reset. Accordingly, an attempt to use that axis from other program generates “Error No. C66: Multiple axis use error”. To release the right to use the applicable axis, set quick return mode 0 (Normal mode = Quick return mode cancelled).

(Note 2) Quick return modes 1 to 3 are cancelled when the program ends (the close distance set by the NBND command and positioning width set by the PBND command are not cancelled).

(Note 3) At the end of combined processing requiring a quick return, be sure to reset the quick return mode to 0 (Normal mode = Quick return mode cancelled).

(Note 4) Always refer to the pages explaining the NBND and PEND commands.

● DFTL (Dedicated SCARA command/Define tool coordinate system)

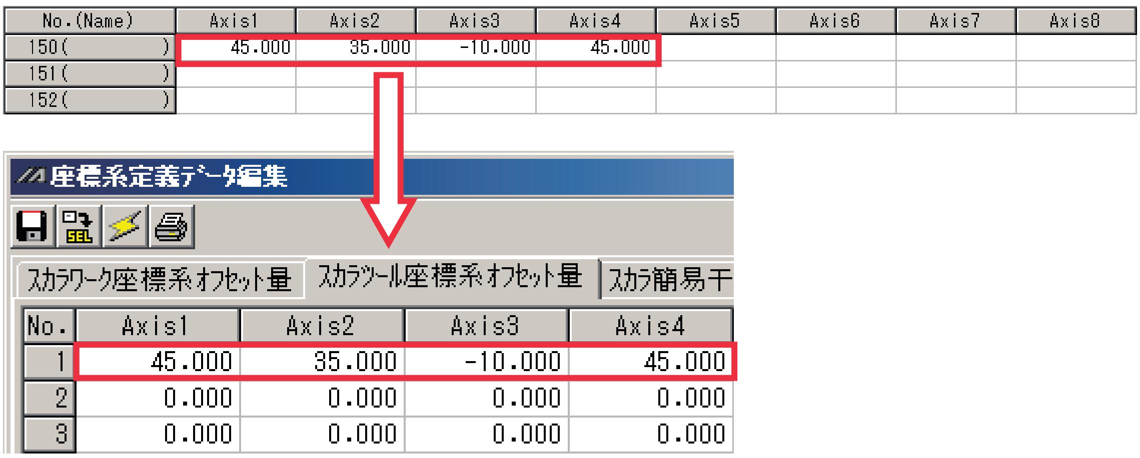
Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	DFTL	Tool coordinate system number	Position number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	○	○	○	×	×	○ (PCX/PGX only)

[Function] Set the position data in operand 2 as the tool coordinate system offset data specified in operand 1.
The position data for all the SCARA axes go into the tool coordinate system offset data, however, 0 will be set for an axis that the position data is invalid. In XSEL-RX/SX/RXD/SXD, if all the position data for the SCARA axes in one unit are invalid, data cannot be established in the tool coordinate system offset, and the data before executing DFTL Command is saved.
In MSEL-PCX/PGX, position data for four axes needs to be set in the tool coordinate system offset data no mater of the number of axes on SCARA Robot.
It is recommended that the position that the tool coordinate system data is set from is used as the dedicated data for the tool coordinate set, not to be shared with the movement target position.
In case there is an additional linear axis is connected on Axis 4 on 3-axis type SCARA Robot, Axis 4 in the position data set to the tool coordinate system in DFTL is not a target position for the additional linear axis.

(Note 1) The tool/work coordinate systems are functions available for SCARA.
(Note 2) Since tool coordinate system No. 0 is reserved by the system as a condition specifying no tool offset, selecting this number generates “Error No. B71: Coordinate system number error”.
(Note 3) The GRP command is invalid with respect to this command.

[XSEL-JX/KX/PX/QX/RX/SX: 1 unit of SCARA connected]
[Example] DFTL 1 150



No.(Name)	Axis1	Axis2	Axis3	Axis4	Axis5	Axis6	Axis7	Axis8
150 ( )	45.000	35.000	-10.000	45.000				
151 ( )								
152 ( )								

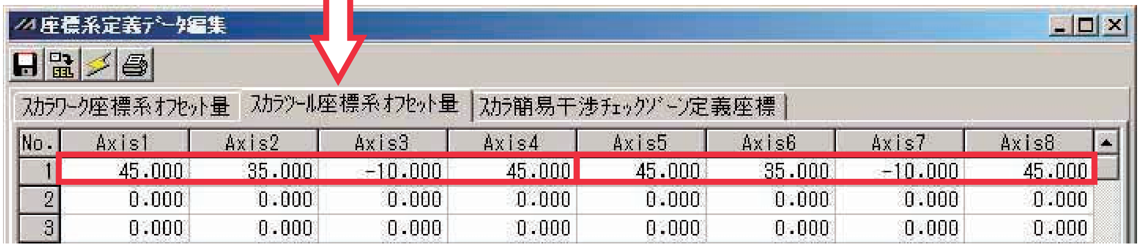
No.	Axis1	Axis2	Axis3	Axis4
1	45.000	35.000	-10.000	45.000
2	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000

[XSEL-RXD/SXD: 2 unit of SCARA connected]

[Example 1]   DFTL   1   150

In case that the command shown above is executed with the position data as shown below, the data is set to Axis 1 to 4 in Tool Coordinate System No. 1 as the position data in Axis 1 to 4 for the SCARA axes (1st to 4th axes) are set effective. There will be no change to Axis 5 to 8 in Tool Coordinate System No. 1 as the position data in Axis 5 to 8 for the SCARA axes (5th to 8th axes) are all set ineffective.

No.(Name)	Axis1	Axis2	Axis3	Axis4	Axis5	Axis6	Axis7	Axis8
150( )	45.000	35.000	-10.000	45.000				
151( )								
152( )								



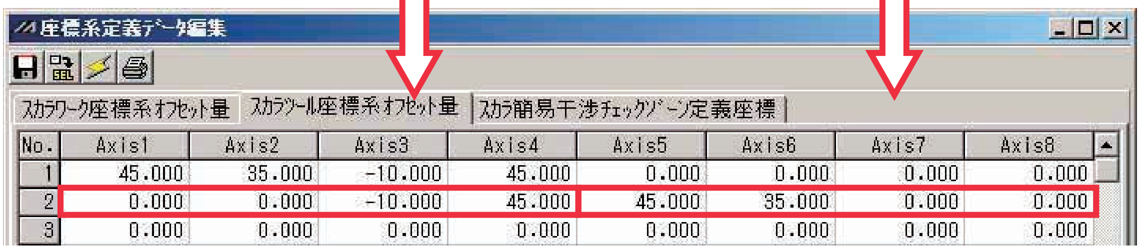
No.	Axis1	Axis2	Axis3	Axis4	Axis5	Axis6	Axis7	Axis8
1	45.000	35.000	-10.000	45.000	45.000	35.000	-10.000	45.000
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

[Example 2]   DFTL   2   152

In case that the command shown above is executed with the position data as shown below, the data is set to Axis 1 to 8 in Tool Coordinate System No. 2 as the position data in either of Axis 1 to 4 or Axis 5 to 8 for the SCARA axes (1st to 4th axes) or SCARA axes (5th to 8th axes) is set effective.

However, 0 will be set to Axis 1 to 2 and 7 to 8 that the position data is the invalid axes.

No.(Name)	Axis1	Axis2	Axis3	Axis4	Axis5	Axis6	Axis7	Axis8
150( )	45.000	35.000	-10.000	45.000				
151( )								
152( )			-10.000	45.000	45.000	35.000		



No.	Axis1	Axis2	Axis3	Axis4	Axis5	Axis6	Axis7	Axis8
1	45.000	35.000	-10.000	45.000	0.000	0.000	0.000	0.000
2	0.000	0.000	-10.000	45.000	45.000	35.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

● SLTL (Dedicated SCARA command/Select tool coordinate system)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	SLTL	Tool coordinate system number	Prohibited	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	○	○	○	×	×	○ (PCX/PGX only)

[Function] Set the tool coordinate system selection number in operand 1.

(Note 1) The tool/work coordinate systems are functions available for SCARA.

(Note 2) The selected number last declared in the system becomes effective.
The selected tool coordinate system number will remain effective even after the program ends, and also after the power is reconnected if the system-memory backup battery is installed (Note 6).

(Note 3) Only one tool coordinate system selection number is present within the system.

(Note 4) Expressly declare SLTL in the program to prevent unwanted problems resulting from forgetting to reset the coordinate system selection number after changing it in the PC software or on the teaching pendant.
(Execute SLTL 0, if the tool coordinate system is not used.)

(Note 5) In XSEL-RX/SX/RXD/SXD 8-axes Series, GRP and BASE Command are available also in the actuator control declaration commands SLTL, SLWK, WGHT, WGT2, PTPR, PTPL PTPE, PTPD, RIGH, LEFT and the system information acquirement command GARM. Establish the setting to have all the SCARA axes valid. Error No. C30 “Axis Pattern Error” will occur if even one axis is set invalid by GRP and BASE Commands.
When GRP and BASE Commands are undeclared, all the axes are effective (equivalent to GRP 11111111).

(Note 6) XSEL-RX/SX/RXD/SXD save the tool coordinate system numbers without using a battery.

[Example 1]	GRP	1111	It makes the 1st to 4th axes effective.
	SLTL	1	Selected tool coordinate system of the SCARA axes (1st to 4th axes) is changed to No. 1.
[Example 2]	GRP	11111111	It makes the 1st to 8th axes effective.
	SLTL	2	Selected tool coordinate system of the SCARA axes (1st to 4th axes) and the SCARA axes (5th to 8th axes) is changed to No. 2.

● GTTL (Dedicated SCARA command/Get tool coordinate system definition data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	GTTL	Tool coordinate system number	Position number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	○	○	○	×	×	○ (PCX/PGX only)

[Function] Set the tool coordinate system offset data specified in operand 1 for the position data specified in operand 2. Tool coordinate system offset data for all SCARA axes is set for the position data.
In MSEL-PCX/PGX, tool coordinate system offset data for four axes is set in the position data no mater of the number of axes on SCARA Robot.
It is recommended that the position that the tool coordinate system is acquired from is used as the dedicated data for the tool coordinate acquirement, not to be shared with the movement target position.
In case there is an additional linear axis is connected on Axis 4 on 3-axis type SCARA Robot, the tool coordinate system R-axis offset in the position data is written by execution of GTTL Command.

(Note 1) The tool/work coordinate systems are functions available for SCARA.

(Note 2) The position data for the liner axes (5th to 8th axes) are cleared when the command is executed.

(Note 3) Since tool coordinate system No. 0 is reserved by the system as a condition specifying no tool offset, selecting this number generates “Error No. B71: Coordinate system number error”.

(Note 4) The GRP command is invalid with respect to this command.

[XSEL-JX/KX/PX/QX/RX/SX: 1 unit of SCARA connected]
[Example]   GTTL   1   150
After the command shown above is executed, the position data for the liner axes (5th to 8th axes) are cleared.

座標系定義データ編集

スカラワーク座標系オフセット量 | スカラツール座標系オフセット量 | スカラ簡易干

No.	Axis1	Axis2	Axis3	Axis4
1	45.000	35.000	-10.000	45.000
2	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000

No.(Name)	Axis1	Axis2	Axis3	Axis4	Axis5	Axis6	Axis7	Axis8
150( )	45.000	35.000	-10.000	45.000				
151( )								
152( )								

The data before GTTL Command was executed gets cleared.

[XSEL-RXD/SXD: 2 unit of SCARA connected]
[Example]   GTTL   1   150

座標系定義データ編集

スカラワーク座標系オフセット量 | スカラツール座標系オフセット量 | スカラ簡易干渉チェックゾーン定義座標

No.	Axis1	Axis2	Axis3	Axis4	Axis5	Axis6	Axis7	Axis8
1	45.000	35.000	-10.000	45.000	0.000	0.000	0.000	0.000
2	0.000	0.000	.000	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	.000	0.000	0.000	0.000	0.000	0.000

No.(Name)	Axis1	Axis2	Axis3	Axis4	Axis5	Axis6	Axis7	Axis8
150( )	45.000	35.000	-10.000	45.000	0.000	0.000	0.000	0.000
151( )								
152( )								

● DFWK (Dedicated SCARA command/Define work coordinate system)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	DFWK	Work coordinate system number	Position number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	○	○	○	×	×	○ (PCX/PGX only)

[Function] Set the position data in operand 2 for the work coordinate system offset data specified in operand 1. The position data for all the axes go into the work coordinate system offset data, however, 0 will be set for an axis that the position data is invalid.
In XSEL-RX/SX/RXD/SXD, if all the position data for the SCARA axes in one unit are invalid, data cannot be established in the tool coordinate system offset, and the data before executing DFWK Command is saved
In MSEL-PCX/PGX, position data for four axes is set in the work coordinate system offset data no mater of the number of axes on SCARA Robot.
It is recommended that the position that the work coordinate system data is set from is used as the dedicated data for the work coordinate set, not to be shared with the movement target position.
In case there is an additional linear axis is connected on Axis 4 on 3-axis type SCARA Robot, Axis 4 in the position data set to the tool coordinate system in DFWK is not a target position for the additional linear axis.

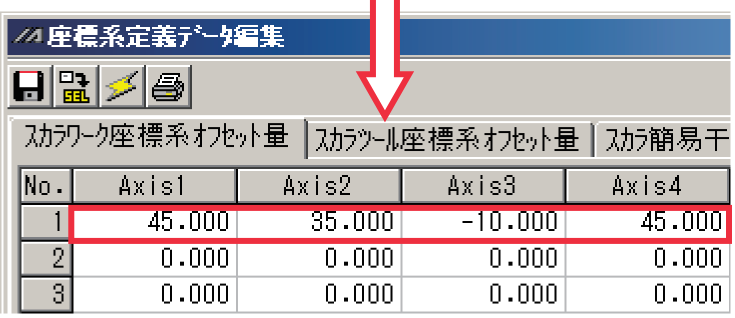
(Note 1) The tool/work coordinate systems are functions available for SCARA.

(Note 2) Since work coordinate system No. 0 is reserved by the system as the base coordinate system, selecting this number generates “Error No. B71: Coordinate system number error”.

(Note 3) The GRP command is invalid with respect to this command.

[XSEL-JX/KX/PX/QX/RX/SX: 1 unit of SCARA connected]
[Example] DFWK 1 150

No.(Name)	Axis1	Axis2	Axis3	Axis4	Axis5	Axis6	Axis7	Axis8
150( )	45.000	35.000	-10.000	45.000				
151( )								
152( )								



No.	Axis1	Axis2	Axis3	Axis4
1	45.000	35.000	-10.000	45.000
2	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000

[XSEL-RXD/SXD: 2 unit of SCARA connected]
[Example 1] DFWK 1 150
In case that the command shown above is executed with the position data as shown below, the data is set to Axis 1 to 4 in Work Coordinate System No. 1 as the position data in Axis 1 to 4 for the SCARA axes (1st to 4th axes) are set effective. There will be no change to Axis 5 to 8 in Work Coordinate System No. 1 as the position data in Axis 5 to 8 for the SCARA axes (5th to 8th axes) are all set ineffective.

No.(Name)	Axis1	Axis2	Axis3	Axis4	Axis5	Axis6	Axis7	Axis8
150( )	45.000	35.000	-10.000	45.000				
151( )								
152( )								

座標系定義ﾃﾞｰﾀ編集

ｽｶﾗﾜｰｸ座標系ｵﾌｾｯﾄ量 | ｽｶﾗﾂｰﾙ座標系ｵﾌｾｯﾄ量 | ｽｶﾗ簡易干渉ﾁｪｯｸｿﾞｰﾝ定義座標

No.	Axis1	Axis2	Axis3	Axis4	Axis5	Axis6	Axis7	Axis8
1	45.000	35.000	-10.000	45.000	45.000	35.000	-10.000	45.000
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

[Example 2] DFWK 2 152
In case that the command shown above is executed with the position data as shown below, the data is set to Axis 1 to 8 in Work Coordinate System No. 2 as the position data in either of Axis 1 to 4 or Axis 5 to 8 for the SCARA axes (1st to 4th axes) or SCARA axes (5th to 8th axes) is set effective.
However, 0 will be set to Axis 1 to 2 and 7 to 8 that the position data is the invalid axes.

No.(Name)	Axis1	Axis2	Axis3	Axis4	Axis5	Axis6	Axis7	Axis8
150( )	45.000	35.000	-10.000	45.000				
151( )								
152( )			-10.000	45.000	45.000	35.000		

座標系定義ﾃﾞｰﾀ編集

ｽｶﾗﾜｰｸ座標系ｵﾌｾｯﾄ量 | ｽｶﾗﾂｰﾙ座標系ｵﾌｾｯﾄ量 | ｽｶﾗ簡易干渉ﾁｪｯｸｿﾞｰﾝ定義座標

No.	Axis1	Axis2	Axis3	Axis4	Axis5	Axis6	Axis7	Axis8
1	45.000	35.000	-10.000	45.000	0.000	0.000	0.000	0.000
2	0.000	0.000	-10.000	45.000	45.000	35.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

● SLWK (Dedicated SCARA command/Select work coordinate system)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	SLWK	Work coordinate system number	Prohibited	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	○	○	○	×	×	○ (PCX/PGX only)

[Function] Set the work coordinate system selection number in operand 1.

(Note 1) The tool/work coordinate systems are functions available for SCARA.

(Note 2) The selected number last declared in the system becomes effective.
The selected work coordinate system number will remain effective even after the program ends, and also after the power is reconnected if the system-memory backup battery is installed (Note 6).

(Note 3) Only one work coordinate system selection number is present within the system.

(Note 4) Expressly declare SLWK in the program to prevent unwanted problems resulting from forgetting to reset the coordinate system selection number after changing it in the PC software or on the teaching pendant.
(Execute SLWK 0, if the work coordinate system is not used.)

(Note 5) In XSEL-RX/SX/RXD/SXD 8-axes Series, GRP and BASE Command are available also in the actuator control declaration commands SLTL, SLWK, WGHT, WGT2, PTPR, PTPL PTPE, PTPD, RIGH, LEFT and the system information acquirement command GARM. Establish the setting to have all the SCARA axes valid. Error No. C30 “Axis Pattern Error” will occur if even one axis is set invalid by GRP and BASE Commands.
When GRP and BASE Commands are undeclared, all the axes are effective (equivalent to GRP 11111111).

(Note 6) XSEL-RX/SX/RXD/SXD save the tool coordinate system numbers without using a battery.

[Example 1]

GRP	1111	It makes the 1st to 4th axes effective.
SLWK	1	Selected work coordinate system of the SCARA axes (1st to 4th axes) is changed to No. 1.

[Example 2]

GRP	11111111	It makes the 1st to 8th axes effective.
SLWK	2	Selected work coordinate system of the SCARA axes (1st to 4th axes) and the SCARA axes (5th to 8th axes) is changed to No. 1.

[11] Actuator Control Declaration

● GTWK (Dedicated SCARA command/Get work coordinate system definition number)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	GTWK	Work coordinate system number	Position number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	○	○	○	×	×	○ (PCX/PGX only)

[Function] Set the work coordinate system offset data specified in operand 1 for the position data specified in operand 2. Work coordinate system offset data for all axes is set for the position data.
In MSEL-PCX/PGX, work coordinate system offset data for four axes is set in the position data no mater of the number of axes on SCARA Robot.
It is recommended that the position that the work coordinate system is acquired from is used as the dedicated data for the work coordinate acquirement, not to be shared with the movement target position.
In case there is an additional linear axis is connected on Axis 4 on 3-axis type SCARA Robot, the work coordinate system R-axis offset in the position data is written by execution of GTWK Command.

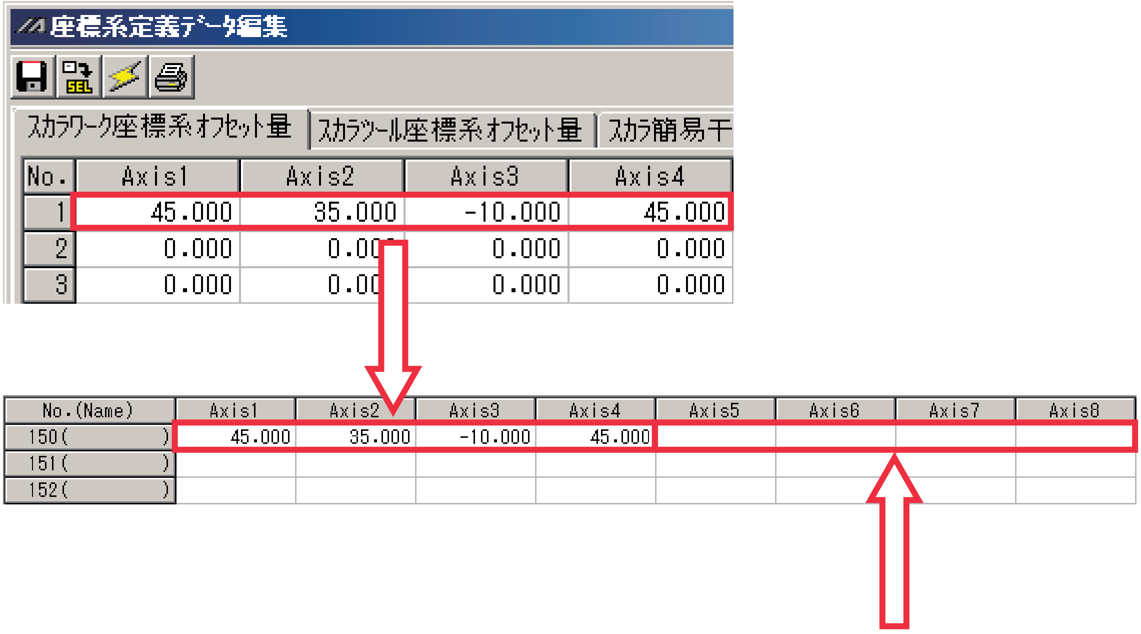
(Note 1) The tool/work coordinate systems are functions available for SCARA.

(Note 2) The position data for the liner axes (5th to 8th axes) are cleared when the command is executed.

(Note 3) Since work coordinate system No. 0 is reserved by the system as the base coordinate system, selecting this number generates “Error No. B71: Coordinate system number error”.

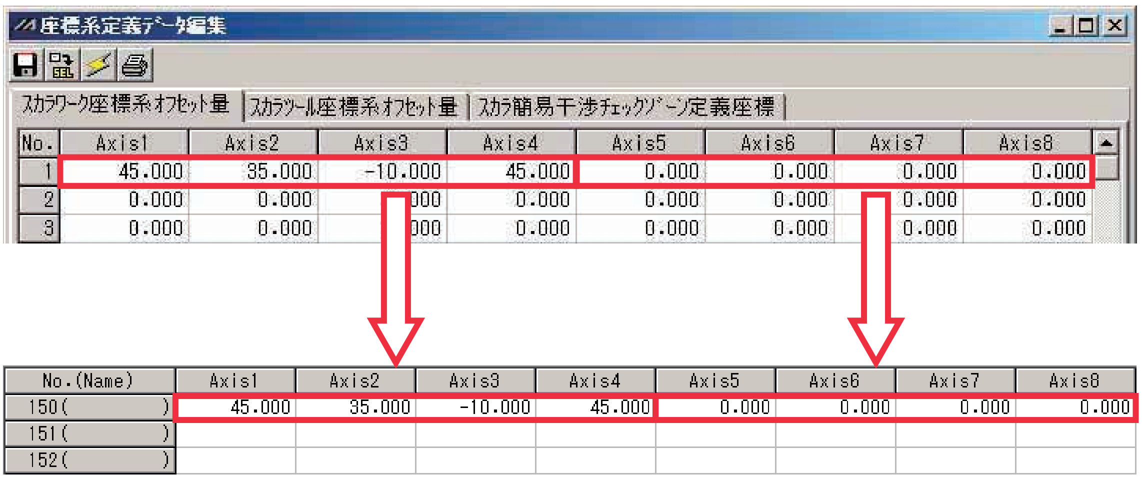
(Note 4) The GRP command is invalid with respect to this command.

[XSEL-JX/KX/PX/QX/RX/SX: 1 unit of SCARA connected]
[Example]   GTWK   1   150



The data before GTWK Command was executed gets cleared.

[XSEL-RXD/SXD: 2 unit of SCARA connected]
[Example]   GTWK   1   150



● RIGH (Dedicated SCARA command/Change current arm system to right arm (arm 2 operation involved if current arm system is opposite))

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RIGH	Prohibited	Prohibited	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	○	○	○	×	×	○ (PCX/PGX only)

[Function] Change the current SCARA arm system to the right arm system. If the current arm system is the left arm system, arm 2 is moved to change it to the right arm system. After the operation, arms 1 and 2 form a straight line. No arm operation is performed if the current arm system is the right arm system.

(Note 1) To use a RIGH or LEFT command, the speed must be set with VELS even when a SCARA PTP operation command is not used.

(Note 2) In XSEL-RX/SX/RXD/SXD 8-axes Series, GRP and BASE Command are available also in the actuator control declaration commands SLTL, SLWK, WGHT, WGT2, PTPR, PTPL PTPE, PTPD, RIGH, LEFT and the system information acquirement command GARM. Establish the setting to have all the SCARA axes valid. Error No. C30 “Axis Pattern Error” will occur if even one axis is set invalid by GRP and BASE Commands.
When GRP and BASE Commands are undeclared, all the axes are effective (equivalent to GRP 11111111).

[Example 1]	GRP	1111	It makes the 1st to 4th axes effective.
	RIGH		The current arm system of the SCARA axes (1st to 4th axes) is changed to the right arm system.
[Example 2]	GRP	11111111	It makes the 1st to 8th axes effective.
	RIGH		The current arm system of the SCARA axes (1st to 4th axes) and SCARA axes (5th to 8th axes) is changed to the right arm system.

● LEFT (Dedicated SCARA command/Change current arm system to left arm (arm 2 operation involved if current arm system is opposite))

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	LEFT	Prohibited	Prohibited	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	○	○	○	×	×	○ (PCX/PGX only)

[Function] Change the current SCARA arm system to the left arm system. If the current arm system is the right arm system, arm 2 is moved to change it to the left arm system. After the operation, arms 1 and 2 form a straight line. No arm operation is performed if the current arm system is the left arm system.

(Note 1) To use a RIGH or LEFT command, the speed must be set with VELS even when a SCARA PTP operation command is not used.

(Note 2) In XSEL-RX/SX/RXD/SXD 8-axes Series, GRP and BASE Command are available also in the actuator control declaration commands SLTL, SLWK, WGHT, WGT2, PTPR, PTPL PTPE, PTPD, RIGH, LEFT and the system information acquirement command GARM. Establish the setting to have all the SCARA axes valid. Error No. C30 “Axis Pattern Error” will occur if even one axis is set invalid by GRP and BASE Commands.
When GRP and BASE Commands are undeclared, all the axes are effective (equivalent to GRP 11111111).

[Example 1]

GRP	1111	It makes the 1st to 4th axes effective
LEFT		The current arm system of the SCARA axes (1st to 4th axes) is changed to the right arm system.

[Example 2]

GRP	11111111	It makes the 1st to 8th axes effective.
LEFT		The current arm system of the SCARA axes (1st to 4th axes) and SCARA axes (5th to 8th axes) is changed to the left arm system.

● PTPR (Dedicated SCARA command/Specify PTP target arm system to right arm (Movement of opposite arm system prohibited (no operation is performed) if target unachievable)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PTPR	Prohibited	Prohibited	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	○	○	○	×	×	○ (PCX/PGX only)

[Function] Specify the target arm system for SCARA PTP operation commands to the right arm system. After the PTPR command is executed, the target arm system for SCARA PTP operation commands becomes the right arm system and an error occurs if the target value cannot be achieved by operating on the right arm system. Executing this command does not initiate any arm operation.

(Note 1) In XSEL-RX/SX/RXD/SXD 8-axes Series, GRP and BASE Command are available also in the actuator control declaration commands SLTL, SLWK, WGHT, WGT2, PTPR, PTPL PTPE, PTPD, RIGH, LEFT and the system information acquirement command GARM. Establish the setting to have all the SCARA axes valid. Error No. C30 “Axis Pattern Error” will occur if even one axis is set invalid by GRP and BASE Commands.
When GRP and BASE Commands are undeclared, all the axes are effective (equivalent to GRP 11111111).

[Example 1]

GRP	1111	It makes the 1st to 4th axes effective.
PTPR		PTP target arm system of the SCARA axes (1st to 4th axes) is indicated to the right arm system.
MOVP	1	Move to Position No. 1 to become the right arm system.

[Example 2]

GRP	11111111	It makes the 1st to 8th axes effective.
PTPR		PTP target arm system of the SCARA axes (1st to 4th axes) and SCARA axes (5th to 8th axes) is indicated to the right arm system.
MOVP	2	Move to Position No. 2 to become the right arm system.

● PTPL (Dedicated SCARA command/Specify PTP target arm system to left arm (Movement of opposite arm system prohibited (no operation is performed) if target unachievable)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PTPL	Prohibited	Prohibited	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	○	○	○	×	×	○ (PCX/PGX only)

[Function] Specify the target arm system for SCARA PTP operation commands to the left arm system. After the PTPL command is executed, the target arm system for SCARA PTP operation commands becomes the left arm system and an error occurs if the target value cannot be achieved by operating on the left arm system. Executing this command does not initiate any arm operation.

(Note 1) In XSEL-RX/SX/RXD/SXD 8-axes Series, GRP and BASE Command are available also in the actuator control declaration commands SLTL, SLWK, WGHT, WGT2, PTPR, PTPL PTPE, PTPD, RIGH, LEFT and the system information acquirement command GARM. Establish the setting to have all the SCARA axes valid. Error No. C30 “Axis Pattern Error” will occur if even one axis is set invalid by GRP and BASE Commands.
When GRP and BASE Commands are undeclared, all the axes are effective (equivalent to GRP 11111111).

[Example 1]

GRP	1111	It makes the 1st to 4th axes effective.
PTPL		PTP target arm system of the SCARA axes (1st to 4th axes) is indicated to the left arm system.
MOVP	1	Move to Position No. 1 to become the left arm system.

[Example 2]

GRP	11111111	It makes the 1st to 8th axes effective.
PTPL		PTP target arm system of the SCARA axes (1st to 4th axes) and SCARA axes (5th to 8th axes) is indicated to the left arm system.
MOVP	2	Move to Position No. 2 to become the left arm system.

● PTPD (Dedicated SCARA command/Specify PTP target arm system to current arm (Movement of opposite arm system permitted (no operation is performed) if target unachievable)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PTPD	Prohibited	Prohibited	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	○	○	○	×	×	○ (PCX/PGX only)

[Function] Specify the target arm system for SCARA PTP operation commands to the current arm system. After the PTPD command is executed, the target arm system for SCARA PTP operation commands becomes the current arm system and an error occurs if the target value cannot be achieved by operating on this arm system. Executing this command does not initiate any arm operation.

(Note 1) In XSEL-RX/SX/RXD/SXD 8-axes Series, GRP and BASE Command are available also in the actuator control declaration commands SLTL, SLWK, WGHT, WGT2, PTPR, PTPL PTPE, PTPD, RIGH, LEFT and the system information acquirement command GARM. Establish the setting to have all the SCARA axes valid. Error No. C30 "Axis Pattern Error" will occur if even one axis is set invalid by GRP and BASE Commands.
When GRP and BASE Commands are undeclared, all the axes are effective (equivalent to GRP 11111111).

[Example 1]

GRP	1111	It makes the 1st to 4th axes effective.
PTPD		PTP target arm system of the SCARA axes (1st to 4th axes) is indicated to the reversed arm system move prohibited when it is not possible.
MOVP	1	Movement is made to Position No. 1 with the current arm system. ("C73: Target Track Software Limit Excess Error" will occur when positioning cannot be performed without changing to the reversed arm system.)

[Example 2]

GRP	11111111	It makes the 1st to 8th axes effective.
PTPR		PTP target arm system of the SCARA axes (1st to 4th axes) and SCARA axes (5th to 8th axes) is indicated to the reversed arm system move prohibited when it is not possible.
MOVP	2	Movement is made to Position No. 2 with the current arm system. ("C73: Target Track Software Limit Excess Error" will occur when positioning cannot be performed without changing to the reversed arm system.)

● PTPE (Dedicated SCARA command/Specify PTP target arm system to current arm (Movement of opposite arm system prohibited (no operation is performed) if target unachievable)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PTPE	Prohibited	Prohibited	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	○	○	○	×	×	○ (PCX/PGX only)

[Function] Specify the target arm system for SCARA PTP operation commands to the current arm system. After the PTPE command is executed, the target arm system for SCARA PTP operation commands becomes the current arm system and if the target value cannot be achieved by operating on this arm system, the target arm system is changed to the one opposite the current arm system. An error occurs if the target value cannot be achieved by operating on either the right arm system or left arm system. Executing this command does not initiate any arm operation.

(Note 1) In XSEL-RX/SX/RXD/SXD 8-axes Series, GRP and BASE Command are available also in the actuator control declaration commands SLTL, SLWK, WGHT, WGT2, PTPR, PTPL PTPE, PTPD, RIGH, LEFT and the system information acquirement command GARM. Establish the setting to have all the SCARA axes valid. Error No. C30 "Axis Pattern Error" will occur if even one axis is set invalid by GRP and BASE Commands.
When GRP and BASE Commands are undeclared, all the axes are effective (equivalent to GRP 11111111).

[Example 1]

GRP	1111	It makes the 1st to 4th axes effective.
PTPE		PTP target arm system of the SCARA axes (1st to 4th axes) is indicated to the reversed arm system move permitted when it is not possible.
MOVP	1	Movement is made to Position No. 1 with the current arm system. (Positioning is performed with the reversed arm system when positioning cannot be performed without changing to the reversed arm system.)

[Example 2]

GRP	11111111	It makes the 1st to 8th axes effective.
PTPE		PTP target arm system of the SCARA axes (1st to 4th axes) and SCARA axes (5th to 8th axes) is indicated to the reversed arm system move permitted when it is not possible.
MOVP	2	Movement is made to Position No. 2 with the current arm system. (Positioning is performed with the reversed arm system when positioning cannot be performed without changing to the reversed arm system.)

● DFIF (Dedicated SCARA command/Define simple contact check zone coordinate)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	DFIF	Contact check zone number	Position number (2 successive positions are used)	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	○	○	○	×	×	○ (PCX/PGX only)

[Function] Set the data of two successive positions starting from the position number specified in operand 2, for the simple contact check zone definition coordinate data in operand 1.
The position data specified in operand 2 is set for simple contact check zone definition coordinate 1, while the data of the next position is set for definition coordinate 2. If the axis pattern does not match between the data of the two successive positions, “Error No. C30: Axis pattern error” occurs.
In MSEL-PCX/PGX, position data for four axes is set in the simple contact check zone coordinate data no mater of the number of axes on SCARA Robot.
It is recommended that the position that the simple contact check zone coordinate data is set from is used as the dedicated data for the simple contact check zone coordinate set, not to be shared with the movement target position.
In case there is an additional linear axis is connected on Axis 4 on 3-axis type SCARA Robot, Axis 4 in the position data set to the simple contact check zone coordinate in DFIF is not a target position for the additional linear axis.

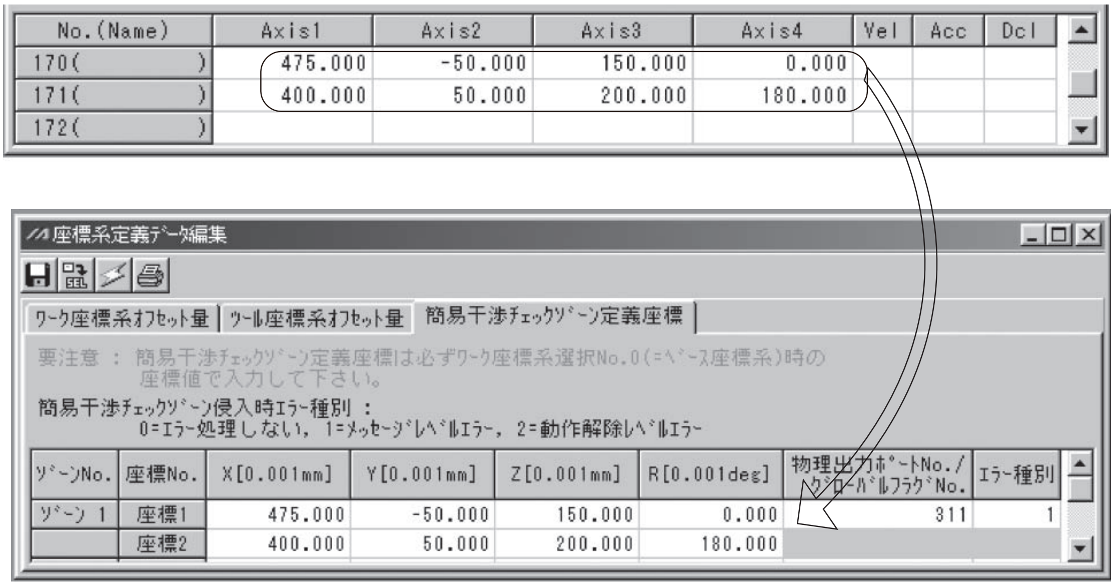
(Note 1) Simple contact check zone definition coordinates are always recognized as data on the base coordinate system (work coordinate system selection No. 0). If you are setting aside position data for use as effective definition coordinates for the DFIF command, you must set the data on the base coordinate system.

(Note 2) When the simple contact check zone definition coordinates are changed, it takes 5msec for the check result based on the new settings to be reflected.

(Note 3) The GRP command is invalid with respect to this command.

(Note 4) Indicate the position data effective either on SCARA axes (1st to 4th axes) or SCARA axes (5th to 8th axes) for the valid axes of the position data. “Error No. C30: Axis Pattern Error” will be issued when both of SCARA axes (1st to 4th axes) and SCARA axes (5th to 8th axes) are set effective for the valid axes of the position data.

[Example] DFIF 1 170



[11] Actuator Control Declaration

● SOIF (Dedicated SCARA command/Specify output for simple contact check zone)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	SOIF	Contact check zone number	Output/ global flag number	CP

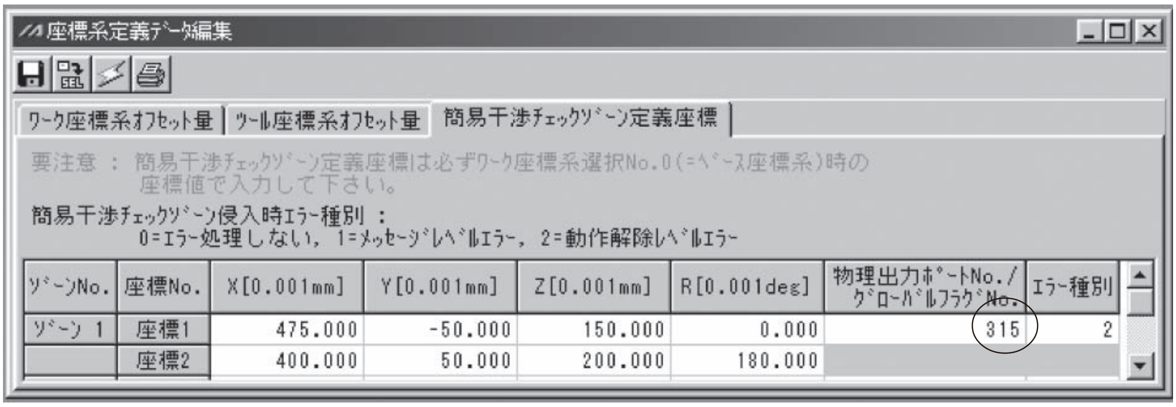
Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	○	○	○	×	×	○ (PCX/PGX only)

[Function] Set the output number/global flag number in operand 2 as the output specification to be applied upon entry into the simple contact check zone specified in operand 1.

(Note 1) The simple contact check zone is a function available for SCARA.

(Note 2) If duplicate physical output port numbers/global flag numbers are specified, chattering occurs and operation results become indeterminable.

[Example] SOIF 1 315



● SEIF (Dedicated SCARA command/Specify type of simple contact check zone)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	SEIF	Contact check zone number	0 or 1 or 2 (error type)	CP

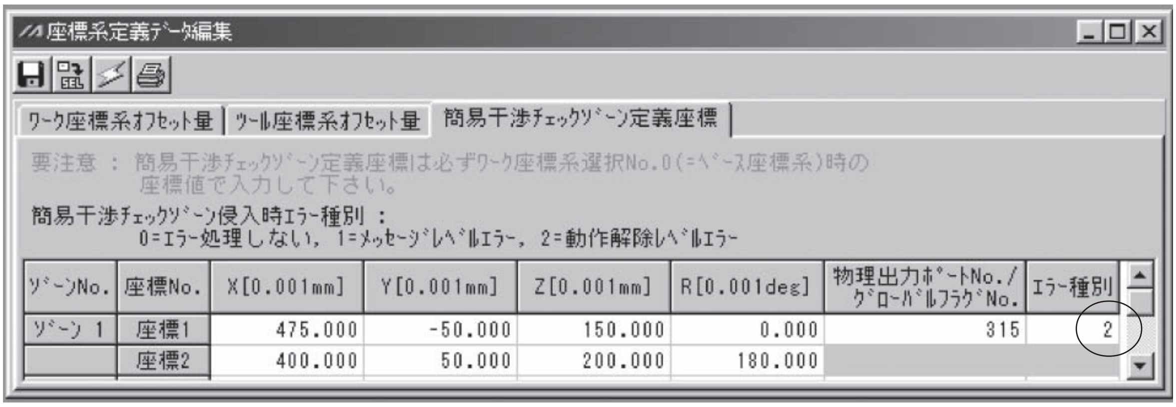
Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	○	○	○	×	×	○ (PCX/PGX only)

[Function] Specify the error type in operand 2 (see below) as the error type to be applied upon entry into the simple contact check zone specified in operand 1.

Error types applicable upon entry into simple contact check zone
0: No error
1: Message level error
2: Operation-cancellation level error

(Note 1) The simple contact check zone is a function available for SCARA.

[Example] SEIF 1 2



● GTIF (Dedicated SCARA command/Get simple contact check zone definition coordinate)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	GTIF	Contact check zone number	Position number (2 successive positions are used)	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	○	○	○	×	×	○ (PCX/PGX only)

[Function] Set the simple contact check zone definition coordinate data in operand 1 for the data of two successive positions starting from the position number specified in operand 2.
Simple contact check zone definition coordinate 1 is set for the position data specified in operand 2, while definition coordinate 2 is set for the data of the next position. At this time, coordinate data in the position data becomes invalid for all axes, and then the simple contact check zone definition coordinate data is set.
In MSEL-PCX/PGX, simple contact check zone coordinate data for four axes is set in the position data no mater of the number of axes on SCARA Robot.
It is recommended that the position that the simple contact check zone coordinate is acquired from is used as the dedicated data for the simple contact check zone coordinate acquirement, not to be shared with the movement target position.
In case there is an additional linear axis is connected on Axis 4 on 3-axis type SCARA Robot, the simple contact check zone coordinate R-axis offset in the position data is written by execution of GTIF Command.

(Note 1) The position data of the invalid SCARA axes in the liner axes or the simple interference check zone definition coordinate data is cleared when the command is executed.

(Note 2) Simple contact check zone definition coordinate is always recognized as data on the base coordinate system (work coordinate system selection No. 0). Accordingly, the position data set by a GTIF command must be handled on the base coordinate system.

(Note 3) The GRP command is invalid with respect to this command.

● WGHT (Dedicated SCARA command/Set tip load mass, inertial moment)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	WGHT	Mass	(Inertial moment)	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	×	○	○	×	×	○ (PCX/PGX only)

This command is supported by controller main application Ver.0.45 or later.
It is supported by PC software of Ver.7.5.0.0 or later and teaching pendants of Ver.1.11 or later.

(Note) Conventional models such as IX-NNN5020 cannot use this command. (A "D8A: Internal parameter error of acceleration/deceleration optimization or horizontal movement Z-position optimization function" occurs.)

[Function] Set the mass and inertial moment of the tip load (tool + work).
Set the mass in operand 1, and inertial moment in operand 2. The unit of operand 1 is [g], while the unit of operand 2 is [kg•mm^2].
The tip load mass/inertial moment set by a WGHT command will be retained until a new WGHT command is set again (= the set values will be retained even after the program ends). However, they are cleared when the power is turned OFF or a software reset is performed, after which you must set the applicable values again expressly in the program.

(Note 1) For the inertial moment in operand 2, set a composite inertial moment covering the tool and work relating to the center of rotation of the R-axis.

(Note 2) Although entry of inertial moment in operand 2 is optional, if no inertial moment is set the maximum allowable inertial moment of the robot is set automatically.

(Note 3) If the tip load mass exceeds the maximum loading capacity of the robot, a "B44: Load mass setting error" occurs.

(Note 4) Executing a WGHT command updates the information of both the tip load mass and inertial moment. You cannot change only the mass or only the inertial moment.

(Note 5) Although both the tip load mass and inertial moment can be approximate values, set values slightly larger than necessary. Before setting the values, round them up to the nearest multiple of 1g or 1kg•mm^2, respectively.

(Note 6) If a WGHT command has not yet been executed, the load mass and inertial moment have been initialized to the maximum loading capacity and maximum allowable inertial moment of the robot. Set an appropriate load mass and inertial moment according to the use conditions.

(Note 7) The load mass and inertial moment set by a WGHT command are used in the SCARA PTP acceleration/deceleration optimization function, SCARA horizontal movement Z-position optimization function, etc.

(Note 8) In XSEL-RX/SX/RXD/SXD, GRP and BASE Command are available also in the actuator control declaration commands SLTL, SLWK, WGHT, PTPR, PTPL PTPE, PTPD, RIGH, LEFT and the system information acquirement command GARM. Establish the setting to have all the SCARA axes valid. Error No. C30 “Axis Pattern Error” will occur if even one axis is set invalid by GRP and BASE Commands.
When GRP and BASE Commands are undeclared, all the axes are effective (equivalent to GRP 11111111).

[Example 1]	GRP	1111		It makes the 1st to 4th axes effective.
	WGHT	2000	5000	Set a tip load with 2000g of weight and 5000kgmm2 of the moment of inertia to the SCARA axes (1st to 4th axes).
[Example 2]	GRP	11111111		It makes the 1st to 8th axes effective.
	WGHT	1000	30000	Set SCARA axes (1st to 4th axes9 and SCARA axes (5th to 8th axes) so the movement is made to Position No. 2 to make it become the right arm system.

● WGT2 (Dedicated SCARA command/Tip load condition setting)

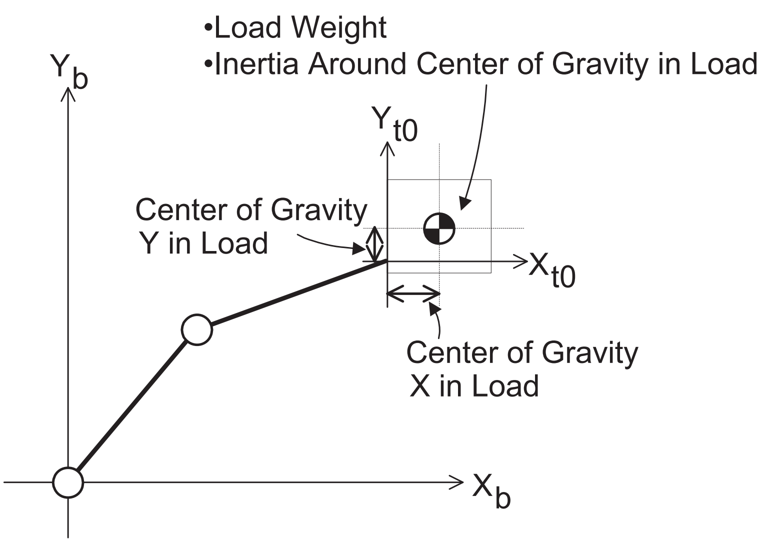
Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	WGT2	Mass	(Variable No.)	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	×	×	○	×	×	×

[Function] Set the weight [gr] of the load on the tip (tool + work piece) in Operation 1, and the center of gravity in the load, inertia around the center of gravity and other related parameters to the six variables in a row from the indicated variable in Operation 2.
The tip load mass/inertial moment set by a WGT2 command will be retained until a new WGT2 command is set again. However, they are cleared when the power is turned OFF or a software reset is performed, after which you must set the applicable values again expressly in the program.

- Indicated Variable in Operation 2

Variable No.	Contents of Setting	Remarks
n	Gravity Center X for Tip Load [1/1000mm unit]	Input the position at Tool Coordinate No. 0.
n+1	Gravity Center Y for Tip Load [1/1000mm unit]	
n+2	Inertia around Center of Gravity in Top Load [$kgmm^2$]	
n+3	Set to 0	Reservation (∗Possibility of use in future)
n+4	Set to 0	Reservation (∗Possibility of use in future)
n+5	Set to 0	Reservation (∗Possibility of use in future)



(Note 1) Inputting in Operation 2 is optional. When the setting in Operation 2 is not established, the parameters are the center of gravity in tip load X-Y = 0 and the maximum allowable moment of inertia.

(Note 2) An error will be issued when the tip load weight exceeds the maximum transportable weight of the robot.

(Note 3) When WGT2 Command is executed, the information for both the tip load weight and the moment of inertia is updated.
A change to individuals such as the weight only or center of gravity in tip load and inertia around the center of gravity only is not available.

(Note 4) Inappropriate setting of the robot tip load condition may cause vibration (abnormal noise) or error, and also may give an impact that shortens the mechanical life.
Establish the setting that reflects the actual mounted load.

(Note 5) For XSEL-RX/SX/RXD/SDX, GRP/BASE Commands become effective even in WGT2 Command. Establish the setting to have all the SCARA axes valid. Error No. C30 “Axis Pattern Error” will occur if even one axis is set invalid by GRP and BASE Commands. When GRP and BASE Commands are undeclared, all the axes are effective (equivalent to GRP 11111111).

[Example 1]	GRP	1111		Indicates SCARA of 1st to 4th axes
	LET	1001	50000	Indicates Center of gravity X in tip load = 50.000mm
	LET	1002	0	Indicates Center of gravity Y in tip load = 0.000mm
	LET	1003	2000	Indicates inertia around center of gravity in load = 2000kg•mm^2
	WGT2	1000	1001	For SCARA of 1st to 4th axes sets weight of 1000g and conditions of the tip load for Variable No. 1001 to 1003

[Example 2]	GRP	11110000		Indicates SCARA of 5th to 8th axes
	LET	1001	20000	Indicates Center of gravity X in tip load = 20.000mm
	LET	1002	20000	Indicates Center of gravity Y in tip load = 20.000mm
	LET	1003	500	Indicates inertia around center of gravity in load = 500kg•mm^2
	WGT2	500	1001	SCARA of 5th to 8th axes sets weight of 500g and conditions of the tip load for Variable No. 1001 to 1003

● NBND (Dedicated linear axis command/Set close distance)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	NBND	Axis pattern	Close distance	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
○	×	×	×	×	×	×	×	×

[Function] Set in operand 2 the close distance (mm) from the target position based on the axis pattern specified in operand 1.
This command is valid only with respect to MOVP, MOVL and PATH commands in quick return mode 2 (closeness-detection return target position addition mode) or quick return mode 3 (closeness-detection return target position change mode).
A different value can be set for each axis.

(Note 1) The default value of 0 is applied if the close distance is not set with a NBND command.

(Note 2) In the case of PATH commands involving successive movements to multiple positions, the close distance becomes effective after the movement to the last position in the last movement is started and also after the processing of the previous position movement is completed. Accordingly, a dead width is created between (= at the overlap of) the movement to the last position in the PATH commands and the movement to the position immediately before it.

(Note 3) The close distance set here will remain effective even after the program ends. When building a system using NBND commands, therefore, specify the close distance expressly with a NBND command in all programs before any operation is started in each program. If you assume that the close distance will be reset after the end of operation in other programs, an unexpected close distance may be applied should the program abort due to an error, etc., in which case unforeseen problems may result.

(Note 4) Be sure to also refer to the pages that explain the QRTN command and PEND command.

(Note 5) Software versions supporting NBND
Controller main application: Ver.1.04 or later
(excluding flash ROM 8Mbit versions)
PC software: Ver.7.2.3.0 or later
Teaching pendant:
IA-T-X (D): Ver.1.44 or later
SEL-T (D): Ver.1.02 or later

[Example 1] NBND 11 50 Set the close distance for axes 1 and 2 to 50mm after this command.

[Example 2] The axis pattern can be specified indirectly using a variable. [Example 1] can be rephrased using indirect specification by variable as follows:
11 (binary) → 3 (decimal)

```
LET   1   3    Assign 3 to variable 1.
NBND  *1  50   Set the close distance for axes 1 and 2 to 50mm
               after this command.
```

[12] Actuator Control Command

● SV☐☐ (Turn ON/OFF servo)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	SV☐☐	Axis pattern	Prohibited	PE

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Turn ON/OFF the servos of the axes specified by the axis pattern in operand 1.

SV☐☐
- ON .... Turn ON the servo.
- OF .... Turn OFF the servo.

(Other than SCARA robot)

[Example 1] SVON 11 — Turn ON the servos of axes 1 and 2. Nothing will occur if the axis servos are already ON.

[Example 2] The axis pattern can be specified indirectly using a variable.
When the command in [Example 1] is rephrased based on indirect specification using a variable:
11 (binary) → 3 (decimal)

```
LET     1     3     Assign 3 to variable 1.
SVON    *1
```

(SCARA robots)

The arm system of SCARA axes (1st to 4th axes or 1st to 3rd axes) is set to Local Variable No. 99 when complete in normal condition.

Right arm system = 1
Left arm system = -1
Indeterminable = 0

The angle of arm 2 is used to make judgment.
The arm system effective immediately after the servo ON is set. The arm system is not monitored continuously.

(Note) The arm system data set in Local Variable No. 99 is the arm system for SCARA axes (1st to 4th axes or 1st to 3rd axes). To acquire the arm system data for SCARA axes (5th to 8th axes), use GARM Command.

● HOME (Dedicated linear axis command/Home return)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	HOME	Axis pattern	Prohibited	PE

Applicable models
XSEL-JX/KX × Other than XSEL-JX/KX ○

[Function] Perform home return of the axes specified by the axis pattern in operand 1.
The servo of each home-return axis will turn ON automatically.
The output will turn OFF at the start of home return, and turn ON when the home return is completed.

(Note 1) This is a dedicated command for linear axes. If a SCARA axis (except for IXP Type Incremental specification) is specified, “Error No. B80: Specification-prohibited axis error” or “Error No. 421: SCARA/linear-axis simultaneous specification error” occurs.

(Note 2) Following a pause of home return, the operation will resume from the beginning of the home-return sequence.

(Note 3) Home-return operation for the axis using an ABS encoder makes a movement to the multi-rotation data reset position, thus it does not always make a movement to the home preset coordinate (including 0).
Use a MOVP command, instead of a HOME command, if you want to turn ON output 304 when I/O parameter No. 50, “Output function selection 304” is set to 1 (Output when all effective linear axes are home (= 0)) or 3 (Output when all effective linear axes are at home preset coordinate).

(Note 4) If an operation pause or cancel is performed during the HOME Command is executed for the axis using an ABS encoder other than the absolute reset mode provided by the PC software or teaching pendant, it may cause the “actual-position soft limit error” due to the position.
It is not recommended to perform home return other than for the purpose of adjusting an absolute-encoder axis.

[Example 1] HOME 11 Axes 1 and 2 return to the home.

[Example 2] The axis pattern can be specified indirectly using a variable.
When the command in [Example 1] is rephrased based on indirect specification using a variable:
11 (binary) → 3 (decimal)

```
LET    1    3    Assign 3 to variable 1.
HOME   *1
```

● MOVP (Move PTP by specifying position data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	MOVP	Position number	Prohibited	PE

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Move the actuator to the position corresponding to the position number specified in operand 1, without interpolation (PTP stands for "Point-to-Point").
The output will turn OFF at the start of axis movement, and turn ON when the movement is complete.

(Note) In XSEL-PX/QX, a movement to a position that indicates the target for SCARA axis and linear drive axis at the same time cannot be made. (421 "SCARA/Linear Drive Axes Double Indication Error")
Use GRP Command, or operate the position data of SCARA axis and linear drive axis separately.

(Other than SCARA robots)

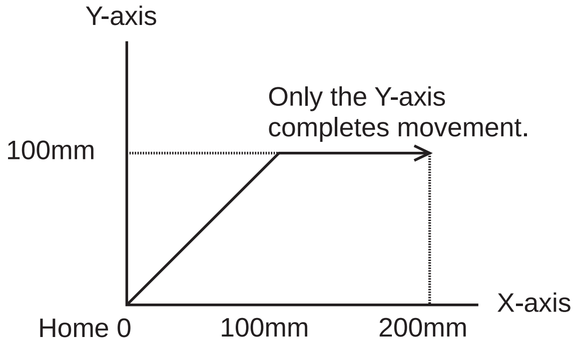
[Example 1]	VEL	100		Set the speed to 100mm/s.
	MOVP	1		Move the axes to the position corresponding to position No. 1 (200, 100).
[Example 2]	VEL	100		Set the speed to 100mm/s.
	LET	1	2	Assign 2 to variable 1.
	MOVP	*1		Move the axes to the position corresponding to the content of variable 1 (position No. 2, or (100, 100)).

Position Data Display in PC Software

No.	Axis 1 (X-axis)	Axis 2 (Y-axis)	Vel	Acc	Dcl
1	200.000	100.000			
2	100.000	100.000			

(Note) If acceleration and deceleration are not specified by position data or ACC (DCL) commands, the actuator operates at the default values set in all-axis parameter No. 11, "Default acceleration" and all-axis parameter No. 12, "Default deceleration".

Travel path from the home to the position corresponding to position No. 1 (200, 100)



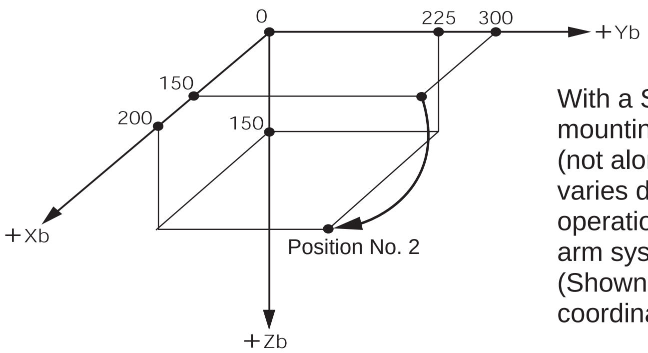
Each axis moves at 100mm/s.

(SCARA robots)
[Example 1] MOVP 2 Move the axes to the positions set under position No. 2 (200, 225, 150, 30).

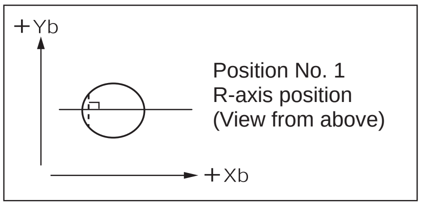
No.(Name)	Axis1	Axis2	Axis3	Axis4	Vel	Acc	Dcl
1( )	150.000	300.000	0.000	0.000			
2( )	200.000	225.000	150.000	30.000			
3( )							
4( )							

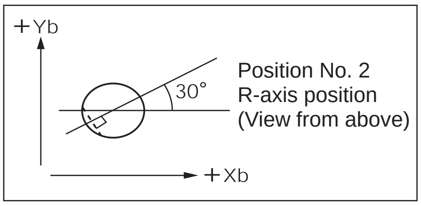
(Note) In the case of a SCARA axis, the axis operates according to all-axis parameter No. 47, "Default PTP acceleration for SCARA axis" or all-axis parameter No. 48, "Default PTP deceleration for SCARA axis" if the acceleration/deceleration is not specified using an ACCS (DCLS) command. In the case of a linear axis, the axis operates according to all-axis parameter No. 200, "Default acceleration for linear axis" or all-axis parameter No. 201, "Default deceleration for linear axis" if the acceleration/deceleration is not specified in the position data table or using an ACC (DCL) command.

Path of moving from position No. 1 to position No. 2



With a SCARA axis, the center of the tool mounting surface or tool tip moves via PTP (not along a straight line). The moving path varies depending on the start position of operation, completion position of operation, arm system, etc.
(Shown to the left are positions on the base coordinate system.)





● MOVL (Move by specifying position data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	MOVL	Position number	Prohibited	PE

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Move the actuator to the position corresponding to the position number specified in operand 1, with interpolation.
The output will turn OFF at the start of axis movement, and turn ON when the movement is complete.

(Note) In XSEL-PX/QX, a movement to a position that indicates the target for SCARA axis and linear drive axis at the same time cannot be made. (421 “SCARA/Linear Drive Axes Double Indication Error”)
Use GRP Command, or operate the position data of SCARA axis and linear drive axis separately.

(Other than SCARA robots)

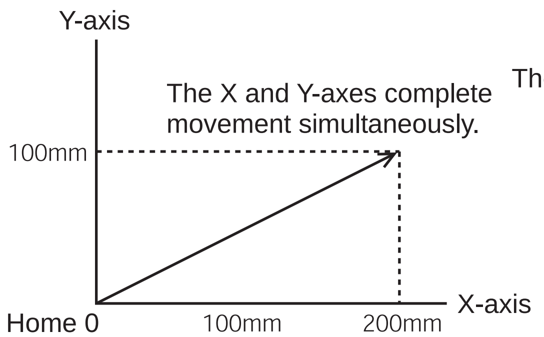
```
[Example 1]  VEL   100        Set the speed to 100mm/s.
             MOVL  1          Move the axes to the position corresponding to
                              position No. 1 (200, 100), with interpolation.

[Example 2]  VEL   100        Set the speed to 100mm/s.
             LET   1    2     Assign 2 to variable 1.
             MOVL  *1         Move the axes to the position corresponding to the
                              content of variable 1 (position No. 2, or (100, 100)),
                              with interpolation.
```

Position Data Display in PC Software

No.	Axis 1 (X-axis)	Axis 2 (Y-axis)	Vel	Acc	Dcl
1	200.000	100.000			
2	100.000	100.000			

(Note) If acceleration and deceleration are not specified by position data or ACC (DCL) commands, the actuator operates at the default values set in all-axis parameter No. 11, “Default acceleration” and all-axis parameter No. 12, “Default deceleration”.

Travel path from the home to the position corresponding to position No. 1 (200, 100)



The tip of each axis moves at 100mm/s.

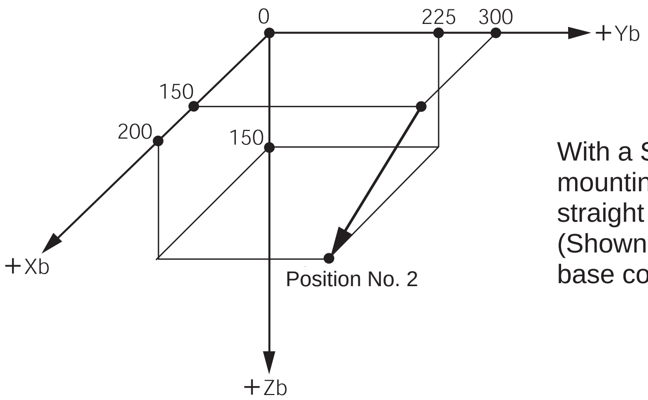
(SCARA robots)

[Example 1]   MOVL   2   Move the axes to the positions set under position No. 2 (200, 225, 150, 30) via interpolation.

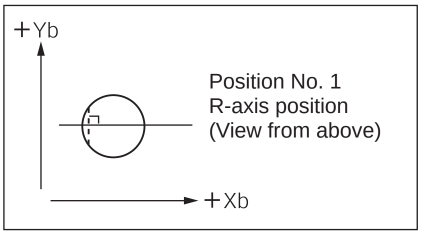
Path of moving from position No. 1 to position No. 2

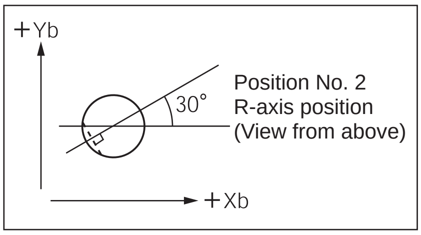
No.(Name)	Axis1	Axis2	Axis3	Axis4	Vel	Acc	Dcl
1( )	150.000	300.000	0.000	0.000			
2( )	200.000	225.000	150.000	30.000			
3( )							
4( )							

(Note)   In the case of a SCARA axis, the axis operates according to all-axis parameter No. 11, “Default CP acceleration for SCARA axis” or all-axis parameter No. 12, “Default CP deceleration for SCARA axis” if the acceleration/deceleration is not specified in the position data table or using an ACC (DCL) command.
In the case of a linear axis, the axis operates according to all-axis parameter No. 200, “Default acceleration for linear axis” or all-axis parameter No. 201, “Default deceleration for linear axis” if the acceleration/deceleration is not specified in the position data table or using an ACC (DCL) command.



With a SCARA axis, the center of the tool mounting surface or tool tip moves along a straight line.
(Shown to the left are positions on the base coordinate system.)





● MVPI (Move via incremental PTP)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	MVPI	Position number	Prohibited	PE

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Move the actuator, without interpolation, from the current position by the travel distance corresponding to the position number specified in operand 1.
The output will turn OFF at the start of axis movement, and turn ON when the movement is complete.

(Note) In XSEL-PX/QX, a movement to a position that indicates the target for SCARA axis and linear drive axis at the same time cannot be made. (421 "SCARA/Linear Drive Axes Double Indication Error")
Use GRP Command, or operate the position data of SCARA axis and linear drive axis separately.

(Other than SCARA robots)

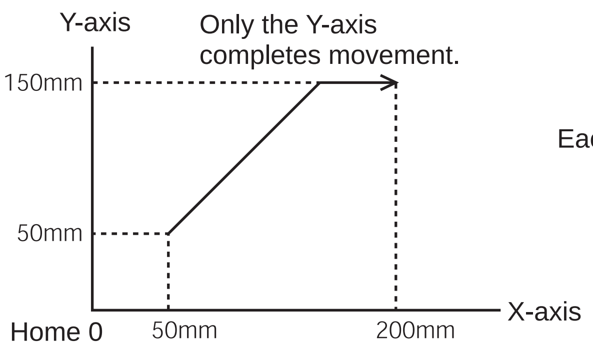
[Example 1]	VEL	100		Set the speed to 100mm/s.
	MVPI	1		If the current position is (50, 50) and position No. 1 is set to (150, 100), the axes will move 150 in the X direction and 100 in the Y direction (200, 150) from the current position.
[Example 2]	VEL	100		Set the speed to 100mm/s.
	LET	1	2	Assign 2 to variable 1.
	MVPI	*1		Move from the current position by the travel distance corresponding to the content of variable 1 (position No. 2, or (100, 100)).

Position Data Display in PC Software

No.	Axis 1 (X-axis)	Axis 2 (Y-axis)	Vel	Acc	Dcl
1	150.000	100.000			
2	100.000	100.000			

(Note) If acceleration and deceleration are not specified by position data or ACC (DCL) commands, the actuator operates at the default values set in all-axis parameter No. 11, "Default acceleration" and all-axis parameter No. 12, "Default deceleration".

Travel path from (50, 50) by the travel distance corresponding to position No. 1 (150, 100)



Each axis moves at 100mm/s.

(Note) If the specified travel distance is equal to or less than the travel distance per encoder pulse [mm/pulse], the axis may not move.
[Calculation formula of travel distance per encoder pulse]
Rotary encoder
Travel distance per encoder pulse [mm/pulse]
= (Screw lead [0.001mm] × Gear ratio numerator)
/ (Encoder resolution [pulses/rev] × Gear ratio denominator
/ (2 ^ Encoder division ratio)
Linear encoder
Travel distance per encoder pulse [mm/pulse]
= Encoder resolution (0.001μm/pulse) × 1000
/ (2 ^ Encoder division ratio)

(Reference) Use the values of the following parameters for the above calculation formulas:

Encoder resolution	: Axis-specific parameter No. 42
Encoder division ratio	: Axis-specific parameter No. 43
Screw lead	: Axis-specific parameter No. 47
Gear ratio numerator	: Axis-specific parameter No. 50
Gear ratio denominator	: Axis-specific parameter No. 51

(SCARA robots)
(Note 1) If an incremental movement command (MVPI, MVLI, TMPI or TMLI) is used repeatedly, coordinate conversion rounding errors, etc., will accumulate. To eliminate these errors, etc., execute an absolute movement command (MOVP, MOVL, etc.) once.

[Example 1] MVPI 6 Move from the current position by the travel according to position No. 6.
If the current positions of the axes are specified by position No. 5 (200, 150, 50, 45) and travels are specified by position No. 6 (15, 30, 20, 30), the axes move to the positions (215, 180, 70, 75).

No.(Name)	Axis1	Axis2	Axis3	Axis4	Vel	Acc	Dcl
5( )	200.000	150.000	50.000	45.000			
6( )	15.000	30.000	20.000	30.000			
7( )							

(Note) In the case of a SCARA axis, the axis operates according to all-axis parameter No. 47, “Default PTP acceleration for SCARA axis” or all-axis parameter No. 48, “Default PTP deceleration for SCARA axis” if the acceleration/deceleration is not specified using an ACCS (DCLS) command.
In the case of a linear axis, the axis operates according to all-axis parameter No. 200, “Default acceleration for linear axis” or all-axis parameter No. 201, “Default deceleration for linear axis” if the acceleration/deceleration is not specified in the position data table or using an ACC (DCL) command.

Caution
A margin of error could accumulate between each pitch if the incremental (relative position indication) movement commands are repeated continuously.
To avoid accumulation of errors, utilize the movement command to indicate the absolute position (MOVP Command).

● MVLI (Move via incremental interpolation)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	MVLI	Position number	Prohibited	PE

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Move the actuator, with interpolation, from the current position by the travel distance corresponding to the position number specified in operand 1.
The output will turn OFF at the start of axis movement, and turn ON when the movement is complete.

(Note) In XSEL-PX/QX, a movement to a position that indicates the target for SCARA axis and linear drive axis at the same time cannot be made. (421 “SCARA/Linear Drive Axes Double Indication Error”)
Use GRP Command, or operate the position data of SCARA axis and linear drive axis separately.

(Other than SCARA robots)

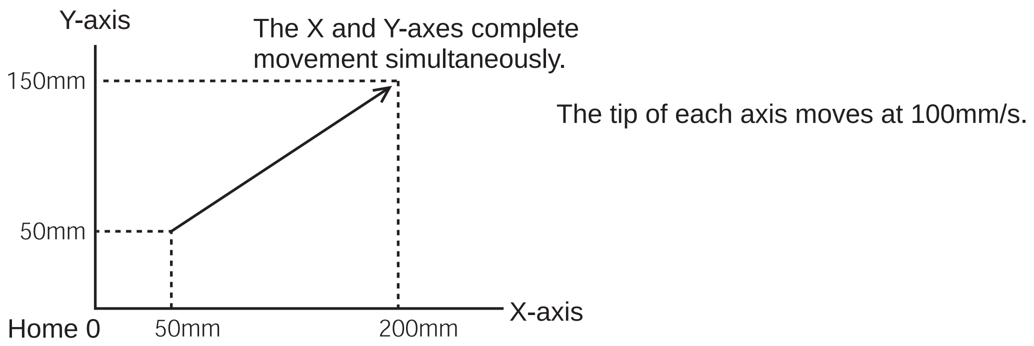
[Example 1]	VEL	100		Set the speed to 100mm/s.
	MVLI	1		If the current position is (50, 50) and position No. 1 is set to (150, 100), the axes will move 150 in the X direction and 100 in the Y direction (200, 150) from the current position, with interpolation.
[Example 2]	VEL	100		Set the speed to 100mm/s.
	LET	1	2	Assign 2 to variable 1.
	MVLI	*1		Move from the current position by the travel distance corresponding to the content of variable 1 (position No. 2, or (100, 100)).

Position Data Display in PC Software

No.	Axis 1 (X-axis)	Axis 2 (Y-axis)	Vel	Acc	Dcl
1	150.000	100.000			
2	100.000	100.000			

(Note) If acceleration and deceleration are not specified by position data or ACC (DCL) commands, the actuator operates at the default values set in all-axis parameter No. 11, “Default acceleration” and all-axis parameter No. 12, “Default deceleration”.

Travel path from (50, 50) by the travel distance corresponding to position No. 1 (150, 100)



(Note) If the specified travel distance is equal to or less than the travel distance per encoder pulse [mm/pulse], the axis may not move.
[Calculation formula of travel distance per encoder pulse]
Rotary encoder
Travel distance per encoder pulse [mm/pulse]
= (Screw lead [0.001mm] × Gear ratio numerator)
/ (Encoder resolution [pulses/rev] × Gear ratio denominator
/ (2 ^ Encoder division ratio)
Linear encoder
Travel distance per encoder pulse [mm/pulse]
= Encoder resolution [0.001μm/pulse] × 1000
/ (2 ^ Encoder division ratio)
(Reference) Use the values of the following parameters for the above calculation formulas:
Encoder resolution : Axis-specific parameter No. 42
Encoder division ratio : Axis-specific parameter No. 43
Screw lead : Axis-specific parameter No. 47
Gear ratio numerator : Axis-specific parameter No. 50
Gear ratio denominator : Axis-specific parameter No. 51

(SCARA robots)
(Note 1) If an incremental movement command (MVPI, MVLI, TMPI or TMLI) is used repeatedly, coordinate conversion rounding errors, etc., will accumulate. To eliminate these errors, etc., execute an absolute movement command (MOVP, MOVL, etc.) once.

[Example 1] MVLI 6 Move from the current position by the travel according to position No. 6.
If the current positions of the axes are specified by position No. 5 (200, 150, 50, 45) and travels are specified by position No. 6 (15, 30, 20, 30), the axes move to the positions (215, 180, 70, 75).

No.(Name)	Axis1	Axis2	Axis3	Axis4	Vel	Acc	Dcl
5( )	200.000	150.000	50.000	45.000			
6( )	15.000	30.000	20.000	30.000			
7( )							

(Note) In the case of a SCARA axis, the axis operates according to all-axis parameter No. 11, “Default CP acceleration for SCARA axis” or all-axis parameter No. 12, “Default CP deceleration for SCARA axis” if the acceleration/deceleration is not specified in the position data or using an ACC (DCL) command.
In the case of a linear axis, the axis operates according to all-axis parameter No. 200, “Default acceleration for linear axis” or all-axis parameter No. 201, “Default deceleration for linear axis” if the acceleration/deceleration is not specified in the position data or using an ACC (DCL) command.

Caution
A margin of error could accumulate between each pitch if the incremental (relative position indication) movement commands are repeated continuously.
To avoid accumulation of errors, utilize the movement command to indicate the absolute position (MOVL Command).

● MOVD (Move via direct value specification)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	MOVD	Target position	(Axis pattern)	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	×	×	×	○	×	○ (PC/PG only)

[Function] Move the axis specified by the axis pattern in operand 2, to the target position corresponding to the value specified in operand 1. If operand 2 is not specified, all axes will be moved.
The output will turn OFF at the start of axis movement, and turn ON when the movement is complete.
The target position is set in mm, and the set value is valid to the third decimal place.

[Example 1]	MOVD	100	10	Move axis 2 to position 100.
[Example 2]	LET	1	100	Assign 100 to variable 1.
	MOVD	*1	11	Move all axes to the content of variable 1 (100).

● MVDI (Move relatively via direct value specification)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	MVDI	Travel distance	(Axis pattern)	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	×	×	×	○	×	○ (PC/PG only)

[Function] Move the axis specified by the axis pattern in operand 2 from its current position by the travel distance corresponding to the value specified in operand 1. If operand 2 is not specified, all axes will be moved.
The output will turn OFF at the start of axis movement, and turn ON when the movement is complete.
The travel distance is set in mm, and the set value is valid to the third decimal place.

(Note) If the specified travel distance is equal to or less than the travel distance per encoder pulse [mm/pulse], the axis may not move.
[Calculation formula of travel distance per encoder pulse]
Rotary encoder
Travel distance per encoder pulse [mm/pulse]
= (Screw lead [0.001mm] × Gear ratio numerator)
/ (Encoder resolution [pulses/rev] × Gear ratio denominator
/ (2 ^ Encoder division ratio)
Linear encoder
Travel distance per encoder pulse [mm/pulse]
= Encoder resolution [0.001μm/pulse] × 1000
/ (2 ^ Encoder division ratio)
(Reference) Use the values of the following parameters for the above calculation formulas:
Encoder resolution : Axis-specific parameter No. 42
Encoder division ratio : Axis-specific parameter No. 43
Screw lead : Axis-specific parameter No. 47
Gear ratio numerator : Axis-specific parameter No. 50
Gear ratio denominator : Axis-specific parameter No. 51

[Example 1] MVDI 30 11 Move all axes from the current position by 30mm in the positive direction.

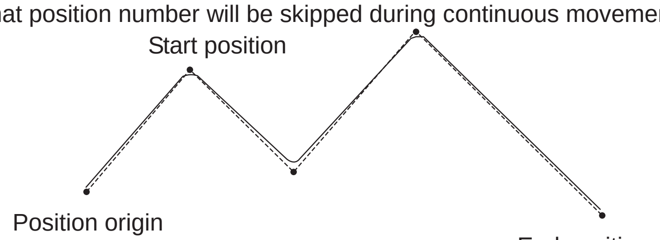
[Example 2] LET 1 -100 Assign -100 to variable 1.
MVDI *1 1 Move axis 1 from the current position in accordance with the content of variable 1 (-100), or by 100mm in the negative direction.

● PATH (Move along path via CP operation)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PATH	Start position number	End position number	PE

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Move continuously from the position specified in operand 1 to the position specified in operand 2.
The output type in the output field can be set using an actuator-declaration command POTP.
Increasing the acceleration will make the passing points closer to the specified positions.
If invalid data is set for any position number between the start and end position numbers, that position number will be skipped during continuous movement.

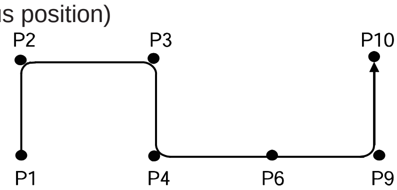


(Note 1) Multi-dimensional movement can be performed using a PATH command.
In this case, input in operand 1 the point number of the next target, instead of the predicted current position upon execution of the applicable command.
(Inputting a point number corresponding to the predicted current position will trigger movement to the same point during continuous movement, thereby causing the speed to drop.)

(Note 2) It is possible to move through discontinuous positions or move continuously by passing the same position.
As shown in the example, specify the number corresponding to the discontinuous position for both the start position number and end position number in the PATH command. In the example, this position is No. 6.

[Example] The actuator moves continuously in the sequence of position No. 1 → 2 → 3 → 4 → 6 → 9 → 10.

```
PATH    1    4
PATH    6    6 (discontinuous position)
PATH    9    10
```



(Note 3) In XSEL-PX/QX, a movement to a position that indicates the target for SCARA axis and linear drive axis at the same time cannot be made. (421 “SCARA/Linear Drive Axes Double Indication Error”)
Use GRP Command, or operate the position data of SCARA axis and linear drive axis separately.

[Example 1] PATH 100 120 Move continuously from position No. 100 to 120.

● J☐W☐ (Jog)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	J☐W☐	Axis pattern	Input/output/ flag number	PE

Applicable models
XSEL-JX/KX ×   Other than XSEL-JX/KX ○

[Function] The axes in the axis pattern specified in operand 1 will move forward or backward while the input or output port or flag specified in operand 2 is ON or OFF.

JBWF .... Move backward while the specified port is OFF.
JBWN.......... Move backward while the specified port is ON.
JFWF .... Move forward while the specified port is OFF.
JFWN.......... Move forward while the specified port is ON.

With SCARA axes, only one axis (X, Y, Z or R-axis) can be specified. If a SCARA axis is specified, operation (CP operation) based on the currently selected work coordinate system is applied. With linear axis, multiple axes can be specified.
(SCARA axes are supported with application Ver.0.33 or later)

(Note 1) In main application Ver.0.33 or older, “Error No. B80: Specification-prohibited axis error” or “Error No. 421: SCARA/linear-axis simultaneous specification error” occurs if a SCARA axis is specified.

(Note 2) With linear axes, this command is also effective on axes that have not yet performed home return. In this case, however, the maximum speed is limited to all-axis parameter No. 15, “Maximum jog speed before coordinate confirmation/home return”. Since the coordinate values have no meaning in this condition, pay due attention to prevent contact with the stroke end. With SCARA axes, operation by this command is disabled only before the confirmation of ABS coordinates.

(Note 3) The jog speed of a SCARA axis is limited by all-axis parameter No. 37, “Maximum SCARA-axis speed under J☐W☐ command” (default: 250mm/sec). This parameter can be edited using PC software Ver.7.0.11.0 or later, teaching pendant (IA-T-X) Ver.1.44 or later or teaching pendant (SEL-T) Ver.1.01 or later. (Although the value set in the above parameter can also be changed using an older PC software or teaching pendant version, the parameter name is not displayed and the set value is indicated in hexadecimal notation.)

(Note 4) Axes other than the Z-axis cannot be operated from other tasks while the X, Y or R-axis is jogging.

(Note 5) If the start position of operation of a SCARA axis is near the point at which arms 1 and 2 form a straight line (singular point), operation is performed at low acceleration to prevent sudden movement.

(Note 6) If the start position of operation of a SCARA axis is outside the work envelope (within the soft limit overt points of each axis, CP operation limit band, tool-reference-point entry prohibition circle (if tool offset is enabled) or back entry prohibition area), select an appropriate axis and direction and move the axis to inside the work envelope. Jogging out of the work envelope is not permitted.

(Note 7) If the R-axis generates "Error No. C74: Actual-position soft limit over error" due to a posture control component, etc., during SCARA-axis jog operation, take an appropriate action, such as bringing the R-axis position closer to the center of the R-axis stroke, using the jog function for each axis in the PC software or on the teaching pendant.

(Note 8) When tool offset for SCARA axis is enabled (tool coordinate system selection number is not 0), jogging of the R-axis involves rotation at the tool tip and thus arms 1 and 2 move. Exercise caution.

(Note 9) If the axis that moves according to J☐W☐ is a linear axis, and also if axis-specific parameter No. 1, "Axis operation type" is set to 0 (Linear movement axis) while axis-specific parameter No. 68, "Linear-axis linear movement mode selection" is set to 1 (Infinite stroke mode*), infinite stroke operation is performed.
During infinite stroke operation, the current position circulates within a range of approx. -10m to 10m.
Any positioning command to a position outside a coordinate range of approx. -9999 to +9990 generates "Error No. CBE: Target-value data boundary over error".
If a positioning command not meeting the above condition is executed outside a coordinate range of approx. -9990 to +9990, "Error No. CC5: Positioning boundary breakout error" occurs.
(These errors are generated intentionally because the user cannot recognize the operating direction precisely around the boundary. If any of these errors occurs, axis-specific parameter No. 10, "ABS reset position movement/home return method" must be set to 1 (Current position 0 home) and, if necessary, the current value may also have to be reset with a HOME command.)
During infinite stroke operation, be sure to implement a timeout check using other task or external system.

The infinite-stroke mode can be specified only when an incremental encoder is used. If you wish to use the infinite-stroke mode, contact IAI's Sales Engineering.

[Example 1]

VEL	100		Set the speed to 100mm/s.
JBWF	10000	10	Move axis 5 backward while input 10 is OFF.

[Example 2]

The axis pattern can be specified indirectly using a variable.
When the command in [Example 1] is rephrased based on indirect specification using a variable:
10000 (binary) → 16 (decimal)

VEL	100		Set the speed to 100mm/s.
LET	1	16	Assign 12 to variable 1.
JBWF	*1	10	

[Example 3]

VEL	100		Set the speed to 100mm/s.
LET	5	20	Assign 20 to variable 5.
JFWN	10000	*5	Move axis 5 forward while the content of variable 5 (input 20), is ON.

● STOP (Stop movement)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	STOP	Axis pattern	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Decelerate and stop the axes specified by the axis pattern in operand 1.

(Note 1) A STOP command can be used with all active servo commands other than a SVOF command.

(Note 2) With a SCARA robots, all axes are decelerated to a stop regardless of the axis pattern.

(Note 3) The STOP command only issues a deceleration stop (operation cancellation) command and the program does not wait for completion of stopping. If other servo command is issued while the axes are stopping, the command becomes invalid or an “axis multiple-use” or other error occurs.
Set a timer, etc., in the program so that the next servo command will be issued after a sufficient deceleration-stop processing time elapses.
Even when a STOP command is to be issued to an axis currently stopped, provide a minimum interval of 0.1sec before the next servo command is issued.

(Other than SCARA robots)
[Example 1] STOP 11 Decelerate and stop axes 1 and 2.

[Example 2] The axis pattern can be specified indirectly using a variable.
When the command in [Example 1] is rephrased based on indirect specification using a variable:
11 (binary) → 3 (decimal)
LET 1 3 Assign 3 to variable 1.
STOP *1

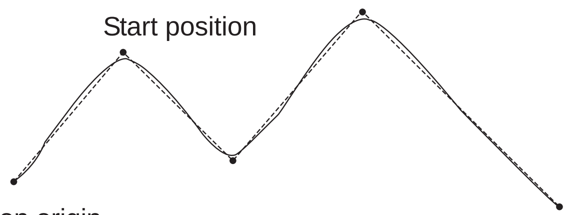
(SCARA robot)
[Example 1] STOP 1 Decelerate the SCARA axes to a stop.

● PSPL (Move along spline via CP operation)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PSPL	Start position number	End position number	PE

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Continuously move from the specified start position to end position via interpolation along a spline-interpolation curve.
The output type in the output field can be set using an actuator-declaration command POTP.
If invalid data is set for any position number between the start and end position numbers, that position number will be skipped during continuous movement.



(The diagram above is an image.)

(Note 1) If the acceleration and deceleration are different between points, the speeds will not be connected smoothly.

In this case, input in operand 1 the point number of the next target, instead of the predicted current position upon execution of the applicable command.
(Inputting a point number corresponding to the predicted current position will trigger movement to the same point during continuous movement, thereby causing the speed to drop.)

(Note 2) In XSEL-PX/QX, a movement to a position that indicates the target for SCARA axis and linear drive axis at the same time cannot be made. (421 “SCARA/Linear Drive Axes Double Indication Error”)
Use GRP Command, or operate the position data of SCARA axis and linear drive axis separately.

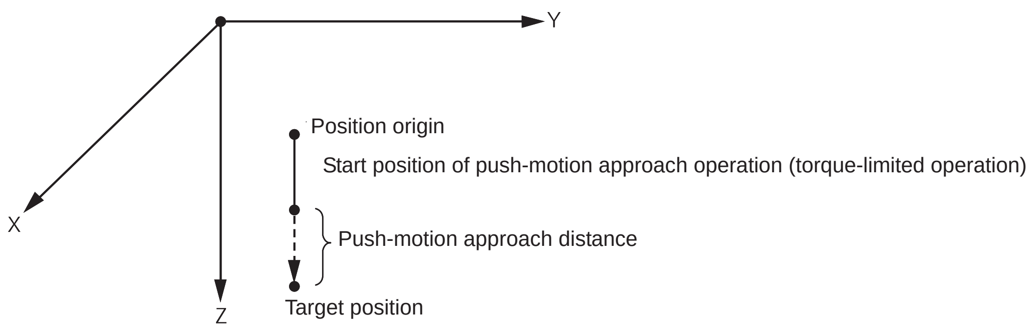
[Example] PSPL 100 120 Continuously move from position Nos. 100 to 120 along a spline-interpolation curve.

● PUSH (Move by push motion)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PUSH	Target position number	Prohibited	PE

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Perform push-motion operation until the target position specified in operand 1 is reached.
The axes move in a normal mode from the position origin to the push-motion approach start position as determined by a PAPR command, after which push-motion approach operation (toque-limiting operation) will be performed. The speed of push-motion approach operation (toque-limiting operation) is determined by the push-motion approach speed specified by a PAPR command. If the output field is specified, the output will turn ON when a contact is confirmed, and turn OFF when a missed contact is detected.
Movement from the position origin to start position of push-motion approach conforms to the speed and acceleration/deceleration specified by VEL/ACC/DCL commands or in the position data table.



The pressing force can be adjusted in Driver Card Parameter No. 38 Limitation for pressing torque in positioning process (default value = 70%) or PTRQ Command.

(Note 1) A PUSH command only moves a single axis. If multiple axes are specified, an “Error No. C91, Multiple push-axes specification error” will generate.

(Note 2) A push-motion approach speed exceeding the maximum speed permitted by the system will be clamped at the maximum speed.
(The maximum system speed is not the maximum practical speed. Determine a practical speed by considering the impact upon contact, etc.)

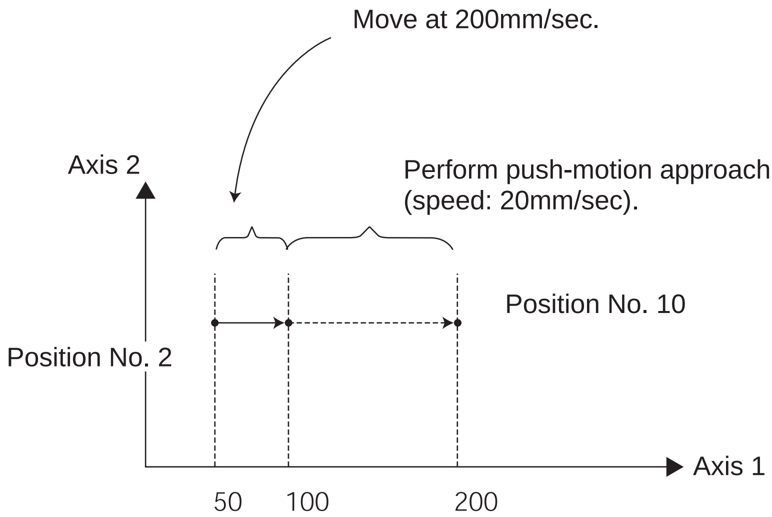
[Example] PAPR 100 20
MOVP 2
PUSH 10

Set the push-motion approach distance to 100mm and push-motion approach speed to 20mm/sec.
Move from the current position to position No. 2.
Perform push-motion movement from position No. 2 to 10.

The diagram below describes a push-motion movement based on the position data shown in the table below:

Position Data Display in PC Software

Position No.	Axis 1	Axis 2	Vel	Acc	Dcl
1					
2	50.000	100.000			
•					
•					
•					
•					
10	200.000		200	0.30	0.30
•					
•					



[12] Actuator Control Command

● PTRQ (Change push torque limit parameter)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PTRQ	Axis pattern	Ratio	CC

Applicable models
XSEL-J/K ×   Other than XSEL-J/K ○

[Function] Change the push torque limit parameter of the axis pattern specified in operand 1 to the value in operand 2. Operand 2 is set as an integer (unit: %).
A PTRQ command temporarily rewrites “Driver parameter No. 38: Push torque limit at positioning”.

(Note 1) If a push torque limit is not set by a PTRQ command, the value set in “Driver parameter No. 38: Push torque limit at positioning” will be used.

(Note 2) The new push torque limit will remain effective even after the program ends. Therefore, when building a system using the PTRQ command, in every program explicitly specify a push torque limit using a PTRQ command before each push-motion operation. Assuming that the push torque limit will be reset to the original value when push-motion operation ends in one program can cause an unexpected problem in another program, because a different push torque limit will be used if the program is aborted due to an error, etc.

(Note 3) The new value set by a PTRQ command will become ineffective after a power ON reset or software reset.

(Note 4) A PTRQ command does not rewrite “Driver parameter No. 38: Push torque limit at positioning” (main CPU flash memory (non-volatile memory)).

[Example]

PTRQ	1	50	Change the push torque limit parameter for axis 1 to 50%.
PAPR	100	20	Set the push-motion approach distance to 100mm and the push-motion approach speed to 20mm/sec.
MOVP	2		Move to position No. 2.
PUSH	10		Move by push motion from position No. 2 to position No. 10.

● CIR2 (Move along circle via CP operation 2 (Arc interpolation))

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	CIR2	Passing position 1 number	Passing position 2 number	PE

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Move along a circle originating from the current position and passing positions 1 and 2, via arc interpolation.
The rotating direction of the circle is determined by the given position data.
The diagram below describes a CW (clockwise) movement. Reversing passing positions 1 and 2 will change the direction of movement to CCW (counterclockwise).

(Other than XSEL-JX/KX/PX/QX/RX/SX/RXD/SXD and MSEL-PCX/PGX)
The speed and acceleration will take valid values based on the following priorities:

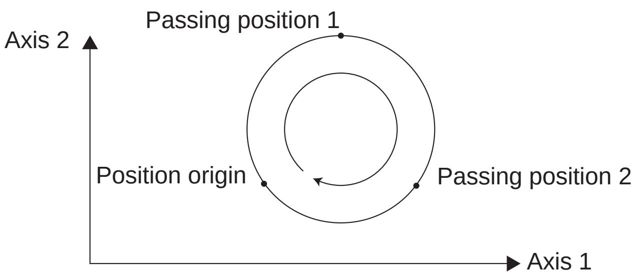
Priority	Speed	Acceleration (deceleration)
1	Setting value in the position data specified in operand 1	Setting value in the position data specified in operand 1
2	Setting value by VEL command	Setting value by ACC (DCL) command
3		Default acceleration in all-axis parameter No. 11 (Default deceleration in all-axis parameter No. 12)

If speed is not set, a “C88 speed specification error” will generate.
If acceleration/deceleration is not valid, a “C89 acceleration/deceleration specification error” will generate.

(XSEL-JX/KX/PX/QX/RX/SX/RXD/SXD and MSEL-PCX/PGX)
The speed and acceleration will take valid values based on the following priorities:

Priority	Speed	Acceleration (deceleration)
1	Setting value in the position data specified in operand 1	Setting value in the position data specified in operand 1
2	Setting value by VEL command	Setting value by ACC (DCL) command
3		All-axis parameter No. 11, “Default acceleration for SCARA axis” (All-axis parameter No. 12, “Default deceleration for SCARA axis”) All-axis parameter No. 200, “Default acceleration for linear axis” (All-axis parameter No. 201, “Default deceleration for linear axis”)

If speed is not set, a “C88 speed specification error” will generate.
If acceleration/deceleration is not valid, a “C89 acceleration/deceleration specification error” will generate.



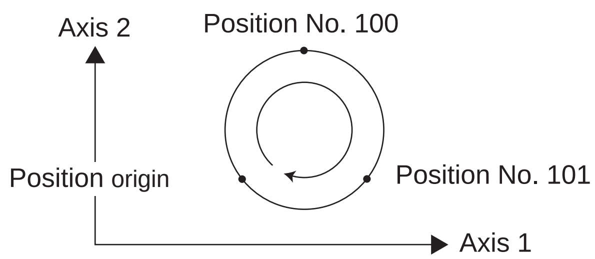
(Note 1) With rectangular actuators, this command is valid on any rectangular planes. If three or more axes are set in the position data, two axes are selected automatically from the axes that have been set, starting from the axis of the youngest number.
If position data is set for axes 2 to 4, for example, a CIR2 command is executed based on the position data of axes 2 and 3.

(Note 2) SCARA axes are available only on XY plane.

(Note 3) If the distance between the position origin and passing position 1 or between passing position 1 and passing position 2 is small and the path is near a soft limit, “Error No. C73: Target-path soft limit over error” may occur.
In this case, increase the distance between the adjacent positions as much as possible, move the path slightly inward from the soft limit boundary, or make other appropriate correction.

(Note 4) XSEL-PX/QX/RX/SX/RXD/SXD cannot make a movement to draw an arch using the SCARA axes and liner axes, or using the SCARA axes (axes 1 to 4) and SCARA axes (axes 5 to 8). Either B80 “Indication Prohibited Axes Error” or 421 “SCARA/Linear Drive Axes Double Indication Error” will occur. Use GRP Command, or operate the position data of SCARA axis and linear drive axis separately.

[Example]				
	VEL	100		Set the speed to 100mm/s.
	CIR2	100	101	Move along a circle (circular interpolation) passing position No. 100 and 101.



● ARC2 (Move along circle via CP operation 2 (Arc interpolation))

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	ARC2	Passing position number	End position number	PE

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Move along an arc originating from the current position, passing the specified position and terminating at the end position, via arc interpolation.

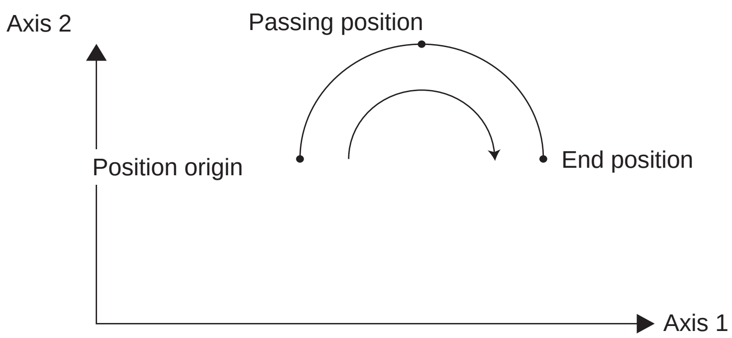
(Other than XSEL-JX/KX/PX/QX/RX/SX/RXD/SXD and MSEL-PCX/PGX)
The speed and acceleration will take valid values based on the following priorities:

Priority	Speed	Acceleration (deceleration)
1	Setting value in the position data specified in operand 1	Setting value in the position data specified in operand 1
2	Setting value by VEL command	Setting value by ACC (DCL) command
3		Default acceleration in all-axis parameter No. 11 (Default deceleration in all-axis parameter No. 12)

(XSEL-JX/KX/PX/QX/RX/SX/RXD/SXD and MSEL-PCX/PGX)
The speed and acceleration will take valid values based on the following priorities:

Priority	Speed	Acceleration (deceleration)
1	Setting value in the position data specified in operand 1	Setting value in the position data specified in operand 1
2	Setting value by VEL command	Setting value by ACC (DCL) command
3		All-axis parameter No. 11, "Default acceleration for SCARA axis" (All-axis parameter No. 12, "Default deceleration for SCARA axis") All-axis parameter No. 200, "Default acceleration for linear axis" (All-axis parameter No. 201, "Default deceleration for linear axis")

If speed is not set, a "C88 speed specification error" will generate.
If acceleration/deceleration is not valid, a "C89 acceleration/deceleration specification error" will generate.



(Note 1) With rectangular actuators, this command is valid on any rectangular planes. If three or more axes are set in the position data, two axes are selected automatically from the axes that have been set, starting from the axis of the youngest number.
If position data is set for axes 2 to 4, for example, a ARC2 command is executed based on the position data of axes 2 and 3.

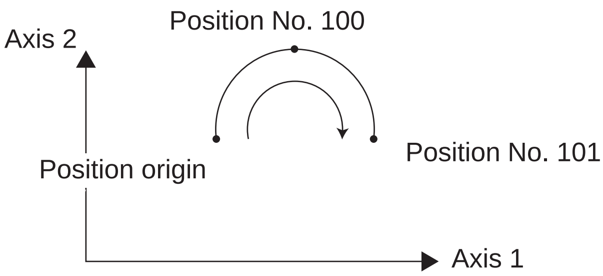
(Note 2) SCARA axes are available only on XY plane.

(Note 3) If the distance between the position origin and passing position 1 or between passing position 1 and passing position 2 is small and the path is near a soft limit, "Error No. C73: Target-path soft limit over error" may occur.
In this case, increase the distance between the adjacent positions as much as possible, move the path slightly inward from the soft limit boundary, or make other appropriate correction.

(Note 4) XSEL-PX/QX/RX/SX/RXD/SXD cannot make a movement to draw an arch using the SCARA axes and liner axes, or using the SCARA axes (axes 1 to 4) and SCARA axes (axes 5 to 8). Either B80 "Indication Prohibited Axes Error" or 421 "SCARA/Linear Drive Axes Double Indication Error" will occur. Use GRP Command, or operate the position data of SCARA axis and linear drive axis separately.

[Example]

VEL	100		Set the speed to 100mm/s.
ARC2	100	101	Move along an arc (circular interpolation) from the current position to position No. 101 by passing position No. 100.

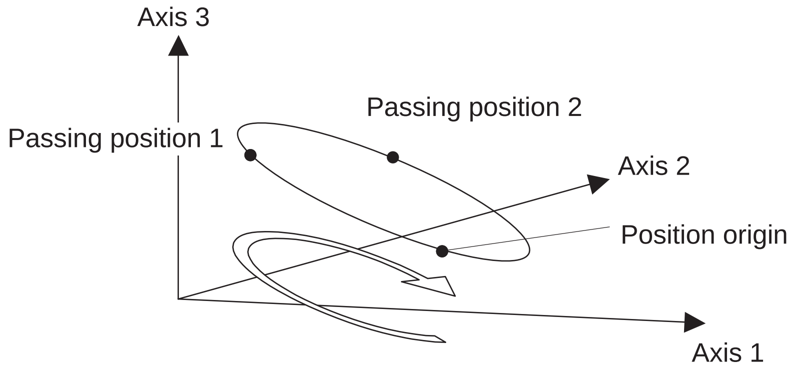


● CIRS (Move along circle three-dimensionally via CP operation)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	CIRS	Passing position 1 number	Passing position 2 number	PE

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Move along a circle by passing the passing positions 1 and 2 in this order, starting from the current position being the origin (three-dimensional movement). The direction in which to go around the circle is determined by the position data given. In the figure below, the rotating direction is reversed if passing positions 1 and 2 are swapped.



(Other than XSEL-JX/KX/PX/QX/RX/SX/RXD/SXD and MSEL-PCX/PGX)
The speed and acceleration will take valid values based on the following priorities:

Priority	Speed	Acceleration	Deceleration
1	Setting value in the position data specified in operand 1	Setting value in the position data specified in operand 1	Same as the effective value of acceleration
2	Setting value by VEL command	Setting value by ACC command	
3		Default acceleration in all-axis parameter No. 11	

(XSEL-JX/KX/PX/QX/RX/SX/RXD/SXD and MSEL-PCX/PGX)
The speed and acceleration will take valid values based on the following priorities:

Priority	Speed	Acceleration (deceleration)
1	Setting value in the position data specified in operand 1	Setting value in the position data specified in operand 1
2	Setting value by VEL command	Setting value by ACC (DCL) command
3		All-axis parameter No. 11, “Default acceleration for SCARA axis” (All-axis parameter No. 12, “Default deceleration for SCARA axis”) All-axis parameter No. 200, “Default acceleration for linear axis” (All-axis parameter No. 201, “Default deceleration for linear axis”)

If speed is not set, a “C88 speed specification error” will generate.
If acceleration/deceleration is not valid, a “C89 acceleration/deceleration specification error” will generate.

(Note 1) This command is valid on any planes in three-dimensional space. If four or more axes are set in the position data, three axes are selected automatically from the axes that have been set, starting from the axis of the youngest number.
If position data is set for axes 2 to 5, for example, a CIRS command is executed based on the position data of axes 2 to 4.

(Note 2) The path tends to shift inward as the speed rises. Minor correction such as setting the position data slightly outward may be required.

(Note 3) If the diameter of the circle is smaller relative to the set speed, the speed may be limited.
(Although the extent to which the speed is limited can be reduced by raising the acceleration/acceleration, make sure the acceleration and deceleration do not exceed the range permitted by the actuator.)

(Note 4) If the distance between the position origin and passing position 1 or between passing position 1 and passing position 2 is small and the path is near a soft limit, “Error No. C73: Target-path soft limit over error” may occur.
In this case, increase the distance between the adjacent positions as much as possible, move the path slightly inward from the soft limit boundary, or make other appropriate correction.

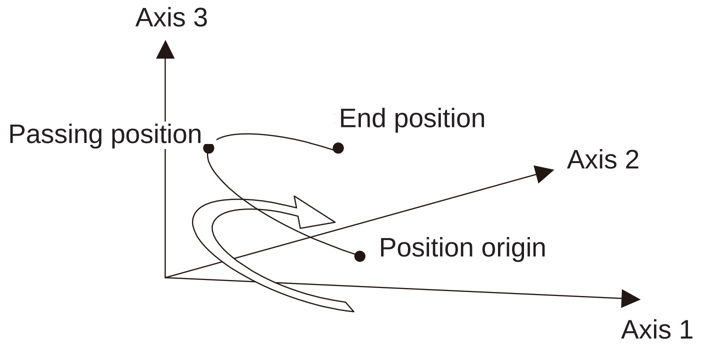
(Note 5) XSEL-PX/QX/RX/SX/RXD/SXD cannot make a movement to draw an arch using the SCARA axes and liner axes, or using the SCARA axes (axes 1 to 4) and SCARA axes (axes 5 to 8). Either B80 “Indication Prohibited Axes Error” or 421 “SCARA/Linear Drive Axes Double Indication Error” will occur. Use GRP Command, or operate the position data of SCARA axis and linear drive axis separately.

● ARCS (Move along arc three-dimensionally via CP operation)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	ARCS	Passing position number	End position number	PE

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Move to the end position along an arc by passing the passing position, starting from the current position being the origin (three-dimensional movement).



(Other than XSEL-JX/KX/PX/QX/RX/SX/RXD/SXD and MSEL-PCX/PGX)
The speed and acceleration will take valid values based on the following priorities:

Priority	Speed	Acceleration	Deceleration
1	Setting value in the position data specified in operand 1	Setting value in the position data specified in operand 1	Same as the effective value of acceleration
2	Setting value by VEL command	Setting value by ACC command	
3		Default acceleration in all-axis parameter No. 11	

(XSEL-JX/KX/PX/QX/RX/SX/RXD/SXD and MSEL-PCX/PGX)
The speed and acceleration will take valid values based on the following priorities:

Priority	Speed	Acceleration (deceleration)
1	Setting value in the position data specified in operand 1	Setting value in the position data specified in operand 1
2	Setting value by VEL command	Setting value by ACC (DCL) command
3		All-axis parameter No. 11, “Default acceleration for SCARA axis” (All-axis parameter No. 12, “Default deceleration for SCARA axis”) All-axis parameter No. 200, “Default acceleration for linear axis” (All-axis parameter No. 201, “Default deceleration for linear axis”)

If speed is not set, a “C88 speed specification error” will generate.
If acceleration/deceleration is not valid, a “C89 acceleration/deceleration specification error” will generate.

(Note 1) This command is valid on any planes in three-dimensional space. If four or more axes are set in the position data, three axes are selected automatically from the axes that have been set, starting from the axis of the youngest number.
If position data is set for axes 2 to 5, for example, a ARCS command is executed based on the position data of axes 2 to 4.

(Note 2) The path tends to shift inward as the speed rises. Minor correction such as setting the position data slightly outward may be required.

(Note 3) If the diameter of the circle is smaller relative to the set speed, the speed may be limited.
(Although the extent to which the speed is limited can be reduced by raising the acceleration/acceleration, make sure the acceleration and deceleration do not exceed the range permitted by the actuator.)

(Note 4) If the distance between the position origin and passing position 1 or between passing position 1 and passing position 2 is small and the path is near a soft limit, “Error No. C73: Target-path soft limit over error” may occur.
In this case, increase the distance between the adjacent positions as much as possible, move the path slightly inward from the soft limit boundary, or make other appropriate correction.

(Note 5) XSEL-PX/QX/RX/SX/RXD/SXD cannot make a movement to draw an arch using the SCARA axes and liner axes, or using the SCARA axes (axes 1 to 4) and SCARA axes (axes 5 to 8). Either B80 “Indication Prohibited Axes Error” or 421 “SCARA/Linear Drive Axes Double Indication Error” will occur. Use GRP Command, or operate the position data of SCARA axis and linear drive axis separately.

● CHVL (Dedicated command for linear axis: Change speed)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	CHVL	Axis pattern	Speed	CP

Applicable models
XSEL-JX/KX ×   Other than XSEL-JX/KX ○

[Function] Change the speed of the axes operating in other task.
When a CHVL command is executed, the speed of the axes specified in operand 1 will change to the value specified in operand 2.

(Note 1) This command is not valid on an axis operated by a CIR, ARC, PSPL, PUSH, or ARCH command.

(Note 2) Executing a CHVL command for an axis operating in sigmoid motion (SCRV command) will generate an "Error No. CC1, Speed-change condition error".

(Note 3) This is a temporary speed-change command issued from other task to the active packet (point). It is not affected by the data declared by VEL.

Program 1	Program 2
	VEL 300
	•
	•
	MOVP 1
CHVL 11 100	MOVP 2
	MOVP 3
	•
	•

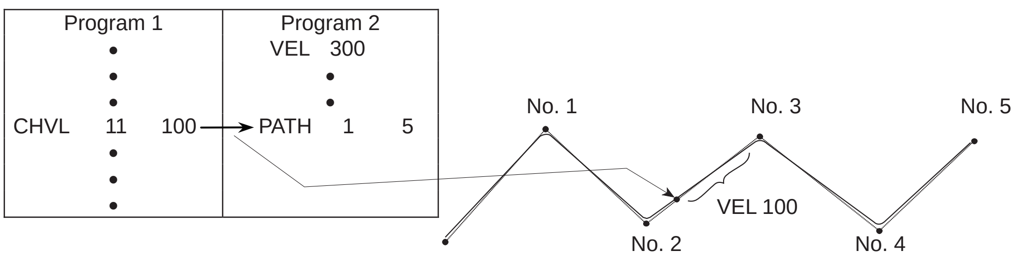
If CHVL is executed in program 1 while MOVP 2 is executed in program 2, the travel speed of MOVP 2 will become 100mm/sec.
The speeds of other move commands will remain 300mm/sec.

The axis pattern can be specified indirectly using a variable.
When program 1 is rephrased based on indirect specification using a variable:

11 (binary) → 3 (decimal)

LET	1	3	Assign 3 to variable 1.
CHVL	*1	100	

(Note 4) Since this command is valid only for the packet that is active at the time of execution of the command for an axis subject to continuous motion in a PATH command, etc., caution must be exercised against the timing shift. The packet handling will be put on hold during speed-change processing, so caution must also be exercised against the locus shift.



If CHVL is executed in program 1 while PATH is executed in program 2, or specifically during the PATH movement from point No. 2 to point No. 3, the speed specified by CHVL (100mm/sec in the above example) will become valid only during the PATH movement to point No. 3. Other travel speeds will remain at the speed specified by VEL (300mm/sec in the above example).

(Note 5) Override of the CHVL call task will be applied, so caution must be exercised.

(Note 6) The maximum speed of the specified axis completing home return will be clamped by the minimum value set in “Axis-specific parameter No. 28, Maximum operating speed of each axis” or “Axis-specific parameter No. 27, Maximum speed limited by maximum motor speed” with respect to the specified axis and related interpolation axes currently operating. To prevent the maximum speed from being limited due to the effect of other axis whose maximum speed is lower than the speed specified in the CHVL command, issue a CHVL command in multiple steps corresponding to the respective axes having different maximum speeds. In particular, specification of a CHVL command in a separate step is recommended for a rotating axis.

(Note 7) This command is dedicated for the liner axes only. “Error No. 80 Indication Prohibited Axis Error” will be issued if the SCARA axes are indicated, or SCARA axes and the liner axes are indicated at the same time.

[Example]	CHVL	11	500	⇒	CHVL	1	500
					CHVL	10	500

● ARCD (Move along arc via CP operation by specifying end position and center angle (Arc interpolation))

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	ARCD	End position number	Center angle	PE

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Move along a circle originating from the current position and passing positions 1 and 2, via arc interpolation.
The rotating direction of the circle is determined by the given position data.
The diagram below describes a CW (clockwise) movement. Reversing passing positions 1 and 2 will change the direction of movement to CCW (counterclockwise).
The setting unit of the center angle is degree and the set value is effective to three decimal points.

(Note) The rotating direction of the actual operation locus may vary from the specified direction depending on how each axis is installed, how the two axes are combined, and so on. Perform test operation to check the rotating direction.
The setting unit of the center angle is degree and the set value is effective to three decimal points.

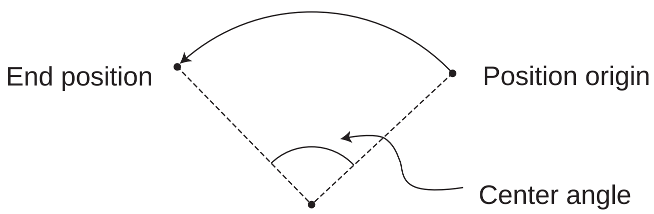
(Other than XSEL-JX/KX/PX/QX/RX/SX/RXD/SXD and MSEL-PCX/PGX)
The speed and acceleration will take valid values based on the following priorities:

Priority	Speed	Acceleration (deceleration)
1	Setting value in the position data specified in operand 1	Setting value in the position data specified in operand 1
2	Setting value by VEL command	Setting value by ACC (DCL) command
3		Default acceleration in all-axis parameter No. 11 (Default deceleration in all-axis parameter No. 12)

(XSEL-JX/KX/PX/QX/RX/SX/RXD/SXD and MSEL-PCX/PGX)
The speed and acceleration will take valid values based on the following priorities:

Priority	Speed	Acceleration (deceleration)
1	Setting value in the position data specified in operand 1	Setting value in the position data specified in operand 1
2	Setting value by VEL command	Setting value by ACC (DCL) command
3		All-axis parameter No. 11, “Default acceleration for SCARA axis” (All-axis parameter No. 12, “Default deceleration for SCARA axis”) All-axis parameter No. 200, “Default acceleration for linear axis” (All-axis parameter No. 201, “Default deceleration for linear axis”)

If speed is not set, a “C88 speed specification error” will generate.
If acceleration/deceleration is not valid, a “C89 acceleration/deceleration specification error” will generate.



(Note 1) With rectangular actuators, this command is valid on any rectangular planes. If three or more axes are set in the position data, two axes are selected automatically from the axes that have been set, starting from the axis of the youngest number.
If position data is set for axes 2 to 4, for example, a ARCD command is executed based on the position data of axes 2 and 3.

(Note 2) SCARA axes are available only on XY plane.

(Note 3) If the center angle is small and the path is near a soft limit, "Error No. C73: Target-path soft limit over error" may occur.
In this case, move the path slightly inward from the soft limit boundary or make other appropriate correction. Also note that the larger the center angle, the smaller the path error becomes.

(Note 4) XSEL-PX/QX/RX/SX/RXD/SXD cannot make a movement to draw an arch using the SCARA axes and liner axes, or using the SCARA axes (axes 1 to 4) and SCARA axes (axes 5 to 8). Either B80 "Indication Prohibited Axes Error" or 421 "SCARA/Linear Drive Axes Double Indication Error" will occur. Use GRP Command, or operate the position data of SCARA axis and linear drive axis separately.

[Example]

VEL	100		Set the speed to 100mm/s.
ARCD	100	120	Move along an arc from the position origin to position No. 100 for a center angle of 120° (CCW direction).

● ARCC (Move along arc via CP operation by specifying center position and center angle (Arc interpolation))

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	ARCC	Center position number	Center angle	PE

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Move along an arc originating from the current position by keeping a specified radius from the center position, via arc interpolation.
Specify the center position in operand 1, and the center angle formed by the position origin and end position in operand 2. The center angle is set in a range from -3600 to 3600° (±10 revolutions). A positive value indicates CCW (counterclockwise-direction) movement, while a negative value indicates CW (clockwise-direction) movement (setting unit: °(degree)).
The setting unit of the center angle is degree and the set value is effective to three decimal points.

(Note) The rotating direction of the actual operation locus may vary from the specified direction depending on how each axis is installed, how the two axes are combined, and so on. Perform test operation to check the rotating direction.
The setting unit of the center angle is degree and the set value is effective to three decimal points.

(Other than XSEL-JX/KX/PX/QX/RX/SX/RXD/SXD and MSEL-PCX/PGX)
The speed and acceleration will take valid values based on the following priorities:

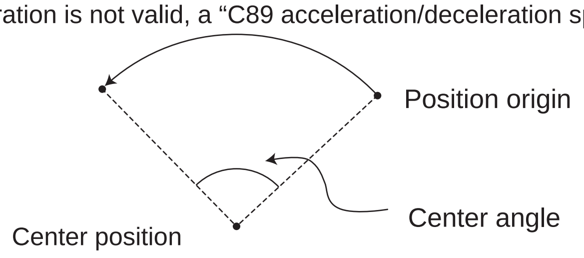
Priority	Speed	Acceleration (deceleration)
1	Setting value in the position data specified in operand 1	Setting value in the position data specified in operand 1
2	Setting value by VEL command	Setting value by ACC (DCL) command
3		Default acceleration in all-axis parameter No. 11 (Default deceleration in all-axis parameter No. 12)

(XSEL-JX/KX/PX/QX/RX/SX/RXD/SXD and MSEL-PCX/PGX)
The speed and acceleration will take valid values based on the following priorities:

Priority	Speed	Acceleration (deceleration)
1	Setting value in the position data specified in operand 1	Setting value in the position data specified in operand 1
2	Setting value by VEL command	Setting value by ACC (DCL) command
3		All-axis parameter No. 11, "Default acceleration for SCARA axis" (All-axis parameter No. 12, "Default deceleration for SCARA axis") All-axis parameter No. 200, "Default acceleration for linear axis" (All-axis parameter No. 201, "Default deceleration for linear axis")

If speed is not set, a "C88 speed specification error" will generate.

If acceleration/deceleration is not valid, a "C89 acceleration/deceleration specification error" will generate.



(Note 1) With rectangular actuators, this command is valid on any rectangular planes. If three or more axes are set in the position data, two axes are selected automatically from the axes that have been set, starting from the axis of the youngest number.
If position data is set for axes 2 to 4, for example, a ARCC command is executed based on the position data of axes 2 and 3.

(Note 2) SCARA axes are available only on XY plane.

(Note 3) If the center angle is small and the path is near a soft limit, “Error No. C73: Target-path soft limit over error” may occur.
In this case, move the path slightly inward from the soft limit boundary or make other appropriate correction. Also note that the larger the center angle, the smaller the path error becomes.

(Note 4) XSEL-PX/QX/RX/SX/RXD/SXD cannot make a movement to draw an arch using the SCARA axes and liner axes, or using the SCARA axes (axes 1 to 4) and SCARA axes (axes 5 to 8). Either B80 “Indication Prohibited Axes Error” or 421 “SCARA/Linear Drive Axes Double Indication Error” will occur. Use GRP Command, or operate the position data of SCARA axis and linear drive axis separately.

[Example]

VEL	100		Set the speed to 100mm/s.
ARCC	100	120	Move along an arc from the position origin for a center angle of 120° around position No. 100 being the center (CCW direction).

● PBND (Set positioning width)

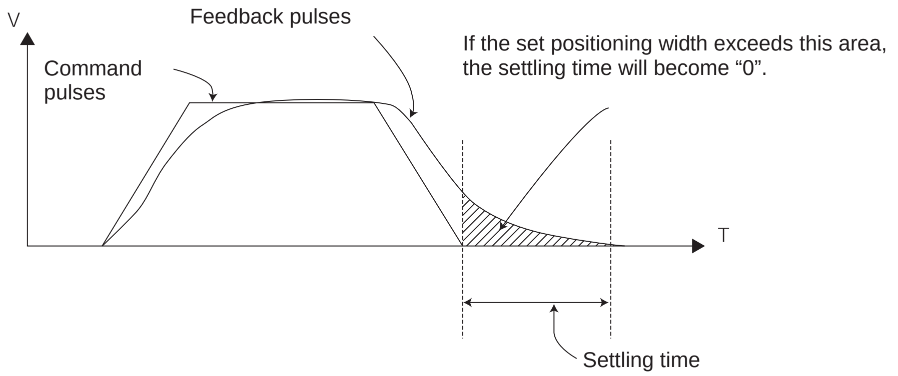
Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PBND	Axis pattern	Distance	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Set the positioning complete width for the axes that correspond to the axis pattern specified in operand 2. The unit of operand 2 is as follows.

	Unit of operand 2
SCARA	X, Y, R: deg / Z: mm
Linear	mm / RS: deg

[Function] As a rule, positioning is deemed complete when all command pulses have been sent and the current position is within the positioning complete width. Accordingly, this command provides an effective way to shorten the tact time by shortening the settling time after rough positioning. (Normally a desired effect can be achieved with approx. 3 to 5°, but you must check on the actual equipment.)



(Note 1) If positioning width is not set with a PBND command, the value set in “Axis-specific parameter No. 58, Positioning width” will be used.

(Note 2) If the positioning width is changed, the new setting will remain valid even after the program ends. Therefore, to build a system using PBND commands, a positioning band must be expressly specified with a PBND command before operation of each program. An assumption that the positioning width will be reset to the original value when the operation ends in other program may lead to an unexpected problem, because the positioning width will become different from what is anticipated in case the applicable program is aborted due to error, etc.

(Note 3) The value set in “Axis-specific parameter No. 58, Positioning width” will not be written by a PBND command.

[Example 1] PBND 11 5 — Set the positioning width for X-axis and Y-axis to 5° after this command.

[Example 2] The axis pattern can be specified indirectly using a variable. When the command in [Example 1] is rephrased based on indirect specification using a variable:
11 (binary) → 3 (decimal)

```
LET    1    3      Assign 3 to variable 1.
PBND   *1   5
```

● TMPI (Dedicated SCARA command/Move incrementally to position on tool coordinate system via PTP operation)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	TMPI	Position number	Prohibited	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	○	○	○	×	×	○ (PCX/PGX only)

[Function] Move incrementally on the tool coordinate system without interpolation (= via PTP operation), by the travel from the current position corresponding to the position data in operand 1.

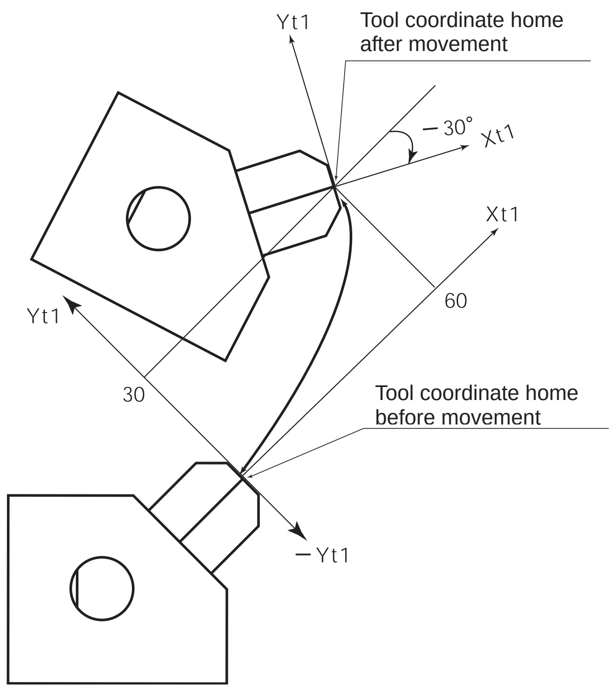
(Note 1) This command is dedicated for the SCARA axes only. “Error No. B80 Indication Prohibited Axis Error” will be issued if the liner axes are indicated.

(Note 2) If an incremental movement command is used repeatedly, coordinate conversion rounding errors, etc., will accumulate.

[Example] TMPI 120

Position data

No.	Axis1	Axis2	Axis3	Axis4	Vel	Acc	Dcl
120	60.000	30.000	0.000	-30.000			
121							
122							



● TMLI (Dedicated SCARA command/Move incrementally to position on tool coordinate system via CP operation)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	TMLI	Position number	Prohibited	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	○	○	○	×	×	○ (PCX/PGX only)

[Function] Move incrementally on the tool coordinate system without interpolation (= via CP operation), by the travel from the current position corresponding to the position data in operand 1.

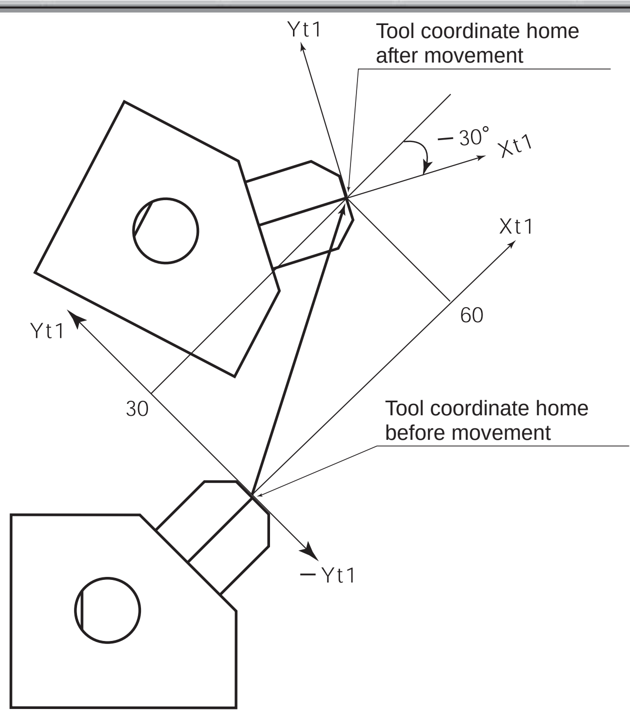
(Note 1) This command is dedicated for the SCARA axes only. "Error No. B80 Indication Prohibited Axis Error" will be issued if the liner axes are indicated.

(Note 2) If an incremental movement command is used repeatedly, coordinate conversion rounding errors, etc., will accumulate.

[Example] TMLI 120

Position data

No.	Axis1	Axis2	Axis3	Axis4	Vel	Acc	Dcl
120	60.000	30.000	0.000	-30.000			
121							
122							



● CIR (Move along circle via CP operation)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	CIR	Passing position 1 number	Passing position 2 number	PE

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Move along a circle originating from the current position and passing the positions specified in operands 1 and 2.
Therefore, reversing the settings of operands 1 and 2 will implement a circular movement in the reverse direction.
The output will turn OFF at the start of circular movement, and turn ON when the movement is complete.
Difference from CIR2:
CIR processing resembles moving along a polygon with a PATH command, while CIR2 actually performs arc interpolation.
Select an applicable command by considering the characteristics of each command. (Normally CIR2 is used.)

(Note 1) If the division angle is set to "0" with a DEG command (division angle is calculated automatically based on priority speed setting), the speed set in the data at passing position 1 or speed set by a VEL command will be used (former is given priority).
The speed set in the data at passing position 2 will have no meaning.

(Note 2) If the division angle is set to a value other than "0" with a DEG command (normal division angle), the speed specified in the target position data will be used. (The speed set by a VEL command will become valid if position data is not specified.)
In the case of circular movement, the axes will return from passing position 2 to the start position at the speed declared by a VEL command.
Therefore, a VEL command must always be used with a CIR command.

(Note 3) The acceleration is selected in the order of the acceleration in the data at passing position 1, followed by the value in "All-axis parameter No. 11, Default acceleration".
The deceleration will become the same value as the valid acceleration selected above. Therefore, the deceleration in the data at passing position 1 and the acceleration/deceleration in the data at passing position 2 will not have any meaning.

(Note 4) With rectangular actuators, this command is valid on any rectangular planes. If three or more axes are set in the position data, two axes are selected automatically from the axes that have been set, starting from the axis of the youngest number.
If position data is set for axes 2 to 4, for example, a CIR command is executed based on the position data of axes 2 and 3.

(Note 5) If the distance between the position origin and passing position 1 or between passing position 1 and passing position 2 is small and the path is near a soft limit, “Error No. C73: Target-path soft limit over error” may occur.
In this case, increase the distance between the adjacent positions as much as possible, move the path slightly inward from the soft limit boundary, or make other appropriate correction.

(Note 6) XSEL-PX/QX/RX/SX/RXD/SXD cannot make a movement to draw an arch using the SCARA axes and liner axes, or using the SCARA axes (axes 1 to 4) and SCARA axes (axes 5 to 8). Either B80 “Indication Prohibited Axes Error” or 421 “SCARA/Linear Drive Axes Double Indication Error” will occur. Use GRP Command, or operate the position data of SCARA axis and linear drive axis separately.

[Example 1]	VEL	100		Set the speed to 100mm/s.
	CIR	100	101	Move along a circle from the current position by passing positions 100 and 101 sequentially.

[Example 2]	VEL	100		Set the speed to 100mm/s.
	LET	1	5	Assign 5 to variable 1.
	LET	2	6	Assign 6 to variable 2.
	CIR	*1	*2	Move along a circle from the current position by passing the contents of variables 1 and 2 (positions 5 and 6) sequentially.

● ARC (Move along arc via CP operation)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	ARC	Passing position number	End position number	PE

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Move along an arc from the current position to the position specified in operand 2, by passing the position specified in operand 1.
The output will turn OFF at the start of arc movement, and turn ON when the movement is complete.
Difference from ARC2:
ARC processing resembles moving along a polygon with a PATH command, while ARC2 actually performs arc interpolation.
Select an applicable command by considering the characteristics of each command. (Normally ARC2 is used.)

(Note 1) If the division angle is set to “0” with a DEG command (division angle is calculated automatically based on priority speed setting), the speed set in the data at passing position 1 or speed set by a VEL command will be used (former is given priority). The speed set in the data at passing position 2 will have no meaning.

(Note 2) If the division angle is set to a value other than “0” with a DEG command (normal division angle), the speed specified in the target position data will be used. (The speed set by a VEL command will become valid if position data is not specified.)

(Note 3) The acceleration is selected in the order of passing position 1 data, ACC command, and all-axis parameter No. 11, “Default acceleration for SCARA axis” or all-axis parameter No. 200, “Default acceleration for linear axis”.
The deceleration will become the same value as the valid acceleration selected above. Therefore, the deceleration in the data at passing position 1 and the acceleration/deceleration in the data at passing position 2 will not have any meaning.

(Note 4) With rectangular actuators, this command is valid on any rectangular planes. If three or more axes are set in the position data, two axes are selected automatically from the axes that have been set, starting from the axis of the youngest number.
If position data is set for axes 2 to 4, for example, a ARC command is executed based on the position data of axes 2 and 3.

(Note 5) If the distance between the position origin and passing position 1 or between passing position 1 and passing position 2 is small and the path is near a soft limit, “Error No. C73: Target-path soft limit over error” may occur.
In this case, increase the distance between the adjacent positions as much as possible, move the path slightly inward from the soft limit boundary, or make other appropriate correction.

(Note 6) XSEL-PX/QX/RX/SX/RXD/SXD cannot make a movement to draw an arch using the SCARA axes and liner axes, or using the SCARA axes (axes 1 to 4) and SCARA axes (axes 5 to 8). Either B80 “Indication Prohibited Axes Error” or 421 “SCARA/Linear Drive Axes Double Indication Error” will occur. Use GRP Command, or operate the position data of SCARA axis and linear drive axis separately.

[Example 1]	VEL	100		Set the speed to 100mm/s.
	ARC	100	101	Move along an arc from the current position to position 101 by passing position 100.

[Example 2]	VEL	100		Set the speed to 100mm/s.
	LET	1	5	Assign 5 to variable 1.
	LET	2	6	Assign 6 to variable 2.
	ARC	*1	*2	Move along an arc from the current position to the content of variable 2 (position 6) by passing the content of variable 1 (position 5).

● PEND (Wait for end of operation by axes currently used by program)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PEND	Prohibited	Prohibited	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
○	×	×	×	×	×	×	×	×

[Function] When a PEND command is executed, the program waits for the end of operation by the axes it is currently using. The output turns ON only when a MOVP, MOVL or PATH command has been successfully executed (positioning has been successful) in quick return mode 2 (closeness-detection return target position addition mode) or quick return mode 3 (closeness-detection return target position change mode) (the output does not turn ON if any other servo command is executed).

(Note 1) To check if the operation has been successful (positioning has been successful), execute a PEND command before the quick return mode is cancelled.

(Note 2) Be sure to also refer to the pages that explain the QRTN command and NBND command.

(Note 3) Software versions supporting PEND

Controller main application: Ver.1.04 or later
(excluding flash ROM 8Mbit versions)

PC software: Ver.7.2.3.0 or later
Teaching pendant:
IA-T-X (D): Ver.1.44 or later
SEL-T (D): Ver.1.02 or later

[13] IF structure

● IF☐☐ (Structural IF)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	IF☐☐	Variable number	Data	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Compare the content of the variable specified in operand 1 with the value specified in operand 2, and proceed to the next step if the condition is satisfied.
If the condition is not satisfied, the program will proceed to the step next to the corresponding ELSE command, if any, or to the step next to the corresponding EDIF command.
If the input condition is not satisfied and the IF☐☐ command is not executed, the program will proceed to the step next to the corresponding EDIF.
A maximum of 15 nests are supported when IS☐☐ and DW☐☐ are combined.

```
IF☐☐
    EQ  ..........  Operand 1 = Operand 2
    NE  ..........  Operand 1 ≠ Operand 2
    GT  ..........  Operand 1 > Operand 2
    GE  ..........  Operand 1 ≥ Operand 2
    LT  ..........  Operand 1 < Operand 2
    LE  ..........  Operand 1 ≤ Operand 2
```

[Example 1]

```
        SVON   1111              Set the current arm system in variable 99.
        PRDQ   1      100        Read the current X coordinate value into
                                 variable 100.
        CPNE   99     0     600  Turn OFF flag 600 if the arm system is
                                 indeterminable.
  600   IFEQ   99     1          Determine the arm system. The
                                 processing ends if the arm system is
                                 indeterminable.
        IFGE   100    0          Move to position No. 1 via PTP if the X
        MOVP   1                 coordinate value is 0 or greater.
        ELSE
        MOVP   2                 Move to position No. 2 via PTP.
        EDIF
        ELSE
        IFGE   100    0          Move to position No. 3 via PTP if the X
        MOVP   3                 coordinate value is 0 or greater.
        ELSE
        MOVP   4                 Move to position No. 4 via PTP.
        EDIF
        EDIF
        EXIT
```

If the current arm system is the right arm and X coordinate is 0 or greater, the axis moves to position No. 1. If the X coordinate is smaller than 0, it moves to position No. 2. If the left arm system is currently used and X coordinate is 0 or greater, the axis moves to position No. 3. If the X coordinate is smaller than 0, it moves to position No. 4.

(Note) Using a GOTO command to branch out of or into an IF☐☐-EDIF syntax is prohibited.

● IS☐☐ (Compare strings)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	IS☐☐	Column number	Column number, character literal	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Compare the character strings in the columns specified in operands 1 and 2, and proceed to the next step if the condition is satisfied.
If the condition is not satisfied, the program will proceed to the step next to the corresponding ELSE command, if any, or to the step next to the corresponding EDIF command.
Comparison will be performed for the length set by a SLEN command.
If a character literal is specified in operand 2, comparison will be performed for the entire length of the literal.
If the input condition is not satisfied and the IS☐☐ command is not executed, the program will proceed to the step next to the EDIF.
A maximum of 15 nests are supported when IF☐☐ and DW☐☐ are combined.

```
IS☐☐
  ├ EQ  ............. Operand 1 = Operand 2
  └ NE  ............. Operand 1 ≠ Operand 2
```

[Example 1]

```
        SCPY   10   'GOFD'
                    (Move forward)
        SCPY   14   'GOBK'
                    (Move backward)
        SLEN   4                     Set the number of comparing
                                     characters to 4.
┌ 600   ISEQ   1    'XAXS' (X-axis)  Select an axis.
│    ┌  ISEQ   5    10               Select a moving direction.
│    │  MOVL   1                     Move to position 1 via CP.
│    ├  ELSE
│    │  MOVL   2                     Move to position 2 via CP.
│    └  EDIF
├       ELSE
│    ┌  ISNE   5    14               Select a moving direction.
│    │  MOVL   3                     Move to position 3 via CP.
│    ├  ELSE
│    │  MOVL   4                     Move to position 4 via CP.
│    └  EDIF
└       EDIF
```

CP operation is performed based on position No. 1 and 2 selected in columns 1 to 4, or position No. 3 and 4 selected in columns 5 to 8.
Nothing will happen if flag 600 is OFF, in which case the program will proceed to the step next to the last EDIF.
If the following data is stored in columns 1 to 8, CP movement to position No. 1 occurs.

1 2	3 4	5 6	7 8	
XA	XS	GO	FD	

[13] IF structure

● ELSE (Else)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Prohibited	Prohibited	ELSE	Prohibited	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] An ELSE command is used arbitrarily in conjunction with an IF□□ or IS□□ command to declare the command part to be executed when the condition is not satisfied.

[Example 1] Refer to the sections on IF□□ and IS□□.

● EDIF (End IF□□)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Prohibited	Prohibited	EDIF	Prohibited	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Declare the end of an IF□□ or IS□□ command.

[Example 1] Refer to the sections on IF□□ and IS□□.

[14] Structural DO

● DW☐☐ (DO WHILE)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	DW☐☐	Variable number	Data	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Compare the content of the variable specified in operand 1 with the value specified in operand 2, and execute the subsequent commands up to EDDO while the condition is satisfied.
The program will proceed to the step next to the corresponding EDDO if the condition is no longer satisfied.
A LEAV command can be used to forcibly end a loop.
If the input condition is not satisfied and the DW☐☐ command is not executed, the program will proceed to the step next to the corresponding EDDO.
A maximum of 15 nests are supported when IF☐☐ and IS☐☐ are combined.

DW☐☐

EQ	....	Operand 1 = Operand 2
NE	....	Operand 1 ≠ Operand 2
GT	....	Operand 1 > Operand 2
GE	....	Operand 1 ≥ Operand 2
LT	....	Operand 1 < Operand 2
LE	....	Operand 1 ≤ Operand 2

[Example 1]

```
008    DWEQ   1    0
         :
         :
       EDDO
```

Repeat the command up to an EDDO command while variable 1 contains “0”.

If DW☐☐ is specified at the start and input 8 is OFF, nothing will occur and the program will proceed to the step next to EDDO.

(Note) Using a GOTO command to branch out of or into a DW☐☐-EDDO syntax is prohibited.

● LEAV (Pull out of DO WHILE)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	LEAV	Prohibited	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Pull out of a DO☐☐ loop and proceed to the step next to EDDO.

[Example 1]		DWEQ	1	0	Repeat the commands up to an EDDO command while variable 1 contains "0".
		:			
	600	LEAV			Forcibly end the loop if flag 600 is ON and proceed to the step next to an EDDO command.
		:			
		EDDO			

● ITER (Repeat)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	ITER	Prohibited	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Forcibly switch the control to EDDO while in a DO☐☐ loop.

[Example 1]

```
        DWEQ    1    0
          :
  600   ITER
          :
        EDDO
```

Repeat the commands up to an EDDO command while variable 1 contains “0”.
Forcibly switch the control to an EDDO command and perform end judgment, if flag 600 is ON.

● EDDO (End DO WHILE)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Prohibited	Prohibited	EDDO	Prohibited	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Declare the end of a loop that began with DW☐☐.
If the DW☐☐ condition is not satisfied, the program will proceed to the step next to this command.

[Example 1] Refer to the section on DW☐☐.

[15] Multi-Branching

● SLCT (Start selected group)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	SLCT	Prohibited	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Branch to the step next to any WH☐☐ or WS☐☐ command that exists before an EDSL command and whose condition is satisfied, or to the step next to an OTHE command if none of the conditions are satisfied.
A SLCT command must be followed by a WH☐☐, WS☐☐ or EDSL command.
A maximum of 15 nests are supported.

(Note) Using a GOTO command to branch out of or into a SLCT-EDSL syntax is prohibited.

[Example 1]

	SCPY	1	'Right'	Assign 'right' to columns 1 and 2.
	:			
600	SLCT			Jump to a W☐☐☐ whose condition is satisfied.
	WSEQ	1	'Right'	If 'right' is stored in columns 1 and 2, this command will be executed.
	:			
	WSEQ	1	'Left'	If 'left' is stored, this command will be executed.
	:			
	OTHE			If the content of columns 1 and 2 is neither of the above, this command will be executed.
	:			
	EDSL			If flag 600 is OFF, the processing will move here upon execution of any of the conditions.

● WH☐☐ (Select if true; variable)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Prohibited	Prohibited	WH☐☐	Variable number	Data	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] This command is used between SLCT and EDSL commands to execute the subsequent commands up to the next W☐☐☐ command or an OTHE or EDSL command when the comparison result of the content of the variable specified in operand 1 with the value specified in operand 2 satisfies the condition.

DW☐☐

EQ	....	Operand 1 = Operand 2
NE	....	Operand 1 ≠ Operand 2
GT	....	Operand 1 > Operand 2
GE	....	Operand 1 ≥ Operand 2
LT	....	Operand 1 < Operand 2
LE	....	Operand 1 ≤ Operand 2

[Example 1]

LET	1	20	Assign 20 to variable 1.
LET	2	10	Assign 10 to variable 2.
:			
SLCT			Execute multi-branching.
WHEQ	1	10	(1) will be executed if the content of variable 1 is 10. Since variable 1 contains 20, however, the next condition will be referenced.
:			
(1)			
:			
WHGT	1	*2	This command will be executed if the content of variable 1 is greater than the content of variable 2. Since variable 1 (= 20) > variable 2 (=10), (2) will be executed.
:			
(2)			
:			
OTHE			This command will be executed if none of the conditions are satisfied. In this example, since (2) was executed, (3) will not be executed.
:			
(3)			
:			
EDSL			The processing will move here if any of the conditions were satisfied and the applicable command executed. In this example, (2) and (4) will be executed.
:			
(4)			
:			

* If multiple conditions are likely to be satisfied, remember that the first W☐☐☐ will become valid and any subsequent commands will not be executed. Therefore, state from the command with the most difficult condition or highest priority.

● WS☐☐ (Select if true; character)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Prohibited	Prohibited	WS☐☐	Column number	Column number, character literal	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] This command is used between SLCT and EDSL commands to execute the subsequent commands up to the next W☐☐☐ command or an OTHE or EDSL command when the comparison result of the character strings in the columns specified in operands 1 and 2 satisfies the condition.
Comparison will be performed for the length set by a SLEN command.
If a character literal is specified in operand 2, comparison will be performed for the entire length of the literal.

```
WS☐☐
  ├ EQ ........... Operand 1 = Operand 2
  └ NE ........... Operand 1 ≠ Operand 2
```

[Example 1]

SLEN	3		Set the number of comparing characters to 3.
SCPY	1	‘ABC’	Assign ‘ABC’ to column 1.
LET	1	2	Assign 2 to variable 1.
:			
SLCT			Execute multi-branching.
WSEQ	1	‘XYZ’	(1) will be executed if columns 1 to 3 contain ‘XYZ’. Since columns 1 to 3 contain ‘ABC’, however, this command will not be executed.
:			
(1)			
:			
WSEQ	2	*1	(2) will be executed if the content of the number of characters specified by SLEN after column 2 is the same as the content of the column specified in variable 1.
:			
(2)			
:			
OTHE			This command will be executed if none of the conditions are satisfied. In this example, since (2) was executed, (3) will not be executed.
:			
(3)			
:			
EDSL			The processing will move here if any of the conditions were satisfied and the applicable command executed. In this example, (2) and (4) will be executed.
:			
(4)			
:			

* If multiple conditions are likely to be satisfied, remember that the first W☐☐☐ will become valid and any subsequent commands will not be executed. Therefore, state from the command with the most difficult condition or highest priority.

● OTHE (Select other)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Prohibited	Prohibited	OTHE	Prohibited	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] This command is used between SLCT and EDSL commands to declare the command to be executed when none of the conditions are satisfied.

[Example 1] Refer to the sections on SLCT, WH☐☐ and WS☐☐.

● EDSL (End selected group)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Prohibited	Prohibited	EDSL	Prohibited	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Declare the end of a SLCT command.

[Example 1] Refer to the sections on SLCT, WH□□ and WS□□.

[16] System Information Acquisition

● AXST (Get axis status)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	AXST	Variable number	Axis number	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Store in the variable specified in operand 1 the status (axis error number) of the axis specified in operand 2.

(Note 1) If the obtained result is “0”, it means no axis error is present.
(Note 2) Since the error lists are written in hexadecimals, they must be converted to decimals.

[Example] AXST 1 2 Read the error number for axis 2 to variable 1.

If 3188 (decimal) is stored in variable 1 after the execution of this command:

3188 / 16 = 199 ...4
199 / 16 = 12 (= C) ...7

$3188 = 12\ (= C) \times 16^2 + 7 \times 16^2 + 4$
$= C74\ (HEX)$ (Hexadecimal number)

Therefore, an “Error No. C74, Actual-position soft limit over error” is present.

● PGST (Get program status)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PGST	Variable number	Program number	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Store in the variable specified in operand 1 the status (program error number) of the program specified in operand 2.

(Note 1) If the obtained result is “0”, it means no program error is present.

(Note 2) Although the error lists are written in hexadecimals, the status to be stored (program error number) is a decimal.
Therefore, the decimal program error numbers must be converted to hexadecimals.

[Example]

PGST	1	2	Read the error number for program No. 2 to variable 1.

● SYST (Get system status)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	SYST	Variable number	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Store the system status (top-priority system error number) in the variable specified in operand 1.

(Note 1) If the obtained result is "0", it means no system error is present.
(Note 2) Since the error lists are written in hexadecimals, they must be converted to decimals.
(Note 3) Relationship of error statuses

System errors
- Program errors
- Axis errors
- Other errors

* An axis error that generates during operation with a program command will be registered both as a program error and an axis error.

[Example] SYST 1 Read the system error number to variable 1.

● GARM (Dedicated SCARA command/Get current arm system)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	GARM	Variable number	Prohibited	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	○	○	○	×	×	○ (PCX/PGX only)

[Function] Acquire the current arm system and set one of the following values corresponding to this arm system in the variable specified in operand 1:
Arm system indeterminable = 0
Right arm system = 1
Left arm system = -1

(Note 1) The arm system effective immediately after the command execution is set. It is not that the arm system is always monitored.

(Note 2) In XSEL-RX/SX/RXD/SXD 8-axes Series, GRP and BASE Command are available also in the actuator control declaration commands SLTL, SLWK, WGHT, PTPR, PTPL PTPE, PTPD, RIGH, LEFT and the system information acquirement command GARM. Establish the setting to have all the SCARA axes valid. Error No. C30 “Axis Pattern Error” will occur if even one axis is set invalid by GRP and BASE Commands.
When GRP and BASE Commands are undeclared, all the axes are effective (equivalent to GRP 11111111).

(Note 3) When GRP Command is undeclared, or GRP 11111111 (1st to 8th axes effective) is declared, the current arm system of the SCARA axes (1st to 4th axes) is set. When an acquirement of the current arm system for the SCARA axes (5th to 8th axes) is required, make only the 5th to 8th axes valid in GRP Command and execute GARM Command.

[Example 1]

GRP	1111	It makes the 1st to 4th axes effective.
GARM	200	Acquire the current arm system of the SCARA axes (1st to 4th axes) to Variable No. 200.

[Example 2]

GRP	11110000	It makes the 5th to 8th axes effective.
GARM	200	Acquire the current arm system of the SCARA axes (5th to 8th axes) to Variable No. 200.

[17] Zone

● WZNA (Dedicated linear axis command/Wait for zone ON based on AND gate)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	WZNA	Zone number	Axis pattern	CP

Applicable models
XSEL-JX/KX × Other than XSEL-JX/KX ○

[Function] Wait for the zone status of all axes (AND) specified by the axis pattern in operand 2 to become ON (inside zone) with respect to the zone specified in operand 1.

(Note 1) The zone status of axes not yet completing home return will remain OFF (outside zone).

(Note 2) A maximum of four areas can be set as zones for each axis (“Axis-specific parameter No. 86 to 97”).

(Note 3) Zone output can be specified using “Axis-specific parameter No. 88, 91, 94 and 97” irrespective of this command.

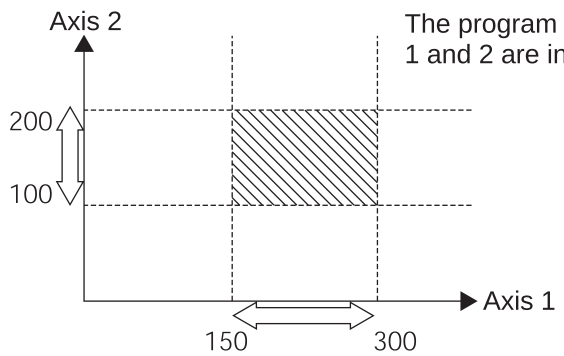
(Note 4) The zone signal is a dedicated command for linear axes. If a SCARA axis is specified for this command, “Error No. B80: Specification-prohibited axis error” occurs.

[Example 1] WZNA 1 11 If the parameters are set as follows, the program will wait until the zone status of axes 1 and 2 becomes ON (inside the shaded area shown in the diagram below).

[Example 2] The axis pattern can be specified indirectly using a variable.
When the command in [Example 1] is rephrased based on indirect specification using a variable:
11 (binary) → 3 (decimal)

```
LET   5   3     Assign 3 to variable 5.
WZNA  1   *5
```

	Axis 1	Axis 2
“Axis-specific parameter No. 86, Zone 1 max.” (Value is set in units of 0.001mm)	300000	200000
“Axis-specific parameter No. 87, Zone 1 min.” (Value is set in units of 0.001mm)	150000	100000



The program will proceed to the next step if both axes 1 and 2 are inside the shaded area.

● WZNO (Dedicated linear axis command/Wait for zone ON based on OR gate)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	WZNO	Zone number	Axis pattern	CP

Applicable models
XSEL-JX/KX × Other than XSEL-JX/KX ○

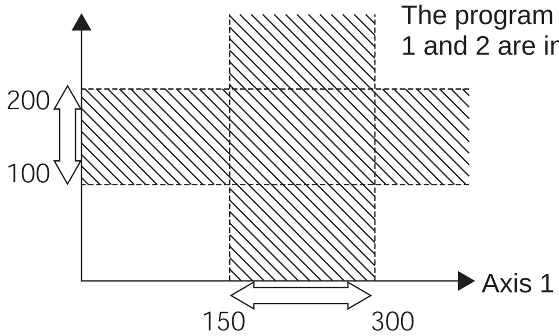
[Function] Wait for the zone status of any of the axes (OR) specified by the axis pattern in operand 2 to become ON (inside zone) with respect to the zone specified in operand 1.

(Note 1) The zone status of axes not yet completing home return will remain OFF (outside zone).
(Note 2) A maximum of four areas can be set as zones for each axis ("Axis-specific parameter No. 86 to 97").
(Note 3) Zone output can be specified using "Axis-specific parameter No. 88, 91, 94 and 97" irrespective of this command.
(Note 4) The zone signal is a dedicated command for linear axes. If a SCARA axis is specified for this command, "Error No. B80: Specification-prohibited axis error" occurs.

[Example 1] WZNO 1 11 If the parameters are set as follows, the program will wait until the zone status of axes 1 or 2 becomes ON (inside the shaded area shown in the diagram below).

[Example 2] The axis pattern can be specified indirectly using a variable.
When the command in [Example 1] is rephrased based on indirect specification using a variable:
11 (binary) → 3 (decimal)
LET 5 3 Assign 3 to variable 5.
WZNO 1 *5

	Axis 1	Axis 2
"Axis-specific parameter No. 86, Zone 1 max." (Value is set in units of 0.001mm)	300000	200000
"Axis-specific parameter No. 87, Zone 1 min." (Value is set in units of 0.001mm)	150000	100000



The program will proceed to the next step if both axes 1 and 2 are inside the shaded area.

[17] Zone

● WZFA (Dedicated linear axis command/Wait for zone OFF based on AND gate)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	WZFA	Zone number	Axis pattern	CP

Applicable models
XSEL-JX/KX × Other than XSEL-JX/KX ○

[Function] Wait for the zone status of all axes (AND) specified by the axis pattern in operand 2 to become OFF (outside zone) with respect to the zone specified in operand 1.

(Note 1) The zone status of axes not yet completing home return will remain OFF (outside zone).
(Note 2) A maximum of four areas can be set as zones for each axis ("Axis-specific parameter No. 86 to 97").
(Note 3) Zone output can be specified using "Axis-specific parameter No. 88, 91, 94 and 97" irrespective of this command.
(Note 4) The zone signal is a dedicated command for linear axes. If a SCARA axis is specified for this command, "Error No. B80: Specification-prohibited axis error" occurs.

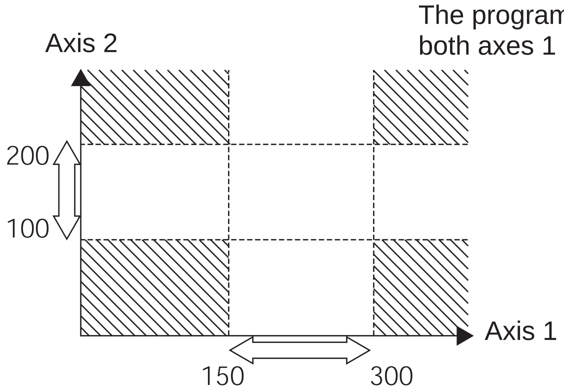
[Example 1] WZFA 1 11 If the parameters are set as follows, the program will wait until the zone status of axes 1 and 2 becomes OFF (inside the shaded area shown in the diagram below)

[Example 2] The axis pattern can be specified indirectly using a variable.
When the command in [Example 1] is rephrased based on indirect specification using a variable:
11 (binary) → 3 (decimal)

```
LET   5   3     Assign 3 to variable 5.
WZFA  1   *5
```

	Axis 1	Axis 2
"Axis-specific parameter No. 86, Zone 1 max." (Value is set in units of 0.001mm)	300000	200000
"Axis-specific parameter No. 87, Zone 1 min." (Value is set in units of 0.001mm)	150000	100000

The program will proceed to the next step if both axes 1 and 2 are inside the shaded



● WZFO (Dedicated linear axis command/Wait for zone OFF based on OR gate)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	WZFO	Zone number	Axis pattern	CP

Applicable models
XSEL-JX/KX × Other than XSEL-JX/KX ○

[Function] Wait for the zone status of any of the axes (OR) specified by the axis pattern in operand 2 to become OFF (outside zone) with respect to the zone specified in operand 1.

(Note 1) The zone status of axes not yet completing home return will remain OFF (outside zone).

(Note 2) A maximum of four areas can be set as zones for each axis ("Axis-specific parameter No. 86 to 97").

(Note 3) Zone output can be specified using "Axis-specific parameter No. 88, 91, 94 and 97" irrespective of this command.

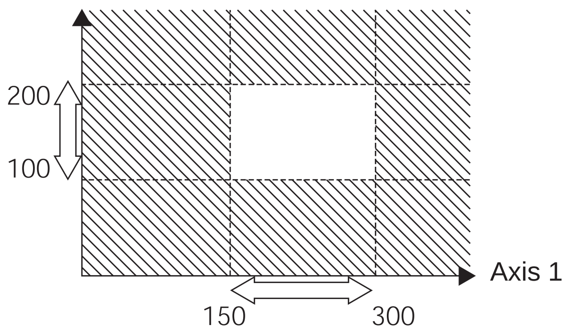
(Note 4) The zone signal is a dedicated command for linear axes. If a SCARA axis is specified for this command, "Error No. B80: Specification-prohibited axis error" occurs.

[Example 1] WZFO 1 11 If the parameters are set as follows, the program will wait until the zone status of axes 1 or 2 becomes OFF (inside the shaded area shown in the diagram below).

[Example 2] The axis pattern can be specified indirectly using a variable.
When the command in [Example 1] is rephrased based on indirect specification using a variable:
11 (binary) → 3 (decimal)
LET 5 3 Assign 3 to variable 5.
WZFO 1 *5

	Axis 1	Axis 2
"Axis-specific parameter No. 86, Zone 1 max." (Value is set in units of 0.001mm)	300000	200000
"Axis-specific parameter No. 87, Zone 1 min." (Value is set in units of 0.001mm)	150000	100000

The program will proceed to the next step if both axes 1 and 2 are inside the shaded



[18] Communication

● OPEN (Open channel)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	OPEN	Channel number	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Open the channel specified in operand 1.
The specified channel will be enabled to send/receive hereafter.
Prior to executing this command, a SCHA command must be used to set an end character.

[Example 1]

```
SCHA    10
OPEN    1
```

Specify 10 (= LF) as the end character.
Open channel 1.

> Note: If "Open 0" is executed the teaching pendant connector (D-sub25pin) is cut off. (This is because channel 0 is used by both the teaching pendant and PC software.)

● CLOS (Close channel)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	CLOS	Channel number	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Close the channel specified in operand 1.
The specified channel will be disabled to send/receive hereafter.

[Example 1]

```
CLOS   1
Close channel 1.

LET    1    2
CLOS   *1
       Assign 2 to variable 1.
       Close the content of variable 1 (channel 2).
```

● READ (Read)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	READ	Channel number	Column number	CC

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Read a character string from the channel specified in operand 1 to the column specified in operand 2.
Read will end when the character specified by a SCHA command is received.
Either a local or global column may be specified.
A return code will be stored in a local variable (variable 99 under the factory setting) immediately after this command is executed.
Whether or not the command has been executed successfully can be checked based on this return code. Define appropriate processing to handle situations where the command execution failed due to an error.
Setting "0" in operand 2 will specify a dummy read (receive buffer cleared and receive disabled) (the return code will indicate that the command was successfully executed). The versions of tools in which 0 can be entered in operand 2 are specified below. With tools of these versions, 0 can be specified indirectly if it cannot be entered directly from the tool:

- PC software Ver.1.1.1.0 or later
- Teaching pendant application Ver.1.06 or later

[Example 1]

SCHA	10		Set LF (= 10) as the end character.
OPEN	1		Open channel 1.
READ	1	2	Read a character string from channel 1 to column 2 until LF is received.
TRAN	1	99	Assign the return code (variable 99) to variable 1.
CLOS	1		Close the channel 1.
SLCT			The processing flow branches out in accordance with each return code. (Note) Using a GOTO command to branch out of an SLCT-EDSL syntax or to other branch processing within the syntax is prohibited.
WHEQ	1	0	If the content of variable 1 is "0" (Completed successfully), (1) will be executed. In (1), define the processing that should take place upon successful command execution.
:			
(1)			
:			
WHEQ	1	1	If the content of variable 1 is "1" (Timeout), (2) will be executed. In (2), define appropriate processing to handle this situation, if necessary.
:			
(2)			
:			
WHEQ	1	2	If the content of variable 1 is "2" (Timer cancelled), (3) will be executed. In (3), define appropriate processing to handle this situation, if necessary.
:			
(3)			
:			
OTHE			If the content of variable 1 is not "0", "1" or "2", (4) will be executed. In (4), define appropriate error handling, if necessary.
:			
(4)			
:			
EDSL			Once one of the specified conditions was met and the corresponding command has been executed, the processing will move here.

(Note 1) A READ command must be executed before the other side sends the end character.

(Note 2) Dummy read (operand 2: 0) cannot be specified for channel No. 31 to 34 (Ethernet option).

```
SCHA    10
OPEN    1
READ    1         2
    <--------------------------- Other side
CLOS    1
```

- Return code of the READ command

  The return code is stored in a local variable. The variable number can be set by "Other parameter No. 24". The default variable number is 99.

0	: READ completed successfully (Receive complete)
1	: READ timeout (the timeout value is set by a TMRD command) (Continue to receive)
2	: READ timer cancelled (the wait status is cancelled by a TIMC command) (Continue to receive)
3	: READ SCIF overrun error (Receive disabled)
4	: READ SCIF receive error (framing error or parity error) (Receive disabled)
5	: READ factor error (program abort error) (Receive disabled) (Cannot be recognized by SEL commands)
6	: READ task ended (program end request, etc.) (Receive disabled) (Cannot be recognized by SEL commands)
7	: READ SCIF receive error due to other factor (Receive disabled)
8	: READ expansion SIO overrun error (Receive disabled)
9	: READ expansion SIO parity error (Receive disabled)
10	: READ expansion SIO framing error (Receive disabled)
11	: READ expansion SIO buffer overflow error (Receive disabled)
12	: READ expansion SIO receive error due to other factor (Receive disabled)
13 to 20	: Used only in Ethernet (optional)
21	: READ SIO receive temporary queue overflow error (Receive disabled)
22	: READ SIO slave receive queue overflow error (Receive disabled)

● TMRD (Set READ timeout value)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	TMRD	Timer period	Prohibited	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
○	×	×	○	×	×	×	TT:○, TTA:×	×

[Function] Set the timeout to be applied to a READ command.
The timer setting specified in operand 1 will set the maximum time the program will wait for the character string read to end when a READ command is executed. If the end character could not be read before the timer is up during the execution of the READ command, a timeout will occur and the program will move to the next step.
(You can check if a timeout has occurred by checking the return code which is stored in a local variable (factory setting: variable 99) immediately after the READ command has been executed. If necessary, program an appropriate processing to be performed when a timeout occurs.)
Setting the timer to "0" will allow the READ command to wait infinitely, without timeout, until the end character is read.
The timer setting is input in seconds (setting range: 0 to 99.00sec) including up to two decimal places.

(Note) TMRD is set to "0" in the default condition before TMRD setting is performed.

[Example]

SCHA	10		Set LF (=10) as the end character.
TMRD	30		Set the READ timeout value to 30sec.
OPEN	1		Open channel 1.
READ	1	2	Read the character string from channel 1 to column 2 until LF is read.
TRAN	1	99	Assign the return code to variable 1.
CLOS	1		Close the channel.
SLCT			The processing flow branches out in accordance with each return code. (Note) Using a GOTO command to branch out of an SLCT-EDSL syntax or to other branch processing within the syntax is prohibited.
WHEQ : (1) :	1	0	If the content of variable 1 is “0” (Completed successfully), (1) will be executed. In (1), define the processing that should take place upon successful command execution.
WHEQ : (2) :	1	1	If the content of variable 1 is “1” (Timeout), (2) will be executed. In (2), define appropriate processing to handle this situation, if necessary.
WHEQ : (3) :	1	2	If the content of variable 1 is “2” (Timer cancelled), (3) will be executed. In (3), define appropriate processing to handle this situation, if necessary.
OTHE : (4) :			If the content of variable 1 is not “0”, “1” or “2”, (4) will be executed. In (4), define appropriate error handling, if necessary.
EDSL			Once one of the specified conditions was met and the corresponding command has been executed, the processing will move here.

Read completes successfully within 30sec → Variable No. 1 = 0
Timeout occurs → Variable No. 1 = 1

* The return code of READ command may not be limited to 0 or 1. The variable to store the return code can be set in “Other parameter No. 24”. (Main application Ver.0.21 or later) For details, refer to the explanation of the READ command.

● TMRW (Set READ/WRIT timeout value)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	TMRW	Read timer setting	(Write timer setting)	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	○	TT:×, TTA:○	○

[Function] Set the timeout to be applied to a READ/WRIT command.
The timer setting specified in operand 1 will set the maximum time the program will wait for the character string read to end when a READ command is executed.
If the end character could not be read before the timer is up during the execution of the READ command, a timeout will occur and the program will move to the next step. (You can check if a timeout has occurred by checking the return code which is stored in a local variable (factory setting: variable 99) immediately after the READ command has been executed.)
If the timer period is set to 0, the READ command causes the program to wait infinitely until the end characters are read, by assuming that there is no timeout.
The timer setting is input in seconds (setting range: 0 to 99.00sec) including up to two decimal places.
A variable can be specified indirectly in operand 1.

(Note) TMRW is set to “0” in the default condition before TMRW setting is performed.

[Example]

```
SCHA   10          Set LF (=10) as the end character.
TMRW   30          Set the READ timeout value to 30sec.
OPEN   1           Open channel 1.
READ   1    2      Read the character string from channel 1 to
                   column 2 until LF is read.
TRAN   1    99     Assign the return code to variable 1.
CLOS   1           Close the channel.
```

Read completes successfully within 30sec → Variable No. 1 = 0
Timeout occurs → Variable No. 1 = 1
* The return code of READ command may not be limited to 0 or 1. The variable to store the return code can be set in “Other parameter No. 24”. Refer to the explanation of READ command for details.

For the time period specified in operand 2, set the timeout value to be applied when a WRIT command is executed (maximum wait time for completion of send). (Maximum wait time for end based on flow control)
The write timer period is valid only for standard SIO (channels 1 and 2 supporting flow control).

For the time period specified in operand 2, set the timeout value to be applied when a WRIT command is executed (maximum wait time for completion of send). (Maximum wait time for end based on flow control) (Arbitrary)
The write timer setting is available only on standard SIO (flow control support channels 1 and 2).
This command is recognized as a TMRD on XSEL-JX/KX controllers, and as TMRW on XSEL-PX/QX controllers. If a program created for an XSEL-JX/KX controller is transferred to an XSEL-PX/QX controller, the PC software automatically converts “TMRD” to “TMRW” before the file is transferred. This command is recognized as a TMRD on XSEL-JX/KX controllers, and as TMRW on XSEL-PX/QX controllers. If a program created for an XSEL-JX/KX controller is transferred to an XSEL-PX/QX controller, the PC software automatically converts “TMRD” to “TMRW” before the file is transferred.

● WRIT (Write)

Extension condition (LD,A,O,AB,OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	WRIT	Channel number	Column number	CC (Note 1)

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Write the character string in the column specified in operand 2 to the channel specified in operand 1.
The operation will end when the character specified by a SCHA command is written.
Either a local or global column can be specified.

[Example]

SCHA	10		Set LF (= 10) as the end character.
OPEN	1		Open channel 1.
WRIT	1	2	Write the character string in column 2 to channel 1 until LF is written.
CLOS	1		Close the channel.

With a standard SIO (channel 1 or 2), WRIT is supported by (can be sent in) a task other than the one that opened the channel, as long as the channel is currently open. Accordingly, by sending WRIT in other task after executing READ in a task that opened the channel, a response can be received from the other side without delay after sending from XSEL.

(Note 1) CP is performed if the channel is other than 1 and 2.

Return code of WRIT command (channels 1 and 2 only)
The return code is stored in a local variable. The variable number can be set by "Other parameter No. 24". The default variable number is 99.
0 : WRIT completed successfully
1 : WRIT timeout (the timeout value is set by a TMRW command)
2 : WRIT timer cancelled (the wait status is cancelled by a TIMC command)
3 to 4 : Reserved by the system
5 : WRIT factor error (program abort error) (Cannot be recognized by SEL commands)
6 : WRIT task ended (program end request, etc.) (Cannot be recognized by SEL commands)

● SCHA (Set end character)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	SCHA	Character code	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Set the end character to be used by a READ or WRIT command.
Any character from 0 to 255 (character code used in BASIC, etc.) can be specified.

[Example] Refer to the sections on READ and WRIT commands.

[19] String Operation

● SCPY (Copy character string)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	SCPY	Column number	Column number, character literal	CC

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Copy the character string in the column specified in operand 2 to the column specified in operand 1.
Copy will be performed for the length set by a SLEN command.
If a character literal is specified in operand 2, copy will be performed for the entire length of the literal.

[Example 1]

SCPY	1	‘ABC’	Copy ‘ABC’ to column 1.
SLEN	10		Set the copying length to 10 bytes.
SCPY	100	200	Copy 10 bytes from column 200 to column 100.

● SCMP (Compare character strings)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	SCMP	Column number	Column number, character literal	EQ

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Compare the column specified in operand 1 with the column specified in operand 2.
Comparison will be performed for the length set by a SLEN command.
If a character literal is specified in operand 2, comparison will be performed for the entire length of the literal.

[Example 1]	SCMP	1	‘ABC’	600	Flag 600 will turn ON if columns 1 to 3 contain ‘ABC’.
	SLEN	5			Set the comparing length to 5 bytes.
	SCMP	10	30	999	Turn ON flag 999 if five bytes from columns 30 and 10 match.

● SGET (Get character)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	SGET	Variable number	Column number, character literal	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Assign one character from the column specified in operand 2 to the variable specified in operand 1.
If a character-string literal is specified in operand 2, the first character will be assigned.

[Example 1]

```
SGET   1    100
Assign one byte from column 100 to variable 1.

LET    1    3       Assign 3 to variable 1.
LET    2    1       Assign 1 to variable 2.
SCPY   1    'A'     Copy 'A' to column 1.
SGET   *1   *2      Assign 'A' from the content of variable 2 (column 1)
                    to the content of variable 1 (variable 3).
```

● SPUT (Set character)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	SPUT	Column number	Data	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Set the data specified in operand 2 in the column specified in operand 1.

[Example 1]

SPUT	5	10	Set 10 (LF) in column 5.
LET	1	100	Assign 100 to variable 1.
LET	2	50	Assign 50 to variable 2.
SPUT	*1	*2	Set the content of variable 2 (50 (‘2’)) in the content of variable 1 (column 100).

● STR (Convert character string; decimal)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	STR	Column number	Data	CC

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Copy to the column specified in operand 1 a decimal character string converted from the data specified in operand 2.
The data will be adjusted to the length set by a SLEN command.
If the data exceeds the specified length, it will be cut off at the length set by a SLEN command.
If the entire data has been converted within the length set by a SLEN command, the output will turn ON.

(Note) If the data specified in operand 2 is a 10 digit integer including eight or more valid digits, conversion of the values in the eighth and subsequent digits will not be guaranteed (the values through the seventh digits will be converted properly.)

[Example]

SLEN	5.3		Set a length consisting of five integer digits and three decimal digits.
STR	1	123	The following values will be set in columns 1 to 9:

1	2	3	4	5	6	7	8	9
		1	2	3	.	0	0	0

LET	1	10	Assign 10 to variable 1.
LET	102	987.6543	Assign 987.6543 to variable 102.
SLEN	2.3		Set a length consisting of two integer digits and three decimal digits.
STR	*1	*102	The following values will be set in columns 10 to 15:

10	11	12	13	14	15
8	7	.	6	5	4

Since the data exceeds the specified length, 87 without 9 in the 100s place is set in the integer part, while 654 with 3 in the fourth decimal place rounded is set in the fraction part.

● STRH (Convert character string; hexadecimal)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	STRH	Column number	Data	CC

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Copy to the column specified in operand 1 a hexadecimal character string converted from the data specified in operand 2.
Only the integer part will be adjusted to the length set by a SLEN command.
If the data exceeds the specified length, it will be cut off at the length set by a SLEN command.
If the entire data has been converted within the length set by a SLEN command, the output will turn ON.

(Note) If the data specified in operand 2 is a negative value, 8 columns will be required to covert the entire data.

[Example]

SLEN	5		Set a format consisting of 5 integer digits.
STRH	1	255	The following values will be set in columns 1 to 5:

1	2	3	4	5
			F	F

LET	1	10	Assign 10 to variable 1.
LET	102	987.6543	Assign 987.6543 to variable 102.
SLEN	2.3		Set a length consisting of 2 integer digits and 3 decimal digits.
STRH	*1	*102	The following values will be set in columns 10 and 11:

10	11
D	B

“.3” in the SLEN command and “.6543” in variable 102, which are the decimal part, will be ignored.
The integer part is expressed as ‘3DB’ in hexadecimal. Since the length is two digits, however, “3” in the third digit will be cut off.

● VAL (Convert character string data; decimal)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	VAL	Variable number	Column number, character literal	CC

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Convert the decimal data in the column specified in operand 2 to a binary and assign the result to the variable specified in operand 1.
Conversion will be performed for the length set by a SLEN command.
If a character-string literal is specified in operand 2, conversion will be performed for the entire length of the literal.

(Note) Keep the converting length to 18 characters or less.

[Example]

SCPY	10	‘1234’	Set ‘1234’ in column 10.
SLEN	4		Set the converting length to 4 bytes.
VAL	1	10	Assign 1234, which is a binary converted from ‘1234’ in column 10, to variable 1.

LET	1	100	Assign 100 to variable 1.
LET	2	20	Assign 20 to variable 2.
SCPY	20	‘1234’	Copy ‘1234’ to column 20.
SCPY	24	‘.567’	Copy ‘.567’ to column 24.
SLEN	8		Set the converting length to 8 bytes.
VAL	*1	*2	Assign 1234.567, which is a binary converted from ‘1234.567’ in the content of variable 2 (column 20) to the content of variable 1 (variable 100).

● VALH (Convert character string data; hexadecimal)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	VALH	Variable number	Column number, character literal	CC

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Convert the hexadecimal data in the column specified in operand 2 to a binary and assign the result to the variable specified in operand 1.
Conversion will be performed for the length set by a SLEN command.
Only the integer part will be converted, with the decimal part being ignored.
If a character-string literal is specified in operand 2, conversion will be performed for the entire length of the literal.

(Note) Keep the converting length to 8 characters or less.

[Example]

SCPY	10	'1234'	Set '1234' in column 10.
SLEN	4		Set the converting length to 4 bytes.
VALH	1	10	Assign 4660, which is a binary converted from hexadecimal '1234' in column 10, to variable 1.
LET	1	100	Assign 100 to variable 1.
LET	2	20	Assign 20 to variable 2.
SCPY	20	'ABCD'	Copy 'ABCD' to column 20.
SLEN	4		Set the converting length to 4 bytes.
VALH	*1	*2	Assign 43981, which is a binary converted from hexadecimal 'ABCD' in the content of variable 2 (column 20) to the content of variable 1 (variable 100).

● SLEN (Set length)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	SLEN	Character string length	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Set the length to be processed by a string command.
This must always be set before using the following commands:

SCMP .... Decimal part is invalid.
SCPY .... Decimal part is invalid.
IS☐☐ .... Decimal part is invalid.
WS☐☐ .... Decimal part is invalid.
STRH .... Decimal part is invalid.
VAL, VALH .... Decimal part is invalid.
STR .... Decimal part is valid.

[Example] Refer to the examples of the above commands:

[20] Arch-Motion

● ARCH (Arch motion)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	ARCH	Position number	Position number	PE

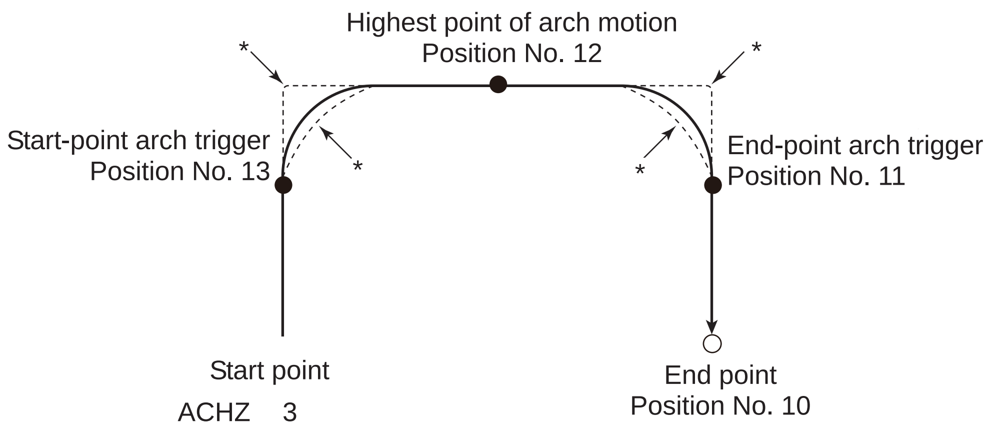
Applicable models
All models [Refer to Section 5.1 for details of models]
○

Perform arch motion from the current point and move to the specified points.

- Move to the points specified in operand 1, via arch motion.
- Movements in directions other than the arch-motion Z-axis direction will begin after rising from the current point to the start-point arch trigger. After the Z point specified in operand 2 (as the highest point) is passed and movements in directions other than the arch-motion Z-axis direction are complete, the axes will come down to the end-point arch trigger and reach the specified point.
- Palletizing arch triggers must be set using an ATRG command.

(Note 1) If the arch motion setting that SCARA axis and linear drive axis exist together is established, 421 “SCARA/Linear Drive Axes Double Indication Error” will occur. Also, if the arch motion setting that SCARA axes for two units exist together is established, B80 “Indication Prohibited Axis Error” will occur. Establish the arch motion setting with a consideration to have the operation axes all the same SCARA axes or all linear drive axes.

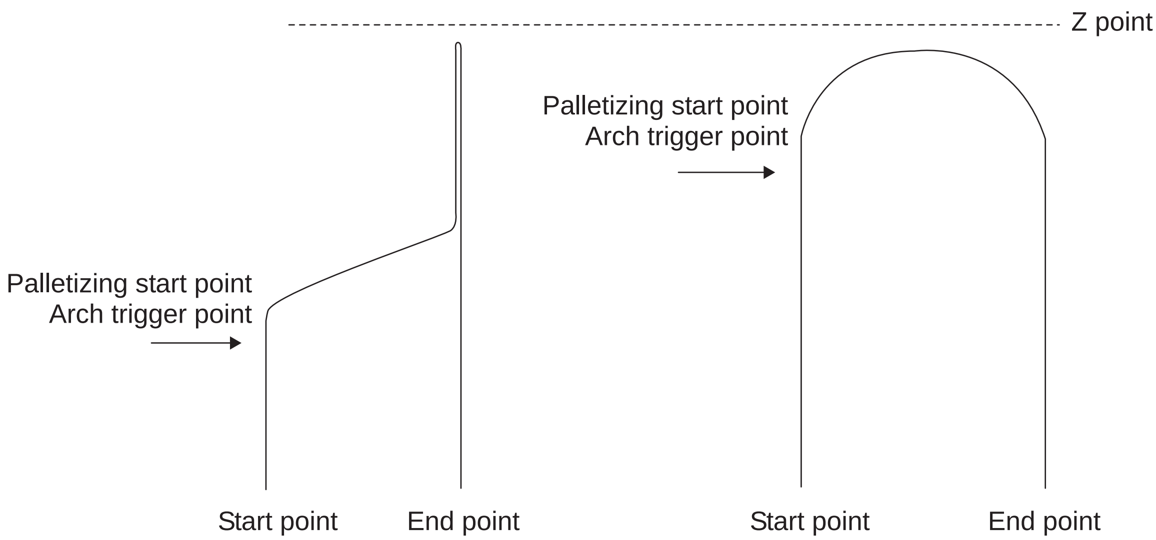
(Note 2) The arch motion operation of SCARA axis is PTP operation and the linear drive axis is CP operation.




```
ACHZ   3
ATRG   13   11
•
•
•
ARCH   10   12
```

* When the operation is resumed after a pause, depending on the position where the operation is resumed the locus may follow the lines (dotted lines) indicated by asterisks in the diagram for the composite section from ascent to horizontal movement or from horizontal movement to descent. Be careful not to cause interference.

- The arch-motion Z-axis coordinate of the end point will become the arch-motion Z-axis component of the point data specified in operand 1, if any, plus the arch-motion Z-axis offset. If there is no arch-motion Z component, the arch-motion Z-axis coordinate of the end point will become the arch-motion Z-axis coordinate of the start point plus the arch-motion Z-axis offset. (Normally the offset is added to all arch-motion positions, such as the arch triggers and Z point.)
- An error will generate if the start-point arch trigger is set below the start point or the end-point arch trigger is set below the end point. (Note: Up/down has nothing to do with +/- on the coordinate system.)
- The arch-motion Z-axis up direction refers to the direction toward the Z point from the start point (the down direction refers to the opposite direction), and has nothing to do with the size of coordinate value. Therefore, be sure to confirm the actual operating direction when using this command.
- The arch-motion Z-axis will come down after a rise-process command value is output. Therefore, one of the following operations will be performed depending on how the arch-trigger point and Z point are set.
  If the resulting operation is undesirable, change the arch trigger and/or Z point to improve the efficiency of movement.



- As for the arch-trigger end position data, movement also starts/ends above the applicable arch trigger for any effective axis, other than the arch motion Z-axis, if data of such axis is included in the position data.
- If the end position data includes R-axis data, movement of the R-axis starts/ends above the applicable arch trigger.
- If a composite arch trigger motion is set, a given effective axis, other than the arch motion Z-axis, also moves if data of such axis is included in the end point data. In this case, movement of the axis also starts/ends above the applicable arch trigger.

● ACHZ (Declare arch-motion Z-axis)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	ACHZ	Axis number	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

Specify the axis number representing the arch-motion Z direction.
The axis number specified in operand 1 will be set as the axis number representing the arch-motion Z direction.
If the output field is specified, the output will turn ON after this command is executed.

[Example] ACHZ 3

(Note 1) The arch motion Z-axis is available for indication only on the work coordinate system Z-axis (Axis No. 3 or Axis No. 7).

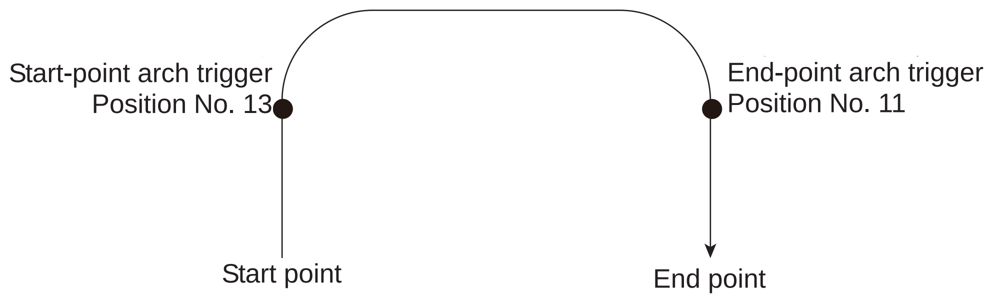
● ATRG (Set arch triggers)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	ATRG	Position number	Position number	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

Set the arch triggers used for arch motion.

(This setting becomes valid when an ARCH command is executed.)
Set the arch-motion Z-axis position data in the point data specified in operand 1 as the start-point arch trigger, and set the arch-motion Z-axis position data in the point data specified in operand 2 as the end-point arch trigger.



ATRG 13 11

(Refer to “Palletizing Setting” – “Arch triggers” under “How to Use”.)
For an arch-motion operation, set it so that a horizontal movement will begin when the start-point arch trigger is reached during ascent from the start point, and that the end-point arch trigger will be reached after a horizontal movement is completed during descent.
If the output field is specified, the output will turn ON after this command is executed.

● AEXT (Set composite arch motion)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	AEXT	(Position number)	Prohibited	CP

Applicable models
ASEL/PSEL/SSEL × Other than ASEL/PSEL/SSEL ○

Set a composite arch motion. Set coordinate values other than the arch motion Z-axis at the end position of arch motion.
Use the position number specified in operand 1 for setting composite motion.
With SCARA robots, the R-axis becomes a composite arch motion axis.
When the arch motion is executed, the end coordinate of the composite axis corresponds to effective axis data, other than that of the arch motion Z-axis, included in the arch-motion end point data.
If nothing is specified in operand 1, the position number already declared for setting composite motion becomes invalid. If the output is specified, it turns ON after this command has been executed.

(Note 1) Setting of the arch motion composition axes cannot be established for linear drive axes in PX/QX.

● OFAZ (Set arch-motion Z-axis offset)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	OFAZ	Offset value	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

Set the offset in the arch-motion Z-axis direction.
The value specified in operand 1 will be set as the offset in the arch-motion Z-axis direction.
The offset amount is set in mm and the effective resolution is 0.001mm.
A negative value can also be specified as the offset, as long as the operation range will not be exceeded.
This offset is valid only at the end point of ARCH (arch motion) operation.
If the output field is specified, the output will turn ON after this command is executed.

[21] Palletizing Definition

● BGPA (Declare start of palletizing setting)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	BGPA	Palletizing number	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

Declare the start of a palletizing setting.
Once this command is executed, palletizing setting for the palletizing number specified in operand 1 will be enabled.
(In the case of an ACHZ, AEXT, OFAZ or ATRG command, setting is enabled without declaring BGPA.)
The input range of palletizing number is from 1 to 10.
When the palletizing setting is complete, execute EDPA.
Nested BGPAs are not supported. To declare start of another palletizing setting, execute an EDPA command and then execute a BGPA command again.
If the output field is specified, the output will turn ON after this command is executed.

(Note) Using a GOTO command to branch out of or into a BGPA-EDPA syntax is prohibited.

● EDPA (Declare end of palletizing setting)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Prohibited	Prohibited	EDPA	Prohibited	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

Declare the end of a palletizing setting.
If a palletizing-setting command (excluding BGPA, ACHZ, ATRG, AEXT and OFAZ) is executed before another BGPA is declared following an execution of this command (= while palletizing setting is not enabled), an error will generate.
If the output field is specified, the output will turn ON after this command is executed.

● PAPI (Set palletizing counts)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PAPI	Count	Count	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

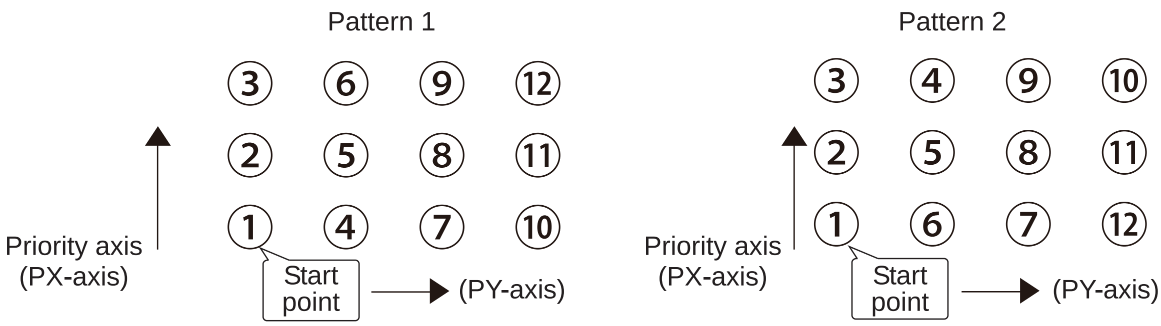
Set counts in the palletizing-axis directions.
The count specified in operand 1 will apply to the preferential-axis (PX-axis) direction, while the count specified in operand 2 will apply to the PY-axis direction.
If this command is executed before BGPA is declared (= while palletizing setting is not enabled), an error will generate.
If the output field is specified, the output will turn ON after this command is executed.

● PAPN (Set palletizing pattern)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PAPN	Pattern number	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

Set a palletizing pattern.
The palletizing pattern specified in operand 1 will be set (1 = Pattern 1, 2 = Pattern 2).
If this command is not declared, pattern 1 will be used.
If this command is executed before BGPA is declared (= while palletizing setting is not enabled), an error will generate.
If the output field is specified, the output will turn ON after this command is executed.



● PASE (Declare palletizing axes)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PASE	Axis number	Axis number	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

Set the two axes to be used in palletizing (PX and PY-axes).
The axis specified in operand 1 will be set as the preferential axis (PX-axis).
The axis specified in operand 2 will be set as the PY-axis.
This command is used in conjunction with PAPT and PAST.
It cannot be used together with a 3-point teaching (PAPS) command. Whichever is set later will be given priority.

3-point teaching (PAPS) is recommended for palletizing that requires precision.

If this command is executed before BGPA is declared (= while palletizing setting is not enabled), an error will generate.
If the output field is specified, the output will turn ON after this command is executed.

If the arch motion setting that SCARA axis and linear drive axis exist together is established, 421 “SCARA/Linear Drive Axes Double Indication Error” will occur.
Also, if the arch motion setting that SCARA axes for two units exist together is established, B80 “Indication Prohibited Axis Error” will occur.
Establish the arch motion setting with a consideration to have the operation axes all the same SCARA axes or all linear drive axes.

● PAPT (Set palletizing pitches)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PAPT	Pitch	Pitch	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

Set palletizing pitches.
The value specified in operand 1 will be set as the pitch for the preferential axis (PX-axis), while the value specified in operand 2 will be set as the pitch for the PY-axis.
This command is used in conjunction with PASE and PAST.
If this command is executed before BGPA is declared (= while palletizing setting is not enabled), an error will generate.
If the output field is specified, the output will turn ON after this command is executed.

● PAST (Set palletizing reference point)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PAST	(Position number)	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

Set the reference point for PX-axis (priority axis), PY-axis and PZ-axis (when palletizing Z-axis declaration is effective) to be used in palletizing calculation.
If a value is set in operand 1, that position number specified in operand 1 will be used to store the reference point data.
If no value is set in operand 1, the position-number setting for storing reference point data will become invalid.
This command is used in conjunction with PASE and PAPT.

If this command is not set, the reference point is defined as X = 0, Y = 0.
Palletizing positions are calculated as points on the palletizing plane constituted by the reference point, PX-axis and PY-axis.
Accordingly, position data of the reference point must include valid coordinate components for PX-axis, PY-axis and PZ-axis (when palletizing Z-axis declaration is effective). If these coordinate components are invalid, an error occurs during palletizing position coordinate calculation for PAPG (Get palletizing calculation data) or other palletizing movement command. Coordinate components of other axes are ignored during palletizing position coordinate calculation.

An error occurs if this command is executed when BGPA is not yet declared (palletizing setting is not permitted).
If the output is specified, it turns ON after this command has been executed.

If the arch motion setting that SCARA axis and linear drive axis exist together is established, 421 “SCARA/Linear Drive Axes Double Indication Error” will occur.
Also, if the arch motion setting that SCARA axes for two units exist together is established, B80 “Indication Prohibited Axis Error” will occur.
Establish the arch motion setting with a consideration to have the operation axes all the same SCARA axes or all linear drive axes.

(Note 1) In the case of SCARA robots, executing a palletizing movement command while the work coordinate system selection number is set to 0 (base coordinate system) and this command is not yet set generates an error because the palletizing start position is (0, 0) and thus movement is disabled.

(Note 2) In the case of SCARA robots, the R-axis should be excluded from the effective axes, if already set in the position data, with a GRP command.
(This is not required if the R-axis field is blank.)
Set the R-axis data at the palletizing position using a PEXT command.

● PAPS (Set palletizing points) For 3-point or 4-point teaching

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PAPS	Position number	(Palletizing position setting type)	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

Set palletizing positions in 3-point teaching.
It can also be used to set palletizing positions in 4-point teaching, in which case the pallet plane can be set to any quadrilateral other than a square, rectangle or parallelogram.
In operand 1, set the position number of the start point needed to set palletizing positions in 3-point teaching. If “n” is set as the position number for the start point, position data for the end point in the PX-axis direction will be stored in position No. n+1, while position data for the end point in the PY-axis direction will be stored in position No. n+2.
In the case of 4-point teaching, position data for the end point should be stored in position No. n+3.

(Note 1) If the arch motion setting that SCARA axis and linear drive axis exist together is established, 421 “SCARA/Linear Drive Axes Double Indication Error” will occur. Also, if the arch motion setting that SCARA axes for two units exist together is established, B80 “Indication Prohibited Axis Error” will occur. Establish the arch motion setting with a consideration to have the operation axes all the same SCARA axes or all linear drive axes.

In operand 2, specify the applicable palletizing position setting type.

[Palletizing position setting type]
If operand 2 is “0” or blank, 3-point teaching will be specified.
As shown in Fig. 1 (a), palletizing positions will be set on the quadrilateral pallet plane determined by the three points including the start point, end point in the PX-axis direction and end point in the PY-axis direction.

If operand 2 is “2,” 4-point teaching will be specified.
As shown in Fig. 1 (b), palletizing positions will be set on the quadrilateral pallet plane determined by the four points including the start point, end point in the PX-axis direction, end point in the PY-axis direction, and end point. Note, however, that whether the shape is planar or not varies depending on the end point data.

Fig. 1 shows two different arrangements of palletizing positions.

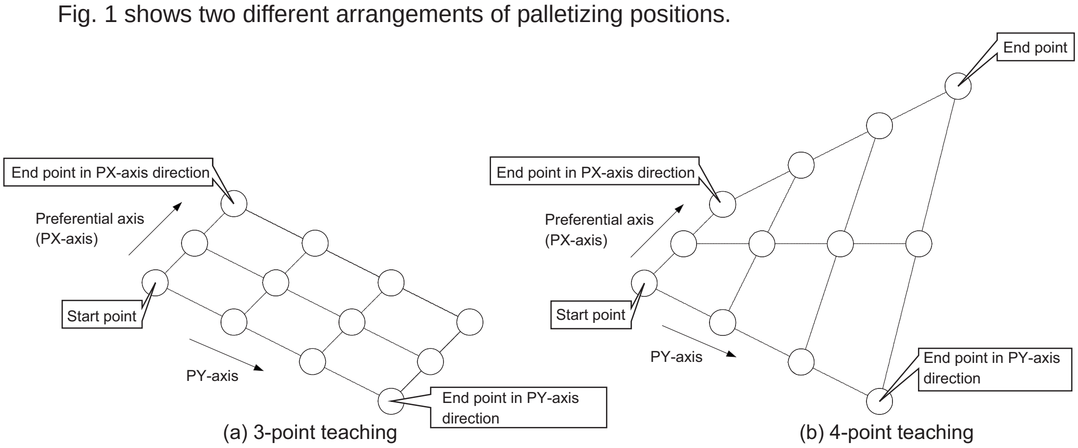


Fig. 1 Layout of Palletizing Positions

(Note) Since ASEL, PSEL and SSEL controllers are 2-axis controllers, setting 2 in operand 2 results in the planar type, just like 1 is set.

If palletizing positions are set by 4-point teaching, it is recommended that the non-planar type be specified as long as all four points are known to be on the plane and the palletizing requires precision.

If operand 2 is set to 1, 4-point teaching (planar type) is set.
Fig. 2-(a)
The plane is determined by three points including the start point, end point in PX-axis direction and end point in PY-axis direction. The end point is moved in parallel in PZ direction (vertical direction) and the point of intersection with the aforementioned plane is defined as the end point for this type of palletizing.
Palletizing positions are placed on the quadrilateral pallet surface determined by these four points.

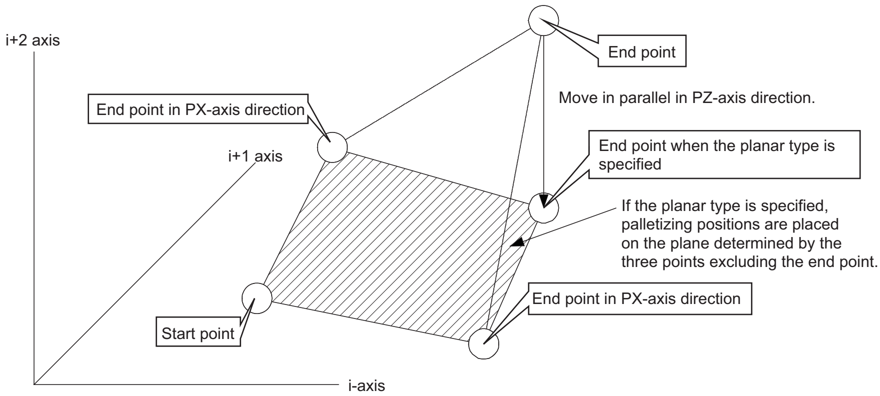


Fig. 2-(a)

Take note, however, that the moving direction of the end point varies if the three points other than the end point meet the conditions specified in Table 1. This is when the plane determined by the three points other than the end point is vertical to the ground. In this case, moving the end points in parallel with PZ direction (vertical direction) does not find a point of intersection with this plane.

Table 1 Moving Direction of End Point Based on Planar Type Specification

Condition	Moving direction of end point
Point data other than i-axis component matches among the three points other than the end point. (Refer to Fig. 2-(b))	Move in parallel in i-axis direction.
Point data other than PZ-axis component matches between the start point and end point in PX-axis direction. (Refer to Fig. 2-(c))	Move in parallel in the direction of one of the two axes other than the PZ-axis, whichever has the smaller axis number.
Point data other than PY-axis component matches between the start point and end point in PX-axis direction. (Refer to Fig. 2-(c))	
Point data other than PZ-axis component matches between the end point in PX-direction and end point in PY-axis direction. (Refer to Fig. 2-(c))	

* i indicates the axis number of one of the two axes other than the PZ-axis.

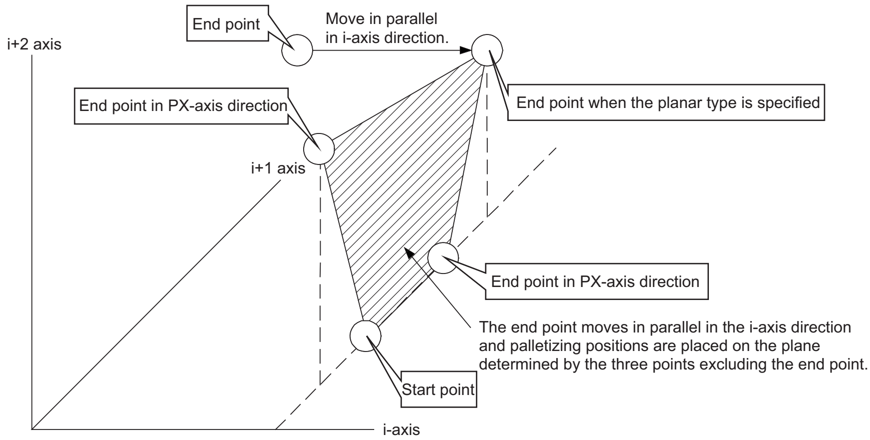


Fig. 2-(b)

The point data for i-axis component matches among the three points other than the end point:

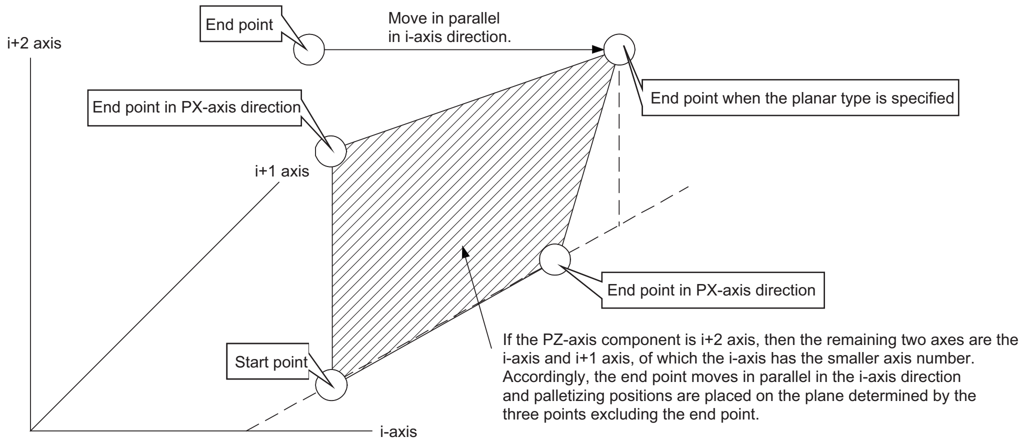


Fig. 2-(c)

The point data other than PZ-axis component matches between two of the three points other than the end point:
(In the figure above, the point data other than PZ-axis component matches between the start point and end point in PY-axis direction.)

- If the valid axis pattern does not match the point data for 3-point teaching or 4-point teaching, an error "CB0, Mismatched valid axes for palletizing 3-point teaching data" will generate. If a PAPS command is executed after specifying the applicable axes using a GRP command, only the point data corresponding to the specified axes, among all axes whose point data is valid, will be used as palletizing point data. Executing a GRP command thereafter with a different setting will have no effect.
- If the PZ-axis has been declared, there must be two effective axes other than the PZ-axis. If the PZ-axis is not yet declared, there must be two or three effective axes. If there are not enough effective axes, a "CAE: Insufficient effective axes for palletizing point data by 3-point teaching" occurs. If there are too many effective axes, on the other hand, a "CAF: Excessive effective axes for palletizing point data by 3-point teaching" occurs. If the planar type is specified and PZ-axis is not yet declared, set two effective axes. If the number of effective axes is other than 2, a "CB4: Arch motion Z-axis non-declaration error" occurs.
- This command cannot be used with a PASE (set palletizing axes) command. Whichever was set later will be given priority. (A single PAPS command can substitute a set of PASE, PAPT and PAST commands.)
- If this command is executed before BGPA is declared (= while palletizing setting is not enabled), an error, "CB5, BGPA not declared at palletizing setting" will generate.
- If the output field is specified, the output will turn ON after this command is executed.

● PSLI (Set zigzag)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PSLI	Offset amount	(Count)	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

Set a zigzag palletizing.
The value specified in operand 1 will be set as the offset amount for even-numbered rows.
The count specified in operand 2 will be set as the count for even-numbered rows.

[Refer to 3.6.5 Palletizing Function]

If operand 2 is not specified, the count for even-numbered rows will become the same as the count for odd-numbered rows.
If palletizing is set with PAPS (Set palletizing points) based on 3-point teaching, the PX and PY-axes need not be parallel with the corresponding axes on the work coordinate system. In this case, the offset direction is parallel with the PX-axis. If the offset value is positive, the measure in the direction of the PX-axis end point defines the offset. If the offset value is negative, the measure in the direction of the reference point defines the offset.
An error occurs if this command is executed when BGPA is not yet declared (palletizing setting is not permitted).
If the output is specified, it turns ON after this command has been executed

● PCHZ (Declare palletizing Z-axis): Only when there are 3 or more axes

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PCHZ	(Axis number)	Prohibited	CP

Applicable models
ASEL/PSEL/SSEL × Other than ASEL/PSEL/SSEL ○

Specify the axis number in palletizing Z direction.
Specify the axis number specified in operand 1 as the axis number in palletizing Z direction.
If operand 1 is not specified, the palletizing Z-axis which is specified and already declared becomes invalid.
An error occurs if this command is executed when BGPA is not yet declared (palletizing setting is not permitted).
If the output is specified, it turns ON after this command has been executed

(Note 1) Only Z-axis (either Axis No. 3 or Axis No. 7) in the work coordinate system is available to indicate for the palletizing Z-axis of the SCARA axes. Setting of the palletize Z-axis cannot be established for linear drive axes in PX/QX.

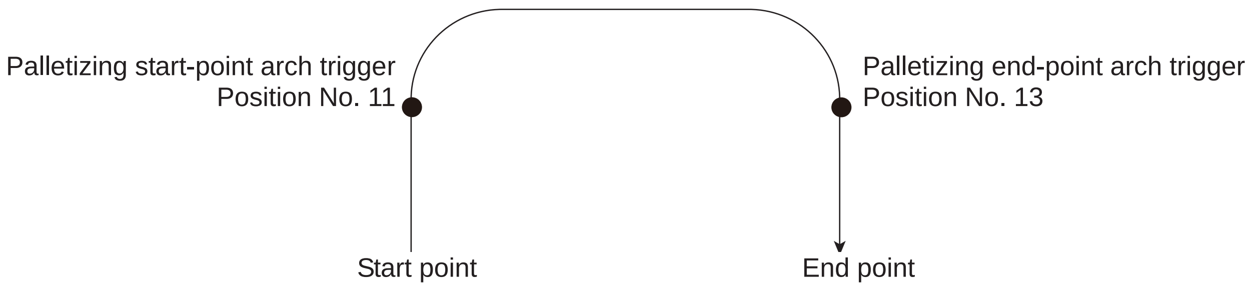
[Example] PCHZ 3

● PTRG (Set palletizing arch triggers)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PTRG	Position number	Position number	CP

Applicable models
ASEL/PSEL/SSEL × Other than ASEL/PSEL/SSEL ○

Set arch triggers for arch motion to a palletizing point.
(This command is valid when a PACH command is executed.)
Set as the palletizing start-point arch trigger the palletizing Z-axis (PZ-axis) position data corresponding to the point data specified in operand 1, and set as the palletizing end-point arch trigger the PZ-axis position data corresponding to the point data specified in operand 2.




```
PTRG    11    13
```

[Refer to 3.6.5 Palletizing Function]

Among the point data, data of the PZ-axis specified by a PCHZ command must be effective.
Set the arch motion operation through palletizing points in such a way that when the axis rises from the start point, it starts parallel movement after reaching the start-point arch trigger, whereas, when descending, the axis completes parallel movement and then reaches the end-point arch trigger.
An error occurs if this command is executed when BGPA is not yet declared (palletizing setting is not permitted).
If the output is specified, it turns ON after this command has been executed.

(Note 1) Setting of the palletize arch trigger cannot be established for linear drive axes in PX/QX.

● PEXT (Set composite palletizing)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PEXT	(Position number)	Prohibited	CP

Applicable models
ASEL/PSEL/SSEL × Other than ASEL/PSEL/SSEL ○

Set composite palletizing.
Set the position number specified in operand 1 for setting composite palletizing.
When a palletizing movement command is executed, effective axis data other than data of the PX and PY (and PZ) axes among the specified point data defines the end coordinate of the composite axis.
With SCARA robots, the R-axis becomes a composite palletizing axis.
If nothing is specified in operand 1, the position number already declared for setting composite palletizing becomes invalid.
An error occurs if this command is executed when BGPA is not yet declared (palletizing setting is not permitted).
If the output is specified, it turns ON after this command has been executed.

(Note 1) The palletizing composition axes setting cannot be made to the linear drive axis for PX/QX.

● OFPZ (Set palletizing Z-axis offset)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	OFPZ	Offset value	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

Set the offset in palletizing Z-axis direction.
Set the value specified in operand 1 as the offset in PZ-axis/palletizing Z-axis direction.
The setting unit of offset is mm. The effective resolution of the set value is 0.001mm.
A negative value can also be set for the offset within the range of operation.
This offset is effective only on the end point of PACH (Arch motion to palletizing point) operation.
An error occurs if this command is executed when BGPA is not yet declared (palletizing setting is not permitted).
If the output is specified, it turns ON after this command has been executed.

(Note) Setting of the palletize Z-axis offset cannot be established for linear drive axes in PX/QX.

[22] Palletizing Calculation

● PTNG (Get palletizing position number)

Extension condition (LD,A,O,AB,OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PTNG	Palletizing number	Variable number	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

Assign the palletizing position number for the palletizing number specified in operand 1 to the variable specified in operand 2.
If the output field is specified, the output will turn ON after this command is executed.

● PINC (Increment palletizing position number by 1)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PINC	Palletizing number	Prohibited	CC

Applicable models
All models [Refer to Section 5.1 for details of models]
○

Increment by 1 the palletizing position number for the palletizing number specified in operand 1. If the incremented value is considered normal as a palletizing position number calculated under the current palletizing setting, the value will be updated. If not, the value will not be updated.
If the output field is specified, the output will turn ON when the value was successfully incremented, and turn OFF if the increment failed.

● PDEC (Decrement palletizing position number by 1)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PDEC	Palletizing number	Prohibited	CC

Applicable models
All models [Refer to Section 5.1 for details of models]
○

Decrement by 1 the palletizing position number for the palletizing number specified in operand 1. If the decremented value is considered normal as a palletizing position calculated under the current palletizing setting, the value will be updated. If not, the value will not be updated.
If the output field is specified, the output will turn ON when the value was successfully decremented, and turn OFF if the decrement failed.

● PSET (Set palletizing position number directly)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PSET	Palletizing number	Data	CC

Applicable models
All models [Refer to Section 5.1 for details of models]
○

Set the value specified in operand 2 as the palletizing position number for the palletizing number specified in operand 1.
If the specified value is considered normal as a palletizing position calculated under the current palletizing setting, the value will be set. If not, the value will not be set.
If the output field is specified, the output will turn ON when the palletizing position number was successfully updated, and turn OFF if the update failed.

● PARG (Get palletizing angle)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PARG	Palletizing number	Axis number	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

Obtain the palletizing angle.
Calculate the palletizing angle (degrees) from the physical axis specified in operand 2 for the palletizing number specified in operand 1, and store the result in variable 199.

This command need not be executed, if not necessary.
If this command is executed following PAPS (Set palletizing by 3-point teaching), the angle formed by the priority axis and specified axis on the work coordinate system is calculated automatically. An error occurs if this command is executed when PAPS is not yet executed or after PASE has been executed following PAPS.
The axis to be used with a GRP command can be specified before PAPS is executed (refer to the detailed explanation of PAPS). If the effective axis pattern for 3-point teaching data does not match, an “CB0: Mismatched effective axes for palletizing point data by 3-point teaching” error occurs.
If the number of effective point data axes (number of effective axes excluding the PZ-axis (palletizing Z-axis) if the PZ-axis is declared) is less than two, a “CAE: Insufficient effective axes for palletizing point data by 3-point teaching” error occurs. If the number of effective point data axes is greater than two, a “CB9: PX/PY-axis indeterminable error at acquisition of palletizing angle” occurs.
If the axis corresponding to the axis number in operand 2 does not specify one of the two valid axes associated with the point data, an error “CBA, Reference-axis/PX/PY-axis mismatch error at palletizing angle acquisition” will generate.
If the data other than PZ-axis component is identical between the reference point and PX-axis end point in 3-point teaching, a “Reference point/PX-axis end point identical error at acquisition of palletizing angle” occurs and angle calculation is disabled.
If the output field is specified, the output will turn ON after this command is executed.

● PAPG (Get palletizing calculation data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PARG	Palletizing number	Position number	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

Store the position coordinate data of the palletizing point corresponding to the palletizing number specified in operand 1, under the position number specified in operand 2.

[23] Palletizing Movement

● PMVP (Move to palletizing points via PTP)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PMVP	Palletizing number	(Position number)	PE

Applicable models
All models [Refer to Section 5.1 for details of models]
○

Move to the calculated palletizing points via PTP.
The axes will move to the palletizing points specified in operand 1, via PTP.
Executing this command will not increment the palletizing position number by 1.

On controllers other than ASEL, PSEL and SSEL, movement does not occur in directions other than PX/PY-axis directions if the PX/PY-axis coordinates of palletizing points alone are effective (such as when the PZ-axis (palletizing Z axis) is not specified). If the PZ-axis coordinates of palletizing points are also effective, movement occurs in PZ-axis direction.
If a position number is specified in operand 2, however, the palletizing calculation result of Z-direction position is ignored and the axis moves to the height corresponding to the specified position number.
If data of any axis other than the Z-axis specified by palletizing is set under the position number specified in operand 2, such data is ignored. An error handling occurs if no PZ-axis data is available.
If composite palletizing is set, any axis whose data is available, other than the PX-axis and PY-axis (and PZ-axis), also operates.
If operand 2 is specified, the palletizing Z-axis must be declared (PCHZ) in the palletizing setting.
An error occurs if the palletizing Z-axis is not declared.

● PMVL (Move to palletizing points via interpolation)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PMVL	Palletizing number	(Position number)	PE

Applicable models
XSEL-JX/KX and MSEL-PCX/PGX × Other than XSEL-JX/KX and MSEL-PCX/PGX ○

Move to the calculated palletizing points via interpolation.
The axes will move to the palletizing points specified in operand 1, via interpolation.
Executing this command will not increment the palletizing position number by 1.

(Note 1) "Error No. B80 Indication Prohibited Axis Error" will be issued if the palletizing setting to operate the SCARA axes is indicated.
For the palletizing setting at PMVL movement, establish the setting to make the all of the operating axes the liner axes.

If a position number is specified in operand 2, however, the palletizing calculation result of Z-direction position is ignored and the axis moves to the height corresponding to the specified position number.
If data of any axis other than the Z-axis specified by palletizing is set under the position number specified in operand 2, such data is ignored. An error handling occurs if no PZ-axis data is available.
If composite palletizing is set, any axis whose data is available, other than the PX-axis and PY-axis (and PZ-axis), also operates.
Executing this command does not increment the palletizing position by 1.
If operand 2 is specified, the palletizing Z-axis must be declared (PCHZ) in the palletizing setting.
An error occurs if the palletizing Z-axis is not declared.

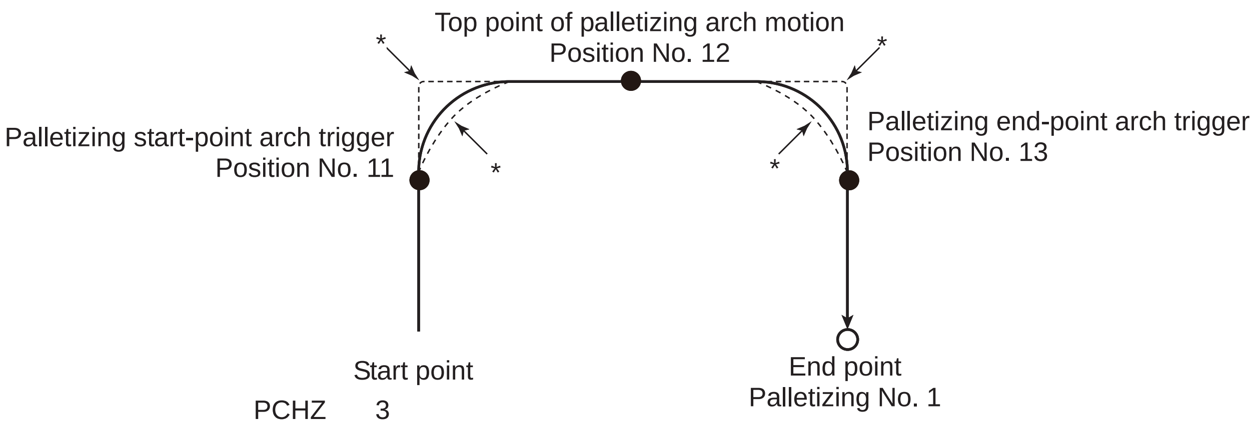
● PACH (Arch motion to palletizing point)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	PACH	Palletizing number	Position number	PE

Applicable models
ASEL/PSEL/SSEL × Other than ASEL/PSEL/SSEL ○

Perform arch motion from the current point to move to the palletizing points.

- Move via arch motion to the palletizing point specified in operand 1.
- Rise from the current point to palletizing start-point arch trigger and then start moving in PX/PY-axis directions. Pass the top point which is the Z point specified in operand 2, complete the movement in PX/PY-axis directions, and then reach the calculated palletizing point by passing near the palletizing end-point arch trigger.
- Palletizing arch triggers must be set for the PTRG command.




```
PCHZ    3
PTRG    11      13
  -
  -
  -
PACH    1       12
```

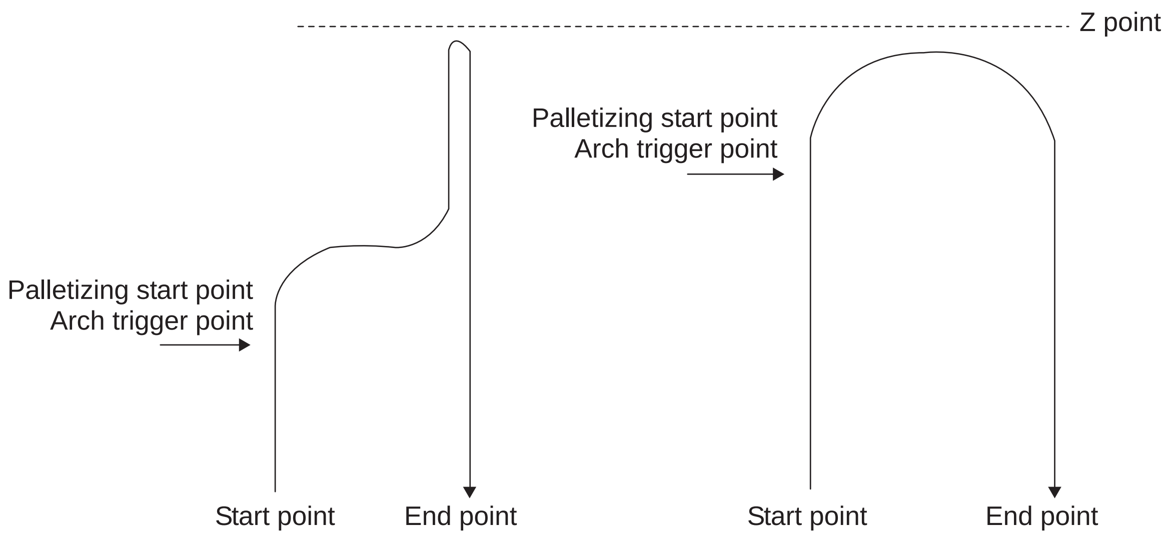
* When the operation is paused and then resumed, the rise operation → horizontal operation composite part and horizontal operation → rise operation composite part follow the paths denoted by * (dotted lines) in the figure depending on the position of resumption. Exercise caution to prevent contact.

(Note 1) When a palletizing setting with the SCARA axes and the liner axes existing together is indicated, “Error No. 421 SCARA and Liner Axes Simultaneous Indication Error” will occur. Also, when a palletizing setting with two units of SCARA axes existing together is indicated, “Error No. B80 Indication Prohibited Axis Error” will occur. Establish the setting to make all the operating axes the same SCARA axes or the linear axes for the palletizing setting at the palletizing point arch motion movement.

(Note 2) The palletize point arch motion operation of SCARA axis is PTP operation and the linear drive axis is CP operation.

(Note 3) The palletize point arch motion operation cannot be performed for linear drive axes in PX/QX.

- The PZ-axis coordinate of the end point corresponds to the PZ-axis component of the position coordinate of the palletizing point, if any, plus the palletizing Z-axis offset. If the PZ component is not available, then the PZ-axis coordinate of the start point, plus the palletizing Z-axis offset, is used. (Normally the offset is added to all applicable positions such as arch trigger and Z points.)
- An error occurs if the palletizing start-point arch trigger is set below the start point, or palletizing end-point arch trigger is set below the end point. (Note: “Above” and “below” have nothing to do with the positive and negative directions of coordinates.)
- The PZ-axis up direction refers to the direction of moving from the start point to Z point (or opposite direction in the case of down direction) and has nothing to do with the magnitude correlation of coordinate values. Accordingly, always check the actual operating directions when this command is used.
- PZ-axis down operation is performed after an up process command value has been output. Accordingly, the following operations may take place depending on how the palletizing arch trigger and Z points are set.



In these cases, change the palletizing arch triggers and PZ point to increase the efficiency of operation.

- If composite palletizing is set (PEXT), any axis whose data is available, other than the PX, PY and PZ-axes, also operates. However, the composite axis starts/ends its operation at a position above the applicable arch trigger. If the R-axis is set with a PEXT command, the R-axis starts/ends its operation above the applicable arch trigger.
- Executing this command does not increment the palletizing position by 1.

[24] Building of Pseudo-Ladder Task

● CHPR (Change task level)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	CHPR	0 or 1	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Specify "1" (User HIGH) if you wish the target task to be processed before other tasks.
This command can also be used with non-ladder tasks.
Task level change (0: User NORMAL, 1: User HIGH) is not a required component, but specifying User HIGH will require a TSLP command explained below.
(Without TSLP, tasks of the User NORMAL level will not be processed.)

● TPCD (Specify processing to be performed when input condition is not specified)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Prohibited	Prohibited	TPCD	0 or 1	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Specify the processing to be performed when input condition is not specified.
(0: Execute, 1: Follow the input condition in the last executed step)
In a ladder task, always input “1” (Follow the input condition in the last executed step) in operand 1.
In a non-ladder task, always input “0” (Execute). (The default value is “0”.)

● TSLP (Task sleep)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Prohibited	Prohibited	TCLP	Time	Prohibited	CP

Applicable models
All models [Refer to Section 5.1 for details of models]
○

[Function] Set the time during which the applicable task will sleep, in order to distribute the processing time to other tasks.
If the task level is set to User HIGH, this command must always be specified.
The applicable task will sleep during the set time.
The time in operand 1 is set in msec.
An appropriate time setting must be examined on the actual system. (Normally approx. 1 to 3 is set.)
(If the ladder statement becomes long, state this command multiple times between steps, as necessary.)
This command can also be used with non-ladder tasks.

[25] Extended Command

● ECMD1 (Get motor current value (as percentage of rated current))

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	ECMD	1	Axis number	CC

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	○	×	×

[Function] Store the motor current value (percentage of the rated current) corresponding to the “axis number” specified in operand 2, in variable 99.

Note:
- The current value data (percentage of the rated current) obtained by this command has been processed by feedback current filtering and includes analog error.
  When comparing with “Constant (Non-Pressing) Torque Limit (Upper)” set in Extension Command Code 250, have 5% or more of a margin.

[Example] ECMD 1 2 Extended command 1
Store the motor current value (percentage of the rated current) of axis 2, in variable 99.

● ECMD2 (Get home sensor status)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	ECMD	2	Axis number	CC

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	○	×	×	×

[Function] Reflect in the output the status of the home sensor corresponding to the "axis number" specified in operand 2.

Note:

- The acquired home sensor status is not the electrical level of H/L, but the operating/non-operating status determined by taking into consideration the setting of axis-specific parameter No. 14, "Home sensor input polarity".
  If 0 (Not used) is set in axis-specific parameter No. 14, "Home sensor input polarity", the sensor status (output) is deemed indeterminable and use of the sensor is prohibited.
  The specified output port/flag is operated only when this command has been executed. Accordingly, this command must be executed repeatedly if you want to constantly reflect the sensor status in the output port/flag.

[Example]

ECMD	2	3	315	Output the home sensor status of axis 1 in output port No. 315.

● ECMD3 (Get overrun sensor status)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	ECMD	3	Axis number	CC

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	○	×	×	×

[Function] Reflect in the output the status of the overrun sensor corresponding to the “axis number” specified in operand 2.

Note:

- The acquired overrun sensor status is not the electrical level of H/L, but the operating/non-operating status determined by taking into consideration the setting of axis-specific parameter No. 15, “Overrun sensor input polarity”.
  If 0 (Not used) is set in axis-specific parameter No. 15, “Overrun sensor input polarity”, the sensor status (output) is deemed indeterminable and use of the sensor is prohibited.
  The specified output port/flag is operated only when this command has been executed. Accordingly, this command must be executed repeatedly if you want to constantly reflect the sensor status in the output port/flag.

[Example]

ECMD	3	1	890	Output the overrun sensor status of axis 1 in global No. 890.

● ECMD4 (Get creep sensor status)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	ECMD	4	Axis number	CC

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	○	×	×	×

[Function] Reflect in the output the status of the creep sensor corresponding to the “axis number” specified in operand 2.

Note:

- The acquired creep sensor status is not the electrical level of H/L, but the operating/non-operating status determined by taking into consideration the setting of axis-specific parameter No. 16, “Creep sensor input polarity”.
  If 0 (Not used) is set in axis-specific parameter No. 16, “Creep sensor input polarity”, the sensor status (output) is deemed indeterminable and use of the sensor is prohibited.
  The specified output port/flag is operated only when this command has been executed. Accordingly, this command must be executed repeatedly if you want to constantly reflect the sensor status in the output port/flag.

[Example]

ECMD	4	2	315	Output the creep sensor status of axis 2 in output port No. 315.

● ECMD5 (Get axis operation status)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	ECMD	5	Axis number	CC

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	○	○	×	×

[Function] Store the status of the axis specified in operand 2, in variable 99.
The axis status is indicated by the ON/OFF level of each bit, as shown below.
Accordingly, the obtained value must be converted to a binary value for interpretation.

Variable 99							
7	6	5	4	3	2	1	0
/	/						

Bit 0: Servo axis in use (0 = Not in use, 1 = In use)
Bits 2–1: Home return (00 = Not yet complete, 01 = In progress, 10 = Complete)
Bit 3: Servo ON/OFF (0 = OFF, 1 = ON)
Bit 4: Successful execution of movement command (0 = Not yet complete, 1 = Successful)
Bit 5: Detection of missed work during push-motion operation (0 = Not detected, 1 = Detected)

(Note) If an invalid axis number is specified in operand 2, “C44, SEL data error” will generate.

[Example] ECMD 5 2 Store the status of axis 2 in variable 99. If 28 (decimal value) was stored in variable 99 after the command was executed, the status of axis 2 is interpreted as follows.

Variable 99
28

Binary notation

Variable 99							
0	0	0	1	1	1	0	0

Status of axis 2:
- Servo axis not in use
- Home return complete
- Servo ON
- Movement command successful
- Missed work not detected during push-motion operation

● ECMD6 (Dedicated SCARA commands/Current position acquirement on each axis system (1 axis direct)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	ECMD	6	Integer Variable number	CC

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	×	×	×	○	×	×	×	○ (PCX/PGX only)

[Function] By using data stored in the four integer variables in a row from the integer variable number indicated in Operation 2, the current position expressed in each axis coordinate system of the indicated axis numbers gets read out to the variable indicated in the current position storage variable number.

• When Operand 2 = Variable number

Variable No.	Description of setting	I/O
n	Axis Number	
n+1	Current Position Storage Variable Number	
n+2	0	Reserved (to be fixed to 0)
n+3	0	Reserved (to be fixed to 0)

(Note 1) Input an integer variable number in Operation 2.
Local area : 1 to 96, 1001 to 1096
Global area : 200 to 296, 1200 to 1296

(Note 2) The units in the result of the readout of the current position for each axis system are as shown below.
SCARA 1st, 2nd and 4th Axes : deg. (degrees)
SCARA 3rd Axis : mm

[Example]

LET	200	4	Set the 4th axis (R-axis) to Variable No. 200
LET	201	300	Set Current Position Storage Variable No. (300) to Variable No. 201
LET	202	0	Set 0 to Variable No. 202
LET	203	0	Set 0 to Variable No. 203
ECMD	6	200	The current position of each coordinate system on R-axis is read out to Variable No. 300.

● ECMD20 (Get parameter value)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	ECMD	20	Variable number	CC

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	○	○	×	○

[Function] Store the value of the specified parameter in variable 99, using the data stored in the three consecutive variables starting from the one corresponding to the variable number specified in operand 2.
The contents and ranges for the variable data settings are as shown below. Setting outside the specified range will generate "C44 SEL data error".

• When Operand 2 = n

Variable No.	Description of setting	Setting value and range for each variable						
		I/O	Common to all axes	Axis-specific	Driver	Encoder	I/O device	Other
n	Parameter type	0	1	2	3	4	5	7
n+1	Device number/axis number	0	0	1 to 8* (up to number of connected axes)	1 to 8* (up to number of connected axes)	1 to 8* (up to number of connected axes)	0 to 9	0
n+2	Parameter number	1 to 999	1 to 400	1 to 250	1 to 112	1 to 30	1 to 112	1 to 200

Specify an integer variable in operand 2 (integer variables 98, 99, 298, 299, 1098, 1099, 1298 and 1299 cannot be specified, because three consecutive integer variables cannot be allocated if any of these integer variables is specified). If a variable of non-integer type is specified, "C3C, Variable number error" will generate.

(Note) Setting of Parameter Type = 10 enables to acquire parameters for the pulse I/O board. [See the next page.]

[Example]

LET	1250	0	Variable No. 1250 = Parameter type (I/O)
LET	1251	0	Variable No. 1251 = Device number (0, in the case of I/O parameter)
LET	1252	30	Variable No. 1252 = Parameter number (No. 30)
ECMD	20	1250	Extended command 20 (Use variable No. 1250 through 1252) Store the value of I/O parameter No. 30, "Input function selection 000", in variable 99.

● ECMD20 (Get parameter value (Extension Motion Control Board Parameters)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	ECMD	20	Variable number	CC

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] Store the value of the specified parameter in variable 99, using the data stored in the five consecutive variables starting from the one corresponding to the variable number specified in Operand 2.
The contents and ranges for the variable data settings are as shown below. Setting outside the specified range will generate “C44 SEL data error”.
When Parameter Type = 10 (Pulse I/O board: Feature dedicated for XSEL) is selected, Parameter Detail Type (n + 3) and Channel Number (n + 4) are required.

• When Operand 2 =n

<table>
<tr><th>Variable No.</th><th>Description of setting</th><th>Setting value and range for each variable</th></tr>
<tr><td>n</td><td>Parameter type</td><td>10: Pulse I/O board</td></tr>
<tr><td>n+1</td><td>Device number</td><td>0 to 1</td></tr>
<tr><td>n+2</td><td>Parameter number</td><td>1 to 100</td></tr>
<tr><td>n+3</td><td>Parameter detail type</td><td>0 : Common
1 : Input Channel
2 : Output Channel</td></tr>
<tr><td>n+4</td><td>Channel number</td><td>The range may differ depending on parameter detail type (n+3).<table>
<tr><th>Parameter detail type (n+3)</th><th>Range for channel number (n+4)</th></tr>
<tr><td>0 (Common)</td><td>Reserved (to be fixed to 0)</td></tr>
<tr><td>1 (Input channel)</td><td>0 to 1</td></tr>
<tr><td>2 (Output channel)</td><td>0 to 7</td></tr>
</table></td></tr>
</table>

Specify an integer variable in operand 2. At this time, make sure to secure five (for XSEL) consecutive variables. C3C will be generated when a variable other than integer variables is indicated.

[Example]

LET	1250	10	Variable No. 1250 = Parameter type (Pulse I/O board)
LET	1251	1	Variable No. 1251 = Device number
LET	1252	2	Variable No. 1252 = Parameter number (No. 2)
LET	1253	2	Variable No. 1252 = Parameter Detail Type (Output Channel)
LET	1253	5	Variable No. 1252 = Channel number (Output channel 5)
ECMD	20	1250	Extended command 20 (Use variable No. 1250 through 1252) Data for the value set in No. 2 (Pulse output mode) in the pulse I/O board parameter output channel 5 is stored to Variable 99.

● ECMD250 (Set torque limit/torque limit over detection time)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	ECMD	250	Axis pattern	CC

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] Set the steady-state (non-push) torque limit (upper limit)/steady-state (non-push) torque limit over detection time. Use the data stored in three successive integer variables, starting from the integer variable number specified in operand 2, to temporarily change the applicable parameters (including internal parameters).

Operand 2 = n

Variable No. n ----- Target axis pattern (decimal entry)
* Example of decimal entry:
1 = Axis 1 only
2 = Axis 2 only
3 = Axes 1 and 2
7 = Axes 1, 2 and 3
15 = Axes 1, 2, 3 and 4

Variable No. n+1 = Set value of steady-state (non-push) torque limit (upper limit) (1% or more of the rating to the value set in driver card parameter No. 40, "Maximum torque limit (%)")
* If the set value is greater than the upper limit specific to each axis, the upper limit specific to the axis is set.

Variable No. n+2 = Set value of steady-state (non-push) torque limit over detection time
(0 to 20000msec)
* Set 1 or greater if you want to use this command to "detect a contact/heavy load" or move an axis.
* If 0 is set, the detection time becomes invalid (infinite). This setting is used mainly to "limit the torque of the supporting axis (horizontal only) in fitting application". If 0 (infinite) is set, the "steady-state (non-push) torque limit (upper limit)" is limited to a maximum of 70% to prevent overheating.

Variable No. n+3 = 0 is set. (Reserved. * May be made accessible in the future.)

Variable No. n+4 = 0 is set. (Reserved. * May be made accessible in the future.)
If a command specifying the "steady-state (non-push) torque limit (upper limit)" has remained effective for the "steady-state (non-push) torque limit over detection time" or longer in steady state (not pushing), appropriate processing is performed based on the parameter below. Note that processing based on the following parameter is not performed if the "steady-state (non-push) torque limit over detection time" is set to 0 (infinite):
All-axis parameter No. 19, "Type of processing upon steady-state (non-push) torque limit over (priority on overload and other driver errors)"
0: Operation-cancellation level error (Recommended)
(Error No. 420: Steady-state (non-push) torque limit over error)
1: Operation cancellation (SEL command output = OFF)

[Example 1]	LET	290	3	Set the target axis pattern (axes 1 and 2) in integer variable 290.
	LET	291	80	Set the steady-state torque limit in integer variable 291.
	LET	292	1000	Set the steady-state torque limit over detection time in integer variable 292.
	ECMD	250	290	Read the values of three successive variables, starting from variable 290. Set axes 1 and 2. Steady-state torque limit = 80%, steady-state torque limit over detection time = 10000msec
	MOVP	2		Move to position No. 2 under the condition set by ECMD250.

* To return to a normal state:

[Example 2]	LET	290	3	Set the target axis pattern (axes 1 and 2) in integer variable 290.
	LET	291	1000	Set the steady-state torque limit in integer variable 291 (specification of the upper limit specific to each axis).
	LET	292	20000	Clear the steady-state torque limit over detection time in integer variable 292. (Clear 20000.)
	STOP	*290		Clear the low-torque axis deviation counter.
	ECMD	250	290	Read the values of three successive variables, starting from variable 290. Steady-state torque limit = Upper limit specific to each axis (maximum torque return) Steady-state torque limit over detection time (20000msec)
	MOVP	2		Move to position 2 at the steady-state torque.

(Note 1) If the torque is set low, dropping (vertical axis, etc.) and overshooting occurs. If the torque is lowered during high-speed operation, overshooting occurs due to insufficient torque.

(Note 2) If the torque is lowered during high-speed operation, normal deceleration cannot be performed due to insufficient torque and overshooting occurs as a result, creating a dangerous situation.

(Note 3) If positioning operation is performed at low torque, the axis may remain stopped near the positioning target due to insufficient torque. When moving an axis, be sure to set the “steady-state (non-push) torque limit over detection time” to 1msec or longer to detect a steady-state (non-push) torque limit over event (timeout).

* If the “steady-state (non-push) torque limit over detection time” is set to 0 to “limit the torque of the supporting axis (horizontal only) in fitting application”, positioning operation to the coordinate of the torque-limited axis is performed when returning after the fitting operation, if the position data for return operation after the fitting operation (via a PUSH command, etc.) includes the coordinate of the supporting axis (torque-limited axis) in fitting application. As a result, the axis may remain stopped near the target position due to insufficient torque. For the position data used in the return operation after the fitting operation, set only the coordinate of the fitting operation axis (axis used by a PUSH command, etc.).

(Note 4) If the torque is set extremely low, servo ON axes may move at very slow speed due to an analog offset error, etc.

(Note 5) Even when the load is normal, the torque becomes slightly higher during acceleration/deceleration. Determine appropriate settings (steady-state torque limit and steady-state torque limit over detection time) to prevent false detection of steady-state torque limit over events.

(Note 6) "Error No. C6B: Deviation overflow error" or "Error No. CA5: Stop deviation overflow error" may be detected before "Error No. 420: Steady-state (non-push) torque limit over error". This is normal.

(Note 7) If the torque is changed to a high level from a low level at which axis movement can no longer be guaranteed, be sure to issue a STOP command to low-torque axes and clear the deviation counter before increasing the torque (from a low level). If the torque setting is changed from low to high when deviations are still accumulated, the axes may move without their speed being limited and thus a dangerous situation may occur.

(Note 8) To return to the normal condition (maximum torque), expressly specify 1000% for the "steady-state (non-push) torque limit (upper limit)" and 20000msec for the "steady-state (non-push) torque limit over detection time".

* If a value greater than the upper limit specific to each axis is set for the "steady-state (non-push) torque limit (upper limit)" of that axis, the upper limit specific to the axis (approx. 200 to 400%) is set.

(Note 9) The following values are used upon power ON reset, software reset and start of home return:
Steady-state (non-push) torque limit (upper limit) = Driver card parameter No. 40, "Maximum toque limit (%)"
Steady-state (non-push) torque limit over detection time = 20000msec

(Note 10) If the "steady-state (non-push) torque limit (upper limit)" and "steady-state (non-push) torque limit over detection time" are changed, the new settings will remain effective even after the SEL program ends. When building a system using this extended command, therefore, expressly set the "steady-state (non-push) torque limit (upper limit)" and "steady-state (non-push) torque limit over detection time" in all SEL programs, before any operation is started in each program, using this extended command. If you assume that the "steady-state (non-push) torque limit (upper limit)" and "steady-state (non-push) torque limit over detection time" will be reset after the end of operation in other programs, unexpected settings of "steady-state (non-push) torque limit (upper limit)" and "steady-state (non-push) torque limit over detection time" may be applied should the program abort due to an error, etc., in which case unforeseen problems may result.

(Note 11) This extended command does not rewrite the value of driver card parameter No. 40, "maximum torque limit" itself (main CPU flash memory) (in non-volatile memory).

[26] RC gateway function commands

● RPGT (Read RC-axis position data)

*1 439 RC Position Data Use Method Error when a command was executed

RC position-data use mode		
	XSEL	○ Can be used
	RC	× Cannot be used*1

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RPGT	RC-axis number	Position number	CC

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] Read the RC-axis position into variable 199.

[Example 1] RPGT 1 2 Read the position corresponding to RC position No. 2 of axis 1 into variable 199.

Position data of axis 1

No.	Pos	Vel	Acc	Push	Inp
0	5.00	300	0.3	0	0.10
1	380.00	300	0.3	0	0.10
2	200.00	300	0.3	0	0.10

→ 200.00 is stored in variable 199.

[Example 2]

	LET	1	2	Assign 2 to variable 1.
	LET	2	3	Assign 3 to variable 2.
	RPGT	*1	*2	Read into variable 199 the RC position corresponding to the content of variable 2, or 3, of the axis corresponding to the content of variable 1, or 2.

● RPPT (Write RC-axis position data)

*1 439 RC Position Data Use Method Error when a command was executed

RC position-data use mode	XSEL	○ Can be used
	RC	× Cannot be used*1

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RPPT	RC-axis number	Position number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] Write the value of variable 199 to the position corresponding to the specified position data [mm].

[Example 1]

LET	199	150	Assign 150 to variable 199.
RPPT	1	2	Write the content of variable 199, or 150, to RC position No. 2 of axis 1.

Position data of axis 1

No.	Pos	Vel	Acc	Push	Inp
0	5.00	300	0.3	0	0.10
1	380.00	300	0.3	0	0.10
2	150.00	300	0.3	0	0.10

Variable 199	150

[Example 2]

LET	199	15	Assign 150 to variable 199.
LET	1	2	Assign 2 to variable 1.
LET	2	3	Assign 3 to variable 2.
RPPT	*1	*2	Write the content of variable 199, or 150, to the RC position corresponding to the content of variable 2, or 3, of the axis corresponding to the content of variable 1, or 2.

● RPCR (Clear RC-axis position data)

*1 439 RC Position Data Use Method Error when a command was executed

RC position-data use mode	XSEL	○ Can be used
	RC	× Cannot be used*1

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RPCR	RC-axis number	Variable number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] Clear position data in the range specified by variable No. n and variable No. n+1. After the data is cleared, the fields become blank.

Variable	Description of setting
n	Clear start position number
n+1	Clear end position number

[Example 1]

```
LET   200  0     Assign 0 to variable 200.
LET   201  1     Assign 1 to variable 201.
RPCR  1    200   Clear 1 from position No. 0 of axis 1.
```

Position data of axis 1

No.	Pos	Vel	Acc	Push	Inp
0					
1					
2	200.00	300	0.3	0	0.10

} Cleared.

● RPCP (Copy RC-axis position data)

*1 439 RC Position Data Use Method Error when a command was executed

RC position-data use mode	XSEL	○ Can be used
	RC	× Cannot be used*1

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RPCP	RC-axis number	Variable number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] Copy the position data specified by variable No. n and variable No. n+1.

Variable	Description of setting
n	Position number to copy data to
n+1	Position number to copy data from

[Example 1]

LET	200	2	Assign 2 to variable 200.
LET	201	0	Assign 0 to variable 201.
RPCP	1	200	Copy the data of position No. 0 of axis 1 specified by the variable, to position No. 2.

Position data of axis 1

No.	Pos	Vel	Acc	Push	Inp
0	5.00	100	0.2	0	0.20
1	380.00	300	0.3	0	0.10
2	5.00	100	0.2	0	0.20

Copy

● RPRD (Read current RC-axis position)

*1 439 RC Position Data Use Method Error when a command was executed

RC position-data use mode	XSEL	○ Can be used
	RC	× Cannot be used*1

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RPRD	Position number	Prohibited	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] Read into a position number the current position of each axis specified by an RAXS command.

Important note: Before executing this command, set an axis pattern using an RAXS command. If not, a "(43B) RC-axis pattern not-set error" occurs.

[Example 1]

RAXS	0	11	Set an axis pattern consisting of axes 0, 1 and 2.
RPRD	100		Read the current positions of axes 0 to 2 into RC position No. 100.

Position data of axis 1

No.	Pos	Vel	Acc	Push	Inp
100	5.00	300	0.3	0	0.10

The current position of axis 1

Position data of axis 2

No.	Pos	Vel	Acc	Push	Inp
100	500.00	200	0.3	0	0.10

The current position of axis 2

Position data of axis 3

No.	Pos	Vel	Acc	Push	Inp
100	100.00	300	0.3	0	0.10

The current position of axis 3

[Example 2]

RAXS	0	111	Set an axis pattern consisting of axes 0, 1 and 2.
LET	1	100	Set 100 in variable 1.
RPRD	*1		Read the current positions of axes 0 to 2 into the RC position corresponding to the content of variable 1, or 100.

● RPRQ (Read current RC-axis position (single-axis direct))

RC position-data use mode	XSEL	○ Can be used
	RC	○ Can be used

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RPDQ	RC-axis number	Variable number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] Read the current position of the RC-axis into the variable specified in operand 2. The current position can be acquired faster than when a RPRD command is used.

[Example] RPRQ 2 100 Read the current position of axis 2 into variable No. 100.

● RPVL (Write RC-axis speed data)

*1 439 RC Position Data Use Method Error when a command was executed

RC position-data use mode		
RC position-data use mode	XSEL	○ Can be used
	RC	× Cannot be used*1

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RPVL	RC-axis number	Position number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] Write the value of variable 199 to the speed [mm/s] corresponding to the position data specified in operand 2.

[Example 1]

LET	199	100	Assign 100 to variable 199.
RPVL	1	2	Write the speed in variable 199, or 100mm/s, to RC position No. 2 of axis 1.

Position data of axis 1

No.	Pos	Vel	Acc	Push	Inp
0	5.00	300	0.3	0	0.10
1	380.00	300	0.3	0	0.10
2	200.00	<u>100</u>	0.3	0	0.10

Variable 199	100

[Example 2]

LET	199	100	Assign 100 to variable 199.
LET	1	2	Assign 2 to variable 1.
LET	2	3	Assign 3 to variable 2.
RPVL	*1	*2	Write the speed in variable 199, or 100mm/s, to the RC position number corresponding to the content of variable 2, or 3, of the axis corresponding to the content of variable 1, or 2.

● RPAD (Write RC-axis acceleration/deceleration data)

*1 439 RC Position Data Use Method Error when a command was executed

RC position-data use mode		
	XSEL	○ Can be used
	RC	× Cannot be used*1

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RPAD	RC-axis number	Position number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] Write the value of variable 199 to the acceleration/specification [G] corresponding to the position data specified in operand 2.

[Example 1]

LET	199	0.1	Assign 0.1 to variable 199.
RPAD	1	2	Write the acceleration/specification in variable 199, or 0.1G, to RC position No. 2 of axis 1.

Position data of axis 1

No.	Pos	Vel	Acc	Push	Inp
0	5.00	300	0.3	0	0.10
1	380.00	300	0.3	0	0.10
2	200.00	300	0.1	0	0.10

Variable 199	0.1

[Example 2]

LET	199	0.3	Assign 0.3 to variable 199.
LET	1	2	Assign 2 to variable 1.
LET	2	3	Assign 3 to variable 2.
RPAD	*1	*2	Write the speed in variable 199, or 0.3G, to the RC position number corresponding to the content of variable 2, or 3, of the axis corresponding to the content of variable 1, or 2.

[26] RC gateway function commands

● RPIP (Write RC-axis in-position width data)

*1 439 RC Position Data Use Method Error when a command was executed

RC position-data use mode		
	XSEL	○ Can be used
	RC	× Cannot be used*1

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RPIP	RC-axis number	Position number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] Write the value of variable 199 to the in-position width [mm] corresponding to the position data specified in operand 2.

[Example 1]

LET	199	0.2	Assign 0.2 to variable 199.
RPIP	1	2	Write the in-position band in variable 199, or 0.2mm, to RC position No. 2 of axis 1.

Position data of axis 1

No.	Pos	Vel	Acc	Push	Inp
0	5.00	300	0.3	0	0.10
1	380.00	300	0.3	0	0.10
2	200.00	300	0.3	0	0.20

Variable 199	0.2

[Example 2]

LET	199	0.2	Assign 0.2 to variable 199.
LET	1	2	Assign 2 to variable 1.
LET	2	3	Assign 3 to variable 2.
RPIP	*1	*2	Write the in-position width in variable 199, or 0.2mm, to the RC position number corresponding to the content of variable 2, or 3, of the axis corresponding to the content of variable 1, or 2.

● RPTQ (Write RC-axis current-limiting value data for push-motion operation)

*1 439 RC Position Data Use Method Error when a command was executed

RC position-data use mode	XSEL	○ Can be used
	RC	× Cannot be used*1

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RPTQ	RC-axis number	Position number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] Write the value of variable 199 to the current-limiting value for push-motion operation [%] corresponding to the position data specified in operand 2.

[Example 1]

LET	199	50	Assign 50 to variable 199.
RPTQ	1	2	Write the current-limiting value in variable 199, or 50%, to RC position No. 2 of axis 1.

Position data of axis 1

No.	Pos	Vel	Acc	Push	Inp
0	5.00	300	0.3	0	0.10
1	380.00	300	0.3	0	0.10
2	200.00	300	0.3	50	0.10

Variable 199	50

[Example 2]

LET	199	50	Assign 50 to variable 199.
LET	1	2	Assign 2 to variable 1.
LET	2	3	Assign 3 to variable 2.
RPTQ	*1	*2	Write the current-limiting value in variable 199, or 50%, to the RC position number corresponding to the content of variable 2, or 3, of the axis corresponding to the content of variable 1, or 2.

● RGVL (Read RC-axis speed data)

*1 439 RC Position Data Use Method Error when a command was executed

RC position-data use mode	XSEL	○ Can be used
	RC	× Cannot be used*1

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RGVL	RC-axis number	Position number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] Read into variable 199 the speed [mm/s] corresponding to the position data specified in operand 2.

[Example] RGVL 2 1 Read into variable 199 the speed specified under RC position No. 1 of axis 2.

Position data of axis 2

No.	Pos	Vel	Acc	Push	Inp
0	5.00	300	0.3	0	0.10
1	380.00	200	0.3	0	0.10

Variable 199	200

● RGAD (Read RC-axis acceleration/deceleration data)

*1 439 RC Position Data Use Method Error when a command was executed

RC position-data use mode	XSEL	○ Can be used
	RC	× Cannot be used*1

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RGAD	RC-axis number	Position number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] Read into variable 199 the acceleration/deceleration [G] corresponding to the position data specified in operand 2.

[Example 1] RGAD 2 1 Read into variable 199 the acceleration/deceleration specified under RC position No. 1 of axis 2.

Position data of axis 2

No.	Pos	Vel	Acc	Push	Inp
0	5.00	300	0.3	0	0.10
1	380.00	300	0.2	0	0.10

Variable 199	0.2

● RGIP (Read RC-axis in-position width data)

*1 439 RC Position Data Use Method Error when a command was executed

RC position-data use mode	XSEL	○ Can be used
	RC	× Cannot be used*1

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RGIP	RC-axis number	Position number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] Read into variable 199 the in-position width [mm] corresponding to the position data specified in operand 2.

[Example] RGIP 2 1 Read into variable 199 the in-position width specified under RC position No. 1 of axis 2.

Position data of axis 2

No.	Pos	Vel	Acc	Push	Inp
0	5.00	300	0.3	0	0.10
1	380.00	300	0.2	0	0.10

Variable 199	0.10

● RGTQ (Read RC-axis current-limiting value data for push-motion operation)

*1 439 RC Position Data Use Method Error when a command was executed

RC position-data use mode		
RC position-data use mode	XSEL	○ Can be used
	RC	× Cannot be used[*1]

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RGTQ	RC-axis number	Position number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] Read into variable 199 the current-limiting value for push-motion operation [%] corresponding to the position data specified in operand 2.

[Example] RGTQ 2 1 Read into variable 199 the current-limiting value specified under RC position No. 1 of axis 2.

Position data of axis 2

No.	Pos	Vel	Acc	Push	Inp
0	5.00	300	0.3	0	0.10
1	380.00	300	0.2	30	0.10

Variable 199	30

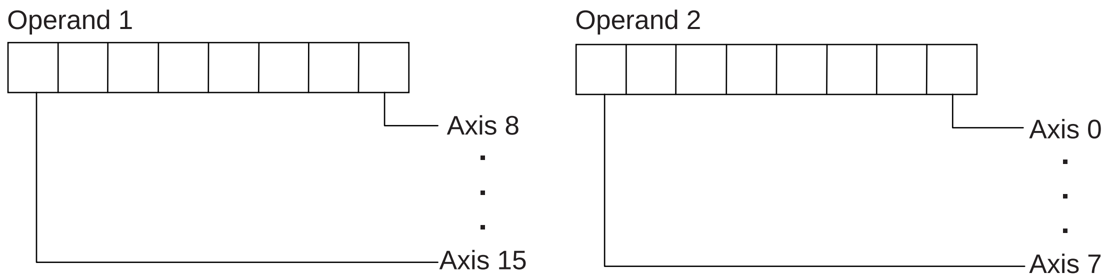
● RAXS (Set RC-axis pattern)

RC position-data use mode		
	XSEL	○ Can be used
	RC	○ Can be used

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RAXS	Axis pattern, upper	Axis pattern, lower	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] Set an axis pattern covering axes 8 to 15 in operand 1, and axis pattern covering axes 0 to 7 in operand 2.
The axes set by the axis pattern are operated simultaneously.



Always set an axis pattern if the commands listed below are used.
(Set 1 for the axis numbers used, and 0 for the axis number not used.)
If an axis pattern is not set, a "(43B) RC-axis pattern not-set error" occurs:

- RPRD : Read current RC-axis position
- RSON : Turn ON RC-axis servo
- RSOF : Turn OFF RC-axis servo
- RHOM : Return RC-axis to home
- RMVP : Move RC-axis by position specification
- RMPI : Move RC-axis incrementally by position specification
- RSTP : Decelerate RC-axis to stop

[Example]	RAXS	1010101	10101010	Set an axis pattern consisting of axes 1, 3, 5, 7, 8, 10, 12 and 14.
	RSON			Turn ON the servos of the specified axes.
	RMVP	20		Move the specified axes to the positions corresponding to position No. 20.

● RSON (Turn ON RC-axis servo)

RC position-data use mode	XSEL	○ Can be used
	RC	○ Can be used

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RSON	Prohibited	Prohibited	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] Turn ON the servo of each RC-axis specified by an RAXS command.

> Important note: Before executing this command, set an axis pattern using an RAXS command. If not, a “(43B) RC-axis pattern not-set error” occurs.

[Example] RAXS 0 1100 Set an axis pattern that uses axes 2 and 3.

RSON Turn ON the servos of the specified axes.

● RSOF (Turn OFF RC-axis servo)

RC position-data use mode	XSEL	○ Can be used
	RC	○ Can be used

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RSOF	Prohibited	Prohibited	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] Turn OFF the servo of each RC-axis specified by an RAXS command.

> Important note: Before executing this command, set an axis pattern using an RAXS command.
> If not, a "(43B) RC-axis pattern not-set error" occurs.

[Example]	RAXS	0	1100	Set an axis pattern consisting of axes 2 and 3.
	RSOF			Turn OFF the servos of the specified axes.

● RHOM (Return RC-axis to home)

RC position-data use mode	XSEL	○ Can be used
	RC	○ Can be used

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RHOM	Prohibited	Prohibited	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] Return each RC-axis specified by an RAXS command to its home.
The servo of the axis to be returned home turns ON automatically.

[Example]

RAXS	0	1100	Set an axis pattern consisting of axes 2 and 3.
RHOM			Return the specified axes to their home.

● RMVP (Move RC-axis by position specification)

RC position-data use mode	XSEL	○ Can be used
	RC	○ Can be used

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RMVP	Position number	Prohibited	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] Move each RC-axis specified by an RAXS command to the position number in operand 1. The output turns OFF when the axis movement is started, and turns ON when completed.

⚠ Caution: The specific operation varies between the XSEL position-data use mode and RC position-data use mode.

1) XSEL position-data use mode
   → Move via PTP to the position corresponding to the position number in operand 1.
2) RC position-data use mode
   → The specific operation varies depending on the position data in the RC controller.

No.	Position data item in RC		
	Push-motion	Incremental	Description of operation
1	0	0	Move via PTP to the position corresponding to the position number in operand 1.
2	0	1	Move incrementally (via PTP) by the travel corresponding to the position number in operand 1.
3	Other than 0	0	Move to the position corresponding to the position number in operand 1 and then perform push-motion operation. The output turns OFF if any one axis has been pushed missed the load.
4	Other than 0	1	Move to the position corresponding to the position number in operand 1 and then perform push-motion operation. The output turns OFF if any one axis has been pushed and missed the load.

Important note: Before executing this command, set an axis pattern using an RAXS command. If not, a “(43B) RC-axis pattern not-set error” occurs.

[Example 1]	RAXS	0	11	Set an axis pattern consisting of axes 0 and 1.
	RMVP	10		Move the specified axes to the positions corresponding to position No. 10.
[Example 2]	RAXS	0	11	Set an axis pattern consisting of axes 0 and 1.
	LET	1	10	Assign 10 to variable 1.
	RMVP	*1		Move the specified axes to the positions corresponding to position No. 10 according to the content of variable 1, or 10.

● RMPI (Move RC-axis incrementally by position specification)

*1 439 RC Position Data Use Method Error when a command was executed

RC position-data use mode	XSEL	○ Can be used
	RC	× Cannot be used*1

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RMPI	Position number	Prohibited	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] Move each RC-axis specified by an RAXS command by the travel corresponding to the position data number in operand 1.
The output turns OFF when the axis movement is started, and turns ON when completed.

Important note: Before executing this command, set an axis pattern using an RAXS command. If not, a "(43B) RC-axis pattern not-set error" occurs.

[Example 1]

RAXS	0	11	Set an axis pattern consisting of axes 0 and 1.
RHOM	10		Move by the travel corresponding to position No. 10.

[Example 2]

RAXS	0	11	Set an axis pattern consisting of axes 0 and 1.
LET	1	10	Assign 10 to variable 1.
RMPI	*1		Move the specified axes by the travels corresponding to position No. 10 according to the content of variable 1, or 10.

(Note 1) 405 RC Gateway Communication Type Error will occur in Fieldbus Type.

● RMVD (Move RC-axis absolutely by direct numerical specification of position)

*1 439 RC Position Data Use Method Error when a command was executed

RC position-data use mode	XSEL	○ Can be used
	RC	× Cannot be used*1

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RMVD	RC-axis number	Variable number	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] Perform absolute position movement using the values in variable No. n to variable No. n+3.
The output turns OFF when the axis movement is started, and turns ON when completed.

Variable number	Description of setting
n	Target position
n+1	Speed [mm/s]
n+2	Acceleration/deceleration [G]
n+3	In-position width [mm]

[Operand 1 setting type]

Operand 1	Specification of execution axis
0 to 15	The axis corresponding to the specified RC-axis number performs absolute position movement.
-1	Each RC-axis specified by an RAXS command performs absolute position movement.

* Specifying -1 is valid with XSEL_P/Q/PCT/QCT Ver.0.87 or later and XSEL_PX/QX Ver.0.42 or later.

[Example]

LET	300	100	Set the target position to 100mm.
LET	301	200	Set the speed to 200mm/s.
LET	302	0.3	Set the acceleration/deceleration to 0.3G.
LET	303	0.1	Set the in-position width to 0.1mm.
RMVD	1	300	Move RC-axis 1 absolutely to the specified position.

● RMDI (Move RC-axis incrementally by direct numerical specification of position)

*1 439 RC Position Data Use Method Error when a command was executed

RC position-data use mode	XSEL	○ Can be used
	RC	× Cannot be used*1

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RMDI	RC-axis number	Variable number	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] Perform incremental position movement using the values in variable No. n to variable No. n+3.
The output turns OFF when the axis movement is started, and turns ON when completed.

Variable number	Description of setting
n	Travel
n+1	Speed [mm/s]
n+2	Acceleration/deceleration [G]
n+3	In-position width [mm]

[Operand 1 setting type]

Operand 1	Specification of execution axis
0 to 15	The axis corresponding to the specified RC-axis number performs incremental position movement.
-1	Each RC-axis specified by an RAXS command performs incremental position movement.

* Specifying -1 is valid with XSEL_P/Q/PCT/QCT Ver.0.87 or later and XSEL_PX/QX Ver.0.42 or later.

[Example]

LET	300	50	Set the travel to 50mm.
LET	301	200	Set the speed to 200mm/s.
LET	302	0.3	Set the acceleration/deceleration to 0.3G.
LET	303	0.1	Set the in-position band to 0.1mm.
RMDI	1	300	Move RC-axis 1 incrementally to the specified position.

(Note 1) 405 RC Gateway Communication Type Error will occur in Fieldbus Type.

● RPUS (Move RC-axis via push motion)

*1 439 RC Position Data Use Method Error when a command was executed

RC position-data use mode	XSEL	○ Can be used
	RC	× Cannot be used*1

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RPUS	RC-axis number	Position number	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] The axis moves to the target position corresponding to the position number in operand 2, and then push the load over the in-position width specified by the position data.
The push force is set by the current-limiting value for push-motion operation among the position data.
The output turns ON when a push action is confirmed, and turns OFF if a miss is detected.

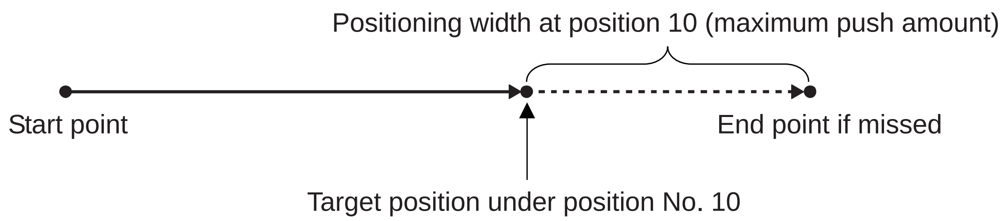
[Operand 1 setting type]

Operand 1	Specification of execution axis	Output specification
0 to 15	The axis corresponding to the specified RC-axis number moves via push motion.	The output turns ON when pushing of the command axis is confirmed.
-1	Each RC-axis specified by an RAXS command moves via push motion.	The output turns ON when pushing of all command axes is confirmed.
-2	Each RC-axis specified by an RAXS command moves via push motion.	The output turns ON when pushing of any one of all command axes is confirmed.

* Specifying -1 is valid with XSEL_P/Q/PCT/QCT Ver.0.87 or later and XSEL_PX/QX Ver.0.42 or later.

⚠ Caution:
- If a positive sign is appended to positioning width data, the load is pushed in the direction of increasing coordinates from the start point of the RPUS command toward the target position.
- If a negative sign is appended, the load is pushed in the direction of decreasing coordinates. (The operation is different from when a PUSH command is used.)

[Example] PRUS 3 10 Move RC-axis 3 to the position corresponding to position No. 10 and cause it to push the load.



● RSTP (Cancel RC-axis movement)

RC position-data use mode	XSEL	○ Can be used
	RC	○ Can be used

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RSTP	Prohibited	Prohibited	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] Decelerate each RC-axis specified by an RAXS command to a stop.
This command is valid with respect to all RC-axis control commands other than RSOF.

> Notice : Before executing this command, set an axis pattern using an RAXS command.
> If not, a “(43B) RC-axis pattern not-set error” occurs.

[Example]

RAXS	0	11	Set an axis pattern consisting of axes 0 and 1.
RSTP			Decelerate the specified axes to a stop.

● RCST (Read RC-axis status)

RC position-data use mode	XSEL	○ Can be used
	RC	○ Can be used

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	RCST	Variable number	RC-axis number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	○	○	×	×	×

[Function] Read the RC-axis status into the variable number in operand 1.
Read the completed position number into variable n+1. (Refer to “Note 2”.)

> Notice 1: The specific status varies between the XSEL position-data use mode and RC position-data use mode.

Variable number	Acquired data
n	RC-axis status
n+1	Completed position number

RC-axis status bit structure

Bit	XSEL position-data use mode		RC position-data use mode	
	Name	Explanation	Name	Explanation
27-31	–	Reserved	–	Reserved
26	ALMX	RC-axis alarm (Error detected by the XSEL) * When ALM turns ON, ALMX also turns ON. However, ALM may not turn ON even if ALMS turns ON depending on the error.	ALMX	RC-axis alarm (Error detected by the XSEL) * When ALM turns ON, ALMX also turns ON. However, ALM may not turn ON even if ALMS turns ON depending on the error.
25	USE	RC-axis in use	USE	RC-axis in use
24	LNK	RC-axis linked	LNK	RC-axis linked
16-23	–	Reserved	–	Reserved
15	RMDS	Operation Mode	RMDS	Operation Mode
14	ALML	Light Error Alarm	ALML	Light Error Alarm
13	ZON2	Zone 2	ZON2	Zone 2
12	ZON1	Zone 1	ZON1	Zone 1
11	–	Reserved	PZON	Position zone
10	–	Reserved	MODS	Teaching mode status
9	SFTY	Safety speed enabled	SFTY	Safety speed enabled
8	BALM	Battery voltage low	BALM	Battery voltage low
7	EMG	Emergency stop	EMG	Emergency stop
6	PSFL	Load not pushed	PSFL	Load not pushed
5	CRDY	Controller ready	CRDY	Controller ready
4	SON	Servo ON	SON	Servo ON
3	MOVE	Moving	MOVE	Moving
2	HEND	Home return complete	HEND	Home return complete
1	PEND	Positioning complete	PEND	Positioning complete
0	ALM	Operation-disabling alarm (Error detected by the RC-axis)	ALM	Operation-disabling alarm (Error detected by the RC-axis)

Notice 2: Completed position numbers are set only in the RC position-data use mode.
In the XSEL position-data use mode, this bit is always set to 0.

[Example] RCST 200 10 Acquire the status of RC-axis 10 into variable 200.

[27] Electronic Cam Control System

● XCRP (Clear input counter record for extension motion control board)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XCRP	Pulse input channel number	Prohibited	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] This clears the specified pulse input channel counter to 0.

> ⚠ Caution
> The counter clear cannot be performed when the pulse I/O board axis is in synchronizing operation with the specified channel used as the master axis.

[Example 1] XCRP 0 It clears the counter for the pulse input channel No. 0.

● XGTP (Acquire the current value for extension motion control board pulse input counter)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XGTP	Pulse input channel number	Prohibited	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It reads the current value for the pulse input channel counter specified in Operand 1 into Variable 99.

[Example 1] XGTP 0 It acquires the pulse input channel No. 0 counter in Variable 99.

> ⚠ Caution
> The pulse I/O board input channel is a signed 32-bit counter.

● XPGT (Read extension motion control board axis position data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XPGT	Axis number	Position number	CC

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It reads the position data location [mm] specified in Operand 2 on the pulse I/O board axis specified in Operand 1 into Variable 199 (minimum effective digit number = 3).

[Example 1]

XPGT	2	3	It reads the position set in Position No. 3 of the 2^{nd} axis into Variable 199.

[Example 2]

LET	1	2	Assign 2 to variable 1.
LET	2	3	Assign 3 to variable 2.
XPGT	*1	*2	It reads the position set in Position No. 3 (content of Variable 2) of the 2^{nd} axis (content of Variable 1) into Variable 199.

⚠ Caution
If ineffective position data is specified in Operand 2, Variable 199 becomes non-operated and the output section is turned OFF.

● XPPT (Write extension motion control board axis position data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XPPT	Axis number	Position number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It reads the position data location [mm] specified in Operand 2 on the pulse I/O board axis specified in Operand 1 into Variable 199 (minimum effective digit number = 3).

[Example 1]

LET	199	150	Assign 150 to variable 199.
XPPT	2	3	It writes Content 150 in Variable 199 in Position No. 3 of the 2nd axis.

[Example 2]

LET	199	150	Assign 150 to variable 199.
LET	1	2	Assign 2 to variable 1.
LET	2	3	Assign 3 to variable 2.
XPPT	*1	*2	It writes Content 150 in Variable 199 in the position set in Position No. 3 (content of Variable 2) of the 2nd axis (content of Variable 1).

● XPCR (Erase extension motion control board axis position data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XPCR	Axis number	Variable number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It erases the pulse I/O board axis position data specified in Operand 1 by using the two variables in a row from Variable No. n specified in Operand 2.
The erased data becomes a blank.

Variable No.	Description of setting
n	Start position number
n+1	End position number

[Example 1]

LET	200	10	Assign 10 to variable 200.
LET	201	20	Assign 20 to variable 201.
XPCR	1	200	It erases Positions No. 10 to 20 in the 1st axis.

● XPCP (Copy extension motion control board axis position data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XPCP	Axis number	Variable number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It copies the pulse I/O board axis position data specified in Operand 1 by using the two variables in a row from Variable No. n specified in Operand 2.

Variable No.	Description of setting
n	Position number to copy data to
n+1	Position number to copy data from

[Example 1]

LET	200	20	Assign 20 to variable 200.
LET	201	10	Assign 10 to variable 201.
XPCP	1	200	It copies Position No. 10 data in the 1st axis to Position No. 20.

● XPRD (Read extension motion control board axis current command position)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XPRD	Positio number	Prohibited	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It reads the current order position of the pulse I/O board axis specified by XAXS Command into the position number specified in Operand 1.

⚠ Caution
- Make sure to set the axis pattern by XAXS Command before executing this command. If the setting is not established, Error No. 445 “Extension motion control board axis pattern not set error” would occur.
- he position acquired in this command is the current order position from the pulse I/O board. Make sure to perform a home-return operation before executing this command.

[Example 1]

XAXS	0	111	Set an pattern that uses axes 0,1 and 2.
XPRD	100		It reads the current order position of 0 to 2 axes into Position No. 100.

[Example 2]

XAXS	0	111	Set an pattern that uses axes 0,1 and 2.
LET	1	100	Assign 100 to variable 1.
XPRD	*1		It reads the current order position of 0 to 2 axes into the position in Content No. 100 of Variable 1.

● XPRQ (Read extension motion control board axis current command position (single-axis direct))

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XPRQ	Axis number	Variable number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It reads the current order position of the pulse I/O board axis specified in Operand 1 into variable specified in Operand 2 (minimum effective digit number = 3). It enables a faster acquirement of the current order position than using XPRD Command.

⚠ Caution
The position acquired in this command is the current order position from the pulse I/O board. Make sure to perform a home-return operation before executing this command.

[Example] XPRQ 2 100 It reads the current order position of the 2nd axis into Variable No. 100.

● XPVL (Write extension motion control board axis speed data)

Extension condition (LD,A,O,AB,OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XPVL	Axis number	Position number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It writes the value in Variable 199 to the position data speed [mm/s] specified in Operand 2 on the pulse I/O board axis specified in Operand 1 (minimum effective digit number = 2).

[Example 1]

LET	199	100	Assign 100 to variable 199.
XPVL	2	3	It writes the speed 100mm/s in Variable 199 to Position No. 3 on the 2nd axis.

[Example 2]

LET	199	100	Assign 199 to variable 100.
LET	1	2	Assign 2 to variable 1.
LET	2	3	Assign 3 to variable 2.
XPVL	*1	*2	It writes the speed 100mm/s in Variable 199 to Position No. 3 (content in Variable 2) on the 2nd axis (content in Variable 1).

● XPAC (Write extension motion control board axis acceleration data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XPAC	Axis number	Position number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It writes the value in Variable 199 to the position data acceleration [G] specified in Operand 2 on the pulse I/O board axis specified in Operand 1 (minimum effective digit number = 2).

[Example 1]

```
LET   199  0.3    Assign 0.3 to variable 199.
XPAC  2    3      It writes the acceleration 0.3G in Variable 199 to
                  Position No. 3 on the 2nd axis.
```

[Example 2]

```
LET   199  0.3    Assign 0.3 to variable 199.
LET   1    2      Assign 2 to variable 1.
LET   2    3      Assign 3 to variable 2.
XPAC  *1   *2     It writes the acceleration 0.3G in Variable 199 to
                  Position No. 3 (content in Variable 2) on the 2nd axis
                  (content in Variable 1).
```

● XPDC (Write extension motion control board axis deceleration data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XPDC	Axis number	Position number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It writes the value in Variable 199 to the position data deceleration [G] specified in Operand 2 on the pulse I/O board axis specified in Operand 1 (minimum effective digit number = 2).

[Example 1]	LET	199	0.3	Assign 0.3 to variable 199.
	XPDC	2	3	It writes the deceleration 0.3G in Variable 199 to Position No. 3 on the 2nd axis.

[Example 2]	LET	199	0.3	Assign 0.3 to variable 199.
	LET	1	2	Assign 2 to variable 1.
	LET	2	3	Assign 3 to variable 2.
	XPDC	*1	*2	It writes the deceleration 0.3G in Variable 199 to Position No. 3 (content in Variable 2) on the 2nd axis (content in Variable 1).

● XPIP (Write extension motion control board axis positioning complete width data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XPIP	Axis number	Position number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It writes the value in Variable 199 to the position data positioning complete width [mm] specified in Operand 2 on the pulse I/O board axis specified in Operand 1 (minimum effective digit number = 3).

[Example 1]

LET	199	0.2	Assign 0.2 to variable 199.
XPIP	2	3	It writes the positioning complete width 0.2mm in Variable 199 to Position No. 3 on the 2nd axis.

[Example 2]

LET	199	0.2	Assign 0.2 to variable 199.
LET	1	2	Assign 2 to variable 1.
LET	2	3	Assign 3 to variable 2.
XPIP	*1	*2	It writes the positioning complete width 0.2mm in Variable 199 to Position No. 3 (content in Variable 2) on the 2nd axis (content in Variable 1).

● XGVL (Read extension motion control board axis speed data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XGVL	Axis number	Position number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It reads the position data speed [mm/s] specified in Operand 2 on the pulse I/O board axis specified in Operand 1 into Variable 199 (minimum effective digit number = 2).

[Example] XGVL 2 3 It reads the speed in Position No. 3 on the 2^{nd} axis into Variable 199.

● XGAC (Read extension motion control board axis acceleration data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XGAC	Axis number	Position number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It reads the position data acceleration [G] specified in Operand 2 on the pulse I/O board axis specified in Operand 1 into Variable 199 (minimum effective digit number = 2).

[Example] XGAC 2 3 It reads the acceleration in Position No. 3 on the 2nd axis into Variable 199.

● XGDC (Read extension motion control board axis deceleration data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XGDC	Axis number	Position number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It reads the position data deceleration [G] specified in Operand 2 on the pulse I/O board axis specified in Operand 1 into Variable 199 (minimum effective digit number = 2).

[Example] XGDC 2 3 It reads the deceleration in Position No. 3 on the 2nd axis into Variable 199.

● XGIP (Read extension motion control board axis positioning complete width data)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XGIP	Axis number	Position number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It reads the position data positioning complete width [mm] specified in Operand 2 on the pulse I/O board axis specified in Operand 1 into Variable 199 (minimum effective digit number = 3).

[Example] XGIP 2 3 It reads the positioning complete width in Position No. 3 on the 2nd axis into Variable 199.

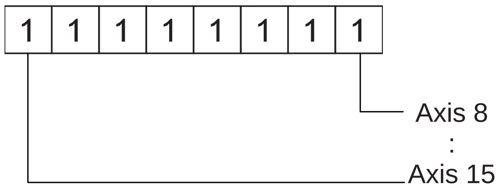
● XAXS (Extension motion control board axis pattern setting)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XAXS	Axis pattern, upper	Axis pattern, lower	CP

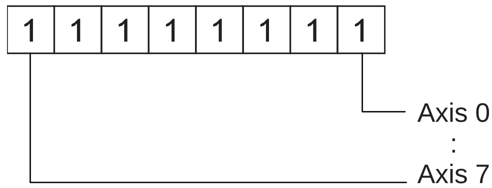
Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It performs a setting for the axis patterns of axes 8 to 15 on the pulse I/O board axis in Operand 1 and the axis patterns of axes 0 to 7 in Operand 2.

Operand 1



Operand 2



After the program execution is started, make sure to set the axis patterns using this command before the following commands are executed.
If the axis pattern setting command XAXS is not conducted, Error No. 445 “Extension motion control board axis pattern not set error” would occur.

XPRD : Read extension motion control board axis current command position
XSON : Servo ON of extension motion control board axis
XSOF : Servo OFF of extension motion control board axis
XHOM : Home return of extension motion control board axis
XMVP : Move extension motion control board axis to indicated position
XMPI : Perform extension motion control board axis position relative movement
XMVL : Move extension motion control board axis for position indicated interpolation
XMLI : Move extension motion control board axis for position relative interpolation
XSTP : Cancel operation of extension motion control board axis

[Example]

XAXS	1010101	10101010	Set an axis pattern consisting of axes 1, 3, 5, 7, 8, 10, 12 and 14.
XSON			It turns the servo ON for axes 1, 3, 5, 7, 8, 10, 12 and 14.
XMVP	20		It moves the axes 1, 3, 5, 7, 8, 10, 12 and 14 to Position 20.

● XSON (Extension motion control board axis servo ON)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XSON	Prohibited	Prohibited	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It turns the servo ON for the pulse I/O board axis specified by XAXS Command.

⚠ Caution
Make sure to set the axis pattern by XAXS Command before this command is executed. If the setting is not established, Error No. 445 “Extension motion control board axis pattern not set error” would occur.

[Example]	XAXS	01	100	Set an axis pattern that uses axes 2 and 3.
	XSON			Turn ON the servos of the specified axes.

● XSOF (Extension motion control board axis servo OFF)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XSOF	Prohibited	Prohibited	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It turns the servo OFF for the pulse I/O board axis specified by XAXS Command.

> ⚠ Caution
> Make sure to set the axis pattern by XAXS Command before this command is executed. If the setting is not established, Error No. 445 “Extension motion control board axis pattern not set error” would occur.

[Example]	XAXS	0	1100	Set an axis pattern that uses axes 2 and 3.
	XSOF			Turn OFF the servos of the specified axes.

● XHOM (Extension motion control board axis home return)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XHOM	Prohibited	Prohibited	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It turns the home return for the pulse I/O board axis specified by XAXS Command.
The servo of the axis to be returned home turns ON automatically.

⚠ Caution
- Make sure to set the axis pattern by XAXS Command before this command is executed. If the setting is not established, Error No. 445 “Extension motion control board axis pattern not set error” would occur.
- The servo would turn OFF if the operation is either paused or stopped to cancel during the home-return operation of the pulse I/O board axis. When resuming the operation after a pause, confirm the servo is ON and then make sure to start with a home-return operation.

[Example]

XAXS	0	1100	Set an axis pattern that uses axes 2 and 3.
XHOM			Home Return the servos of the specified axes.

● XMVP (Move extension motion control board axis to indicated position)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XMVP	Position number	Prohibited	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It moves the pulse I/O board axis specified by XAXS Command by PTP operation to the position number specified in Operand 1.

⚠ Caution
- Make sure to set the axis pattern by XAXS Command before this command is executed. If the setting is not established, Error No. 445 "Extension motion control board axis pattern not set error" would occur.
- It is able to specify another axis that is connected to a different pulse I/O board at the same time. However, since the system is controlled by each board, the operation cannot be synchronized.

[Example 1]

XAXS	0	11	Set an axis pattern that uses axes 0 and 1.
XMVP	10		Move the specified axes to the positions corresponding to position No. 10.

[Example 2]

XAXS	0	11	Set an axis pattern that uses axes 0 and 1.
LET	1	10	Assign 10 to variable 1.
XMVP	*1		Move the specified axes to the positions corresponding to position No. 10 according to the content of variable 1, or 10.

● XMPI (Perform extension motion control board axis position relative movement)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XMPI	Position number	Prohibited	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It moves the pulse I/O board axis specified by XAXS Command by PTP operation with the position number in Operand 1 taken as the amount of movement.

⚠ Caution

- Make sure to set the axis pattern by XAXS Command before this command is executed. If the setting is not established, Error No. 445 “Extension motion control board axis pattern not set error” would occur.
- It is able to specify another axis that is connected to a different pulse I/O board at the same time. However, since the system is controlled by each board, the operation cannot be synchronized.

[Example 1]

XAXS	0	11	Set an axis pattern that uses axes 0 and 1.
XMPI	10		Move by the travel corresponding to position No. 10.

[Example 2]

XAXS	0	11	Set an axis pattern that uses axes 0 and 1.
LET	1	10	Assign 10 to variable 1.
XMPI	*1		Move the specified axes by the travels corresponding to position No. 10 according to the content of variable 1, or 10.

● XMVL (Move extension motion control board axis for position indicated interpolation)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XMVL	Position number	Prohibited	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It moves the pulse I/O board axis specified by XAXS Command by direct interpolation movement to the position number specified in Operand 1.

(Note 1) Make sure to set the axis pattern by XAXS Command before this command is executed. If the setting is not established, Error No. 445 “Extension motion control board axis pattern not set error” would occur.

(Note 2) If another axis connected to a different pulse I/O board is specified, Error No. C30 “Axis pattern error” would occur.

(Note 3) It is necessary to specify the speed, acceleration and deceleration values by VEL, VLMX, ACC, and DCL Commands before executing this command. If not specified, an error would occur.

[Example 1]

XAXS	0	11	Set an axis pattern that uses axes 0 and 1.
XMVL	10		Move the specified axes to the positions corresponding to position No. 10.

[Example 2]

XAXS	0	11	Set an axis pattern that uses axes 0 and 1.
LET	1	10	Assign 10 to variable 1.
XMVL	*1		Move the specified axes to the positions corresponding to position No. 10 according to the content of variable 1, or 10.

● XMLI (Move extension motion control board axis for position relative interpolation)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XMLI	Position number	Prohibited	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It moves the pulse I/O board axis specified by XAXS Command by direct interpolation movement with the position number in Operand 1 taken as the amount of movement.

(Note 1) Make sure to set the axis pattern by XAXS Command before this command is executed. If the setting is not established, Error No. 445 “Extension motion control board axis pattern not set error” would occur.

(Note 2) If another axis connected to a different pulse I/O board is specified, Error No. C30 “Axis pattern error” would occur.

(Note 3) It is necessary to specify the speed, acceleration and deceleration values by VEL, VLMX, ACC, and DCL Commands before executing this command. If not specified, an error would occur.

[Example 1]

XAXS	0	11	Set an axis pattern that uses axes 0 and 1.
XMLI	10		Move by the travel corresponding to position No. 10.

[Example 2]

XAXS	0	11	Set an axis pattern that uses axes 0 and 1.
LET	1	10	Assign 10 to variable 1.
XMLI	*1		Move the specified axes by the travels corresponding to position No. 10 according to the content of variable 1, or 10.

● XMVD (Move extension motion control board axis to directly indicated absolute position)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XMVD	Axis number	Variable number	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It moves the pulse I/O board axis specified in Operand 1 by absolute position movement to the values specified in the five variables in a row from Variable No. n in Operand 2.

Variable No.	Description of setting	Effective Digits
n	Target position [mm]	3 digits minimum
n+1	Speed [mm/s]	2 digits minimum
n+2	Acceleration [G]	2 digits minimum
n+3	Deceleration [G]	2 digits minimum
n+4	Positioning complete width [mm]	3 digits minimum

(Note 1) VLMX Command is invalid to this command.

[Example]

```
LET   300  100   Set the target position to 100mm.
LET   301  200   Set the speed to 200mm/s.
LET   302  0.3   Set the acceleration/deceleration to 0.3G.
LET   303  0.3   Set the deceleration/deceleration to 0.3G.
LET   304  0.1   Set the in-position width to 0.1mm.
XMVD  1    300   Move RC-axis 1 absolutely to the specified position.
```

● XMDI (Move extension motion control board axis to directly indicated relative position)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XMDI	Axis number	Variable number	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It moves the pulse I/O board axis specified in Operand 1 by relative position movement to the values specified in the five variables in a row from Variable No. n in Operand 2.

Variable No.	Description of setting	Effective Digits
n	Travel [mm]	3 digits minimum
n+1	Speed [mm/s]	2 digits minimum
n+2	Acceleration [G]	2 digits minimum
n+3	Deceleration [G]	2 digits minimum
n+4	Positioning complete width [mm]	3 digits minimum

(Note 1) VLMX Command is invalid to this command.

[Example]

```
LET   300  50    Set the travel to 50mm.
LET   301  200   Set the speed to 200mm/s.
LET   302  0.3   Set the acceleration/deceleration to 0.3G.
LET   303  0.3   Set the deceleration/deceleration to 0.3G.
LET   304  0.1   Set the in-position width to 0.1mm.
XMDI  1    300   Move RC-axis 1 absolutely to the specified position.
```

● XJ□□ (Perform extension motion control board axis jog operation)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XJ□□	Input, output, flag number	Prohibited	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It moves the pulse I/O board control shaft specified by XAXS Command in back and forth while the flag on the input port or output port specified in Operand 1 is turning ON and OFF.

XJFN ············It moves forward when the specified port is ON.
XJFF·············It moves forward when the specified port is OFF.
XJBN ············It moves backward when the specified port is ON.
XJBF ············It moves backward when the specified port is ON.

(Note 1) Make sure to set the axis pattern by XAXS Command before this command is executed. If the setting is not established, Error No. 445 “Extension motion control board axis pattern not set error” would occur.

(Note 2) It is effective also to the axis that the home-return operation is incomplete. However, the upper limit for the speed is that set in pulse I/O board command parameter No. 4 “Maximum JOG speed at home return incomplete”. In such a condition, exercise precaution not to crash into the work or stroke end since the coordinate values become meaningless.

(Note 3) This command is valid on Main CPU Application Section Ver.1.02 or later. And a PC software Ver.7.6.5.0 or later which is applicable for this command is also required. (This is for XSEL-P/Q. It is available from the first for XSEL-R/S.)

[Example 1]

VEL	100		Set the speed to 100mm/s.
XAXS	0	11	Set an axis pattern that uses axes 0 and 1.
XJBF	10		Move axis 5 backward while input 10 is OFF.

[Example 2]

VEL	100		Set the speed to 100mm/s.
LET	5	20	Assign 20 to variable 5.
XAXS	0	11	Set an axis pattern that uses axes 0 and 1.
XJFN	*5		Move axis 0 and 1 forward while the content of variable 5 (input 20), is ON.

● XPED (Waiting for extension motion control board axis to finish positioning operation of axis used by self-program)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XPED	Prohibited	Prohibited	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It waits for the positioning operation of the pulse I/O board axis used in the program its own. By this command, it is possible to wait for the completion of the positioning operation (XMVP, XMPI, XMVL, XMLI, XMVD and XMDI) when the positioning complete width is valid. The output becomes ON when the operation is completed in normal condition. The command would not react after an execution of any operation command other than positioning operation. (Output section is OFF.)
For an operation that the positioning complete band is valid, recovery from the operation command is performed once the actuator reaches in front of the positioning complete band at the current position (or current position command when the pulse input and output boards are mounted). (Output section is OFF.) It is possible to confirm the positioning is complete by executing this command after the command recovery. Also, the driven axis is usually occupied by the executed program after the operation command recovery. By executing this command, the axis gets released, thus the axis becomes available for a use by other programs.

[Example]

XAXS	0	11	Set an axis pattern that uses axes 0 and 1.
XMVP	10		Move the specified axes to the positions corresponding to position No. 10. For an operation that the positioning complete band is valid, recovery from the operation command is performed once the actuator reaches in front of the positioning complete band at the current position (or current position command when the pulse input and output boards are mounted).
BTON	308		It turns ON Output Port No. 308.
XPED			It waits for the positioning operation axis No. 0 and 1 of the program itself to complete.

● XSTP (Cancel operation of extension motion control board axis)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XSTP	Prohibited	Prohibited	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It decelerates and stops the expansion pulse I/O board axis specified by XAXS Command. It is valid for the pulse I/O board axis actuator control command other than XSOF command.

(Note 1) Make sure to set the axis pattern by XAXS Command before this command is executed. If the setting is not established, Error No. 445 “Extension motion control board axis pattern not set error” would occur.

[Example]

XAXS	0	11	Set an axis pattern that uses axes 0 and 1.
XSTP			Decelerate the specified axes to a stop

● XWIP (Waiting for extension motion control board axis positioning complete signal to be turned ON)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XWIP	Prohibited	Prohibited	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It waits till the positioning complete signal of the pulse I/O board control shaft specified by XAXS Command turns ON. This enables to wait for the completion of the positioning operation of the slave shaft (= slave shaft positioning complete signal ON) while in synchronizing process by executing this command to the synchronizing slave shaft after the synchronizing master shaft operation command is complete (*). The positioning complete signal for the slave shaft turns ON when position deviation ≤ positioning complete width. The status would not become waiting unless the pulse order is output from the master shaft side to the slave side.

* The pulse order of the slave shaft is completed by the completion of the master shaft operation command.

(Note 1) Make sure to set the axis pattern by XAXS Command before this command is executed. If the setting is not established, Error No. 445 “Extension motion control board axis pattern not set error” would occur.

(Note 2) If the positioning complete signal does not turn ON even after the time set in the pulse I/O board output channel parameter No. 33 “Positioning complete confirmation time” of the specified axis is passed, Error No. 454 “pulse I/O board axis positioning complete timeout error” would occur.
Check if the positioning complete signal cable is broken.

(Note 3) This command is valid on Main CPU Application Section Ver.1.02 or later. And a PC software Ver.7.6.5.0 or later which is applicable for this command is also required. (This is for XSEL-P/Q. It is available from the first for XSEL-R/S.)

[Example]

XCAS	0	10	It starts to synchronize the electronic cam on axis 0. (*1)
XCAS	1	20	It starts to synchronize the electronic cam on axis 1. (*2)
MOVP	5		It moves the 1st axis of the main CPU control axes to Position No. 5.
MOVP	6		It moves the 1st axis of the main CPU control axes to Position No. 6.
XAXS	0	11	Set an axis pattern that uses axes 0 and 1.
XWIP			It waits till the positioning complete signal of axes 0 and 1 to turn ON. (Axes 0 and 1 continue the synchronizing process.)
MOVP	7		It moves the 1st axis of the main CPU control axe to Position No. 7.

* It is assumed the setting that the 1st axis of the main CPU control axes is set to Variables No. 10 to 19 as the electronic cam synchronizing process is established.
* It is assumed the setting that the 1st axis of the main CPU control axes is set to Variables No. 20 to 29 as the electronic cam synchronizing process is established.

● XCAS (Start synchronizing extension motion control board axis electronic cam (indicating main axis))

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XCAS	Slave shaft number	Variable number	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It starts the synchronizing process with the axis specified in Operand 1 as the slave shaft following the electronic cam table. The synchronizing electronic cam operation settings such as the master shaft on the electronic cam table are to be specified in ten variables in a row from Variable No. n in Operand 2. The output section turns ON when the synchronizing process is started.

■Operand 2 : Synchronizing Electronic Cam Operation Settings

<table>
<tr><th>Variable No.</th><th>Data name</th><th colspan="2">Description</th></tr>
<tr><td>n</td><td>Synchronizing type</td><td colspan="2">See below</td></tr>
<tr><td>n+1</td><td>Master shaft type</td><td colspan="2">0 : Main CPU control shaft
1 : Pulse I/O board control shaft
2 : Pulse input channel</td></tr>
<tr><td rowspan="4">n+2</td><td rowspan="4">Master shaft number</td><td>Master shaft type</td><td></td></tr>
<tr><td>0</td><td>1 to 6 axis (XSEL-P/Q), 1to 8 axis (XSEL-R/S)</td></tr>
<tr><td>1</td><td>0 to 15 axis</td></tr>
<tr><td>2</td><td>0 to 3 channel</td></tr>
<tr><td>n+3</td><td>Electronic cam table number</td><td colspan="2">*0 to</td></tr>
<tr><td>n+4</td><td>Stroke type</td><td colspan="2">0 : Master shaft stroke length indication
1 : Master shaft stroke end position indication</td></tr>
</table>

<table>
<tr><th>Variable No.</th><th>Data name</th><th colspan="3">Description</th></tr>
<tr><td rowspan="8">n+5</td><td rowspan="8">Master shaft stroke length / stroke end position (Storage position number)</td><td>Stroke type</td><td>Master shaft type</td><td></td></tr>
<tr><td rowspan="3">0</td><td>0</td><td>Master shaft stroke length storage position number
* Indicate the main CPU control master shaft number (from 0 to Max. position No.)</td></tr>
<tr><td>1</td><td>Master shaft stroke length storage position number
* Indicate the pulse I/O board control master shaft position number (from 0 to Max. position No.)</td></tr>
<tr><td>2</td><td>Master shaft stroke length (pulse unit)</td></tr>
<tr><td rowspan="3">1</td><td>0</td><td>Master shaft stroke end position storage position number
* Indicate the main CPU control master shaft number (from 0 to Max. position No.)</td></tr>
<tr><td>1</td><td>Master shaft stroke end position storage position number
* Indicate the pulse I/O board control master shaft position number (from 0 to Max. position No.)</td></tr>
<tr><td>2</td><td>Master shaft stroke end position indication (pulse unit)</td></tr>
<tr style="display:none"></tr>
<tr><td>n+6</td><td>Slave stroke length storage position number</td><td colspan="3">Indicate the pulse I/O board control slave shaft position number (from 0 to Max. position No.)</td></tr>
<tr><td rowspan="4">n+7</td><td rowspan="4">Master shaft synchronizing start position (Storage position number)
* Effective only when “Master shaft reaches specified synchronizing start position” is selected for synchronizing type</td><td colspan="2">Master shaft type</td><td></td></tr>
<tr><td colspan="2">0</td><td>Master shaft synchronizing start position storage position number
* Indicate the main CPU control master shaft number (from 0 to Max. position No.)</td></tr>
<tr><td colspan="2">1</td><td>Master shaft synchronizing start position storage position number
* Indicate the pulse I/O board control master shaft position number (from 0 to Max. position No.)</td></tr>
<tr><td colspan="2">2</td><td>Master shaft synchronizing start position (pulse unit)</td></tr>
<tr><td>n+8</td><td>Reserved</td><td colspan="3">Make sure to set 0</td></tr>
<tr><td>n+9</td><td>Reserved</td><td colspan="3">Make sure to set 0</td></tr>
</table>

■Synchronizing Type (Variable No.n)

<table>
<tr><th rowspan="2">Set value</th><th colspan="2">Description</th></tr>
<tr><th>Synchronizing start type</th><th>Synchronizing process repeat type</th></tr>
<tr><td>0</td><td>Immediately</td><td>Operate for 1 cycle</td></tr>
<tr><td>1</td><td>Immediately</td><td>Repeated operation</td></tr>
<tr><td>2</td><td>Master shaft reaches specified synchronizing start position</td><td>Operate for 1 cycle</td></tr>
<tr><td>3</td><td>Master shaft reaches specified synchronizing start position</td><td>Repeated operation</td></tr>
</table>

The synchronizing process continues until:

- XSYE Command (to cancel synchronizing process) is executed,
- an operation cancel is executed to the slave shaft (XSTP Command, CANC Command),
- Synchronizing Process Repeat Type is set to 1 cycle and the master shaft reaches to the stroke end, or the slave shaft operation program that XCAS Command is executed is over.

- If the master axis is a main CPU control axis or pulse I/O board control axis, set the master stroke length/stroke end position and master shaft synchronizing start position to the master shaft position data. If the master shaft is the pulse input channel, set it directly to the variable for operation settings. Set the slave shaft stroke length to the slave shaft position data.
- If Stroke Type = Indicate master stroke end position, the master stroke length (1 cycle) on the electronic cam table is [Master shaft stroke end position-Synchronizing start master shaft position]. The relation between the master shaft position and the electronic cam table phase is that the synchronizing start master shaft position is the phase 0, and the direction from the synchronizing start master shaft position to the master shaft stroke end position is the phase positive direction.
- If Stroke Type = Indicate master shaft stroke length, the relation between the master shaft position and the electronic cam table is that the synchronizing start master shaft position is the phase 0, and if the stroke length is a positive value, the positive direction on the master axis coordinate is the phase positive direction and, if the stroke length is a negative value, the positive direction on the master shaft coordinate is the phase negative direction.

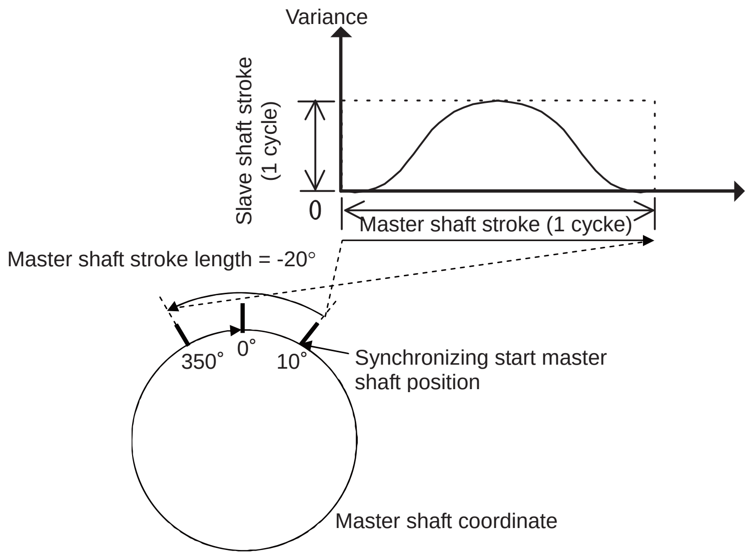
⚠ Caution

- If there is a mistake in the synchronizing electronic cam operation settings specified in the variables in Operand 2, Error No. 455 “Extension motion control board synchronizing electronic cam operation setting error” would occur. The variable numbers with an error setting will be shown on the error list in Info. 2 (in hexadecimal numbers).
    - Variable with an error occurred: Master axis number (Stored variable)
        - The specified master shaft number is inappropriate or invalid
        - The specified master shaft is a synchronized slave shaft or ZR unit shaft (if the master shaft is a main CPU control shaft)
        - The specified master shaft is the shaft specified as the slave (if the master shaft is a pulse I/O board control shaft)
    - The specified master shaft is on a different pulse I/O board or channel from that the slave shaft is on (if the master shaft is a pulse I/O board control shaft or a pulse input channel)
    - Variable with an error occurred: stroke length/stroke end position storage position number
        - The specified position number is inappropriate or position data is invalid
- If the master shaft type for the synchronizing electronic cam operation settings is the main CPU control shaft, BASE Command settings would be effective to the master shaft number. Also, GRP Command settings are invalid to the position data to store the stroke length and stroke end position.
- If the robot is equipped with multiple pulse I/O board, the electronic cam table which is stored to the board that the slave shaft is connected to would be used.
- If the slave shaft starts to move for a synchronizing process during the master shaft is in move, the speed and acceleration/deceleration may get too high and may cause an error. Lower the settings for the speed and acceleration of the master shaft during the slave synchronizing movement starts.
- During a movement following the electronic cam table, the speed and acceleration/deceleration may get too high and may cause an error. Change the settings for the speed, acceleration/deceleration and electronic cam table so they are set to the allowable speed and acceleration/deceleration for the shaft.

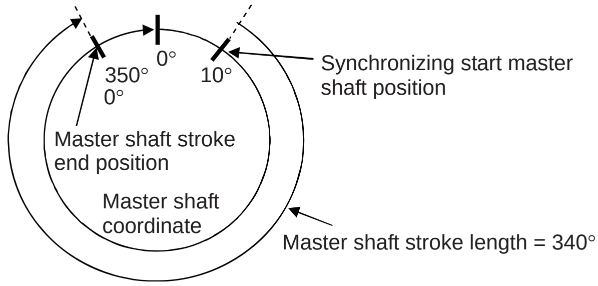
⚠ Caution

- Once the slave shaft starts synchronizing, it will be occupied by the program until XSYE Command (to cancel synchronizing) is executed or the slave shaft operation program that XCAS Command is executed is finished.
  Therefore Error No. 449 “Extension motion control board shaft duplication use error” would occur if the shaft is used by another program. Also, even in the same program, Error No. 449 would occur if an operation command is executed to the shaft that the synchronizing process is already completed. Execute XSYE Command if a next operation is required after the synchronizing process is finished.
  For XSEL-R/S, the number of the main CPU control axes that can be the master axis for the synchronizing operation of such as the electronic cam is six axes at the maximum.
  The axes that can be the master axis can be selected in I/O Parameter No. 529 “Extension Motion Control Board Synchronizing Main CPU Control Master Select Axis Pattern” (dynamic change not available). Please refer to the parameter list in XSEL-R/S Instruction Manual for the details of the parameter.
  When indicating an axis that is not selected as the main axis select in I/O Parameter No. 529 as the main axis in XCAS Command, Error No. 455 “Extension Motion Control Board Synchronizing Electronic Cam Operation Setting Error” will occur.
- If the master shaft is the main CPU control axis with the rotation axis close control, set the master shaft stroke type in the synchronizing electronic cam operation settings to the stroke length setting. If the setting is specified to the stroke end position, it may not perform a synchronizing process that is expected.

[Example] For the synchronizing process in range of master shaft position = 10° to 350°



If the stroke end position = 350° assuming the master shaft stroke type = stroke end position, the figure will be as shown below:



Program Example

LET	200	1	It sets the synchronizing type = 1 (Immediate start, Repeat operation) to Variable No. 200.
LET	201	0	It sets the master shaft type = 0 (Main CPU control shaft) to Variable No. 201.
LET	202	1	It sets the master shaft No. = 1 to Variable No. 202.
LET	203	0	It sets the electronic cam table No. = 1 to Variable No. 203.
LET	204	1	It sets the stroke type = 1 (Master stroke end position specification) to Variable No. 204.
LET	205	2	It sets the master shaft stroke end position storage position No. = 2 to Variable No. 205.
LET	206	0	It sets the slave stroke length storage position No. = 0 to Variable No. 206.
LET	207	0	It sets 0 to Variable No. 207 (Unused data)
LET	208	0	It sets 0 to Variable No. 208 (Reserved area)
LET	209	0	It sets 0 to Variable No. 209 (Reserved area)
XAXS	0	1	It specifies the pulse I/O board 0^{th} axis.
XSON			It turns the pulse I/O board 0^{th} axis servo ON.
XHOM			It returns the pulse I/O board 0^{th} axis to home return.
XCAS	0	200	It starts the synchronizing electronic cam operation for the pulse I/O board 0^{th} axis with the synchronizing electronic cam operation settings specified in Variables No. 200 to 209.
TAG	1		
MOVP	2		It moves the XSEL control master axis to Position No. 2.
MOVP	1		It moves the XSEL control master axis to Position No. 1
GOTO	1		

● XCTM (Extension motion control board Single Electronic Cam (Time Specification) Movement)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XCTM	Slave shaft number	Variable number	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It performs a movement following the electronic cam table having the time axis of the shaft specified in Operand 1 as the master shaft. Single electronic cam operation settings such as the movement time and the electronic cam table number, etc., are to be specified in five variables in a row from Variable No. n in Operand 2. The output turns OFF at the same time the command is started and turns ON when the movement is complete.

■Operand 2 : Single Electronic Cam Operation Settings

Variable No.	Data	Description
n	Electronic cam table number	
n+1	Moving time	Unit in 0.001sec
n+2	Slave stroke length storage position number	* Indicate the pulse I/O board control slave shaft position number (from 0 to Max. position No.)
n+3	Reserved	Set 0
n+4	Reserved	Set 0

Set the slave shaft stroke length to the slave shaft position data.
When the slave shaft stroke length is a positive value, the movement is made to the coordinate positive direction. When the slave shaft stroke length is a negative value, the movement is made to the coordinate positive direction.

⚠ Caution

- If there is a mistake in the single electronic cam operation settings specified in the variables in Operand 2, Error No. 456 “Extension motion control board single electronic cam operation settings error” would occur. The variable numbers with an error setting will be shown on the error list in Info. 2 (in hexadecimal numbers).

  - Variable with an error occurred: Slave stroke length storage position number (Stored variable)
    - Specified position number is inappropriate or the position data is inefficient.

- If the robot is equipped with multiple pulse I/O board, the electronic cam table which is stored to the board that the slave shaft is connected to would be used.

- During a movement following the electronic cam table, the speed and acceleration/deceleration may get too high and may cause an error. Change the settings for the moving time and electronic cam table so they are set to the allowable speed and acceleration/deceleration for the shaft.

Program Example

LET	200	0	It sets the electronic cam table No. = 0 to Variable No. 200.
LET	201	1000	It sets the movement time 1000ms to Variable 201.
LET	202	0	It sets the slave stroke length storage position No. = 0 to Variable No. 202.
LET	203	0	It sets 0 to Variable No. 203 (Reserved area)
LET	204	0	It sets 0 to Variable No. 204 (Reserved area)
XAXS	0	1	It specifies the pulse I/O board 0th axis.
XSON			It turns the pulse I/O board 0th axis servo ON.
XHOM			It returns the pulse I/O board 0th axis to home position.
XCTM	0	200	It starts the single electronic cam operation for the pulse I/O board 0th axis with the single electronic cam operation settings specified in Variables No. 200 to 204.

● XSFS (Extension Motion Montrol Board Electronic Shaft Synchronizing Start)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XSFS	Slave shaft number	Variable number	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It starts the synchronizing operation of the shaft specified in Operand 1 as the slave shaft following the master shaft. The electronic shaft operation settings such as the master shaft are to be specified in the four variables in a row from Variable No. n in Operand 2. The output section turns ON with the synchronizing start.

■Operand 2 : Single Electronic Shaft Operation Settings

Variable number	Data	Description
n	Master shaft type	0 : Main CPU control shaft 1 : Pulse I/O board control shaft 2 : Pulse input channel
n+1	Master shaft number	* Axes 1 to 6 (XSEL-P/Q), 1 to 8 axis (XSEL-R/S) when main CPU control shaft, axes 0 to 15 when pulse I/O board control shaft, channels 0 to 3 when pulse input channel
n+2	Gear ratio numerator	-10000 to -1, 1 to 10000
n+3	Gear ratio denominator	1 to 10000

The synchronizing process continues until:
• XSYE Command (to cancel synchronizing process) is executed,
• an operation cancel is executed to the slave shaft (XSTP Command, CANC Command),
• Synchronizing Process Repeat Type is set to 1 cycle and the master shaft reaches to the stroke end, or the slave shaft operation program that XSFS Command is executed is over.

If the gear ratio is set to a negative value, the slave shaft operates in a reverse direction against the master shaft.

⚠ Caution

If there is a mistake in the single electronic cam operation settings specified in the variables in Operand 2, Error No. 456 “Extension motion control board single electronic cam operation settings error” would occur. The variable numbers with an error setting will be shown on the error list in Info. 2 (in hexadecimal numbers).

- Variable with an error occurred : Master shaft number
  - The specified master shaft number is inappropriate or invalid
  - The specified master shaft is a synchronized slave shaft or ZR unit shaft (if the master shaft is a XSEL control shaft)
  - The specified master shaft is the shaft specified as the slave (if the master shaft is a pulse I/O board control shaft)
  - The specified master shaft is on a different pulse I/O board or channel from that the slave shaft is on (if the master shaft is a pulse I/O board control shaft or a pulse input channel)

⚠ Caution

- If the master shaft type in the electronic shaft operation settings is the main CPU control shaft, BASE Command would be effective to the master shaft number.
- If the master shaft is the pulse input channel, the slave shaft operates with a condition taking 1 input pulse from the pulse input channel as 0.001mm.
- If the slave shaft starts to move for a synchronizing process during the master shaft is in move, the speed and acceleration/deceleration may get too high and may cause an error. Lower the settings for the speed and acceleration of the master shaft during the slave synchronizing movement starts.
- During a master shaft, the speed and acceleration/deceleration may get too high and may cause an error. Change the settings for the speed, acceleration/deceleration and gear ratio so they are set to the allowable speed and acceleration/deceleration for the shaft.
- Once the slave shaft starts synchronizing, it will be occupied by the program until XSYE Command (to cancel synchronizing) is executed or the slave shaft operation program that XSFS Command is executed is finished.
  Therefore Error No. 449 “Extension motion control board shaft duplication use error” would occur if the shaft is used by another program. Also, even in the same program, Error No. 449 would occur if an operation command is executed to the shaft that the synchronizing process is already completed. Execute XSYE Command if a next operation is required after the synchronizing process is finished.
  For XSEL-R/S, the number of the main CPU control axes that can be the master axis for the synchronizing operation of such as the electronic cam is six axes at the maximum.
  The axes that can be the master axis can be selected in I/O Parameter No. 529 “Extension Motion Control Board Synchronizing Main CPU Control Master Select Axis Pattern” (dynamic change not available). Please refer to the parameter list in XSEL-R/S Instruction Manual for the details of the parameter.
  When indicating an axis that is not selected as the main axis select in I/O Parameter No. 529 as the main axis in XCAS Command, Error No. 457 “Extension Motion Control Board Electronic Cam Operation Setting Error” will occur.

[Example]	LET	200	0	It sets the master shaft type = 0 (Main CPU control shaft) to Variable No. 200.
	LET	201	1	It sets the master shaft No. = 1 to Variable No. 201.
	LET	202	1	It sets the gear ratio numerator = 1 to Variable No. 202.
	LET	203	50	It sets the gear ratio denominator = 1 to Variable No. 203.
	XSFS	0	200	It starts electronic shaft synchronizing process of the pulse I/O board 0^{th} shaft with the electronic shaft operation settings specified in Variables No. 200 to 203.
	TAG	1		
	MOVP	2		It moves the main CPU control master axis to Position No. 2.
	MOVP	1		It moves the main CPU control master axis to Position No. 1.
	GOTO	1		

● XSYE (Extension motion control board synchronizing process complete)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XSYE	Slave shaft number	(Complete type)	PE

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It finishes the synchronizing process of the slave shaft specified in Operand 1. This command is effective to the slave shaft that is in the synchronizing process with the synchronizing electronic cam (master shaft specified) started by the same program or that in electronic shaft synchronizing process (XSFS Command). If another shaft is specified, Error No. 444 “Extension motion control board axis number error” would occur.
It is able to specify the complete type in Operand 2. If 0 is select or no selection is done, the synchronizing process would be cancelled. If 1 is selected, it waits for the synchronizing process to finish. It is applicable in a case to wait for the slave shaft to finish its synchronizing process with “Synchronizing type = operate for 1 cycle” in XCAS Command or to wait till the synchronizing process to be cancelled by XSTP Command from another program.
The output section turns ON when 1 is selected for the complete type and the slave shaft finishes 1 cycle of operation with the synchronizing type = “Operate for 1 cycle”.
■Operand 2 : Complete Type
= 0 or no selection: Synchronizing process to be cancelled
= 1: Wait for synchronizing process to finish

⚠ Caution
- In the case “Synchronizing process to be cancelled” is chosen for the complete type, the command would only finishes the synchronizing process and would not confirm the slave shaft positioning completion (Slave Driver positioning complete signal). If waiting for the positioning to complete is desired, wait till the positioning complete signal input port turns ON directly by WTON Command after XSYE Command execution.
- By executing this command the occupation of the shaft is released. Thus, the slave shaft being in the synchronizing process can be used for other programs.

Program Example

LET	200	1	It sets the synchronizing type = 1 (Immediate start, operate for 1 cycle) to Variable No. 200.
LET	201	0	It sets the master shaft type = 0 (Main CPU control shaft) to Variable No. 201.
LET	202	1	It sets the master shaft No. = 1 to Variable No. 202.
LET	203	0	It sets the electronic cam table No. = 1 to Variable No. 203.
LET	204	1	It sets the stroke type = 1 (Master stroke end position specification) to Variable No. 24.
LET	205	2	It sets the master shaft stroke end position storage position No. = 2 to Variable No. 205.
LET	206	0	It sets the slave stroke length storage position No. = 0 to Variable No. 206.
LET	207	0	It sets 0 to Variable No. 207 (Unused data)
LET	208	0	It sets 0 to Variable No. 208 (Reserved area)
LET	209	0	It sets 0 to Variable No. 209 (Reserved area)
XCAS	0	200	It starts the synchronizing electronic cam operation for the pulse I/O board 0th axis with the synchronizing electronic cam operation settings specified in Variables No. 200 to 209.
XSYE	0	1	It waits till the pulse I/O board 0th shaft to operate 1 cycle for the synchronizing electronic cam operation. (Assuming the master shaft is operated by another program)
XAXS	0	1	It set the pulse I/O board 0th shaft to the axis pattern.
XMVP	10		It moves the specified axis to Position No. 10.

● XAST (Acquire extension motion control board axis status)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output operation type (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	XAST	Variable number	Axis number	CP

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

[Function] It reads the axis status specified in Operand 2 into the variable in Operand 1.

Bit Construction of Axis Status

Bit	Information
27-31	Reserved
26	Axis Alarm (error detected by XSEL) * "Axis Alarm" includes "Continuous Impossible Alarm Occurrence (error detected in slave controller)" as well as the errors related to the extension motion control board of XSEL.
25	Axis in use
24	Reserved
14-23	Reserved
13	Reserved
12	Reserved
11	Reserved
10	Reserved
9	Safety speed valid status (safety speed is valid for XSEL)
8	Reserved
7	Reserved
6	Reserved
5	Reserved
4	Servo ON status.
3	Reserved
2	Home return completion * The bit rises when the home-return operation of XSEL controller is finished and the home-return complete status on the slave driver turns on.
1	Point position completion * The bit rises when an operation command of XSEL controller is finished and the positioning complete status on the slave driver turns on.
0	Continuity disabled alarm is generated (an error the slave driver generated)

[Example] XAST 200 10 Variable

[28] Conveyor Tracking Related Commands

● TRMD (Tracking mode setting)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Outpu (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	TRMD	0 (Mode OFF) or 1 (Mode ON)	Operand 1 = 0 Prohibited Operand 1 = 1 (TRAC Command timeout time)	CC

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	×	×	○	○	×	×	×

[Function] Set the Tracking Mode ON/OFF in Operand 1.
Only when Operand 1 = 1 (Tracking Mode ON), TRAC Command (explained later) timeout time (timeout time until the datum point in the working range exceeds the “minimum work position available for the tracking operation start” after TRAC Command is executed) can be selected in Operand 2. The settable range for the timeout time is settable from 0.00 to 99.00sec. When a selection of no timeout time setting (Operand 2 = not set) is made, TRAC Command defines there is no timeout setting and waits with no time limitation.
Work detection process becomes valid only when Tracking Mode is ON.

• Return Code in TRMD Command (Variable 99 (Local Space))
* When Operand 1 = 0 (Tracking Mode OFF), the return code cannot be returned. (Variable 99 not operated)
* When the return code is the numbers except for 0, Tracking Mode is turned OFF.

0 : Tracking Mode ON (In normal condition)
1 : Vision System initializing incomplete
2 : Ethernet connection incomplete

⚠ Caution : TRMD and TRAC Commands are available only when they are in the same program (task).
Dedicated application software is required when using the conveyor tracking function. Please contact us for the details.

● TRAC (Tracking operation setting & datum point position information obtainment in work)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Outpu (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	TRAC	0 (Operation OFF) or 1 (Operation (Standby) ON)	Operand 1 = 0 Prohibited Operand 1 = 1 Position number to save the work position information	CC

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	×	×	○	○	×	×	×

[Function] Set the Tracking Mode ON/OFF in Operand 1.
It is necessary to specify the work position information storage position number in Operand 2 if Operand 1 = 1 (Tracking operation on setting) is specified.
After the tracking operation command is executed, the datum position information for the identified top work is stored to the position number specified in Operand 2 if the datum point within the work detected and confirmed during the work detection process exceeds “Minimum tracking operation start work position” (if it is already exceeded, at the same time TRAC Command is executed). If the work position information is acquired, move the actuator to the position above the work immediately with MOVL Command with a care to Z-axis (height).

Datum Point Position Information in Work Saved in Position Data
• X, Y, (rotation) R-axis

If Tracking Operation ON Command is executed while already in the conveyor tracking operation, the tracking operation will continue and only the datum point position information obtainment in the next work is performed.
When the tracking operation OFF command is executed, the tracking operation is cancelled and it decelerates and stops tracking. If the tracking operation is cancelled by the tracking operation OFF command, etc., the data such as the acquired work datum position information would be invalid (meaningless).

- Return Code in TRAC Command (Variable 99 (Local Space))
  - * When Operand 1 = 0 (Tracking Operation OFF), the return code cannot be returned. (Variable 99 not operated)
  - 0: Tracking operation start & datum point position information obtaining succeeded

1. Datum point in work position information obtaining timeout
   Timeout value should be indicated in Operand 2 of TRMD Command as described previously.
2. Datum point in work position information obtaining timer cancel (Timer cancel by TIMC Command)
3. Reached the maximum work position for tracking operation start (Work reached a position that cannot be tracked)
   Even thought the datum point position information in work can be obtained, the data is no more meaningful, thus ensure not to do the positioning with that position information. The work attribute (it is for the future expansion, currently fixed value = no attribute identification) isaved to the local variable indicated in "All-Axes Parameter No. 93 Tracking Work Attribute Saved Local Variable Number".
4. Tracking operation stop
   When the work reaches the position to finish the tracking operation, tracking reversed operation workposition, or an error is occurred, the tracking operation gets cancelled (stopped).
5. Tracking Mode Cancelled
   Work detection is set to invalid by Tracking Mode OFF Command or an error and all the existed work information is deleted.

⚠ Caution

1) TRMD and TRAC Commands are available only when they are in the same program (task).
2) Execute the Tracking Operation ON Command on the position where there is no interference to the surroundings with the tracking operation, movement to the point above the datum point in the working range after the tracking, or the combination of both operations.
3) Ensure to use MOVL Command for the movement on the axis during the conveyor tracking operation. If the position data (Datum point position information in Work) is “obtained in normal condition”, perform a positioning quickly with “MOVL” to the point around the position (around the point above the datum point in the work) considering “the target values for the axes that the data is not obtained for, such as Z-axis (height)”. The obtained position data is effective only in “the tracking operation that time” and becomes ineffective after “the tracking operation that time” is complete.
   For SCARA Robot, the robot arm getting close to the area around the peculiar point as the result of conveyor tracking may cause an abnormal acceleration and it is very risky. In the case this abnormal acceleration around the peculiar point is occurred, the arm deceleration angle after the error detection also becomes larger. Do not locate interfering object in the surroundings. The following errors will be detected if the abnormal acceleration around the peculiar point:
   - Error No. B74 CP Operation Limited Area Invasion Error
   - Error No. B91 Main Excess Speed Necessity Error
   - Error No. D09 Driver Excess Speed Error

   To avoid this phenomenon, the work tracking limit can be set in “All-Axes No.75 Tracking Operation Complete Work Position”, however, since it all depends on the work position, there is still a risk that the robot arm reaches the peculiar position unless it is quickly moved to the position (Datum Point in Work) obtained in normal condition by Tracking Operation ON Command.
   - It is also an effective way for the debug test operation when turning the system on to detect in the simple interference check zone before invasion to the peculiar point on the exist side if the operation is under a comparatively low conveyor speed.
   - If reaching to the axis soft limit or interference range due to the positional correlation of “minimum work position for tracking operation start” and “point above datum point for work”, have an appropriate treatment on the sequence to avoid it such as by setting the different start time for the positioning to the point above the work datum point with a timer, etc.
4) Since the right for the servo use is occupied by the TRAC Command execution task during Tracking Operation ON Command, the tracking related servo axis cannot be used from other tasks. (For SCARA Robot, 4 axes are occupied for the purposes of the posture control and other related.)
5) For SCARA Robot, it is operated on the work coordinate system of when the conveyor tracking operation is started during the conveyor tracking operation.
6) Conveyor tracking operation does not stop at the break points of SEL program.
   - The break point only pauses the next program step execution.
7) PUSH Command cannot be used during the conveyor tracking operation.

[29] Vision System I/F Related Command

● SLVS (Select vision system I/F)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Outpu (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	SLVS	Select vision system I/F	(Timeout time)	CC

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	TT:×, TTA:○	○ (PC/PG only)

[Function] Select whether using Vision System I/F in this command (GTVD Command).

Operand 1 : Select Vision System I/F
0 : Vision System I/F not selected
1 : Vision System I/F selected for use

Operand 2 : Operand 1 = Invalid when set to “0”.······Prohibited
Operand 1 = Except for “0” ···· Timeout time (sec) when GTVD Command is executed
The setting range for the timeout time is from 0.00 to 99.00sec.
When no indication (Operand 2 = blank) is defined, the timeout setting is not established and is set to no limitation.

- Return Code in SLVS Command (Variable 99 (Local Space))

The result in SLVS execution is stored in Variable 99 as a return code.
* No return code will be obtained (Variable 99 not executed) when Operand 1 = 0.
* The return codes not listed below are in common with OPEN Command (for Ethernet connection). Refer to “OPEN Command” in Ethernet Instruction Manual provided separately.

0 : Completed in normal condition
1 : Timeout
(Related Parameters: I/O Parameter No. 127, Network Attribute 8, Bits 0 to 7)
2 : Timer cancelled (condition that the waiting status is cancelled by TIMC Command)
6 : Task Complete (Program complete request, etc.)
(Unable to identify from SEL Command)
23 : Vision System Initializing Incomplete Error

(Note 1) SLVS and GTVD Commands can be executed only on the same program (task).

(Note 2) Executing SLVS Command with Operand 1 = 1 is indicated opens the communication channel that is specified in I/O Parameter No. 351, Bits 4 to 7. And also, executing SLVS Command with Operand 1 = 0 is indicated closes the communication channel that is specified in I/O Parameter No. 351, Bits 4 to 7.

(Note 3) When the Vision System I/F is used with Ethernet, message communication attribute is fixed to client.

[Example 1]

SLVS	1		Select Vision System I/F Usage
•			(GTVD Command Timeout Value = None)
•			
SLVS	0		Cancel Vision System I/F Selection

[Example 2]

SLVS	1	60	Select Vision System I/F Usage
•			(GTVD Command Timeout Value = 60sec is indicated)
•			
SLVS	0		Cancel Vision System I/F Selection

● GTVD (Vision system I/F image-capture data acquirement)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Outpu (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	GTVD	Capturing trigger classification	Variable number	CC

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	TT:×, TTA:○	○ (PC/PG only)

[Function] This outputs the image-capture command to the Vision System I/F selected by SLVS Command and stores the received image data to the variables and position data. With one time of execution of this command, one image data can be obtained.

Operand 1 : Capturing Trigger Classification
- 0 : Reserved
- 1 : Immediate Image-Capture Command Output
- 2 : Image-Capture Command Output when Image-Capture Trigger Port (I/O Port and Flag) is ON
- 3 to 6 : Reserved

Operand 2 : Variable number

Assuming the variable number selected in Operand 2 is n, the contents are stored in the variables of quantity 8 in a row starting from n.

Variable No.n : Top position number for image data work coordinates storage
No. 1 to 12 … 1 to 12 positions of centers of work piece gravity
(Note) Make sure the continuous 12 positions after the top position number are not in use.

Variable No.n+1 : Variable number for image data work attribute storage
(Note) Make sure the continuous 12 variables after the top variable number are not in use.

Variable No.n+2 : Variable number for image data work quantity storage
Variable No.n+3 : Image-capture trigger port number
(Valid only when Operand 1 = 2 is input)
Variable No.n+4 : Reserved (to be fixed to 0)
Variable No.n+5 : Reserved (to be fixed to 0)
Variable No.n+6 : Reserved (to be fixed to 0)
Variable No.n+7 : Reserved (to be fixed to 0)

- Return Code in GTVD Command (Variable 99 (Local Space))
  The result in GTVD execution is stored in Variable 99 as a return code.
  0 : Completed in normal condition
  1 : Work Information Acquirement WAIT Timeout
  2 : GTVD Timer cancelled (condition that the waiting status is cancelled by TIMC Command)
  3 : Vision System Unset Detection (SLVS Command not executed, etc.))
  4 : Work Detection Cancel Status Detection (errors, etc.)

(Note 1) SLVS and GTVD Commands can be executed only on the same program (task).

(Note 2) Receivable communication formats can be switched in I/O Parameter No. 352, Bits 0 to 7.

(Note 3) The system is capable to obtain the work data (coordinates and attributes) of 12 work pieces in 1 shot of image capturing.
Error No. 417 is issued when 13 or more work pieces are detected in 1 shot, and "4: Work Detection Cancel Status Detection (error, etc.)" is set to the return code.

(Note 4) Error No. 416 (Received Message Error) is issued when there is an error in the received message during SLVS Command execution.
Check the communication format selection parameter (I/O Parameter No. 352 or Bits 0 to 7) settings and the output communication format on Vision System side.

(Note 5) There will be no change in the variables for work attribute storage and the position data when the quantity of detected work piece in the received image data is 0.

(Note 6) It is prohibited to capture an image during the movement of the robot if the camera is mounted on the robot.
Make sure to capture an image in the stop condition.
An accurate work data cannot be acquired if a capturing is conducted during the robot movement.

[30] Anti-Vibration Control Related Command

● NTCH (Anti-Vibration Control Parameter Set Select)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Outpu (Output, flag)
		Command, declaration	Operand 1	Operand 2	
E	N, Cnd	Cmnd	Operand 1	Operand 2	Pst
Optional	Optional	NTCH	Axis pattern	Parameter set number	CC

Applicable models								
XSEL -J/K	XSEL -P/Q/ PCT/QCT	XSEL -R/S	XSEL -JX/KX	XSEL -PX/QX	XSEL -RX/SX/ RXD/SXD	ASEL PSEL SSEL	TT/TTA	MSEL
×	○	○	×	×	×	×	×	×

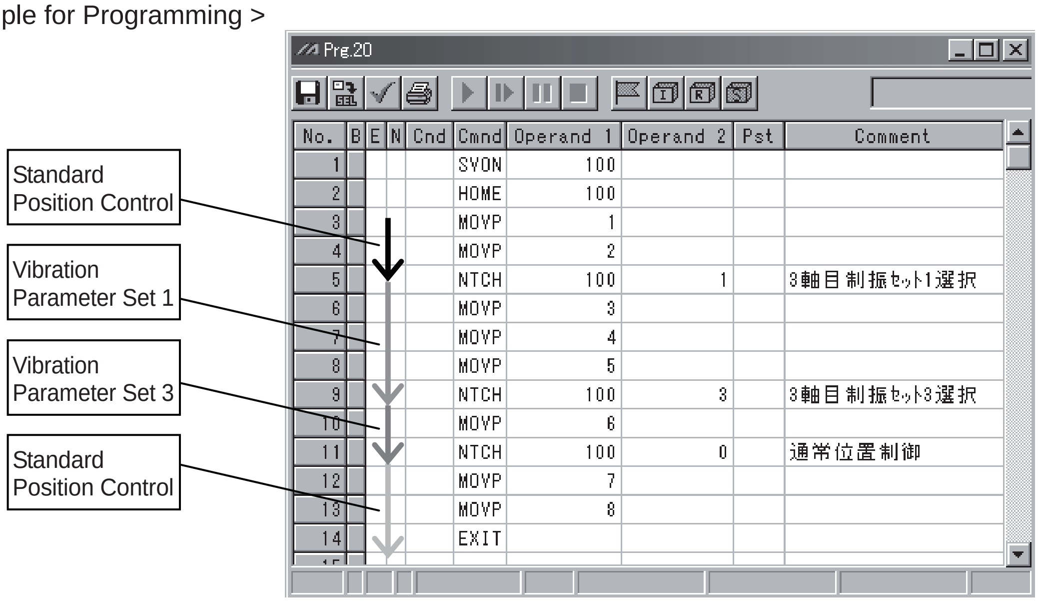
[Function] It declares what, in the specific frequency patterns registered to the parameters, is to be used for the anti-vibration control for the axis pattern set in Operand 1.

Operand 1 : Axis pattern selection
Indicate the axis that the anti-vibration control parameter set selection is conducted as “1” and the one not to be conducted as “0”.

Operand 2 : Parameter set number
Select if use/not to use the anti-vibration control and which specific frequency pattern (parameter set) is to be used.
0 : Standard Position Control (Anti-vibration control is not done)
1 : Vibration Control Parameter Set 1 (Each Axis Parameter No.151 to 154)
2 : Vibration Control Parameter Set 2 (Each Axis Parameter No.156 to 159)
3 : Vibration Control Parameter Set 3 (Each Axis Parameter No.161 to 164)
Except for 0 to 3 : Standard Position Control (Anti-vibration control is not done)

[Example] NTCH 110 2 Setting the anti-vibration control parameter set 2 to the 2nd and 3rd axes

<Example for Programming >

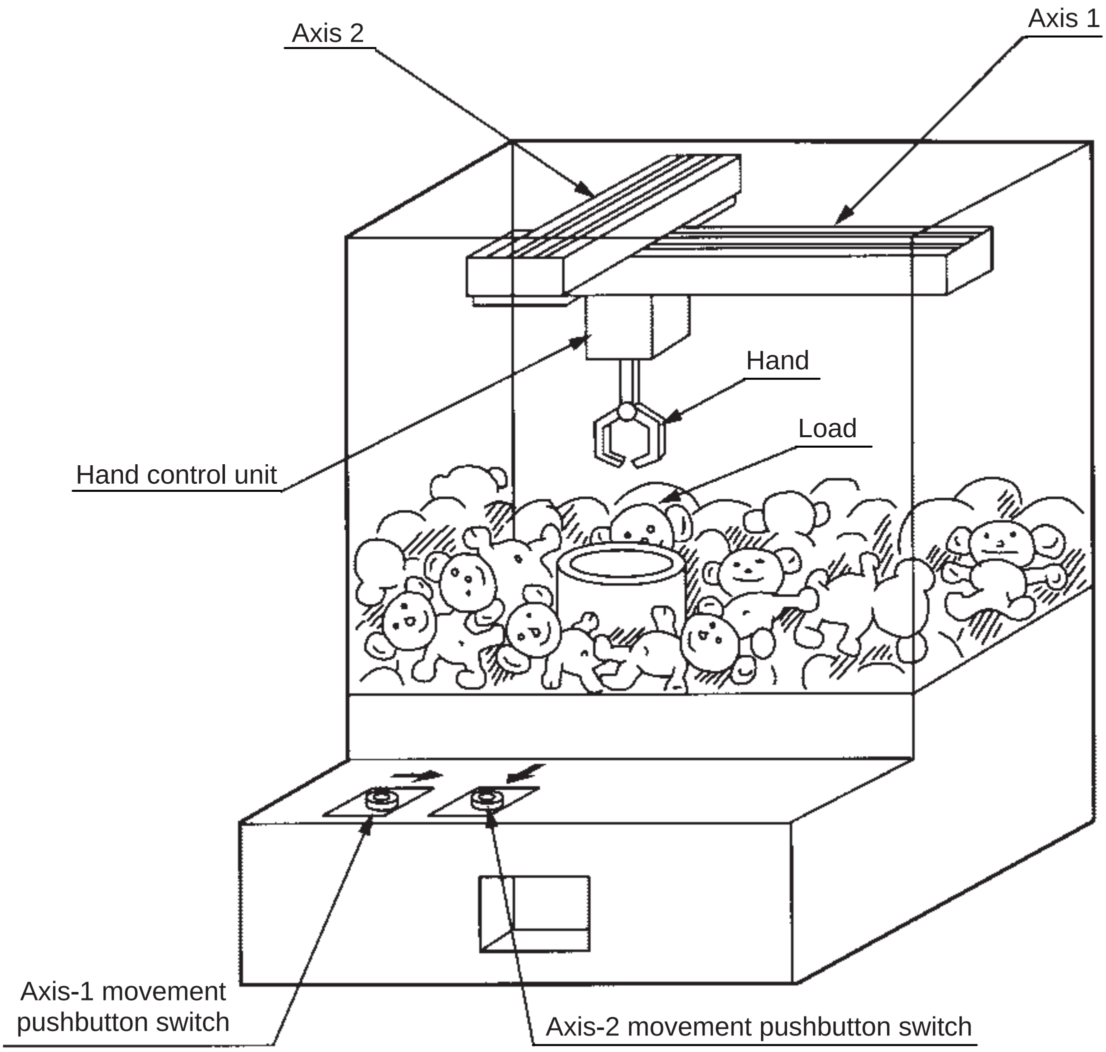


6. Program Examples

6.1 Operation by Jog Command Doll-Picking Game Machine

(1) Overview of the system

This system is a doll-picking game machine consisting of axis-1 and axis-2 actuators. Pushbutton switches corresponding to the two axes are provided on an external operation switch box, and these switches are used to move the actuators to a desired position to grab and pick up dolls inside the case.



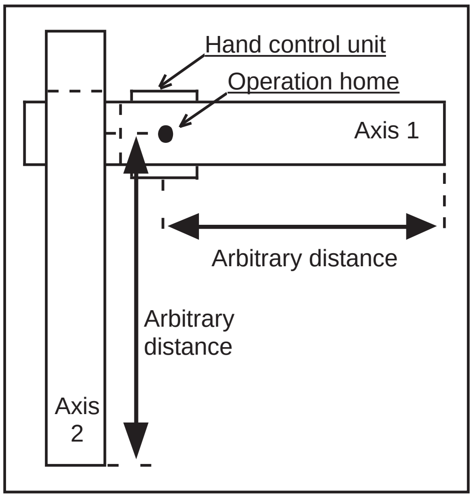
(2) Explanation of the operation

How this system operates is explained.

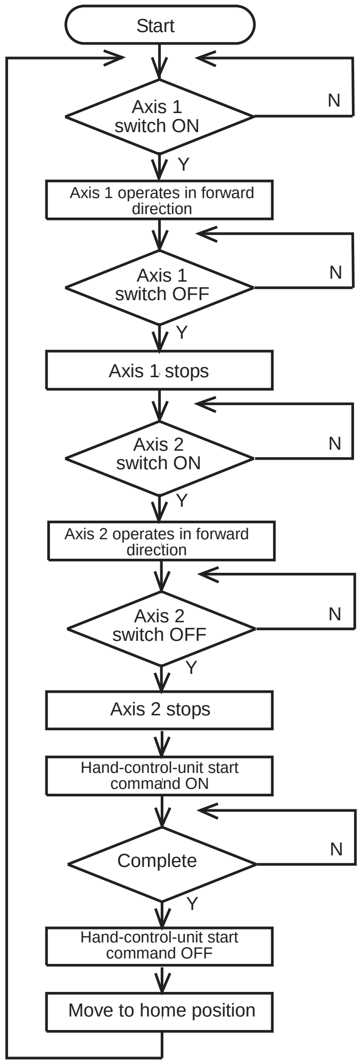
1) Wait for the axis-1 movement pushbutton switch to turn ON.
2) The X-axis moves while the pushbutton switch is ON, and stops when the switch turns OFF.
3) Wait for the axis-2 movement pushbutton switch to turn ON.
4) The Y-axis moves while the pushbutton switch is ON, and stops when the switch turns OFF.
5) Output a start command to the hand control unit.
6) Wait for an operation completion input from the hand control unit.
7) Move to the home after the input is received.

The above operation will be repeated. The operation position, external I/O assignments and operation flow chart of this operation are shown below:

Operation Position



Operation Flow Chart



I/O Assignments

Category		I/O No.	Signal name	Specification
XSEL	Input	16	Axis-1 movement command	Pushbutton switch
		17	Axis-2 movement command	Pushbutton switch
		18	Hand operation completion	External control unit
	Output	309	Hand start command	24V DC
	* Flag is not used.			

(3) XSEL Controller application program

Step	E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
1				HOME	11			Axes 1 and 2 return to home (servo ON).
2				VEL	400			Set speed to 400mm/s.
3				TAG	1			
4				WTON	16			Wait for input from axis-1 movement switch.
5				JFWN	1	16		Move forward while axis-1 movement switch is ON.
6				WTON	17			Wait for input from axis-2 movement switch.
7				JFWN	10	17		Move forward while axis-2 movement switch is ON.
8				BTON	309			Start command for external control unit turns ON.
9				WTON	18			Wait for external control unit to complete operation.
10				BTOF	309			Start command for external control unit turns OFF.
11				JBWF	11	18		Axes 1 and 2 move backward while 18 is ON.
12				GOTO	1			Jump to TAG1.
13								
14								
15								
16								
17								
18								
19								
20								
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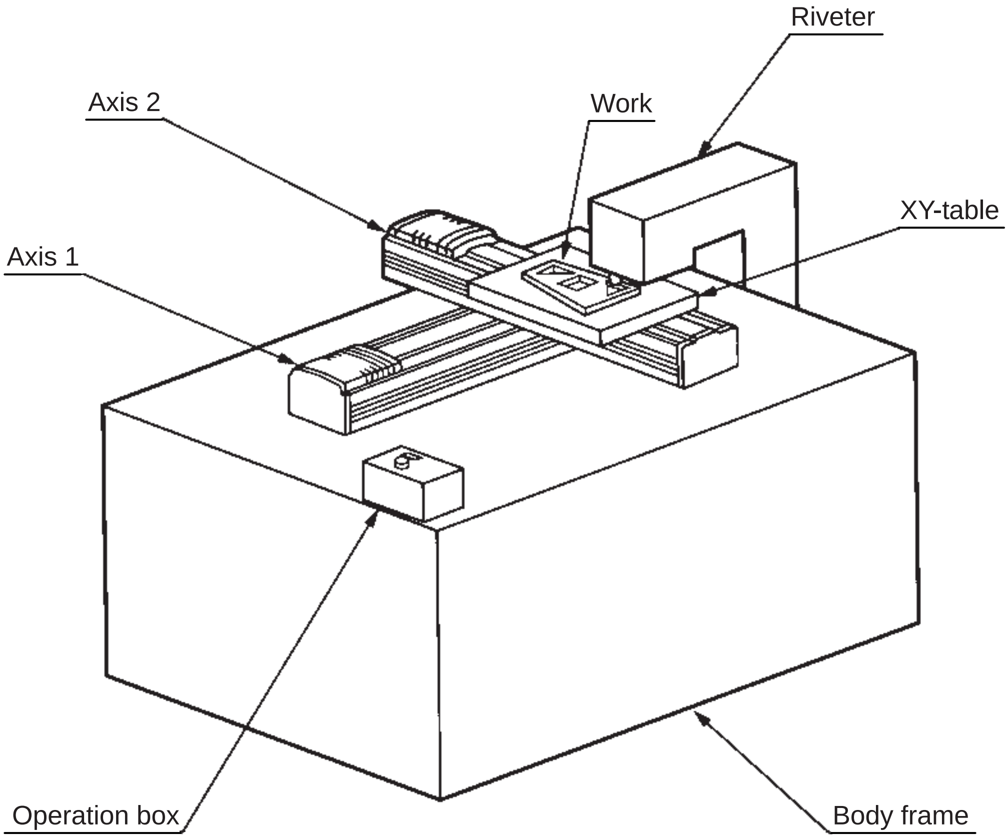
32								

6.2 Operation by Point Movement Command   Riveting System

(1) Overview of the system
This system is a riveting system consisting of an XY-table operated by axis-1 and axis-2 actuators and a riveter. By setting a work on the XY-table at the operation home and turning ON the start switch, rivets will be driven at the three points specified on the work.



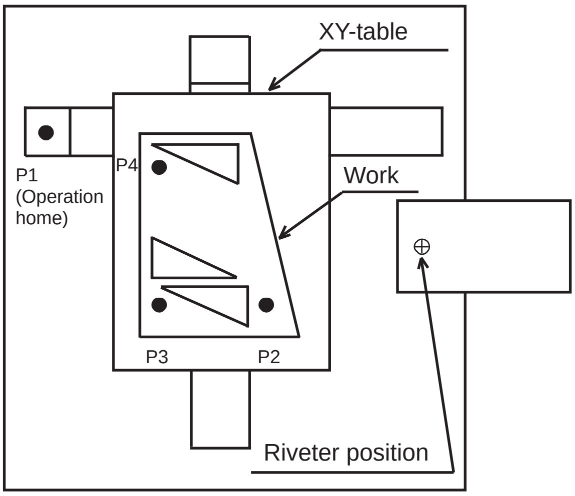
(2) Explanation of the operation

How this system operates is explained.

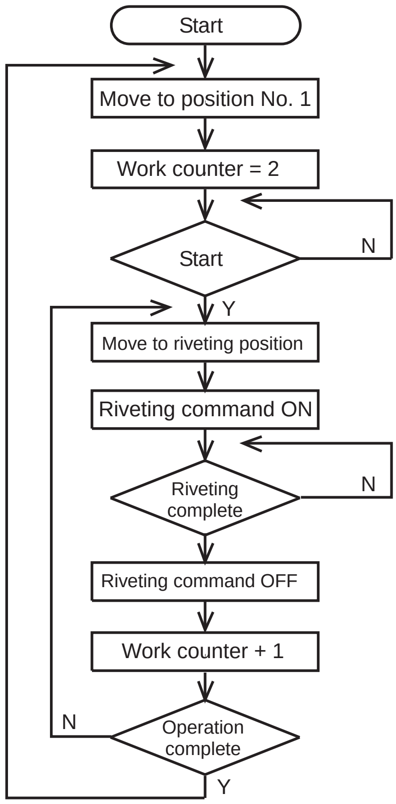
1) The XY-table moves to the operation home (P1) and waits.
2) The operator sets a work on the XY-table and turns ON the start switch.
3) The XY-table moves to riveting position No. 1 (P2) on the work and a riveting command is output to the riveter.
4) When the riveter completes the riveting operation and a completion signal is input, the table will move to riveting position No. 2 (P3) and then No. 3 (P4), in the same manner.
5) When all three points have been riveted, the table will return to the operation home (P1).

The above operation will be repeated. The operation position, external I/O assignments and operation flow chart of this operation are shown below:

Operation Position



Operation Flow Chart



I/O Assignments

Category		I/O No.	Signal name	Specification
XSEL	Input	16	Start command	Pushbutton switch
		17	Riveting completion	Contact signal
	Output	309	Riveting command	24V DC
	* Flag is used from 600.			

(3) XSEL Controller application program

Step	E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
1				HOME	11			XY-table returns to home (servo ON).
2				VEL	400			Set speed to 400mm/s.
3				TAG	1			
4				MOVL	1			Move to position No. 1 (home of work).
5				LET	1	2		Set 2 in work counter.
6				BTOF	600			Clear completion flag.
7				WTON	16			Wait for start command.
8				TAG	2			
9				MOVL	*1			Move to work counter position.
10				BTON	309			Riveting command turns ON.
11				WTON	17			Wait for riveting to complete.
12				BTOF	309			Riveting command turns OFF.
13				ADD	1	1		Increment work counter by 1.
14				CPEQ	1	5	600	Turns ON flag if operation is complete.
15		N	600	GOTO	2			Jump to TAG2 if not complete.
16				GOTO	1			Jump to TAG1 if complete.
17								
18								
19								
20								
21								
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23								
24								
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27								
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29								
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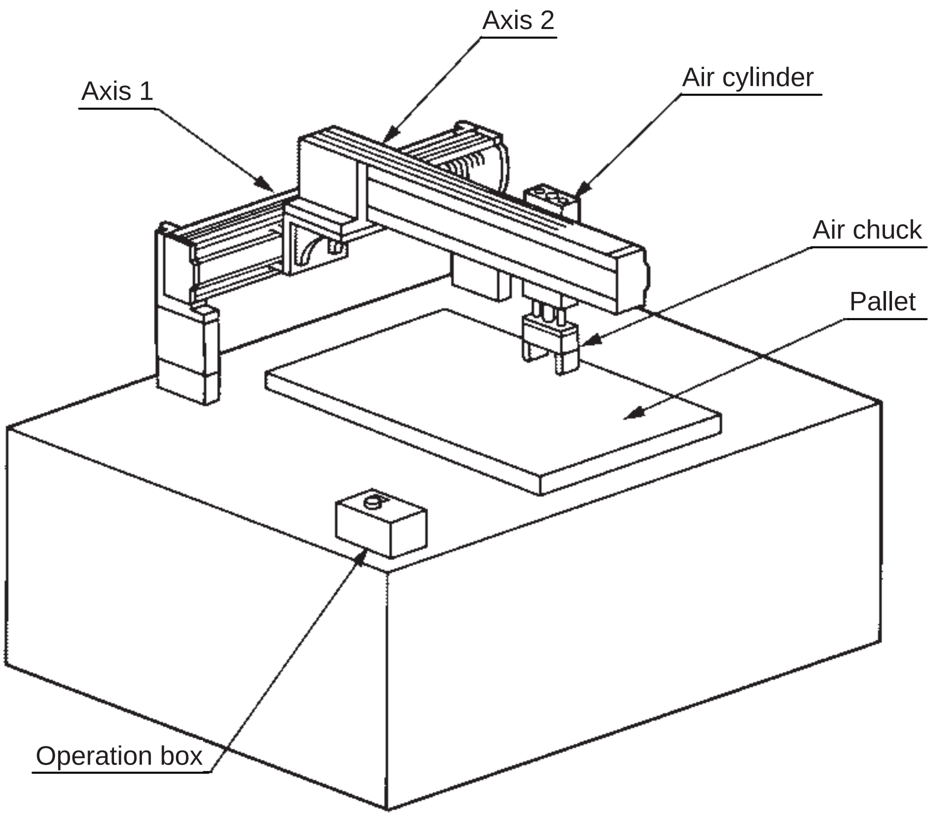
31								
32								

6.3 Palletizing Operation Palletizing System

(1) Overview of the system

This system is a palletizing system consisting of axis-1 and axis-2 actuators and a Z-axis air cylinder. It clamps a work at the work feed point and transfers it onto a pallet, and repeats this operation in a sequence.

(Operation is implemented by an offset command without using a palletizing function.)

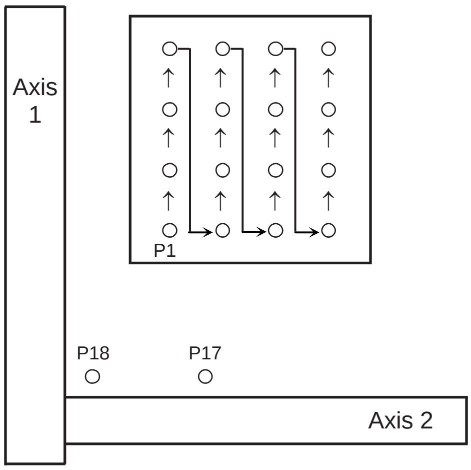


(2) Explanation of the operation
How this system operates is explained.

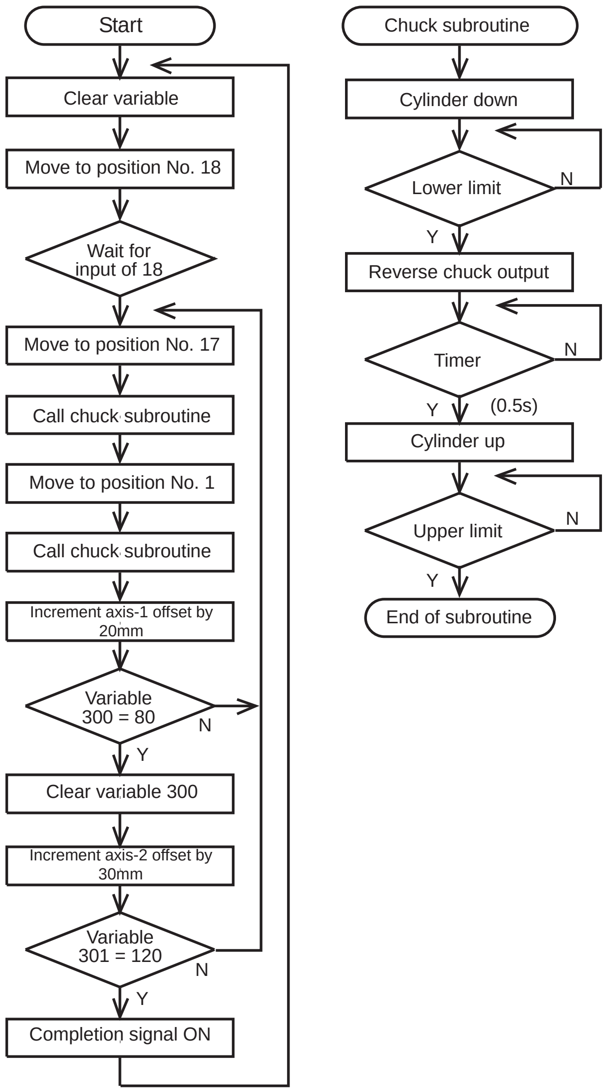
1) Move to the standby point and wait for a start input.
2) Move to the work feed point after a start input is received.
3) The Z-axis comes down and the air chuck clamps the work.
4) The Z-axis rises and moves to above the pallet.
5) The Z-axis comes down and releases the work.
6) The Z-axis rises and moves to above the work feed point.
7) When the pallet becomes full, a pallet-completion indicator signal is output. The axes move to P18 and then wait for restart.

The above operation will be repeated. The operation position, external I/O assignments and operation flow chart of this operation are shown below:

Operation Position



Operation Flow Chart



I/O Assignments

Category		I/O No.	Signal name	Specification
XSEL	Input	16	Z-axis cylinder upper limit	Proximity SW
		17	Z-axis cylinder lower limit	Proximity SW
		18	Start	Pushbutton switch
	Output	309	Z-axis cylinder SV	24V DC
		310	Z-axis chuck SV	24V DC
		311	Pallet-completion indicator	24V DC
	* Flag is used from 600.			

Pallet specifications
Axis-1 direction: 20mm pitch
Axis-2 direction: 30mm pitch

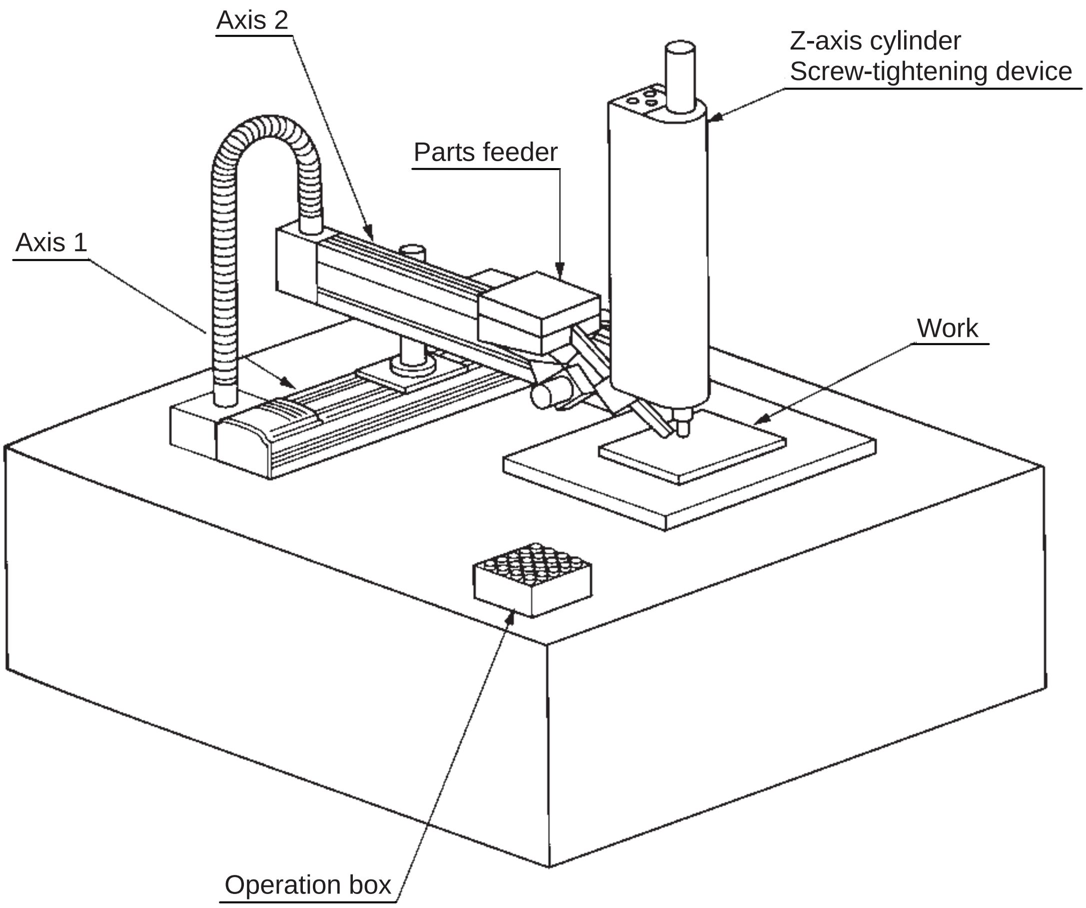
(3) XSEL Controller application program

Step	E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
1				HOME	11			Axes 1 and 2 return to home.
2				VEL	100			Set speed to 100mm/s.
3				ACC	0.2			Acceleration/deceleration: 0.2G
4				TAG	1			
5				LET	300	0		Clear variable.
6				LET	301	0		Clear variable.
7				OFST	11	0		Clear offset value.
8				MOVL	18			Move to position No. 18.
9				WTON	18			Wait for start input.
10				BTOF	311			Output 311 turns OFF.
11				TAG	2			
12				OFST	11	0		Clear offset value.
13				MOVL	17			Move to position No. 17.
14				EXSR	1			Call chuck subroutine (chuck).
15				OFST	1	*300		Offset axis 1 by value in variable 300.
16				OFST	10	*301		Offset axis 2 by value in variable 301.
17				MOVL	1			Move to position No. 1 + offset value.
18				EXSR	1			Call chuck subroutine (unchuck).
19				ADD	300	20		Add 20 to variable 300.
20				CPEQ	300	80	600	Turn ON flag 600 if variable 300 = 80.
21		N	600	GOTO	2			Jump to TAG2 if flag 600 is OFF.
22				LET	300	0		Clear variable 300.
23				ADD	301	30		Add 30 to variable 301.
24				CPEQ	301	120	601	Turn ON flag 601 if variable 301 = 120.
25		N	601	GOTO	2			Jump to TAG2 if flag 601 is OFF.
26				BTON	311			Output 311 turns ON.
27				GOTO	1			Jump to TAG1.
28				BGSR	1			Start chuck subroutine.
29				BTON	309			Z-axis cylinder down
30				WTON	17			Wait for lower-limit input.
31				BTNT	310			Reverse air-chuck output.
32				TIMW	0.5			Timer: 0.5 second
33				BTOF	309			Z-axis cylinder up
34				WTON	16			Wait for upper-limit input.
35				EDSR				End of chuck subroutine
36								
37								
38								
39								

6.4 Screw-Tightening Machine

(1) Overview of the system

This system consists of axis-1 and axis-2 actuators, Z-axis cylinder, screw-tightening device and parts feeder, and tightens the screws fed by the parts feeder at the specified positions on the work.



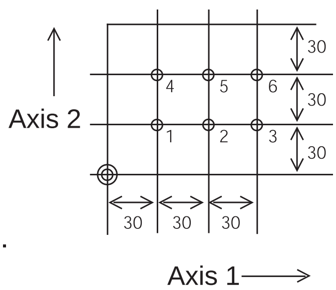
(2) Equipment

Screw-tightening machine (for Z-axis)	
Actuators (for axes 1 and 2)	IAI’s 60W servo motor/actuator with 300mm stroke × 2
Controller	IAI’s XSEL controller

(3) Explanation of the operation

(1) Tighten six screws at 30mm pitches on axes 1 and 2.
1) The actuators move to a screw-tightening position.
2) The Z-axis air cylinder of the screw-tightening machine comes down.
3) The screw-tightening machine starts operating.
4) When the screw tightening is complete, the Z-axis air cylinder rises.
5) The actuators move to the next position.

Coordinates



(2) The parts feeder operates in parallel with the above operation.
1) The parts feeder starts when screws are short.
2) The parts feeder stops when the screws are fully loaded.

[Hardware]

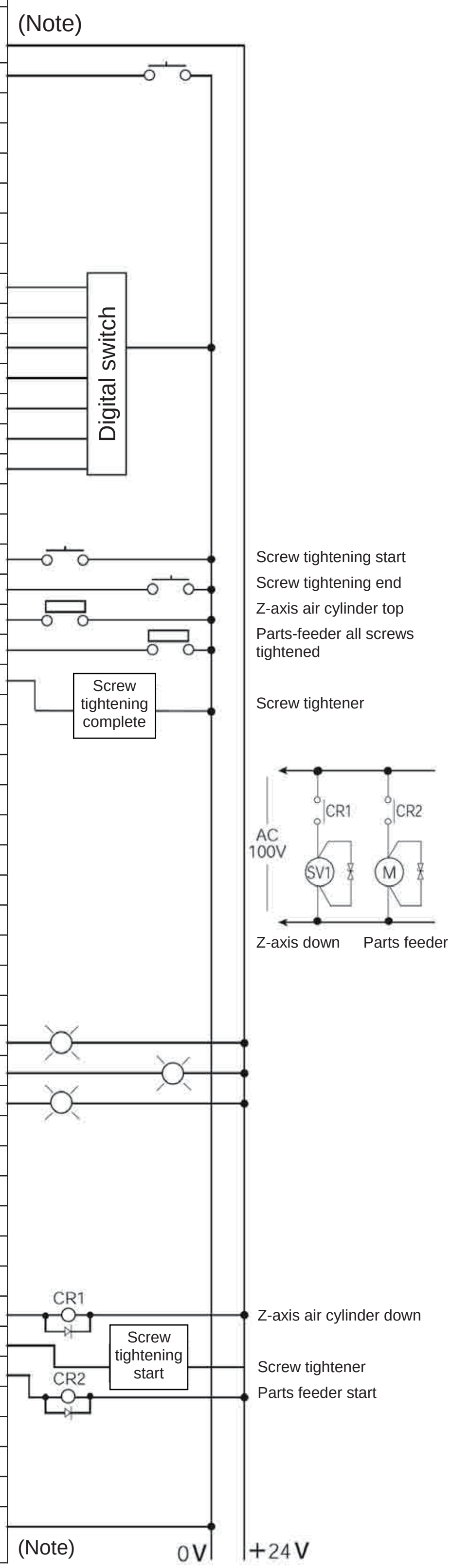
1) I/O assignment

I/O connector (50 pins)

Pin No.	Category	Port No.	Function	Cable color
1	Input	–	General-purpose: NC / Compact: +24V input	Brown-1
2		000	Program start	Red-1
3		001	General-purpose input	Orange-1
4		002	General-purpose input	Yellow-1
5		003	General-purpose input	Green-1
6		004	General-purpose input	Blue-1
7		005	General-purpose input	Purple-1
8		006	General-purpose input	Gray-1
9		007	Program specification (PRG No.1)	White-1
10		008	Program specification (PRG No.2)	Black-1
11		009	Program specification (PRG No.4)	Brown-2
12		010	Program specification (PRG No.8)	Red-2
13		011	Program specification (PRG No.10)	Orange-2
14		012	Program specification (PRG No.20)	Yellow-2
15		013	Program specification (PRG No.40)	Green-2
16		014	General-purpose input	Blue-2
17		015	General-purpose input	Purple-2
18		016	Screw tightening start	Gray-2
19		017	Screw tightening end	White-2
20		018	Z-axis air cylinder top	Black-2
21		019	Parts-feeder all screws tightened	Brown-3
22		020	Screw tightening complete	Red-3
23		021	General-purpose input	Orange-3
24		022	General-purpose input	Yellow-3
25		023	General-purpose input	Green-3
26		024	General-purpose input	Blue-3
27		025	General-purpose input	Purple-3
28		026	General-purpose input	Gray-3
29		027	General-purpose input	White-3
30		028	General-purpose input	Black-3
31		029	General-purpose input	Brown-4
32		030	General-purpose input	Red-4
33		031	General-purpose input	Orange-4
34	Output	300	Alarm output	Yellow-4
35		301	Ready output	Green-4
36		302	Emergency stop output	Blue-4
37		303	General-purpose output	Purple-4
38		304	General-purpose output	Gray-4
39		305	General-purpose output	White-4
40		306	General-purpose output	Black-4
41		307	General-purpose output	Brown-5
42		308	General-purpose output	Red-5
43		309	Z-axis air cylinder down	Orange-5
44		310	Screw tightening start	Yellow-5
45		311	Parts feeder start	Green-5
46		312	General-purpose output	Blue-5
47		313	General-purpose output	Purple-5
48		314	General-purpose output	Gray-5
49		315	General-purpose output	White-5
50		–	General-purpose: NC / Compact: 0V	Black-5

2) Layout drawing

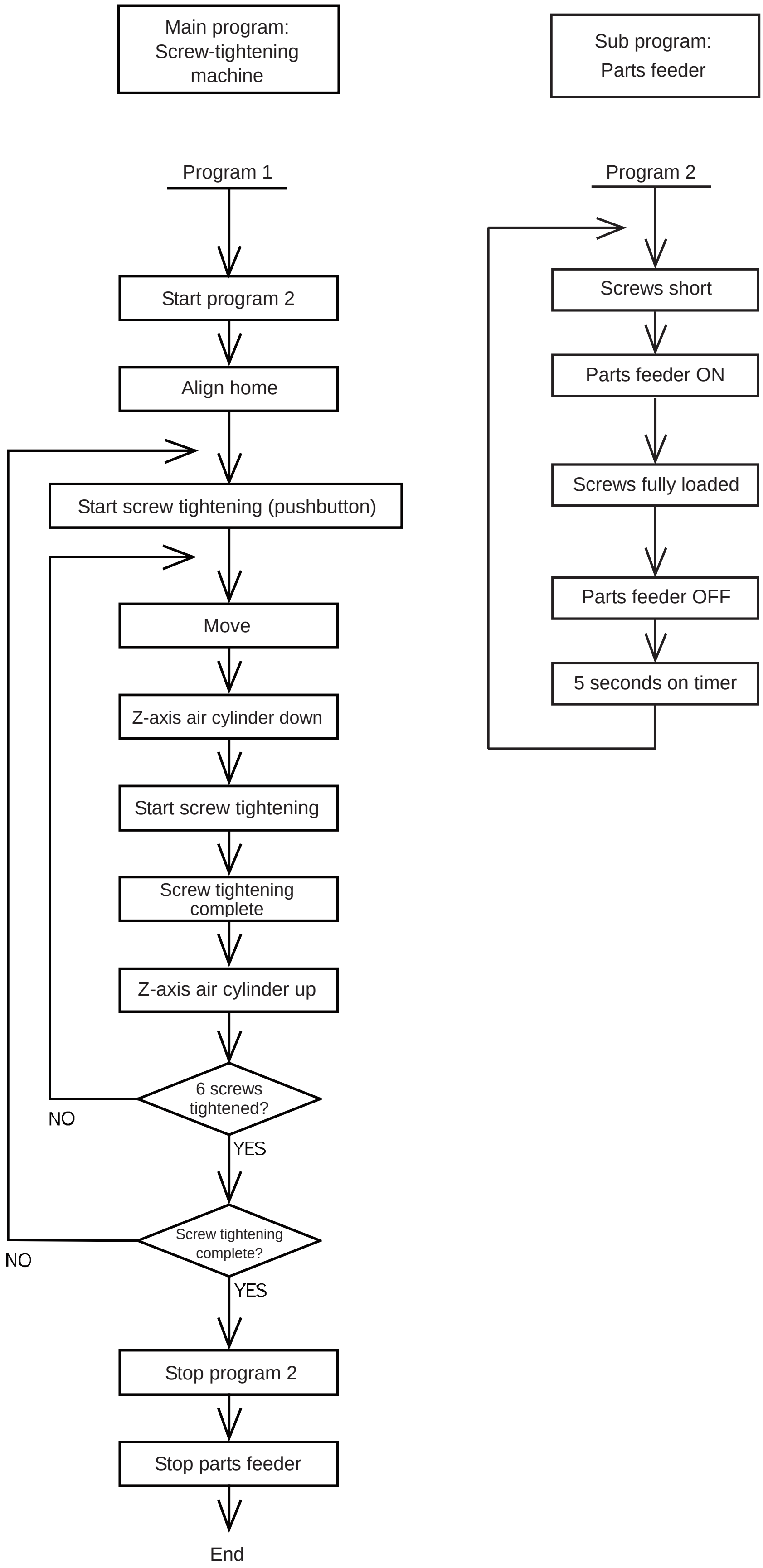
Pin No.	Category	Port No.	Function
1	Input	–	General-purpose: NC / Compact: +24V input
2		000	Program start
3		001	General-purpose input
4		002	General-purpose input
5		003	General-purpose input
6		004	General-purpose input
7		005	General-purpose input
8		006	General-purpose input
9		007	Program specification (PRG No.1)
10		008	Program specification (PRG No.2)
11		009	Program specification (PRG No.4)
12		010	Program specification (PRG No.8)
13		011	Program specification (PRG No.10)
14		012	Program specification (PRG No.20)
15		013	Program specification (PRG No.40)
16		014	General-purpose input
17		015	General-purpose input
18		016	Screw tightening start
19		017	Screw tightening end
20		018	Z-axis air cylinder top
21		019	Parts-feeder all screws tightened
22		020	Screw tightening complete
23		021	General-purpose input
24		022	General-purpose input
25		023	General-purpose input
26		024	General-purpose input
27		025	General-purpose input
28		026	General-purpose input
29		027	General-purpose input
30		028	General-purpose input
31		029	General-purpose input
32		030	General-purpose input
33		031	General-purpose input
34	Output	300	Alarm output
35		301	Ready output
36		302	Emergency stop output
37		303	General-purpose output
38		304	General-purpose output
39		305	General-purpose output
40		306	General-purpose output
41		307	General-purpose output
42		308	General-purpose output
43		309	Z-axis air cylinder down
44		310	Screw tightening start
45		311	Parts feeder start
46		312	General-purpose output
47		313	General-purpose output
48		314	General-purpose output
49		315	General-purpose output
50		–	General-purpose: NC / Compact: 0V



Pin No. 1 and 50 are not connected for general-purpose types.
Pin No. 1 is connected to +24V, while Pin No. 50 is connected to 0V, for compact types.

[Software]

1) Control flow chart



2) Main program
Screw-tightening program No. 1

Application program

Comment	Extension condition	Input condition	Command			Output condition	Comment
	AND, OR	I/O, flag	Command	Operand 1	Operand 2	Output port, flag	
1			EXPG	2			Start program 2.
2			HOME	11			Align home.
3			VEL	100			Speed: 100mm/sec
4			ACC	0.3			Acceleration: 0.3G
5			TAG	1			Jump destination at restart
6			WTON	16			Screw-tightening start pushbutton
7			LET	1	1		Set screw counter.
8			TAG	2			Jump destination after tightening one screw
9			MOVL	*1			Move.
10			BTON	309			Z-axis air cylinder down
11			BTON	310			Start screw tightening.
12			WTON	20			Screw tightening complete.
13			BTOF	309	310		Cylinder up, screw tightening stopped.
14			WTON	18			Check Z-axis air cylinder top position.
15			ADD	1	1		Increment screw counter by 1.
16			CPEQ	1	7	900	Compare after tightening six screws.
17		N900	GOTO	2			Go to next screw-tightening cycle after tightening one screw.
18		N17	GOTO	1			Restart screw tightening.
19			ABPG	2			Stop program 2.
20			BTOF	311			Stop parts feeder.
21			EXIT				End of program 1

Position program

No.	X	Y
1	30	30
2	60	30
3	90	30
4	30	60
5	60	60
6	90	60

3) Sub program
Parts feeder program No. 2

Application program

Comment	Extension condition	Input condition	Command			Output condition	Comment
	AND, OR	I/O, flag	Command	Operand 1	Operand 2	Output port, flag	
1			TAG	1			Jump destination for repeating
2			WTOF	19			Screws short.
3			BTON	311			Start parts feeder.
4			WTON	19			Screws fully loaded.
5			BTOF	311			Stop parts feeder.
6			TIMW	5			5 seconds on restart timer
7			GOTO	1			Repeat.

7. Appendix

ASCII Code Table

Upper 3 bits → / ↓ Lower 4 bits	0	1	2	3	4	5	6	7
0	NUL	DLE	SP	0	@	P	`	p
1	SOH	DC1	!	1	A	Q	a	q
2	STX	DC2	"	2	B	R	b	r
3	ETX	DC3	#	3	C	S	c	s
4	EOT	DC4	$	4	D	T	d	t
5	ENQ	NAK	%	5	E	U	e	u
6	ACK	SYN	&	6	F	V	f	v
7	BEL	ETB	'	7	G	W	g	w
8	BS	CAN	(	8	H	X	h	x
9	HT	EM	)	9	I	Y	i	y
A	LF/NL	SUB	*	:	J	Z	j	z
B	VT	ESC	+	;	K	[	k	{
C	FF	FS	,	<	L	\	l	|
D	CR	GS	-	=	M	]	m	}
E	SO	RS	.	>	N	^	n	~
F	SI	US	/	?	O	_	o	DEL

Change History

Revision Date	Description of Revision
2010.11	First edition 1A → 1B (note corrected) Correction of page number for each command in pages 1 to 19, 254 to 260 Pages 44 Correction in reference for (3) Pages 103 Correction in right-hand rule Pages 248 Addition of note to state to refer to TT Instruction Manual Pages 295 Correction to the note of continuous operation command reference Pages 489 and 491 Correction to the note of palletizing reference
2011.11	Second edition Contents changed in Safety Guide Caution notes added for when working with two or more persons Contents deleted regarding Vertical Articulated and Rectangular 6-Axes Robots
2011.12	Edition 2B Note corrected etc.
2012.04	Third edition Note added for PCT/QCT Types for CT4 Actuator and explanation changed for related command (SCRV)
2012.09	Fourth edition Note added for XSEL-R/S/RX/SX/RXD/SXD types and related commands added and changed
2012.10	Fifth edition Note revised
2013.10	Sixth edition TTA added
2014.06	Seventh edition MSEL added
2014.08	Eighth edition Notes added for MSEL Cartesian Type application

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