X-SEL Controller
PX/QX Type

Operation Manual Eighth Edition

IAI America, Inc.

Please Read Before Use

Thank you for purchasing our product.

This Operation Manual explains the handling methods, structure and maintenance of this product, among others, providing the information you need to know to use the product safely.

Before using the product, be sure to read this manual and fully understand the contents explained herein to ensure safe use of the product.
The CD that comes with the product contains operation manuals for IAI products.
When using the product, refer to the necessary portions of the applicable operation manual by printing them out or displaying them on a PC.

After reading the Operation Manual, keep it in a convenient place so that whoever is handling this product can reference it quickly when 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.

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
For retention of encoder rotation data.

Since these batteries are not rechargeable, they will eventually be 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.

(Reference)

System-memory backup battery ---	An alarm occurs when the voltage drops to approximately 2.6 V. Data backup becomes impossible at a battery voltage of approximately 2.3 V (rated voltage: 3.0 V).
Absolute-encoder backup battery ---	An alarm occurs when the voltage drops to approximately 3.2 V. Data backup becomes impossible at a battery voltage of approximately 2.7 V (rated voltage: 3.6 V).

To prevent this problem, the controller can output a low battery voltage alarm from its I/O port.

Output port No. 313 is assigned as an alarm output for low system-memory backup battery voltage.
Output port No. 314 is assigned as an alarm output for low absolute-encoder backup battery voltage.

It is recommended that this function be utilized to prevent unnecessary problems resulting rom low battery voltage (consumption of battery life).

The person in charge of system design should utilize this function to provide a method for issuing an operator alarm using an output signal from an I/O port, while the person in charge of electrical design should provide a circuit implementation that has the same effect.
Refer to the applicable section in the operating manual for the batter replacement.

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

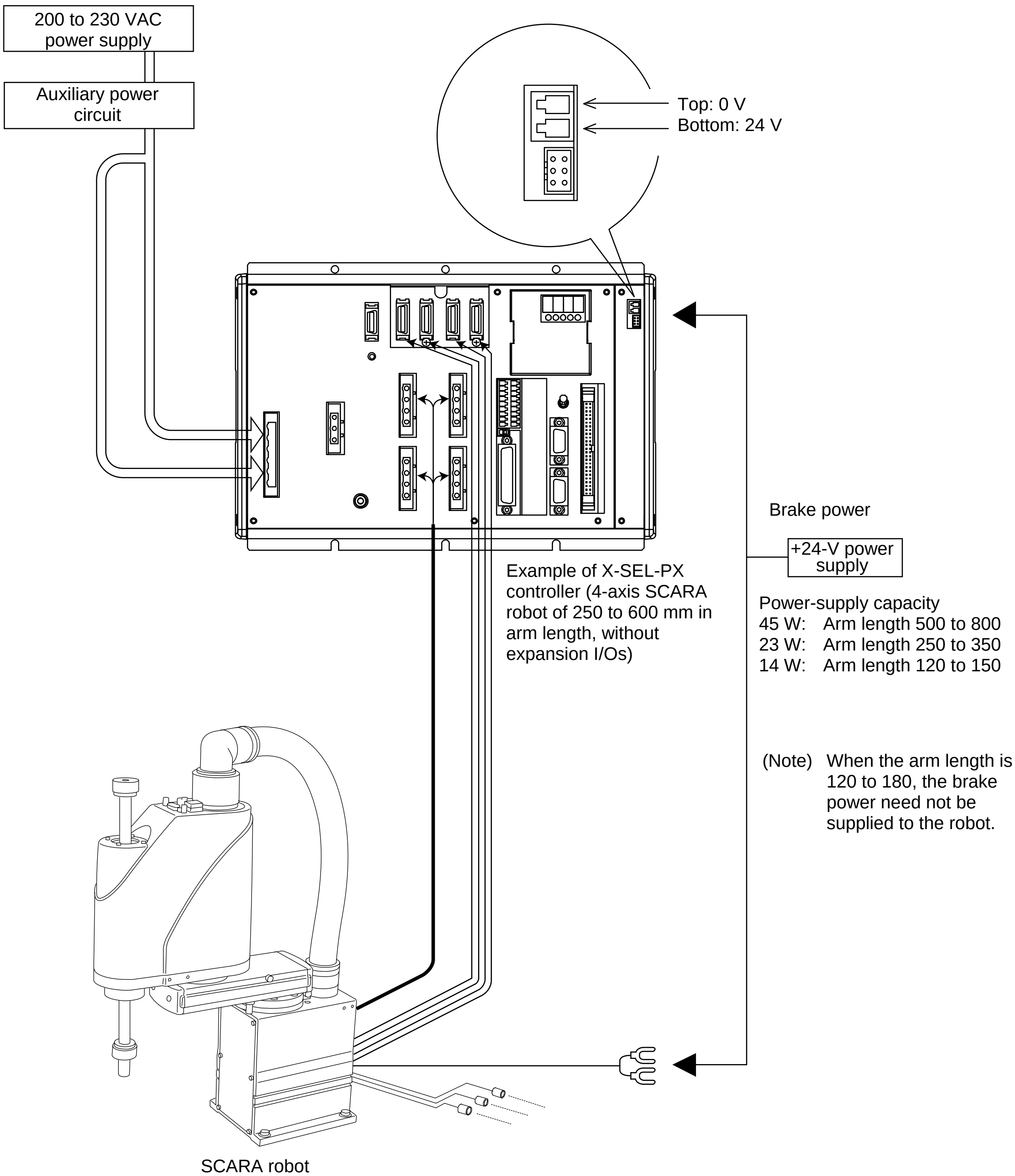
Compatible Teaching Pendant/PC Software

QX controllers only support the following teaching pendant/PC software:

Teaching pendant:	IA-T-XA (ANSI type)
PC software:	IA-101-XA-MW (with category 4 cable)

Notes on Supply of Brake Power (+24 V)

Besides connecting the brake power cable from the SCARA robot, the brake power must also be supplied to the controller.
Follow the illustration below to supply the brake power (+24 V) also to the controller.



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

Because of their circuit configuration, XSEL-PX controllers of single-phase, standard specification are the only class of controllers that may generate a “drive-source cutoff relay error (E6D),” notifying fusion of an internal relay, when the time after the power is turned off until it is turned back on (= until the power is reconnected) is too short.
Although the specific time varies depending on the input voltage and number of external regenerative resistance boxes being connected, as a guide wait for at least 40 seconds before reconnecting the power.

Note on Controllers with Increased CPU Unit Memory Size

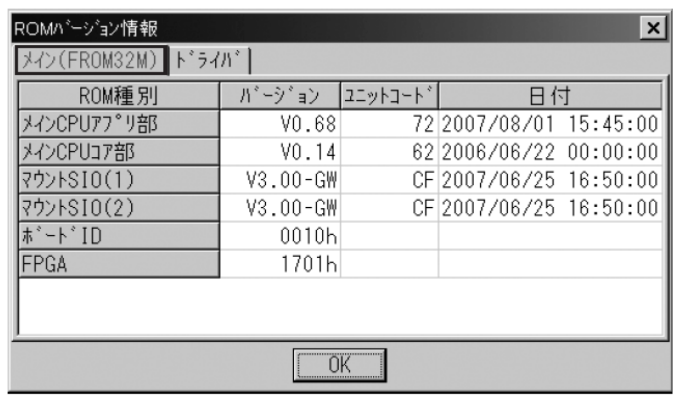
* Controllers with gateway function come with an increased memory size in their CPU unit.

If you are using a controller with increased CPU unit memory size, use PC software and teaching pendants of the versions specified below.

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

[How to Check if Controller Has Increased Memory Size]
Check the ROM version information in the PC software (Version 6.0.0.0 or later) (by selecting **Controller (C)** → **About ROM (V)**), or check the main CPU firmware version information on the teaching pendant (IA-T-X, IA-T-XD: Version 1.121 or later / SEL-T, SEL-TD: Version 1.00 or later) (by selecting **Moni** → **Ver** → **Main**).

• If the memory size has been increased: On the PC software screen, you will see "Main (FROM32M)," as shown below. On the teaching pendant screen, you will see "Main (FROM32M)," as shown below.



Checking in PC Software

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Moni−Ver



Main  Drv  Tp
```

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Ver  -Main (FROM:32M)
Main    V0.68  07/08/01
Maic    V0.14  06/06/22
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Checking on Teaching Pendant

Table of Contents

Safety Guide

This "Safety Guide" is intended to ensure the correct use of this product and prevent dangers and property damage. Be sure to read this section before using your product.

Regulations and Standards Governing Industrial Robots

Safety measures on mechanical devices are generally classified into four categories under the International Industrial Standard ISO/DIS 12100, "Safety of machinery," as follows:

Safety measures
- Inherent safety design
- Protective guards --- Safety fence, etc.
- Additional safety measures --- Emergency stop device, etc.
- Information on use --- Danger sign, warnings, operation manual

Based on this classification, various standards are established in a hierarchical manner under the International Standards ISO/IEC. The safety standards that apply to industrial robots are as follows:

Type C standards (individual safety standards) → ISO10218 (Manipulating industrial robots – Safety)

→ JIS B 8433
(Manipulating industrial robots – Safety)

Also, Japanese laws regulate the safety of industrial robots, as follows:

Industrial Safety and Health Law Article 59
Workers engaged in dangerous or harmful operations must receive special education.

Ordinance on Industrial Safety and Health
Article 36 --- Operations requiring special education
- No. 31 (Teaching, etc.) --- Teaching and other similar work involving industrial robots (exceptions apply)
- No. 32 (Inspection, etc.) --- Inspection, repair, adjustment and similar work involving industrial robots (exceptions apply)

Article 150 --- Measures to be taken by the user of an industrial robot

Requirements for Industrial Robots under Ordinance on Industrial Safety and Health

Work area	Work condition	Cutoff of drive source	Measure	Article
Outside movement range	During automatic operation	Not cut off	Signs for starting operation	Article 104
			Installation of railings, enclosures, etc.	Article 150-4
Inside movement range	During teaching, etc.	Cut off (including stopping of operation)	Sign, etc., indicating that work is in progress	Article 150-3
		Not cut off	Preparation of work rules	Article 150-3
			Measures to enable immediate stopping of operation	Article 150-3
			Sign, etc., indicating that work is in progress	Article 150-3
			Provision of special education	Article 36-31
			Checkup, etc., before commencement of work	Article 151
	During inspection, etc.	Cut off	To be performed after stopping the operation	Article 150-5
			Sign, etc., indicating that work is in progress	Article 150-5
		Not cut off (when inspection, etc., must be performed during operation)	Preparation of work rules	Article 150-5
			Measures to enable immediate stopping of operation	Article 150-5
			Sign, etc., indicating that work is in progress	Article 150-5
			Provision of special education (excluding cleaning and lubrication)	Article 36-32

Applicable Modes of IAI's Industrial Robot

Machines meeting the following conditions are not classified as industrial robots according to Notice of Ministry of Labor No. 51 and Notice of Ministry of Labor/Labor Standards Office Director (Ki-Hatsu No. 340):

(1) Single-axis robo with a motor wattage of 80 W or less
(2) Combined multi-axis robot whose X, Y and Z-axes are 300 mm or shorter and whose rotating part, if any, has the maximum movement range of within 300 mm^3 including the tip of the rotating part
(3) Multi-joint robot whose movable radius and Z-axis are within 300 mm

Among the products featured in our catalogs, the following models are classified as industrial robots:

1. Single-axis ROBO Cylinders
   RCS2/RCS2CR-SS8☐ whose stroke exceeds 300 mm
2. Single-axis robots
   The following models whose stroke exceeds 300 mm and whose motor capacity also exceeds 80 W:
   ISA/ISPA, ISDA/ISPDA, ISWA/ISPWA, IF, FS, NS
3. Linear servo actuators
   All models whose stroke exceeds 300 mm
4. Cartesian robos
   Any robot that uses at least one axis corresponding to one of the models specified in 1 to 3
5. IX SCARA robots
   All models whose arm length exceeds 300 mm
   (All models excluding IX-NNN1205/1505/1805/2515, NNW2515 and NNC1205/1505/1805/2515)

Notes on Safety of Our Products

Common items you should note when performing each task on any IAI robot are explained below.

No.	Task	Note
1	Model selection	● This product is not planned or designed for uses requiring high degrees of safety. Accordingly, it cannot be used to sustain or support life and must not be used in the following applications: [1]Medical devices relating to maintenance, management, etc., of life or health [2]Mechanisms or mechanical devices (vehicles, railway facilities, aircraft facilities, etc.) intended to move or transport people [3]Important safety parts in mechanical devices (safety devices, etc.) ● Do not use this product in the following environments: [1]Place subject to flammable gases, ignitable objects, flammables, explosives, etc. [2]Place that may be exposed to radiation [3]Place where the surrounding air temperature or relative humidity exceeds the specified range [4]Place subject to direct sunlight or radiated heat from large heat sources [5]Place subject to sudden temperature shift and condensation [6]Place subject to corrosive gases (sulfuric acid, hydrochloric acid, etc.) [7]Place subject to excessive dust, salt or iron powder [8]Place where the product receives direct vibration or impact ● Do not use this product outside the specified ranges. Doing so may significantly shorten the life of the product or result in product failure or facility stoppage.
2	Transportation	● When transporting the product, exercise due caution not to bump or drop the product. ● Use appropriate means for transportation. ● Do not step on the package. ● Do not place on the package any heavy article that may deform the package. ● When using a crane of 1 ton or more in capacity, make sure the crane operators are qualified to operate cranes and perform slinging work. ● When using a crane, etc., never hoist articles exceeding the rated load of the crane, etc. ● Use hoisting equipment suitable for the article to be hoisted. Calculate the load needed to cut off the hoisting equipment and other loads incidental to equipment operation by considering a safety factor. Also check the hoisting equipment for damage. ● Do not climb onto the article while it is being hoisted. ● Do not keep the article hoisted for an extended period of time. ● Do not stand under the hoisted article.
3	Storage/ preservation	● The storage/preservation environment should conform to the installation environment. Among others, be careful not to cause condensation.
4	Installation/ startup	(1) Installing the robot, controller, etc. ● Be sure to firmly secure and affix the product (including its work part). If the product tips over, drops, malfunctions, etc., damage or injury may result. ● Do not step on the product or place any article on top. The product may tip over or the article may drop, resulting in injury, product damage, loss of/drop in product performance, shorter life, etc. ● If the product is used in any of the following places, provide sufficient shielding measures: [1]Place subject to electrical noise [2]Place subject to a strong electric or magnetic field [3]Place where power lines or drive lines are wired nearby [4]Place subject to splashed water, oil or chemicals

No.	Task	Note
4	Installation/ startup	(2) Wiring the cables ● Use IAI's genuine cables to connect the actuator and controller or connect a teaching tool, etc. ● Do not damage, forcibly bend, pull, loop round an object or pinch the cables or place heavy articles on top. Current leak or poor electrical continuity may occur, resulting in fire, electric shock or malfunction. ● Wire the product correctly after turning off the power. ● When wiring a DC power supply (+24 V), pay attention to the positive and negative polarities. Connecting the wires in wrong polarities may result in fire, product failure or malfunction. ● Securely connect the cables and connectors so that they will not be disconnected or come loose. Failing to do so may result in fire, electric shock or product malfunction. ● Do not cut and reconnect the cables of the product to extend or shorten the cables. Doing so may result in fire or product malfunction.
		(3) Grounding ● Be sure to provide class D (former class 3) grounding for the controller. Grounding is required to prevent electric shock and electrostatic charges, improve noise resistance and suppress unnecessary electromagnetic radiation.
		(4) Safety measures ● Implement safety measures (such as installing safety fences, etc.) to prevent entry into the movement range of the robot when the product is moving or can be moved. Contacting the moving robot may result in death or serious injury. ● Be sure to provide an emergency stop circuit so that the product can be stopped immediately in case of emergency during operation. ● Implement safety measures so that the product cannot be started only by turning on the power. If the product starts suddenly, injury or product damage may result. ● Implement safety measures so that the product will not start upon cancellation of an emergency stop or recovery of power following a power outage. Failure to do so may result in injury, equipment damage, etc. ● Put up a sign saying "WORK IN PROGRESS. DO NOT TURN ON POWER," etc., during installation, adjustment, etc. If the power is accidently turned on, electric shock or injury may result. ● Implement measures to prevent the work part, etc., from dropping due to a power outage or emergency stop. ● Ensure safety by wearing protective gloves, protective goggles and/or safety shoes, as necessary. ● Do not insert fingers and objects into openings in the product. Doing so may result in injury, electric shock, product damage, fire, etc. ● When releasing the brake of the vertically installed actuator, be careful not to let the actuator drop due to its dead weight, causing pinched hands or damaged work part, etc.
5	Teaching	● Whenever possible, perform teaching from outside the safety fences. If teaching must be performed inside the safety fences, prepare "work rules" and make sure the operator understands the procedures thoroughly. ● When working inside the safety fences, the operator should carry a handy emergency stop switch so that the operation can be stopped any time when an abnormality occurs. ● When working inside the safety fences, appoint a safety watcher in addition to the operator so that the operation can be stopped any time when an abnormality occurs. The safety watcher must also make sure the switches are not operated inadvertently by a third party. ● Put up a sign saying "WORK IN PROGRESS" in a conspicuous location.

No.	Task	Note
5	Teaching	● When releasing the brake of the vertically installed actuator, be careful not to let the actuator drop due to its dead weight, causing pinched hands or damaged load, etc. * Safety fences --- Indicate the movement range if safety fences are not provided.
6	Confirmation operation	● After teaching or programming, carry out step-by-step confirmation operation before switching to automatic operation. ● When carrying out confirmation operation inside the safety fences, follow the specified work procedure just like during teaching. ● When confirming the program operation, use the safety speed. Failure to do so may result in an unexpected movement due to programming errors, etc., causing injury. ● Do not touch the terminal blocks and various setting switches while the power is supplied. Touching these parts may result in electric shock or malfunction.
7	Automatic operation	● Before commencing automatic operation, make sure no one is inside the safety fences. ● Before commencing automatic operation, make sure all related peripherals are ready to operate in the auto mode and no abnormalities are displayed or indicated. ● Be sure to start automatic operation from outside the safety fences. ● If the product generated abnormal heat, smoke, odor or noise, stop the product immediately and turn off the power switch. Failure to do so may result in fire or product damage. ● If a power outage occurred, turn off the power switch. Otherwise, the product may move suddenly when the power is restored, resulting in injury or product damage.
8	Maintenance/ inspection	● Whenever possible, work from outside the safety fences. If work must be performed inside the safety fences, prepare "work rules" and make sure the operator understands the procedures thoroughly. ● When working inside the safety fences, turn off the power switch, as a rule. ● When working inside the safety fences, the operator should carry a handy emergency stop switch so that the operation can be stopped any time when an abnormality occurs. ● When working inside the safety fences, appoint a safety watcher in addition to the operator so that the operation can be stopped any time when an abnormality occurs. The safety watcher must also make sure the switches are not operated inadvertently by a third party. ● Put up a sign saying "WORK IN PROGRESS" in a conspicuous location. ● Use appropriate grease for the guides and ball screws by checking the operation manual for each model. ● Do not perform a withstand voltage test. Conducting this test may result in product damage. ● When releasing the brake of the vertically installed actuator, be careful not to let the actuator drop due to its dead weight, causing pinched hands or damaged work part, etc. * Safety fences --- Indicate the movement range if safety fences are not provided.
9	Modification	● The customer must not modify or disassemble/assemble the product or use maintenance parts not specified in the manual without first consulting IAI. ● Any damage or loss resulting from the above actions will be excluded from the scope of warranty.
10	Disposal	● When the product becomes no longer usable or necessary, dispose of it properly as an industrial waste. ● When disposing of the product, do not throw it into fire. The product may explode or generate toxic gases.

Indication of Cautionary Information

The operation manual for each model denotes safety precautions under “Danger,” “Warning,” “Caution” and “Note,” as specified below.

Level	Degree of danger/loss	Symbol
Danger	Failure to observe the instruction will result in an imminent danger leading to death or serious injury.	Danger
Warning	Failure to observe the instruction may result in death or serious injury.	Warning
Caution	Failure to observe the instruction may result in injury or property damage.	Caution
Note	The user should take heed of this information to ensure the proper use of the product, although failure to do so will not result in injury.	Note

CE Marking

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

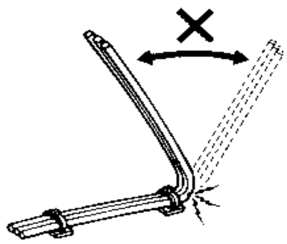
Prohibited Handling of Cables

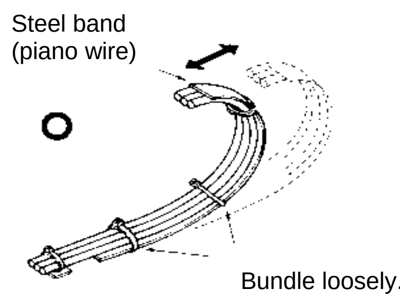
⚠ Caution

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.

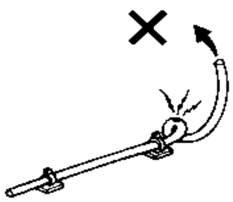
<u>Ten Rules for Handling Cables (Must be Observed!)</u>

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

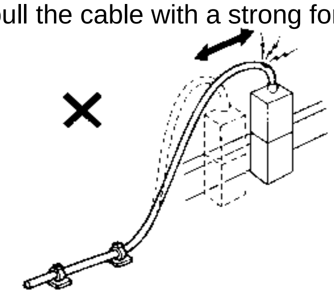




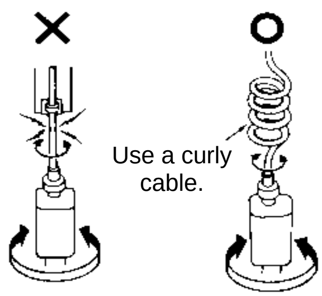
2. Do not let the cable bend, kink or twist.



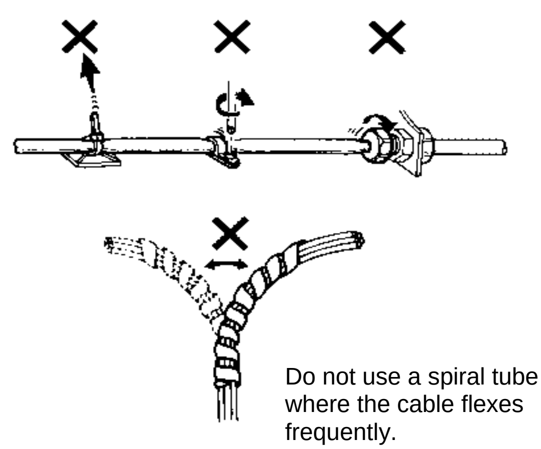
3. Do not pull the cable with a strong force.



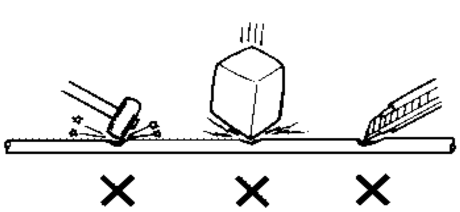
4. Do not let the cable receive a turning force at a single point.



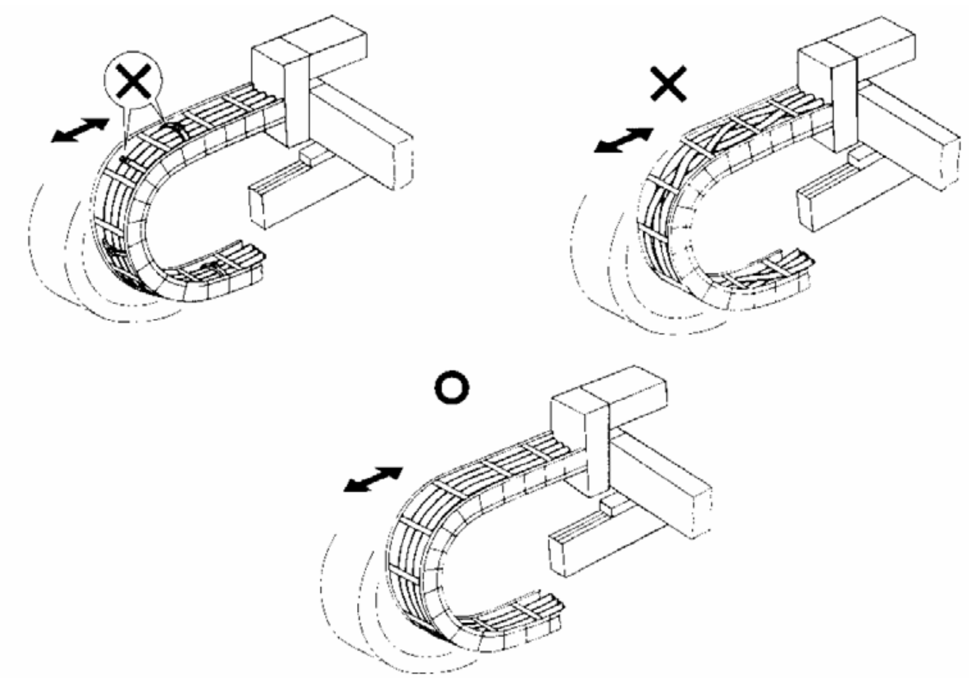
5. When fixing the cable, provide a moderate slack and do not tension it too tight.



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

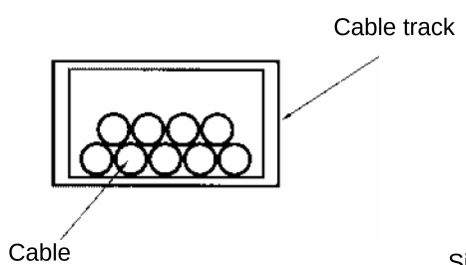


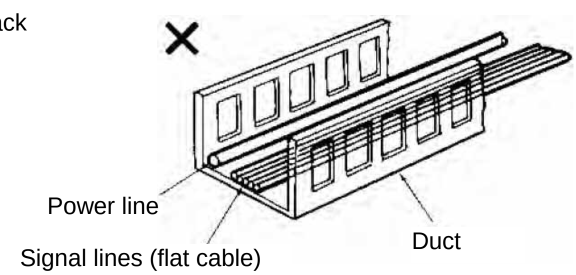
7. Do not let the cable got tangled or kinked in a cable track or flexible tube. When bundling the cable, keep a certain degree of flexibility (so that the cable will not become too taut when bent).



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

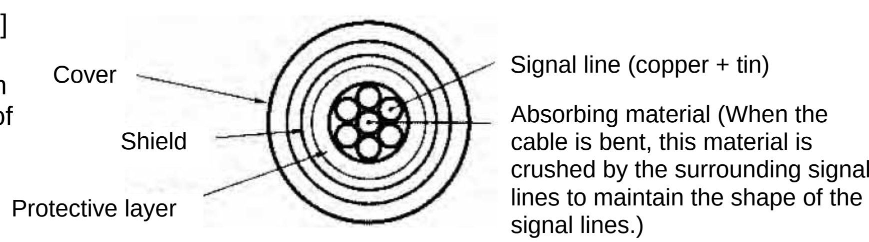
9. Do not lay signal lines together with circuit lines that create a strong electric field.





10. Always use a robot cable 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 robot cable offering significantly higher flexibility be used in this type of application.

Introduction

Thank you for purchasing the X-SEL controller.

Inappropriate use will prevent this product from operating at its full potential, 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 relavent items when needed.

The controller types covered by this manual are listed below.

Type	Specification
XSEL-PX	Standard
XSEL-QX	Global

Refer to the following table for details on type specification.

Type

[High speed model]

XSEL - PX6 - NNN5020H - 200AL - 200ABL - DV - N1 - EEE - 2 - 3

[1] [2] [3] [4] [5] [6] [7] [8] [9] [10]

[1] Series	[2] Controller type	[3] IX actuator type	[4] Axis 5 motor wattage	[5] Axis 6 motor wattage	[6] Network (dedicated slot)	[7] Standard I/O	[8] Expansion I/O			[9] I/O flat cable length	[10] Power-source voltage
						Slot 1	Slot 2	Slot 3	Slot 4		
XSEL	PX4 (Large-capacity 4-axis type) PX5 (Large-capacity 5-axis type) PX6 (Large-capacity 6-axis type) QX4 (Large-capacity global 4-axis type) QX5 (Large-capacity global 5-axis type) QX6 (Large-capacity global 6-axis type)	NNN2515H~8040H (Standard type) NSN5016H~6016H (High-speed type) NNW2515H~8040H (Dustproof/splash-proof type) TNN3015H~3515H (Wall-mount type) UNN3015H~3515H (Wall-mount inverse type) HNN5020H~8040H (Ceiling-mount type) INN5020H~8040H (Inverse type) NNC1205H~8040H (Cleanroom type)	Blank (No single axis) 20□ (20W) 30□ (30W) 60□ (60W) 100□ (100W) 200□ (200W) 400□ (400W) 600□L (600W) 750□L (750W)	Blank (No single axis) 20□ (20W) 30□ (30W) 60□ (60W) 100□ (100W) 200□ (200W) 400□ (400W) 600□L (600W) 750□L (750W)	Blank (No network support) DV (DeviceNet type) CC (CC Link type) PR (ProfiBus type) ET (Ethernet type)	E (Not used) N1 (I/O board NPN32/16) N2 (I/O board NPN16/32) N3 (I/O board NPN48/48) P1 (I/O board PNP32/16) P2 (I/O board PNP16/32) P3 (I/O board PNP48/48)	E (Not used) N1 (I/O board NPN32/16) N2 (I/O board NPN16/32) N3 (I/O board NPN48/48) P1 (I/O board PNP32/16) P2 (I/O board PNP16/32) P3 (I/O board PNP48/48)	E (Not used) N1 (I/O board NPN32/16) N2 (I/O board NPN16/32) N3 (I/O board NPN48/48) P1 (I/O board PNP32/16) P2 (I/O board PNP16/32) P3 (I/O board PNP48/48)	E (Not used) N1 (I/O board NPN32/16) N2 (I/O board NPN16/32) N3 (I/O board NPN48/48) P1 (I/O board PNP32/16) P2 (I/O board PNP16/32) P3 (I/O board PNP48/48)	2 (Standard specification 2m) 3 (3m) 5 (5m) 0 (None)	3 (3-phase, 200V)

* The number of axes that are connectable as axis 5 and/or axis 6, and the total motor wattages, are shown below.

Type	Number of connectable axes	Total motor wattage for axes 5/6
*N*2515H/*N*3515H	2	1500
*N*50**H/*N*60**H	2	600
*N*70**H/*N*80**H	0	-
NSN5016H/NSN6016H	0	-

* RCS2-RA7** / LSA series models cannot be connected for axes 5 and 6.

Type

[Conventional models]

XSEL - PX6 - NNN5020 - 750AL - 750ABL - DV - N1 - EEE - 2 - 3

[1] [2] [3] [4] [5] [6] [7] [8] [9] [10]

[1] Series	[2] Controller type	[3] IX actuator type	[4] Axis 5 motor wattage	[5] Axis 6 motor wattage	[6] Network (dedicated slot)	[7] Standard I/O	[8] Expansion I/O			[9] I/O flat cable length	[10] Power-source voltage
						Slot 1	Slot 2	Slot 3	Slot 4		
XSEL	PX4 (Large-capacity 4-axis type) PX5 (Large-capacity 5-axis type) PX6 (Large-capacity 6-axis type) QX4 (Large-capacity global 4-axis type) QX5 (Large-capacity global 5-axis type) QX6 (Large-capacity global 6-axis type)	NNN1205~8040 (Standard type) NSN5016~6016 (High-speed type) NNW2515~8040 (Dustproof/splash-proof type) TNN3015~3515 (Wall-mount type) UNN3015~3515 (Wall-mount inverse type) HNN5020~8040 (Ceiling-mount type) INN5020~8040 (Inverse type) NNC1205~8040 (Cleanroom type)	Blank (No single axis) 20□ (20W) 30□ (30W) 60□ (60W) 100□ (100W) 200□ (200W) 400□ (400W) 600□L (600W) 750□L (750W)	Blank (No single axis) 20□ (20W) 30□ (30W) 60□ (60W) 100□ (100W) 200□ (200W) 400□ (400W) 600□L (600W) 750□L (750W)	Blank (No network support) DV (DeviceNet type) CC (CC Link type) PR (ProfiBus type) ET (Ethernet type)	E (Not used) N1 (I/O board NPN32/16) N2 (I/O board NPN16/32) N3 (I/O board NPN48/48) P1 (I/O board PNP32/16) P2 (I/O board PNP16/32) P3 (I/O board PNP48/48)	E (Not used) N1 (I/O board NPN32/16) N2 (I/O board NPN16/32) N3 (I/O board NPN48/48) P1 (I/O board PNP32/16) P2 (I/O board PNP16/32) P3 (I/O board PNP48/48)	E (Not used) N1 (I/O board NPN32/16) N2 (I/O board NPN16/32) N3 (I/O board NPN48/48) P1 (I/O board PNP32/16) P2 (I/O board PNP16/32) P3 (I/O board PNP48/48)	E (Not used) N1 (I/O board NPN32/16) N2 (I/O board NPN16/32) N3 (I/O board NPN48/48) P1 (I/O board PNP32/16) P2 (I/O board PNP16/32) P3 (I/O board PNP48/48)	2 (Standard specification 2m) 3 (3m) 5 (5m) 0 (None)	2 (Single-phase 200V) 3 (3-phase 200V)

* RCS2-RA7** / LSA series models cannot be connected for axes 5 and 6.

The Axis 5 [4] and Axis 6 [5] portions of the model number are explained below.

750 A L

<Motor wattage>

20: 20 W
30D: 30 W for RCS2
30R: 30 W for RS
60: 60 W
100: 100 W
150: 150 W
200: 200 W
300: 300 W
400: 400 W
600: 600 W
750: 750 W

<Options>

B: With brake
C: Creep sensor
HA: High-acceleration/deceleration specification
L: Home sensor/LS type
M: Master axis specification
S: Slave axis specification

<Encoder type>

I: Incremental
A: Absolute
G: Quasi-absolute

This controller receives power in order to drive the actuator motor(s) (three-phase/single-phase, 200 to 220 V) and to operate the controller itself (200 to 220 V). (*The single-phase power specification is applicable only to single-phase controllers.)
The actuator 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.

With the global controller, always configure a safety circuit (drive-source cutoff circuit).

- 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.
- Duty of cartesian-axis actuators
  IAI recommends that our cartesian-axis actuators be used at a duty of 50% or less as a guideline in view of the relationship of service life and accuracy. The duty is calculated by the formula specified below:

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

- After turning off the control power, be sure to wait for at least 5 seconds (or 40 seconds in the case of a P type controller of single-phase specification) before turning it back on. Any shorter interval may generate “E6D: Drive-source cutoff error.”
- Do not insert or remove connectors while the controller power is on. Doing so may cause a malfunction.
- Precautions for when introducing the linear movement axis absolute specification:
  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 bottom position.
  (The controller is shipped with this switch set to the bottom 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.
  If the encoder cable of a linear movement axis was removed to relocate the actuator, etc., you must always perform the above steps.

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 X-SEL PX/QX Controller can support a combination of a SCARA robot and linear movement axes to perform integrated control of all axes including peripheral equipment. In other words, the 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 incorrect 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, 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 required to prevent accidents. Also read the appendix entitled, "Safety Rules and Others."

1. Do not handle this product in a manner 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 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, they should communicate 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 and confirm the responses from the others first before actually performing the operation.

Chapter 2 Warranty Period and Scope of Warranty

The X-SEL Controller you have purchased passed our strict outgoing inspection. This unit is covered by the following warranty:

1. Warranty Period

The warranty period shall be either of the following periods, whichever ends first:

- 18 months after shipment from our factory
- 12 months after delivery to a specified location

2. Scope of Warranty

The warranty is valid only for the IAI product you have purchased, provided that the failure occurred during the aforementioned warranty period despite proper use of the product. If the failure is clearly caused by defective material or poor workmanship, IAI will repair the product free of charge. Take note, however, that the following items are excluded from the scope of warranty:

- Discoloration of paint or other normal aging
- Wear of consumable parts due to use
- Subjective imperfection, such as noise not affecting mechanical function
- Defect caused by inappropriate handling or use by the user
- Defect caused by inappropriate or erroneous maintenance/inspection
- Defect caused by use of a part other than IAI's genuine part
- Defect caused by unauthorized modification, etc., not approved by IAI or its agent
- Defect due to an act of God, accident, fire, etc.

Only the product itself, without accessories, cables, etc., is covered by the warranty. The warranty does not cover any losses arising from a failure of the delivered product.
The user must bring the defective product to our factory to receive a warranty repair.

3. Scope of Service

The price of the delivered product does not include costs incurred in association with program generation, dispatch of technician, etc. Therefore, a separate fee will be chargeable in the following cases even during the warranty period:

- Guidance on installation/adjustment and witnessing of test operation
- Maintenance/inspection
- Technical guidance and training on operation, wiring method, etc.
- Technical guidance and training regarding programs, such as program generation
- Other services and operations where IAI finds a need to charge a separate fee

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 damage).
(2) Prevent foreign matter from entering the controller through the ventilation holes. Since the controller is not designed as dustproof or waterproof, avoid using it in a dusty place or a place subject to water mist, oil, or cutting fluid.
(3) Do not expose the controller to direct sunlight or radiant heat from a high heat source.
(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

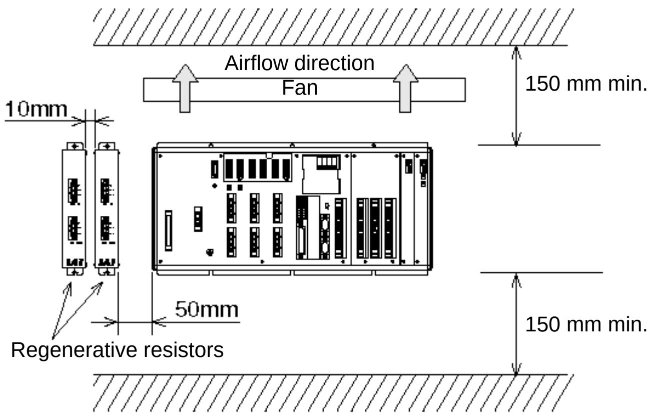
Item	Specification and description
Surrounding Air Temperature Range	0 ~ 40°C
Surrounding Humidity Range	10% ~ 95% (non-condensing; conforming to JIS C3502 RH-2)
Storage Temperature Range	-25°C ~ 70°C (excluding the battery)
Maximum Operating Altitude	2000 m
Protection Class	IP20
Vibration	$10 \leq f < 57$: 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

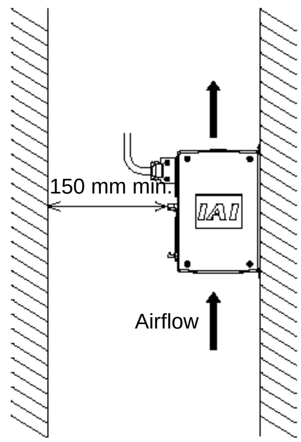
Electrical Specifications of Controller

Item	Specification	
Power-source Voltage	Three-phase, 200 ~ 230 VAC ± 10%	Single-phase, 200 ~ 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 insulation, 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 surrounding air 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 fans on top of the controllers will help maintain a uniform surrounding air 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 approximately 50 mm between the regenerative resistor and the controller, and a clearance of approximately 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 X-SEL 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 supply capacity
Calculate the power supply capacity according to 3, “Power Supply Capacity and Heat Output” in Part 1, “Installation.”
Power supply capacity indicates the rated power supply capacity. The motor current of a given axis may increase to as much as three times the rated current during high acceleration. Although all four axes of a SCARA robot will not reach three times the rated current at the same time, consider the possibility of any one axis reaching three times the rated current and select breakers and other components based on a power supply capacity of 1.5 times the rated power supply capacity.

(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)
PX type (Standard specification)	0.4 mA (200-VAC input)	2 mA or less (200-VAC input)
QX type (Global specification)	0.2 mA (200-VAC input)	2 mA or less (200-VAC input)

(3) Rush current
The table below lists reference rush currents that may be observed 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)

[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
Noise filter	Densei-Lambda	MC1320 (for three-phase power supply) MXB-1220-33 (for single-phase power supply)
Ring core	NEC Tokin	ESD-R-25
Clamp filter A	TDK	ZCAT3035-1330
Clamp filter B	Kitagawa Industries	RFC-H13

[5] Surge absorber
With both the global specification and standard specification, the motor drive part of the X-SEL 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.

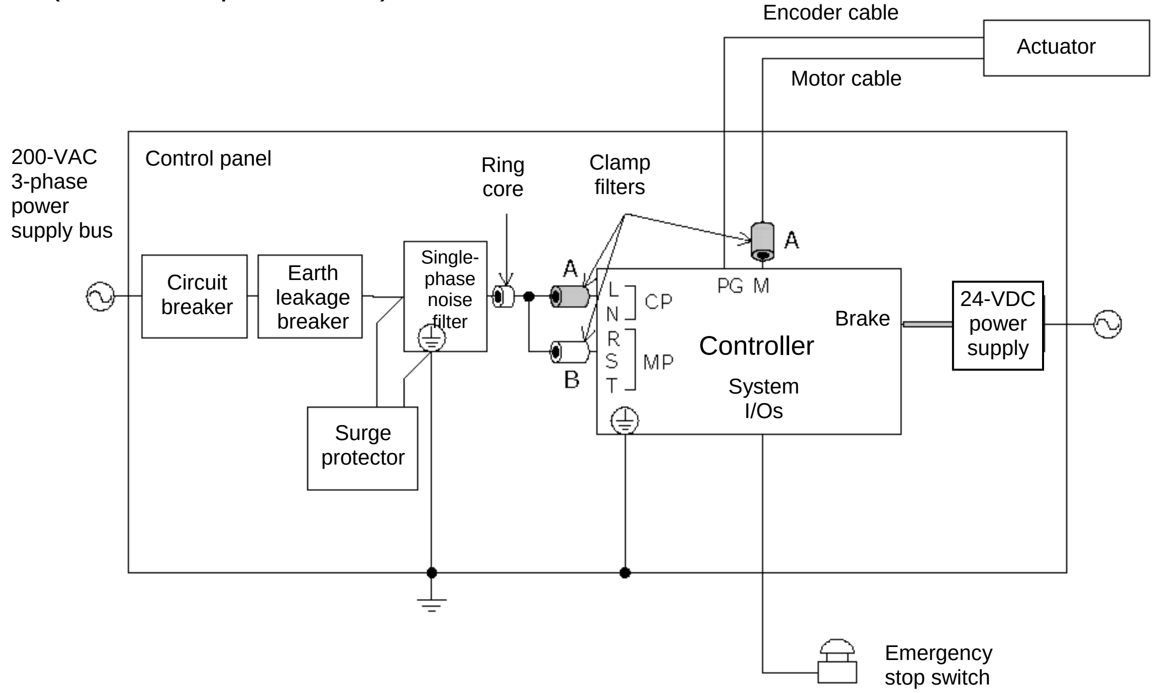
Caution: Besure to use the following surge absorber to ensure compliance with the EC Directives.
Recommended surge absorber:
R/A/V-781BXZ-4 (Three-phase) by Okaya Electric Industries
R/A/V-781BXZ-2A (Single-phase) by Okaya Electric Industries

Peripheral configurations for the global and standard specifications are shown on the following pages.

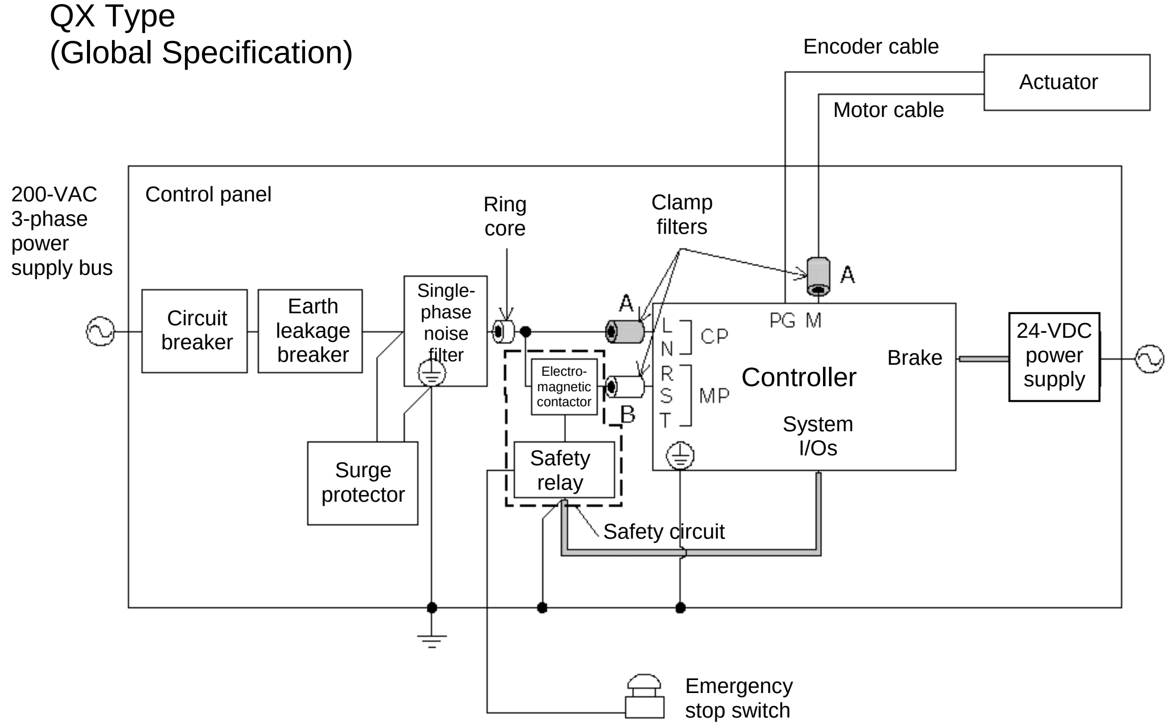
Peripheral Configurations

3-phase Power Supply Specification

PX Type
(Standard Specification)



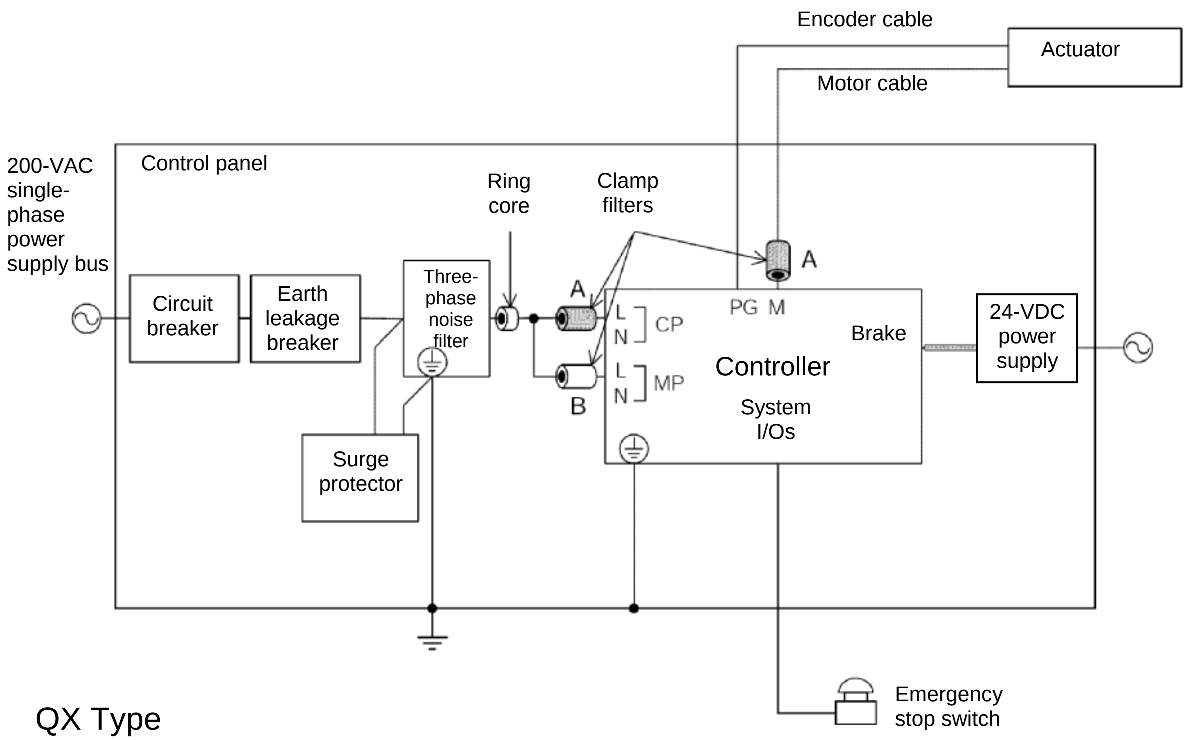
QX Type
(Global Specification)



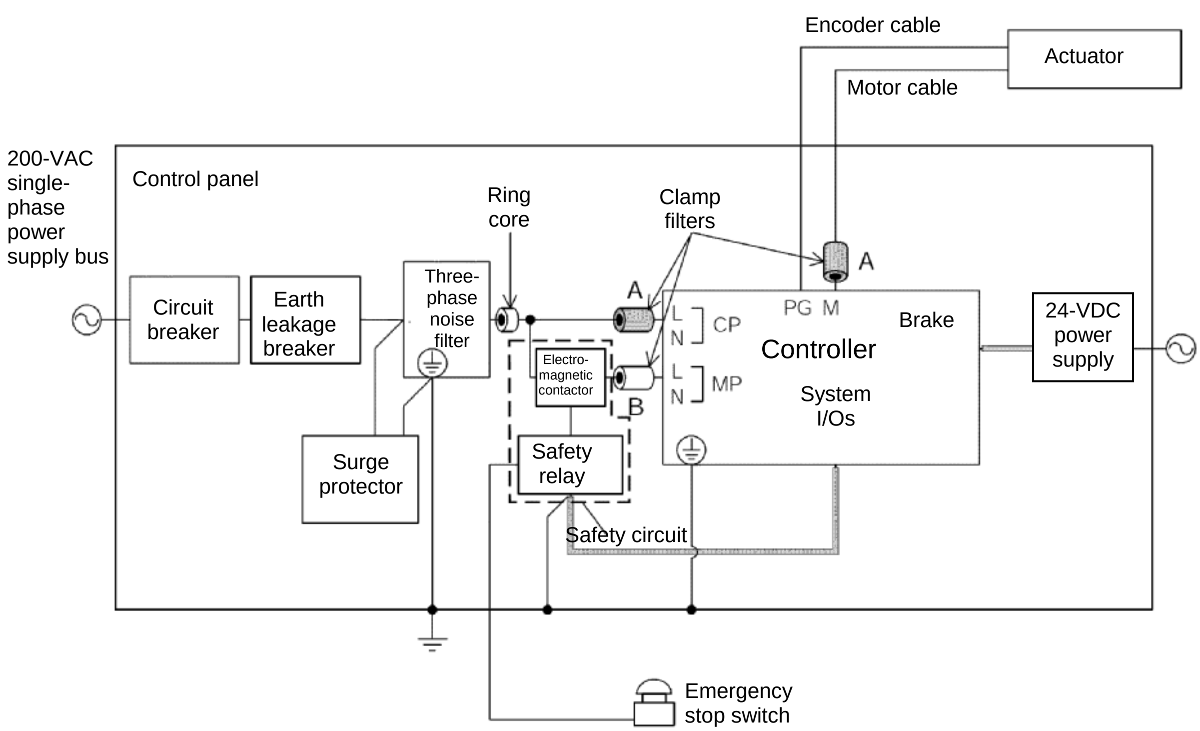
Peripheral Configurations

Single-phase Power Supply Specification

PX Type
(Standard Specification)



QX Type
(Global Specification)

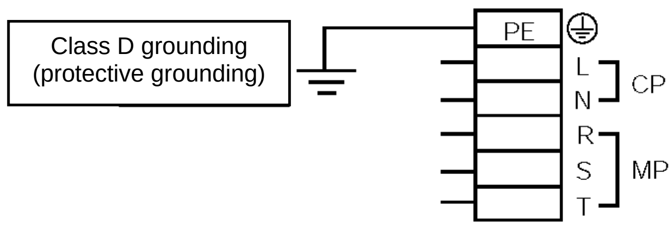


4. Noise Control Measures and Grounding

(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.

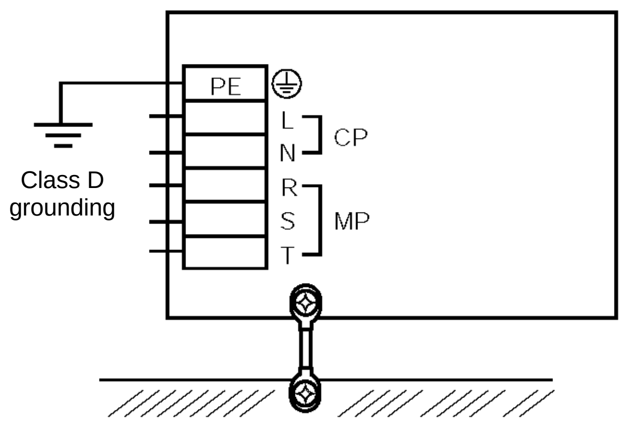


[1] Notes on wiring method

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).

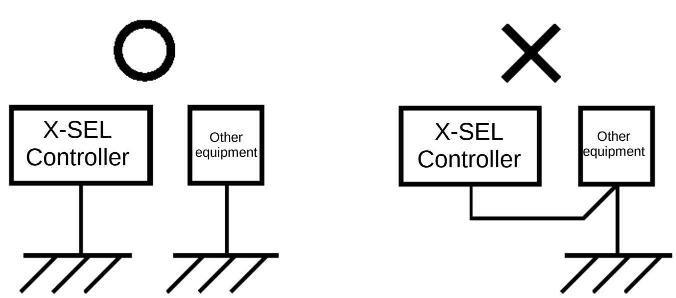
If you wish to extend the motor cable or encoder cable beyond the length of each supplied cable, please contact IAI's Technical Service Section or Sales Engineering Section.

(2) Noise-elimination grounding



Metal enclosure

Provide dedicated grounding for the FG and PE.

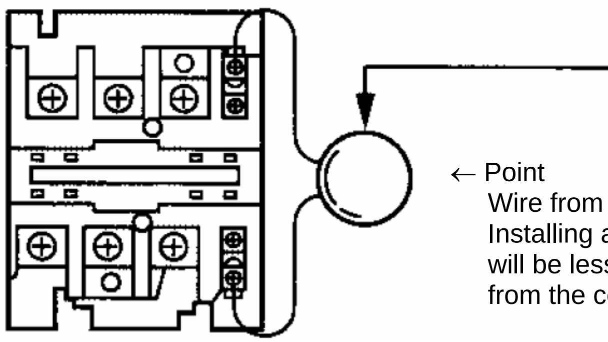


Do not connect as above.

(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:

[1] AC solenoid valve, magnet switch, relay

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

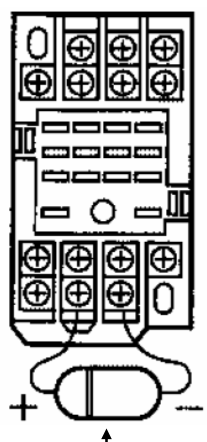


Surge killer

← 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.

[2] 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.

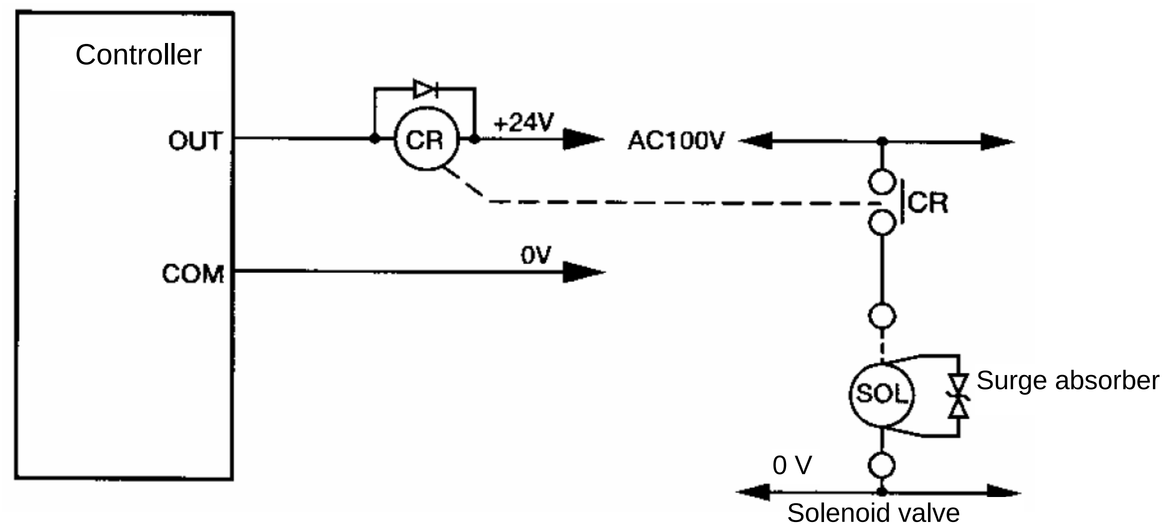


In a DC circuit, connecting a diode in reversed polarity will damage the diode, internal parts of the controller and DC power supply. Exercise due caution.

Diode

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.

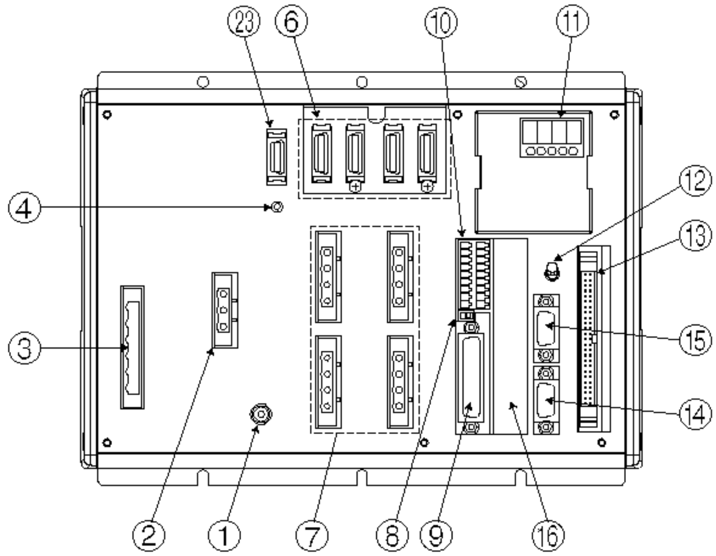
Reference Circuit Diagram



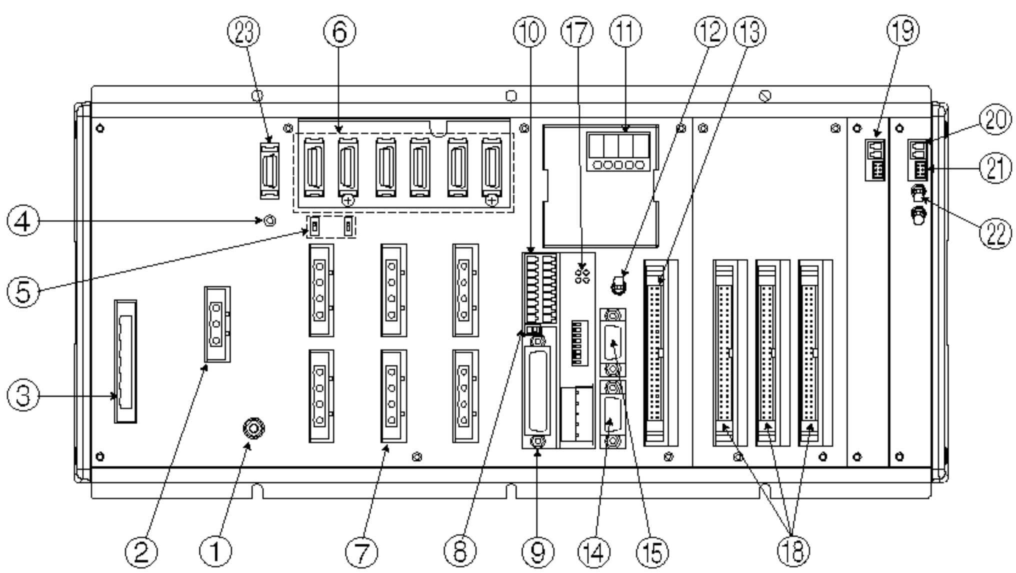
Chapter 4 Name and Function of Each Part

1. Front View of Controller

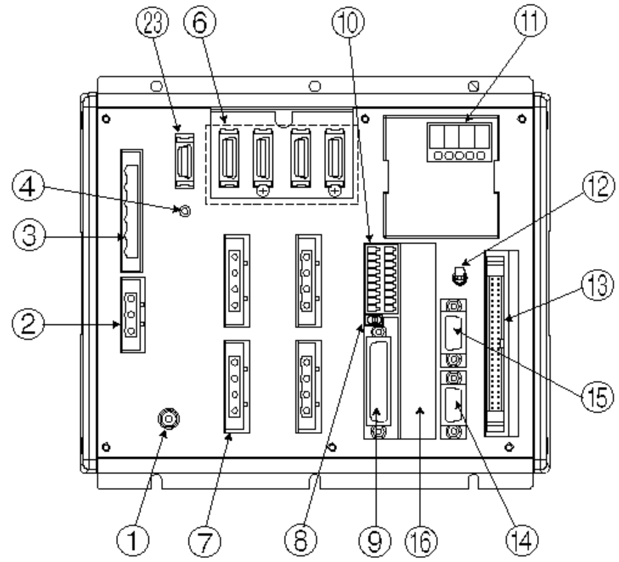
PX Type (Standard Specification), 4 axes (SCARA axes only)



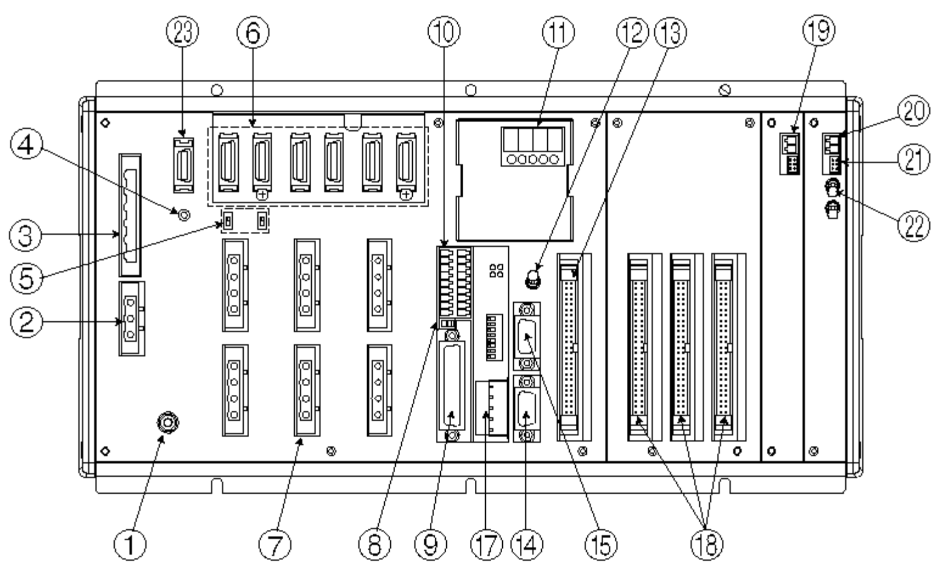
PX Type (Standard Specification), expanded by 2 additional linear movement axes, with I/O brake unit



QX Type (Global Specification), 4 axes (SCARA axes only)



QX Type (Global Specification), expanded by 2 additional linear movement axes, with I/O 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 ~ 5.5 mm^2 min.
Grounding method	Class D grounding

[2] External regenerative unit connector............ (Linear movement axis only) When a linear movement axis decelerates or moves downward, regenerative energy is produced. The capacitor and resistor in the controller alone may not be able to absorb this regenerative energy (in which case an "Error No. 60C, Power-system overhear error" will generate). In this case, connect a regenerative unit or units.
Whether or not your system needs one or more regenerative units depends on the specific application such as the configuration of linear movement axes. Refer to Appendix, "Number of Regenerative Units to be Connected."
If all axes are SCARA axes, no regenerative unit is required.

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	
Size of supplied cable	1.0 mm^2 (equivalent to AWG17)	The cable is supplied with the external regenerative unit.
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/three-phase input connector consisting of six terminals including motor power terminals, control power terminals and a PE terminal.

Note) Select the single-phase input specification or three-phase input specification, whichever is applicable, for motor drive power.

The standard type only comes with a terminal block.

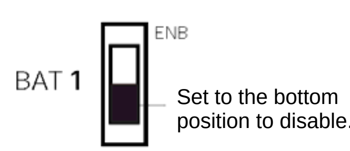
Caution To prevent electric shock, do not touch this connector when the controller is receiving power.

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 200/230 VAC power supply, 50/60 Hz				
Single-phase specification	Terminal assignments	6		PE	Protective grounding wire	
		5	IN	CP_L	Control power 200 VAC, phase L	Cable size 0.75 mm^2 (AWG18)
		4	IN	CP_N	Control power 200 VAC, phase N	
		3		NC	Do not connect anything to this terminal.	
		2	IN	MP_L	Motor power 200 VAC, phase L	Cable size 2 mm^2 (AWG14)
		1	IN	MP_N	Motor power 200 VAC, phase N	
Three-phase specification	Terminal assignments	6		PE	Protective grounding wire	
		5	IN	CP_L	Control power 200 VAC, phase L	Cable size 0.75 mm^2 (AWG18)
		4	IN	CP_N	Control power 200 VAC, phase N	
		3	IN	NC	Motor power 200 VAC, phase R	Cable size 2 mm^2 (AWG14)
		2	IN	MP_L	Motor power 200 VAC, phase S	
		1	IN	MP_N	Motor power 200 VAC, phase T	

[4] Control-power monitor LED .... A green light illuminates when the control power supply is providing the correct amount of power.

[5] Absolute-data backup battery enable/disable switch (Linear movement axis only) .... This switch is used to change the backup operation setting; i.e., whether or not to back up the encoder using the absolute-encoder backup battery for the linear movement axis. This function is disabled when the controller is shipped. After connecting the encoder and axis-sensor cables, turn on the power, and then set this switch to the top position. This switch is not provided for SCARA axes.



[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.
The connectors are assigned to axis 1, axis 2, and so on, from the right.

Encoder/Axis-sensor Connector Specifications

Item	Overview	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 ~ 6	Encoder/axis-sensor connector
Maximum wiring distance	30 m	

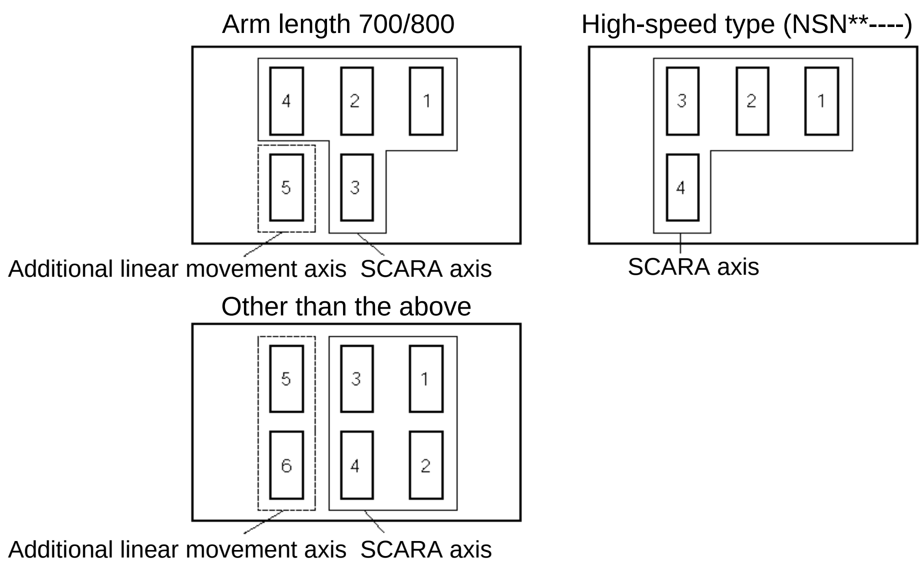
	Pin No.	Signal name	Description
Signal table	**1**		
	2		
	3		
	4		
	5		
	6		
	7	SRD+	Send/receive differential + (pulse/magnetic pole switching +)
	8	SRD–	Send/receive differential - (pulse/magnetic pole switching -)
	9	NC	Not connected
	10	NC	Not connected
	11	NC	Not connected
	12	24VOUT	Sensor power 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	Overview			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

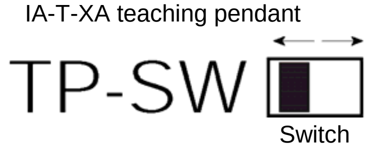
The position of the motor connector for each axis varies depending on the SCARA type, as shown below.



[8] Teaching-pendant type switch (P 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 (conforming 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



Note 1: The safety gate switch will not function if this switch is not set correctly.

Note 2: IAI’s standard teaching pendants cannot be used with Q type controllers.

Note 3: TP-SW is not available on QX type controllers.

[9] Teaching connector.... The teaching interface connects IAI's teaching pendant or a PC 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 pendant connector. (P type only)
* With Q-type controllers, connect the supplied dummy plug to the teaching connector during the AUTO mode.

Interface Specifications of Teaching Serial Interface

Item	Overview	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 X-SEL, 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	X-SEL teaching protocol	The connector supports the X-SEL-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 cable size	0.2 ~ 1.3 mm^2 (AWG24-16)
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 8 mA (PX type)
	5		line-	
	4	EMG2	line+	Emergency stop switch 2 8 mA (PX type)
	3		line-	
	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.) 8 mA (PX type)
	14		line-	
	13	ENB2	line+	Enable gate switch 2 8 mA (PX type)
	12		line-	
	11	RDY	Out+	Ready signal contact output
	10		Out-	

Only a terminal block is supplied without a 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.
* If you are using a QX type controller, connect the supplied dummy plug to the teaching connector [9] during 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	Alarm output for low system-memory backup battery voltage	Purple-5
48		314	Alarm output for low absolute-encoder backup battery voltage	Gray-5
49		315	General purpose output	White-5
50		-	0V	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.

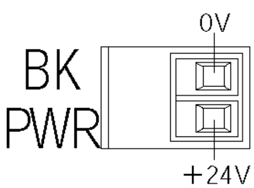
[16] Installation position of field network board ..... This is where a Fieldbus interface module is installed. In this example, this position is left unoccupied (no module is installed).

[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] Brake power input connector (SCARA axis only) ...... This connector is used to input the power for SCARA brake control. 24 VDC must be supplied externally.
Connect the SCARA-axis brake power to both the brake power cable from the SCARA robot and this connector.

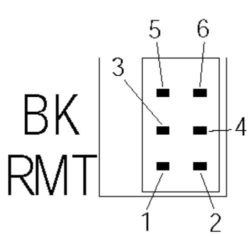
[20] Brake power input connector .... A power input connector for driving the brake of a linear axis, high-speed SCARA robot (NSN**…) or actuator with an arm length of 700 or 800.
24 VDC must be supplied externally. If the specified power is not supplied, the actuator brake cannot be released. Be sure to supply the power to this connector if you are using a high-speed SCARA robot (NSN**…), actuator with an arm length of 700 or 800 or linear axis with brake.
As for the brake power cable, use a shielded cable and connect the shield on the 24-V power-supply side. The bottom side of the connector connects to +24 V.



Brake Power 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 cable size: 0.1 ~ 2.0 mm^2 (AWG28-14)
Connector name	BK PWR	
Input voltage	24 VDC ± 10%	
Terminal assignments	0 V	24 V power ground
	+24 V	24 V power input

[21] Brake release switch connector (Linear movement axis only) ... This connector accepts a switch that releases the brake of a linear movement axis 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 linear movement axis manually in the event of a power failure or error in the controller.



Brake-release Switch Connector Specifications

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

*) Mating connector --- Hirose socket: DF11-6DS-2C, crimp terminal: DF11-2428SC

[22] Brake switch (Linear movement axis only)... 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 the controller to release the brake.
Note: The SCARA-axis brake switch is located on the panel of the SCARA robot.

[23] Conveyor tracking connector.................... This connector is used only when the controller is of conveyor tracking specification.
Normally this connector is not used.

2. Explanation of Codes Displayed on the Panel Window

2.1 Application

Display				Priority (*1)	Description
	A	C	F	1	AC power is cut off (including momentary power failure or drop in power source voltage).
E	F	X	X	1	System down level error
	P	r	d	2	Writing data to the flash ROM.
	E	r	G	3	Emergency stop is being actuated (except during the update mode).
	E	n	b	4	Enable switch (deadman switch/safety gate) OFF (except in the update mode)
E	E	X	X	5	Cold start level error
E	d	X	X	5	Cold start level error
E	C	X	X	5	Operation cancellation level error
E	b	X	X	5	Operation cancellation level error
-		r	P	6	Waiting for a drive source cutoff reset input (except during the update mode).
-		r	S	6	Operation is paused and waiting for a restart signal (except during the update mode)
-	I	L	C	7	All servo axes are interlocked (except during the update mode)
E	A	X	X	8	Message level error
E	q	X	X	8	Message level error
r	U	d	C	9	Core update mode
	U	d	C	9	Core update is in progress
F	U	d	C	9	Core update has completed
r	U	d	S	9	Slave update mode
	U	d	S	9	Slave update is in progress
F	U	d	S	9	Slave update has completed
P	N	o.		9	A program is running (last started program). *** indicates the program number. (Controller with increased memory size (with gateway function))
	P	N	o.	9	A program is running (last started program). ** indicates the program number. (Controller with increased memory size)
I	n	X	X	9	Initialization sequence number
	d	b	G	9	Debug mode
A	r	d	Y	9	Ready status (auto mode)
	r	d	Y	9	Ready status (manual mode)

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

2.2 Core

Display				Priority (*1)	Description
	A	C	F	1	AC power is cut off (including momentary power failure or drop in power source voltage)
E	E	X	X	1	Coldstart level error
E	d	X	X	1	Coldstart level error
E	C	X	X	1	Operationcancellation level error
E	b	X	X	1	Operationcancellation level error
E	A	X	X	2	Message level error
E	9	X	X	2	Message level error
r	U	d	A	2	Application update mode
	U	d	A	2	Application update is in progress
F	U	d	A	2	Application update has completed
P	_	_	_	2	Hardware test mode process
	E	r	A	2	Clearing the application flash ROM
F	E	r	A	2	Application flash ROM has been cleared
	J	P	A	2	Jump to the application
C	H	F	C	2	Core flash ROM check process
C	H	F	A	2	Application flash ROM check process
C	H	S	d	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.

(1) Current monitor

Currents of up to four axes having continuous axis numbers can be monitored.

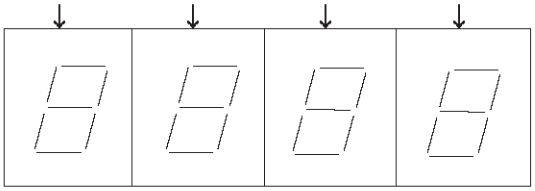
Parameter settings

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.

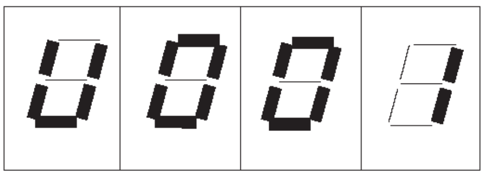
	0 < Motor current to rating ratio (%) ≤ 25		100 < Motor current to rating ratio (%) ≤ 150
	25 < Motor current to rating ratio (%) ≤ 50		150 < Motor current to rating ratio (%) ≤ 200
	50 < Motor current to rating ratio (%) ≤ 75		200 < Motor current to rating ratio (%)
	75 < Motor current to rating ratio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

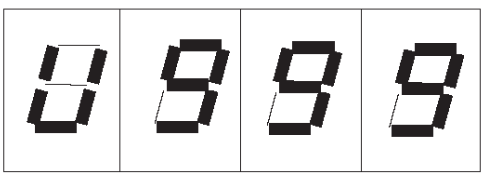
Thick lines indicate illuminated segments.

(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. PX Type (Standard Specification)

<table>
<tr><td></td><td colspan="3">1-axis to 6-axis controller</td></tr>
<tr><td>Total output when maximum number of axes are connected</td><td colspan="2">Single-phase specification: 1600 W</td><td>Three-phase specification: 2400 W</td></tr>
<tr><td>Control power input</td><td colspan="3">Single phase, 200 to 230 VAC ± 10%</td></tr>
<tr><td>Motor power input</td><td colspan="2">Single-phase specification: 200 to 230 VAC ± 10%</td><td>Three-phase specification: 200 to 230 VAC ± 10%</td></tr>
<tr><td>Power source frequency</td><td colspan="3">50/60 Hz</td></tr>
<tr><td>Insulation resistance</td><td colspan="3">10 MΩ min. (measured at 500 VDC between the power terminal and I/O terminals and between the external terminals and case)</td></tr>
<tr><td>Withstand voltage</td><td colspan="3">1500 VAC for 1 minute [Note 1)]</td></tr>
<tr><td>Surrounding air temperature range</td><td colspan="3">0 to 40°C</td></tr>
<tr><td>Surrounding humidity range</td><td colspan="3">10% to 95% (Non-condensing; conforming to JIS C3502 RH-2)</td></tr>
<tr><td>Storage temperature range</td><td colspan="3">-25°C to 70°C (Excluding the battery)</td></tr>
<tr><td>Protection class</td><td colspan="3">IP20</td></tr>
<tr><td>Drive-source cutoff method</td><td colspan="3">Internal relay</td></tr>
<tr><td>Emergency stop input</td><td colspan="3">Contact B input (Internal power-supply type)</td></tr>
<tr><td>Emergency stop action</td><td colspan="3">Deceleration stop + Regenerative brake by timer (failsafe)</td></tr>
<tr><td>Enable input</td><td colspan="3">Contact B input (Internal power-supply type)</td></tr>
<tr><td>System ready output</td><td colspan="3">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).</td></tr>
<tr><td>Axis control method</td><td colspan="3">AC full digital servo</td></tr>
<tr><td>Position detection methods</td><td colspan="3">17 bit incremental encoder (Wire-saving type)
17 bit rotation data backup absolute encoder
Resolution: 14 bits under both methods (16384 pulses)</td></tr>
<tr><td>Batteries</td><td colspan="3">Absolute-data backup battery: AB-5 made by IAI
System-memory backup battery: CR2032</td></tr>
<tr><td>Speed setting</td><td colspan="3">1 mm/sec to 3000 mm/sec (Varies according to the applicable model.)</td></tr>
<tr><td>Acceleration/deceleration setting</td><td colspan="3">0.01 G to 3 G (Varies according to the applicable model.)</td></tr>
<tr><td>Programming language</td><td colspan="3">Super SEL language</td></tr>
<tr><td rowspan="2">Program steps</td><td>Controller with increased memory size (with gateway function)</td><td colspan="2">9999 steps (total)</td></tr>
<tr><td>Controller without increased memory size</td><td colspan="2">6000 steps (total)</td></tr>
<tr><td rowspan="2">Number of positions</td><td>Controller with increased memory size (with gateway function)</td><td colspan="2">20000 positions (total)
Position Nos. 1 to 10000 can be saved to the battery backup memory.
Position Nos. 10001 to 20000 can be saved to the flash memory.</td></tr>
<tr><td>Controller without increased memory size</td><td colspan="2">4000 positions (total)
All position data can be saved to the battery backup memory.</td></tr>
</table>

Number of programs	Controller with increased memory size (with gateway function)	128 programs
	Controller without increased memory size	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) There are no limitation on the number of brake axes (A 5/6-axis system with brake can be supported.)	
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 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 X-SEL 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 and LSA-series actuators cannot be connected as axis 5 or 6.

1.2 QX Type (Global Specification)

	1-axis to 6-axis controller	
Total output when maximum number of axes are connected	Single-phase specification: 1600 W	Three-phase specification: 2400 W
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	
Insulation 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)]	
Surrounding air temperature range	0 to 40°C	
Surrounding 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-power cutoff method	External safety circuit	
Emergency stop input	Contact B input (Internal power-supply type, redundant)	
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	17 bit incremental encoder (Wire-saving type) 17 bit rotation data backup absolute encoder Resolution: 14 bits under both methods (16384 pulses)	
Batteries	Absolute-data backup battery: AB-5 made by IAI System-memory backup battery: CR2032	
Speed setting	1 mm/sec to 3000 mm/sec (Varies according to the applicable model.)	
Acceleration/deceleration setting	0.01 G to 3 G (Varies according to the applicable model.)	
Programming language	Super SEL language	
Program steps	Controller with increased memory size (with gateway function)	9999 steps (total)
	Controller without increased memory size	6000 steps (total)
Number of positions	Controller with increased memory size (with gateway function)	20000 positions (total) Position Nos. 1 to 10000 can be saved to the battery backup memory. Position Nos. 10001 to 20000 can be saved to the flash memory.
	Controller without increased memory size	4000 positions (total) All position data can be saved to the flash memory.
Number of programs	Controller with increased memory size (with gateway function)	128 programs
	Controller without increased memory size	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) There are no limitation on the number of brake axes (A 6-axis system with all axes equipped with a brake can be supported.)
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 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 X-SEL PC software connection MODBUS/TCP remote I/O (IN: 32 bytes max./OUT: 32 bytes max.)

Note 1) The voltage protection rating of the actuator motor is 1000 V for 1 minute.
When performing a 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 and LSA-series actuators cannot be connected as axis 5 or 6.

1.3 Differences between QX Type (Global Specification) and PX Type (Standard Specification)

Users require different safety categories in accordance with the overall configuration of their equipment. The QX 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 PX 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	QX type (global specification)	PX 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

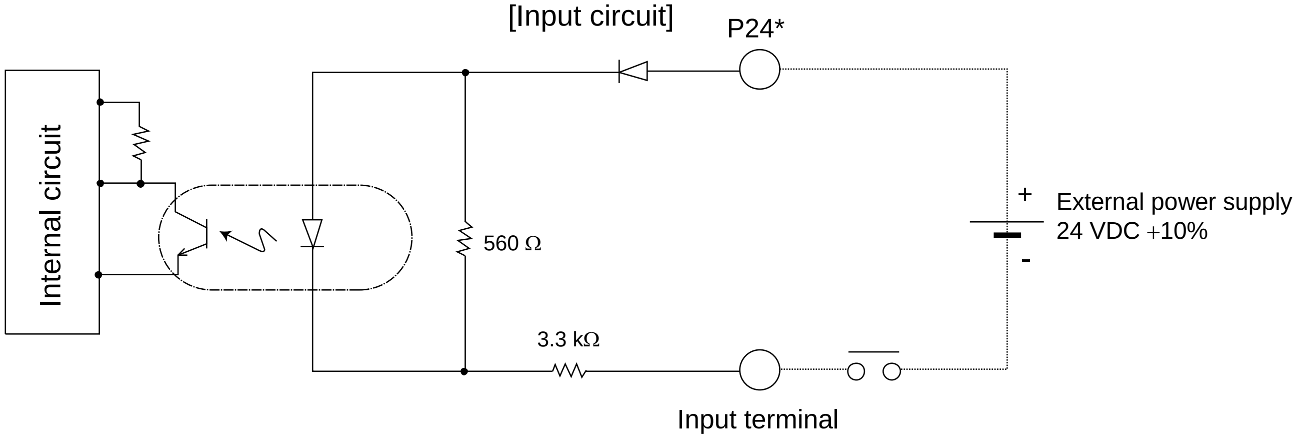
2.1. NPN Specification

(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.
Insulation method	Photocoupler insulation
External devices	[1] No voltage contact (minimum load of approximately 5 VDC/1 mA) [2] Photoelectric/proximity sensor (NPN type) [3] Sequencer transistor output (open-collector type) [4] Sequencer contact output (minimum load of approximately 5 VDC/1 mA)

[Input circuit]

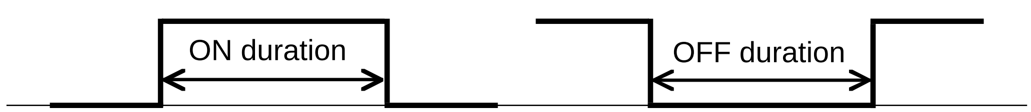


* P24: I/O interface pin No. 1

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.

⦿ X-SEL controller's input signal



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

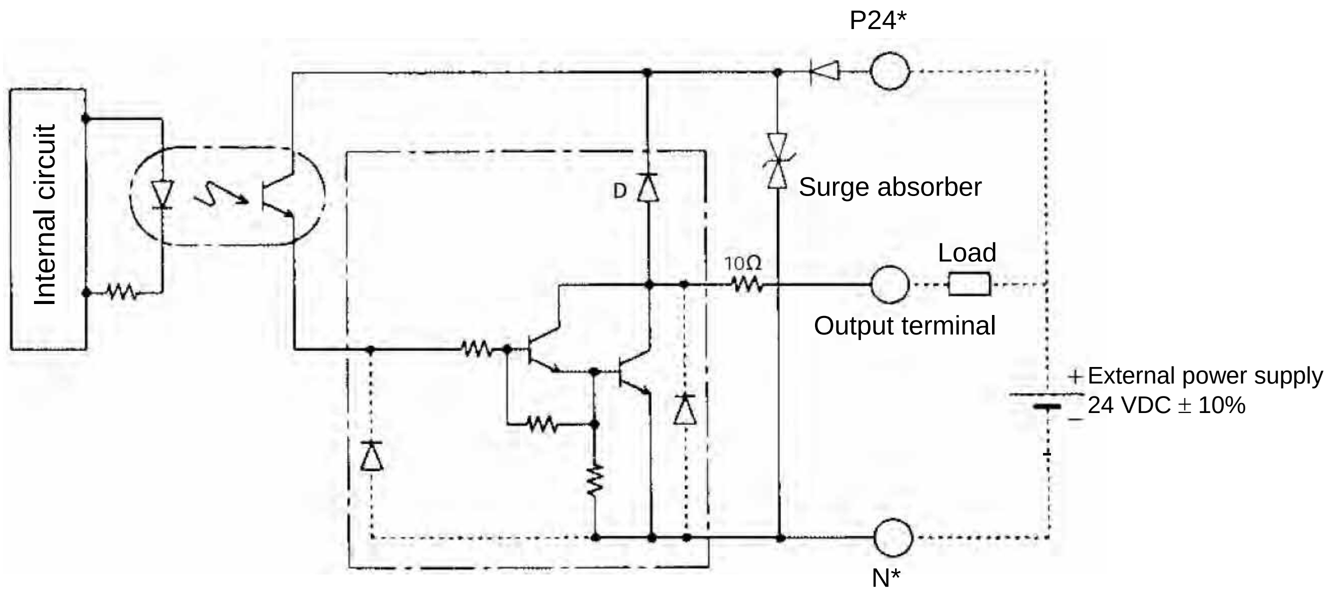
(2) Output part

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	
Insulation method	Photocoupler insulation	
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, the overcurrent protection circuit will cut the power. However, give due consideration to the circuit connection layout to prevent a short-circuit or overcurrent.

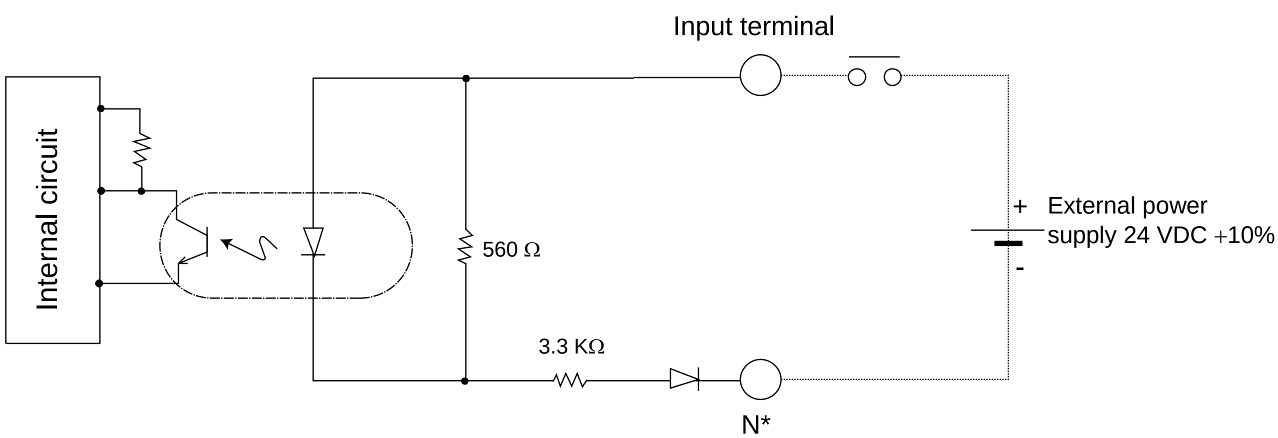
2.2. PNP Specification

(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.
Insulation method	Photocoupler insulation
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]

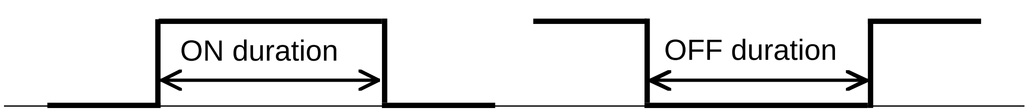


* N: I/O interface pin No. 50

Caution

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

⊙ X-SEL controller's input signal



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

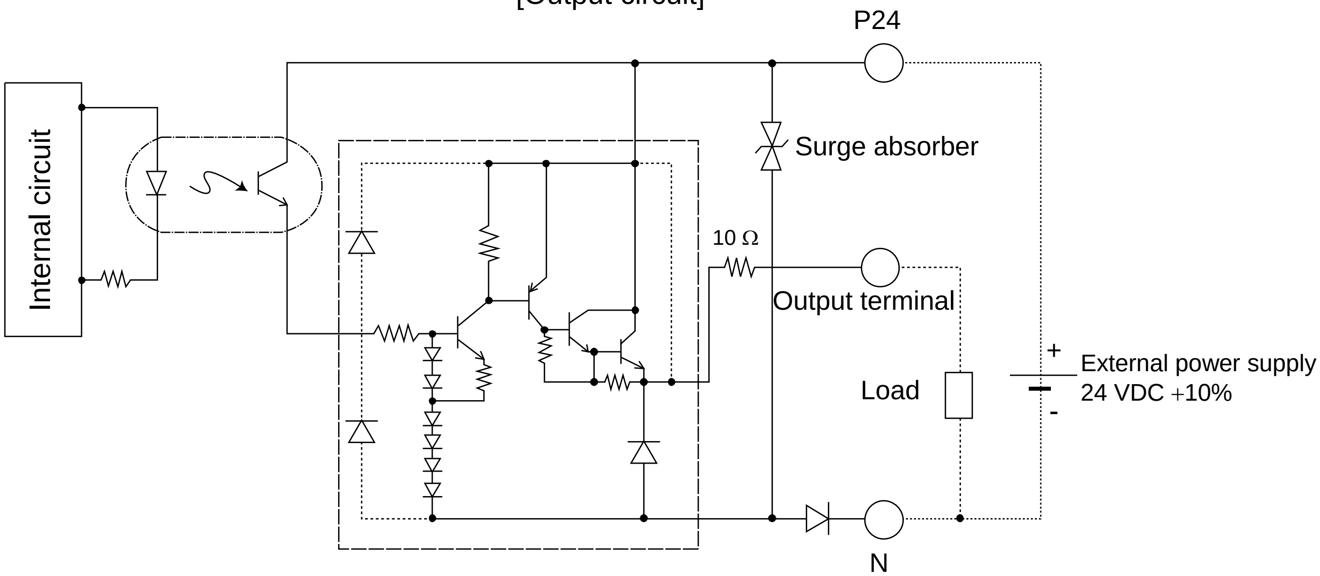
(2) Output part

External Output Specifications

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	
Insulation method	Photocoupler insulation	
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, the overcurrent protection circuit will cut the power. However, give due consideration to the circuit connection layout to prevent a short-circuit or overcurrent.

3. Power Source Capacity and Heat Output

The power consumption and heat output of the X-SEL 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 X-SEL controller.

The X-SEL 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.
   * The single-phase power specification is applicable only to single-phase controllers.
C. I/O power
   If a DIO card is installed in an I/O slot, 24 VDC must be supplied.
D. Brake power
   24 VDC must be supplied only when a brake type actuator is driven.

(1) Power source capacity and heat output of the control part

The control part consists of the standard units connected to every controller and optional units such as an I/O card. Therefore, the power consumption and heat output of the control part will vary depending on the system configuration.
Additionally, heat outputs from the units operated by an external power source must also be considered.
The table below lists the power consumption of various controller units.

List of Power Consumptions of teh Control Part

		Control power supply		External power source		Quantity
		Internal consumption	External consumption	Internal consumption	External consumption	
Base part		13.19 W				1
Driver *1	Per board	2.63 W				1 ~ 3
Encoder	Per axis	1 W	1.5 W			2 ~ 6
Fan unit *2	Per fan	2.4 W				4 ~ 6
Axis sensor	Per axis	1.92 W				0 ~ 2
DIO card	DIO (48 points)	2.5 W		6.1 W		0 ~ 4
	DIO (96 points)	3.5 W		11.26 W		0 ~ 4
Network module	DeviceNet	1 W		0.72 W		0 ~ 1
	CC-Link	1 W		0.5 W		0 ~ 1
	Profibus-DP	1.75 W				0 ~ 1
	Ethernet	2.25 W				0 ~ 1
Teaching pendant	IAI standard		1.5 W			0 ~ 1
	ANSI		4.08 W			0 ~ 1
Brake *3	Per axis			2.5 W	5.8 W	0 ~ 4

*1 One 750 or 600-W SCARA axis occupies one board.
   With actuators of 400 W or below, two axes occupy one board.

*2 The number of fan units varies depending on the controller specification.
The number of fan units varies as follows in accordance with the number of controller axes (whether or not linear movement axis is added) and use/no-use of any expansion I/O board.
Controller Specifications and Number of Fan Units

		PX	QX
SCARA axes only (without linear movement axis)	Without expansion I/O board	4	3
	With expansion I/O board	5	4
5/6-axis specification (with linear movement axis)	Without expansion I/O board	5	4
	With expansion I/O board	6	5

*3 For a SCARA robot with an arm length of 500 mm or more, two axes come with a brake.
For a SCARA robot with an arm length of 250 to 350 mm, one axis comes with a brake.
For a SCARA robot with an arm length of 120 or 150 mm, a brake is optional.
(If the system has a linear movement axis with brake, this brake is provided in addition to the brake(s) for the SCARA axis(es).)

[1] Control power source capacity
The power source capacity of the control power supply is obtained by applying the efficiency coefficient and power factor to the sum of all power consumptions of controlled units, based on the applicable values shown in the table.

Control power source capacity [VA] = Σ (Power consumption of each controlled unit x Quantity) ÷ 0.7 (Efficiency coefficient) ÷ 0.6 (Power factor)

[2] Heat output of the control system
The heat output of the controller's control system is obtained as the total sum of all internal power consumptions of controlled units and internal power consumptions of external power sources, based on the applicable values shown in the table.

Heat output from control system [W] =
Σ (Internal power consumption of each controlled unit x Quantity) + Σ (Internal power consumption of each external power source x Quantity).

[3] I/O power-source capacity
The I/O power source capacity (24 VDC) is obtained as the total sum of all power consumptions of external power sources for DIO cards.

I/O power source capacity [W] =
Σ (Internal power consumption of each external power source for DIO x Quantity)

[4] Brake power source capacity
The brake power source capacity (24 VDC) is obtained as the total sum of all power consumptions of external power sources for brakes.

Brake power source capacity [W] =
Σ (Power consumption of each external power source for brake x Quantity)

(2) Power consumption and heat output of the motor drive part

Both the power consumption and heat output of the motor drive part will vary depending on the number of axes connected to the controller and wattage configuration. The table below lists per axis motor power consumptions.

List of Motor Drive Powers

		Power [W] (rated output)	Power ÷ 0.6 [Power factor] [VA	Output stage loss [W]
SCARA (High-speed models)	NN☐1205 NN☐1505 NN☐1805	129.8	216.3	8.13
	NN☐2515H NN☐3515H TNN☐3015H TNN3515H UNN3015H UNN3515H	1117.9	1863.1	44.8
	NN☐50☐☐H NN☐60☐☐H HNN5020H HNN6020H INN5020H INN6020H	2218.0	3696.7	69.7
	NN☐70☐☐H NN☐80☐☐H HNN7020H HNN8020H INN7020H INN8020H	3880.6	6467.7	93.2
	NSN5016H NSN6016H	4102.9	6838.1	95.2

List of Motor Drive Powers

		Power [W] (rated output)	Power ÷ 0.6 [Power factor] [VA	Output stage loss [W]
SCARA (Conventional models)	NN☐2515 NN☐3515 TNN3015 TNN3515 UNN3015 UNN3515	615.8	1026.3	24.75
	NN☐50☐☐ NN☐60☐☐ HNN5020 HNN6020 INN5020 INN6020	1122.8	1871.3	44.12
	NN☐70☐☐ NN☐80☐☐ HNN7020 HNN8020 INN7020 INN8020	2120.4	3534.0	78.41
	NSN5016H NSN6016H	2003.7	3339.5	72.21
Linear movement axis	20W	15.6	26.0	1.58
	30W	27.6	46.0	2.07
	60W	83.0	138.3	3.39
	100W	140.1	233.5	6.12
	150W	196.9	328.2	8.30
	200W	252.6	421.0	9.12
	400W	477.5	795.8	19.76
	600W	698.2	1163.7	27.20
	750W	912.8	1521.3	29.77

The power values in the table include the motor drive power, copper loss and driver output loss.

[1] Motor power source capacity

The power source capacity of the motor power supply is obtained as the total sum of all powers for the number of actuators used, based on the applicable values shown in the table.

Motor power source capacity [VA] = (Power of each axis ÷ 0.6 [Power factor])

[2] Heat output of the motor power supply

The heat output from the controller's motor power supply is obtained as the total sum of all output stage losses for the number of actuators used, based on the applicable values shown in the table.

Heat output from motor power supply [W] = (Output stage loss of each axis)

(3) Calculation example
Obtain the power source capacities and heat outputs when a controller of the following specifications is used.
SCARA: IX-NNN5020
Linear movement axis: Axis 5 --- ISA-MXM-200-* (200 W), Axis 6 --- ISA-MZM-100-*-B (100 W, with brake)
Standard DIO
Options: DeviceNet, teaching pendant (IAI's standard type)

[1] Control power supply capacity

$$\{\underbrace{13.19}_{\text{Base part}} + \underbrace{2.63 \times 3}_{\text{Drivers}} + \underbrace{(1 + 1.5) \times 6}_{\text{Encoders}} + \underbrace{2.4 \times 5}_{\text{Fan units}} + \underbrace{2.5 \times 1}_{\text{DIO}} + \underset{\text{DeviceNet}}{1.5}\} \div 0.7 \div 0.6 \cong 124.0\ [\text{VA}]$$

[2] Heat output from control system

$$\{\underbrace{13.19}_{\text{Base part}} + \underbrace{2.63 \times 3}_{\text{Drivers}} + \underbrace{1 \times 6}_{\text{Encoders}} + \underbrace{2.4 \times 5}_{\text{Fan units}} + \underset{\text{DIO}}{2.5} + \underset{\text{DeviceNet}}{1}\} + \underbrace{6.1 \times 1}_{\text{DIO}} + \underset{\text{DeviceNet}}{0.72} + \underbrace{2.5 \times 3}_{\text{Brake}} \cong 56.9\ [\text{W}]$$

[3] I/O power-source capacity (24 VDC)
$6.1 \times 1 = 6.1$ [W]

[4] Brake power source capacity (24 VDC)
$(2.5 + 5.8) \times 3 = 24.9$ [W]

[5] Motor power source capacity
SCARA: 1,871.3 [VA]
Linear movement axis: 421.0 + 233.5 = 654.5 [VA]
1871.3 + 654.5 = 2525.8 [VA]

[6] Heat output from motor power supply
$44.12 + 9.12 + 6.12 \cong 59.4$ [W]

[7] Power source capacity
[1] Control power source capacity + [5] Motor power source capacity = 124.0 + 2525.8 = <u>2649.8 [VA]</u>

[8] Heat output
[2] Heat output from control system + [6] Heat output from motor power supply = 56.9 + 59.4 = <u>116.3 [W]</u>

(4) Reference example
The power supply capacity and heat output of a SCARA-axis controller (4-axis specification without additional linear movement axis) are shown below.
All figures assume use of a standard DIO board, with DeviceNet support and a teaching pendant (IAI's standard type) added as options.

		Power supply capacity [VA]	Heat output [W]
(High-speed models)	Arm length: 120 to 180 mm NN☐1205/1505/1805	340.3	50.5
	Arm length: 250 to 350 mm NN☐2515/3515H ☐NN3015/3515H	1987.1	78.5
	Arm length: 500 to 600 mm NN☐5020H (5030H) /6020H (6030H) ☐NN5020H (5030H) /6020H (6030H)	3820.7	97.9
	Arm length: 700 to 800 mm NN☐7020H (7030H) /8020H (8030H) ☐NN7020H (7030H) /8020H (8030H)	6591.7	134.8
	High-speed type NSN5016H/6016H	6962.1	128.6
(Conventional models)	Arm length: 250 to 350 mm NN☐2515/3515H ☐NN3015/3515H	1150.3	69.7
	Arm length: 500 to 600 mm NN☐5020H (5030H) /6020H (6030H) ☐NN5020H (5030H) /6020H (6030H)	1995.3	91.5
	Arm length: 700 to 800 mm NN☐7020H (7030H) /8020H (8030H) ☐NN7020H (7030H) /8020H (8030H)	3658.0	130.8
	High-speed type NSN5016H/6016H	3463.5	124.6

4. External Dimensions

4.1 List of External Dimension Drawings

The external controller dimensions vary depending on the SCARA model (arm length) and whether or not a linear movement axis or expansion I/O board is used, among others.
The table below lists the external dimension drawing numbers applicable to the respective specifications.

<table>
<tr><td colspan="3" rowspan="2"></td><td colspan="2">NN□1205
NN□1505
NN□1805

(Arm length 120 to 180 mm)</td><td colspan="2">NN□2515
NN□3515
TNN2515
TNN3515
UNN2515
UNN3515
NN□50□□
NN□60□□
HNN5020
HNN6020
INN5020
INN6020

(Arm length 250 to 600 mm)</td><td colspan="2">NN□70□□
NN□80□□
HNN7020
HNN8020
INN7020
INN8020

Arm length 700/800 mm)</td><td colspan="2">NSN5016
NSN6016

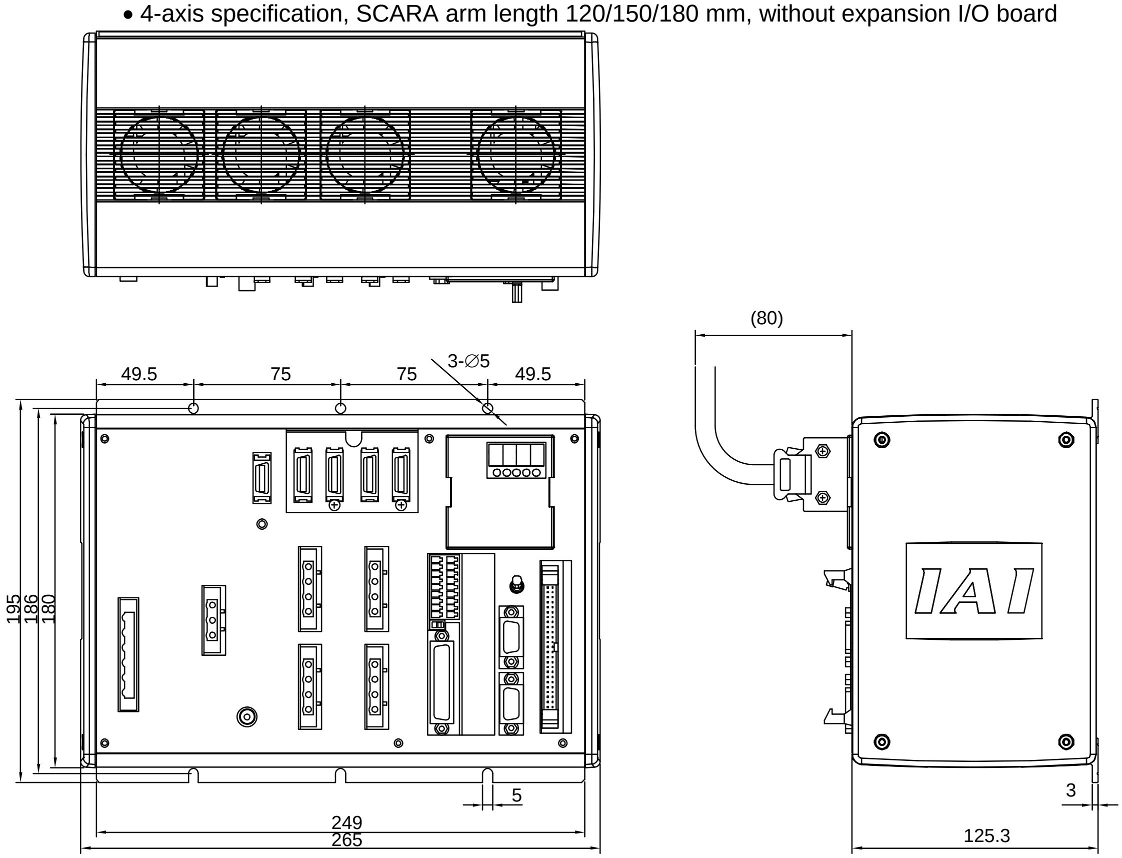
(High-speed type)</td></tr>
<tr><td>PX type</td><td>QX type</td><td>PX type</td><td>QX type</td><td>PX type</td><td>QX type</td><td>PX type</td><td>QX type</td></tr>
<tr><td rowspan="2">SCARA axes only</td><td colspan="2">Without expansion I/O board</td><td>4-1</td><td>4-9</td><td>4-5</td><td>4-13</td><td>4-7</td><td>4-15</td><td>4-7</td><td>4-15</td></tr>
<tr><td colspan="2">With expansion I/O board</td><td>4-2</td><td>4-10</td><td>4-6</td><td>4-14</td><td>4-8</td><td>4-16</td><td>4-8</td><td>4-16</td></tr>
<tr><td rowspan="4">With linear movement axis (5/6-axis specification)</td><td rowspan="2">Without expansion I/O board</td><td>*1</td><td>4-3</td><td>4-11</td><td rowspan="2">4-7</td><td rowspan="2">4-15</td><td rowspan="2">4-7</td><td rowspan="2">4-15</td><td rowspan="2">-</td><td rowspan="2">-</td></tr>
<tr><td>*2</td><td>4-7</td><td>4-15</td></tr>
<tr><td rowspan="2">With expansion I/O board</td><td>*1</td><td>4-4</td><td>4-12</td><td rowspan="2">4-8</td><td rowspan="2">4-6</td><td rowspan="2">4-8</td><td rowspan="2">4-16</td><td rowspan="2">-</td><td rowspan="2">-</td></tr>
<tr><td>*2</td><td>4-8</td><td>4-16</td></tr>
</table>

*1: Incremental linear movement axis without brake
*2: Absolute linear movement axis or linear movement axis with brake

4.2 PX/QX Type (Three-phase Standard Specification, Single-phase Global Specification, Single-phase Standard Specification) Controller

Fig. 4-1 PX/QX Type (Three-phase Standard Specification, Single-phase Global Specification, Single-phase Standard Specification)

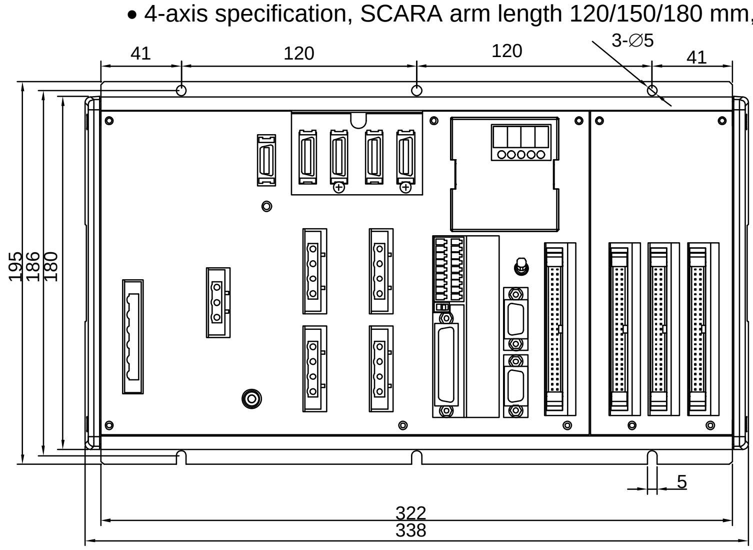
- 4-axis specification, SCARA arm length 120/150/180 mm, without expansion I/O board



Example of applicable model: X-SEL-PX-NNN1205-N1-EEE-2-3

Fig. 4-2 PX/QX Type (Three-phase Standard Specification, Single-phase Global Specification, Single-phase Standard Specification)

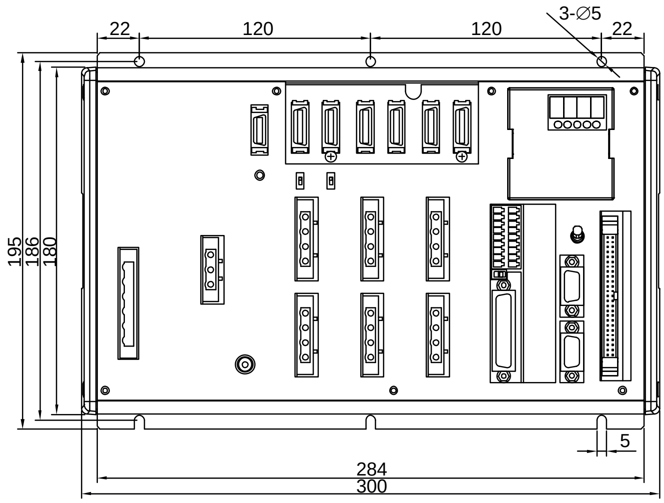
- 4-axis specification, SCARA arm length 120/150/180 mm, with expansion I/O board



Example of applicable model: X-SEL-PX-NNN1205-N1-N1N1N1-2-3

Fig. 4-3 PX/QX Type (Three-phase Standard Specification, Single-phase Global Specification, Single-phase Standard Specification)

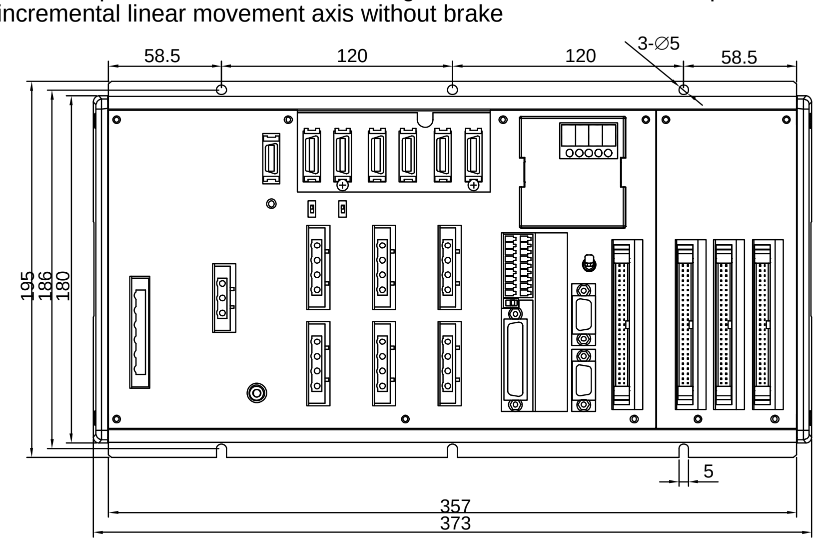
- 5/6-axis specification, SCARA arm length 120/150/180 mm, without expansion I/O board, with incremental linear movement axis without brake



Example of applicable model: X-SEL-PX-NNN1205-200I-200I-N1-EEE-2-3

Fig. 4-4 PX/QX Type (Three-phase Standard Specification, Single-phase Global Specification, Single-phase Standard Specification)

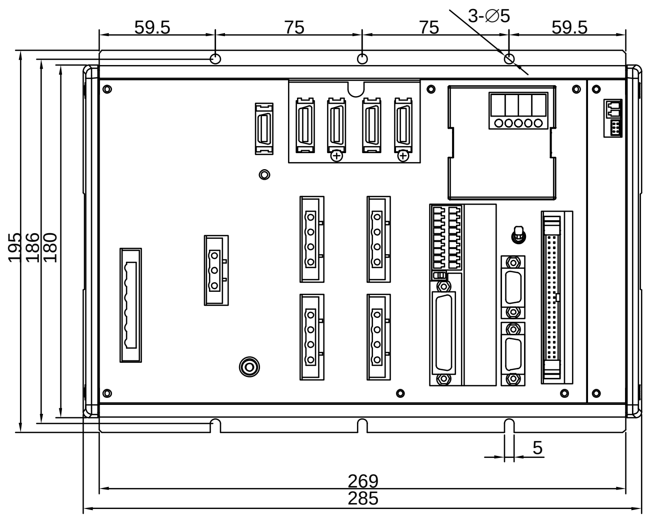
- 5/6-axis specification, SCARA arm length 120/150/180 mm, with expansion I/O board, with incremental linear movement axis without brake



Example of applicable model: X-SEL-PX-NNN1205-200I-200I-N1-N1N1N1-2-3

Fig. 4-5 PX/QX Type (Three-phase Standard Specification, Single-phase Global Specification, Single-phase Standard Specification)

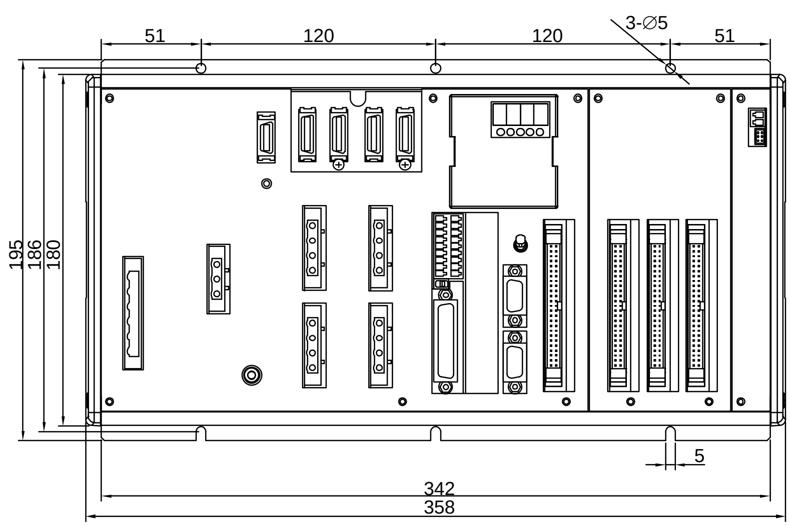
- 4-axis specification, SCARA arm length 250 to 600 mm, without expansion I/O board



Example of applicable model: X-SEL-PX-NNN2515-N1-EEE-2-3

Fig. 4-6 PX/QX Type (Three-phase Standard Specification, Single-phase Global Specification, Single-phase Standard Specification)

- 4-axis specification, SCARA arm length 250 to 600 mm, with expansion I/O board

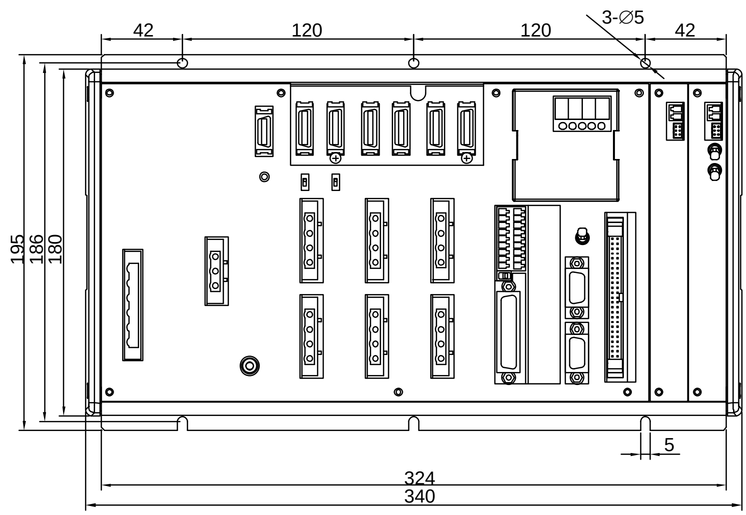


Example of applicable model: X-SEL-PX-NNN2515-N1-N1N1N1-2-3

Fig. 4-7 PX/QX Type (Three-phase Standard Specification, Single-phase Global Specification, Single-phase Standard Specification)

- 5/6-axis specification, SCARA arm length 250 to 600 mm, without expansion I/O board
- 5/6-axis specification, SCARA arm length 120/150/180 mm, without expansion I/O board, with absolute linear movement axis or linear movement axis with brake
- SCARA arm length 700/800 mm, without expansion I/O board
- High-speed type, without expansion I/O board

Availability and position of the motor connector/encoder-axis sensor connector varies depending on the SCARA model.

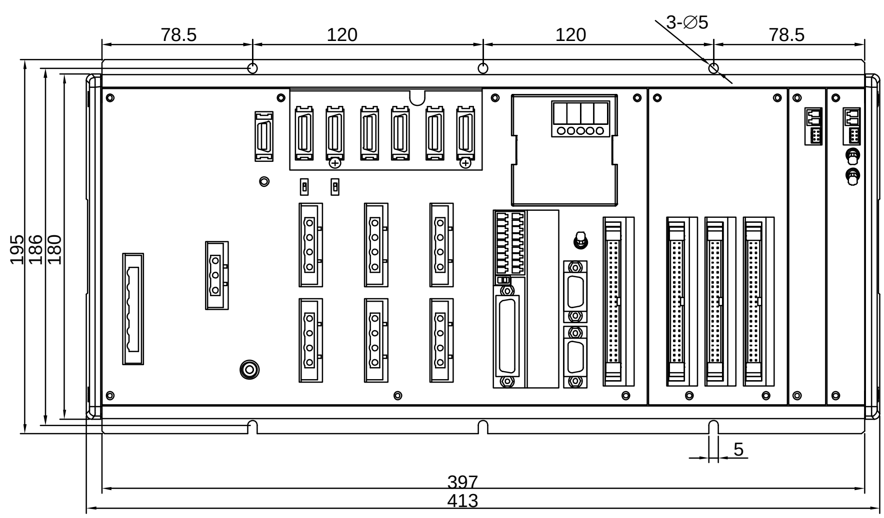


Example of applicable model: X-SEL-PX-NNN5020-400AB-200AB-N1-EEE-2-3

Fig. 4-8 PX/QX Type (Three-phase Standard Specification, Single-phase Global Specification, Single-phase Standard Specification)

- 5/6-axis specification, SCARA arm length 250 to 600 mm, with expansion I/O board
- 5/6-axis specification, SCARA arm length 120/150/180 mm, with expansion I/O board, with absolute linear movement axis or linear movement axis with brake
- SCARA arm length 700/800 mm, with expansion I/O board
- High-speed type, with expansion I/O board

Availability and position of the motor connector/encoder-axis sensor connector varies depending on the SCARA model.

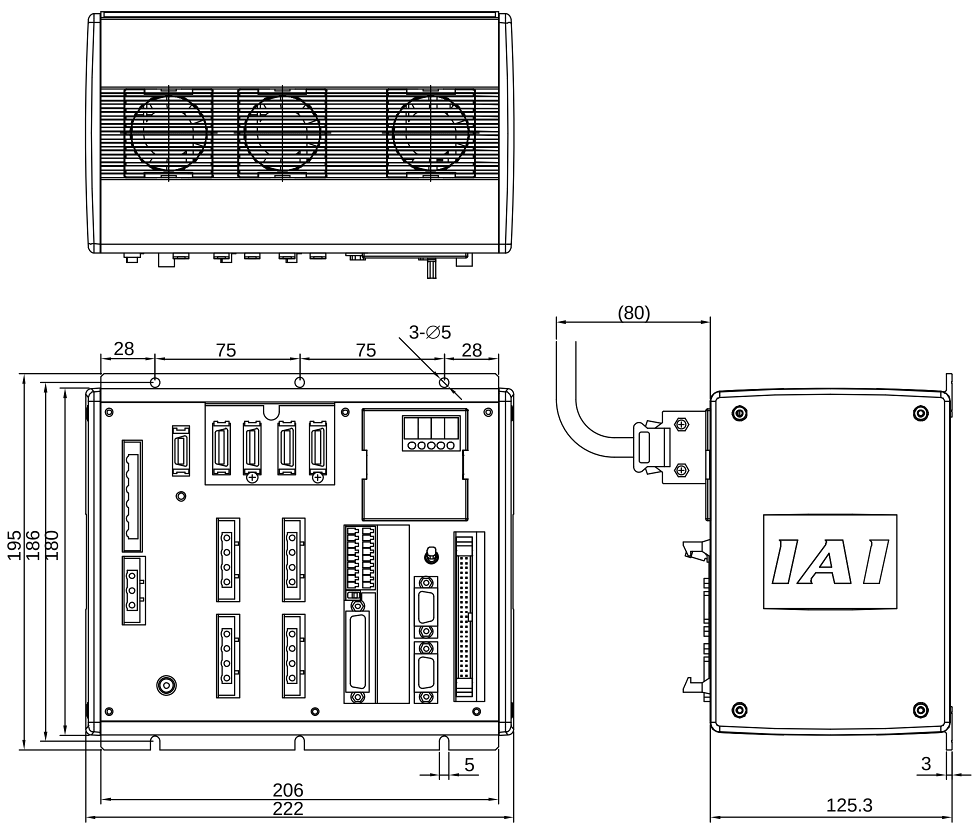


Example of applicable model: X-SEL-PX-NNN5020-400AB-200AB-N1-N1N1N1-2-3

4.3 QX Type (Three-phase Global Specification) Controller

Fig. 4-9 QX Type (Three-phase Global Specification)

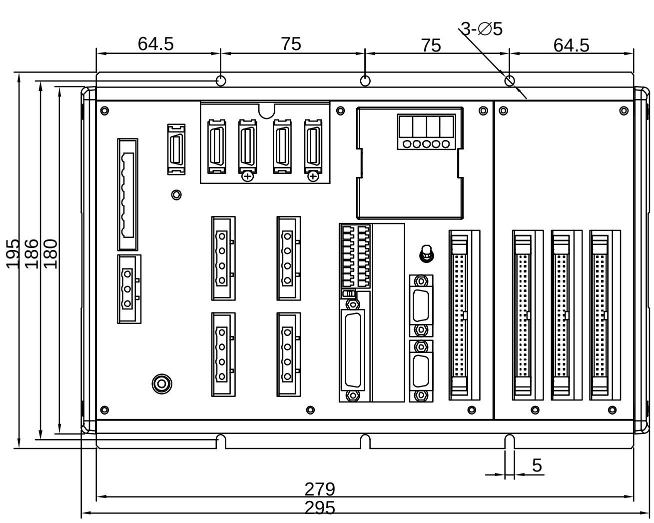
• 4-axis specification, SCARA arm length 120/150/180 mm, without expansion I/O board



Example of applicable model: X-SEL-QX-NNN1205-N1-EEE-2-3

Fig. 4-10 QX Type (Three-phase Global Specification)

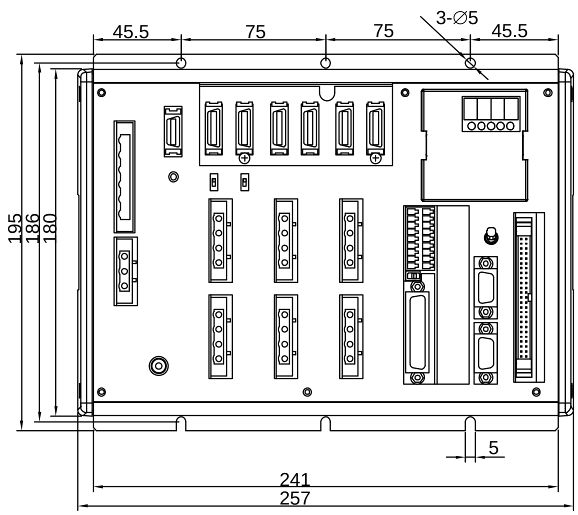
• 4-axis specification, SCARA arm length 120/150/180 mm, with expansion I/O board



Example of applicable model: X-SEL-QX-NNN1205-N1-N1N1N1-2-3

Fig. 4-11 QX Type (Three-phase Global Specification)

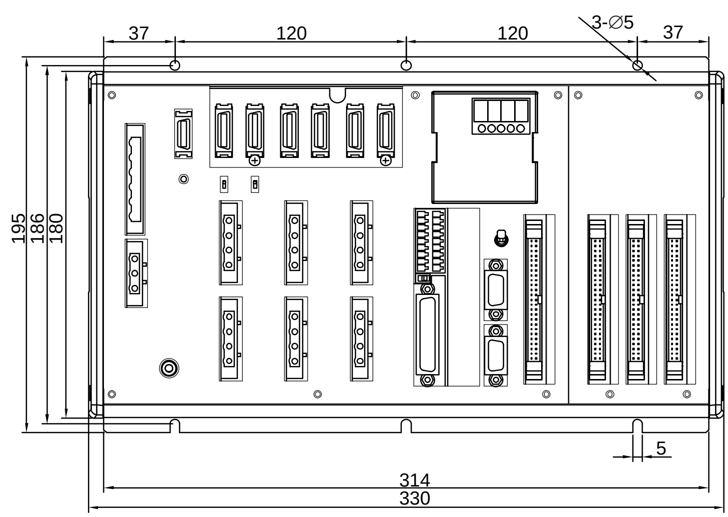
- 5/6-axis specification, SCARA arm length 120/150/180 mm, without expansion I/O board, with incremental linear movement axis without brake



Example of applicable model: X-SEL-QX-NNN1205-200I-200I-N1-EEE-2-3

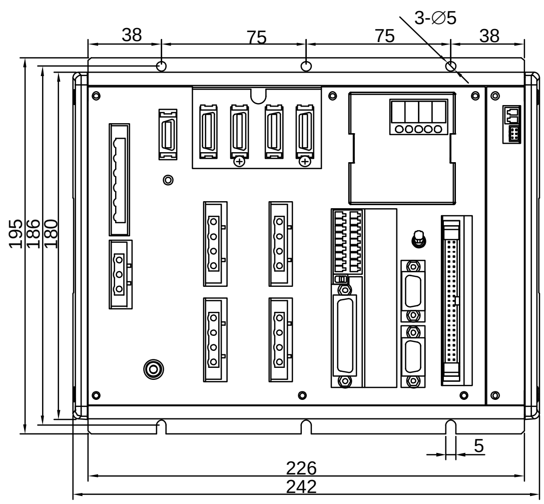
Fig. 4-12 QX Type (Three-phase Global Specification)

- 5/6-axis specification, SCARA arm length 120/150/180 mm, with expansion I/O board, with incremental linear movement axis without brake



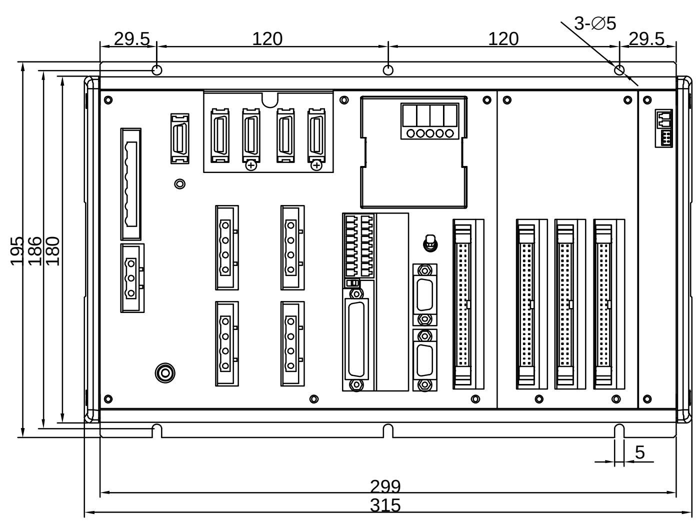
Example of applicable model: X-SEL-QX-NNN1205-200I-200I-N1-N1N1N1-2-3

Fig. 4-13 QX Type (Three-phase Global Specification)
• 4-axis specification, SCARA arm length 250 to 600 mm, without expansion I/O board



Example of applicable model: X-SEL-QX-NNN2521-N1-EEE-2-3

Fig. 4-14 QX Type (Three-phase Global Specification)
• 4-axis specification, SCARA arm length 250 to 600 mm, with expansion I/O board

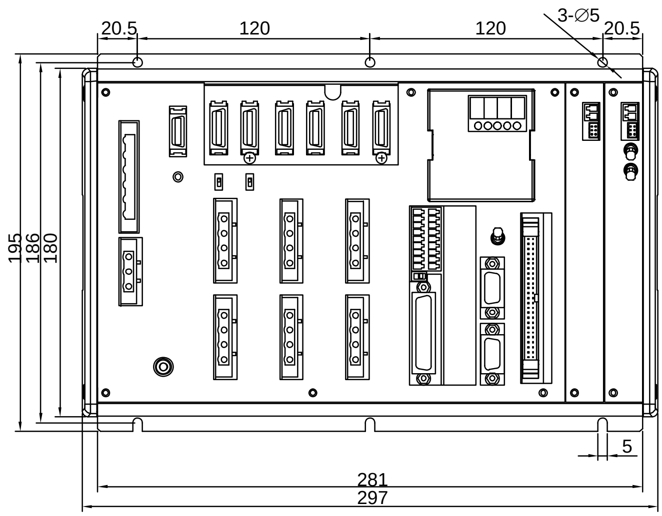


Example of applicable model: X-SEL-QX-NNN2515-200I-200I-N1-N1N1N1-2-3

Fig. 4-15 QX Type (Three-phase Global Specification)

- 5/6-axis specification, SCARA arm length 250 to 600 mm, without expansion I/O board
- 5/6-axis specification, SCARA arm length 120/150/180 mm, without expansion I/O board, with absolute linear movement axis or linear movement axis with brake
- SCARA arm length 700/800 mm, without expansion I/O board
- High-speed type, without expansion I/O board

Availability and position of the motor connector/encoder-axis sensor connector varies depending on the SCARA model.

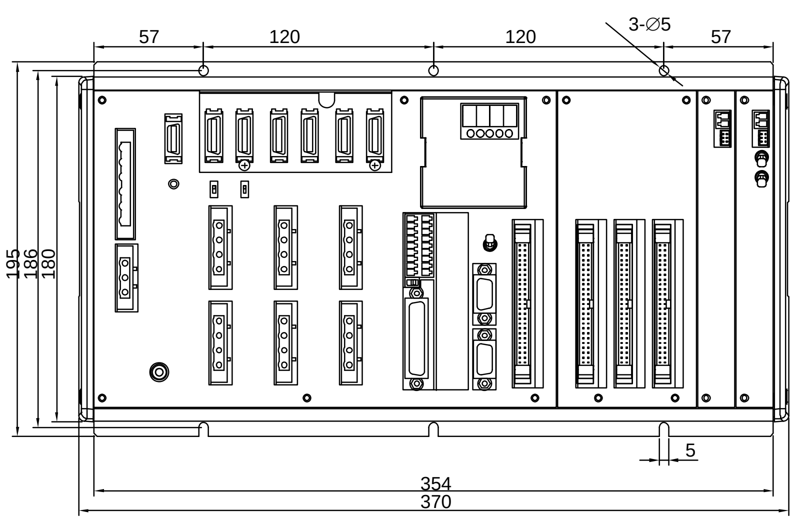


Example of applicable model: X-SEL-QX-NNN5020-400AB-200AB-N1-EEE-2-3

Fig. 4-16 QX Type (Three-phase Global Specification)

- 5/6-axis specification, SCARA arm length 250 to 600 mm, with expansion I/O board
- 5/6-axis specification, SCARA arm length 120/150/180 mm, with expansion I/O board, with absolute linear movement axis or linear movement axis with brake
- SCARA arm length 700/800 mm, with expansion I/O board
- High-speed type, with expansion I/O board

Availability and position of the motor connector/encoder-axis sensor connector varies depending on the SCARA model.



Example of applicable model: X-SEL-QX- NNN5020-400AB-200AB-N1-N1N1N1-2-3

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 X-SEL 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 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/O
   The safety circuit of the X-SEL controller is designed to operate with 24 VDC. Therefore, never apply 100 or 200 VAC to the system I/O. Doing so may damage the internal circuitry of the controller.

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

2. Safety Circuit for PX Type (Standard Specification) Controller

The PX 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 QX type (global specification) controller explained later.
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 pendant 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 pendant 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.

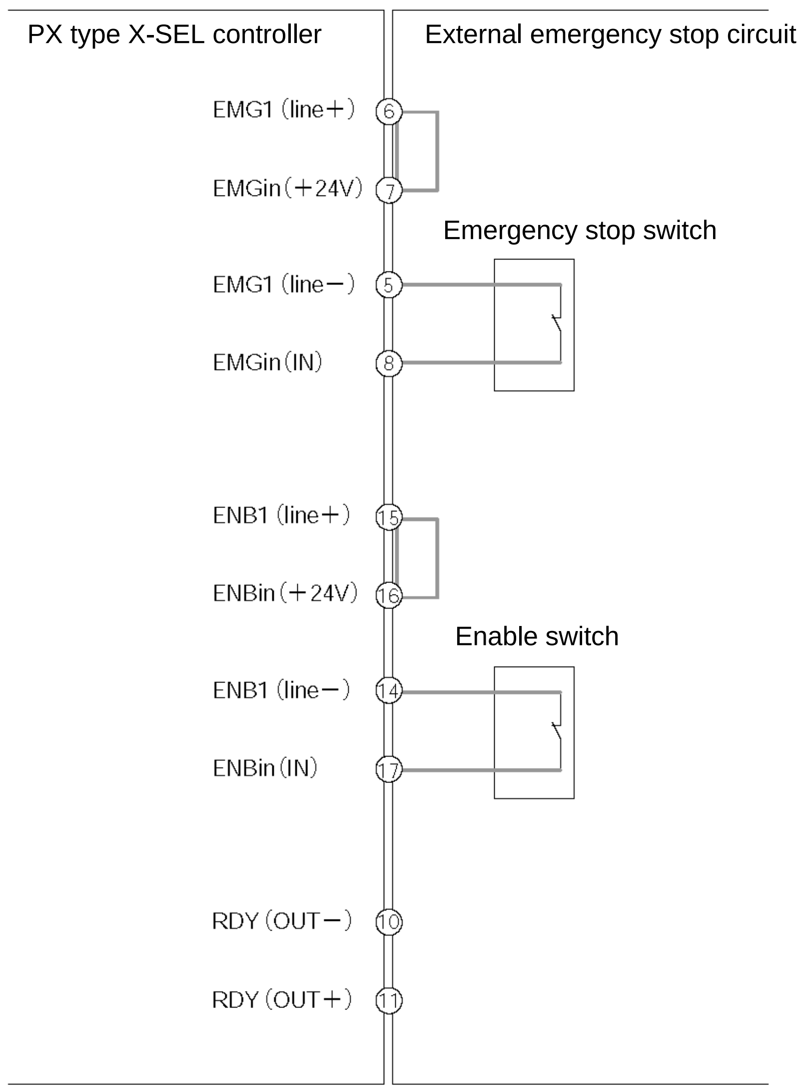
System I/O Connector for PX Type

<table>
<tr><th>Item</th><th>Overview</th><th>Details</th></tr>
<tr><td rowspan="3">Connector</td><td>COMBICON (2-row, 9-pin)</td><td>MCD1.5/9-G1-3.5P26THR (by Phoenix Contact)</td></tr>
<tr><td>Cable end connector</td><td>FMC1.5/9-ST-3.5</td></tr>
<tr><td>Applicable cable size</td><td>0.2 to 1.3 mm^2 (AWG24-16)</td></tr>
</table>

Terminal Assignments

<table>
<tr><th></th><th>Pin No.</th><th>Signal name</th><th colspan="2">Overview</th><th>Details</th></tr>
<tr><td rowspan="9">Left</td><td>9</td><td>DET</td><td>IN</td><td>Not connected</td><td>Not used</td></tr>
<tr><td>8</td><td rowspan="2">EMGin</td><td>IN</td><td>To external EMG</td><td>Emergency-stop detection input</td></tr>
<tr><td>7</td><td>+24 V</td><td rowspan="2">Shorted
Wired before shipment</td><td>24 V power output for emergency-stop detection input</td></tr>
<tr><td>6</td><td rowspan="2">EMG1</td><td>line+</td><td rowspan="2">Emergency stop switch 1
Wire circuit 1 connected to EMG of the TP</td></tr>
<tr><td>5</td><td>line-</td><td>To external EMG</td></tr>
<tr><td>4</td><td rowspan="2">EMG2</td><td>line+</td><td>Not connected</td><td rowspan="2">Not used</td></tr>
<tr><td>3</td><td>line-</td><td>Not connected</td></tr>
<tr><td>2</td><td rowspan="2">SDN</td><td>Out+</td><td>Not connected</td><td rowspan="2">External relay drive cutoff contact outputs</td></tr>
<tr><td>1</td><td>Out-</td><td>Not connected</td></tr>
<tr><td rowspan="9">Right</td><td>18</td><td>DET</td><td>+24 V</td><td>Not connected</td><td>Not used</td></tr>
<tr><td>17</td><td rowspan="2">ENBin</td><td>IN</td><td>To external ENB</td><td>Enable detection input</td></tr>
<tr><td>16</td><td>+24 V</td><td rowspan="2">Shorted
Wired before shipment</td><td>24 V power output for enable detection input</td></tr>
<tr><td>15</td><td rowspan="2">ENB1</td><td>line+</td><td rowspan="2">Enable switch 1 (safety gate, etc.)
Wire circuit 1 connected to ENB of the TP</td></tr>
<tr><td>14</td><td>line-</td><td>To external ENB</td></tr>
<tr><td>13</td><td rowspan="2">ENB2</td><td>line+</td><td>Not connected</td><td rowspan="2">Not used</td></tr>
<tr><td>12</td><td>line-</td><td>Not connected</td></tr>
<tr><td>11</td><td rowspan="2">RDY</td><td>Out+</td><td rowspan="2">May be used if necessary</td><td rowspan="2">Ready signal contact outputs (dry contacts)
(for inductive load of up to 400 mA)</td></tr>
<tr><td>10</td><td>Out-</td></tr>
</table>

With the PX type, use only the signals shown in the shaded fields of the table for connection with the safety switches.
Ensure that the specified pins are wired correctly, as incorrect wiring will compromise the safety mechanisms 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 QX 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 standard 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 provide for emergency stop action and enabling action operate on the internal power supply.
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 QX 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 cable size	0.2 ~ 1.3 mm^2 (AWG24-16)

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		+24 V		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 cutoff contact output Signal for requesting the controller to cutoff the drive source
	1		Out-		
Right	18	DET	+24 V	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		+24 V		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 (for inductive load of up to 400 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 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). This signal is disabled when the controller is shipped. To enable the DET input, set bits 8 to 11 of I/O parameter No. 24 to "1" (= change I/O parameter No. 24 from the default setting of 10000 to 10100).
Be sure to use this signal if you want the X-SEL 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. To use the DET terminal, change I/O parameter No. 24 from the default setting of 10000 to 10100 (by setting bits 8 to 11 of I/O parameter No. 24 to "1").

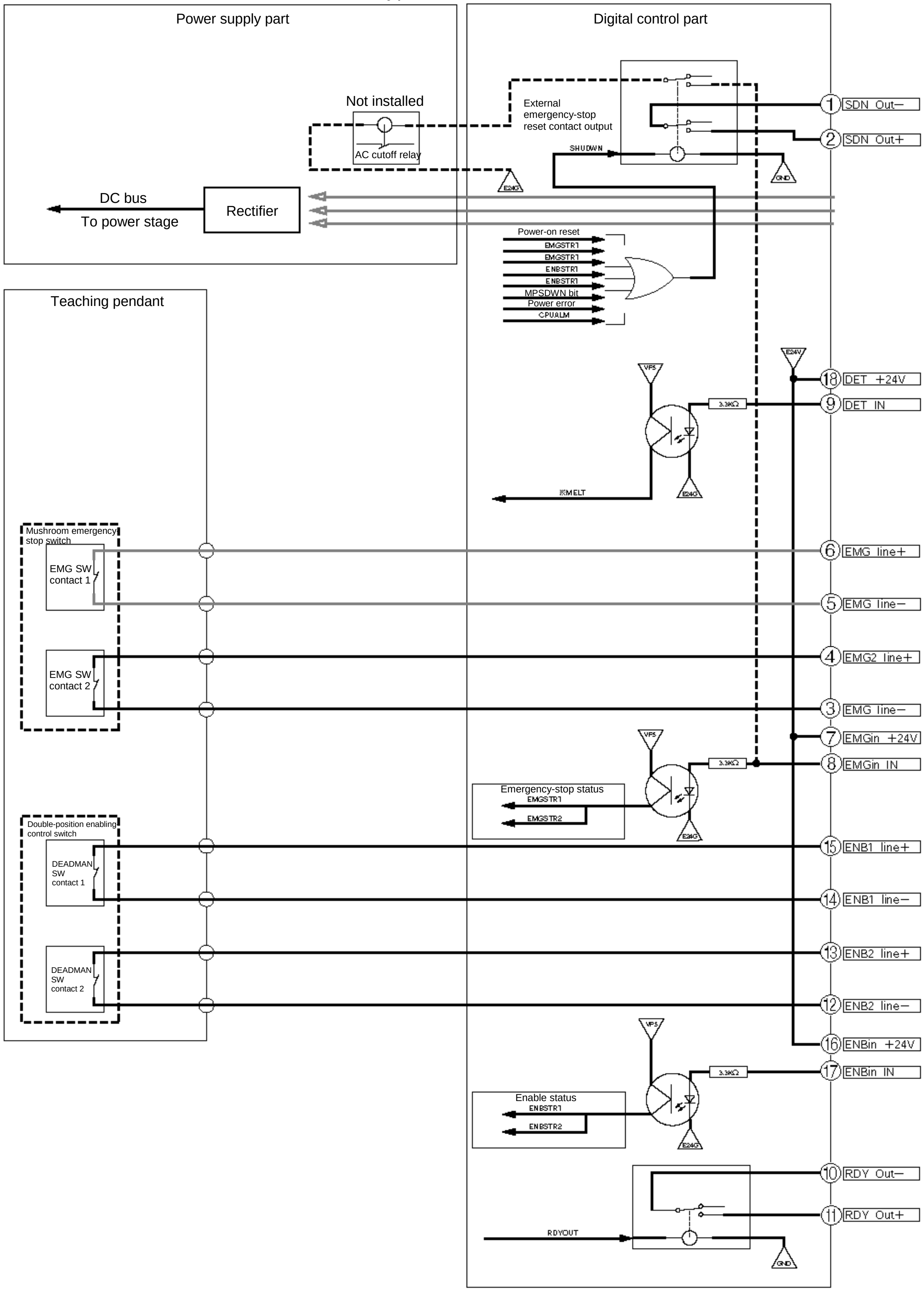
- SDN
  SDN (OUT+) and SDN (OUT-) are output contacts that remain open while the controller is prohibiting the motor power supply from the external power source. This condition will occur immediately after the controller power is turned on, when an error occurs in the equipment, or when a drive source 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 controller power first, confirm that the SDN contacts are closed, and then turn on the drive power. (If the control power and drive power are turned on simultaneously, "E6D: Drive-source cutoff relay error" will generate.

- EMG1/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.

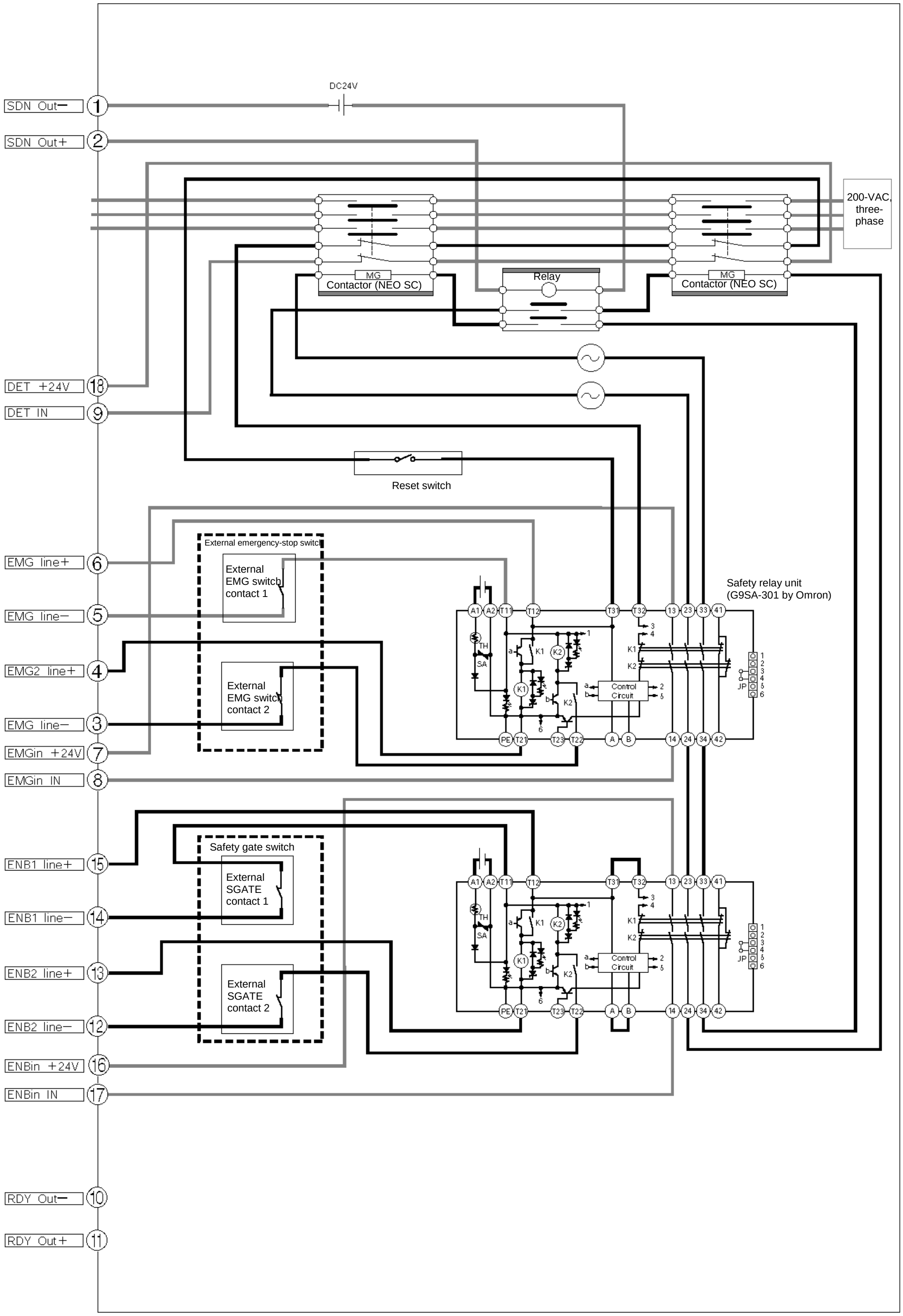
- EMGin, ENBin
  EMGin (IN) and EMGin (+24V) are contact inputs that notify the controller of the drive source cutoff input received by the drive source cutoff circuit via an EMG signal. ENBin (IN) and ENBin (+24V) are contact inputs that notify the controller via an ENB signal. These contact signals 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.

QX Type X-SEL Controller



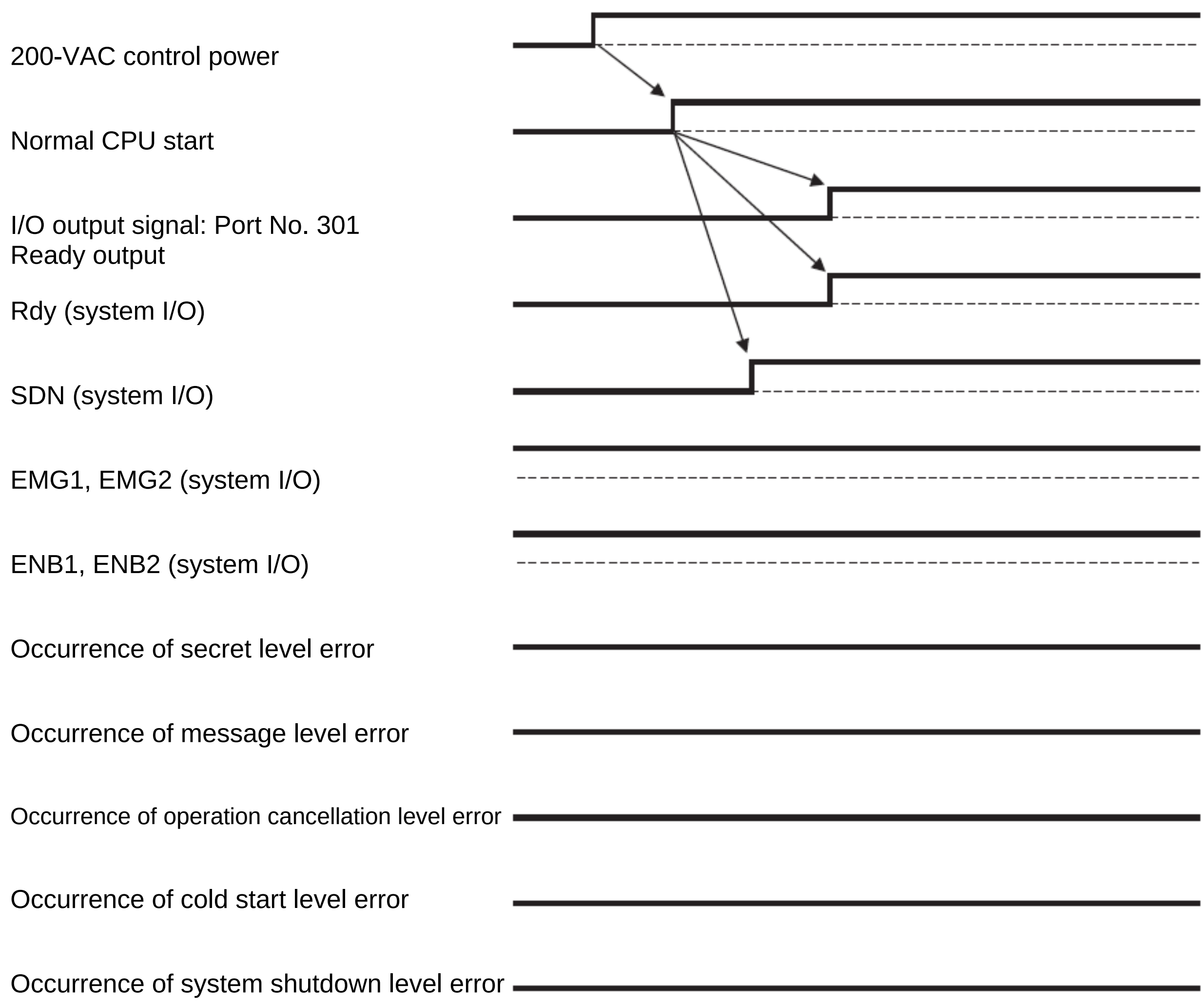
External Emergency Stop Circuit



4. Timing Chart of Safety Circuit for QX-type SEL Controller

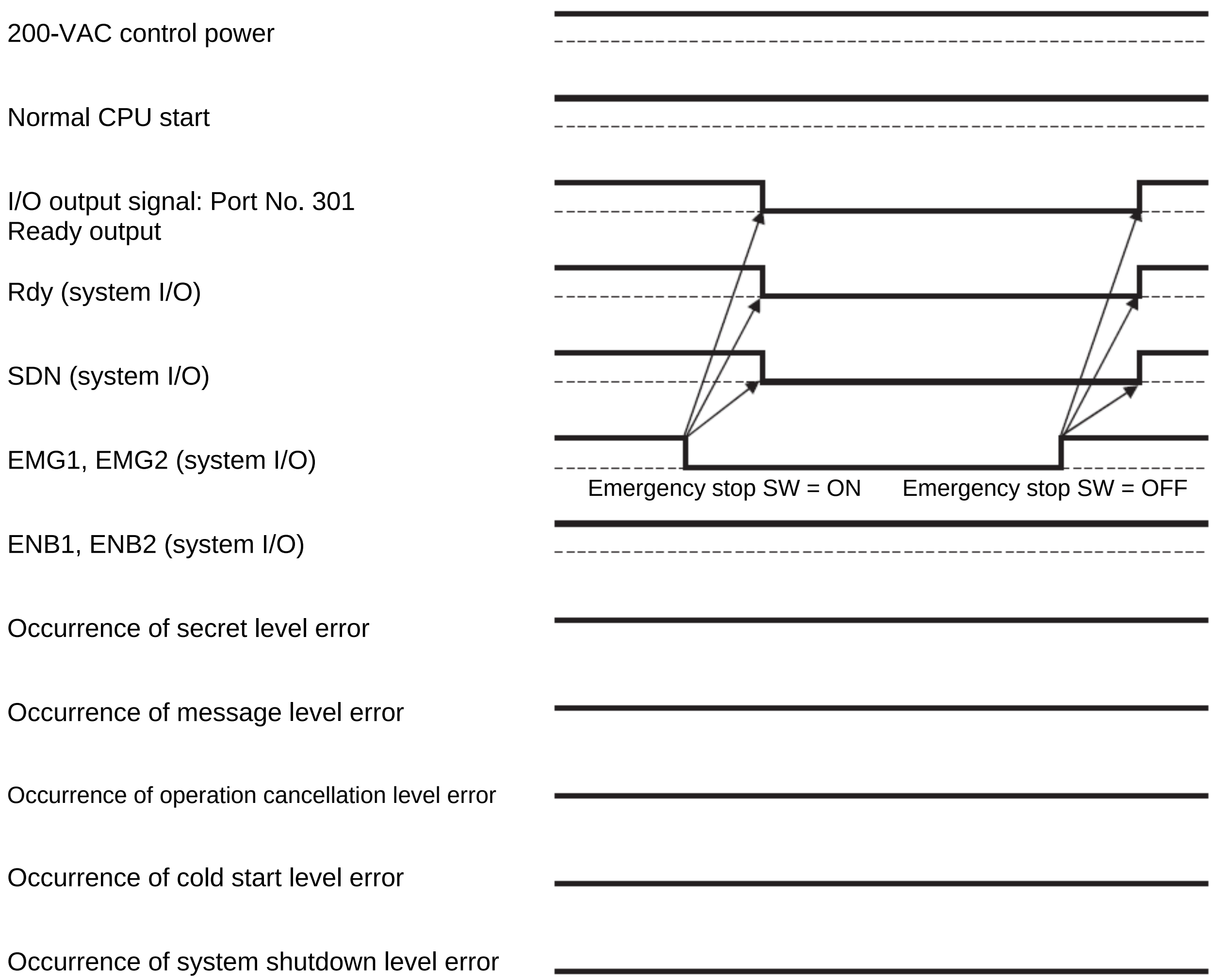
A timing chart of the safety circuit for QX-type SEL controller is shown below.
The points in time shown in this timing chart are: “[1] Power on,” “[2] Emergency stop,” “[3] Power on without cancelling emergency stop,” “[4] Enable operation,” “[5] System shutdown level error,” [6] “Cold start level error,” “[7] Operation cancellation level error,” “[8] Power on (in combination with cutoff reset input),” and “[9] Emergency stop (in combination with cutoff reset input).”

[1] Power on



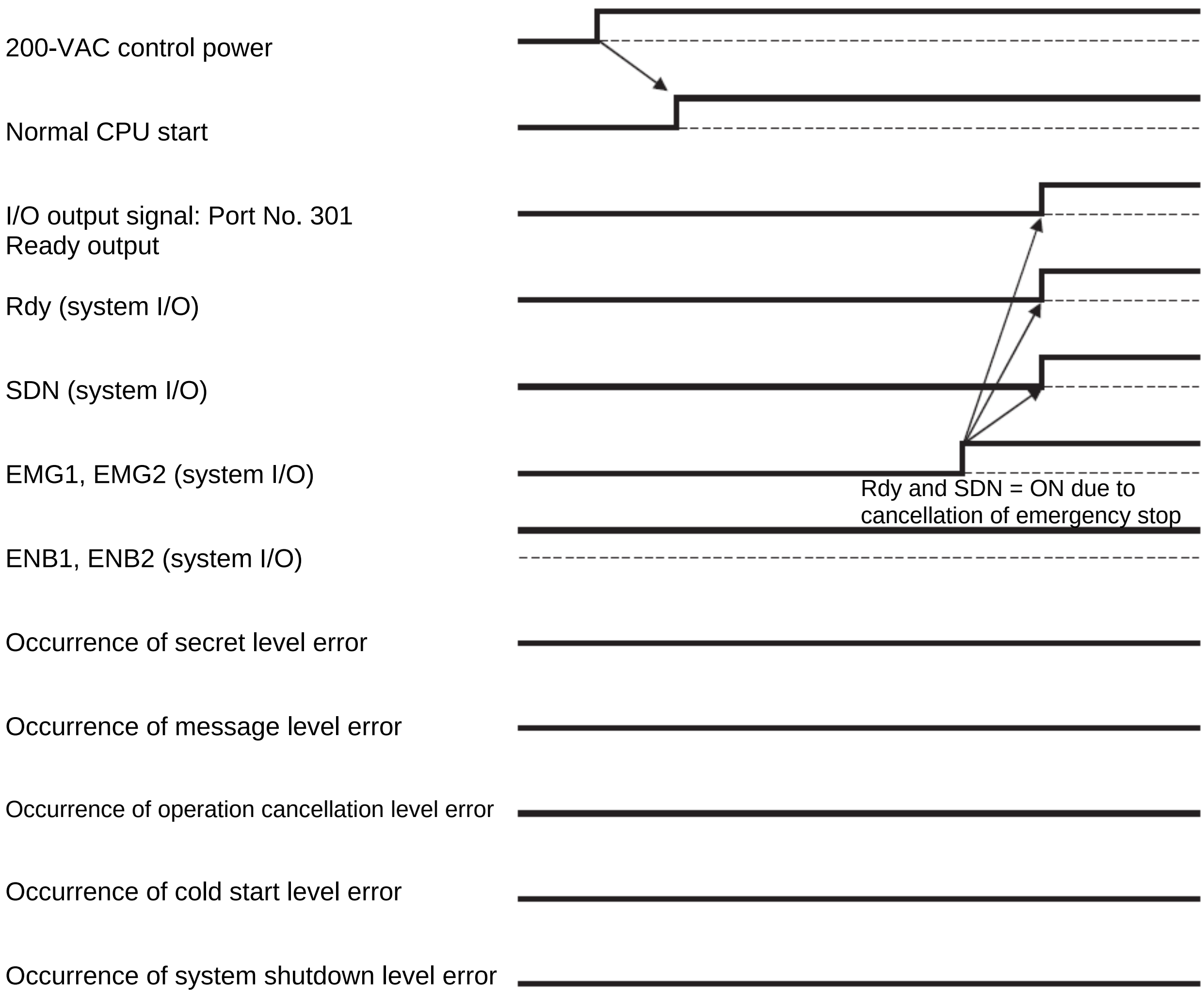
• I/O parameter No. 24, bits 0 to 3 = 0:	The RDYOUT output (system I/O) is SYSRDY (PIO trigger program operation enabled) and the hardware is normal (emergency stop is not actuated and no hardware errors are detected).
• I/O parameter No. 44 = 0:	The drive-source cutoff reset input is not yet used.
•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

[2] Emergency stop



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

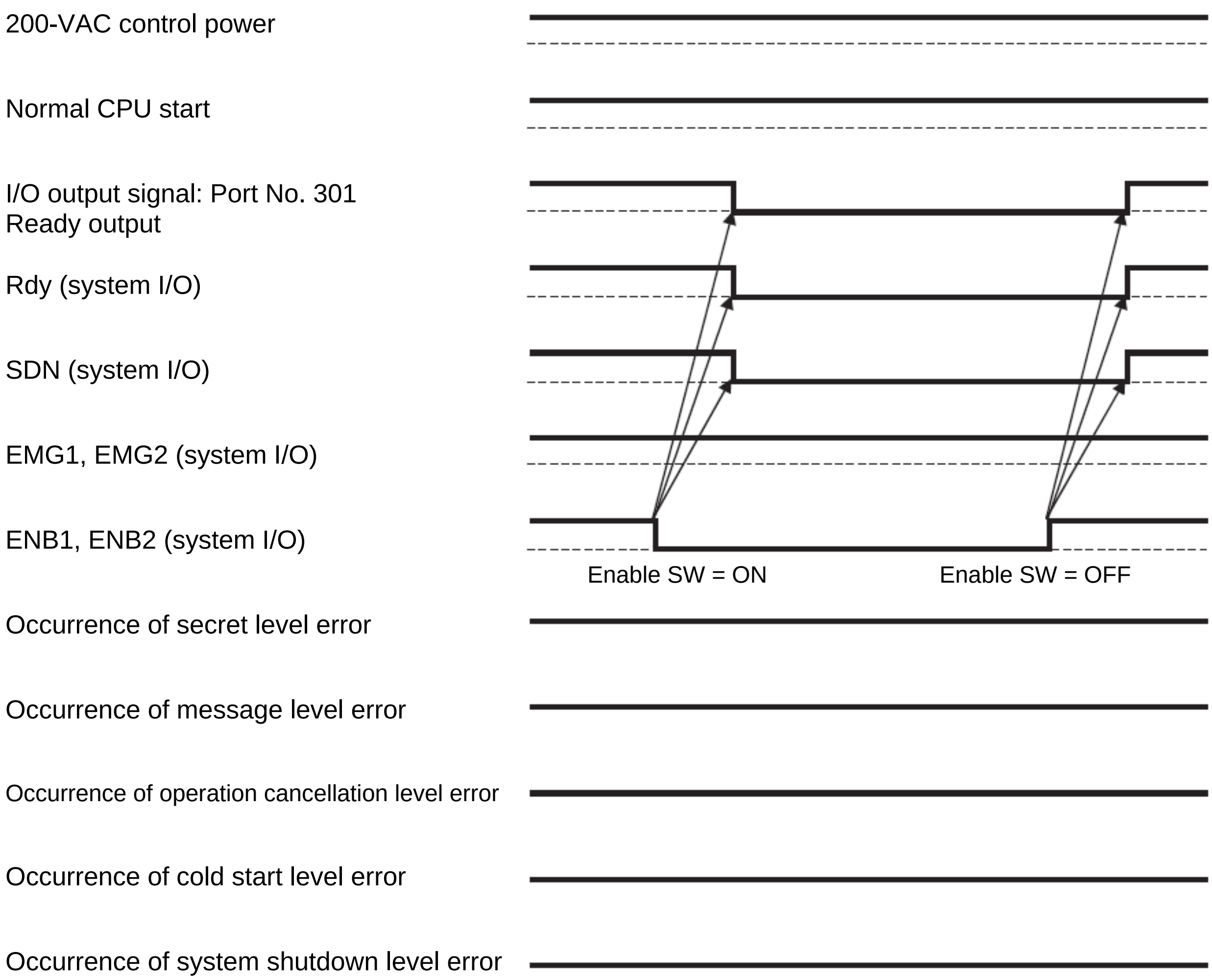
[3] Power on without cancelling emergency stop



Assume that the same timings will apply when the power is turned on without performing an enable operation.

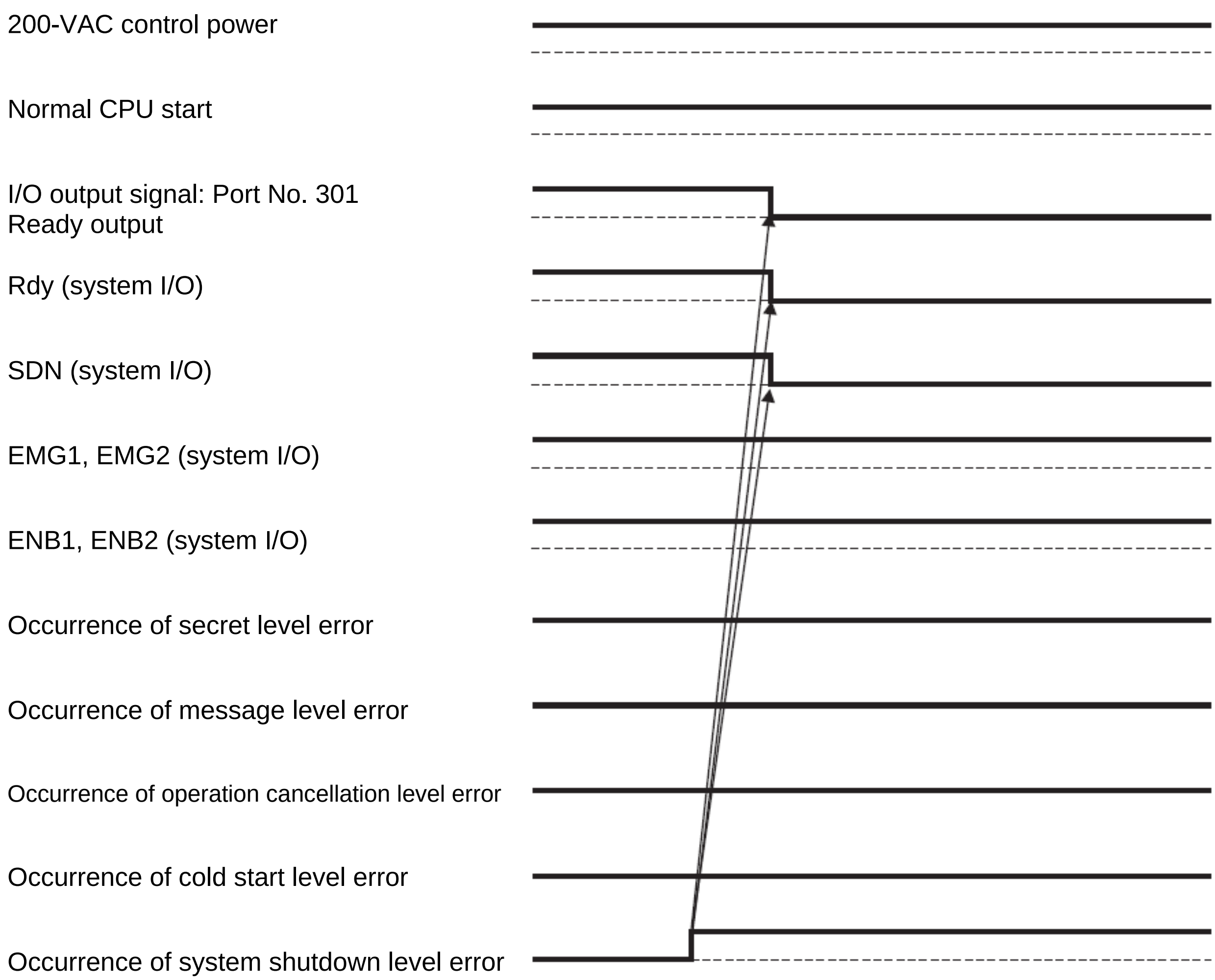
• I/O parameter No. 24, bits 0 to 3 = 0:	The RDYOUT output (system I/O) is SYSRDY (PIO trigger program operation enabled) and the hardware is normal (emergency stop is not actuated and no hardware errors are detected).
• I/O parameter No. 44 = 0:	The drive-source cutoff reset input is not yet used.
•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

[4] Enable operation



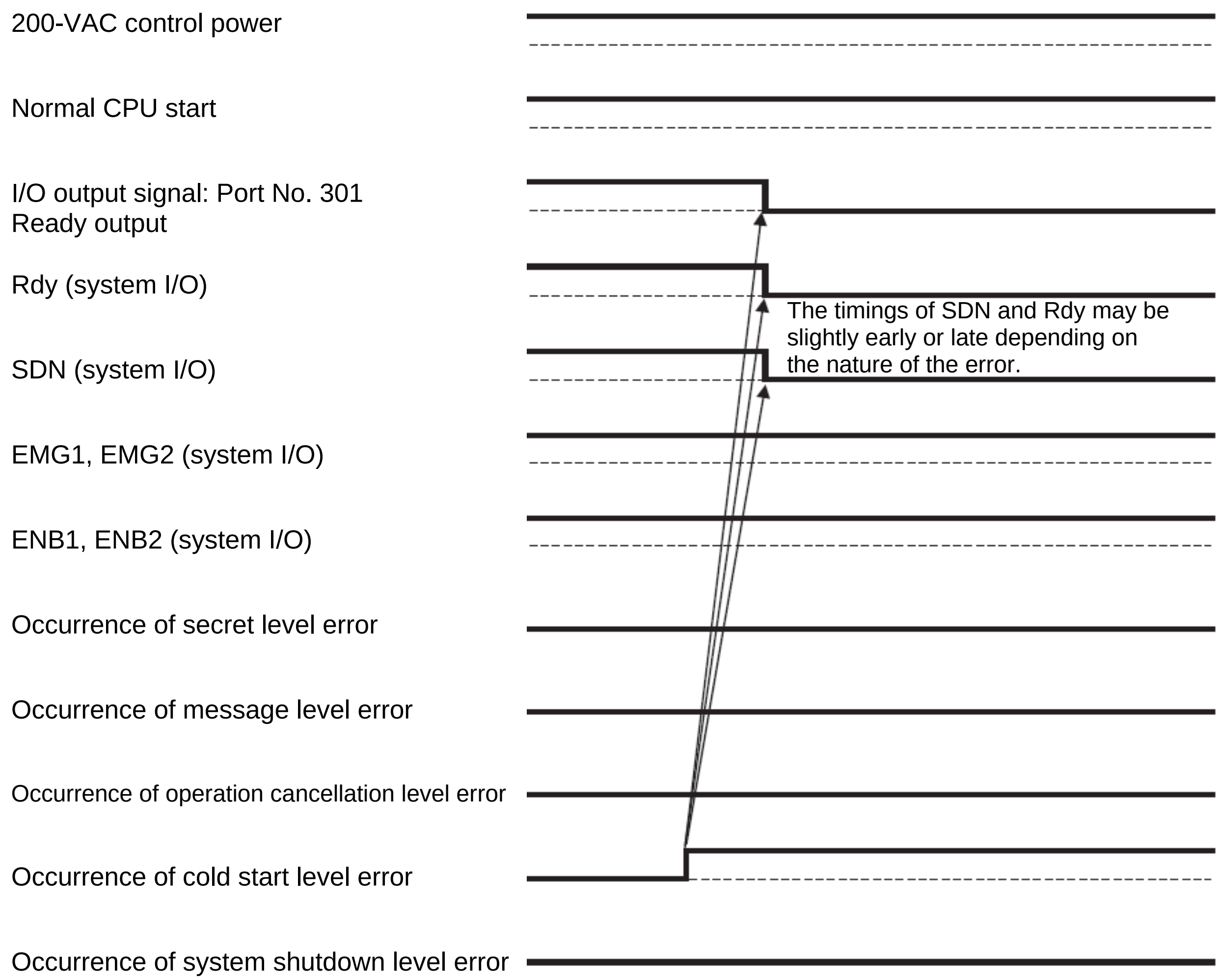
• I/O parameter No. 24, bits 0 to 3 = 0:	The RDYOUT output (system I/O) is SYSRDY (PIO trigger program operation enabled) and the hardware is normal (emergency stop is not actuated and no hardware errors are detected).
• I/O parameter No. 44 = 0:	The drive-source cutoff reset input is not yet used.
•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

[5] System shutdown level error



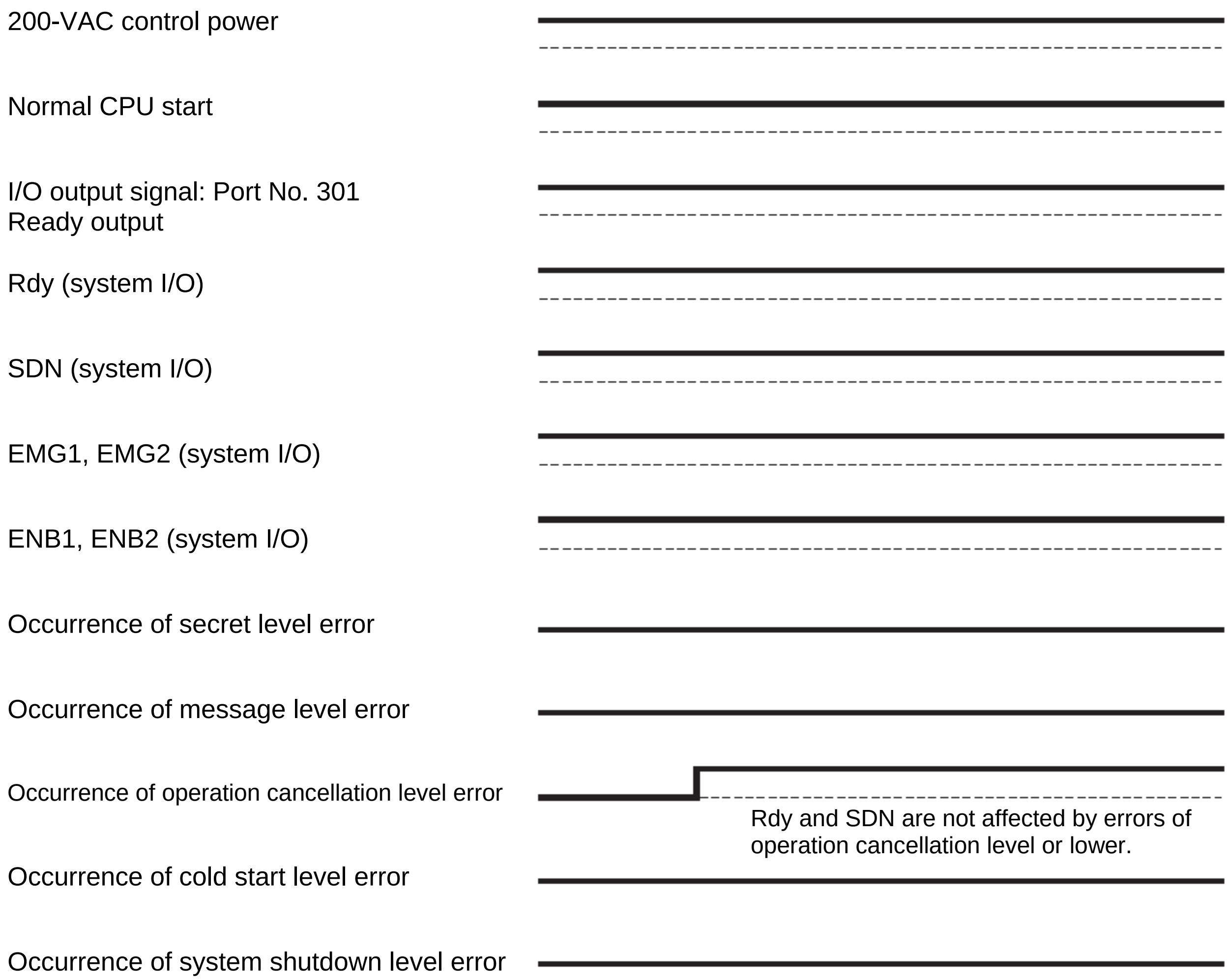
• I/O parameter No. 24, bits 0 to 3 = 0:	The RDYOUT output (system I/O) is SYSRDY (PIO trigger program operation enabled) and the hardware is normal (emergency stop is not actuated and no hardware errors are detected).
• I/O parameter No. 44 = 0:	The drive-source cutoff reset input is not yet used.
•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

[6] Cold start level error



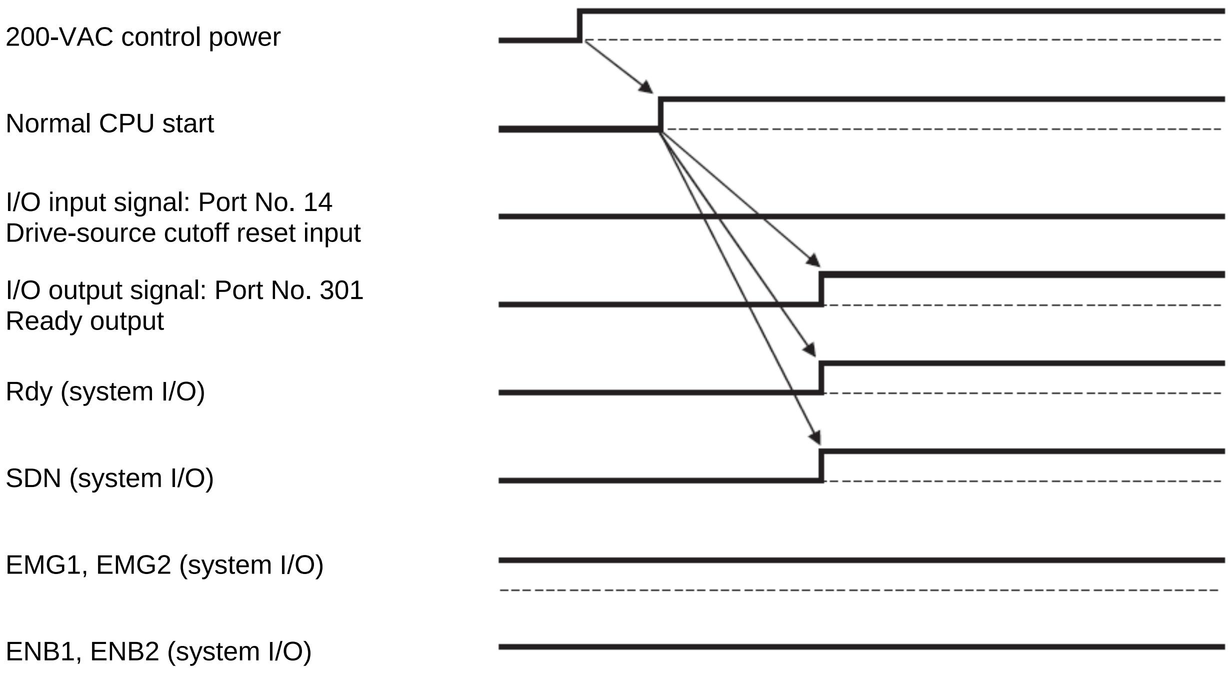
- I/O parameter No. 24, bits 0 to 3 = 0: The RDYOUT output (system I/O) is SYSRDY (PIO trigger program operation enabled) and the hardware is normal (emergency stop is not actuated and no hardware errors are detected).
- I/O parameter No. 44 = 0: The drive-source cutoff reset input is not yet used.
-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

[7] Operation cancellation level error



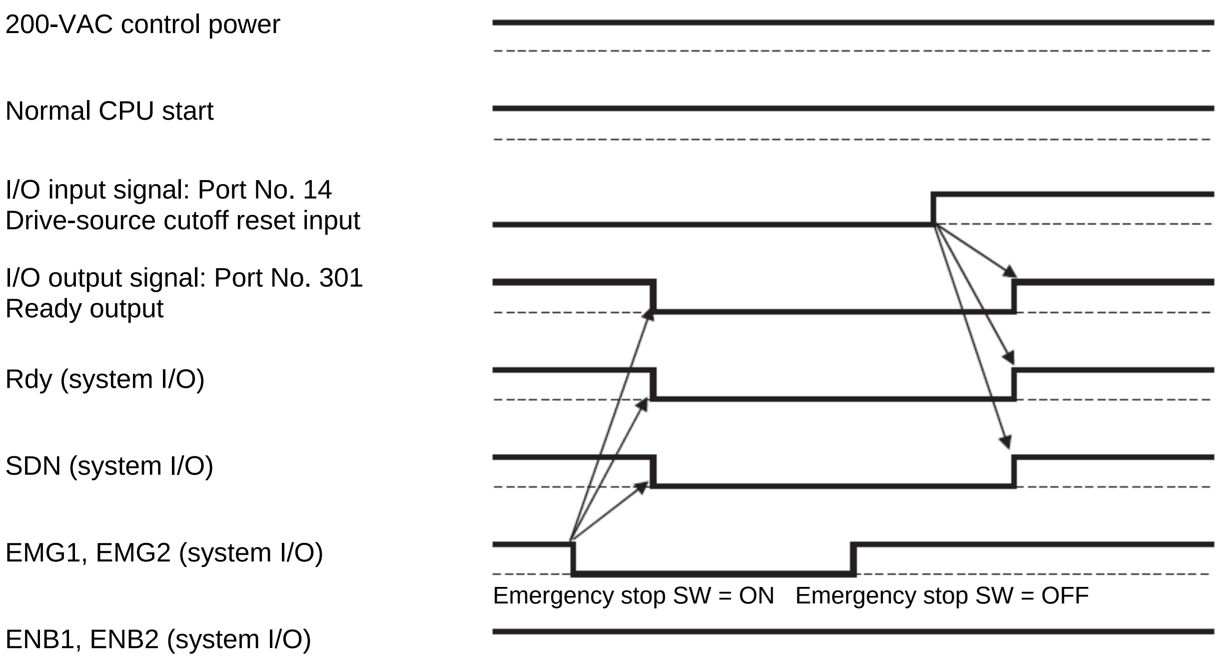
• I/O parameter No. 24, bits 0 to 3 = 0:	The RDYOUT output (system I/O) is SYSRDY (PIO trigger program operation enabled) and the hardware is normal (emergency stop is not actuated and no hardware errors are detected).
• I/O parameter No. 44 = 0:	The drive-source cutoff reset input is not yet used.
•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

[8] Power on (in combination 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 operation enabled) and the hardware is normal (emergency stop is not actuated and no hardware errors are detected).
• I/O parameter No. 44 = 0:	The drive-source cutoff reset input is not yet used.
• I/O parameter No. 47 = 3:	Output function 301 = READY output (PIO program operation enabled and no errors of cold start level or higher have occurred).

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

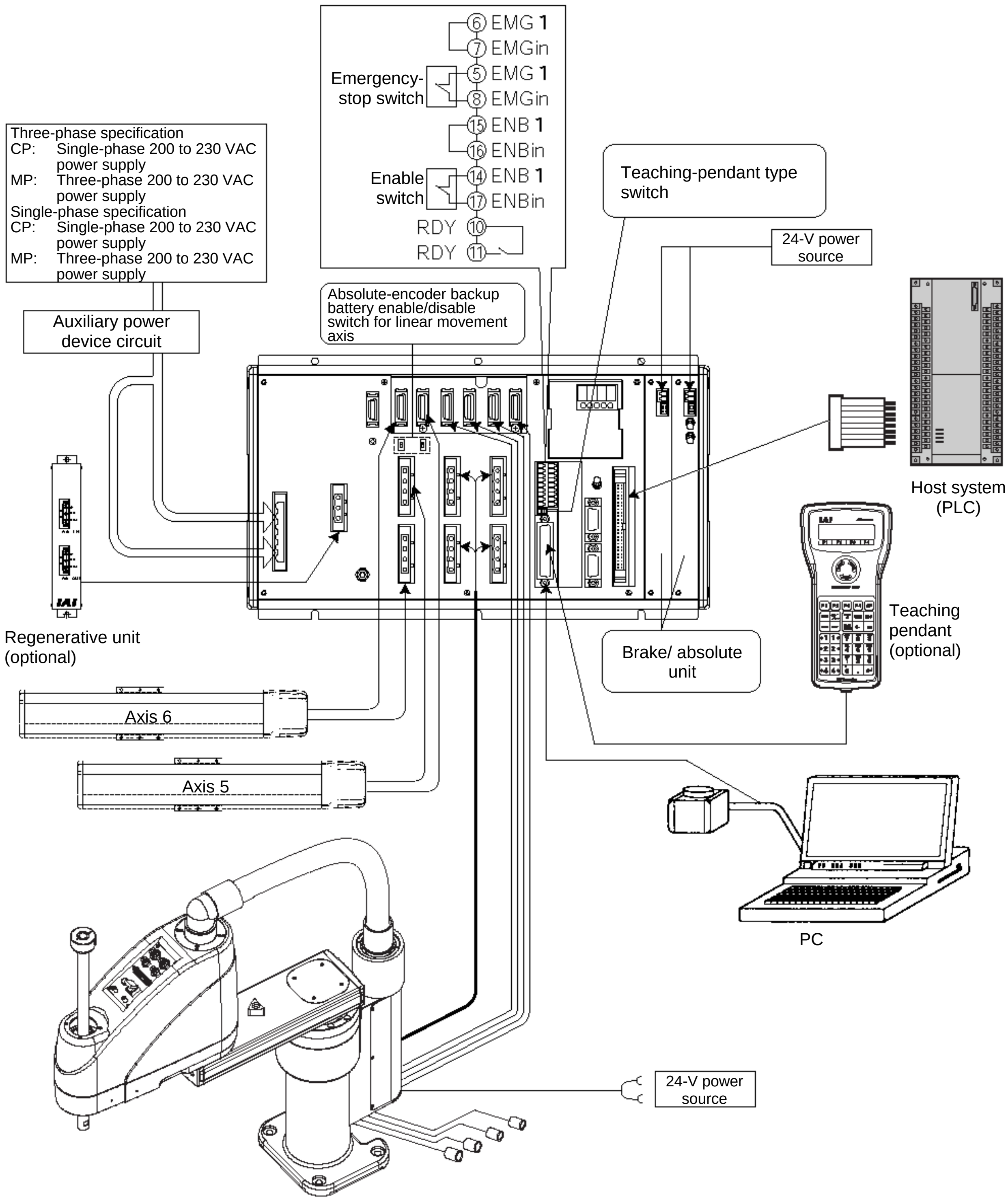


• I/O parameter No. 24, bits 0 to 3 = 0:	The RDYOUT output (system I/O) is SYSRDY (PIO trigger program operation enabled) and the hardware is normal (emergency stop is not actuated and no hardware errors are detected).
• I/O parameter No. 44 = 0:	The drive-source cutoff reset input is not yet used.
•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

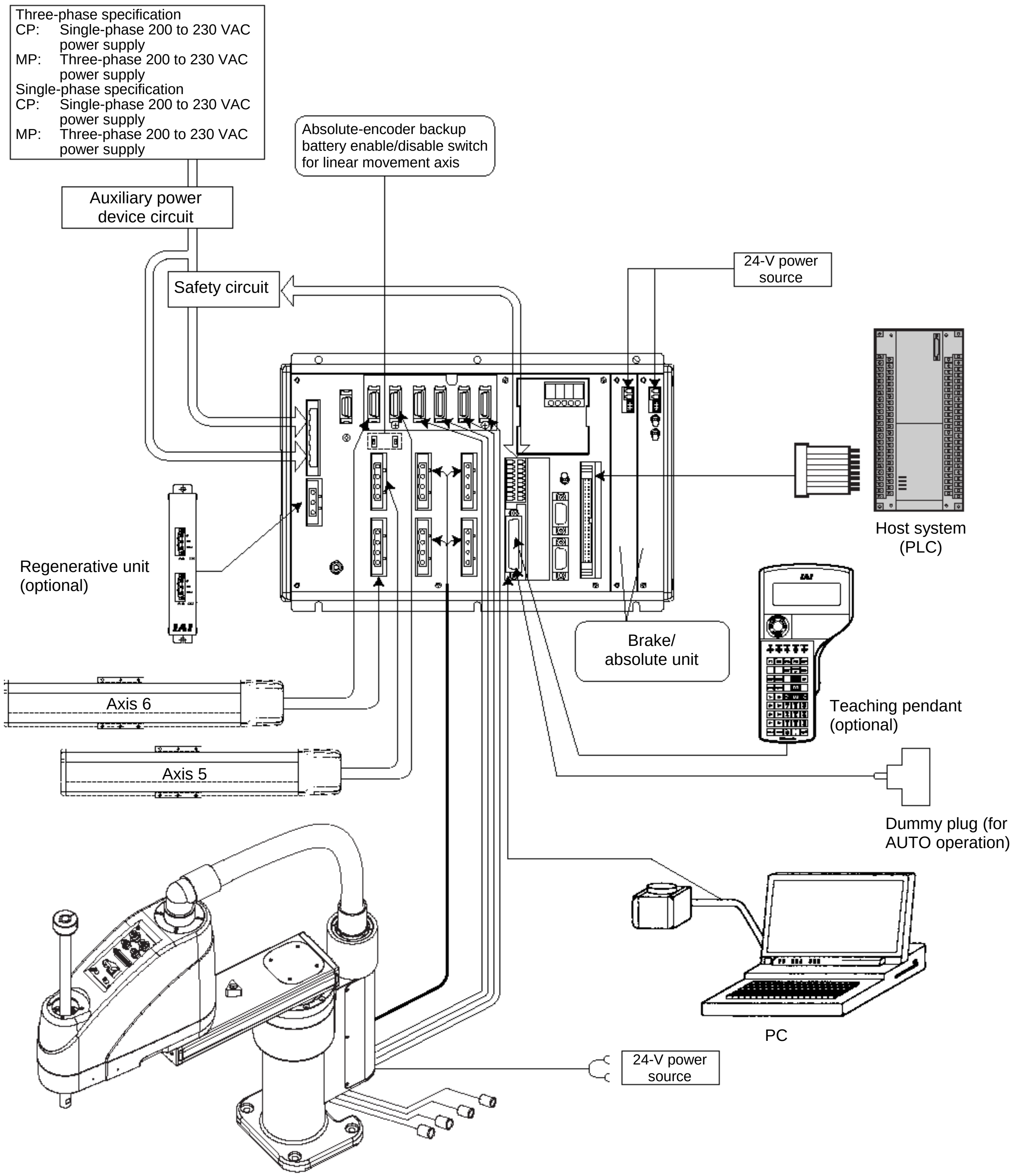
Chapter 7 System Setup

1. Connection Method of Controller and Actuator

1.1 Connection Diagram for PX Type (Standard Specification)

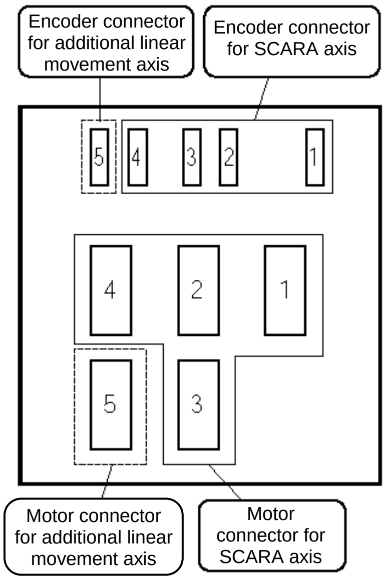


1.2 Connection Diagram for QX Type (Global Specification)

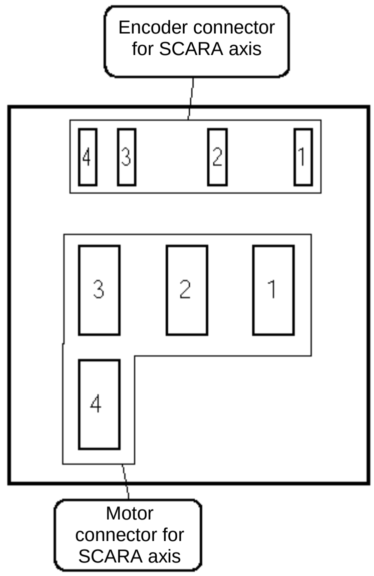


The positions of motor connectors and encoder connectors vary depending on the SCARA type.
The figure below shows where the motor connectors and encoder connectors are located for each SCARA type, as viewed from the front side of the controller.

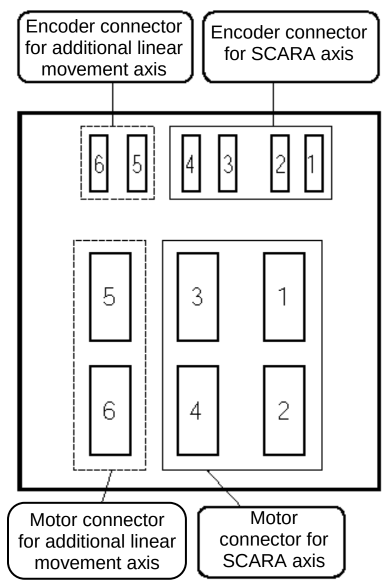
Arm length 700/800



High-speed type (NSN**----)



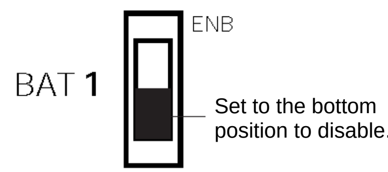
Other than the above



1.3 Startup procedure

Caution:	Be sure to connect the cables from the respective actuators to the correct connectors. When connecting multiple axes to the controller, be sure the actuator cables are going to the correct connectors. Check the type of the actuator connected. If the cables and connectors are not connected properly, motor/board damage or malfunction may result.

[1] When connecting an absolute linear movement axis, set the absolute-encoder backup battery enable/disable switch to the bottom position for all axes (the controller is shipped with all of these switches set to the bottom position).



[2] Connect the motor cables and encoder cables from the actuators, to the controller.
Before turning on the power, be sure to confirm that each connector on the controller is connected to the correct actuator.

[3] Connect the brake power cable of the SCARA robot to the 24-V power supply.
Also connect the brake/absolute unit of the controller to the 24-V power supply.
If a regenerative unit or units are required, connect each regenerative unit to the controller using a cable.

[4] Connect the teaching-pendant cable or PC-software cable to the teaching connector. Once the teaching pendant has been connected, set the mode switch to MANU
(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.)

[5] Set the teaching-pendant type switch.
Left: PC cable (conforming 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
Note 1: TP-SW is not available on QX type controllers.
Note 2: IAI's standard teaching pendants and standard PC cables cannot be used with QX type controllers.

[6] Turn on the controller power.

[7] If an absolute linear movement axis is connected, set the absolute-encoder backup battery enable/disable switch to the top position (ENB side).

[8] 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 an absolute linear movement axis is connected, "E914," or "ECA2" is displayed. Refer to Chapter 8, "How to Perform An Absolute Encoder Reset."
Absolute reset is not required for SCARA axes.

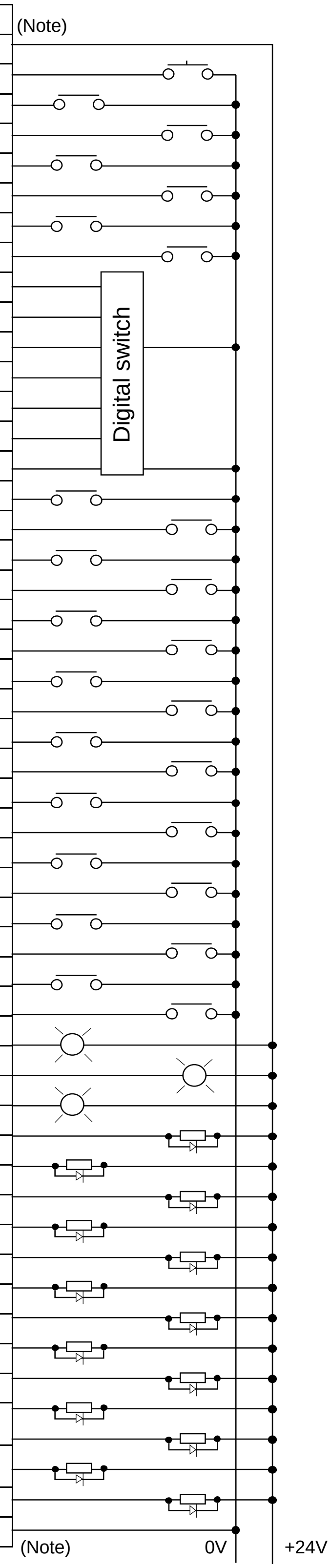
The controller is now ready to operate.

- 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

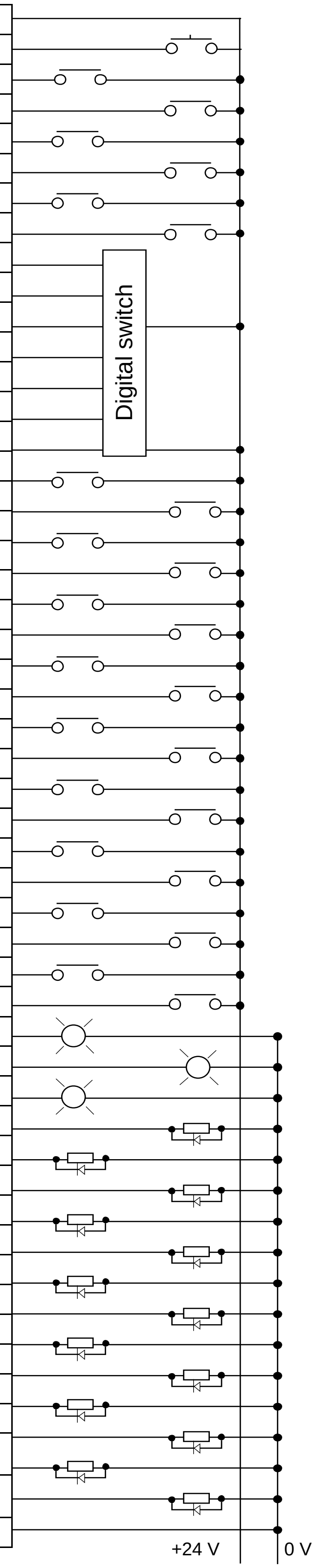
Pin No.	Category	Port No.	Function (factory setting)
1	Input	-	+24-V input
2		000	Program start
3		001	General-purpose input
4		002	General-purpose input
5		003	General-purpose input
6		004	General-purpose input
7		005	General-purpose input
8		006	General-purpose input
9		007	Program specification (PRG 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	Alarm output for low system-memory backup battery voltage
48		314	Alarm output for low absolute-encoder backup battery voltage
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

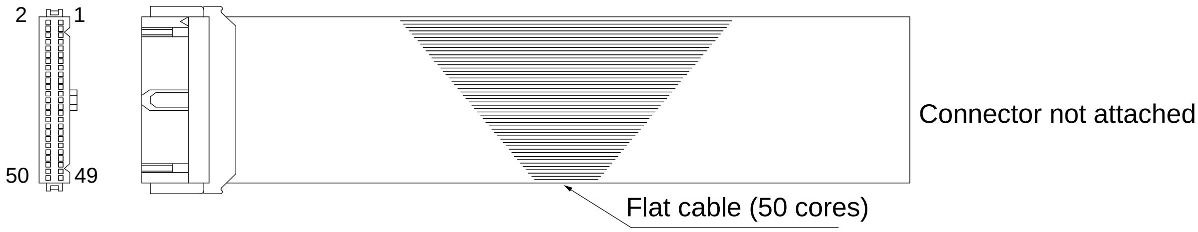
Pin No.	Category	Port No.	Function (factory setting)
1		-	+24-V input
2		000	Program start
3		001	General-purpose input
4		002	General-purpose input
5		003	General-purpose input
6		004	General-purpose input
7		005	General-purpose input
8		006	General-purpose input
9		007	Program specification (PRG No. 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	Alarm output for low system-memory backup battery voltage
49		315	Alarm output for low absolute-encoder backup battery voltage
50		-	0 V



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

2.3 I/O Flat Cable

Flat cable: KFX-50 (S) (Color) (Kaneko Cord)



Socket (with strain relief): XG4M-5030-T (Omron)

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

3. Multipoint DIO Board

This board is a multipoint DIO board for XSEL controllers on which 48 input points and 48 output points are provided.

3.1 Overview

3.1.1 Features

[1] 96 points can be input/output using a single board.
One board provides 48 input points and 48 output points to enable multipoint I/O control with your XSEL controller.

[2] PNP/NPN DIO interfaces are supported.
As with other current IO boards, two types of DIO interfaces–NPN and PNP–are available.

[3] Overcurrent & I/O power monitor functions
The DO board is monitored for overcurrent and IO power-supply voltage and if an overcurrent is detected or the specified voltage is exceeded, DO outputs are cut off. Take note, however, that unlike with current IO boards, the overcurrent detection is performed based on 400 mA/24 points. (Current IO boards: 400 mA/8 points)

3.1.2 Board Variations

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

Model	
IA-IO-3204-NP	General-purpose, large-capacity XSEL multipoint I/O board (NPN specification)
IA-IO-3204-NP	General-purpose, large-capacity XSEL multipoint I/O board (PNP specification)

3.2 Specifications

3.2.1 I/O Specifications

Item	Specification
Number of I/O points	48 input points, 48 output points
External power-supply voltage	DC 24 V ± 10%
Input insulation	Photocoupler insulation
Input current	Max. 7 mA/1 point
Input leak current	Max. 7 mA/1 point
Output insulation	Photocoupler insulation
Output element	Transistor
Maximum output load current	50 mA/1 point (400 mA/24 points)
Output leak current	Max. 0.1 mA/1 point

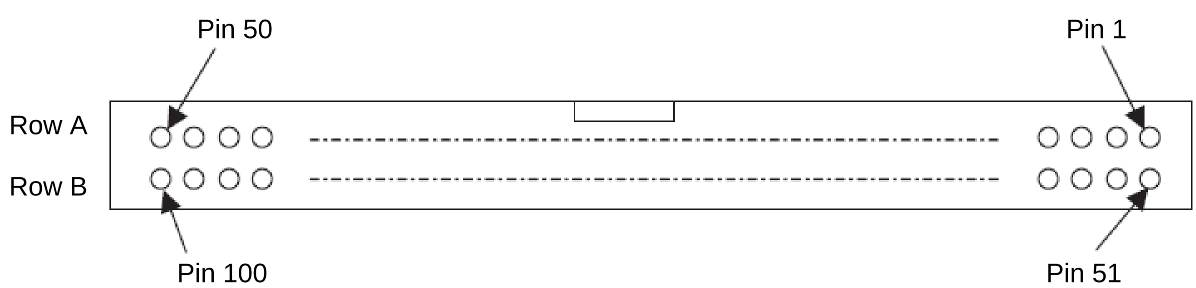
3.3 External Interface Specifications

3.3.1 External DIO Interface Terminal Assignment

Overview or multipoint 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	24 VDC ± 10%	The power supply is separated for every 24 DI points/24 DO points.
DI	48 points	
DO	48 points	

Pin layout (Connector engagement side)



3.3.2 IO24-V Power-supply Input

The power supply for IN000 to 023/OUT300 to 323 is insulated from the power supply for IN024 to 047/OUT324 to 347. Connect an external power supply to each power-supply terminal.
Also note that this board detects errors relating to I/O power supply through the following monitor functions:

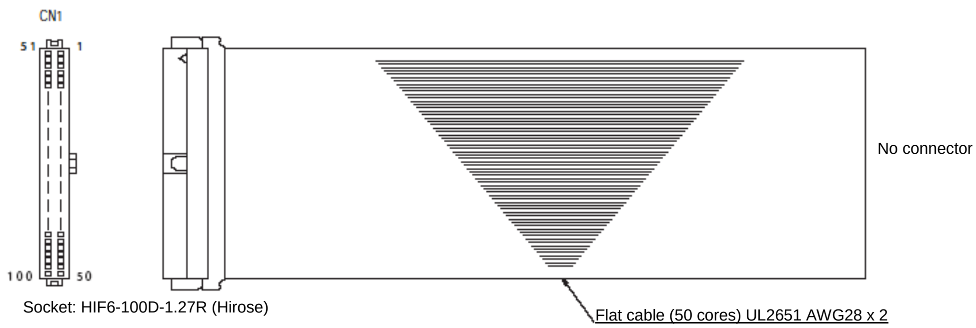
1. Monitor the voltage of the external IO power supply (+24 V)
2. Monitor the output current for every 24 points

3.4 Multipoint I/O Board Connection Cables

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

3.5 Multipoint I/O Board Connection Cables

Model: CB-X-PIOH020



3.6 I/O Circuits

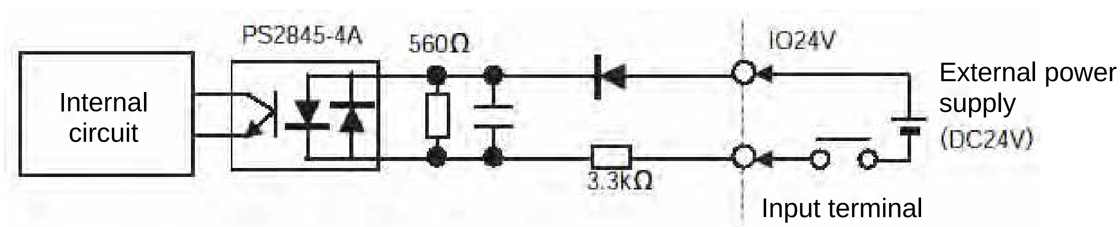
3.6.1 Input

Input specifications

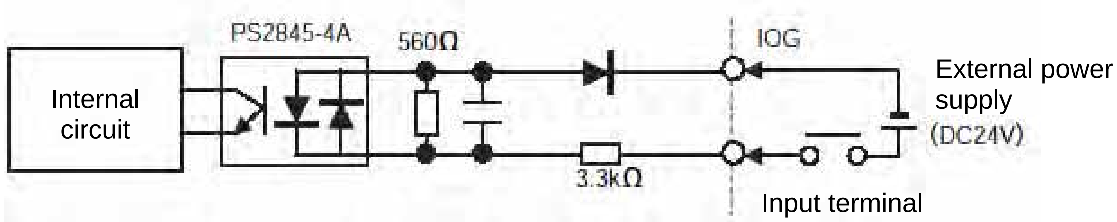
Item	Specification (common to PNP/NPN)
External power-supply voltage	24 VDC ± 10%
Input current	Max. 7 mA/1 point
Leak current	Max. 7 mA/1 point

Input circuit

- NPN specification



- PNP specification



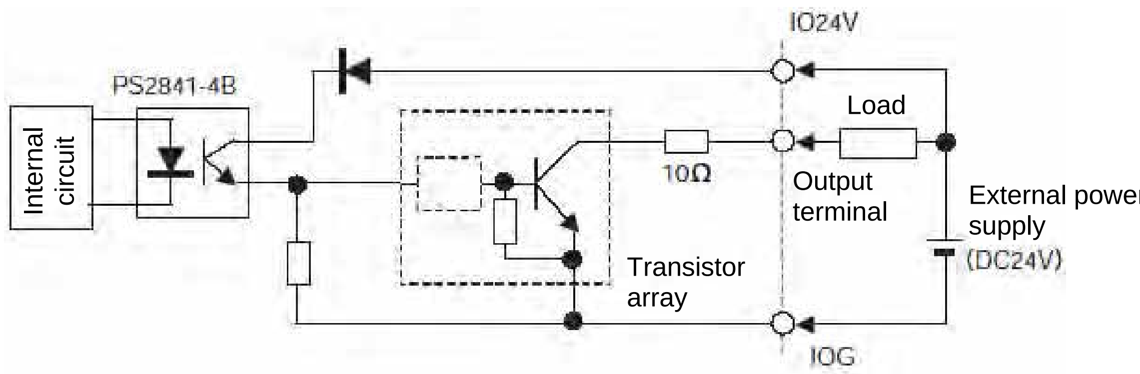
3.6.2 Output

Output specifications

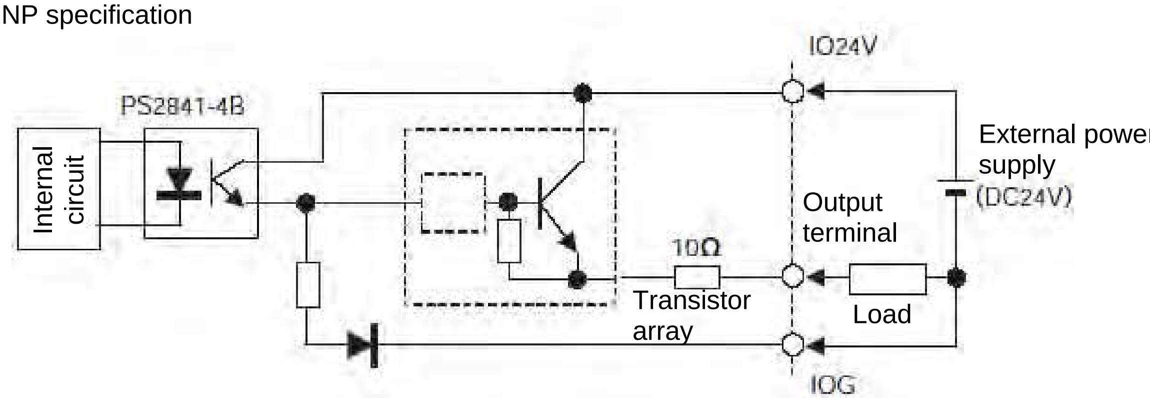
	Specification
Output element	Transistor array NPN specification: TD62084AF by Toshiba PNP specification: TD62784AF by Toshiba
External power-supply voltage	24 VDC ± 10%
Maximum load current	Max. 50 mA/1 point (Max. 400 mA/24 points): *1
Leak current	Max. 0.1 mA/1 point

*1: The total output current for every 24 points is 400 mA.

- NPN specification



- PNP specification



Chapter 8 How to Perform An Absolute Encoder Reset of A Direct Movement Axis (Absolute Specification)

When the absolute-encoder backup battery voltage of a linear movement axis is abnormal or when the battery or encoder cable of a linear movement axis has been disconnected, an encoder battery error will generate and an absolute encoder reset must be performed.
For the procedure to execute an absolute reset of a SCARA axis, refer to the separate document entitled, “Horizontal Articulated Robot IX Series.” At the initial setup, SCARA axes do not require an absolute reset.
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. Preparation

(1) PC
A PC in which IAI’s X-SEL 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.

2. Procedure

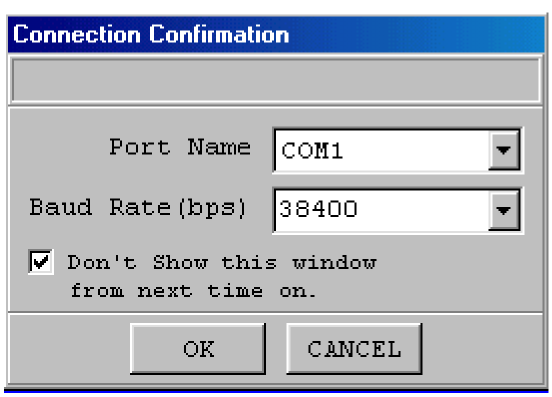
(1) Turn off the X-SEL Controller power. Turn on the PC power and wait for the operating system to be started.

(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.

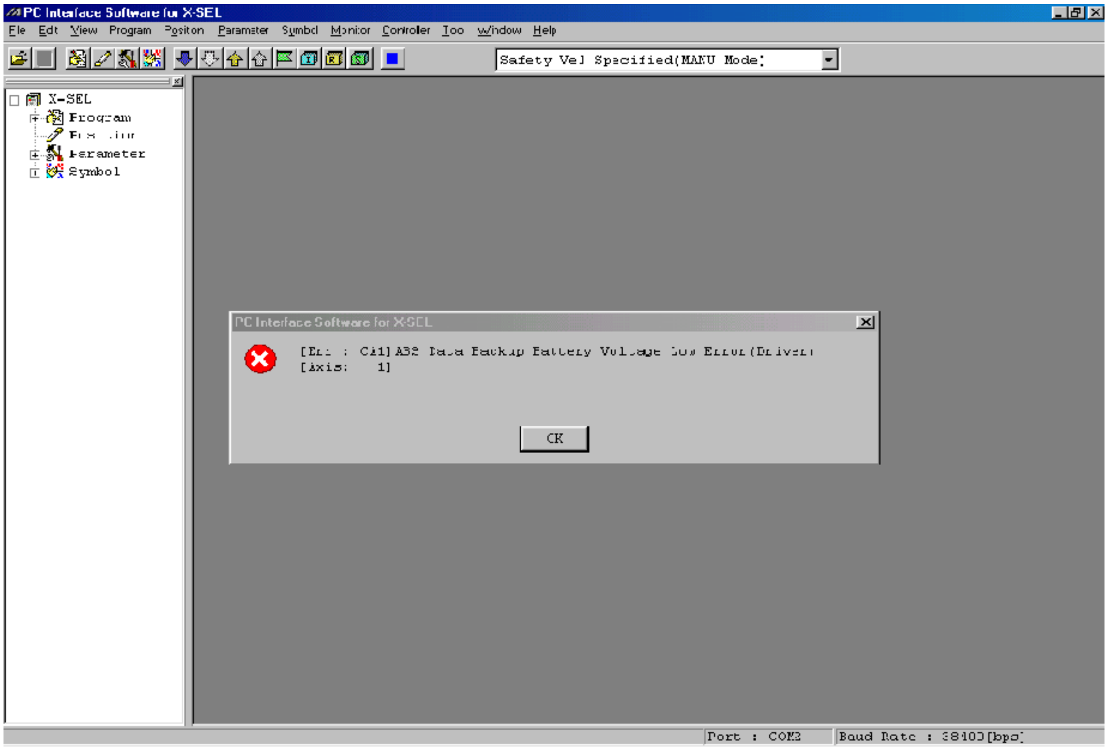
(3) Turn on the controller power. If an encoder battery error is present but no other adjustments are pending, the 7 segment LED display will show “E194” or“ECA2” indicating that the controller has detected an encoder battery error.

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

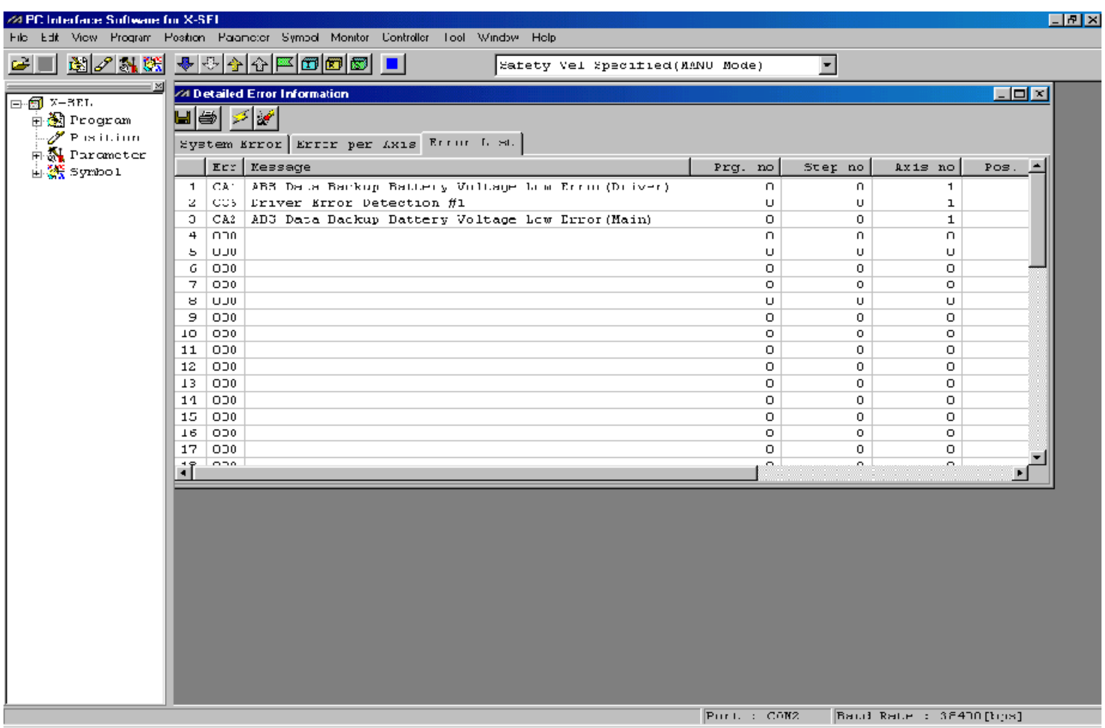
(5) When the [Connection Confirmation] dialog box is displayed, select the port name you are using on the PC. Click the [OK] button (the software will automatically detect the baud rate).



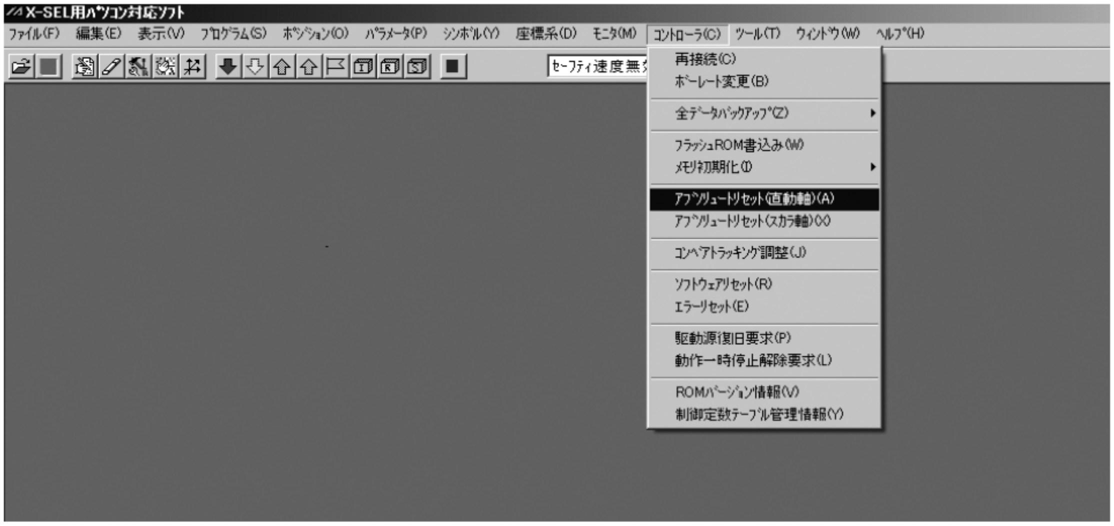
(6) The X-SEL PC software window will be displayed. Clicking the [OK] button will clear the error message.



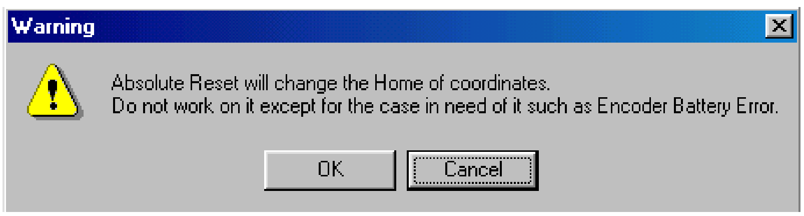
(7) From the [Monitor (M)] menu, select [Detailed Error Information (E)] to check the current error status. In the case of an encoder battery error, the following will be displayed (when axis 4 is using an absolute encoder). After checking the error status, close the [Detailed Error Information] window.



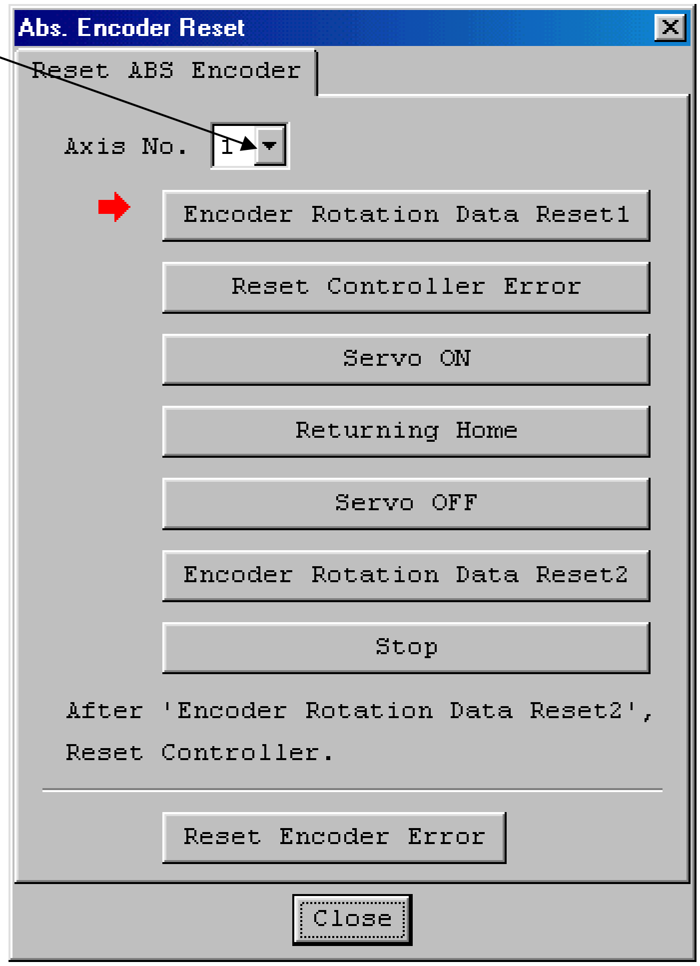
(8) From the [Controller (C)] menu, select [Absolute Reset (Linear Movement Axis) (A)].



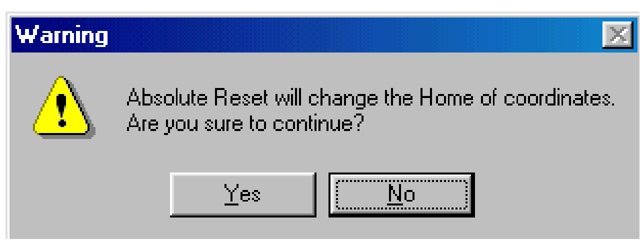
(9) When a [Warning] dialog box is displayed, click the [OK] button.



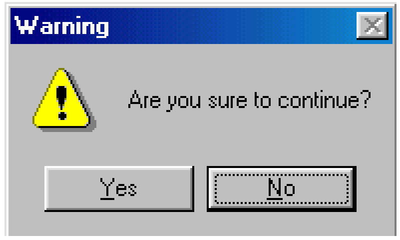
(10) The [Abs. Encoder Reset] dialog box will be displayed.
Click here to select the axis for which you wish to perform an absolute reset.



(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.



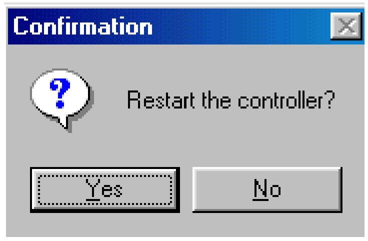
(13) When the processing of "encoder rotation data reset 1" is complete, the red arrow will move to the next item. Press the following processing buttons one by one (the red arrow will move to the next item when each process is completed):

1. Reset Controller Error
2. Servo ON
3. Returning Home
4. Servo OFF
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 an "Error No. C70, ABS coordinate non-confirmation 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 X-SEL PC software and repeat the procedure from the beginning.

(Note) On some models, the current value may not become "0 mm" after an absolute reset is completed, but this is not a malfunction. Refer to the coordinate value list by model provided below for the coordinate value that should become effective on each model after an absolute reset is completed.

Mode	Lead	Current value after completion of absolute 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 models not listed above, the current value will become "0" after an absolute reset.

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 is adverse, 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 objects, 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:

  The battery models, installation positions and service lives are shown below.

		Model	Installation position	Replacement interval (Note 2)
SCARA axis	Arm length: 120/150	AB-6	Inside the robot	3 years
	Arm length: 250 to 800	AB-3		
Linear movement axis		AB-5	Controller	2 years

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

(Note) On a controller with increased memory size (with gateway function), the system memory can only save position Nos. 1 to 10000.
To save position data of Nos. 10001 to 20000, you must write the data 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

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 X-SEL Controller will be backed up by the system memory backup battery on the panel board:

- Position data (Position Nos. 1 to 10000 for a controller with increased memory size (with gateway function))
- SEL global data (flags, integer/real variables, string variables)
- Error lists
- User-data backup memory of the controller with increased memory size (with gateway function)

Therefore, <u>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)</u>. 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 on your PC, save the position data to a file using the PC software. The data will be used 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.

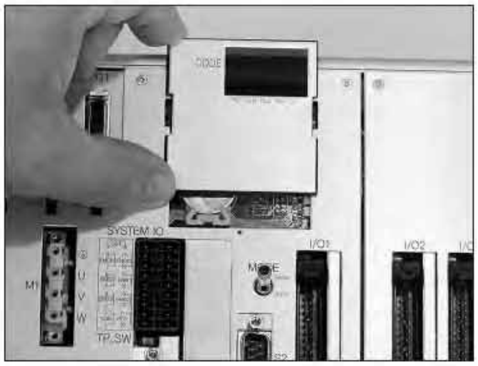
(5) Perform a software reset to restart the controller (the SEL global data and error lists will be saved to the special area in the flash ROM).

(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).

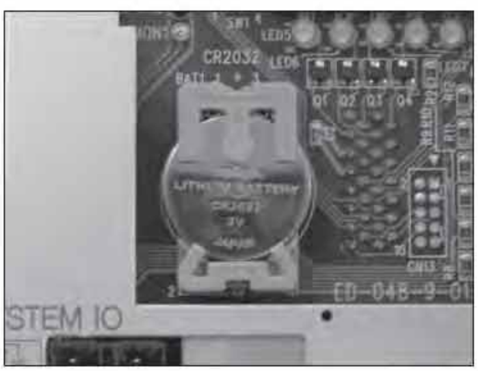
(7) Replace the system memory backup battery (SRAM data will be destroyed if steps 1 through 6 are not performed properly).

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).

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

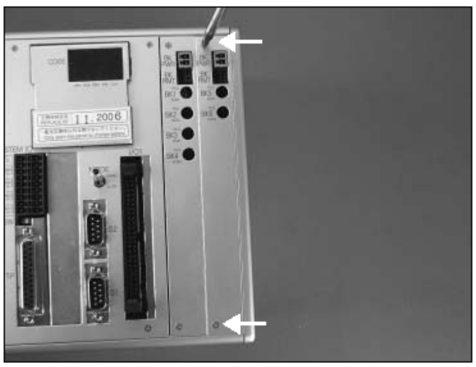
4. Replacement Procedure for Absolute-Encoder Backup Battery for Linear Movement Axis

The replacement procedure will vary depending on if errors are present at the time of replacement and if so, which errors are present (Nos. A23, 914, CA2).

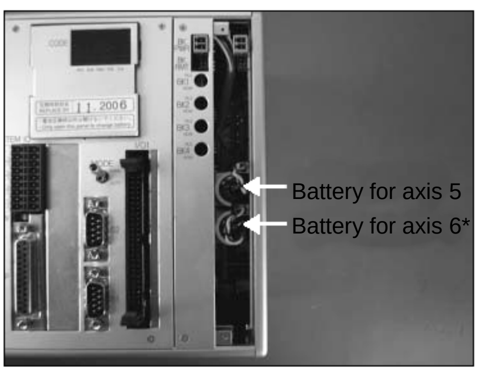
- If no error is present, perform steps (1) to (8).
- If an absolute data backup battery low voltage warning (error No. A23) is present, perform steps (1) to (15).
- If an absolute data backup battery voltage error (error No. 914 or CA2) is present, perform steps (1) to (8), and then perform an absolute 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).



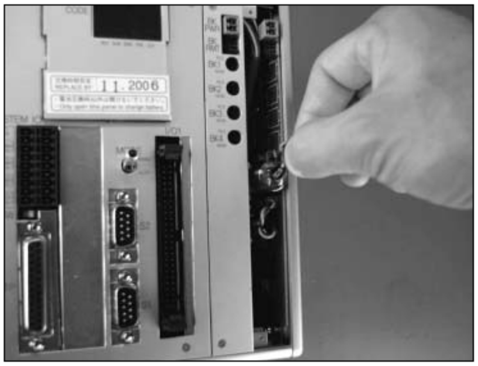
(2) Take out the brake/absolute unit panel at the far right. (Remove the two screws indicated by arrows, and take out the panel.)



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

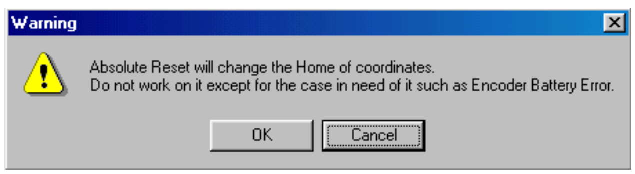
* For a SCARA robot with an arm length of 700/800, take out the battery for axis 5.

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



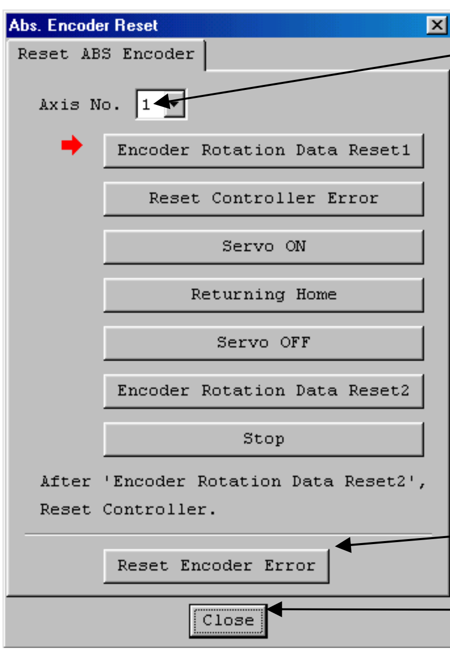
(5) Insert a new battery into the holder and plug in the battery connector.

(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 occurred or an A23 error has occurred.
(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.



Abs. Encoder Reset

(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

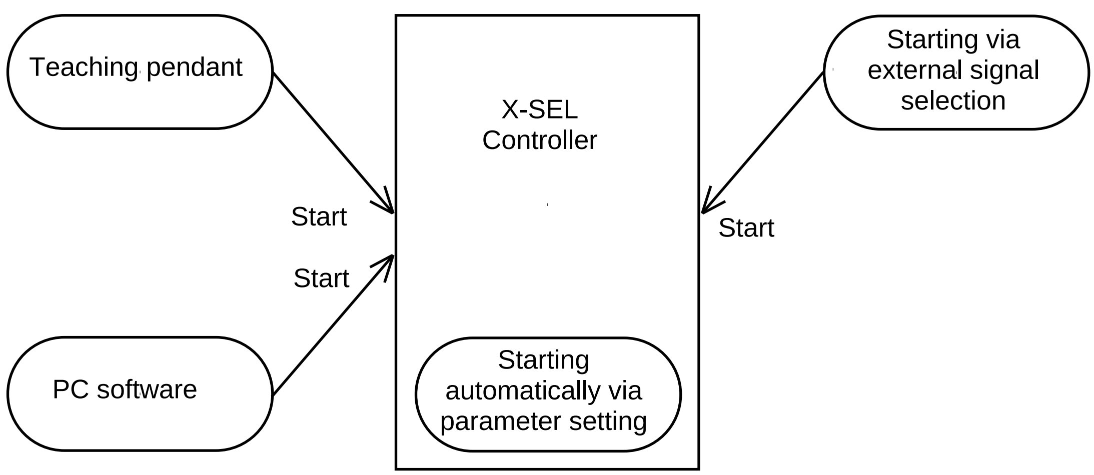
This completes the reset procedure following a battery low voltage warning.

Part 2 Operation

Chapter 1 Operation

How to Start a Program

With the X-SEL controller, the stored programs can be started 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 “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 number will start automatically.*

Caution

[Note on starting a program by auto start]
The automatic operation will begin immediately after the controller is reset. 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.

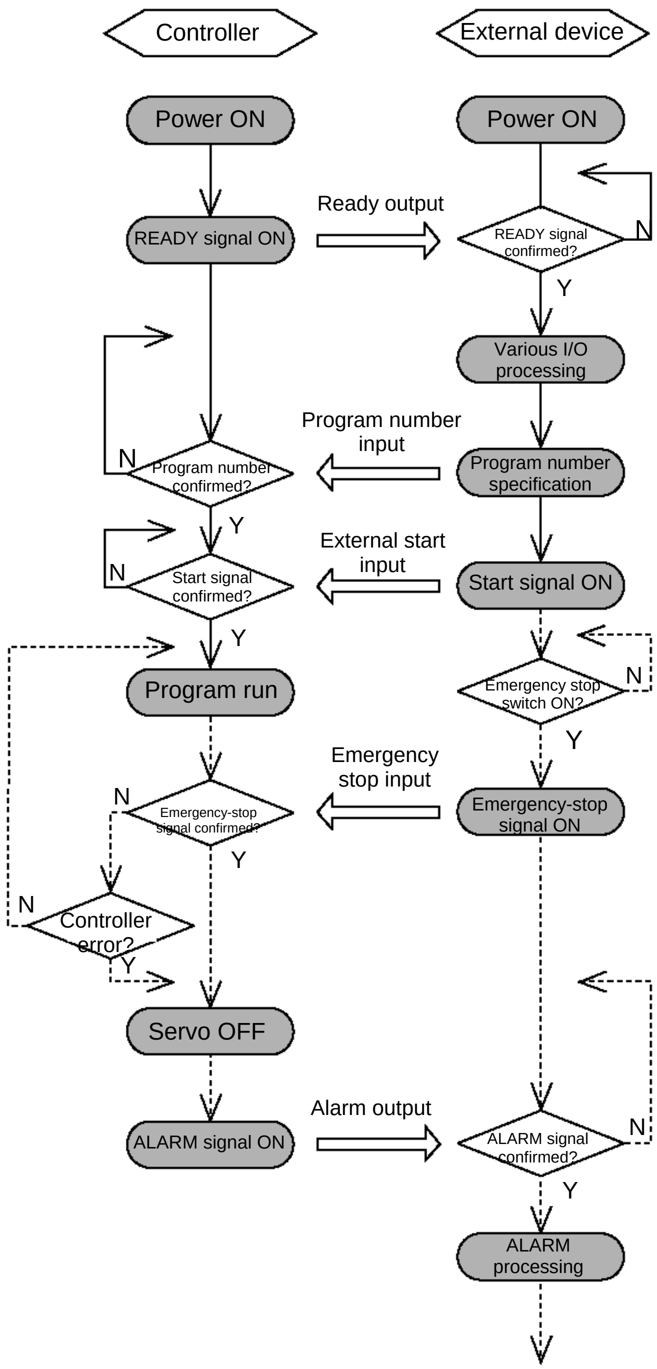
If you wish to start multiple programs at the same time, write multiple “EXPG” commands at the beginning of the main program to start the remaining programs. Provide safety measures for each program to be started.

* 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.

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.

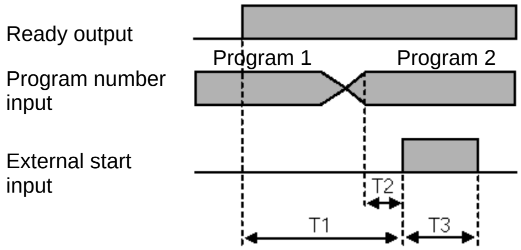
If an emergency-stop signal was input from the external device or a controller error occurred, the controller will turn off the servo power (the RDY lamp will turn off).

*1 You can input program numbers as binary codes by setting I/O parameter 30 (input function selection 000) to "2." (This parameter has been set to "1," or BCD code specification, at the factory.)

Note: On a controller with increased memory size (with gateway function), up to 128 programs can be stored. Take note, however, that 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] Start of program

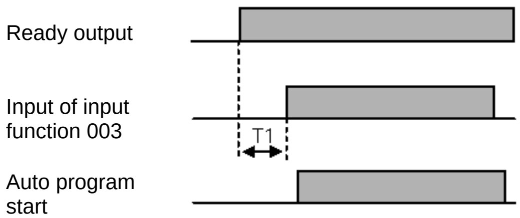


T1: Duration after the ready output turns ON until input of external start signal is permitted
T1 = 10 msec min.

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.

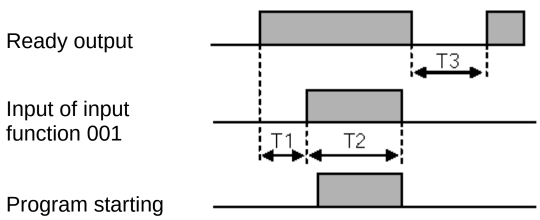
[2] Start of program by auto program start
* When I/O parameter No. 33 is set to “2”



T1: Time after the ready output is turned ON until input function 003 can be input
T1 = 10 msec min.

* Auto program start:
Set the program you want to start automatically in Other parameter No. 1, “Auto start program number.”

[3] Soft reset signal
* When I/O parameter No. 31 is set to “1”

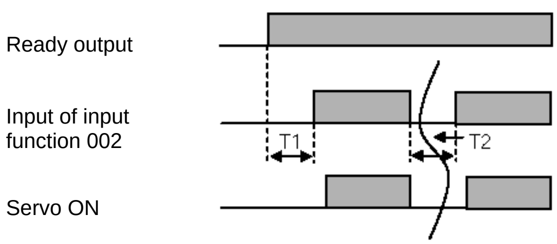


T1: Time after the ready output is turned ON until input function 001 can be input
T1 = 10 msec min.

T2: Time until the soft reset signal starts functioning
T2 = 1 sec min.

T3: Time after the soft reset signal is cancelled until the ready signal is output

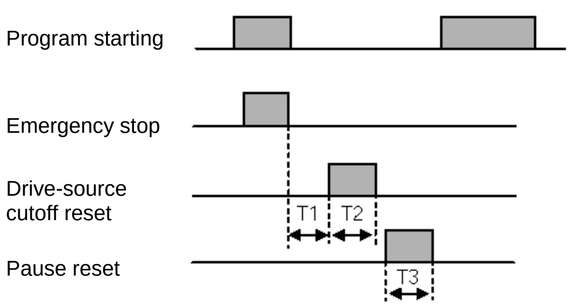
[4] Servo ON signal
* When I/O parameter No. 32 is set to “1”



T1: Time after the ready output is turned ON until input function 002 can be input
T1 = 10 msec min.

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

[5] When the recovery type after emergency stop or enabling operation is set to “Operation continued”
* When other parameter No. 10 is set to “2”
Set I/O parameter No. 35 to “1” (Operation pause reset signal)
Set I/O parameter No. 44 to “1” (Drive-power cutoff reset input)



T1: Time after the emergency stop input is cancelled until the drive-source cutoff reset signal can be input
T1 = 2 sec min.

T2: Drive-source cutoff reset input time
T1 = 10 msec min.

T3: Pause reset input time
T1 = 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

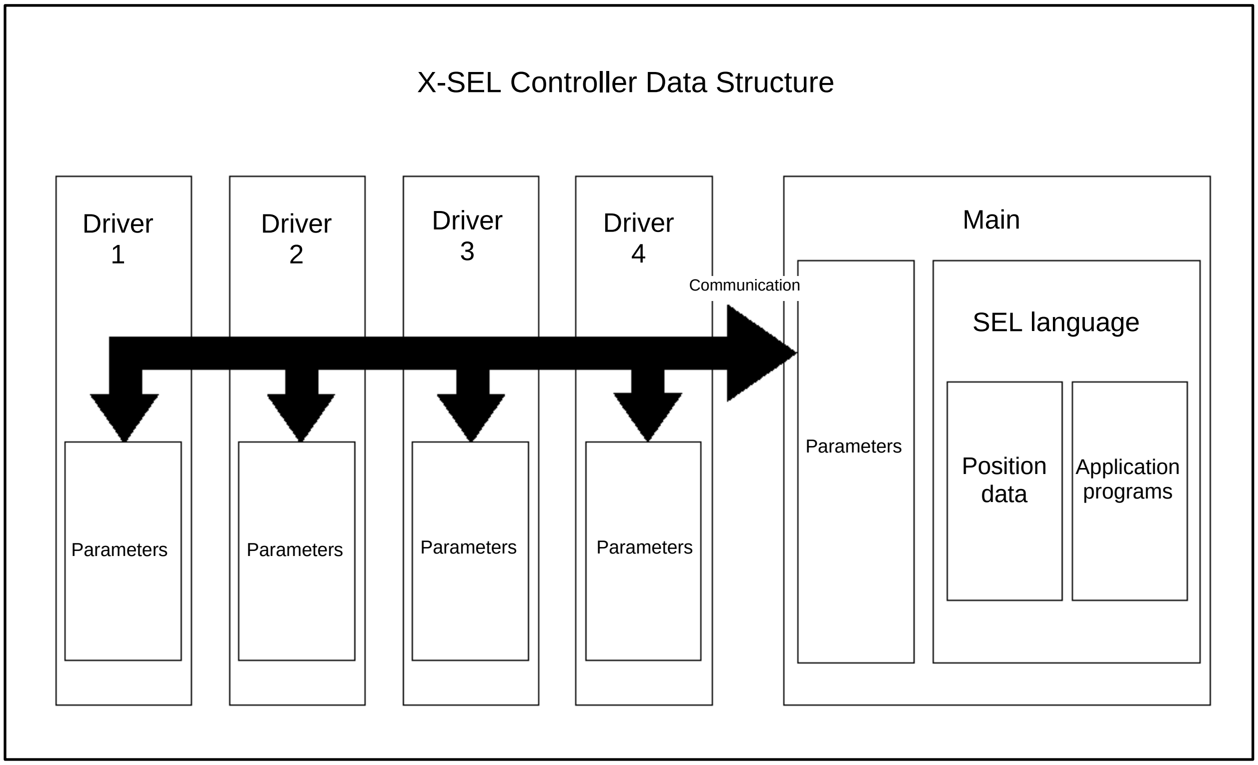
An operation pause reset request is required in any of the following cases:

- An emergency stop was actuated during automatic operation when other parameter No. 10 was set to "2" (Emergency stop recovery type = Continued operation, and 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 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 the Appendix "List of Parameters," for details on the parameters.

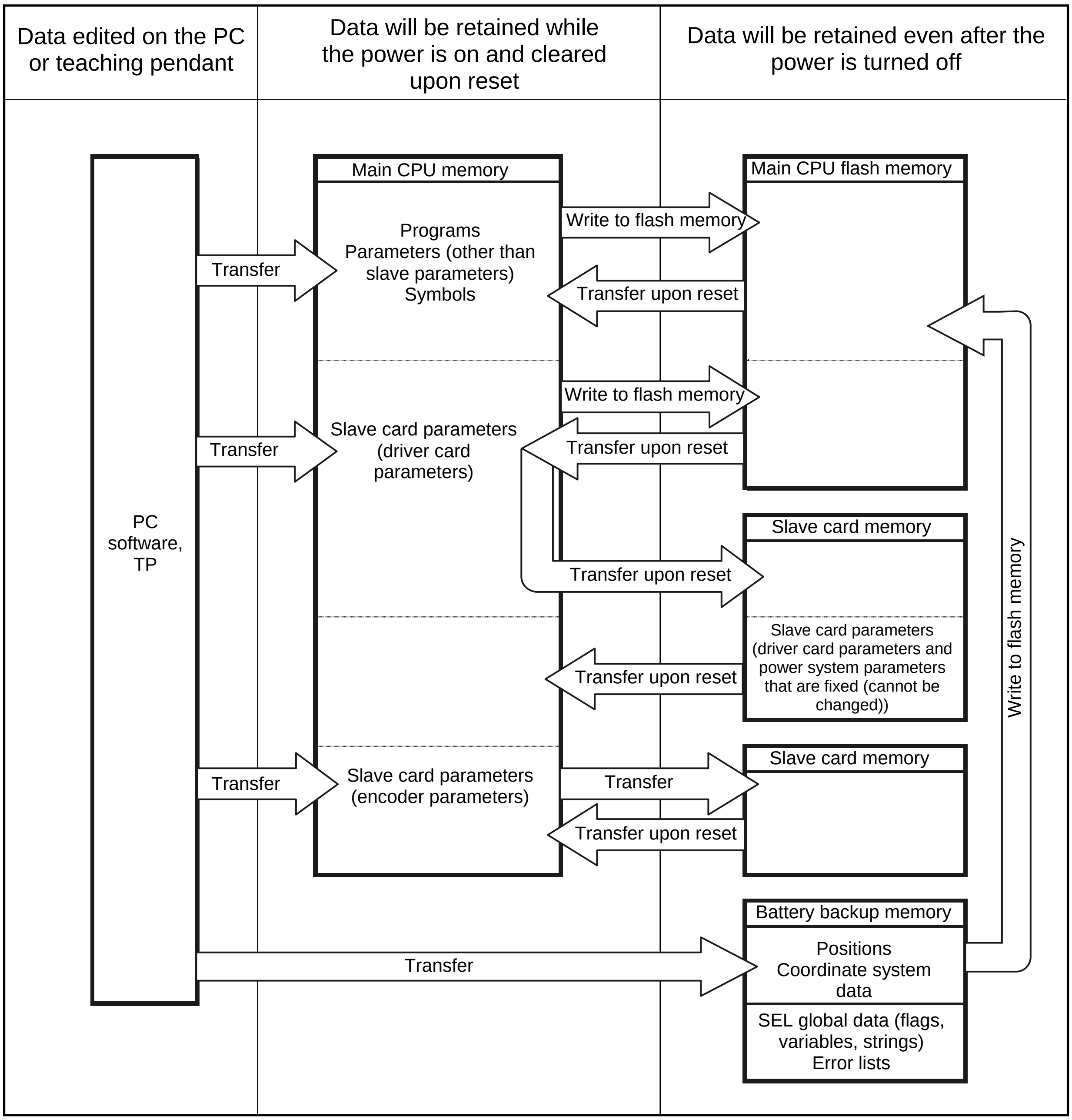
Chapter 1 How to Save Data

Since the X-SEL 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 Increased Memory Size

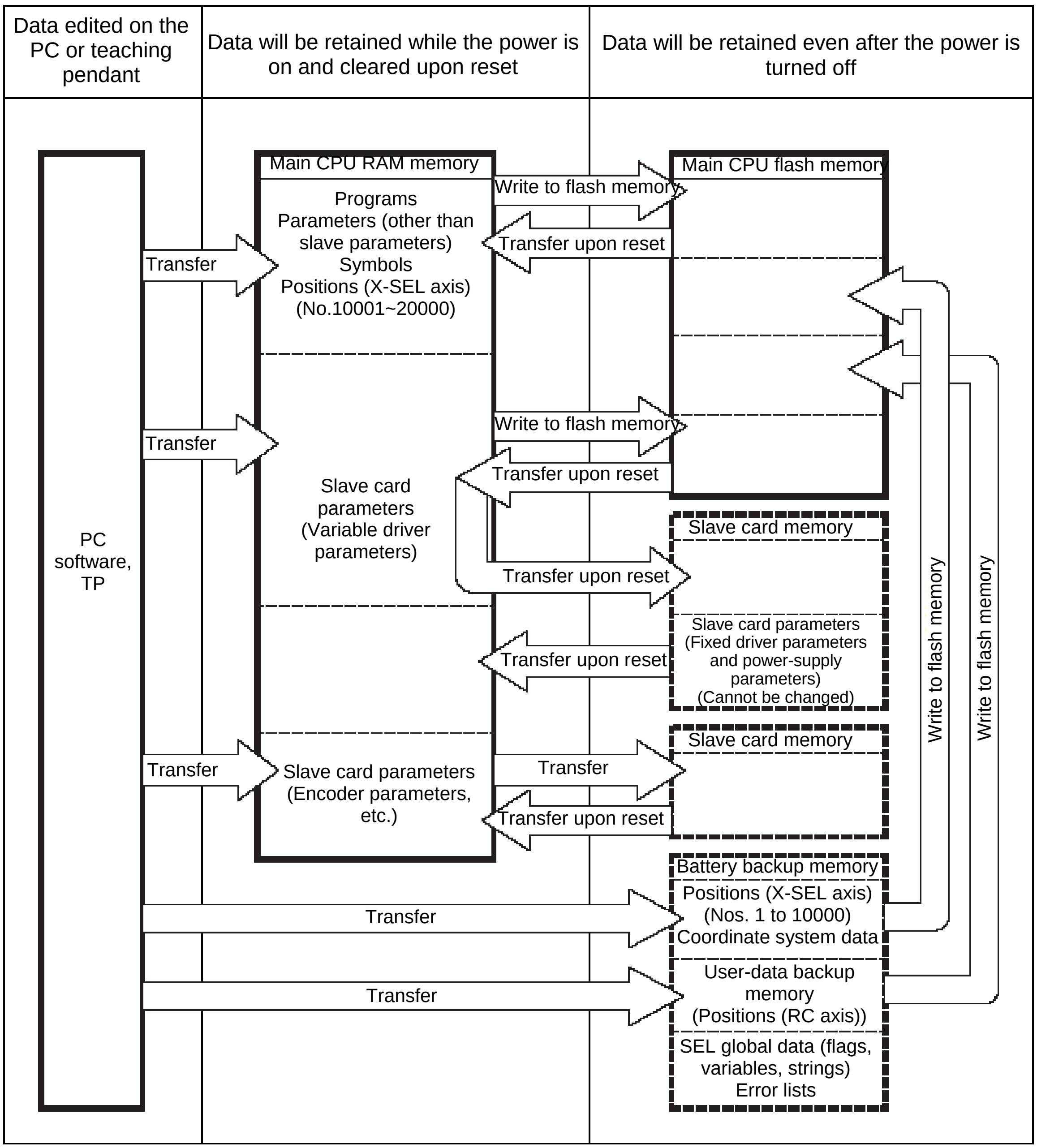
(Other parameter No. 20 = 2 (System-memory backup battery installed))



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 Increased Memory Size (with Gateway Function)

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

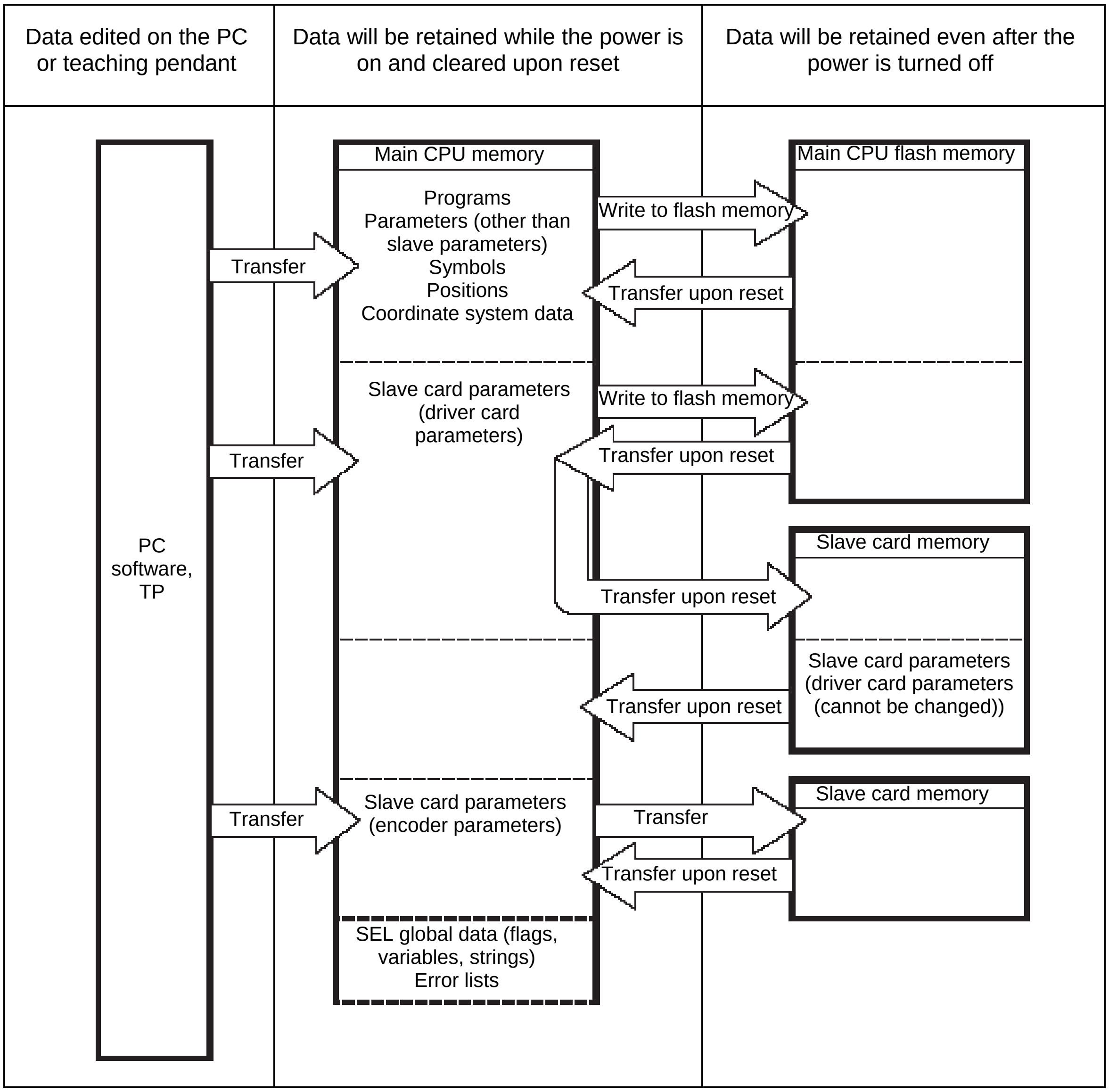


The programs, parameters, symbols and positions are read from the flash memory at restart. The data in the main CPU memory will remain the same as the original data before edit unless the edited data are written to the flash memory. The controller always operates in accordance with the data in the main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

2. When the System Memory Backup Battery is Not Used

2.1 Controller without Increased Memory Size

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

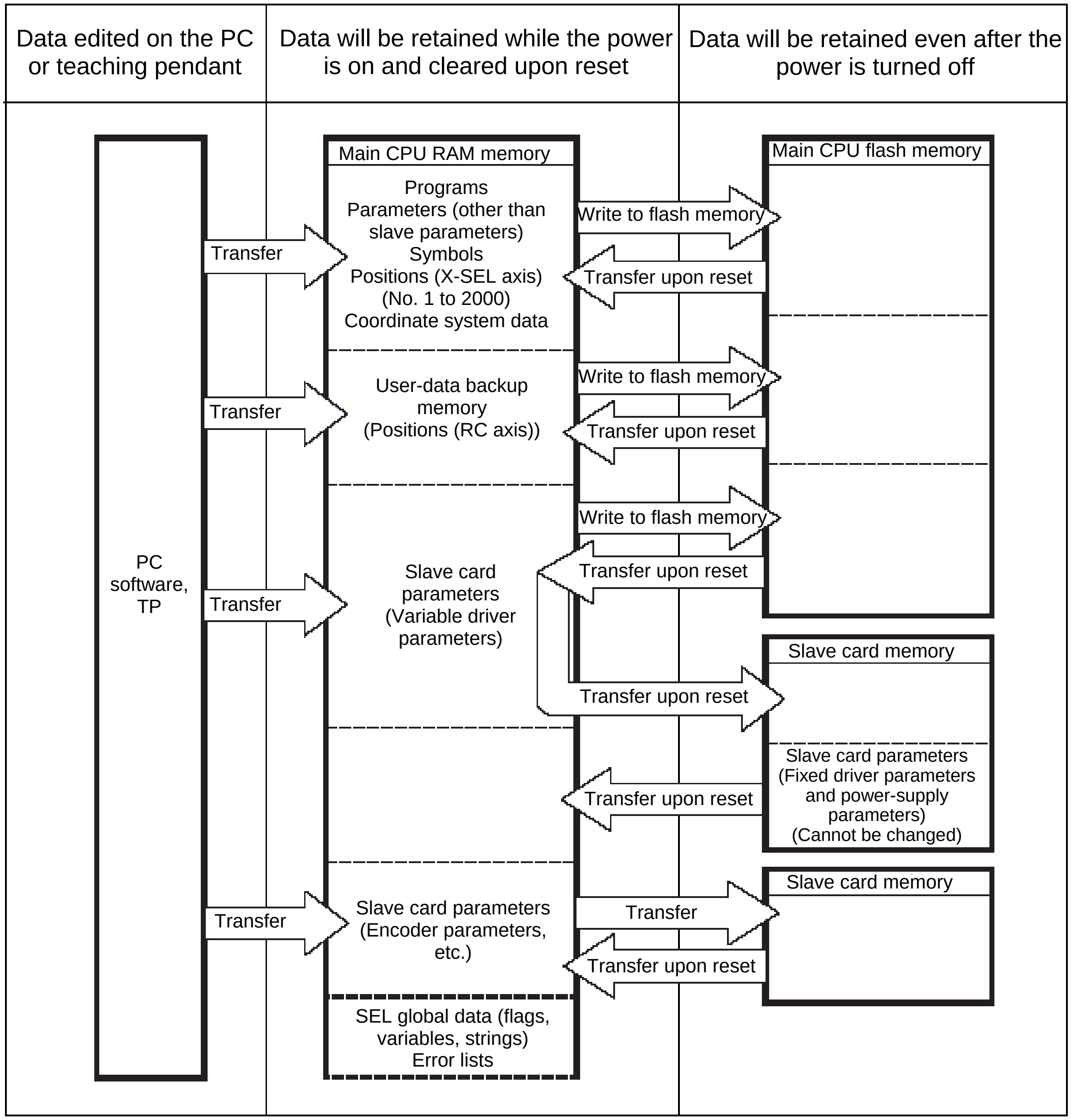


The programs, parameters, symbols and positions are read from the flash memory at restart. The data in the main CPU memory will remain the same as the original data before edit unless the edited data are written to the flash memory. The controller always operates in accordance with the data in the main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

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

2.2 Controller with Increased Memory Size (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.

Notes on increased positions

On controllers with increased memory size (with gateway function), the number of position data has been increased to 20000.

Accordingly, take note of the following points:

* When the backup memory is used (other parameter No. 20 = 2), position data will be saved in the battery backup memory for position Nos. 1 to 10000, and in the flash ROM of the main CPU for position Nos. 10001 to 20000. Accordingly, turning off the power or performing a software reset without writing the data to the flash ROM will result in loss of data of position Nos. 10001 to 20000. When the power is turned on again, the effective data last written to the flash ROM will be loaded. To save the above position data, always write the data to the flash ROM. Also note that when the backup memory is not used (other parameter No. 20 = 2), all position data of Nos. 1 to 20000 will be saved in the flash ROM of the main CPU. To save the position data, also write the data to the flash ROM.

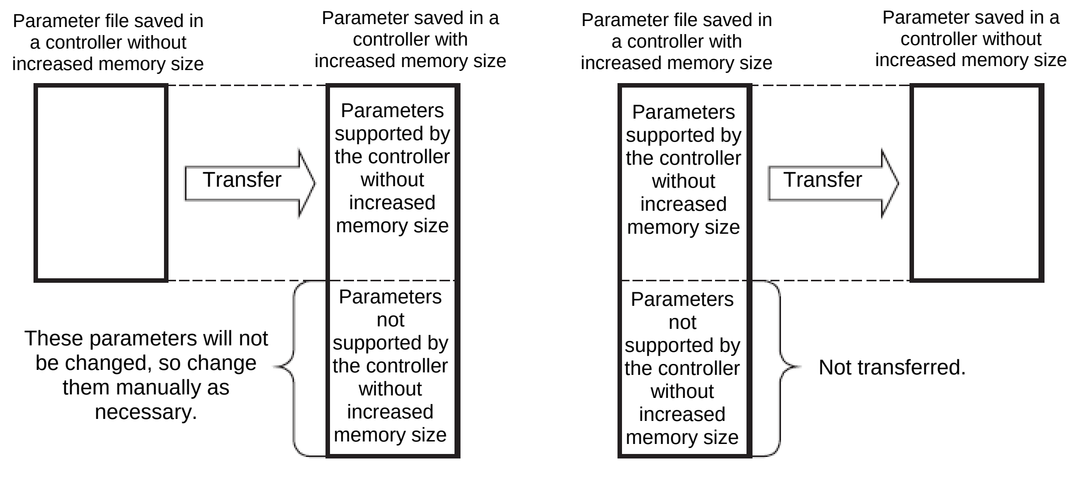
Note on increased parameters

On controllers with increased memory size (with gateway function), the number of parameters has been increased.

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

Take note of the following points:

* When a parameter file saved in a controller without increased memory size is transferred to a controller with increased memory size, or when a parameter file saved in a controller with increased memory size is transferred to a controller without increased memory size, only the parameters supported by the controller without increased memory size will be transferred, as shown below.



Transferring a parameter file saved in a controller without increased memory size to a controller with increased memory size

Transferring a parameter file saved in a controller with increased memory size to a controller without increased memory size

Chapter 2 X-SEL Language Data

1. Values and Symbols Used in SEL Language

1.1 List of Values and Symbols Used

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

Function		Global range	Local range	Remarks
Input port		000 ~ 299 (300)		Varies depending on the function.
Output port		300 ~ 599 (300)		Varies depending on the function.
Flag		600 ~ 899 (300)	900 ~ 999 (100)	
Variable (integer)		200 ~ 299 (100) 1200 ~ 1299 (100)	1 ~ 99 (99) 1001 ~ 1099 (99)	99 is used for IN, INB, OUT, OUTB, etc.
Variable (real)		300 ~ 399 (100) 1300 ~ 1399 (100)	100 ~ 199 (100) 1100 ~ 1199 (100)	199 is used for PPUT, PGET, PARG, etc.
String		300 ~ 999 (700)	1 ~ 299 (299)	
Tag number			1 ~ 256 (256)	
Subroutine number			1 ~ 99 (99)	
Load coordinate system		0 ~ 31 (32)		SCARA axis only
Tool coordinate system		0 ~ 127 (128)		SCARA axis only
Simple interference check zone number		1 ~ 10 (10)		SCARA axis only
Zone number		1 ~ 4 (4)		Linear movement axis only
Pallet number			1 ~ 10 (10)	
Axis number		1 ~ 6 (6)		Varies depending on the function.
Axis pattern		0 ~ 111111		
Position number	Controller with increased memory size (with gateway function)	1 ~ 20000 (20000)		
	Controller without increased memory size	1 ~ 4000 (40000)		
Program number	Controller with increased memory size (with gateway function)	1 ~ 128 (128)		
	Controller without increased memory size	1 ~ 64 (64)		
Step number	Controller with increased memory size (with gateway function)	1 ~ 9999 (9999)		
	Controller without increased memory size	1 ~ 6000 (6000)		
Task level		NORMAL/HIGH (2)		
SIO channel number		1 ~ 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 ~ 7299 (300)		
Virtual output port (SEL user program → SEL system)		7300 ~ 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 X-SEL 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 9999.99 (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 accuracy 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 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 ~ 7040	(For future expansion = Use strictly prohibited)
7041 ~ 7070	(For future expansion = Use strictly prohibited)
7071	In AUTO mode
7072	During automatic operation
7073 ~ 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 ~ 7299	(For future expansion = Use strictly prohibited)

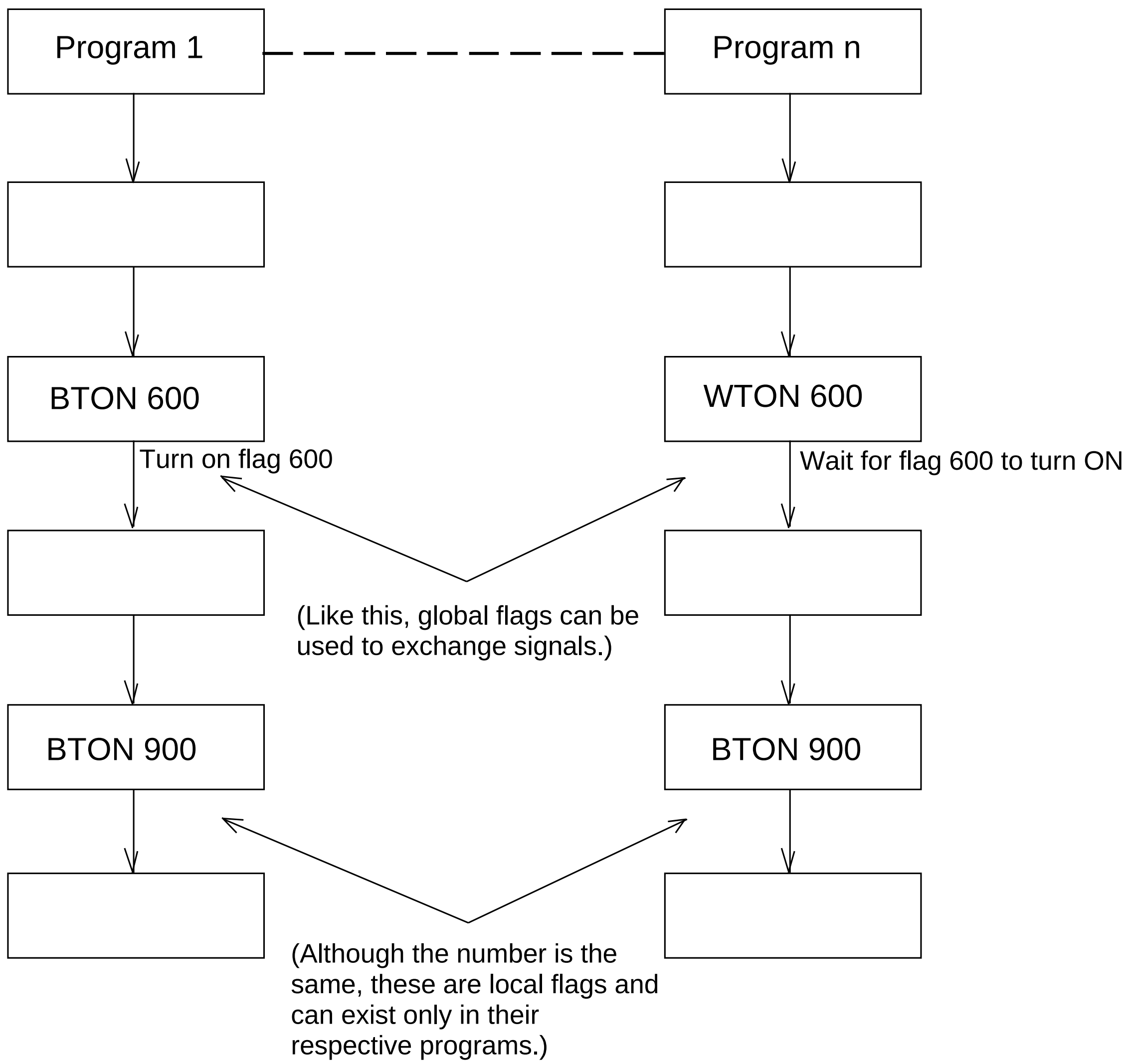
(2) Virtual output ports

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 ~ 7380	(For future expansion = Use strictly prohibited)
7381 ~ 7399	(For future expansion = Use strictly prohibited)
7400 ~ 7599	(For future expansion = Use strictly prohibited)

1.4 Flags

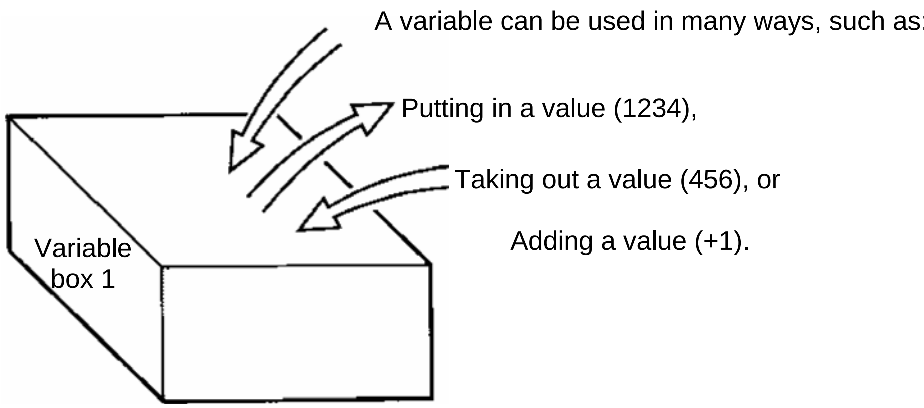
Contrary to its common meaning, the term “flag” as used in programming means “memory.” Flags are used to set or reset data. They correspond to “auxiliary relays” in a sequencer.
Flags are divided into global flags (Nos. 600 to 899) that can be used in all programs, and local flags (Nos. 900 to 999) that 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 ~ 899	Can be used in all programs “Global flags”
Flag number	900 ~ 999	Used only in each program “Local flags”



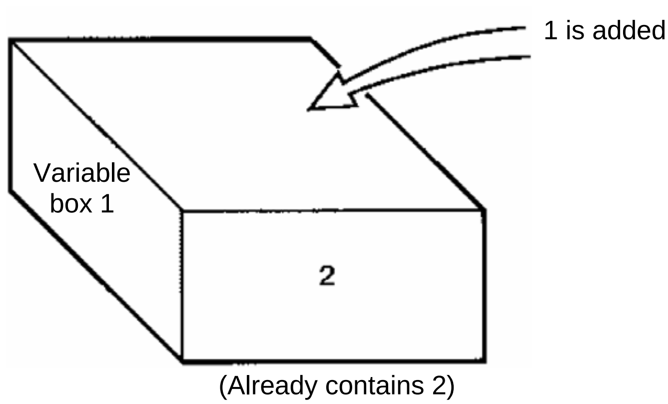
1.5 Variables

(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.



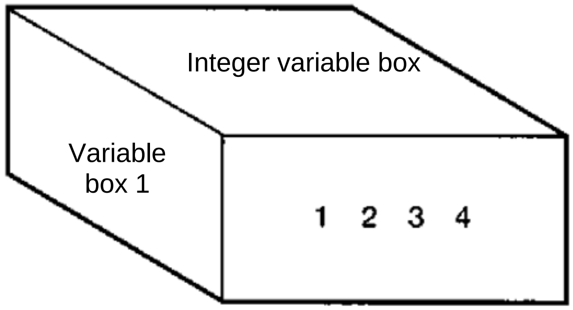
Command	Operand 1	Operand 2
ADD	1	1

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:

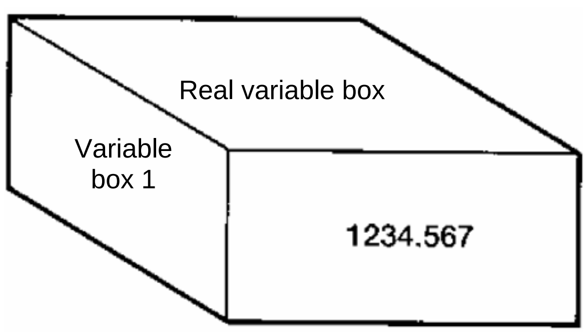
[1] Integer variables
These variables cannot handle decimal places.
[Example] 1234



Integer variable number	200 ~ 299 1200 ~ 1299	Can be used in all programs	“Global integer variables”
Integer variable number	1 ~ 99 1001 ~ 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)

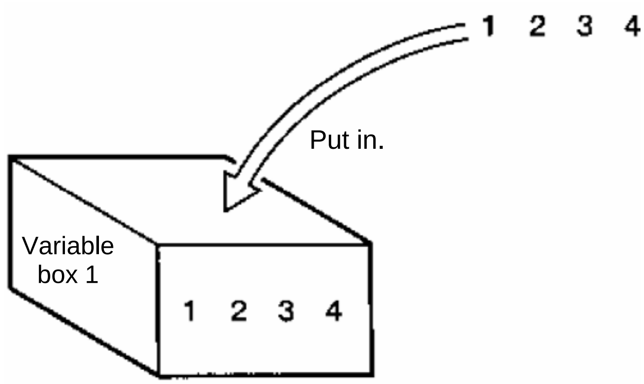


Real variable number	300 ~ 399 1300 ~ 1399	Can be used in all programs	“Global real variables”
Real variable number	100 ~ 199 1100 ~ 1199	Used only in each program	“Local real variables”

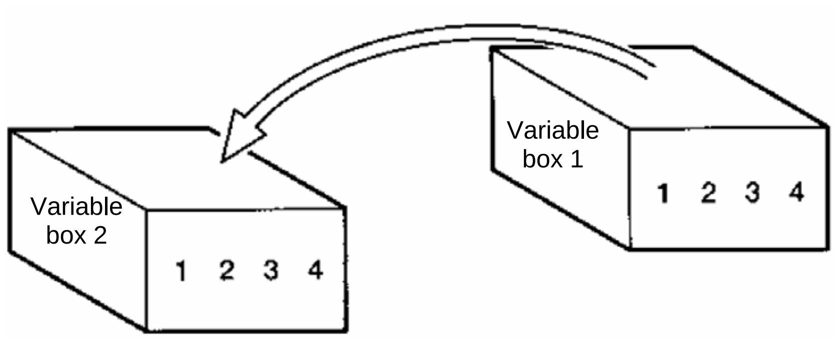
Caution Real number 199 is a special register this system uses in real-number operations. Any value in the range from –99,999.9 to 999,999.9 (eight digits including a sign) can be input in programs.

[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



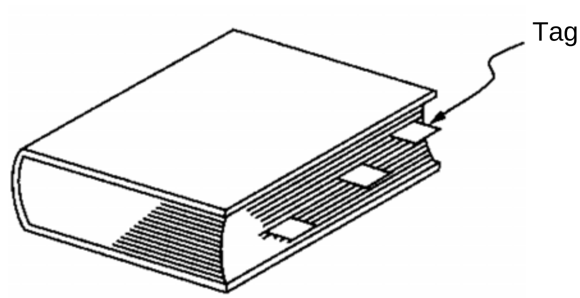
The above use of variables is called "indirect specification."

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).

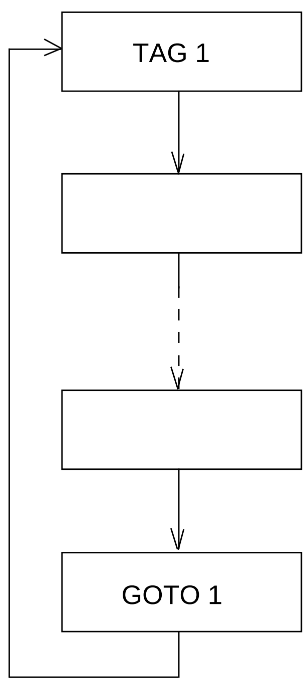
1.6 Tags

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 256)

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)

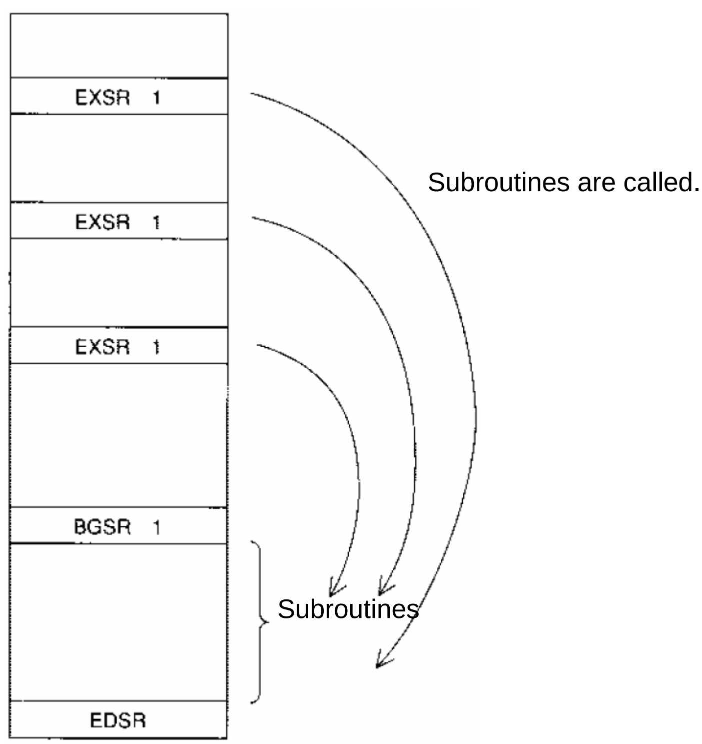
Subroutine execution command

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 X-SEL 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 X-SEL teaching pendant or “Symbol Edit Window” in the operation manual for X-SEL 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, or a constant.

(2) Description rules of symbols
[1] A maximum of nine bytes are used to represent alphanumeric characters (the length of a character string literal must not exceed eight 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, one 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 one 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
    ↓
0011 ---  The two 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 the 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

X-SEL 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 ~ 2000 mm/sec

*2
Standard
0.3 G

*2
Standard
0.3 G

Position No.	Axis 1	Axis 2	Axis 3	Axis 4	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

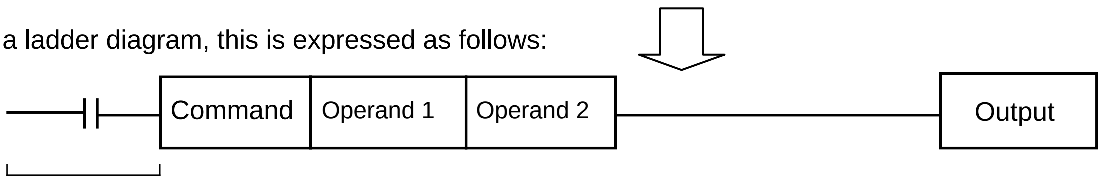
The primary feature of SEL language is its very simple command structure. Since the structure is simple, there is no need for a compiler (to translate into computer language) and high speed operation is possible via an interpreter (the program runs as commands are translated).

3.1 SEL language Structure

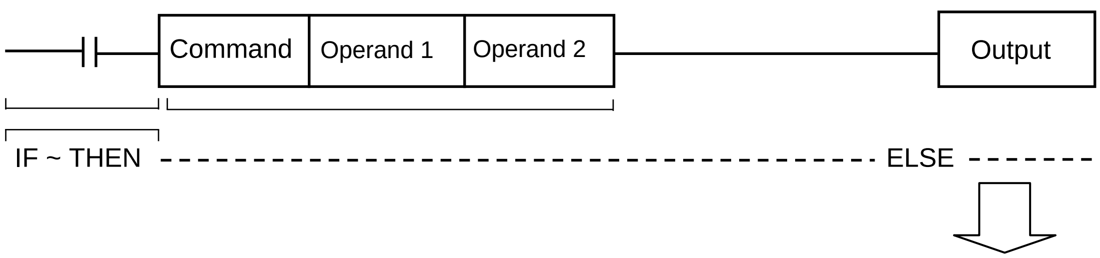
The table below shows the structure of one command step.

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:

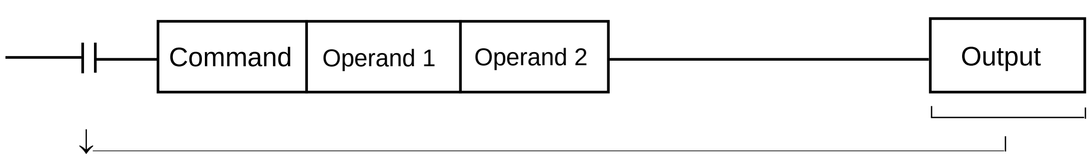


(1) The condition before the command is equivalent to “IF ~ THEN…” in BASIC.



[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 (“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:

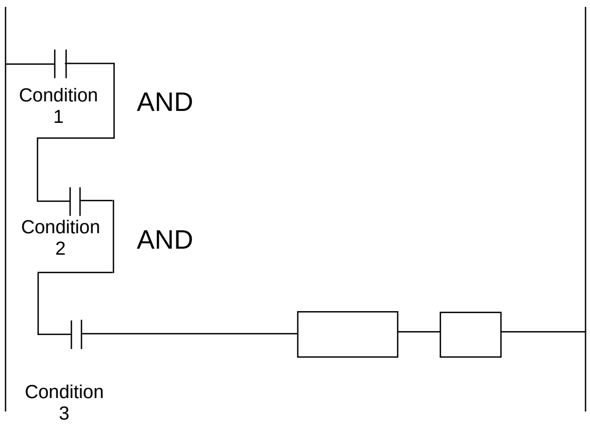


[1] In the case of a control command relating to actuator operation, etc., the output will turn OFF the moment the execution of command is started, and turn ON when the execution is completed. In the case of a calculation operation command, etc., the output will turn ON if the result corresponds to a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

3.2 Extension Condition

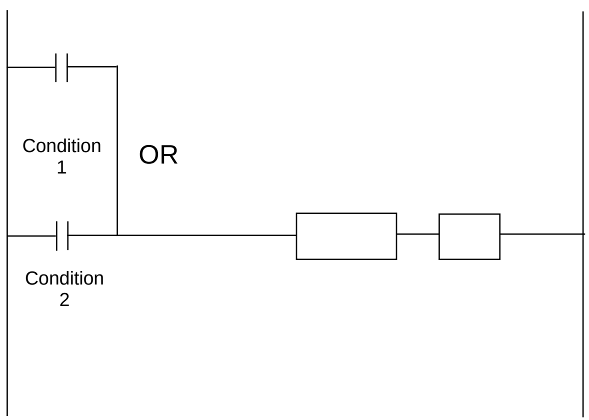
Conditions can be combined in a complex manner.

AND extension (Ladder diagram) (SEL language)



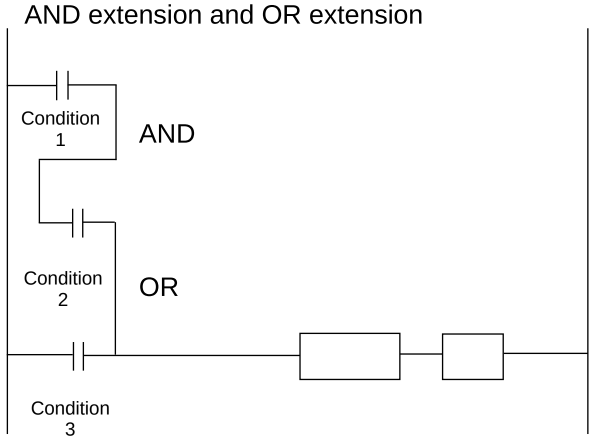
Extension condition	Input condition	Command			Output
		Command	Operand 1	Operand 2	
	Condition 1				
A	Condition 2				
A	Condition 3	Command	Operand 1	Operand 2	

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) 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	141
	Optional	TRAN	Copy destination variable	Copy source variable	ZR	Copy	141
	Optional	CLR	Start of clear variable	End of clear variable	ZR	Clear variable	142
Arithmetic operation	Optional	ADD	Augend variable	Addend	ZR	Add	143
	Optional	SUB	Minuend variable	Subtrahend	ZR	Subtract	143
	Optional	MULT	Multiplicand variable	Multiplier	ZR	Multiply	144
	Optional	DIV	Dividend variable	Divisor	ZR	Divide	144
	Optional	MOD	Remainder assignment variable	Divisor	ZR	Calculate remainder	145
Function operation	Optional	SIN	Sine assignment variable	Operand [radian]	ZR	Sine	146
	Optional	COS	Cosine assignment variable	Operand [radian]	ZR	Cosine	147
	Optional	TAN	Tangent assignment variable	Operand [radian]	ZR	Tangent	148
	Optional	ATN	Inverse-tangent assignment operation	Operand	ZR	Inverse tangent	149
	Optional	SQR	Root assignment variable	Operand	ZR	Root	150
Logical operation	Optional	AND	AND operand variable	Operand	ZR	Logical AND	151
	Optional	OR	OR operand variable	Operand	ZR	Logical OR	152
	Optional	EOR	Exclusive OR operand variable	Operand	ZR	Logical exclusive OR	153
Comparison	Optional	CP☐☐	Comparison variable	Comparison value	EQ, NE, GT, GE, LT, LE	Compare	154
Timer	Optional	TIMW	Wait time (sec)	Prohibited	TU	Wait	155
	Optional	TIMC	Program number	Prohibited	CP	Cancel waiting	156
	Optional	GTTM	Time assignment variable	Prohibited	CP	Get time	157
I/O, flag operation	Optional	BT☐☐	Start output, flag	(End output, flag)	CP	Output, flag [ON, OF, NT]	158
	Optional	BTPN	Output port, flag	Timer setting	CP	Output ON pulse	159
	Optional	BTPF	Output port, flag	Timer setting	CP	Output OFF pulse	160
	Optional	WT☐☐	I/O, flag	(Wait time)	TU	Wait for I/O, flag [ON, OF]	161
	Optional	IN	Head I/O, flag	End I/O, flag	CC	Input binary (32 bits max.)	162
	Optional	INB	Head I/O, flag	Conversion digits	CC	Input BCD (8 digits max.)	163
	Optional	OUT	Head output, flag	End I/O, flag	CC	Output binary (32 bits max.)	164
	Optional	OUTB	Head output, flag	Conversion digits	CC	Output BCD (8 digits max.)	165
	Optional	FMIO	Format type	Prohibited	CP	Set IN (B)/OUT (B) command format	166

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	169
	Prohibited	TAG	Declaration tag number	Prohibited	CP	Declare jump destination	169
	Optional	EXSR	Execution subroutine number	Prohibited	CP	Execute subroutine	170
	Prohibited	BGSR	Declaration subroutine number	Prohibited	CP	Start subroutine	170
	Prohibited	EDSR	Prohibited	Prohibited	CP	End subroutine	171
Task management	Optional	EXIT	Prohibited	Prohibited	CP	End program	172
	Optional	EXPG	Execution program number	(Execution program number)	CC	Start program	173
	Optional	ABPG	Stop program number	(Stop program number)	CC	Stop other program	174
	Optional	SSPG	Pause program number	(Pause program number)	CC	Pause program	175
	Optional	RSPG	Resumption program number	(Resumption program number)	CC	Resume program	176
Position operation	Optional	PGET	Axis number	Position number	CC	Assign position to variable 199	177
	Optional	PPUT	Axis number	Position number	CP	Assign value of variable 199	178
	Optional	PCLR	Start position number	End position number	CP	Clear position data	179
	Optional	PCPY	Copy destination position number	Copy source position number	CP	Copy position data	180
	Optional	PRED	Read axis pattern	Save destination position number	CP	Read current axis position	181
	Optional	PRDQ	Axis number	Variable number	CP	Read current axis position (1 axis direct)	182
	Optional	PTST	Confirmation axis pattern	Confirmation position number	CC	Confirm position data	183
	Optional	PVEL	Speed [mm/sec]	Assignment destination position number	CP	Assign position speed	184
	Optional	PACC	Acceleration [G]	Assignment destination position number	CP	Assign position acceleration	185
	Optional	PDCL	Deceleration [G]	Assignment destination position number	CP	Assign position deceleration	186
	Optional	PAXS	Axis pattern assignment variable number	Position number	CP	Read axis pattern	187
	Optional	PSIZ	Size assignment variable number		CP	Confirm position size	188
	Optional	GVEL	Variable number	Position number	CP	Get speed data	189
	Optional	GACC	Variable number	Position number	CP	Get acceleration data	190
	Optional	GDCL	Variable number	Position number	CP	Get deceleration data	191

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 declaration	Optional	VEL	Speed [mm/sec]	Prohibited	CP	Set speed	192
	Optional	VELS	Ratio [%]	Prohibited	CP	Set speed ratio for PTP operation (SCARA only)	193
	Optional	OVRD	Speed ratio [%]	Prohibited	CP	Set speed coefficient	194
	Optional	ACC	Acceleration [G]	Prohibited	CP	Set acceleration	195
	Optional	ACCS	Ratio [%]	Prohibited	CP	Set acceleration ratio for PTP operation (SCARA only)	196
	Optional	DCL	Deceleration [G]	Prohibited	CP	Set deceleration	197
	Optional	DCLS	Ratio [%]	Prohibited	CP	Set deceleration ratio for PTP operation (SCARA only)	198
	Optional	VLMX	Prohibited	Prohibited	CP	Specify VLMX speed (Linear movement axis only)	199
	Optional	SCRV	Ratio [%]	Prohibited (S-motion type)	CP	Set sigmoid motion ratio	200
	Optional	OFST	Setting axis pattern	Offset value [mm]	CP	Set offset	202
	Optional	DEG	Division angle [deg]	Prohibited	CP	Set division angle	203
	Optional	BASE	Reference axis number	Prohibited	CP	Set reference axis	204
	Optional	GRP	Valid axis pattern	Prohibited	CP	Set group axes	205
	Optional	HOLD	(Input port to pause)	(HOLD type)	CP	Declare port to pause	206
	Optional	CANC	(Input port to abort)	(CANC type)	CP	Declare port to abort	207
	Optional	DIS	Distance	Prohibited	CP	Set spline division distance	208
	Optional	POTP	0 or 1	Prohibited	CP	Set PATH output type	209
	Optional	PAPR	Distance	Speed	CP	Set PUSH command distance, speed	210
	Optional	DFTL	Tool coordinate system number	Position number	CP	Define tool coordinate system (SCARA only)	211
	Optional	SLTL	Tool coordinate system number	Prohibited	CP	Select tool coordinate system (SCARA only)	212
	Optional	GTTL	Tool coordinate system number	Position number	CP	Get tool coordinate system definition data (SCARA only)	213
	Optional	DFWK	Load coordinate system number	Position number	CP	Define load coordinate system (SCARA only)	214
	Optional	SLWK	Load coordinate system number	Prohibited	CP	Select load coordinate system (SCARA only)	215
	Optional	GTWK	Load coordinate system number	Position number	CP	Get load coordinate system definition data (SCARA only)	216
	Optional	RIGH	Prohibited	Prohibited	PE	Change current arm system to right arm (Arm 2 may operate if the current arm system is the opposite arm) (SCARA only)	217
	Optional	LEFT	Prohibited	Prohibited	PE	Change current arm system to left arm (Arm 2 may operate if the current arm system is the opposite arm) (SCARA only)	218
	Optional	PTPR	Prohibited	Prohibited	CP	Specify right arm as PTP target arm system (Movement of the opposite arm system is prohibited when the target value cannot be achieved) (No arm operation) (SCARA only)	219
	Optional	PTPL	Prohibited	Prohibited	CP	Specify left arm as PTP target arm system (Movement of the opposite arm system is prohibited when the target value cannot be achieved) (No arm operation) (SCARA only)	220
	Optional	PTPD	Prohibited	Prohibited	CP	Specify current arm as PTP target arm system (Movement of the opposite arm system is prohibited when the target value cannot be achieved) (No arm operation) (SCARA only)	221
	Optional	PTPE	Prohibited	Prohibited	CP	Specify current arm as PTP target arm system (Movement of the opposite arm system is permitted when the target value cannot be achieved) (No arm operation) (SCARA only)	222
	Optional	DFIF	Interference check zone number	Position number	CP	Define coordinates of simple interference check zone (SCARA only)	223
	Optional	SOIF	Interference check zone number	Output/global flag number	CP	Specify output for simple interference check zone (SCARA only)	224
	Optional	SEIF	Interference check zone number	0 or 1 or 2 (Error type)	CP	Specify error type for simple interference check zone (SCARA only)	225
	Optional	GTIF	Interference check zone number	Position number	CP	Get definition coordinates of simple interference check zone (SCARA only)	226
	Optional	WGHT	Mass	(Inertial moment)	CP	Set tip load mass/inertial moment	227

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	HOME	Home-return axis pattern	Prohibited	PE	Return to home (Linear movement axis only)	228
	Optional	SV☐☐	Operation axis pattern	Prohibited	PE	Servo [ON, OF]	229
	Optional	MOVP	Destination position number	Prohibited	PE	Move to specified position	230
	Optional	MOVL	Destination position number	Prohibited	PE	Move to specified position via interpolation	231
	Optional	MVPI	Travel position number	Prohibited	PE	Move to relative position	232
	Optional	MVLI	Travel position number	Prohibited	PE	Move to relative position via interpolation	233
	Optional	PATH	Start position number	End position number	PE	Move along path	234
	Optional	J☐W☐	Axis operation pattern	Start I/O, flag	PE	Jog [FN, FF, BN, BF]	235
	Optional	STOP	Axis stop pattern	Prohibited	CP	Decelerate and stop axis	237
	Optional	PSPL	Start position number	End position number	PE	Move along spline	238
	Optional	PUSH	Target position number	Prohibited	PE	Move by push motion	239
	Optional	CIR2	Passing position 1 number	Passing position 2 number	PE	Move along circle 2 (arc interpolation)	241
	Optional	ARC2	Passing position number	End position number	PE	Move along arc 2 (arc interpolation)	243
	Optional	CIRS	Passing position 1 number	Passing position 2 number	PE	Move three dimensionally along circle	245
	Optional	ARCS	Passing position number	Passing position number	PE	Move three dimensionally along arc	247
	Optional	ARCD	End position number	Center angle [deg]	PE	Move along arc via specification of end position and center angle	249
	Optional	ARCC	Center position number	Center angle [deg]	PE	Move along arc via specification of center position and center angle	251
	Optional	CHVL	Axis pattern	Speed	CP	Change speed (Linear movement axis only)	253
	Optional	PBND	Axis pattern	Distance	CP	Set positioning band	255
	Optional	TMPI	Position number	Prohibited	PE	Move relatively between positions on tool coordinate system (SCARA only)	256
	Optional	TMLI	Position number	Prohibited	PE	Move relatively between positions on tool coordinate system via interpolation (SCARA only)	257
	Optional	PTRQ	Axis pattern	Ratio [%]	CC	Change push torque limit parameter	258
	Optional	CIR	Passing position 1 number	Passing position 2 number	PE	Move along circle (CIR2 is recommended)	259
	Optional	ARC	Passing position number	End position number	PE	Move along arc (ARC2 is recommended)	260
	Refer to the page on palletizing for commands relating to arch motion.						
	Optional	ARCH	Position number	Position number	PE	Arch motion	315
	Optional	ACHZ	Axis number	Prohibited	CP	Declare arch motion Z-axis	305
	Optional	ATRG	Position number	Position number	CP	Set arch trigger	306
	Optional	AEXT	(Position number)	Prohibited	CP	Set arch motion composition	307
	Optional	OFAZ	Offset value	Prohibited	CP	Set arch motion Z-axis offset	307
Structural IF	Optional	IF☐☐	Comparison variable	Comparison value	CP	Compare [EQ, NE, GT, GE, LT, LE]	261
	Optional	IS☐☐	Column number	Column number, character literal	CP	Compare strings	262
	Prohibited	ELSE	Prohibited	Prohibited	CP	Declare execution destination when IF command condition is not satisfied	263
	Prohibited	EDIF	Prohibited	Prohibited	CP	Declare end of IF	263
Structural DO	Optional	DW☐☐	Comparison variable	Comparison value	CP	Loop [EQ, NE, GT, GE, LT, LE]	264
	Optional	LEAV	Prohibited	Prohibited	CP	Pull out from DO	264
	Optional	ITER	Prohibited	Prohibited	CP	Repeat DO	265
	Prohibited	EDDO	Prohibited	Prohibited	CP	Declare end of DO	265
Multi-branching	Optional	SLCT	Prohibited	Prohibited	CP	Declare start of multi-branching	266
	Prohibited	WH☐☐	Comparison variable	Comparison value	CP	Branch value [EQ, NE, GT, GE, LT, LE]	267
	Prohibited	WS☐☐	Column number	Column number, character literal	CP	Branch character string [EQ, NE]	268
	Prohibited	OTHE	Prohibited	Prohibited	CP	Declare branching destination when condition is not satisfied	269
	Prohibited	EDSL	Prohibited	Prohibited	CP	Declare end of SLCT	269

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	270
	Optional	PGST	Variable number	Program number	CP	Get program status	271
	Optional	SYST	Variable number	Prohibited	CP	Get system status	272
	Optional	GARM	Variable number	Prohibited	CP	Get current arm system	273
Zone	Optional	WZNA	Zone number	Axis pattern	CP	Wait for zone ON, with AND (Linear movement axis only)	274
	Optional	WZNO	Zone number	Axis pattern	CP	Wait for zone ON, with OR (Linear movement axis only)	275
	Optional	WZFA	Zone number	Axis pattern	CP	Wait for zone OFF, with AND (Linear movement axis only)	276
	Optional	WZFO	Zone number	Axis pattern	CP	Wait for zone OFF, with OR (Linear movement axis only)	277
Communication	Optional	OPEN	Channel number	Prohibited	CP	Open channel	278
	Optional	CLOS	Channel number	Prohibited	CP	Close channel	278
	Optional	READ	Channel number	Column number	CC	Read from channel	279
	Optional	TMRW	Read timer setting	(Write timer setting)	CP	Set READ timeout value	281
	Optional	WRIT	Channel number	Column number	CC	Output to channel	282
	Optional	SCHA	Character code	Prohibited	CP	Set end character	283
String operation	Optional	SCPY	Column number	Column number, character literal	CC	Copy character string	284
	Optional	SCMP	Column number	Column number, character literal	EQ	Compare character strings	285
	Optional	SGET	Variable number	Column number, character literal	CP	Get character	286
	Optional	SPUT	Column number	Data	CP	Set character	287
	Optional	STR	Column number	Data	CC	Convert character string; decimal	288
	Optional	STRH	Column number	Data	CC	Convert character string; hexadecimal	289
	Optional	VAL	Variable number	Column number, character literal	CC	Convert character string data; decimal	290
	Optional	VALH	Variable number	Column number, character literal	CC	Convert character string data; hexadecimal	291
	Optional	SLEN	Character string length	Prohibited	CP	Set length	292

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	293
	Prohibited	EDPA	Prohibited	Prohibited	CP	Declare end of palletizing setting	293
	Optional	PAPI	Count	Count	CP	Set palletizing counts	294
	Optional	PAPN	(Pattern number)	Prohibited	CP	Set palletizing pattern	294
	Optional	PASE	Axis number	Axis number	CP	Set palletizing axes	295
	Optional	PAPT	Pitch	Pitch	CP	Set palletizing pitches	295
	Optional	PAST	Position number	Prohibited	CP	Set palletizing reference point	296
	Optional	PAPS	Position number	Palletizing position setting type	CP	Set 3 palletizing points for 4-point teaching	297
	Optional	PSLI	Offset amount	(Count)	CP	Set zigzag	301
	Optional	PCHZ	Axis number	Prohibited	CP	Set palletizing Z-axis (SCARA only)	302
	Optional	PTRG	Position number	Position number	CP	Set palletizing arch triggers (SCARA only)	303
	Optional	PEXT	(Position number)	Prohibited	CP	Set palletizing composition (SCARA only)	304
	Optional	OFPZ	Offset amount	Prohibited	CP	Set palletizing Z-axis offset (SCARA only)	304
	Optional	ACHZ	Axis number	Prohibited	CP	Declare arch motion Z-axis	305
	Optional	ATRG	Position number	Position number	CP	Set arch triggers	306
	Optional	AEXT	(Position number)	Prohibited	CP	Set arch motion composition (SCARA only)	307
	Optional	OFAZ	Offset amount	Prohibited	CP	Set arch motion Z-axis offset	307
	Optional	PTNG	Palletizing number	Variable number	CP	Get palletizing position number	308
	Optional	PINC	Palletizing number	Prohibited	CC	Increment palletizing position number by 1	308
	Optional	PDEC	Palletizing number	Prohibited	CC	Decrement palletizing position number by 1	309
	Optional	PSET	Palletizing number	Data	CC	Set palletizing position number directly	309
	Optional	PARG	Palletizing number	Axis number	CP	Get palletizing angle	310
	Optional	PAPG	Palletizing number	Position number	CP	Get palletizing calculation data	310
	Optional	PMVP	Palletizing number	(Position number)	PE	Move to palletizing points via PTP	311
	Optional	PMVL	Palletizing number	(Position number)	PE	Move to palletizing points via interpolation (Linear movement axis only)	312
	Optional	PACH	Palletizing number	Position number	PE	Palletizing-point arch motion (SCARA only)	313
	Optional	ARCH	Position number	Position number	PE	Arch motion	315
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	317
	Prohibited	TPCD	0 or 1	Prohibited	CP	Specify processing to be performed when input condition is not specified	317
	Prohibited	TSLP	Time	Prohibited	CP	Task sleep	318
	Optional	OUTR	Output, flag number	Prohibited	CP	Output relay for ladder	373
	Optional	TIMR	Local flag number	Timer setting	CP	Timer relay for ladder	373
Extended commands	Optional	ECMD	1	Axis number	CC	Get motor current value	319
	Optional	ECMD	2	Axis number	CC	Get home sensor status	319
	Optional	ECMD	3	Axis number	CC	Get overrun sensor status	320
	Optional	ECMD	4	Axis number	CC	Get creep sensor status	320
	Optional	ECMD	250	Axis pattern	CC	Set torque limit/detection time for torque limit over error	321

RC Gateway Function Commands (Controllers with Gateway Function Only)

* For the RC gateway function commands, refer to "Operation Manual for X-SEL Controller P/Q/PX/QX RC Gateway Function."

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	RC position data use mode		Operand 1	Operand 2	Output	Function
			In X-SEL	In RC				
RC axis position operation	Optional	RPGT	O	X	RC axis number	Position number	CC	Assign RC axis position to variable 199
	Optional	RPPT	O	X	RC axis number	Position number	CP	Assign variable 199 to RC axis position
	Optional	RPCR	O	X	RC axis number	Variable number	CP	Clear RC axis position data
	Optional	RPCP	O	X	RC axis number	Variable number	CP	Copy RC axis position data
	Optional	RPRD	O	X	Position number	Prohibited	CP	Read current RC axis position
	Optional	RPRQ	O	O	RC axis number	Variable number	CP	Read current RC axis position (1 axis, direct)
	Optional	RPVL	O	X	RC axis number	Position number	CP	Assign variable 199 to RC axis position speed
	Optional	RPAD	O	X	RC axis number	Position number	CP	Assign variable 199 to RC axis position acceleration/deceleration
	Optional	RPIP	O	X	RC axis number	Position number	CP	Assign variable 199 to RC axis position positioning band
	Optional	RPTQ	O	X	RC axis number	Position number	CP	Assign variable 199 to RC axis position current-limiting value
	Optional	RGVL	O	X	RC axis number	Position number	CP	Assign RC axis position speed to variable 199
	Optional	RGAD	O	X	RC axis number	Position number	CP	Assign RC axis position acceleration/deceleration to variable 199
	Optional	RGIP	O	X	RC axis number	Position number	CP	Assign RC axis position positioning band to variable 199
	Optional	RGTQ	O	X	RC axis number	Position number	CP	Assign RC axis position current-limiting value to variable 199
RC actuator control command	Optional	RAXS	O	O	Axis pattern, upper	Axis pattern, lower	CP	Set RC axis pattern
	Optional	RSON	O	O	Prohibited	Prohibited	PE	Turn RC axis servo ON
	Optional	RSOF	O	O	Prohibited	Prohibited	PE	Turn RC axis servo OFF
	Optional	RHOM	O	O	Prohibited	Prohibited	PE	Return RC axis to its home
	Optional	RMVP	O	O	Position number	Prohibited	PE	Move by RC axis position specification
	Optional	RMPI	O	X	Position number	Prohibited	PE	Incremental move by RC axis position specification
	Optional	RMVD	O	X	RC axis number	Variable number	PE	Move by RC axis direct specification
	Optional	RMDI	O	X	RC axis number	Variable number	PE	Incremental move by RC axis direct specification
	Optional	RPUS	O	X	RC axis number	Position number	PE	Move by RC axis push-motion operation
	Optional	RSTP	O	O	Prohibited	Prohibited	PE	Decelerate RC axis to stop
RC axis information acquisition	Optional	RCST	O	O	Variable number	RC axis number	PE	Get RC axis status

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	174	Optional	Stop program number	(Stop program number)	CC	Stop other program
ACC	195	Optional	Acceleration	Prohibited	CP	Set acceleration
ACCS	196	Optional	Ratio [%]	Prohibited	CP	Set acceleration ratio in PTP operation (SCARA only)
ACHZ	305	Optional	Axis number	Prohibited	CP	Declare arch motion Z-axis
ADD	143	Optional	Augend variable	Addend	ZR	Add
AEXT	307	Optional	(Position number)	Prohibited	CP	Set arch motion composition (SCARA only)
AND	151	Optional	AND operand variable	Operand	ZR	Logical AND
ARC	260	Optional	Passing position number	End position number	PE	Move along arc
ARC2	243	Optional	Passing position number	End position number	PE	Move along arc 2
ARCC	251	Optional	Center position number	Center angle	PE	Move along arc via specification of center position and center angle
ARCD	249	Optional	End position number	Center angle	PE	Move along arc via specification of end position and center angle
ARCH	315	Optional	Position number	Position number	PE	Arch motion
ARCS	247	Optional	Passing position number	Passing position number	PE	Move along arc three-dimensionally
ATN	149	Optional	Inverse tangent assignment operation	Operand	ZR	Inverse tangent
ATRG	306	Optional	Position number	Position number	CP	Set arch trigger
AXST	270	Optional	Variable number	Axis number	CP	Get axis status
B						
BASE	204	Optional	Reference axis number	Prohibited	CP	Set reference axis
BGPA	293	Optional	Palletizing number	Prohibited	CP	Declare start of palletizing setting
BGSR	170	Prohibited	Declaration subroutine number	Prohibited	CP	Start subroutine
BTPF	160	Optional	Output port, flag	Timer setting	CP	Output OFF pulse
BTPN	159	Optional	Output port, flag	Timer setting	CP	Output ON pulse
BT□□	158	Optional	Start output, flag	(End output, flag)	CP	Output, flag [ON, OF, NT]
C						
CANC	207	Optional	(Input port to abort)	(CANC type)	CP	Declare port to abort
CHPR	317	Optional	0 or 1	Prohibited	CP	Change task level
CHVL	253	Optional	Axis pattern	Speed	CP	Change speed (Linear movement axis only)
CIR	259	Optional	Passing position 1 number	Passing position 2 number	PE	Move along circle
CIR2	241	Optional	Passing position 1 number	Passing position 2 number	PE	Move along circle 2
CIRS	245	Optional	Passing position 1 number	Passing position 2 number	PE	Move three dimensionally along circle
CLOS	278	Optional	Channel number	Prohibited	CP	Close channel
CLR	142	Optional	Start of clear variable	End-of-clear variable	ZR	Clear variable
COS	147	Optional	Cosine assignment variable	Operand	ZR	Cosine
CP□□	154	Optional	Comparison variable	Comparison value	EQ NE GT GE LT LE	Compare
D						
DCL	197	Optional	Deceleration	Prohibited	CP	Set deceleration
DCLS	198	Optional	Ratio [%]	Prohibited	CP	Set acceleration ratio in PTP operation (SCARA only)
DEG	203	Optional	Division angle	Prohibited	CP	Set division angle
DFIF	223	Optional	Interference check zone number	Psition number	CP	Define coordinates of simple interference check zone (SCARA only)
DFTL	221	Optional	Tool coordinate system number	Psition number	CP	Define tool coordinate system (SCARA only)
DFWK	214	Optional	Load coordinate system number	Psition number	CP	Define load coordinate system (SCARA only)
DIS	208	Optional	Distance	Prohibited	CP	Set spline division distance
DIV	144	Optional	Dividend variable	Divisor	ZR	Divide
DW□□	264	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	319	Optional	1	Axis number	CC	Get motor current value
ECMD	319	Optional	2	Axis number	CC	Get home sensor status
ECMD	320	Optional	3	Axis number	CC	Get overrun sensor status
ECMD	320	Optional	4	Axis number	CC	Get creep sensor status
ECMD	321	Optional	250	Axis pattern	CC	Set torque limit/detection time for torque limit over error
EDDO	265	Prohibited	Prohibited	Prohibited	CP	Declare end of DO
EDIF	263	Prohibited	Prohibited	Prohibited	CP	Declare end of IF
EDPA	293	Prohibited	Prohibited	Prohibited	CP	Declare end of palletizing setting
EDSL	269	Prohibited	Prohibited	Prohibited	CP	Declare end of SLCT
EDSR	171	Prohibited	Prohibited	Prohibited	CP	End subroutine
ELSE	263	Prohibited	Prohibited	Prohibited	CP	Declare execution destination when IF command condition is not satisfied
EOR	153	Optional	Exclusive OR operand variable	Operand	ZR	Logical exclusive OR
EXIT	172	Optional	Prohibited	Prohibited	CP	End program
EXPG	170	Optional	Execution program number	(Execution program number)	CC	Start program
EXSR	170	Optional	Execution subroutine number	Prohibited	CP	Execute subroutine
F						
FMIO	166	Optional	Format type	Prohibited	CP	Set IN (B)/OUT (B) command format
G						
GACC	190	Optional	Variable number	Position number	CP	Get acceleration data
GARM	273	Optional	Variable number	Prohibited	CP	Get current arm system
GDCL	191	Optional	Variable number	Position number	CP	Get deceleration data
GOTO	169	Optional	Jump destination tag number	Prohibited	CP	Jump
GRP	205	Optional	Valid axis pattern	Prohibited	CP	Set group axes
GTIF	226	Optional	Interference check zone number	Position number	CP	Get definition coordinates of simple interference check zone (SCARA only)
GTTL	213	Optional	Tool coordinate system number	Position number	CP	Get tool coordinate system definition data (SCARA only)
GTTM	157	Optional	Time assignment variable	Prohibited	CP	Get time
GTWK	216	Optional	Load coordinate system number	Position number	CP	Get load coordinate system definition data (SCARA only)
GVEL	189	Optional	Variable number	Position number	CP	Get speed data
H						
HOLD	206	Optional	(Input port to pause)	(HOLD type)	CP	Declare port to pause
HOME	228	Optional	Home return axis pattern	Prohibited	PE	Return to home (Linear movement axis only)
I						
IF□□	261	Optional	Comparison variable	Comparison value	CP	Compare [EQ, NE, GT, GE, LT, LE]
INB	163	Optional	Head I/O, flag	Conversion digits	CC	Input BCD (8 digits max.)
IN	162	Optional	Head I/O, flag	End I/O, flag	CC	Input binary (32 bits max.)
IS□□	262	Optional	Column number	Column number, character literal	CP	Compare strings
ITER	265	Optional	Prohibited	Prohibited	CP	Repeat DO
J						
J□W□	235	Optional	Axis operation pattern	Start I/O, flag	PE	Jog [FN, FF, BN, BF]
L						
LEAV	264	Optional	Prohibited	Prohibited	CP	Pull out from DO
LEFT	218	Optional	Prohibited	Prohibited	PE	Change current arm system to left arm (SCARA only) (Arm 2 may operate if the current arm system is the opposite arm)
LET	141	Optional	Assignment variable	Assigned value	ZR	Assign

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
M						
MOD	145	Optional	Remainder assignment variable	Divisor	ZR	Calculate remainder
MOVL	231	Optional	Destination position number	Prohibited	PE	Move to specified position via interpolation
MOVP	230	Optional	Destination position number	Prohibited	PE	Move to specified position
MULT	144	Optional	Multiplicand variable	Multiplier	ZR	Multiply
MVLI	233	Optional	Travel position number	Prohibited	PE	Move to relative position via interpolation
MVPI	232	Optional	Travel position number	Prohibited	PE	Move to relative position
O						
OFAZ	307	Optional	Offset amount	Prohibited	CP	Set arch-motion Z-axis offset
OFPZ	304	Optional	Offset amount	Prohibited	CP	Set palletizing Z-axis offset (SCARA only)
OFST	202	Optional	Setting axis pattern	Offset value	CP	Set offset
OPEN	278	Optional	Channel number	Prohibited	CP	Open channel
OR	152	Optional	OR operand variable	Operand	ZR	Logical OR
OTHE	269	Prohibited	Prohibited	Prohibited	CP	Declare branching destination when condition is not satisfied
OUT	164	Optional	Head output, flag	End I/O, flag	CC	Output binary (32 bits max.)
OUTB	165	Optional	Head output, flag	Conversion digits	CC	Output BCD (8 digits max.)
OUTR	373	Optional	Output, flag number	Prohibited	CP	Output relay for ladder
OVRD	194	Optional	Speed ratio	Prohibited	CP	Set speed ratio
P						
PACC	185	Optional	Acceleration	Assignment destination position number	CP	Assign position acceleration
PACH	313	Optional	Palletizing number	Position number	PE	Palletizing point arch motion (SCARA only)
PAPG	310	Optional	Palletizing number	Position number	CP	Get palletizing calculation data
PAPI	294	Optional	Count	Count	CP	Set palletizing counts
PAPN	294	Optional	Pattern number	Prohibited	CP	Set palletizing pattern
PAPR	210	Optional	Distance	Speed	CP	Set PUSH command distance, speed
PAPS	297	Optional	Position number	Palletizing position setting type	CP	Set 3 palletizing points for 4-point teaching
PAPT	295	Optional	Pitch	Pitch	CP	Set palletizing pitches
PARG	310	Optional	Palletizing number	Axis number	CP	Get palletizing angle
PASE	295	Optional	Axis number	Axis number	CP	Set palletizing axes
PAST	296	Optional	(Position number)	Prohibited	CP	Set palletizing reference point
PATH	234	Optional	Start position number	End position number	PE	Move along path
PAXS	187	Optional	Axis pattern assignment variable number	Position number	CP	Read axis pattern
PBND	255	Optional	Axis pattern	Distance	CP	Set positioning band
PCHZ	302	Optional	Axis number	Prohibited	CP	Set palletizing Z-axis (SCARA only)
PCLR	179	Optional	Start position number	End position number	CP	Clear position data
PCPY	180	Optional	Copy destination position number	Copy source position number	CP	Copy position data
PDCL	186	Optional	Deceleration	Assignment-destination position number	CP	Assign position deceleration
PDEC	309	Optional	Palletizing number	Prohibited	CC	Decrement palletizing position number by 1
PEXT	304	Optional	(Position number)	Prohibited	CP	Set palletizing composition (SCARA only)
PGET	177	Optional	Axis number	Position number	CC	Assign position to variable 199
PGST	271	Optional	Variable number	Program number	CP	Get program status
PINC	308	Optional	Palletizing number	Prohibited	CC	Increment palletizing position number by 1
PMVL	312	Optional	Palletizing number	(Position number)	PE	Move to palletizing points via interpolation (Linear movement axis only)
PMVP	311	Optional	Palletizing number	(Position number)	PE	Move to palletizing points via PTP
POTP	209	Optional	0 or 1	Prohibited	CP	Set PATH output type
PPUT	178	Optional	Axis number	Position number	CP	Assign value of variable 199
PRDQ	182	Optional	Axis number	Variable number	CP	Read current axis position (1 axis direct)

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
P						
PRED	181	Optional	Read axis pattern	Save destination position number	CP	Read current axis position
PSET	309	Optional	Palletizing number	Data	CC	Set palletizing position number directly
PSIZ	188	Optional	Size assignment variable number		CP	Confirm position size
PSLI	301	Optional	Offset amount	(Count)	CP	Set zigzag
PSPL	238	Optional	Start position number	End position number	PE	Move along spline
PTNG	308	Optional	Palletizing number	Variable number	CP	Get palletizing position number
PTPD	221	Optional	Prohibited	Prohibited	CP	Specify current arm as PTP target arm system (SCARA only) (Movement of the opposite arm system is prohibited when the target value cannot be achieved) (No arm operation)
PTPE	222	Optional	Prohibited	Prohibited	CP	Specify current arm as PTP target arm system (SCARA only) (Movement of the opposite arm system is permitted when the target value cannot be achieved) (No arm operation)
PTPL	220	Optional	Prohibited	Prohibited	CP	Specify left arm as PTP target arm system (SCARA only) (Movement of the opposite arm system is prohibited when the target value cannot be achieved) (No arm operation)
PTPR	219	Optional	Prohibited	Prohibited	CP	Specify right arm as PTP target arm system (SCARA only) (Movement of the opposite arm system is prohibited when the target value cannot be achieved) (No arm operation)
PTRG	303	Optional	Position number	Position number	CP	Set palletizing arch triggers (SCARA only)
PTRQ	258	Optional	Axis pattern	Ratio	CC	Change push torque limit parameter
PTST	183	Optional	Confirmation axis pattern	Confirmation position number	CP	Confirm position data
PUSH	239	Optional	Target position number	Prohibited	PE	Move by push motion
PVEL	184	Optional	Speed	Assignment destination position number	CP	Assign position speed
R						
READ	279	Optional	Channel number	Column number	CC	Read from channel
RIGH	217	Optional	Prohibited	Prohibited	PE	Change current arm system to right arm (SCARA only) (Arm 2 may operate if the current arm system is the opposite arm)
RSPG	176	Optional	Resumption program number	(Resumption program number)	CC	Resume program
S						
SCHA	283	Optional	Character code	Prohibited	CP	Set end character
SCMP	285	Optional	Column number	Column number, character literal	EQ	Compare character strings
SCPY	284	Optional	Column number	Column number, character literal	CC	Copy character string
SCRV	200	Optional	Ratio	Prohibited (S-motion type)	CP	Set sigmoid motion ratio
SEIF	225	Optional	Interference check zone number	0 or 1 or 2 (Error type)	CP	Specify error type for simple interference check zone (SCARA only)
SGET	286	Optional	Variable number	Column number, character literal	CP	Get character
SIN	146	Optional	Sine assignment variable	Operand	ZR	Sine
SLCT	266	Optional	Prohibited	Prohibited	CP	Declare start of multi-branching
SLEN	292	Optional	Character string length	Prohibited	CP	Set length
SLTL	212	Optional	Tool coordinate system number	Prohibited	CP	Select tool coordinate system (SCARA only)
SLWK	215	Optional	Load coordinate system number	Prohibited	CP	Select load coordinate system (SCARA only)
SOIF	224	Optional	Interference check zone number	Output/global flag number	CP	Specify output for simple interference check zone (SCARA only)

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
S						
SPUT	287	Optional	Column number	Data	CP	Set character
SQR	150	Optional	Root assignment variable	Operand	ZR	Root
SSPG	175	Optional	Pause program number	(Pause program number)	CC	Pause program
STOP	237	Optional	Axis stop pattern	Prohibited	CP	Decelerate and stop axis
STR	288	Optional	Column number	Data	CC	Convert character string; decimal
STRH	289	Optional	Column number	Data	CC	Convert character string; hexadecimal
SUB	143	Optional	Minuend variable	Subtrahend	ZR	Subtract
SV☐☐	229	Optional	Operation axis pattern	Prohibited	PE	Servo [ON, OF]
SYST	272	Optional	Variable number	Prohibited	CP	Get system status
T						
TAG	169	Prohibited	Declaration tag number	Prohibited	CP	Declare jump destination
TAN	148	Optional	Tangent assignment variable	Operand	ZR	Tangent
TIMC	156	Optional	Program number	Prohibited	CP	Cancel waiting
TIMR	373	Optional	Local flag number	Timer setting	CP	Timer relay for ladder
TIMW	155	Optional	Wait time	Prohibited	TU	Wait
TMLI	257	Optional	Position number	Prohibited	PE	Move relatively between positions on tool coordinate system via interpolation (SCARA only)
TMPI	256	Optional	Position number	Prohibited	PE	Move relatively between positions on tool coordinate system (SCARA only)
TMRW	281	Optional	Read timer setting	(Write timer setting)	CP	Set READ timeout value
TPCD	317	Prohibited	0 or 1	Prohibited	CP	Specify processing to be performed when input condition is not specified
TRAN	141	Optional	Copy destination variable	Copy source variable	ZR	Copy
TSLP	318	Prohibited	Time	Prohibited	CP	Task sleep
V						
VAL	290	Optional	Variable number	Column number, character literal	CC	Convert character string data; decimal
VALH	291	Optional	Variable number	Column number, character literal	CC	Convert character string data; hexadecimal
VEL	192	Optional	Speed	Prohibited	CP	Set speed
VELS	193	Optional	Ratio	Prohibited	CP	Set speed ratio in PTP operation (SCARA only)
VLMX	199	Optional	Prohibited	Prohibited	CP	Specify VLMX speed (Linear movement axis only)
W						
WGHT	227	Optional	Mass	(Inertial moment)	CP	Set tip load mass/inertial moment
WH☐☐	267	Prohibited	Comparison variable	Comparison value	CP	Branch value [EQ, NE, GT, GE, LT, LE]
WRIT	282	Optional	Channel number	Column number	CC	Output to channel
WS☐☐	268	Prohibited	Column number	Column number, character literal	CP	Branch character string [EQ, NE]
WT☐☐	161	Optional	I/O, flag	(Wait time)	TU	Wait for I/O, flag [ON, OF]
WZFA	276	Optional	Zone number	Axis pattern	CP	Wait for zone OFF, with AND (Linear movement axis only)
WZFO	277	Optional	Zone number	Axis pattern	CP	Wait for zone OFF, with OR (Linear movement axis only)
WZNA	274	Optional	Zone number	Axis pattern	CP	Wait for zone ON, with AND (Linear movement axis only)
WZNO	275	Optional	Zone number	Axis pattern	CP	Wait for zone ON, with OR (Linear movement axis only)

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. A LET command of the same effect as the above operation
	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 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)
MULT	101	3.141592	(30° will be converted to radian and assigned to
DIV	101	180	variable 101.)
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)
	MULT	101	3.141592	(60° will be converted to radian and assigned to
	DIV	101	180	variable 101.)
	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 $\pi \div 180$

[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.
CPNE	*1	*3	310	Turn ON output 310 if the content of variable 1 (variable 2) is not 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) System time indicates the time counted in 32 bits starting from 0 representing the time the controller is started. Accordingly, you can use the time difference obtained by this command to check the elapsed time after the controller was started, for the duration of continuous operation for up to approx. 248 days (21474836.47 seconds) after the start.

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.

(Note) A dedicated output (system output), other than a general-purpose output, cannot be specified for operand 1 or 2.

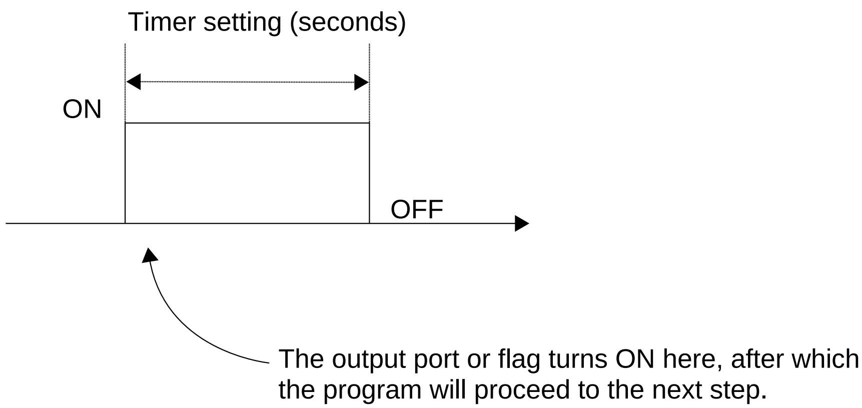
BT□□
- ON .... Switch the status to ON.
- OF .... Switch the status to OFF.
- NT .... Reverse the status.

[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) A dedicated output (system output), other than a general-purpose output, cannot be specified for operand 1.

(Note 6) If other task/interruption process is inserted after the port is turned ON, and before it is turned OFF, an error will generate in the pulse output time. Accordingly, this command cannot be used as a constant time pulse output.

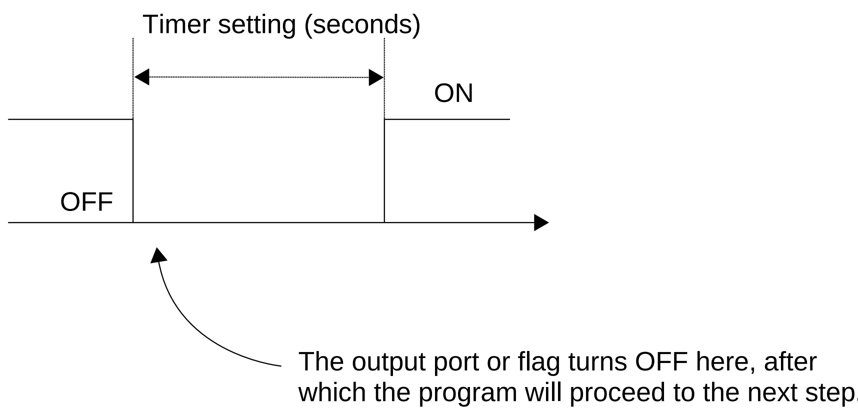
[Example]

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) A dedicated output (system output), other than a general-purpose output, cannot be specified for operand 1.

(Note 6) If other task/interruption process is inserted after the port is turned ON, and before it is turned OFF, an error will generate in the pulse output time. Accordingly, this command cannot be used as a constant time pulse output.

[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 specified for 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

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

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

$\boxed{133}$ .... 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.

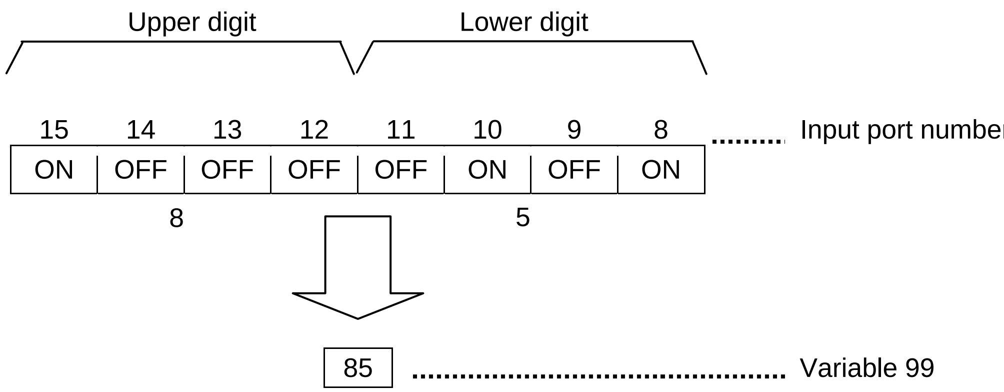
(Note 3) The data format used for read can be changed using a FMIO command (refer to the explanation of the FMIO command).

[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	Output, 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).

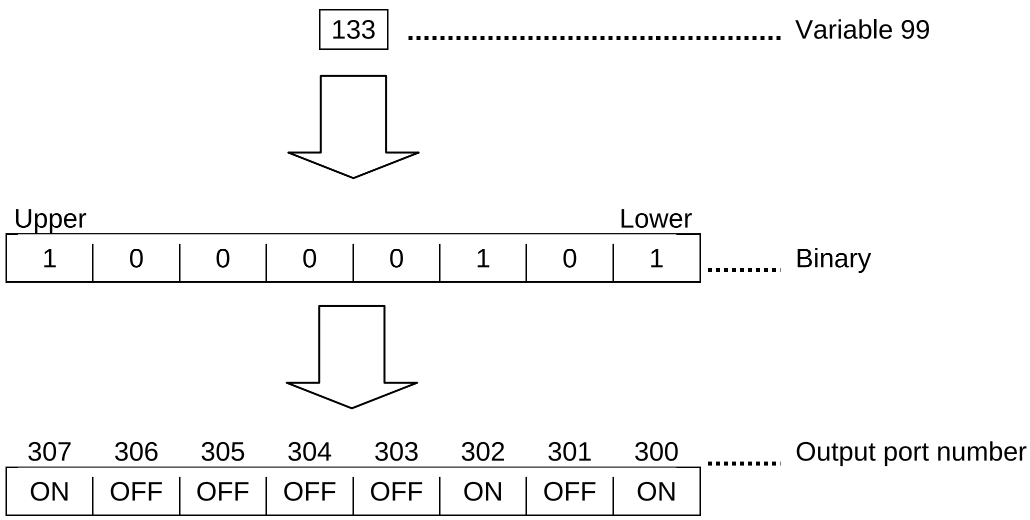
(Note 3) The data format used for read can be changed using a FMIO command (refer to the explanation of the FMIO command).

[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.

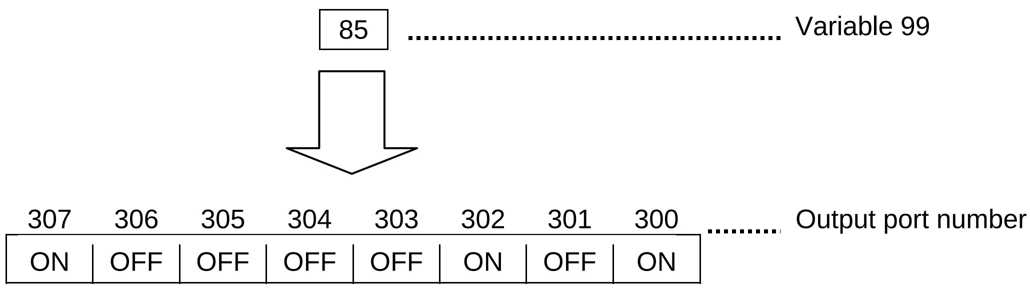
(Note 2) The data format used for read can be changed using a FMIO command (refer to the explanation of the FMIO command).

[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 data format used for read can be changed using a FMIO command (refer to the explanation of the 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

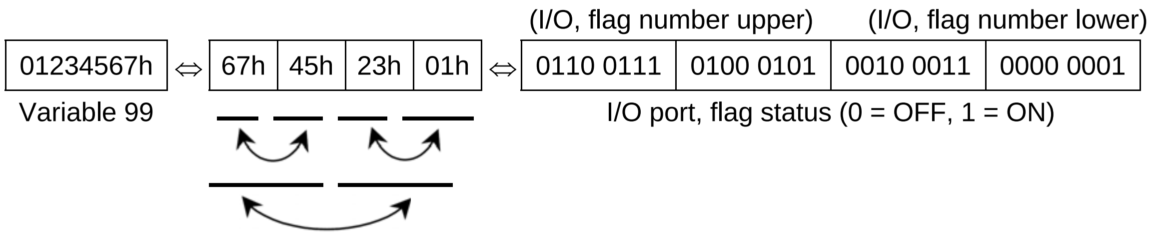
Variable 99 — I/O port, flag status (0 = OFF, 1 = ON)

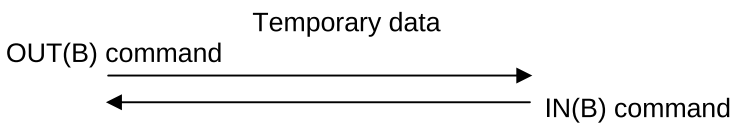
Temporary data

OUT(B) command →

← IN(B) command

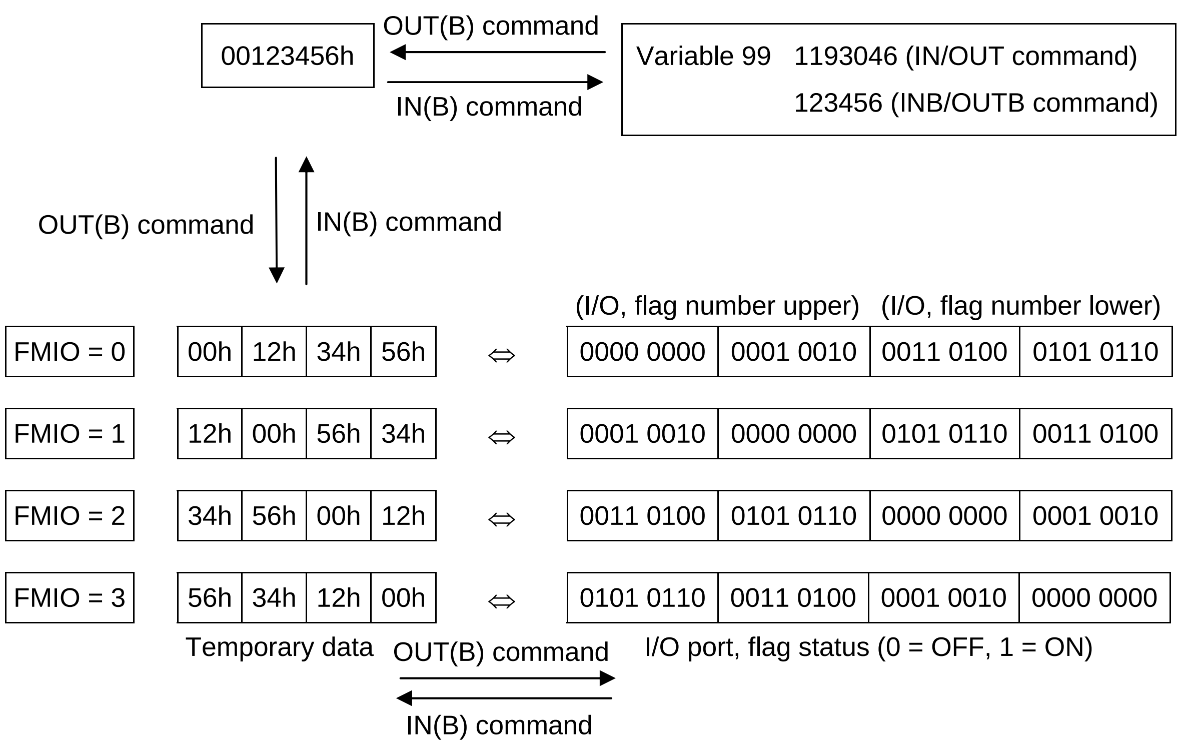
[4] Operand 1 = 3
Data is read or written after its upper 16 bits and lower 16 bits are reversed every 32 bits and its upper eight bits and lower eight bits are reversed every 16 bits.





(Note) FMIO command is supported in main application version 0.56 or later, 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)



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

00001234h $\xrightarrow{\text{OUT(B) command}}$ / $\xleftarrow{\text{IN(B) command}}$ 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 $\xrightarrow{\text{OUT(B) command}}$ / $\xleftarrow{\text{IN(B) command}}$ I/O port, flag status (0 = OFF, 1 = ON)

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

00000012h $\xrightarrow{\text{OUT(B) command}}$ / $\xleftarrow{\text{IN(B) command}}$ Variable 99 18 (IN/OUT command)
12 (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	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 $\xrightarrow{\text{OUT(B) command}}$ / $\xleftarrow{\text{IN(B) command}}$ I/O port, flag status (0 = OFF, 1 = ON)

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 1) A GOTO command is valid only within the same program.
(Note 2) Do not create a program containing an indefinite loop of continuous movement commands (refer to Chapter 4 in Part 4) using the TAG-GOTO syntax. It will result in an accumulation of coordinate conversion errors.

[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)

<table>
<tr><th rowspan="2">Extension condition (LD, A, O, AB, OB)</th><th rowspan="2">Input condition (I/O, flag)</th><th colspan="3">Command, declaration</th><th rowspan="2">Output (Output, flag)</th></tr>
<tr><th>Command, declaration</th><th>Operand 1</th><th>Operand 2</th></tr>
<tr><td>Optional</td><td>Optional</td><td>EXPG</td><td>Program number</td><td>(Program number (Note))</td><td>CC</td></tr>
</table>

[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)

<table>
<tr><td rowspan="3">Status of the specified program</td><td colspan="3">No program number error *1</td><td rowspan="3">Program number error *1</td></tr>
<tr><td colspan="2">Program already registered</td><td rowspan="2">Program not yet registered</td></tr>
<tr><td>Program running</td><td>Program not running</td></tr>
<tr><td>Error</td><td>A57
“Multiple program start error”</td><td>None</td><td>C03
“Non-registered program specification error”</td><td>C2C
“Program number error”</td></tr>
<tr><td>Output operation</td><td>ON</td><td>ON</td><td>OFF</td><td>OFF</td></tr>
</table>

* 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 less than 1 or exceeding the number of maximum supported programs has been specified.

When multiple EXPG programs are specified (both operands 1 and 2 are specified)

<table>
<tr><td rowspan="3">Status of the specified program</td><td colspan="3">No program number error *2</td><td rowspan="3">Program number error *1</td></tr>
<tr><td colspan="2">Registered program exists inside the specified range *3</td><td rowspan="2">None of programs inside the specified range are registered</td></tr>
<tr><td>Running program exists inside the specified range</td><td>None of programs inside the specified range are running</td></tr>
<tr><td>Error</td><td>A57
“Multiple program start error”</td><td>None</td><td>C03
“Non-registered program specification error”</td><td>C2C
“Program number error”</td></tr>
<tr><td>Output operation</td><td>ON</td><td>ON</td><td>OFF</td><td>OFF</td></tr>
</table>

* 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 less than 1 or exceeding the number of maximum 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.

● 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 less than 1 or exceeding the number of maximum 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 --- A program number error indicates that a range of numbers including a number or numbers less than 1 or exceeding the number of maximum supported programs has been specified.
* 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.

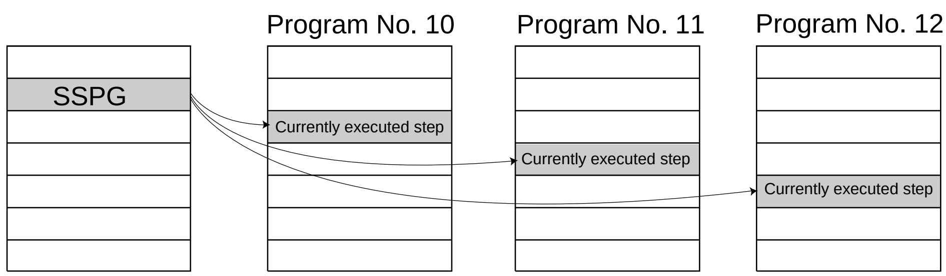
- SSPG (Pause program)

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 less than 1 or exceeding the number of maximum 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 range of numbers including a number or numbers less than 1 or exceeding the number of maximum 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.

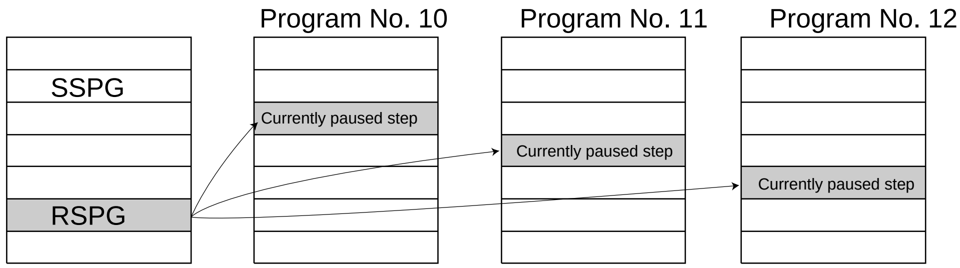
- RSPG (Resume program)

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 less than 1 or exceeding the number of maximum 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 range of numbers including a number or numbers less than 1 or exceeding the number of maximum 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.
If the position data table has no data that can be loaded when a PGET command is executed (= position data display on the teaching pendant: X.XXX / position data display in the PC software: blank), data will not be assigned to variable 199 (the PGET command will not be executed).
Axis No. 1: X-axis, Axis No. 2: Y-axis, Axis No. 3: Z-axis, Axis No. 4: R-axis, Axis Nos. 5/6: Additional linear movement axes

[Example 1]	PGET	2	3	Read to variable 199 the data of the 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 of variable 1 (Y-axis (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.
Axis No. 1: X-axis, Axis No. 2: Y-axis, Axis No. 3: Z-axis, Axis No. 4: R-axis, Axis Nos. 5, 6: Additional linear movement axes

[Example 1]	LET	199	150	Assign 150 to variable 199.
	PPUT	2	3	Write the content of variable 199 (150) to the 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 of variable 199 (150) to the content of variable 1 (Y-axis (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.
Once data is deleted, only the data field will become blank and the data will not change to 0.000.
The position data display on the teaching pendant will change to X.XXX, while the position data display in the PC software will show a blank field.

[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 the X and Y-axes to position No. 10.

[Example 2] An axis pattern can be indirectly specified using a variable. An example of specifying the operation in [Example 1] indirectly using a variable is shown below.
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 the X and Y-axes 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

[Function] Read the current position of the axis number specified in operand 1 to the variable specified in operand 2.
Axis No. 1: X-axis, Axis No. 2: Y-axis, Axis No. 3: Z-axis, Axis No. 4: R-axis, Axis Nos. 5, 6: Additional linear movement axes

[Example] PRDQ 2 100 Read the current position of the Y-axis (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 (= position data display on the teaching pendant: X.XXX / position data display in the PC software: blank). 0 is treated as valid data.

[Example 1]	PTST	11	10	300	Turn ON output 300 if there are no valid values of the X and Y-axes at position 10. Output 300 will turn OFF if the position data is given as follows:

[Example 2] An axis pattern can be indirectly specified using a variable. An example of specifying the operation in [Example 1] indirectly using a variable is shown below.
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 the X, Y and R-axes 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	
Optional	Optional	PVEL	Speed	Position number	CP

[Function] Write the SCARA CP operation speed/linear movement axis speed specified in operand 1, to the position number specified in operand 2. The unit of operand 1 is mm/sec.

(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 SCARA CP operation acceleration/linear movement axis acceleration specified in operand 1, to the position number specified in operand 2.
The acceleration in operand 1 is set in G and may include up to two decimal places.

(Note) Range check is not performed for a PACC command.

[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] Write the SCARA CP operation deceleration/linear movement axis deceleration specified in operand 1, to the position number specified in operand 2.
The deceleration in operand 1 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	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	
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.

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	
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 1] 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	
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.

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.

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 travel speed for CP operation in the value specified in operand 1.
The unit is mm/sec.

(Note 1) Decimal places cannot be used.
(Note 2) The minimum speed is 1 mm/s.

[Example 1]	VEL	100	Set the speed to 100 mm/sec.
	MOVL	1	Move to point 1 at 100 mm/sec.
[Example 2]	VEL	500	Set the speed to 500 mm/sec.
	MOVL	2	Move to point 2 at 500 mm/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	
Optional	Optional	VELS	Ratio	Prohibited	CP

[Function] Set the travel speed for PTP operation command (angular velocity for axes other than the Z-axis) as a ratio of the maximum PTP speed to be specified in operand 1. The ratio in operand 1 is set as an integer (unit: %).

(Note 1) When a RIGH or LEFT command is used, the speed must be set via VELS even when PTP operation commands are not used.

[Example 1]

VELS	50	Set the travel speed for PTP operation command to 50% of the maximum speed.
MOVP	1	The axes will move to position No. 1 in PTP mode 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	
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.
(Smoothness of actual operation cannot be guaranteed. Movement must be checked on the actual machine.)
(The speed specified with a PAPR command (push-motion approach speed) is clamped by the minimum speed of 1 mm/sec.)

[Example 1]

VEL	150	Set the SCARA CP operation speed/linear movement axis speed to 150 mm/sec.
VELS	90	Set the SCARA PTP operation speed ratio to 90%.
OVRD	50	Reduce the speed to 50%. The SCARA CP operation speed/linear movement axis speed becomes 75 mm/sec, while the SCARA PTP operation speed ratio becomes 45%.

- 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 SCARA CP operation acceleration/linear movement axis acceleration in the value specified in operand 1.
The acceleration in operand 1 is set in G and may include up to two decimal places.

(Note) In CP operation where the position data does not include acceleration and an acceleration has not been set using an ACC command, either, the SCARA will use the default value registered in "All-axis parameter No. 11, Default CP acceleration of SCARA axis," while the linear movement axis will use the default value registered in "All-axis parameter No. 200, Default acceleration of linear movement axis."

[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.

- 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	
Optional	Optional	ACCS	Ratio	Prohibited	CP

[Function] Set the travel acceleration for SCARA PTP operation command (angular acceleration for axes other than the Z-axis), as the ratio to the maximum PTP acceleration, in the value specified in operand 1. The ratio in operand 1 is set as an integer (unit: %).

(Note 1) When setting the acceleration ratio, always refer to 5, "Precautions for Use," in the operation manual for the IX-Series Horizontal Articulated Robot.

[Example] ACCS 50 Set the travel acceleration for PTP operation command to 50% of the maximum acceleration.

- 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 SCARA CP operation deceleration/linear movement axis deceleration in the value specified in operand 1.
The deceleration in operand 1 is set in G and may include up to two decimal places.

(Note) In CP operation where the position data does not include deceleration and a deceleration has not been set using a DCL command, either, the SCARA will use the default value registered in “All-axis parameter No. 12, Default CP deceleration of SCARA axis,” while the linear movement axis will use the default value registered in “All-axis parameter No. 201, Default deceleration of linear movement axis.”
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.

- 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	
Optional	Optional	DCLS	Ratio	Prohibited	CP

[Function] Set the travel deceleration for SCARA PTP operation command (angular deceleration for axes other than the Z-axis), as the ratio to the maximum PTP deceleration, in the value specified in operand 1. The ratio in operand 1 is set as an integer (unit: %).

(Note 1) When setting the deceleration ratio, always refer to 5, "Precautions for Use," in the operation manual for the IX-Series Horizontal Articulated Robot.

[Example] DCLS 50 Set the travel deceleration for PTP operation command to 50% of the maximum deceleration.

- VLMX (Dedicated linear movement 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	
Optional	Optional	VLMX	Prohibited	Prohibited	CP

[Function] Set the travel speed of a linear movement axis to the VLMX speed (normally the maximum speed).
When a VLMX command is executed, the value registered in “Axis-specific parameter No. 29, VLMX speed of linear movement axis” will be set as the travel speed.

(Note) When the VLMX speed is specified in a continuous position movement command (PATH or PSPL), the target speed to each position will become a composite speed calculated based on the VLMX speed, provided that the speed for each axis does not exceed “Axis-specific parameter No. 28, Maximum PTP speed (SCARA axis)/maximum operating speed of each axis (linear movement axis).” To keep the target speed constant, a speed must be explicitly specified using a VEL command.

[Example]

```
VEL     1000  ┐
MOVP    1     │ The speed in this section becomes 1,000 mm/sec.
MOVP    2     ┘
VLMX          ┐
MOVP    3     │ The speed in this section becomes VLMX mm/sec.
MOVP    4     ┘
```

- 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	(S-motion type)	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 (%).

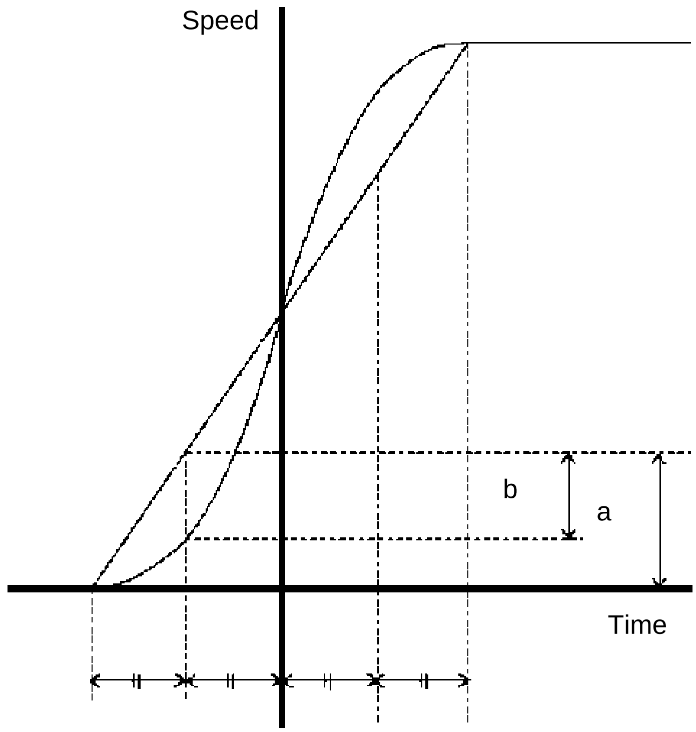
If the ratio is not set using this command or 0% is set, a trapezoid motion will be implemented.

A SCRV command can be used with the following commands: MOVP, MOVL, MVPI, MVLI, TMPI, TMLI, JBWF, JBWN, JFWF, JFWN

You can set the S-motion type in operand 2 if the main application version is 0.45 or later. This setting is valid in PC software version 7.5.0.0 or later and teaching pendant version 1.11 or later.

Value set in operand 2	Description
0 or blank	S-motion A
1	S-motion B (recommended)

- S-motion A (Operand 2 = Blank or 0)



- S-motion B (Operand 2 = 1)
  If S-motion B is selected, the speed pattern becomes smoother (compared to the S-motion control ratio applicable when S-motion A is selected). (The deviation peak from the trapezoid motion becomes smaller.)

[Example 1]	SCRV	30	Set the sigmoid motion ratio to 30%.

- 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.

(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, MVLI, TMLI, and TMPI commands.

[Example 1]	OFST	110	50	Add 50 mm to the specified positions of the Y and Z-axes.

[Example 2] An axis pattern can be indirectly specified using a variable. An example of specifying the operation in [Example 1] indirectly using a variable is shown below.
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 (30°) to the specified position of the 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	
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 (Set reference 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	BASE	Axis number	Prohibited	CP

[Function] Sequentially count the axes, starting from the axis number specified in operand 1 as the first axis.
A BASE command is effective with PRED, PRDQ, AXST, ARCH, PACH, PMVP and PMVL commands as well as actuator control commands and zone commands. Take note that zone areas are assigned to each actuator using parameters.

[Example 1]

BASE	5		The fifth axis is considered axis 1.
HOME	1		Axis 5 executes home return.
HOME	10		Axis 6 executes home return.

[Example 2]

LET	1	5	Assign 5 to variable 1.
BASE	*1		The content of variable 1 (axis 5) is considered axis 1.

Hereafter, axes 5 and 6 will operate based on specification of 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 OFST, DFTL, GTTL, DFWK, GTWK, DFIF and GTIF commands, as well as with servo operation commands using position data.

[Example 1]

```
GRP     11          Data of the X and Y-axes become valid.
CIR2    1     2     Axis-pattern error will not generate even if data is set for
                    the Z and R-axes.
```

[Example 2] An axis pattern can be indirectly specified using a variable. An example of specifying the operation in [Example 1] indirectly using a variable is shown below.
11 (binary) → 3 (decimal)

```
LET     1     3     Assign 3 to variable 1.
GRP     *1
CIR2    1     2
```

- 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.

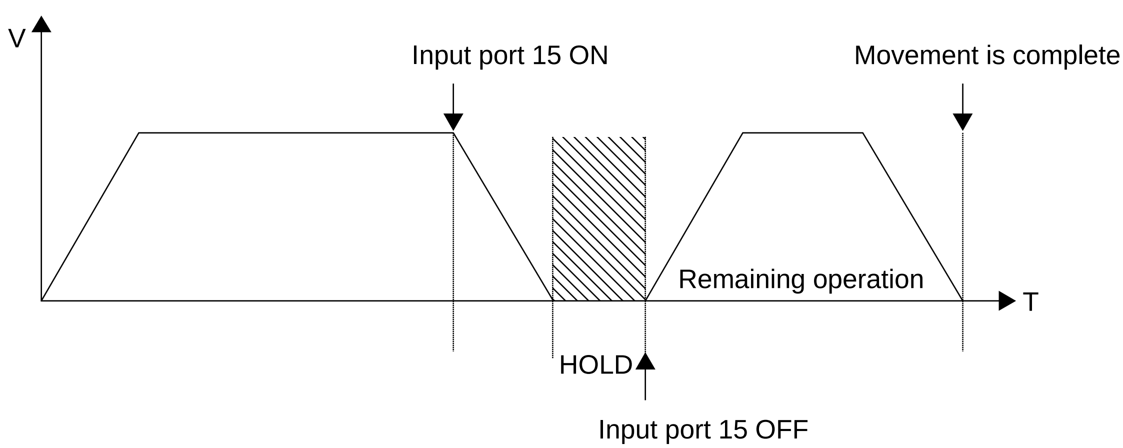
[HOLD type]
0 = Contact a (Deceleration stop)
1 = Contact b (Deceleration stop)
2 = Contact b (Deceleration stop → Servo OFF (The drive source will not be cut off))

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 operation.)

[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	
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.

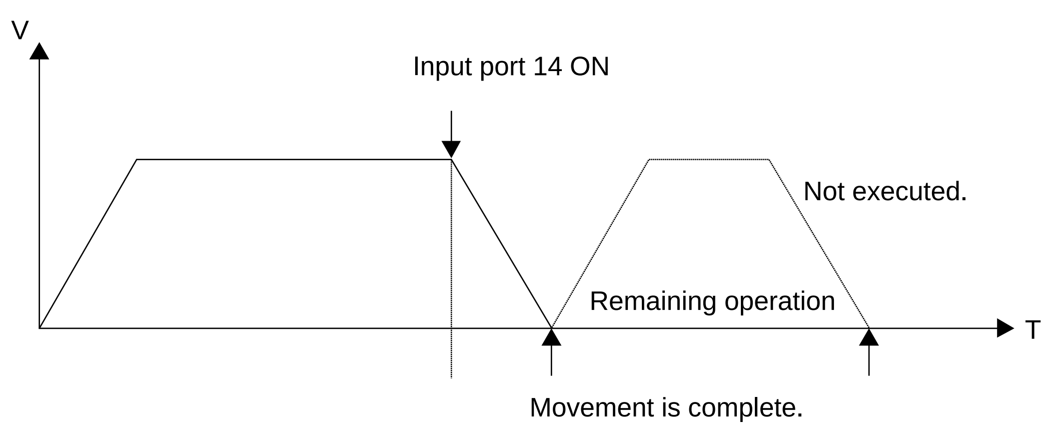
[CANC type]
0 = Contact a (Deceleration stop)
1 = Contact b (Deceleration stop)

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 PATH operation.)

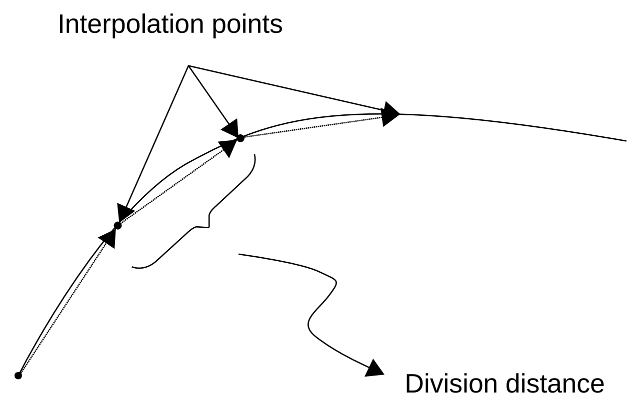
[Example] CANC 14 0 The axes will decelerate to a stop when input port 14 turns ON.



● 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

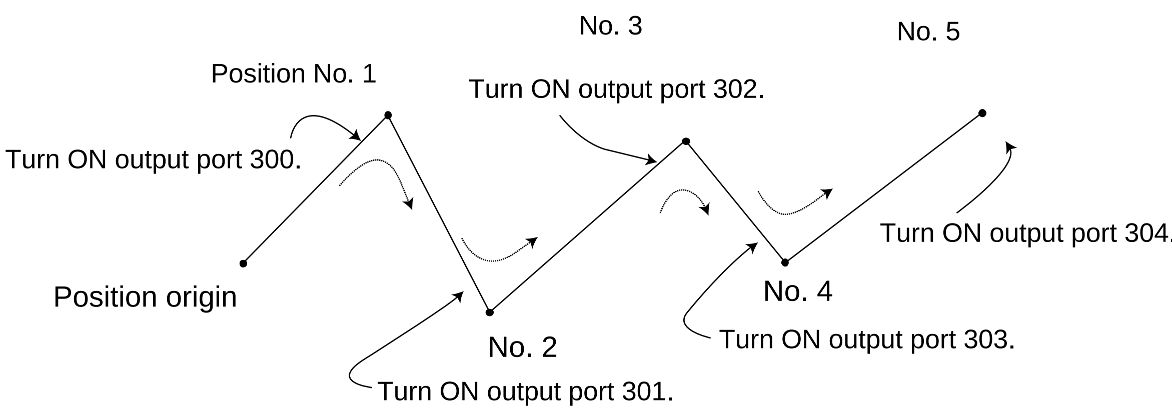
[Function] Set the output type in the output field to be used when a PATH or PSPL command is executed.
When a PATH or PSPL command is executed, the output will operate as follows in accordance with the setting of the POTP command.

(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]

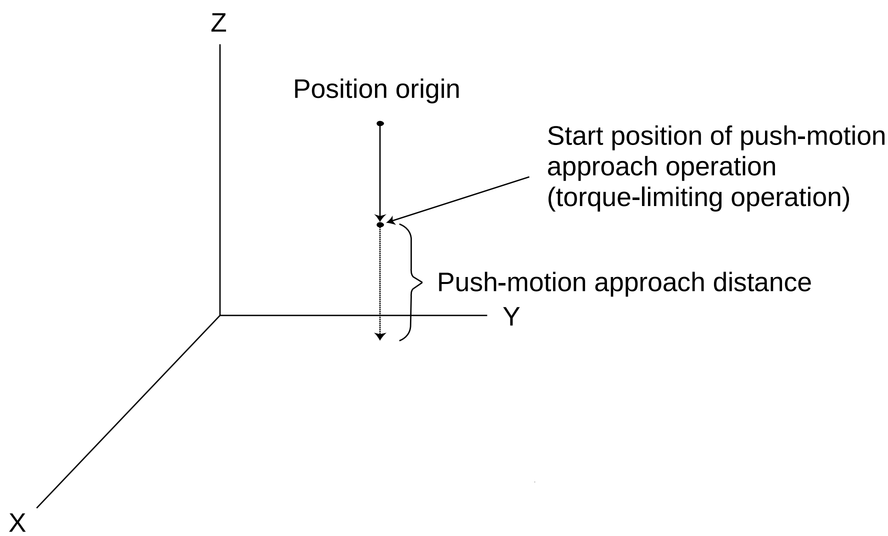
POTP	1			
PATH	1	5	300	Turn ON output port Nos. 300 through 304 sequentially each time a specified position approaches during a pass movement from position Nos. 1 through 5, starting from the first position.



- 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	10		
PUSH	11		

(Note) When an OVRD command is used, the push-motion approach speed is clamped by the minimum speed of 1 mm/sec.
(The minimum speed does not guarantee reliable push motion operation. If low-speed push-motion approach is needed, confirm the operation on the actual machine by considering the effects of mechanical characteristics, etc.)

● 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	
Optional	Optional	DFTL	Tool coordinate system number	Position number	CP

[Function] Set the position data specified in operand 2 as the offset data for the tool coordinate system specified in operand 1.
The offset data for tool coordinate system corresponding to all SCARA axes will be set in the position data, but the position data for invalid axes will be set as “zero offset.”

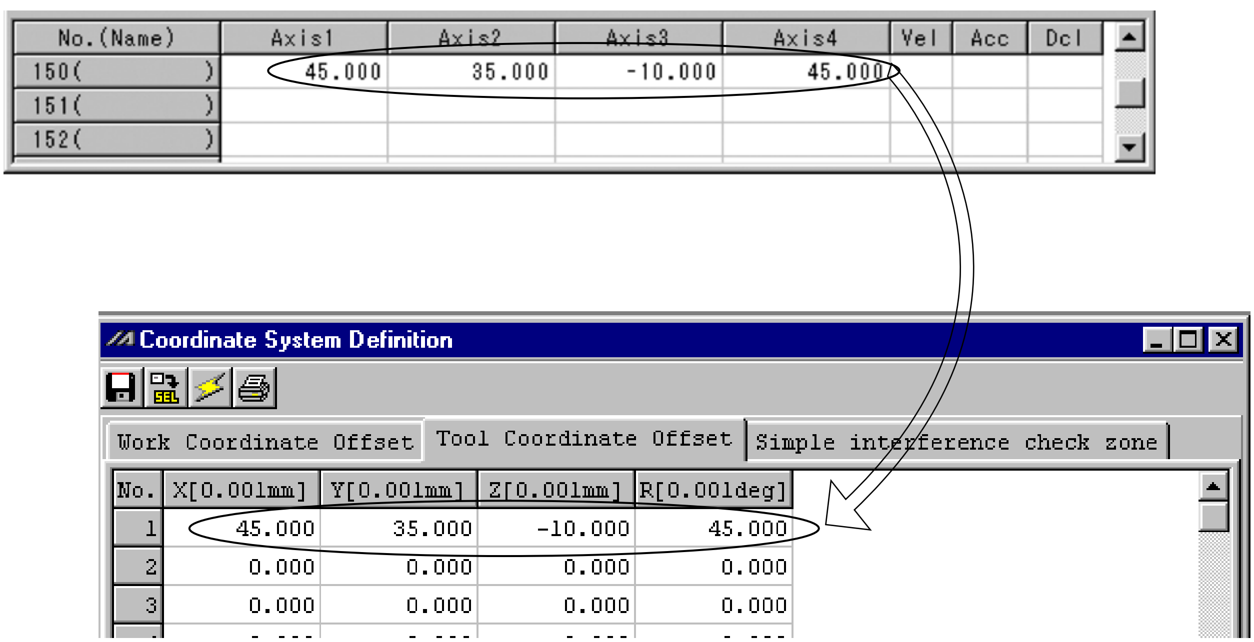
(Note 1) The tool and load coordinate systems are dedicated SCARA functions.

(Note 2) Tool coordinate system No. 0 is reserved for a condition where no tool offset is applicable. Therefore, setting this coordinate system number will generate an "Error No. B71: Coordinate system number error."

(Note 3) GRP commands are invalid with respect to this command.

[Example] DFTL 1 150

Position data



● 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	
Optional	Optional	SLTL	Tool coordinate system number	Prohibited	CP

[Function] Set the value specified in operand 1 as the selected tool coordinate system number. Refer to 3, "Coordinate System," in Chapter 3 of Part 4.

(Note 1) The tool and load coordinate systems are dedicated SCARA functions.

(Note 2) The number declared last in the system becomes valid.
The selected tool coordinate system number will remain valid after the program ends, or even after reconnection of power if a system-memory backup battery is installed.

(Note 3) Only one tool coordinate system number can be selected in the system.

(Note 4) Expressly declare SLTL in the program to prevent problems that may occur when the coordinate system number changed via the PC software or teaching pendant was not returned to the original setting.
(Set SLTL = 0, if tool coordinate system is not used.)

- 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	
Optional	Optional	GTTL	Tool coordinate system number	Position number	CP

[Function] Set in the position data specified in operand 2 the offset data for the tool coordinate system specified in operand 1. The offset data for tool coordinate system corresponding to all SCARA axes will be set in the position data.

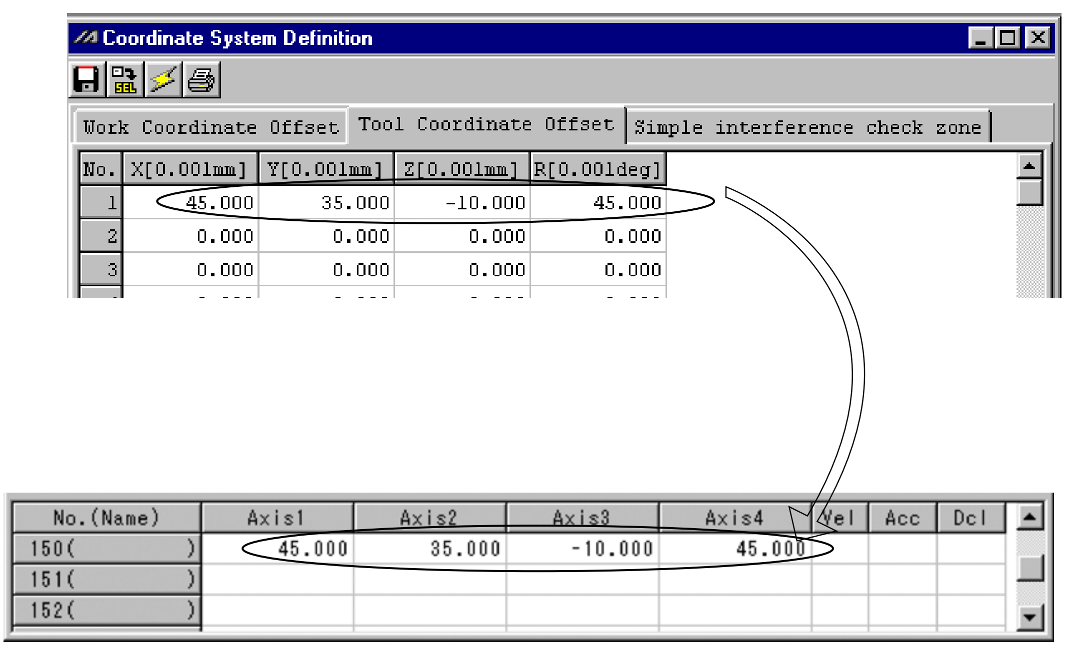
(Note 1) The tool and load coordinate systems are dedicated SCARA functions.

(Note 2) When this command is executed, the position data for axis 5 and subsequent axes will be cleared.
Accordingly, do not specify any position currently used in linear movement axis operation.

(Note 3) Tool coordinate system No. 0 is reserved for a condition where no tool offset is applicable. Therefore, setting this coordinate system number will generate an "Error No. B71: Coordinate system number error."

(Note 4) GRP commands are invalid with respect to this command.

[Example 1]	OFST	110	50	The specified Y and Z-axis positions will be incremented by 50 mm.
[Example 2]	LET	1	30	Assign 30 to variable 1.
	OFST	1000	*1	The specified R-axis position will be incremented by the content of variable 1 (30).
[Example]	GTTL	1	150	



- DFWK (Dedicated SCARA command: define load 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	
Optional	Optional	DFWK	Load coordinate system number	Position number	CP

[Function] Set the position data specified in operand 2 as the offset data for the load coordinate system specified in operand 1. The offset data for load coordinate system will include the specified position data corresponding to all axes, but the position data for invalid axes will be set as "zero offset."

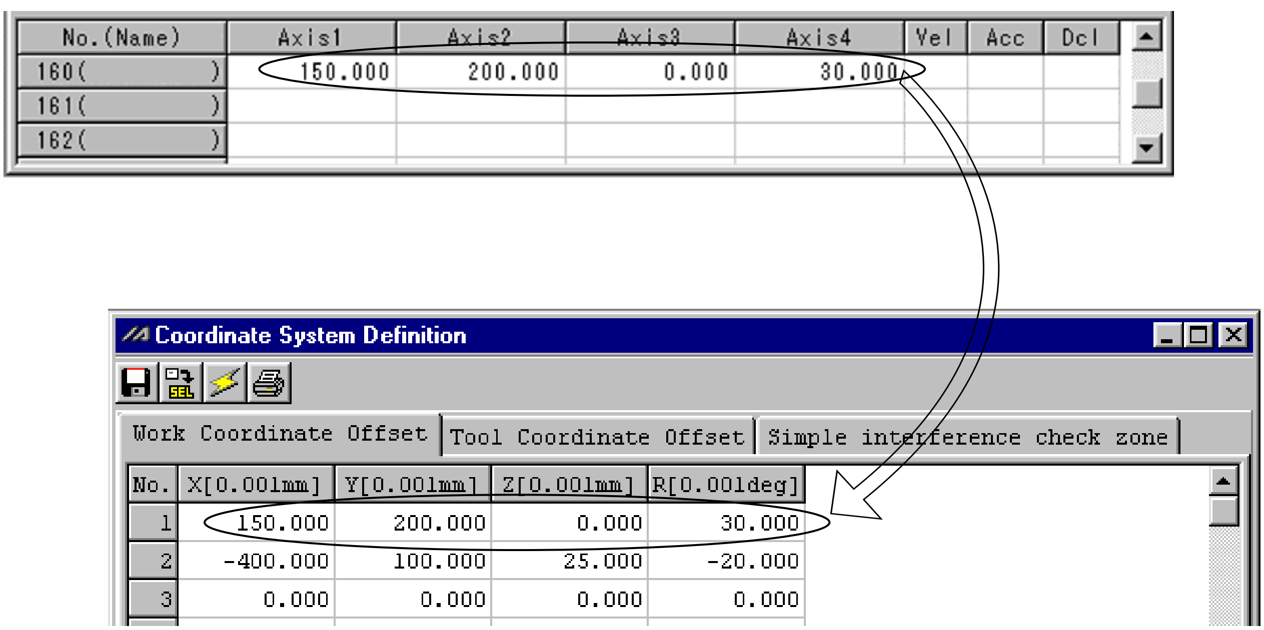
(Note 1) The tool and load coordinate systems are dedicated SCARA functions.

(Note 2) Load coordinate system No. 0 is reserved as the base coordinate system. Therefore, setting this coordinate system number will generate an "Error No. B71: Coordinate system number error."

(Note 3) GRP commands are invalid with respect to this command.

[Example] DFWK 1 160

Position data



● SLWK (Dedicated SCARA command: select load 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	
Optional	Optional	SLWK	Load coordinate system number	Prohibited	CP

[Function] Set the value specified in operand 1 as the selected load coordinate system number. Refer to 3, "Coordinate System," in Chapter 3 of Part 4.

(Note 1) The tool and load coordinate systems are dedicated SCARA functions.

(Note 2) The number declared last in the system becomes valid.
The selected load coordinate system number will remain valid after the program ends, or even after reconnection of power if a system-memory backup battery is installed.

(Note 3) Only one load coordinate system number can be selected in the system.

(Note 4) Expressly declare SLWK in the program to prevent problems that may occur when the coordinate system number changed via the PC software or teaching pendant was not returned to the original setting.
(Set SLWK = 0, if load coordinate system is not used.)

- GTWK (Dedicated SCARA command: get load 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	
Optional	Optional	GTWK	Load coordinate system number	Position number	CP

[Function] Set in the position data specified in operand 2 the offset data for the load coordinate system specified in operand 1. The position data will include the specified offset data for load coordinate system corresponding to all axes.

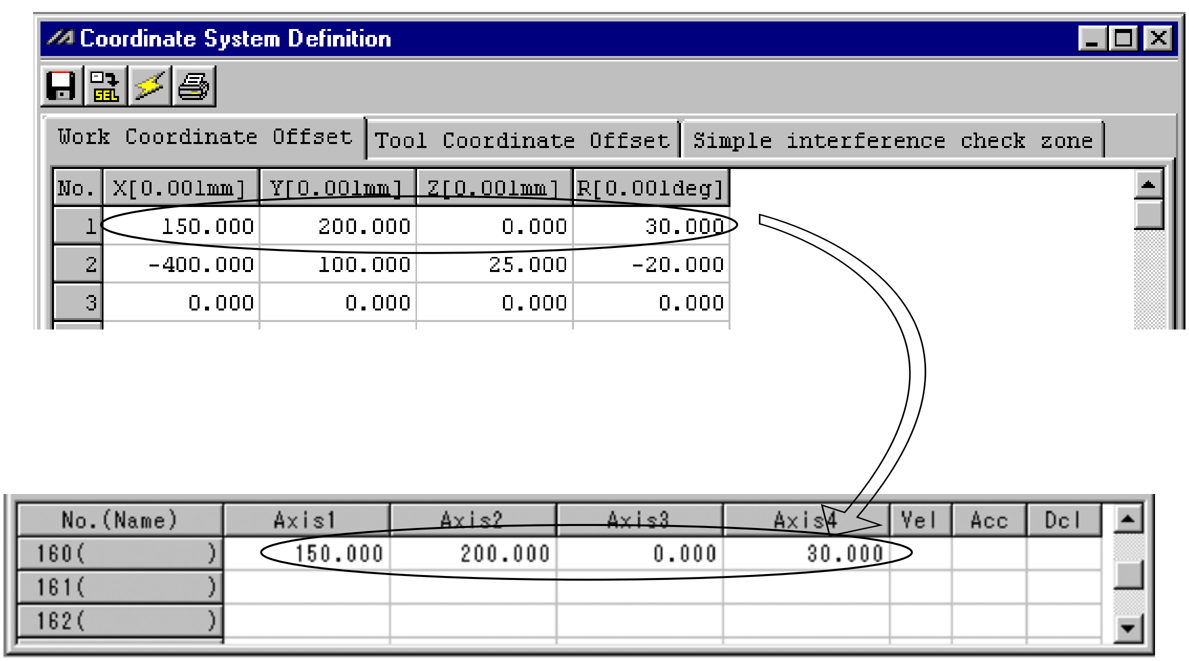
(Note 1) The tool and load coordinate systems are dedicated SCARA functions.

(Note 2) When this command is executed, the position data for axis 5 and subsequent axes will be cleared.
Accordingly, do not specify any position currently used in linear movement axis operation.

(Note 3) Load coordinate system No. 0 is reserved as the base coordinate system. Therefore, setting this coordinate system number will generate an "Error No. B71: Coordinate system number error."

(Note 4) GRP commands are invalid with respect to this command.

[Example] GTWK 1 160



- RIGH (Dedicated SCARA command: change current arm system to right arm (Arm 2 may operate if the current arm system is the opposite arm))

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	RIGH	Prohibited	Prohibited	PE

[Function] Change the current SCARA arm system to the right arm system. If the current arm system is the left arm system, arm 2 will be operated to change the arm system to the right arm system. After this operation, arms 1 and 2 will form a straight line. If the current arm system is the right arm system, no arm operation will take place.
(For details, refer to 2, "Arm System," in Chapter 3 of Part 4.)

(Note 1) When a RIGH or LEFT command is used, the speed must be set via VELS even when SCARA PTP operation commands are not used.

- LEFT (Dedicated SCARA command: change current arm system to left arm (Arm 2 may operate if the current arm system is the opposite arm))

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	LEFT	Prohibited	Prohibited	PE

[Function] Change the current SCARA arm system to the left arm system. If the current arm system is the right arm system, arm 2 will be operated to change the arm system to the left arm system. After this operation, arms 1 and 2 will form a straight line. If the current arm system is the left arm system, no arm operation will take place.
(For details, refer to 2, "Arm System," in Chapter 3 of Part 4.)

(Note 1) When a RIGH or LEFT command is used, the speed must be set via VELS even when SCARA PTP operation commands are not used.

- PTPR (Dedicated SCARA command: specify right arm as PTP target arm system (Movement of the opposite arm system is prohibited when the target value cannot be achieved) (No arm 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	PTPR	Prohibited	Prohibited	CP

[Function] Specify the right arm system as the target arm system for SCARA PTP operation command. Once a PTPR command is executed, the target arm system for SCARA PTP operation command will become the right arm system and any target value that cannot be achieved with the right arm system will generate an error. Executing this command itself will not accompany any arm operation.
(For details, refer to 2, "Arm System," in Chapter 3 of Part 4.)

- PTPL (Dedicated SCARA command: specify left arm as PTP target arm system (Movement of the opposite arm system is prohibited when the target value cannot be achieved) (No arm 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	PTPL	Prohibited	Prohibited	CP

[Function] Specify the left arm system as the target arm system for SCARA PTP operation command. Once a PTPL command is executed, the target arm system for SCARA PTP operation command will become the left arm system and any target value that cannot be achieved with the left arm system will generate an error. Executing this command itself will not accompany any arm operation.
(For details, refer to 2, "Arm System," in Chapter 3 of Part 4.)

- PTPD (Dedicated SCARA command: specify current arm as PTP target arm system (Movement of the opposite arm system is prohibited when the target value cannot be achieved) (No arm 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	PTPD	Prohibited	Prohibited	CP

[Function] Specify the current arm system as the target arm system for SCARA PTP operation command. Once a PTPD command is executed, the target arm system for SCARA PTP operation command will become the current arm system and any target value that cannot be achieved with this arm system will generate an error. Executing this command itself will not accompany any arm operation.
(For details, refer to 2, "Arm System," in Chapter 3 of Part 4.)

- PTPE (Dedicated SCARA command: specify current arm as PTP target arm system (Movement of the opposite arm system is permitted when the target value cannot be achieved) (No arm 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	PTPE	Prohibited	Prohibited	CP

[Function] Specify the current arm system as the target arm system for SCARA PTP operation command. Once a PTPE command is executed, the target arm system for SCARA PTP operation command will become the current arm system and any target value that cannot be achieved with this arm system will be processed by changing the target arm system to the opposite arm system. Any target value that cannot be achieved with either the right or left arm system will generate an error. Executing this command itself will not accompany any arm operation.
(For details, refer to 2, "Arm System," in Chapter 3 of Part 4.)

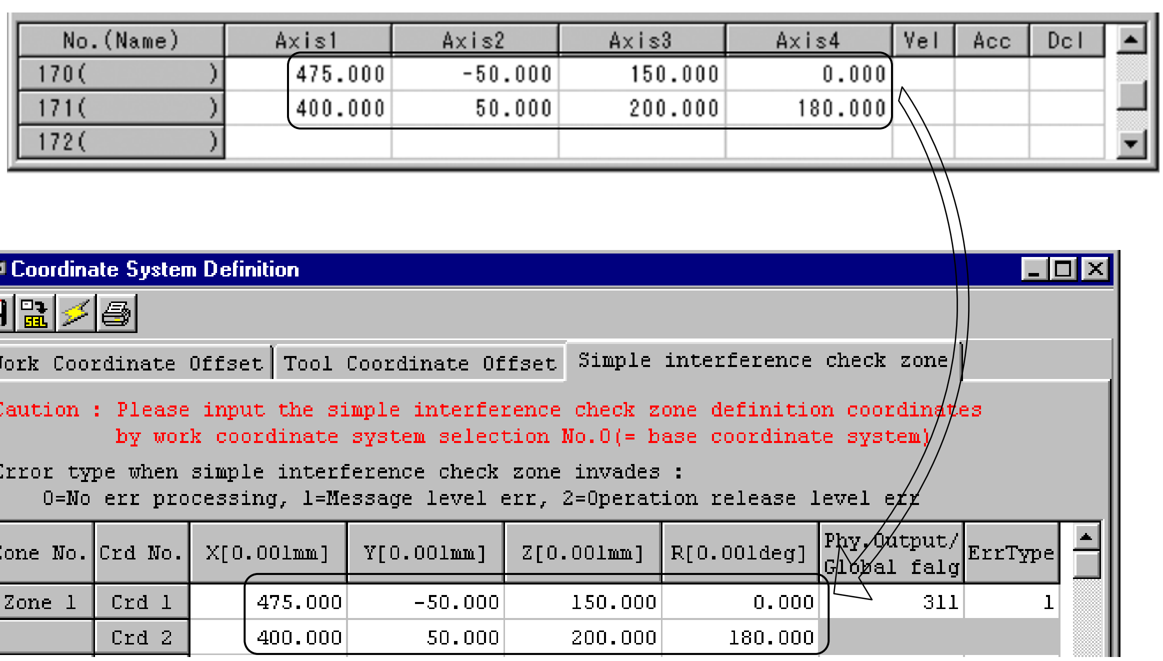
● DFIF (Dedicated SCARA command: define coordinates of simple interference check zone)

Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	DFIF	Interference check zone number	Position number (Consecutive two positions will be used)	CP

[Function] Set the consecutive two position data starting from the position number specified in operand 2 as the coordinate data defining the simple interference check zone specified in operand 1.
The position data specified in operand 2 will be set as definition coordinates 1 of the simple interference check zone, while the next position data will be set as definition coordinates 2.
If the axis patterns of the consecutive two position data do not match, an "Error No. C30: Axis pattern error" will generate.

(Note 1) The simple interference check zone is a dedicated SCARA function.
(Note 2) The definition coordinates of simple interference check zone are always treated as data on the base coordinate system (load coordinate system No. 0). Therefore, to provide position data for valid definition coordinates for the purpose of executing a DFIF command, the data must be set on the base coordinate system beforehand.
(Note 3) After the definition coordinates of simple interference check zone are changed, it will take 5 msec before the check result reflects the new settings.
(Note 4) GRP commands are invalid with respect to this command.

[Example 1] DFIF 1 170



No.(Name)	Axis1	Axis2	Axis3	Axis4	Vel	Acc	Dcl
170( )	475.000	-50.000	150.000	0.000			
171( )	400.000	50.000	200.000	180.000			
172( )							

Zone No.	Crd No.	X[0.001mm]	Y[0.001mm]	Z[0.001mm]	R[0.001deg]	Phy.Output/ Global falg	ErrType
Zone 1	Crd 1	475.000	-50.000	150.000	0.000	311	1
	Crd 2	400.000	50.000	200.000	180.000		

- SOIF (Dedicated SCARA command: specify output for simple interference check zone)

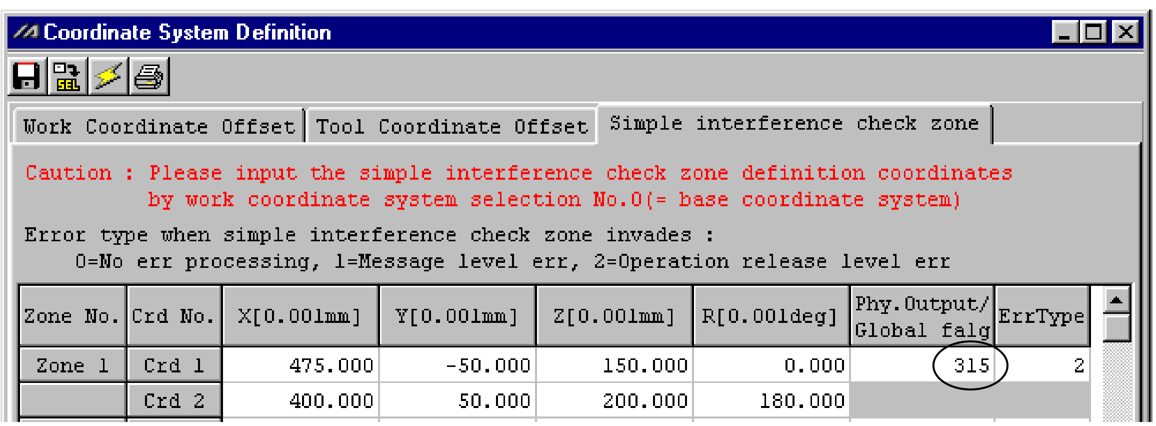
Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	SOIF	Interference check zone number	Output/global flag number	CP

[Function] Set the output number/global flag number specified in operand 2 as the output to be turned on upon entry into the simple interference check zone specified in operand 1.

(Note 1) The simple interference check zone is a dedicated SCARA function.

(Note 2) Duplicate specifications of physical output numbers or global flag numbers will cause chattering and the result will become indeterminable.

[Example] SOIF 1 315



- SEIF (Dedicated SCARA command: specify error type for simple interference check zone)

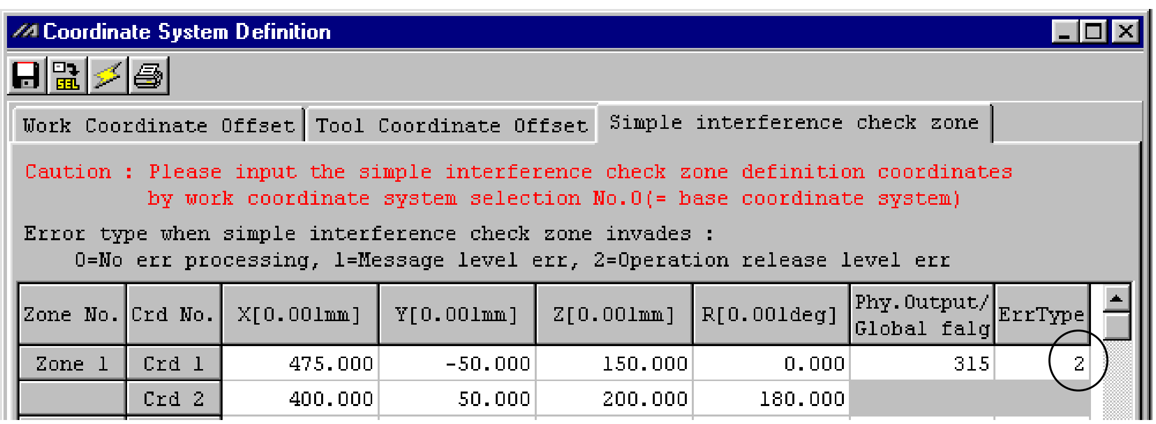
Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	SEIF	Interference check zone number	0 or 1 or 2 (Error type)	CP

[Function] Set the error type specified in operand 2 (see below) as the type of error generated upon entry into the simple interference check zone specified in operand 1.

Type of error generated upon entry into the simple interference check zone
0: No error
1: Message level error
2: Operation-cancellation level error

(Note 1) The simple interference check zone is a dedicated SCARA function.

[Example 1] SEIF 1 2



● GTIF (Dedicated SCARA command: get definition coordinates of simple interference 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	
Optional	Optional	GTIF	Interference check zone number	Position number (Consecutive two positions will be used)	CP

[Function] Set the definition coordinate data for the simple interference check zone specified in operand 1 in the consecutive two position data starting from the position number specified in operand 2.
Definition coordinates 1 of the simple interference check zone will be set in the position data specified in operand 2, while definition coordinates 2 will be set in the next position data. The coordinate data in the position data will include the specified definition coordinate data for simple interference check zone after all axes are set invalid.

(Note 1) The simple interference check zone is a dedicated SCARA function.

(Note 2) When this command is executed, the position data for axis 5 and subsequent axes will be cleared. Accordingly, do not specify any position currently used in linear movement axis operation.

(Note 3) The definition coordinates of simple interference check zone are always treated as data on the base coordinate system (load coordinate system No. 0). Therefore, position data set via a GTIF command must be handled on the base coordinate system.

(Note 4) GRP commands are 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	
Optional	Optional	WGHT	Mass	(Inertial moment)	CP

This command is supported by main controller application version 0.45 or later.
It is valid in PC software version 7.5.0.0 or later and teaching pendant version 1.11 or later.
20.

(Note) This command cannot be used with certain conventional models such as IX-NNN5020 (“D8A: Optimal acceleration/deceleration, Horizontal move optimization function based on Z position internal parameter error” will generate).

[Function] Set the mass and inertial moment of the load at the tip (tool + work).
Set the mass in operand 1 and inertial moment in operand 2. The unit is [g] for operand 1 and [kg-mm^2] for operand 2.
Once set by a WGHT command, the tip load mass and inertial moment will be retained until a new WGHT command is set (the set values will be retained even after the program ends). However, note that the set values will be cleared when the power is turned off or a software reset is performed, which means that this command must be set expressly in the program.

(Note 1) For the inertial moment in operand 2, set the total inertial moment for the tool and work related 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 will be set automatically.

(Note 3) If the tip load mass exceeds the maximum loading capacity of the robot, “B44: Load mass setting error” will generate.

(Note 4) When a WGHT command is executed, information of both the tip load mass and inertial moment will be refreshed. You cannot change only the mass or only the inertial moment.

(Note 5) Although the values of both tip load mass and inertial moment can be rough estimates, it is recommended that you set slightly larger values. Round up each value to the next multiple of 1 g or 1 kg-mm^2.

(Note 6) If no WGHT command is executed, the load mass and inertial moment are initialized by the maximum loading capacity and maximum allowable inertial moment of the robot. Set the load mass and inertial moment according to the applicable conditions of use.

(Note 7) The load mass and inertial moment set by a WGHT command are used by the PTP optimal acceleration/deceleration function for SCARA, Horizontal move optimization function based on Z position for SCARA, etc.

[Example	WGHT	1000	300	Set a tip load with a mass of 1000 g and inertial moment of 300 kg-mm^2.

- HOME (Dedicated linear movement axis command: 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 1) This command is used exclusively for linear movement axes. If it is specified for a SCARA axis, an “Error No. B80, Specification-prohibited axis error” or “Error No. 421, SCARA/linear movement axis simultaneous specification error” will generate.

(Note 2) 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 linear movement axes are at the home (= 0)) or “3” (output if all valid linear movement 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 therefore not recommended to perform home return other than for the purpose of adjusting an absolute encoder axis.

[Example 1] HOME 110000 Return axes 5 and 6 to the home.

[Example 2] An axis pattern can be indirectly specified using a variable. An example of specifying the operation in [Example 1] indirectly using a variable is shown below.

110000 (binary) → 48 (decimal)

```
LET     1     48     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.

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 an axis servo ON/OFF.

SV□□
- ON .... Turn ON the servo.
- OF .... Turn OFF the servo.

The arm system is set in local variable No. 99 upon successful completion of SVON.
Right arm system = 1
Left arm system = -1
Indeterminable = 0
Judgment is made based on the angle of arm 2.
Judgment is made on the basis of the angle of arm 2 after the arm 2 servo is turned ON.
This command sets the arm system immediately after servo ON and will not monitor the arm system continuously.

[Example 1] SVON 1 Turn on the servo for SCARA axis 1.

[Example 2] SVON 110000 Turn ON the servos for linear movement axes (axes 5 and 6).

● MOVP (Move by specifying position data in 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	
Optional	Optional	MOVP	Position number	Prohibited	PE

[Function] Move the actuator in PTP mode to the position 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.

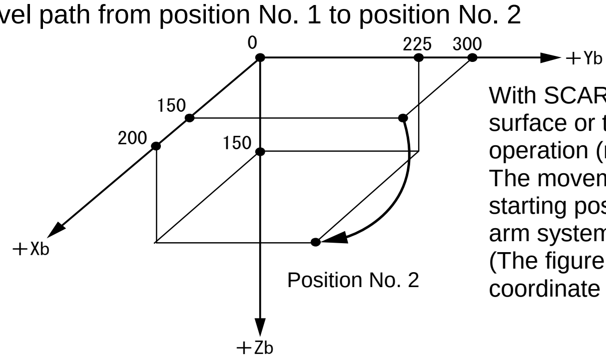
(Note) Movement to any position where target values for both SCARA and linear movement axes are specified simultaneously is prohibited ("Error No. 421, SCARA/linear movement axis simultaneous specification error").
To perform any operation meeting the above condition, use a GRP command or set different position data for SCARA axes and for linear movement axes.

[Example 1] MOVP 2 Move the axes to the position corresponding to position No. 2 (200, 225, 150, 30).

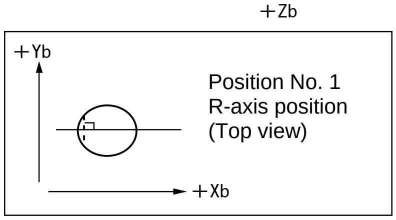
No.(Name)	Axis1	Axis2	Axis3	Axis4	Vel	Acc	Dcl
1( )	150.000	300.000	0.000	0.000			
2( )	200.000	225.000	150.000	30.000			
3( )							
4( )							

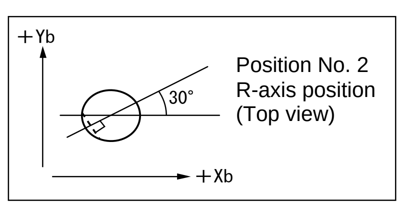
(Note) In the case of a SCARA axis, the axis will move based on the value of all-axis parameter No. 47, "Default SCARA axis PTP acceleration" or all-axis parameter No. 48, "Default SCARA axis PTP deceleration" if the acceleration or deceleration is not set by an ACCS (DCLS) command.
In the case of a linear movement axis, the axis will move based on the value of all-axis parameter No. 200, "Default linear movement axis acceleration" or all-axis parameter No. 201, "Default linear movement axis deceleration" if the acceleration or deceleration is not set by an ACC (DCL) command.

Travel path from position No. 1 to position No. 2



With SCARA, the center of the tool-mounting surface or the tool tip will move via PTP operation (not linearly).
The movement locus will vary depending on the starting position and end position of operation, arm system, etc.
(The figure at left shows positions on the base coordinate system.)





● MOVL (Move by specifying position data in 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	
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 (linear CP operation).
The output will turn OFF at the start of axis movement, and turn ON when the movement is complete.

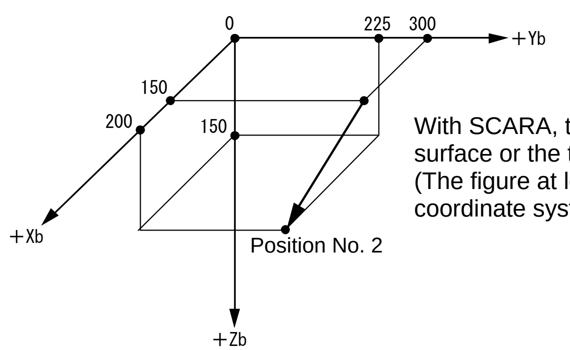
(Note 1) Movement to any position where target values for both SCARA and linear movement axes are specified simultaneously is prohibited (“Error No. 421, SCARA/linear movement axis simultaneous specification error”).
To perform any operation meeting the above condition, use a GRP command or set different position data for SCARA axes and for linear movement axes.

[Example 1] MOVL 2 Move the axes to the position corresponding to position No. 2 (200, 225, 150, 30), with interpolation.

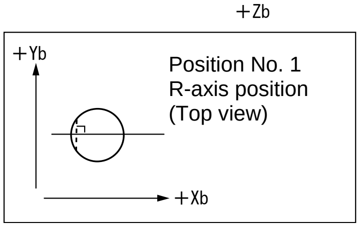
Travel path from position No. 1 to position No. 2

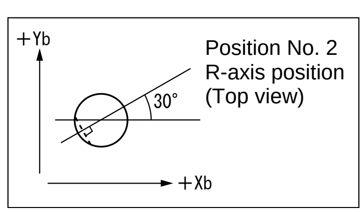
No.(Name)	Axis1	Axis2	Axis3	Axis4	Vel	Acc	Dcl
1( )	150.000	300.000	0.000	0.000			
2( )	200.000	225.000	150.000	30.000			
3( )							
4( )							

(Note) In the case of a SCARA axis, the axis will move based on the value of all-axis parameter No. 11, “Default SCARA axis CP acceleration” or all-axis parameter No. 12, “Default SCARA axis CP deceleration” if the acceleration or deceleration is not set by an ACC (DCL) command.
In the case of a linear movement axis, the axis will move based on the value of all-axis parameter No. 200, “Default linear movement axis acceleration” or all-axis parameter No. 201, “Default linear movement axis deceleration” if the acceleration or deceleration is not set by an ACC (DCL) command.



With SCARA, the center of the tool-mounting surface or the tool tip will move linearly.
(The figure at left shows positions on the base coordinate system.)





- MVPI (Move incrementally in 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	
Optional	Optional	MVPI	Position number	Prohibited	PE

[Function] Move the actuator in PTP mode 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 1) Movement to any position where target values for both SCARA and linear movement axes are specified simultaneously is prohibited ("Error No. 421, SCARA/linear movement axis simultaneous specification error").
To perform any operation meeting the above condition, use a GRP command or set different position data for SCARA axes and for linear movement axes.

(Note 2) With a SCARA axis, repeated use of incremental (relative) movement commands (MVPI, MVLI, TMPI and TMLI) will accumulate coordinate-conversion rounding errors. To eliminate these errors, execute an absolute movement command (MOVP, MOVL, etc.).

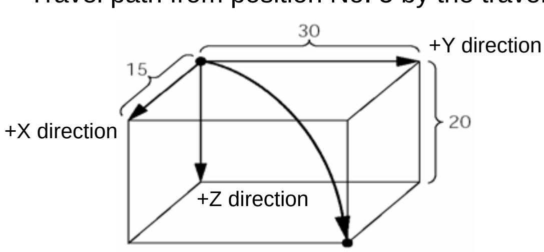
[Example 1] MVPI 6

Each axis will move from the current position by the travel amount specified in position No. 6.
If the current positions are (200, 150, 50, 45) as specified in position No. 5 and the travel amounts are (15, 30, 20, 30) as specified in position No. 6, the positions after movement will become (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 will move based on the value of all-axis parameter No. 47, "Default SCARA axis PTP acceleration" or all-axis parameter No. 48, "Default SCARA axis PTP deceleration" if the acceleration or deceleration is not set by an ACCS (DCLS) command.
In the case of a linear movement axis, the axis will move based on the value of all-axis parameter No. 200, "Default linear movement axis acceleration" or all-axis parameter No. 201, "Default linear movement axis deceleration" if the acceleration or deceleration is not set by an ACC (DCL) command.

Travel path from position No. 5 by the travel distance corresponding to position No. 6



With SCARA, the center of the tool-mounting surface or the tool tip will move via PTP operation. The movement locus will vary depending on the starting position and end position of operation, arm system, etc.

● MVLI (Move via incremental interpolation in 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	
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.

(Note 1) Movement to any position where target values for both SCARA and linear movement axes are specified simultaneously is prohibited ("Error No. 421, SCARA/linear movement axis simultaneous specification error").
To perform any operation meeting the above condition, use a GRP command or set different position data for SCARA axes and for linear movement axes.

(Note 2) With a SCARA axis, repeated use of incremental (relative) movement commands (MVPI, MVLI, TMPI and TMLI) will accumulate coordinate-conversion rounding errors. To eliminate these errors, execute an absolute movement command (MOVP, MOVL, etc.).

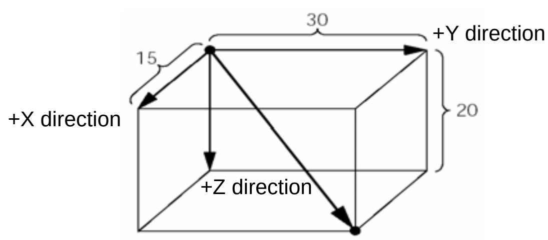
[Example 1] MVLI 6

Each axis will move from the current position by the travel amount specified in position No. 6.
If the current positions are (200, 150, 50, 45) as specified in position No. 5 and the travel amounts are (15, 30, 20, 30) as specified in position No. 6, the positions after movement will become (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 will move based on the value of all-axis parameter No. 11, "Default SCARA axis CP acceleration" or all-axis parameter No. 12, "Default SCARA axis CP deceleration" if the acceleration or deceleration is not set by an ACC (DCL) command.
In the case of a linear movement axis, the axis will move based on the value of all-axis parameter No. 200, "Default linear movement axis acceleration" or all-axis parameter No. 201, "Default linear movement axis deceleration" if the acceleration or deceleration is not set by an ACC (DCL) command.

Travel path from position No. 5 by the travel distance corresponding to position No. 6

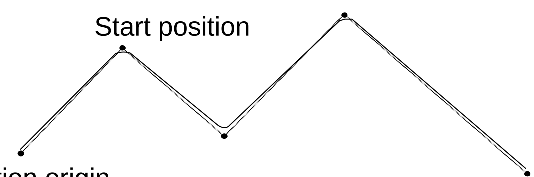


With SCARA, the center of the tool-mounting surface or the tool tip will move linearly.

● PATH (Move along path in 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	
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.

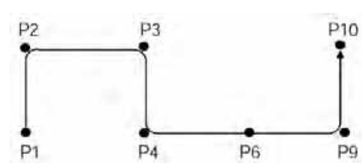


(Note 1) Movement to any position where target values for both SCARA and linear movement axes are specified simultaneously is prohibited ("Error No. 421, SCARA/linear movement axis simultaneous specification error").
To perform any operation meeting the above condition, use a GRP command or set different position data for SCARA axes and for linear movement axes.

(Note 2) 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 3) It is also possible to move the axis continuously along a path that passes one discontinuous 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 this example, the discontinuous position is position No. 6.
[Example] The axis will move continuously in the sequence of position Nos. 1 → 2 → 3 → 4 → 6 → 9 → 10.

```
PATH    1    4
PATH    6    6    Discontinuous position
PATH    9    10
```



[Example 1] PATH 100 120 Move continuously from position Nos. 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	
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

Only one SCARA axis (X, Y, Z or R-axis) can be specified. If a SCARA axis is specified, the axis will move according to the currently selected load coordinate system (CP operation). It is possible to specify multiple linear movement axes.
(SCARA axes are supported in main application version 0.33 or later.)

(Note 1) If the main application is older than version 0.33, specifying a SCARA axis will generate an "Error No. B80, Specification-prohibited axis error" or "Error No. 421, SCARA/linear movement axis simultaneous specification error."

(Note 2) This command is effective for a linear movement axis that has not yet completed home return. In this case, however, the maximum speed will be limited by "All-axis parameter No. 15, Maximum jog speed before confirmation of coordinates/home return." Since coordinate values do not mean anything before the completion of home return, pay due attention to preventing contact with the stroke ends. SCARA axes can operate only when ABS coordinates are not yet confirmed.

(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: 250 mm/sec). Parameter editing is supported by PC software of version 7.0.11.0 or later, teaching pendants (IA-T-X) of version 1.44 or later and teaching pendants (SEL-T) of version 1.01 or later. (Parameter settings can be changed using PC software and teaching pendants of older versions. However, the parameter names will not be displayed and the set values will be displayed as hexadecimals.)

(Note 4) When the X, Y or R-axis is jogged, none of the axes can be operated, except for the Z-axis, from other task.

(Note 5) If the operation of a SCARA axis is started near a straight point (singular point) of arm 1 or arm 2, the acceleration will be reduced to prevent rapid operation.

(Note 6) If the operation of a SCARA axis is started outside the movement range (outside the soft limits of each axis, inside the CP operation limit band, inside the tool reference-point entry prohibition circle (when tool offset is enabled) or inside the back entry prohibition area), select an appropriate axis and direction and move the axis to inside the movement range. Jog operation cannot be performed to outside the movement range.

(Note 7) If the R-axis generates an "Error No. C74, Actual-position soft limit over error" due to the posture control component, etc., while a SCARA axis is jogging, take an appropriate action such as jogging each axis system using the PC software or teaching pendant to bring the R-axis position closer to the center of the R-axis stroke.

(Note 8) When tool offset is enabled for a SCARA axis (tool coordinate system selection number = other than 0), jog operation of the R-axis is implemented as rotational operation of the tool tip, meaning that arm 1 or 2 will operate. Exercise caution.

(Note 9) If an axis moving in accordance with J□W□ 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 for linear movement axis” 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 approximately –10 m and 10 m.
Any positioning command other than the above to a position exceeding a coordinate range from approximately –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 pull-out error.”
(These errors generate because the controller cannot recognize the operating direction reliably around the boundary. The current value may need to be reset using a HOME command, in conjunction with “Axis-specific parameter No. 10, Method of movement to absolute reset position/home return” being set to “1” (current position 0 home).)
When infinite stroke is enabled, be sure to perform a timeout check using other task or an external system.

The infinite-stroke mode can be specified only when an incremental encoder is used. Be sure to contact IAI’s Sales Engineering if you wish to use the infinite-stroke mode.

[Example 1]

VEL	100		Set the speed to 100 mm/s.
JBWF	10000	10	Move axis 5 backward while input 10 is OFF.

[Example 2] An axis pattern can be indirectly specified using a variable. An example of specifying the operation in [Example 1] indirectly using a variable is shown below.
10000 (binary) → 16 (decimal)

VEL	100		Set the speed to 100 mm/s.
JET	1	16	Assign 12 to variable 1.
JBWF	*1	10	

[Example 3]

VEL	100		Set the speed to 100 mm/s.
JET	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	
Optional	Optional	STOP	Axis pattern	Prohibited	CP

[Function] Decelerate an axis to a stop.

(Note 1) A STOP command can be used with all active servo commands other than a SVOF command.

(Note 2) With SCARA, all axes will be decelerated to a stop regardless of the axis pattern.

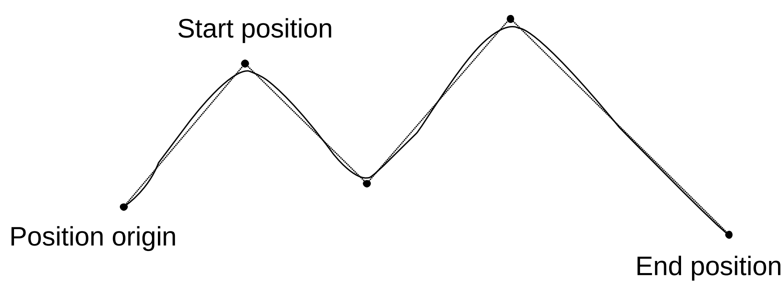
(Note 3) A STOP command only issues a deceleration-stop command (operation stop) and does not wait for stopping to complete. Issuing other servo commands to a decelerating axis will either become invalid or generate an "axis duplication error," etc.
Set a timer, etc., in the program so that the next servo command will be issued after a sufficient deceleration-stop processing time elapses.
Even when a STOP command is to be is issued to an axis currently stopped, provide a minimum interval of 0.1 second before the next servo command is issued.

[Example 1]	STOP	1	Decelerate SCARA axes to a stop.
[Example 2]	STOP	110000	Decelerate linear movement axes (axes 5 and 6) to a stop.

● PSPL (Move along spline in 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	
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 1) Movement to any position where target values for both SCARA and linear movement axes are specified simultaneously is prohibited (“Error No. 421, SCARA/linear movement axis simultaneous specification error”).
To perform any operation meeting the above condition, use a GRP command or set different position data for SCARA axes and for linear movement axes.

(Note 2) If the acceleration and deceleration are different between points, the speeds will not be connected smoothly.

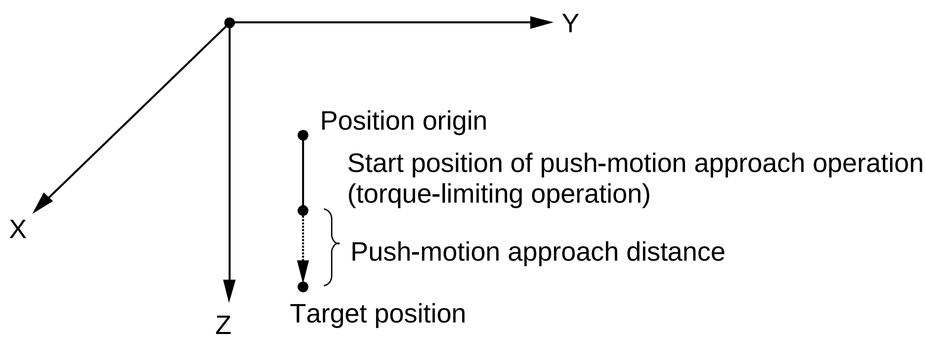
In this case, input in operand 1 the point number of the next target, instead of the predicted current position upon execution of the applicable command.
(Inputting a point number corresponding to the predicted current position will trigger movement to the same point during continuous movement, thereby causing the speed to drop.)

[Example] PSPL 100 120 Continuously move from position Nos. 100 to 120 along a spline-interpolation curve.

- PUSH (Move by push motion in 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	
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 speed and acceleration of movement from the position origin to the push-motion approach start position will conform to the values specified by a VEL, ACC or DCL command or position data.



The push force can be adjusted using “Driver-card parameter No. 38, Push torque limit at positioning” (default value: 70%).

(Note 1) Among SCARA axes, a PUSH command only moves the Z-axis. If multiple axes are specified, an “Error No. C91, Multiple push-axes specification error” will generate.

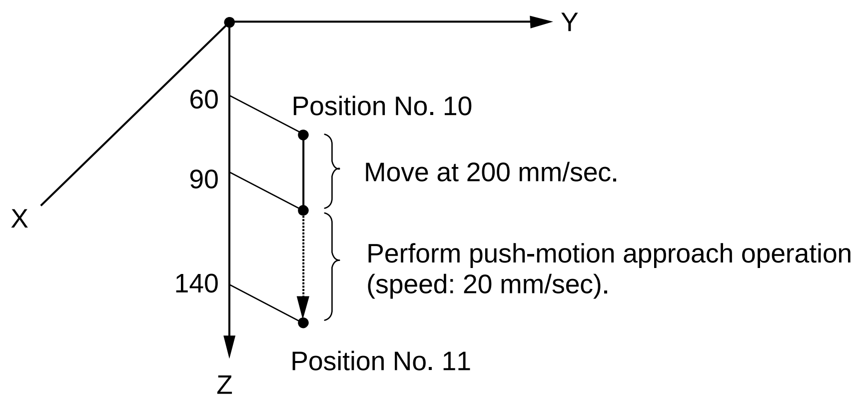
(Note 2) A push-motion approach speed exceeding the maximum speed permitted by the system will be clamped at the maximum speed. (The maximum system speed is not the maximum practical speed. Determine a practical speed by considering the impact upon contact, etc.)

[Example]	PAPR	50	20
	MOVP	10	
	PUSH	11	

Set the push-motion approach distance to 50 mm and push-motion approach speed to 20 mm/sec.
Move from the current position to position No. 10.
Perform push-motion movement from position Nos. 10 to 11.

The diagram below describes a push-motion movement based on the position data shown in the table below:

No.(Name)	Axis1	Axis2	Axis3	Axis4	Vel	Acc	Dcl
10( )	250.000	100.000	60.000	0.000	200	0.80	0.80
11( )			140.000				
12( )							



- CIR2 (Move along circle in CP operation (arc interpolation))

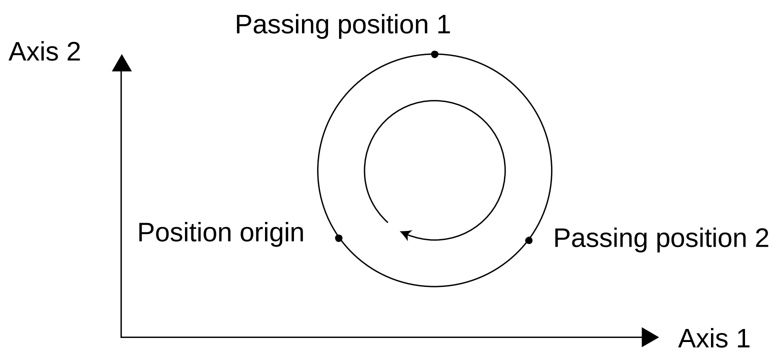
Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	CIR2	Passing position 1 number	Passing position 2 number	PE

[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		All-axis parameter No. 11, Default acceleration of SCARA axis (All-axis parameter No. 12, Default deceleration of SCARA axis) All-axis parameter No. 200, Default acceleration of linear movement axis (All-axis parameter No. 201, Default deceleration of linear movement axis)

If neither speed is set, a “C88 speed specification error” will generate.
If neither acceleration/deceleration is valid, a “C89 acceleration/deceleration specification error” will generate.

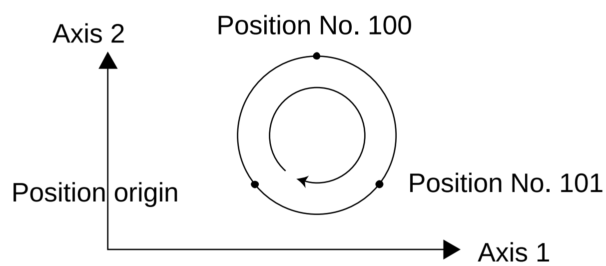


(Note 1) Movement to any position where target values for both SCARA and linear movement axes are specified simultaneously is prohibited (“Error No. 421, SCARA/linear movement axis simultaneous specification error”).
To perform any operation meeting the above condition, use a GRP command or set different position data for SCARA axes and for linear movement axes.

(Note 2) With SCARA axes, this command is valid only on the XY plane.

(Note 3) If the interval between the position origin and passing position 1 or between passing position 1 and passing position 2 is small and the locus passes near a soft limit, an “Error No. C73, Target-locus soft limit over error” may generate. In this case, take an appropriate action such as increasing the position intervals as much as possible or setting the locus slightly inward of the soft limit boundary.

[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 arc in CP operation (arc interpolation))

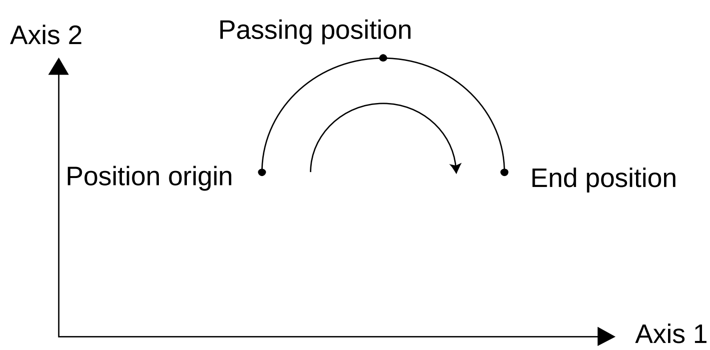
Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	ARC2	Passing position number	End position number	PE

[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		All-axis parameter No. 11, Default acceleration of SCARA axis (All-axis parameter No. 12, Default deceleration of SCARA axis) All-axis parameter No. 200, Default acceleration of linear movement axis (All-axis parameter No. 201, Default deceleration of linear movement 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.

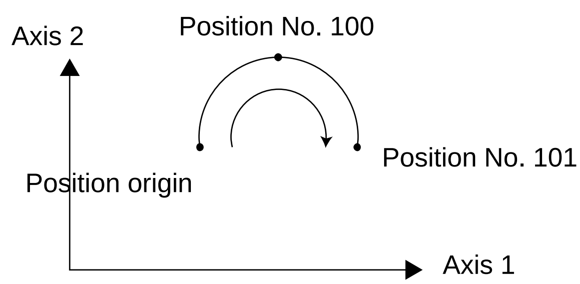


(Note 1) Movement to any position where target values for both SCARA and linear movement axes are specified simultaneously is prohibited ("Error No. 421, SCARA/linear movement axis simultaneous specification error").
To perform any operation meeting the above condition, use a GRP command or set different position data for SCARA axes and for linear movement axes.

(Note 2) With SCARA axes, this command is valid only on the XY plane.

(Note 3) If the interval between the position origin and passing position or between the passing position and end position is small and the locus passes near a soft limit, an "Error No. C73, Target-locus soft limit over error" may generate.
In this case, take an appropriate action such as increasing the position intervals as much as possible or setting the locus slightly inward of the soft limit boundary.

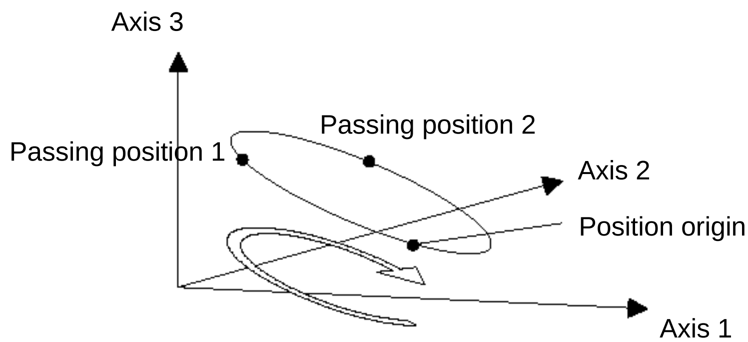
[Example]	VEL	100		Set the speed to 100 mm/s.
	ARC2	100	101	Move along an arc (circular interpolation) from the current position to position No. 101 by passing position No. 100.



- CIRS (Move three-dimensionally along circle in 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	
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
2	Setting by VEL command	Setting by ACC (DCL) command
3		All-axis parameter No. 11, Default acceleration of SCARA axis (All-axis parameter No. 12, Default deceleration of SCARA axis) All-axis parameter No. 200, Default acceleration of linear movement axis (All-axis parameter No. 201, Default deceleration of linear movement 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) Movement to any position where target values for both SCARA and linear movement axes are specified simultaneously is prohibited (“Error No. 421, SCARA/linear movement axis simultaneous specification error”).
To perform any operation meeting the above condition, use a GRP command or set different position data for SCARA axes and for linear movement axes.

(Note 2) With SCARA axes, 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 3) The locus tends to shift inward as the speed increases. Minor adjustment, such as setting the position data slightly outward, may be required.

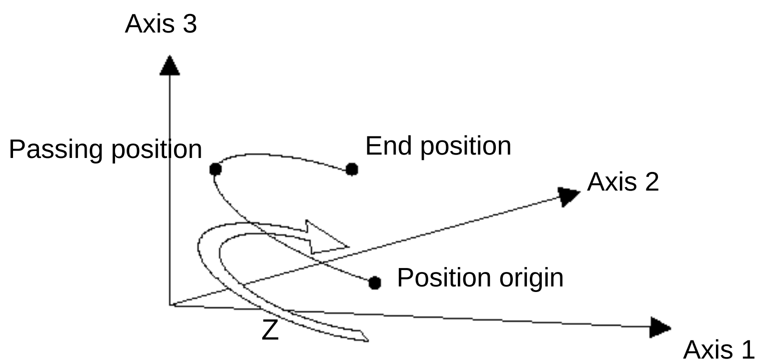
(Note 4) If the circle diameter is small with respect to the set speed, the speed may be limited. (Although increasing the acceleration/deceleration will ease the speed limitation, do not increase the acceleration/deceleration beyond the range permitted for the actuator.)

(Note 5) If the interval between the position origin and passing position 1 or between passing position 1 and passing position 2 is small and the locus passes near a soft limit, an “Error No. C73, Target-locus soft limit over error” may generate. In this case, take an appropriate action such as increasing the position intervals as much as possible or setting the locus slightly inward of the soft limit boundary.

● ARCS (Move three-dimensionally along arc in 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	
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
2	Setting by VEL command	Setting by ACC (DCL) command
3		All-axis parameter No. 11, Default acceleration of SCARA axis (All-axis parameter No. 12, Default deceleration of SCARA axis) All-axis parameter No. 200, Default acceleration of linear movement axis (All-axis parameter No. 201, Default deceleration of linear movement 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) Movement to any position where target values for both SCARA and linear movement axes are specified simultaneously is prohibited ("Error No. 421, SCARA/linear movement axis simultaneous specification error").
To perform any operation meeting the above condition, use a GRP command or set different position data for SCARA axes and for linear movement axes.

(Note 2) 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 3) The locus tends to shift inward as the speed increases. Minor adjustment, such as setting the position data slightly outward, may be required.

(Note 4) If the arc diameter is small with respect to the set speed, the speed may be limited. (Although increasing the acceleration/deceleration will ease the speed limitation, do not increase the acceleration/deceleration beyond the range permitted for the actuator.)

(Note 5) If the interval between the position origin and passing position or between the passing position and end position is small and the locus passes near a soft limit, an "Error No. C73, Target-locus soft limit over error" may generate.
In this case, take an appropriate action such as increasing the position intervals as much as possible or setting the locus slightly inward of the soft limit boundary.

● ARCD (Move along arc via specification of end position and center angle in CP operation (arc interpolation))

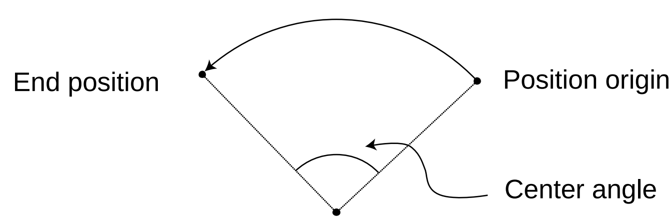
Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	ARCD	End position number	Center angle	PE

[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		All-axis parameter No. 11, Default acceleration of SCARA axis (All-axis parameter No. 12, Default deceleration of SCARA axis) All-axis parameter No. 200, Default acceleration of linear movement axis (All-axis parameter No. 201, Default deceleration of linear movement 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) Movement to any position where target values for both SCARA and linear movement axes are specified simultaneously is prohibited (“Error No. 421, SCARA/linear movement axis simultaneous specification error”).
To perform any operation meeting the above condition, use a GRP command or set different position data for SCARA axes and for linear movement axes.

(Note 2) With SCARA axes, this command is valid only on the XY plane.

(Note 3) If the center angle is small and the locus passes near a soft limit, an “Error No. C73, Target-locus soft limit over error” may generate.
In this case, take an appropriate action such as setting the locus slightly inward of the soft limit boundary. The larger the center angle, the smaller the locus error becomes.

[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 in CP operation (arc interpolation))

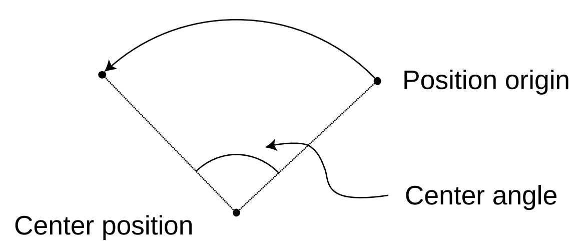
Extension condition (LD, A, O, AB, OB)	Input condition (I/O, flag)	Command, declaration			Output (Output, flag)
		Command, declaration	Operand 1	Operand 2	
Optional	Optional	ARCC	Center position number	Center angle	PE

[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		All-axis parameter No. 11, Default acceleration of SCARA axis (All-axis parameter No. 12, Default deceleration of SCARA axis) All-axis parameter No. 200, Default acceleration of linear movement axis (All-axis parameter No. 201, Default deceleration of linear movement 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) Movement to any position where target values for both SCARA and linear movement axes are specified simultaneously is prohibited ("Error No. 421, SCARA/linear movement axis simultaneous specification error").
To perform any operation meeting the above condition, use a GRP command or set different position data for SCARA axes and for linear movement axes.

(Note 2) With SCARA axes, this command is valid only on the XY plane.

(Note 3) If the center angle is small and the locus passes near a soft limit, an "Error No. C73, Target-locus soft limit over error" may generate.
In this case, take an appropriate action such as setting the locus slightly inward of the soft limit boundary. The larger the center angle, the smaller the locus error becomes.

[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).

- CHVL (Dedicated linear movement axis command: 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 axes currently 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 used exclusively for linear movement axes. If it is used for a SCARA axis, an “Error No. B80, Specification-prohibited axis error” will generate.
(Note 2) This command is not valid on an axis operated by a CIR, ARC, PSPL, PUSH, ARCH, PACH, CIRS or ARCS command.
(Note 3) Executing a CHVL command for an axis operating in sigmoid motion (SCRV command) will generate an “Error No. CC1, Speed change condition error.”
(Note 4) 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.

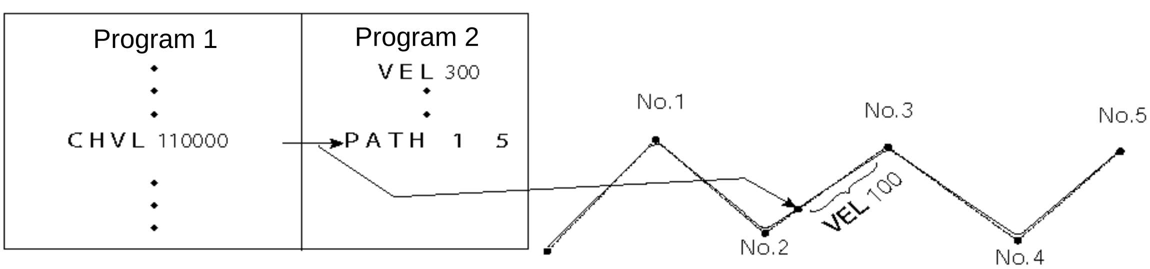
Program 1	Program 2
	VEL 300
	.
	.
	MOVP 1
CHVL 10000 100	MOVP 2
	MOVP 3
	.

If CHVL is executed in program 1 while MOVP 2 is being 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.

An axis pattern can be indirectly specified using a variable. An example of specifying program 1 indirectly using a variable is shown below.
10000 (binary) → 16 (decimal)

LET	1	16	Assign 16 to variable 1.
CHVL	*1	100	

(Note 5) Since this command is valid only for the packet that is active at the time of execution of the command for an axis pertaining to continuous-motion packet points in a PATH command, etc., caution must be exercised against a timing shift, etc. The packet handling will be put on hold during speed change processing, so caution must also be exercised against a locus shift.



If CHVL is executed in program 1 while PATH is being executed in program 2, or specifically during the 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 movement to point No. 3. Other travel speeds will remain at the speed specified by VEL (300 mm/sec in the above example).

(Note 6) Override of the CHVL call task will be applied, so caution must be exercised.

(Note 7) The maximum speed of the specified axis that has completed 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 in such a way that each command applies to an axis or group of axes having the same speed. In particular, specification of a CHVL command in a separate step is recommended for a rotational movement axis.

[Example]

```
CHVL  110000  500  ⇒  CHVL   100000    500
                      CHVL   10000     500
```

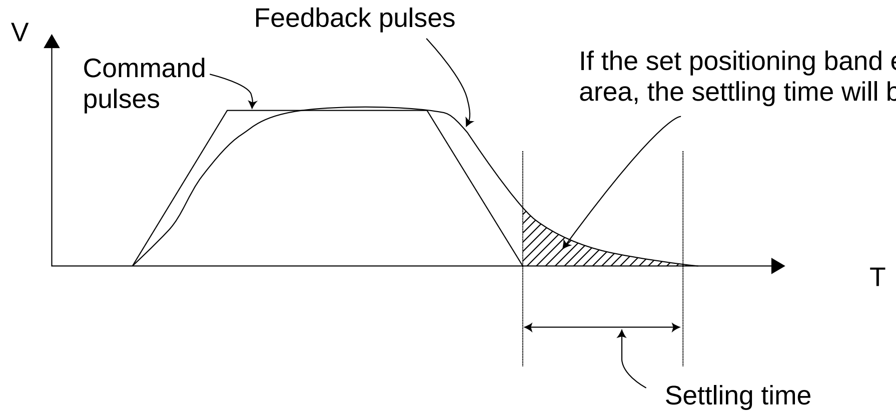
- PBND (Set positioning band)

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 band for the axes in the axis pattern specified in operand 1. The units of operand 2 are specified below.

	Unit of operand 2
SCARA	X, Y, R: deg, Z: mm
Linear movement axis	mm, RS: deg

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° will have effect, but the effect must be confirmed on the actual machine.)



(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 the X and Y-axes to 5° after this command.

[Example 2] An axis pattern can be indirectly specified using a variable. An example of specifying the operation in [Example 1] indirectly using a variable is shown below.

11 (binary) → 10 (decimal)

LET	1	3	Assign 3 to variable 1.
PBND	*1	5	

- TMPI (Dedicated SCARA command: Move relatively between positions on tool coordinate system in 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	
Optional	Optional	TMPI	Position number	Prohibited	PE

[Function] Each axis will move relatively on the tool coordinate system without interpolation (= PTP operation) based on the position data specified in operand 1 setting the travel amount from the current position.

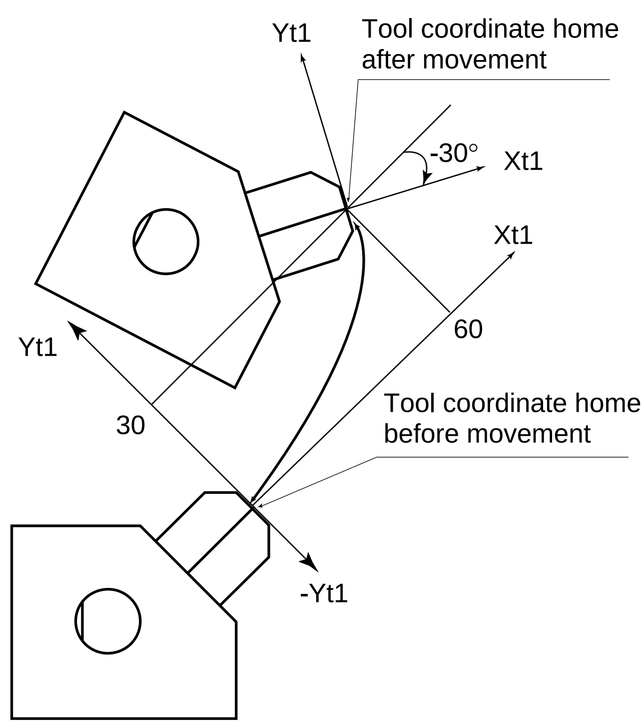
(Note 1) This command is used exclusively for SCARA axes. If it is specified for a linear movement axis, an “Error No. B80, Specification-prohibited axis error” or “Error No. 421, SCARA/linear movement axis simultaneous specification error” will generate.

(Note 2) Repeated use of incremental (relative) movement commands will accumulate coordinate-conversion rounding errors.

[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 relatively between positions on tool coordinate system via interpolation in 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	
Optional	Optional	TMLI	Position number	Prohibited	PE

[Function] Each axis will move relatively on the tool coordinate system with interpolation (= CP operation) based on the position data specified in operand 1 setting the travel amount from the current position.

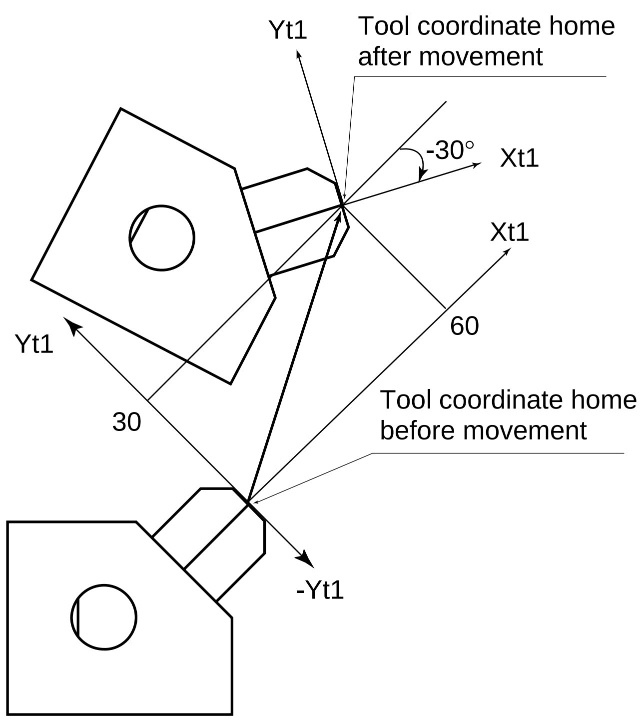
(Note 1) This command is used exclusively for SCARA axes. If it is specified for a linear movement axis, an “Error No. B80, Specification-prohibited axis error” or “Error No. 421, SCARA/linear movement axis simultaneous specification error” will generate.

(Note 2) Repeated use of incremental (relative) movement commands will accumulate coordinate-conversion rounding errors.

[Example] TMLI 120

Position data

No.	Axis1	Axis2	Axis3	Axis4	Vel	Acc	Dcl
120	60.000	30.000	0.000	-30.000			
121							
122							



- 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 for the axis pattern specified in operand 1 (among SCARA axes, this command can be specified only for the Z-axis) to the value specified in operand 2. The ratio in operand 2 is set as an integer (unit: %).
"Driver-card parameter No. 38: Push torque limit at positioning" can be rewritten temporarily using a PTRQ command.

(Note 1) If push torque limit is not set with a PTRQ command, the value set in "Driver-card parameter No. 38: Push torque limit at positioning" will be used.
(Note 2) If the push torque limit is changed, the new setting will remain valid even after the program ends. Therefore, to build a system using PTRQ commands, a push torque limit must be expressly specified with a PTRQ command before operation of each program. An assumption that the push torque limit will be reset to the original value when the operation ends in other program may lead to an unexpected problem, because the push torque limit will become different from what is anticipated in case the applicable program is aborted due to error, etc.
(Note 3) The new value set with a PTRQ command will become invalid after a power-ON reset or software reset.
(Note 4) The value set in "Driver-card parameter No. 38: Push torque limit at positioning" (in the main CPU flash memory (nonvolatile memory)) will not be written by a PTRQ command.

[Example]

PTRQ	100	50	Change the push torque limit parameter for the Z-axis to 50%.
PAPR	50	20	Set the push-motion approach distance to 50 mm and push-motion approach speed to 20 mm/sec.
MOVP	10		Move to position No. 10.
PUSH	11		Move from position No. 10 to position No. 11 via push-motion operation.

- CIR (Move along circle in 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	
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) Movement to any position where target values for both SCARA and linear movement axes are specified simultaneously is prohibited (“Error No. 421, SCARA/linear movement axis simultaneous specification error”).
To perform any operation meeting the above condition, use a GRP command or set different position data for SCARA axes and for linear movement axes.

(Note 2) 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 3) 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 4) The acceleration is selected in the order of the acceleration in the data at passing position 1, followed by the value set in an ACC command, and the value in “All-axis parameter No. 11, Default acceleration of SCARA axis” or “All-axis parameter No. 200, Default acceleration of linear movement 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 5) This command is valid on arbitrary cartesian planes. (Depending on the position data, axis 2 may be selected automatically and preferentially before axis 1.)

(Note 6) If the interval between the position origin and passing position 1 or between passing position 1 and passing position 2 is small and the locus passes near a soft limit, an “Error No. C73, Target-locus soft limit over error” may generate. In this case, take an appropriate action such as increasing the position intervals as much as possible or setting the locus slightly inward of the soft limit boundary.

[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 in 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	
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) Movement to any position where target values for both SCARA and linear movement axes are specified simultaneously is prohibited ("Error No. 421, SCARA/linear movement axis simultaneous specification error").
To perform any operation meeting the above condition, use a GRP command or set different position data for SCARA axes and for linear movement axes.

(Note 2) 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 3) 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 4) The acceleration is selected in the order of the acceleration in the data at passing position 1, followed by the value set in an ACC command, and the value in "All-axis parameter No. 11, Default acceleration of SCARA axis" or "All-axis parameter No. 200, Default acceleration of linear movement 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 5) This command is valid on arbitrary cartesian planes. (Depending on the position data, axis 2 may be selected automatically and preferentially before axis 1.)

(Note 6) If the interval between the position origin and passing position or between the passing position and end position is small and the locus passes near a soft limit, an "Error No. C73, Target-locus soft limit over error" may generate.
If the interval between the position origin and passing position 1 or between passing position 1 and passing position 2 is small and the locus passes near a soft limit, an "Error No. C73, Target-locus soft limit over error" may generate. In this case, take an appropriate action such as increasing the position intervals as much as possible or setting the locus slightly inward of the soft limit boundary.

[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]

```
             SVON   1111                 Set the current arm system in variable 99.
             PRDQ   1      100           Read the current X coordinate into variable 100.
             CPNE   99     0      600    If the arm system is indeterminable, the arm
┌─ 600       IFEQ   99     1             system whose flag 600 is turned OFF will be
│                                        determined. If this arm system is also
│                                        indeterminable, the operation will end.
│         ┌─ IFGE   100    0             If the X coordinate is 0 or greater:
│         │  MOVP   1                    Move the axis to position No. 1 in PTP mode.
│         ├─ ELSE
│         │  MOVP   2                    Move the axis to position No. 2 in PTP mode.
│         └─ EDIF
├─────────── ELSE
│         ┌─ IFGE   100    0             If the X coordinate is 0 or greater:
│         │  MOVP   3                    Move the axis to position No. 3 in PTP mode.
│         ├─ ELSE
│         │  MOVP   4                    Move the axis to position No. 4 in PTP mode.
│         └─ EDIF
└─────────── EDIF
             EXIT
```

If the current arm system is the right arm and the X coordinate is 0 or greater, the axis will move to position No. 1; if the X coordinate is below 0, the axis will move to position No. 2. If the current arm system is the left arm and the X coordinate is 0 or greater, the axis will move to position No. 3; if the X coordinate is below 0, the axis will move 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	
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)
          SLEN   4                        Set the number of comparing characters to 4.
┌─ 600    ISEQ   1    "AXSX" (X-axis)     Select an axis.
│     ┌── ISEQ   5    10                  Select a moving direction.
│     │   MOVL   1                        Move the axis to position No. 1 in CP mode.
│     ├── ELSE
│     │   MOVL   2    5                   Move the axis to position No. 2 in CP mode.
│     └── EDIF
├──────── ELSE
│     ┌── ISNE   5    14                  Select a moving direction.
│     │   MOVL   3                        Move the axis to position No. 3 in CP mode.
│     ├── ELSE
│     │   MOVL   4                        Move the axis to position No. 4 in CP mode.
│     └── EDIF
└──────── EDIF
```

Move in CP mode by selecting position Nos. 1 and 2 by columns 1 to 4 and position Nos. 3 and 4 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, the axis will be moved to position No. 1 in CP mode.

1 2	3 4	5 6	7 8	
AX	SX	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 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	
Optional	Optional	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.
:			
EDSL			The processing will move here if any of the conditions
:			was satisfied and the applicable command executed. In
(4)			this example, (2) and (4) will be executed.
:			

* 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 was 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 ÷ 16 = 199 ,,,4
199 ÷ 16 = 12 (= C) ,,,7

$3188 = 12\ (= C) \times 16^2 + 7 \times 16 + 4$
$= C74$ (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.

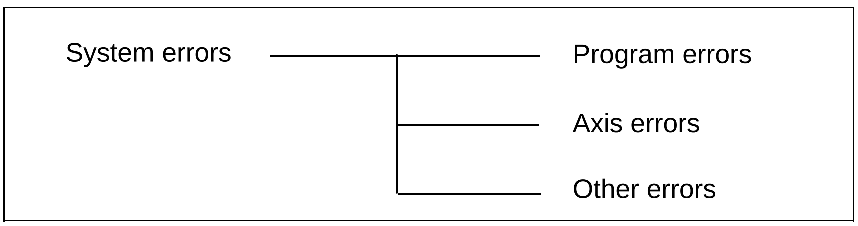
[Example] PGST 1 2 Read the error number for program No. 2 to variable 1.

● 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.

- 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	
Optional	Optional	GARM	Variable number	Prohibited	CP

[Function] Obtain the current arm system and set in the variable specified in operand 1 one of the following values corresponding to this arm system:

Arm system is indeterminable = 0
Right arm system = 1
Left arm system = -1

(Note 1) This command sets the arm system immediately after command execution. The arm system will not be monitored continuously.

[Example] GARM 200 — Set "1" in variable No. 200 if the current arm system is the right arm system, or "-1" if the current arm system is the left arm system.

1.17 Zone

- WZNA (Dedicated linear movement axis command: 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 statuses 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.

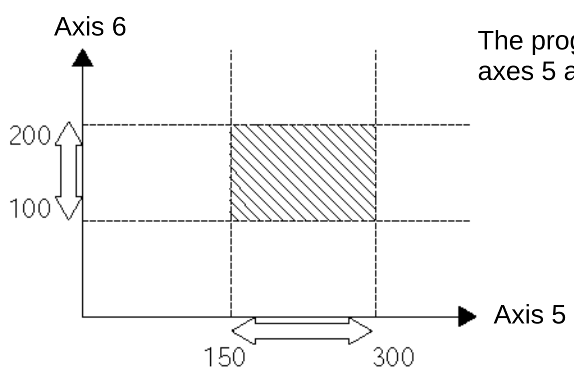
(Note 1) The zone command is a dedicated linear movement axis function. If this command is specified for a SCARA axis, an “Error No. B80, Specification-prohibited axis error” will generate.
(Note 2) The zone status for a given axis remains OFF (outside zone) until the axis completes home return.
(Note 3) Four zone areas can be set for each axis (“Axis-specific parameter Nos. 86 to 97”).
(Note 4) Irrespective of this command, zone outputs can be specified using “Axis-specific parameter Nos. 88, 91, 94 and 97.”

[Example 1] WZNA 1 110000 Wait until the zone statuses of axes 5 and 6 become ON when the parameters are set as follows (= until both axes enter the shaded range specified below).

[Example 2] An axis pattern can be indirectly specified using a variable. An example of specifying the operation in [Example 1] indirectly using a variable is shown below.
110000 (binary) → 48 (decimal)

LET	5	48	Assign 48 to variable 5.
WZNA	1	*5	

	Axis 5	Axis 6
“Axis-specific parameter No. 86, Zone 1 MAX of linear movement axis” (specified in units of 0.001 mm)	300000	200000
“Axis-specific parameter No. 87, Zone 1 MIN of linear movement axis” (specified in units of 0.001 mm)	150000	100000



The program will proceed to the next step once axes 5 and 6 are inside the shaded area.

- WZNO (Dedicated linear movement axis command: 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.

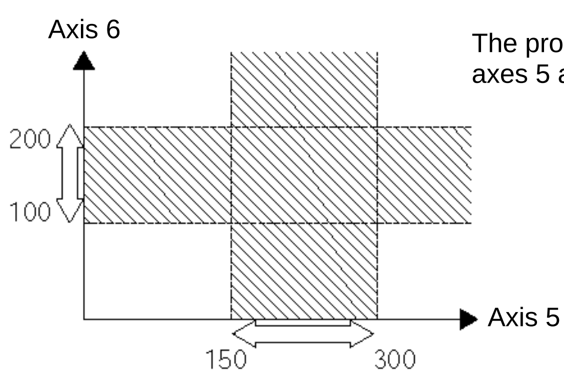
(Note 1) The zone command is a dedicated linear movement axis function. If this command is specified for a SCARA axis, an "Error No. B80, Specification-prohibited axis error" will generate.
(Note 2) The zone status for a given axis remains OFF (outside zone) until the axis completes home return.
(Note 3) Four zone areas can be set for each axis ("Axis-specific parameter Nos. 86 to 97").
(Note 4) Irrespective of this command, zone outputs can be specified using "Axis-specific parameter Nos. 88, 91, 94 and 97."

[Example 1] WZNO 1 110000 Wait until the zone status of axis 5 or 6 becomes ON when the parameters are set as follows (= until either axis enters the shaded range specified below).

[Example 2] An axis pattern can be indirectly specified using a variable. An example of specifying the operation in [Example 1] indirectly using a variable is shown below.
110000 (binary) → 48 (decimal)

LET	5	48	Assign 48 to variable 5.
WZNO	1	*5	

	Axis 5	Axis 6
"Axis-specific parameter No. 86, Zone 1 MAX of linear movement axis" (specified in units of 0.001 mm)	300000	200000
"Axis-specific parameter No. 87, Zone 1 MIN of linear movement axis" (specified in units of 0.001 mm)	150000	100000



The program will proceed to the next step once axes 5 and 6 are inside the shaded area.

- WZFA (Dedicated linear movement axis command: 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 statuses 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.

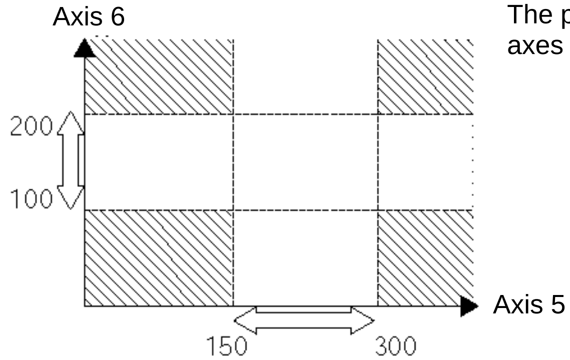
(Note 1) The zone command is a dedicated linear movement axis function. If this command is specified for a SCARA axis, an “Error No. B80, Specification-prohibited axis error” will generate.
(Note 2) The zone status for a given axis remains OFF (outside zone) until the axis completes home return.
(Note 3) Four zone areas can be set for each axis (“Axis-specific parameter Nos. 86 to 97”).
(Note 4) Irrespective of this command, zone outputs can be specified using “Axis-specific parameter Nos. 88, 91, 94 and 97.”

[Example 1] WZFA 1 110000 Wait until the zone statuses of axes 5 and 6 become OFF when the parameters are set as follows (= until both axes enter the shaded range specified below).

[Example 2] An axis pattern can be indirectly specified using a variable. An example of specifying the operation in [Example 1] indirectly using a variable is shown below.
110000 (binary) → 48 (decimal)

LET	5	48	Assign 48 to variable 5.
WZFA	1	*5	

	Axis 5	Axis 6
“Axis-specific parameter No. 86, Zone 1 MAX of linear movement axis” (specified in units of 0.001 mm)	300000	200000
“Axis-specific parameter No. 87, Zone 1 MIN of linear movement axis” (specified in units of 0.001 mm)	150000	100000



The program will proceed to the next step once axes 5 and 6 are inside the shaded area.

- WZFO (Dedicated linear movement axis command: 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.

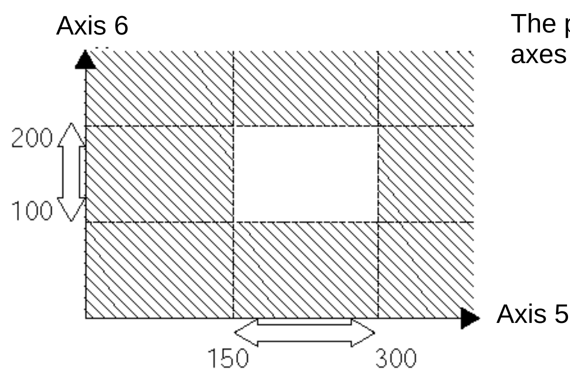
(Note 1) The zone command is a dedicated linear movement axis function. If this command is specified for a SCARA axis, an "Error No. B80, Specification-prohibited axis error" will generate.
(Note 2) The zone status for a given axis remains OFF (outside zone) until the axis completes home return.
(Note 3) Four zone areas can be set for each axis ("Axis-specific parameter Nos. 86 to 97").
(Note 4) Irrespective of this command, zone outputs can be specified using "Axis-specific parameter Nos. 88, 91, 94 and 97."

[Example 1] WZFO 1 110000 Wait until the zone status of axis 5 or 6 becomes OFF when the parameters are set as follows (= until either axis enters the shaded range specified below).

[Example 2] An axis pattern can be indirectly specified using a variable. An example of specifying the operation in [Example 1] indirectly using a variable is shown below.
110000 (binary) → 48 (decimal)

```
LET    5    48    Assign 48 to variable 5.
WZFO   1    *5
```

	Axis 5	Axis 6
"Axis-specific parameter No. 86, Zone 1 MAX of linear movement axis" (specified in units of 0.001 mm)	300000	200000
"Axis-specific parameter No. 87, Zone 1 MIN of linear movement axis" (specified in units of 0.001 mm)	150000	100000



The program will proceed to the next step once axes 5 and 6 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: If "OPEN 0" is executed, the teaching connector (D-sub, 25-pin) will be disconnected. (This is because channel 0 is shared by the teaching pendant/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	
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 (variable 99 based on the factory setting). You can check the return code to see if the command has been executed successfully. If necessary, define a process to be performed in the event that the command was aborted due to an error.
With the main application of version 0.41 or later, a dummy read (clearing the receive buffer and disabling reception) can be implemented by specifying “0” in operand 2 (the return code will indicate successful completion). The versions of tools that permit entry of “0” in operand 2 are shown below. If “0” cannot be entered from your tool, you can still specify a dummy read 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 the return code (content of variable 99) to variable 1.
CLOS	1		Close the channel.
SLCT			The program branches to the process corresponding to each return code.
WHEQ	1	0	(Note) Using a GOTO command to branch out of or into a SLCT-EDSL syntax is prohibited.
:			
[1]			If the content of variable 1 is “0” (completed successfully), [1] is executed. Define the process to be performed upon successful completion of the command, in [1].
:			
WHEQ	1	1	If the content of variable 1 is “1” (timeout occurred), [2] is executed. If necessary, define an appropriate process to be performed upon timeout, in [2].
:			
[2]			
:			
WHEQ	1	2	If the content of variable 1 is “2” (timer cancelled), [3] is executed. If necessary, define an appropriate process to be performed upon timer cancellation, in [3].
:			
[3]			
:			
OTHE			If the content of variable 1 is not “0,” “1” or ‘2,” [4] is executed. If necessary, define an appropriate process to be performed in this condition, in [4].
:			
[4]			
:			
EDSL			If any of the above conditions was satisfied and the corresponding part of the command has been executed, the program jumps to this step.

(Note 1) A READ command must have been executed before the other side sends the end character.

(Note 2) Dummy read specification (operand 2: 0) is not supported by channel Nos. 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. Variable number can be set by "Other parameter No. 24." The default variable number is 99.
  The variable number is fixed to 99 in main application version 0.20 and earlier.
  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 was 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 expanded-SIO overrun error (Receive disabled)
  9: READ expanded-SIO parity error (Receive disabled)
  10: READ expanded-SIO framing error (Receive disabled)
  11: READ expanded-SIO buffer overflow error (Receive disabled)
  12: READ expanded-SIO receive error due to other factor (Receive disabled)
  13 to 20: Used only in Ethernet communication (optional)
  21: READ SIO temporary receive QUE overflow error (Receive disabled)
  22: READ SIO slave receive QUE 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)	CP

[Function] Set a timeout value used with 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.
(Whether or not a timeout has occurred can be checked from the return code (variable 99 based on the factory setting) that will be stored in a local variable immediately after the READ command is executed.)
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.
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 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 (maximum time to wait for completion of send) to be applied when a WRIT command is executed (= maximum time to wait for send based on flow control).
The WRIT timer setting is effective only for standard SIOs (channel 1 or 2 supporting flow control).

The timer setting specified in operand 2 sets the timeout value (maximum time to wait for completion of send) to be applied when a WRIT command is executed (= maximum time to wait for send based on flow control) (arbitrary).
The WRIT timer setting is effective only for standard SIOs (channel 1 or 2 supporting flow control).
TMRD used in the X-SEL-JX/KX type controller is treated as TMRW in the X-SEL-PX/QX type controller. If a program file created for an X-SEL-JX/KX controller is transferred to an X-SEL-PX/QX 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 X-SEL.

(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. 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 and 4: For future extension
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 longer than the specified length, the value in the 100s place, or 9, is rounded off and the resulting 87 is set as the integer part, while the value in the fourth decimal place, or 3, is rounded and the resulting 654 is set as the decimal 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	
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.

(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.

Do not use any palletizing setting involving both SCARA and linear movement axes.
If the palletizing setting involves both SCARA and linear movement axes, an “Error No. 421, SCARA/linear movement axis simultaneous specification error” will generate.

● 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 for the PX-axis (preferential axis), PY-axis and PZ-axis (when palletizing Z-axis declaration is valid) for use 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 will be set to X = 0 and Y = 0.
Palletizing positions are calculated as points on the palletizing plane consisting of the reference point, PX-axis and PY-axis. Therefore, the position data defining the reference point must include valid coordinate components for the PX-axis, PY-axis and PZ-axis (when palletizing Z-axis declaration is valid). If the coordinate components for these axes are invalid, an error will generate during palletizing-position coordinate calculation accompanying a PAPG command (get palletizing calculation data) or any palletizing movement command. The coordinate components for other axes will be ignored during palletizing-position coordinate calculation.

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.

Do not use any palletizing setting involving both SCARA and linear movement axes.
If the palletizing setting involves both SCARA and linear movement axes, an "Error No. 421, SCARA/linear movement axis simultaneous specification error" will generate.

(Note 1) If this command is not set while load coordinate system No. 0 (base coordinate system) is selected, executing a palletizing movement command will generate an error because the palletizing start point becomes (0, 0) and the axes are unable to move.

(Note 2) If the R-axis is set in the position data, exclude the R-axis from the valid axes using a GRP command. (This is not necessary if the R-axis column is empty.)
The R-axis data of a given palletizing position is set using a PEXT command.

- PAPS (Set palletizing points) For 3-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 for 3-point teaching.

This command can also be used to set palletizing positions for 4-point teaching. In this case, the pallet surface can be defined as any quadrangle other than square, rectangle or parallelogram.

Specify in operand 1 the start-point position number needed to set a series of palletizing positions for 3-point teaching. If “n” is set as the start-point position number, point n+1 will represent the end point in the PX-axis direction and point n+2 will represent the end point in the PY-axis direction.
In the case of 4-point teaching, position data corresponding to the end point must be stored in position No. n+3.
(Note) Do not use any palletizing setting involving both SCARA and linear movement axes.
If the palletizing setting involves both SCARA and linear movement axes, an “Error No. 421, SCARA/linear movement axis simultaneous specification error” will generate.

In operand 2, specify a desired palletizing position setting type.

[Palletizing position setting type]
If “0” is set in operand 2 or operand 2 is not specified, the settings will be recognized as those for 3-point teaching.
The palletizing positions will be arranged on the quadrangular pallet surface determined by the three points, namely, the start point, end point in the PX-axis direction, and end point in the PY-axis direction, as shown in Fig. 1-(a).
If “2” is set in operand 2, the settings will be recognized as those for 4-point teaching (non-planar type).
The palletizing positions will be arranged on the quadrangle pallet surface determined by the four points, namely, the start point, end point in the PX-axis direction, end point in the PY-axis direction, and end point, as shown in Fig. 1-(b). Take note that whether the shape is planar or not depends on the end point data.

Fig. 1 shows the arrangements of palletizing positions.

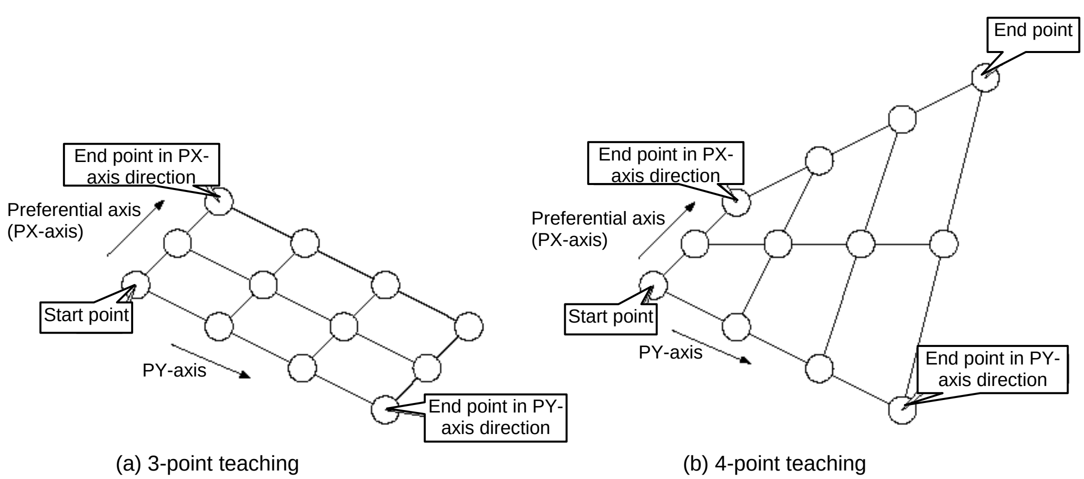


Fig. 1 Arrangements of Palletizing Positions

- <u>When setting palletizing positions for 4-point teaching where all four points are known to be on a plane and the settings also require accuracy, it is recommended that non-planar settings be used.</u>

  If “1” is set in operand 2, the settings will be recognized as those for 4-point teaching (planar type). The plane is determined by the three points, namely, the start point, end point in the PX-axis direction, and end point in the PY-axis direction, as shown in Fig. 2-(a). Move the end point in parallel toward the PZ direction (vertical direction), and the intersection with the aforementioned plane will become the end point of this palletizing movement.
  Arrange palletizing positions on the quadrangular pallet surface determined by these four points.

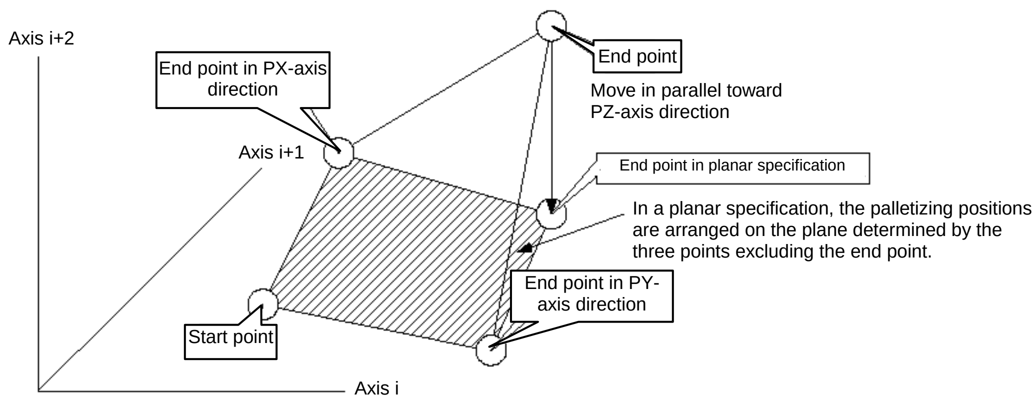


Fig. 2-(a)

However, caution must be exercised when the three points excluding the end point meet any of the conditions specified in Table 1, because then the moving direction of the end point will vary. This is when the plane determined by the three points excluding the end point is lying vertical to the ground. In this case, moving the end point in parallel toward the PZ direction (vertical direction) will not find an intersection with the aforementioned plane.

Table 1 Moving Directions of End Point in Planar Specification

Condition	Moving direction of end point
The point data of the axis i component matches among all three points excluding the end point (refer to Fig. 2-(b)).	Move in parallel toward axis i.
The point data other than that of the PZ-axis component matches between the start point and the end point in the PX-axis direction (refer to Fig. 2-(c)).	Move in parallel toward one of the two axes other than the PZ-axis, whichever has the smaller axis number.
The point data other than that of the PZ-axis component matches between the start point and the end point in the PY-axis direction (refer to Fig. 2-(c)).	
The point data other than that of the PZ-axis component matches between the end point in the PX-axis direction and the end point in the PY-axis direction (refer to Fig. 2-(c)).	

* i indicates the axis number for either of the two axes other than the PZ-axis.

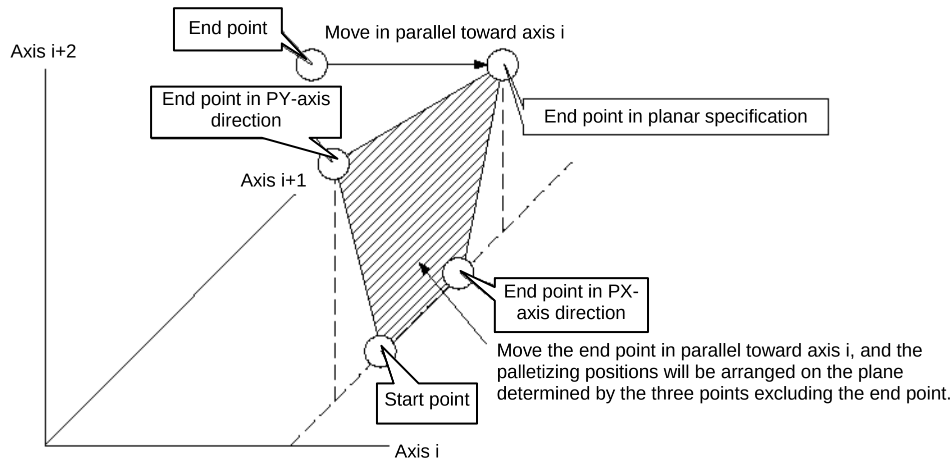


Fig. 2-(b)

When the point data of the axis i component matches among all three points excluding the end point

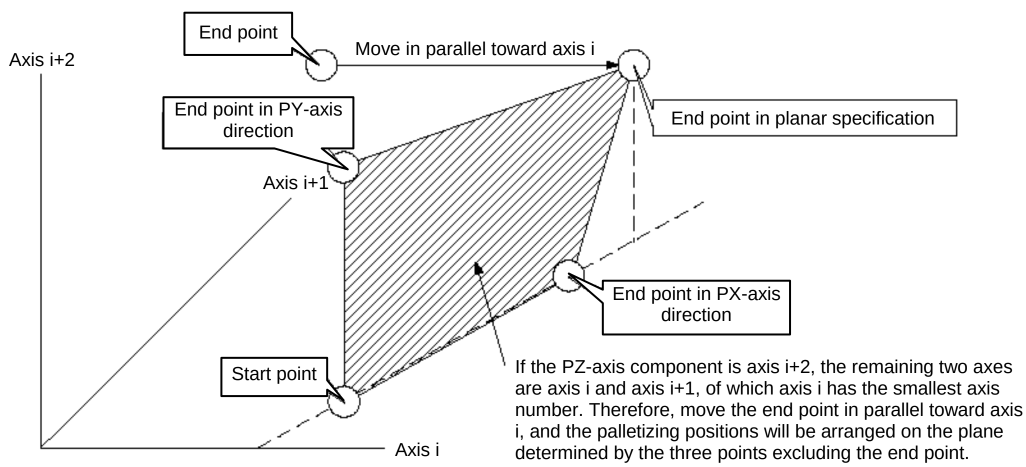


Fig. 2-(c)

When the point data of the two points other than that of the PZ-axis component matches among the three points excluding the end point (= in the above figure, when the point data other than that of the PZ-axis component matches between the start point and the end point in the PY-axis direction)

- If the valid axis pattern of the 3-point teaching or 4-point teaching data does not match, an error “CB0, Mismatched valid axes and palletizing 3-point teaching data” will generate. Take note that if this command is executed after specifying the axes to be used with a GRP command, only the specified axes will be used for palletizing position data, among all valid axes with point data. Executing GRP again thereafter in other settings will not have any effect.

- If a PZ-axis has been declared, the number of valid axes excluding the PZ-axis must be two. If a PZ-axis has not been declared yet, the number of valid axes excluding the PZ-axis must be two or three. If the number of valid axes is not sufficient, 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. When a PZ-axis has not yet been declared in a planar specification, keep the number of valid axes to two. If the number of valid axes is other than two in this condition, an error, “CB4, Arch-motion Z-axis non-declaration error” will generate.

- This command cannot be used with PASE (set palletizing axes). Whichever is set later will be given priority. (A single PAPS command can substitute PASE, PAPT and PAST.)

- If this command is executed before BGPA is declared (= while palletizing setting is not enabled), an error "CB5, BGPA non-declaration error during 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	
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 (Dedicated SCARA command: Declare palletizing 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	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.

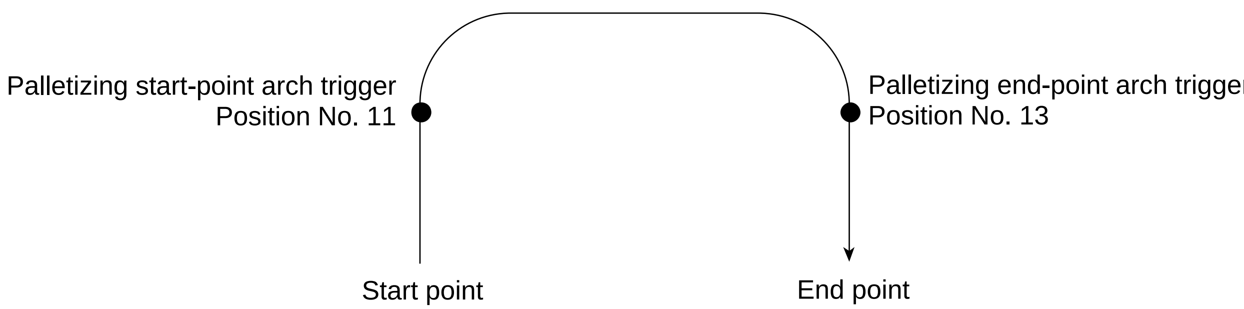
(Note 1) The palletizing Z-axis can be specified only as the Z-axis on the load coordinate system (axis No. 3).
The palletizing Z-axis cannot be set when setting palletizing using any linear movement axis.

[Example] PCHZ 3

- PTRG (Dedicated SCARA command: 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 PZ-axis (palletizing Z-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 (Dedicated SCARA command: Set palletizing composition (Set R-axis coordinate))

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

This command sets a R-axis coordinate of a given palletizing position.
Set palletizing composition.
The position number specified in operand 1 will be set for use in composition.
The R-axis coordinate of a given palletizing position is set using this command.
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.

(Note 1) The palletizing composition axis cannot be set when setting palletizing using any linear movement axis.

● OFPZ (Dedicated SCARA command: 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 PZ-axis (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.

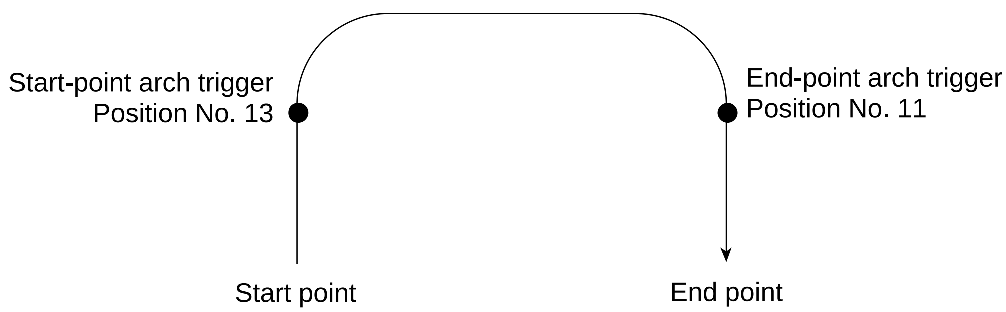
(Note 1) A SCARA axis other than the Z-axis on the load coordinate system (axis No. 3) cannot be specified as the arch-motion Z-axis.

[Example] ACHZ 3

- 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 (Dedicated SCARA command: 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.

(Note 1) Linear movement axes cannot be set as the axes for arch-motion composition.

- 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 will 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 load coordinate system 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 load coordinate system 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 PZ-axis (palletizing Z-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.
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 a PZ-axis (palletizing Z-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 Z-direction position will move to the height of the specified position number by ignoring the palletizing calculation.
Any data other than palletizing Z-axis data contained in the position number specified in operand 2 will be ignored. Absence of PZ-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.

(Note 1) If the specified palletizing setting involves both SCARA and linear movement axes, an "Error No. 421, SCARA/linear movement axis simultaneous specification error" will generate.
When setting palletizing for any PMVP movement, make sure all operating axes are SCARA axes or all are linear movement axes.

- PMVL (Dedicated linear movement axis command: 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	Prohibited	PE

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) If the specified palletizing setting involves any SCARA-axis operation, an “Error No. B80, Specification-prohibited axis error” or “Error No. 421, SCARA/linear movement axis simultaneous specification error” will generate. When setting palletizing for any PMVL movement, make sure all operating axes are linear movement axes.

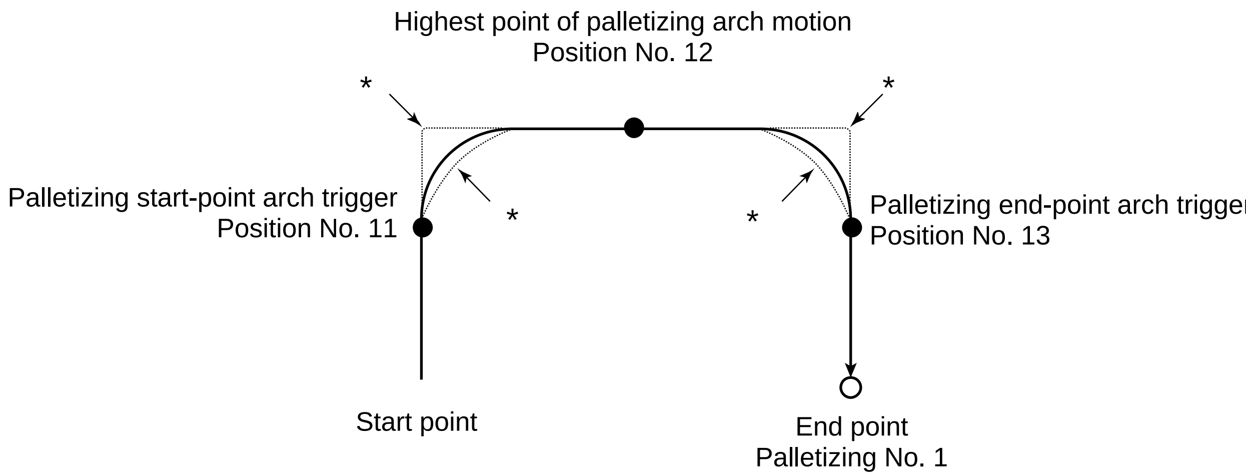
● PACH (Dedicated SCARA command)

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.

(Note) If the specified palletizing setting involves both SCARA and linear movement axes, an “Error No. 421, SCARA/linear movement axis simultaneous specification error” will generate.
When setting palletizing where the palletizing points define an arch-motion movement, make sure all operating axes are SCARA axes.




```
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:

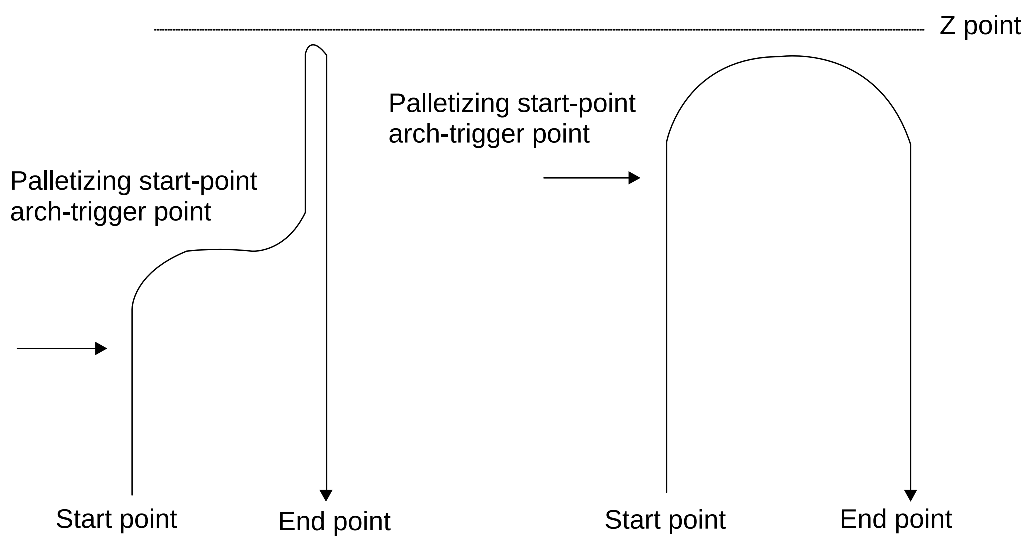


Fig. 5

In this case, change the palletizing arch triggers and PZ point to increase the operation efficiency.

- If palletizing composition (PEXT) 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. If the R-axis is set with a PEXT command, R-axis operation will start and end above the arch triggers.

- Executing this command will not increment the palletizing position number by 1.

(Note 1) The PACH command executes PTP operation.

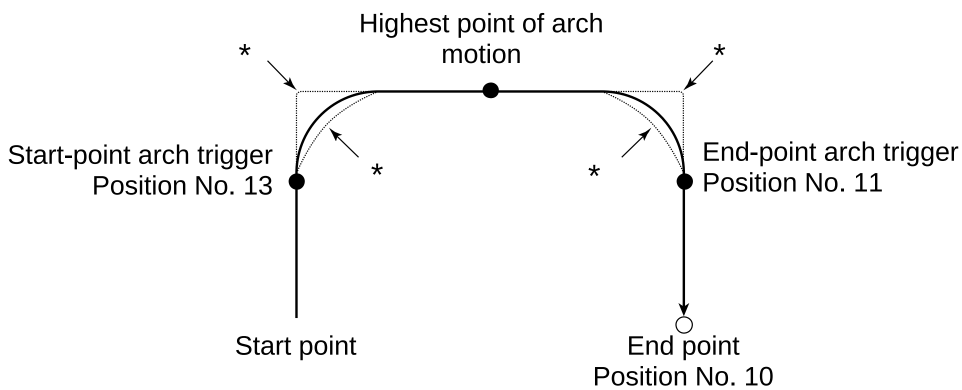
- ARCH (Arch motion)

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.

(Note) If the specified palletizing setting involves both SCARA and linear movement axes, an “Error No. 421, SCARA/linear movement axis simultaneous specification error” will generate.
In an arch-motion setting, make sure all operating axes are SCARA axes or all are linear movement axes.




```
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 R-axis data is included in the end-point data, R-axis operation will start and end 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.

(Note 1) The ARCH command executes PTP operation.

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 (% 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

[Function] Store in variable 99 the motor current value (% of the rated current) corresponding to the "axis number" specified in operand 1.

(Note)
- The motor current value (% of the rated current) to be obtained represents feedback-current filtered data containing analog error.

Accordingly, provide a margin of 5% or more when comparing against the "steady-state (non-push) torque limit (upper limit)" set by extended command code 250.

[Example] ECMD 1 2 Extended command 1
Store the motor current value (% 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

[Function] Reflect in the output field the home sensor status corresponding to the "axis number" specified in operand 2.

(Note)
- The home sensor status to be obtained is not an electrical level of H or L, but a differential/non-operating status that takes 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 field) is deemed indeterminable and its use will be prohibited.
  The output port/flag specified in the output field will be operated only when this command is 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 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

[Function] Reflect in the output field the overrun sensor status corresponding to the "axis number" specified in operand 2.

(Note)
- The overrun sensor status to be obtained is not an electrical level of H or L, but a differential/non-operating status that takes 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 field) is deemed indeterminable and its use will be prohibited.
  The output port/flag specified in the output field will be operated only when this command is 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 status of axis 1 to output port 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

[Function] Reflect in the output field the creep sensor status corresponding to the "axis number" specified in operand 2.

(Note)
- The creep sensor status to be obtained is not an electrical level of H or L, but a differential/non-operating status that takes 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 field) is deemed indeterminable and its use will be prohibited.
  The output port/flag specified in the output field will be operated only when this command is 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 status of axis 2 to output port No. 315.

- ECMD250 (Set torque limit/detection time for torque limit over error)

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	Axis pattern	CC

[Function] Set the steady-state (non-push) torque limit (upper limit)/detection time for steady-state (non-push) torque limit over error. The applicable parameter (it may be an internal parameter) is changed temporarily using the data stored in the three consecutive integer variables starting from the one corresponding to the integer variable number specified in operand 2.

When operand 2 = n

Variable No. n: Target axis pattern (Decimal input)
* Examples of decimal input: 1 is input = Axis 1 only
2 is input = Axis 2 only
3 is input = Axes 1 and 2
7 is input = Axes 1, 2 and 3
15 is input = Axes 1, 2, 3 and 4

Variable No. n+1: Set value of steady-state (non-push) torque limit (upper limit)
(1% of the rated torque to the value set in Driver card parameter No. 40, “Maximum torque limit (%)”)
* If the specified value is greater than the upper limit specified for each axis, the upper-limit value specified for each value will be set.

Variable No. n+2: Set value of detection time for steady-state (non-push) torque limit over error
(0 to 20000 msec)
* Set “1” or a greater value if you want to use this function to “detect contact/heavy load” or move an axis.
* When 0 is set, the certification time becomes invalid (infinitely long). This setting is mainly used to “limit the torque of the support axis (horizontal only) upon engagement.” If 0 (infinitely long) is set, the maximum value of “steady-state (non-push) torque limit (upper limit)” will be limited to 70% to prevent overheating.

Variable No. n+3: Set to 0. (Reserved. * May be made accessible in the future.)

Variable No. n+4: Set to 0. (Reserved. * May be made accessible in the future.)

If the “steady-state (non-push) torque limit (upper limit)” value is specified for the “detection time for steady-state (non-push) torque limit over error” or longer in a steady state (non-push), an appropriate process based on the following parameter will be performed. Note, however, that if the “detection time for steady-state (non-push) torque limit over error” is set to = 0 (infinitely long), the aforementioned process based on the following parameter will not be performed.

All-axis parameter No. 19, “Processing type upon steady-state (non-push) torque limit over error (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 (The SEL command output part remains 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 detection time for steady-state torque limit over error in integer variable 292.
	ECMD	250	290	Read the values of three consecutive variables, starting from variable 290: Setting of axes 1 and 2 Steady-state torque limit: 80% Detection time for steady-state torque limit over error: 10000 msec
	MOVP	2		Move to position No. 2 under the condition set by ECMD250.

* When reverting to a normal condition

[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 (upper limit specified for each axis) in integer variable 291.
	LET	292	20000	Clear the detection time for steady-state torque limit over error in integer variable 292. (20000 = Clear)
	STOP	*290		Clear the low-torque axis deviation counter.
	ECMD	250	290	Read the values of three consecutive variables, starting from variable 290: Setting of axes 1 and 2 Steady-state torque limit: Upper-limit value specified for each axis (reverting to the maximum torque) Detection time for steady-state torque limit over error (20000 msec)
	MOVP	2		Move to position No. 2 at the steady-state torque.

(Note 1) If a low torque is set, the load may drop (in the case of a vertical axis, etc.) or overshooting may occur. If a low torque is set while the actuator is operating at high speed, overshooting will occur due to insufficient torque.

(Note 2) If positioning operation is performed at a low torque, the actuator may stop near the target position due to insufficient torque and remain stopped there.

(Note 3) When changing the torque setting from a very low level at which axis movement cannot be guaranteed, to a high level, be sure to issue a STOP command to the low-torque axis before the setting is changed to high torque (= while the torque is still low) in order to clear the deviation counter.

(Note 4) When the setting of “steady-state (non-push) torque limit (upper limit)” or “detection time for steady-state (non-push) torque limit over error” has been changed, the new setting will remain effective even after the SEL program ends.

(Note 5) Even at a normal load, the torque becomes slightly higher during acceleration/deceleration. Determine appropriate settings (steady-state torque limit and detection time for steady-state torque limit over) so that a steady-state torque limit over will not be detected.

(Note 6) An “Error No., C6B deviation overflow error” or “Error No., CA5, Stop deviation overflow error” is sometimes detected before “Error No., 420, Steady-state (non-push) torque over error.” This is normal.

(Note 7) When changing the torque setting 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 the low-torque axis to clear the deviation counter before changing to a high torque (while the torque is still low). If the torque setting is changed from low to high while deviation pulses are still accumulated, control of axis movement speed may be disabled and a dangerous situation may occur.

(Note 8) To return to a normal state (maximum torque), expressly specify “Steady-state (non-push) torque limit (upper limit)” = 1000% and “Detection time for steady-state (non-push) torque limit over” = 20000 msec.

* If a value greater than the upper limit of each axis is specified for “Steady-state (non-push) torque limit (upper limit),” the upper limit of that axis (approx. 200 to 400%) will be set.

(Note 9) The following values are applied upon power ON reset, software reset or start of home return:
“Steady-state (non-push) torque limit (upper limit)” = Driver card parameter No. 40, “Maximum torque limit (%)”
“Detection time for steady-state (non-push) torque limit over” = 20000 msec.

(Note 10) After the values of “Steady-state (non-push) torque limit (upper limit)” and “Detection time for steady-state (non-push) torque limit over” are changed, the new settings will remain effective even after the SEL program ends.
Accordingly, if you want to build a system by using this extended command, expressly set “Steady-state (non-push) torque limit (upper limit)” and “Detection time for steady-state (non-push) torque limit over” using extended commands in all SEL programs prior to the commencement of each applicable operation. Do not assume the settings of “Steady-state (non-push) torque limit (upper limit)” and “Detection time for steady-state (non-push) torque limit over” will return to their original values when the applicable operation ends under other program, because different settings of “Steady-state (non-push) torque limit (upper limit)” and “Detection time for steady-state (non-push) torque limit over” will apply if the program is aborted due to an error, etc., in which case unexpected problems may occur.

(Note 11) This extended command will not rewrite the value of Driver card parameter No. 40, “Maximum torque limit” (main CPU flash memory) (inside the non-volatile memory).

Chapter 3 Key Characteristics of Horizontal Articulated Robot (SCARA) Operation

This chapter explains how to set the key characteristics of horizontal articulated robot operation, such as commands and operations, arm systems, various coordinate systems and simple interference check zones.

1. CP Operation and PTP Operation

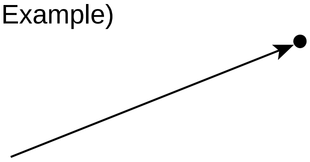
A horizontal articulated robot performs CP operation and PTP operation.

1.1 CP Operation

(1) Locus

The axes move to the target position via mutual interpolation. The locus of axis tip during movement can be specified using commands (linear, circular, arc, path movement, etc.).

Example)



Position No. 1

MOVL 1
Move from the current position to position No. 1 linearly.

The arm system will 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 Chapter 2, "Explanation of Commands."

(2) Speed and acceleration/deceleration settings for CP operation

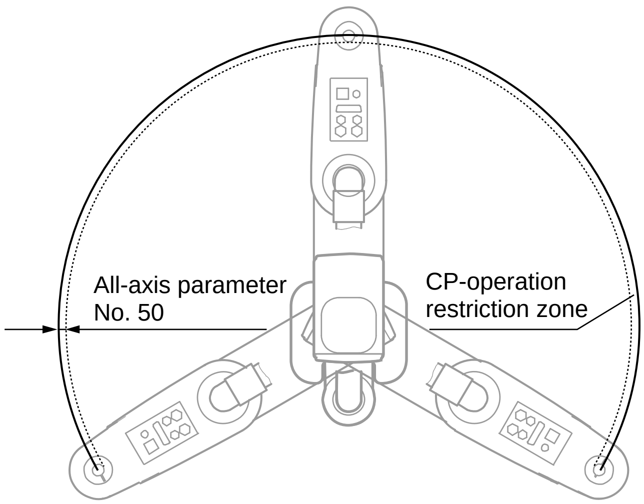
The speed and acceleration/deceleration for CP operation are predefined in a program using control declaration commands.
Speed setting command "VEL"; unit [mm/sec]
Acceleration setting command "ACC"; unit [G]
Deceleration setting command "DCL"; unit [G]

Example)

ACC	0.5	Set the acceleration for CP operation to 0.5 G.
DCL	0.5	Set the deceleration for CP operation to 0.5 G.
VEL	500	Set the speed for CP operation to 500 mm/sec.
MOVL	2	Move to position No. 2 linearly.

The speed and acceleration/deceleration for CP operation can also be set in the VEL, ACC and DCL columns of position data.
If the speed and acceleration/deceleration are set in position data, they must be set for each position number. If they are set in the VEL, ACC and DCL columns of a given position number, movement to that position number will be given priority over the commands "VEL," "ACC" and "DCL" in the program.

(3) Notes on CP operation
The singular point refers to a position where arms 1 and 2 form a straight line.
Performing CP operation along a path near the singular point may reduce locus accuracy, cause vibration (noise) or generate errors. The errors that may occur include the following:
"D09: Driver overspeed error," "B91: Main overspeed error," "C64: Invalid servo acceleration/deceleration error," "B74: CP-operation restriction zone entry error," and "C6B: Deviation overflow error"
These problems may be prevented by lowering the speed or acceleration/deceleration.



The CP-operation restriction zone is defined as the area between the singular point locus and the locus of the value set in all-axis parameter No. 50. CP operation is prohibited inside this area. (In the figure shown at left, the area between the solid line and dotted line is the CP-operation restriction zone.)

The controller will generate an error upon detecting that the target locus used in locus calculation or the actual movement locus has entered the CP-operation restriction zone. If the target movement locus has entered the CP-operation restriction zone during locus calculation, a "B7C: Error due to target locus inside CP-operation restriction zone (PTP/jogging of each axis enabled)" will generate.
When the actual movement locus has entered the CP-operation restriction zone, a "B74: CP-operation restriction zone entry error (PTP/jogging of each axis enabled)" or "C74: Actual-position soft limit over error" will generate.
The width of the CP-operation restriction zone (distance between the solid line and dotted line) will vary depending on the robot arm length. (If the arm length is 500/600, the restriction zone will become approx. 0.5 mm wide (All-axis parameter No. 50: Width of CP-operation restriction zone near arm 1/2 straight-line point)).

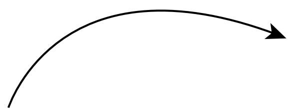
Avoid creating a program that will cause the axes to pass the CP-operation restriction zone during CP operation.
Once inside, the axes cannot be pulled out of the CP-operation restriction zone via CP operation. Move the axes via PTP operation. Exercise caution when the arm condition is not recognized at the start of program, etc.
As for CP operation, always perform test operation at low speed and confirm absence of problem beforehand. Then, gradually raise the speed to an appropriate level.

1.2 PTP Operation

(1) Movement locus

The axes move to the target position at the specified speed. The locus of axis tip during movement cannot be specified using commands.

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 or upon execution of an arm-system control command.
PTP operation commands: MOVP, MVPI, TMPI, PACH, PMVP, ARCH
For details on these commands, refer to Chapter 2, "Explanation of Commands."

(2) Speed and acceleration/deceleration settings for PTP operation

The speed and acceleration/deceleration for PTP operation are predefined in a program using control declaration commands.
Speed setting command "VELS"; unit [% (ratio to the value set in “Axis-specific parameter No. 28: Maximum PTP speed (SCARA axis)”)]
Acceleration setting command "ACCS"; unit [% (ratio to the value set in “Axis-specific parameter No. 134: Maximum PTP acceleration (SCARA axis)”)]
Deceleration setting command "DCLS"; unit [% (ratio to the value set in “Axis-specific parameter No. 135: Maximum PTP deceleration (SCARA axis)”)]

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 No. 2 via PTP operation.

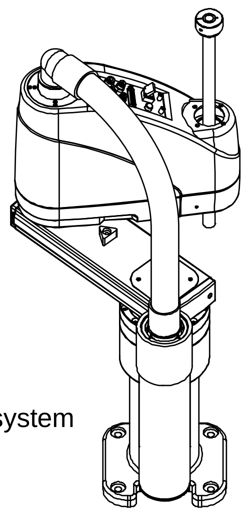
(3) Notes on PTP operation

The arm system may change during movement depending on the operation area or upon execution of an arm-system control command.
Refer to 2, "Arm System," on the following page.

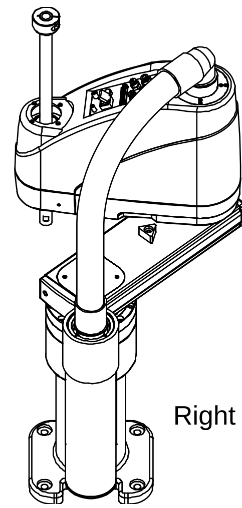
2. Arm System

2-1 Right/Left Arm Systems

The robot position has two patterns based on the right arm system and the left arm system, respectively.



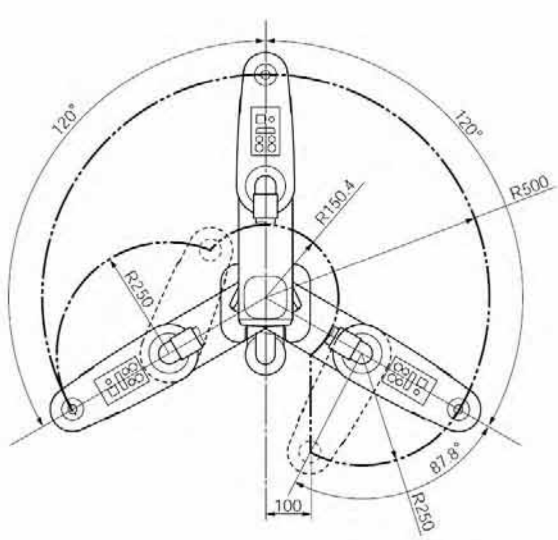
Left arm system



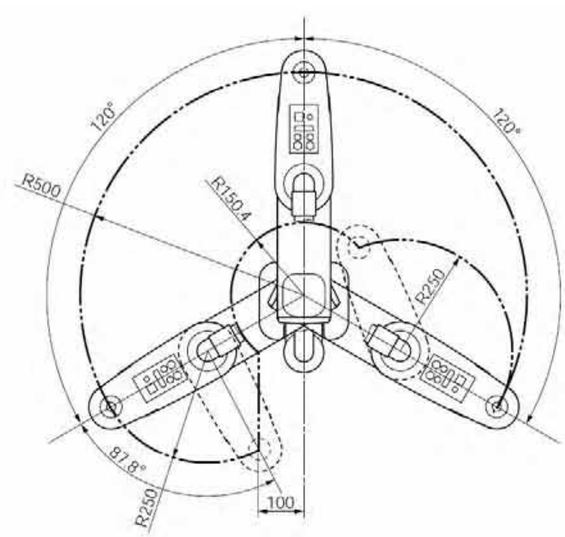
Right arm system

Right arm system: Arm 2 is located at a point away in the CCW direction from the position where arms 1 and 2 form a straight line.
Left arm system: Arm 2 is located at a point away in the CW direction from the position where arms 1 and 2 form a straight line.
Both terms express a robot arm condition by drawing a parallel to human arms.

The operation area is different between the right arm system and the left arm system.
The figure below shows the operation area of each arm system on a robot with an arm length of 500 mm:



Operation area of the left arm system



Operation area of the right arm system

2-2 Arm-System Control Commands (Dedicated SCARA Command)

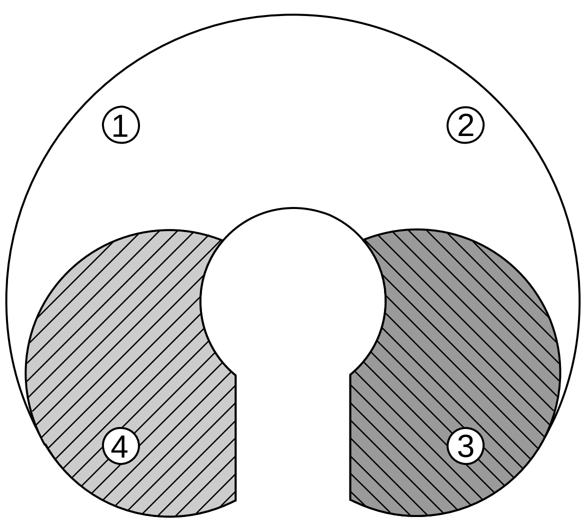
The right and left arm systems are defined as the opposite arm systems to the left and right arm systems, respectively.
The actual arm system that is currently effective is defined as the current arm system.
The arm system to be used for positioning to the target using a movement command is defined as the target arm system.

The commands used to control the robot's arm system include PTPD, PTPE, PTPR, PTPL, RIGH and LEFT.
PTPD, PTPE, PTPR and PTPL are control declaration commands for the target arm system in PTP operation. Therefore, once executed these commands will remain valid while the program is running.
CP operation commands do not accompany change of arm systems during command execution, so they are not affected by the above commands and the relevant operations will be performed by the current arm system.
Only one of PTPD, PTPE, PTPR and PTPL, whichever is executed last, will become valid.
RIGH and LEFT are control commands for the current arm system.

2-3 Arm-System Control Commands and Change of Arm Systems

This section explains the arm-system control commands and how the arm system changes in PTP operation after declaration of each command.

Position Nos. 1 to 4 are set as illustrated below ([1] to [4]).
Movement in the order of 1 → 2 → 3 → 2 → 1 → 4 will be attempted using MOVP commands (PTP operation).
The robot is initially resting at position No. 1.
Position No. 3 exists inside an area accessible only by the left arm system. (Positioning to this point cannot be performed with the right arm system.)
Position No. 4 exists inside an area accessible only by the right arm system. (Positioning to this point cannot be performed with the left arm system.)




```
:
:
:
Arm-system control commands
MOVP        2
MOVP        3
MOVP        2
MOVP        1
MOVP        4
EXIT
```

: Area accessibly only by the right arm system

: Area accessibly only by the left arm system

How the arm system will change is explained for each arm-system control command.

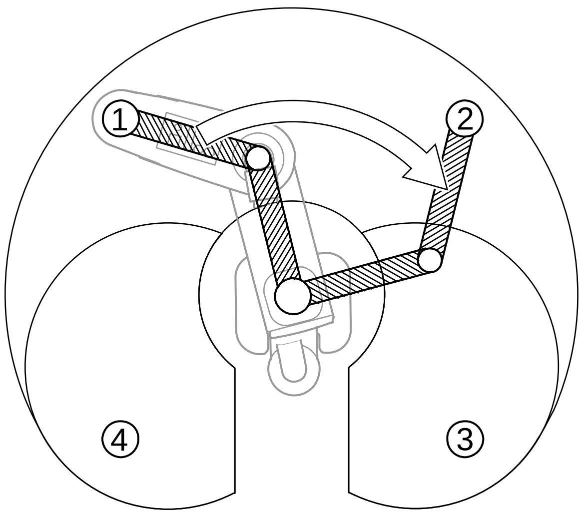
In the figure, a black arrow indicates a movement involving change of arm systems.
A white arrow indicates a movement not involving change of arm systems.
The striped arm represents the right arm system, while the white arm represents the left arm system.

(1) PTPD

After a PTPD command is executed, the robot will move the current arm system to perform positioning. The PTPD command prohibits the current arm system and target arm system from becoming the opposite arm systems. Attempting a movement to an area where positioning is possible only with the opposite arm system will generate an error (C73: Target-locus soft limit over error).

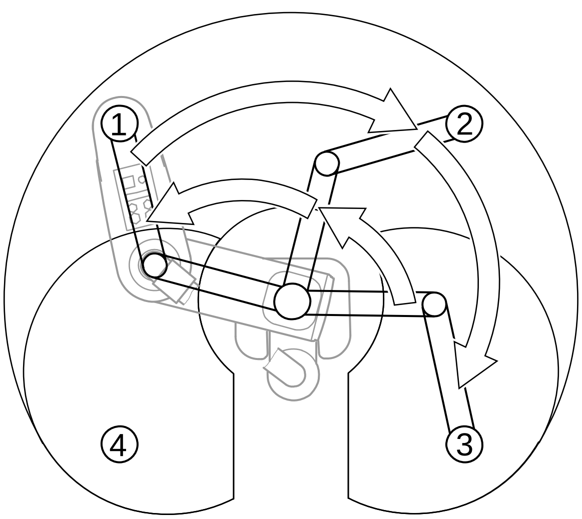
When a program is started, the robot is already in a PTPD-declared mode even before executing a PTPD command.

a. Starting with the right arm system




```
:
:
:
PTPD
MOVP    2
MOVP    3 ⇒ C73 error will generate.
```

[2] Starting with the left arm system



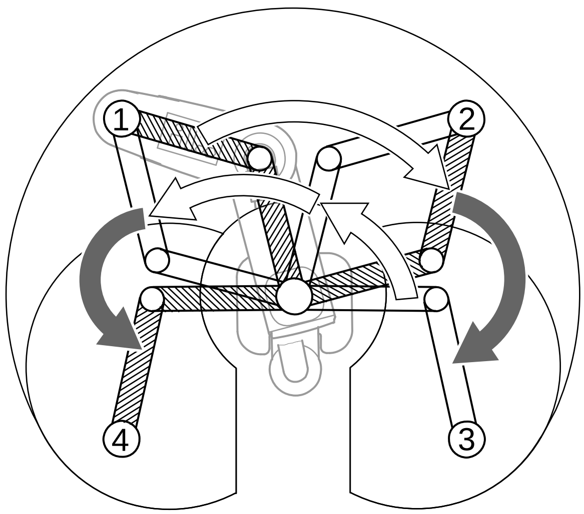

```
:
:
:
PTPD
MOVP    2
MOVP    3
MOVP    2
MOVP    1
MOVP    4 ⇒ C73 error will generate.
```

(2) PTPE

After a PTPE command is executed, the robot will give priority to movements and positioning operations using the current arm system. The PTPE command permits the current arm system and target arm system to become the opposite arm systems. Therefore, movements to an area accessible only by the opposite arm system will also be enabled.

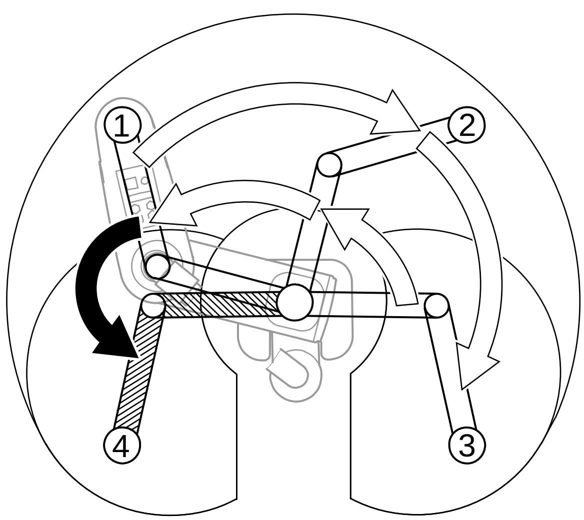
After permitting movements to an area accessible only by the opposite arm system, prohibition of such movements can be effectuated by executing a PTPD command.

[1] Starting with the right arm system




```
      :
      :
      :
PTPE
MOVP      2
MOVP      3
MOVP      2
MOVP      1
MOVP      4
EXIT
```

[2] Starting with the left arm system

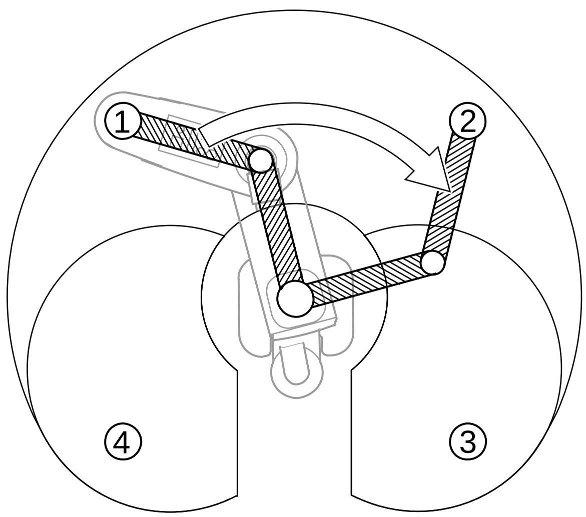



```
      :
      :
      :
PTPE
MOVP      2
MOVP      3
MOVP      2
MOVP      1
MOVP      4
EXIT
```

(3) PTPR

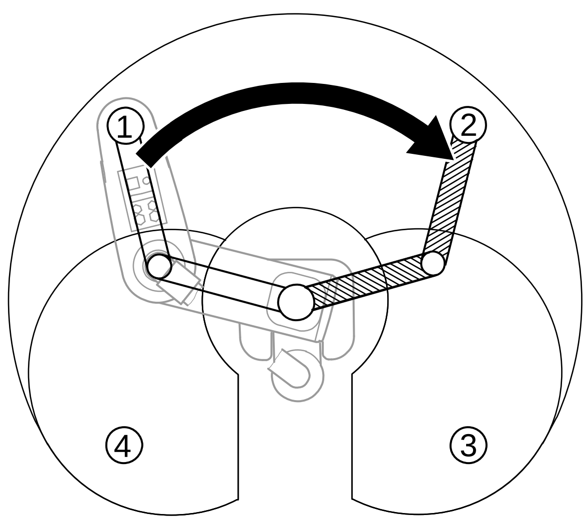
After a PTPR command is executed, the robot will perform positioning using the right arm system. The PTPR command limits the target arm system to the right arm system. Therefore, attempting a movement to an area where positioning is possible only with the left arm system will generate an error (C73: Target-locus soft limit over error).
Executing a PTPR command itself will not trigger any arm operation.
If a PTP movement command is executed following a PTPR command when the current arm system is the left arm system, the axes will move as the arm system changes from left to right and the positioning will be performed using the right arm system.

[1] Starting with the right arm system




```
    :
    :
    :
PTPR
MOVP        2
MOVP        3 ⇒ C73 error will generate.
```

[2] Starting with the left arm system

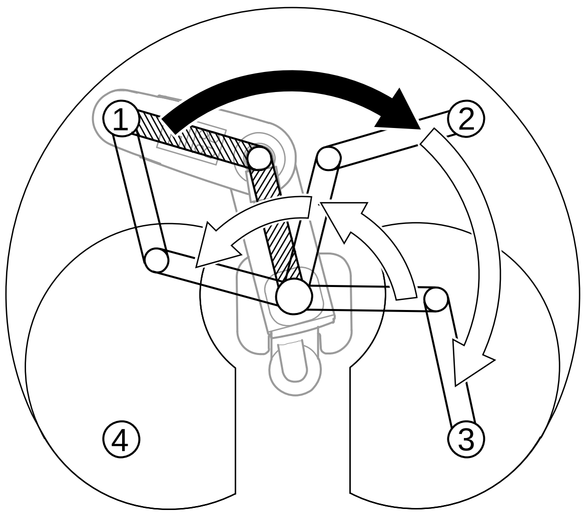



```
    :
    :
    :
PTPR
MOVP        2
MOVP        3 ⇒ C73 error will generate.
```

(4) PTPL

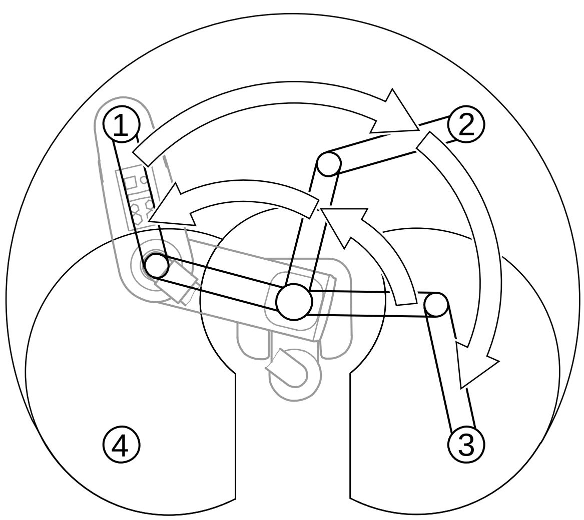
After a PTPL command is executed, the robot will perform positioning using the left arm system.
The PTPL command limits the target arm system to the left arm system. Therefore, attempting a movement to an area where positioning is possible only with the right arm system will generate an error (C73: Target-locus soft limit over error).
Executing a PTPL command itself will not trigger any arm operation.
If a PTP movement command is executed following a PTPL command when the current arm system is the right arm system, the axes will move as the arm system changes from right to left and the positioning will be performed using the left arm system.

[1] Starting with the right arm system



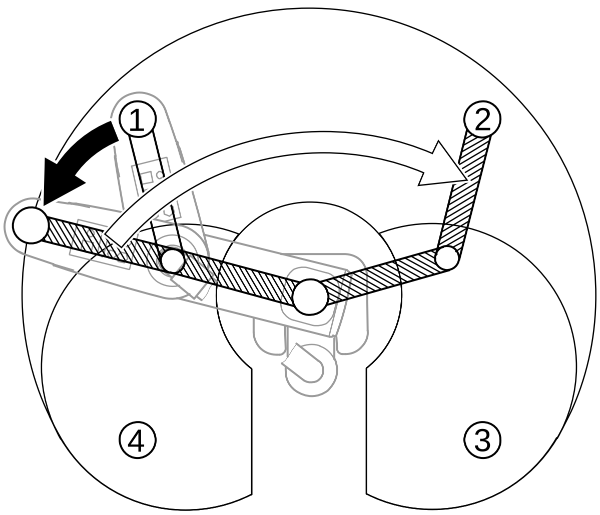

```
   :
   :
   :
PTPL
MOVP        2
MOVP        3
MOVP        2
MOVP        1
MOVP        4 ⇒ C73 error will generate.
```

[2] Starting with the left arm system



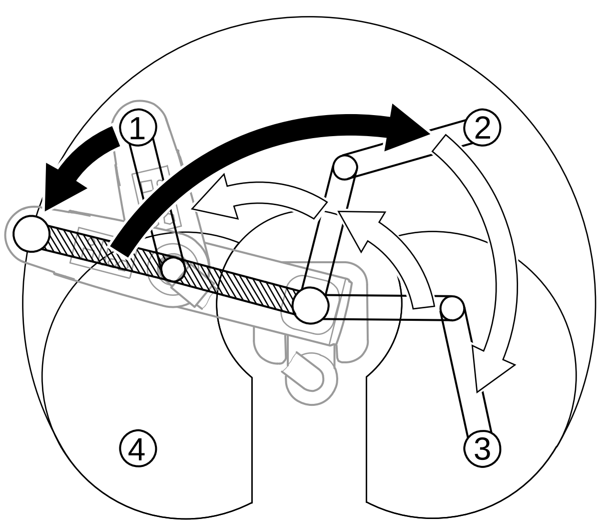

```
   :
   :
   :
PTPL
MOVP        2
MOVP        3
MOVP        2
MOVP        1
MOVP        4 ⇒ C73 error will generate.
```

(5) RIGH
The RIGH command changes the current arm system to the right arm system.
If a RIGH command is executed when the current arm system is the left arm system, arm 2 will move until arms 1 and 2 form a straight line.
Executing a RIGH command when the current arm system is the right arm system will not trigger any arm operation.
[1] Starting with the left arm system




```
   :
   :
   :
RIGH
MOVP      2
MOVP      3 ⇒ C73 error will generate.
```

In the above example, no arm-system control command is set except for a RIGH command and therefore a PTPD command is valid.
The RIGH command controls only the current arm system. It does not limit the positioning arm in PTP operation to the right arm system. Which arm system is used in a given positioning operation will depend on which control declaration (PTPD, PTPE, PTPR or PTPL) is valid for the target arm system. Therefore, the operation to follow a RIGH command execution will vary depending on the valid control declaration for the target arm system.
[2] RIGH command when a PTPL command is valid

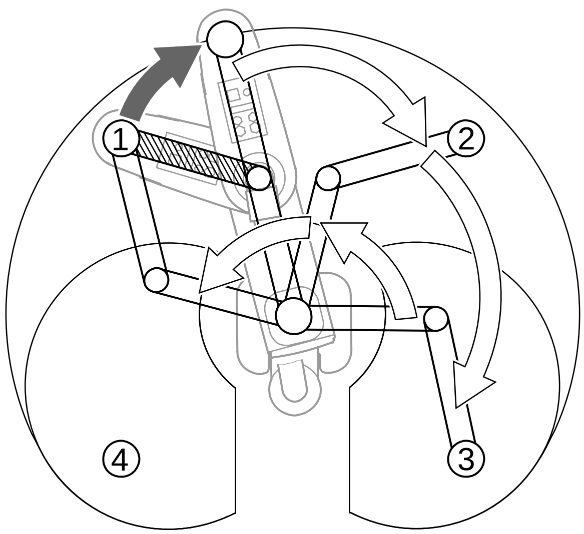



```
   :
   :
   :
PTPL
   :
   :
   :
RIGH
MOVP      2
MOVP      3
MOVP      2
MOVP      1
MOVP      4 ⇒ C73 error will generate.
```

(6) LEFT

The LEFT command changes the current arm system to the left arm system.
If a LEFT command is executed when the current arm system is the right arm system, arm 2 will move until arms 1 and 2 form a straight line.
Executing a LEFT command when the current arm system is the left arm system will not trigger any arm operation.

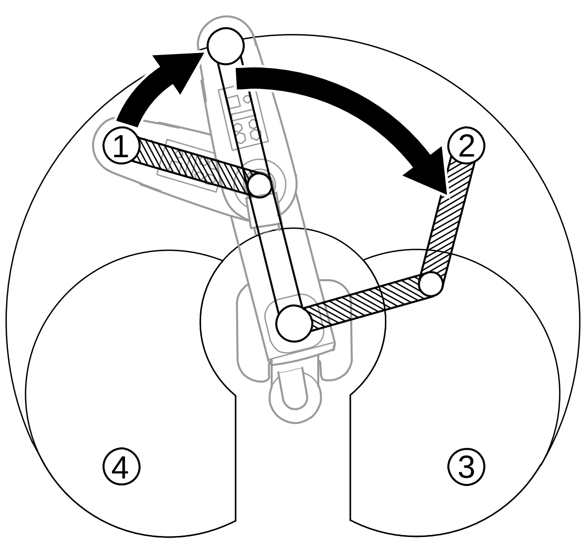
[1] Starting with the right arm system




```
  :
  :
  :
LEFT
MOVP      2
MOVP      3
MOVP      2
MOVP      1
MOVP      4 ⇒ C73 error will generate.
```

In the above example, no arm-system control command is set except for a LEFT command and therefore a PTPD command is valid.
The LEFT command controls only the current arm system. It does not limit the positioning arm in PTP operation to the left arm system. Which arm system is used in a given positioning operation will depend on which control declaration (PTPD, PTPE, PTPR or PTPL) is valid for the target arm system. Therefore, the operation to follow a LEFT command execution will vary depending on the valid control declaration for the target arm system.

[2] LEFT command when a PTPR command is valid



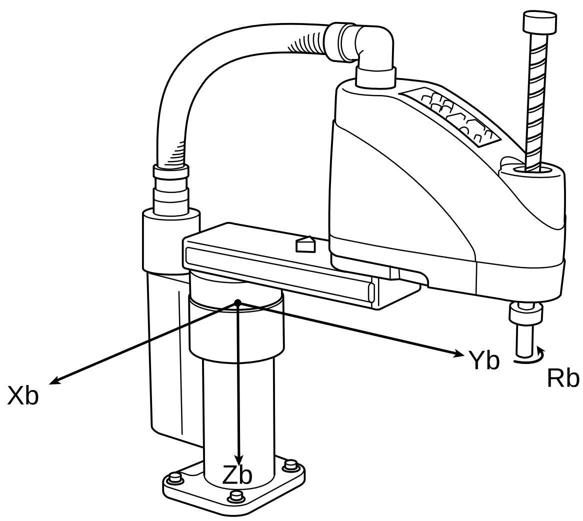

```
  :
  :
  :
PTPR
  :
  :
  :
LEFT
MOVP      2
MOVP      3 ⇒ C73 error will generate.
```

3. SCARA Coordinate System

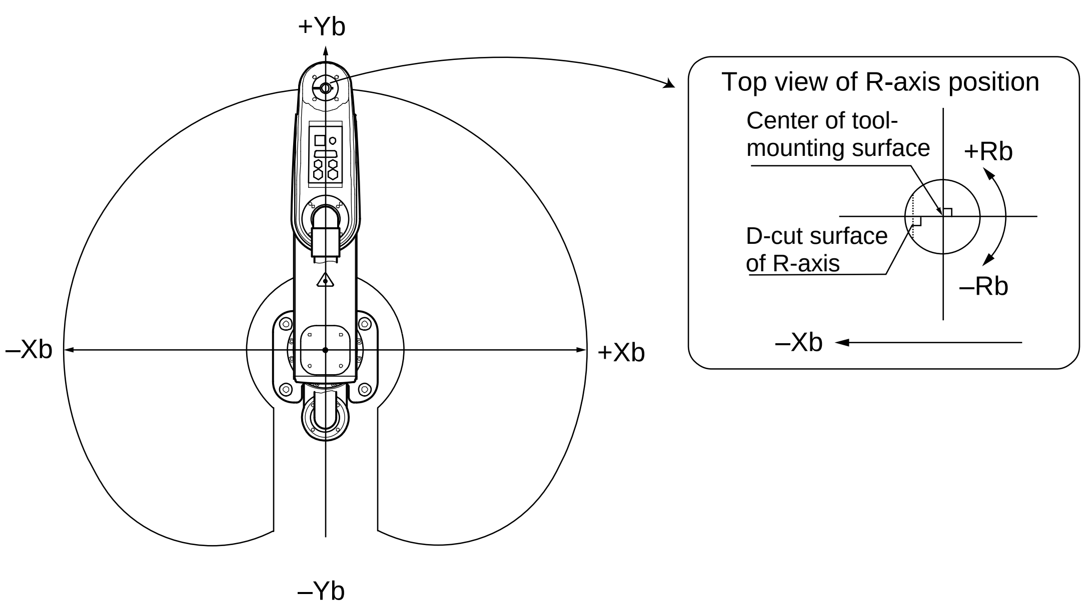
A horizontal articulated robot uses three types of coordinate systems: base coordinate system, load coordinate system and tool coordinate system.
When tool coordinate system No. 0 (= tool coordinate system offsets are 0) is selected, normally the robot will position the center of the tool-mounting surface on the selected load coordinate system. If any of tool coordinate system Nos. 1 to 127 (= tool coordinate system offsets are valid) is selected, the robot will position the tool tip on the selected load coordinate system. Note that the SEL commands TMPI and TMLI as well as jog commands on XY (tool) coordinates will be executed on the tool coordinate system.

3.1 Base Coordinate System (= Load Coordinate System No. 0)

This coordinate system covers the three-dimensional cartesian coordinates and rotating-axis coordinates factory-defined in the robot.
The base coordinate system corresponds to load coordinate system No. 0 (load coordinate system offsets are 0).

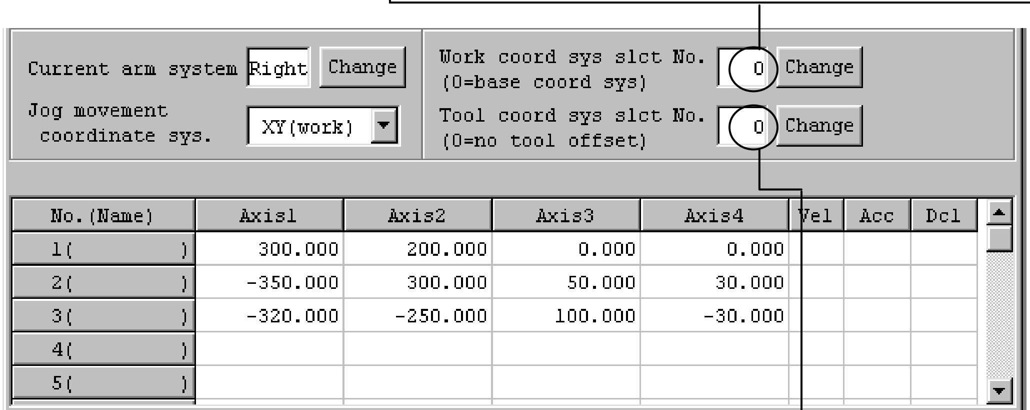


The XY-axis home is located at the base center (rotating center of arm 1).
The Z-axis home is located at the upper end of the valid Z-axis stroke.
The R-axis home is where the D-cut surface faces the –Xb direction.
The X-axis, Y-axis, Z-axis and R-axis on the base coordinate system are expressed as Xb, Yb, Zb and Rb, respectively.



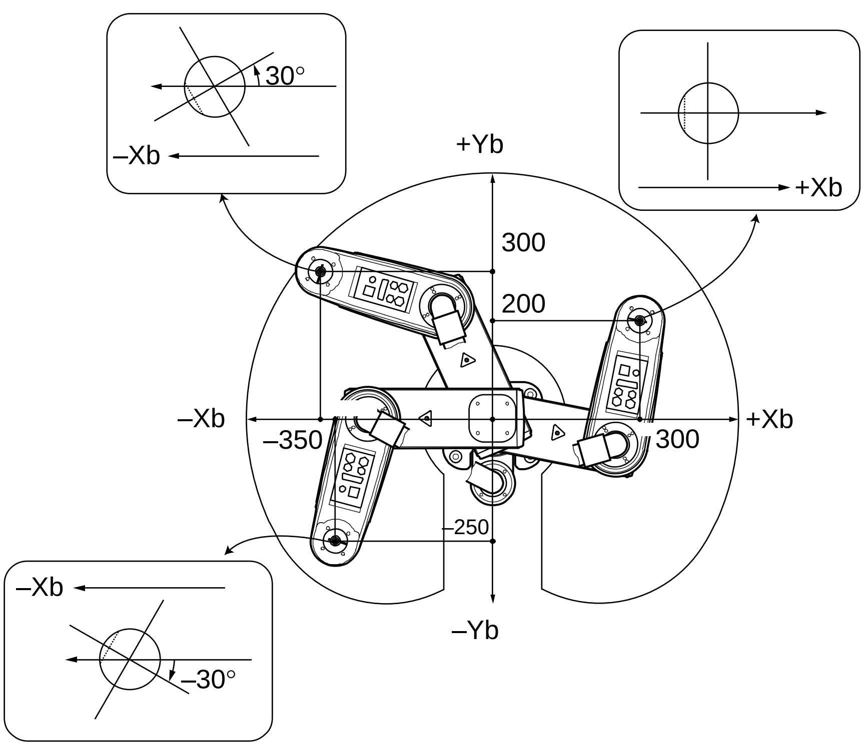
(1) Positioning on the base coordinate system
Perform positioning after selecting load coordinate system No. 0.
Use a SLWK command to select a load coordinate system number in a SEL program. The selected load coordinate system number will remain valid after the program ends, and even after reconnection of power if a system-memory backup battery is installed.
The figure below shows a part of the position data edit screen on the PC software for horizontal articulated robot. Sample teaching data comprising the following contents have been entered:
X = 300, Y = 200, Z = 0, R = 0 as the position data of position No. 1
X = -350, Y = 300, Z = 50, R = 30 as the position data of position No. 2
X = -320, Y = -250, Z = 100, R = -30 as the position data of position No. 3

The selected load coordinate system number is displayed. Load coordinate system No. 0 = Base coordinate system



The selected tool coordinate system number is displayed. Tool coordinate system No. 0 = Positioning of the center of the tool-mounting surface

When poisoning to the above position data in PTP mode:

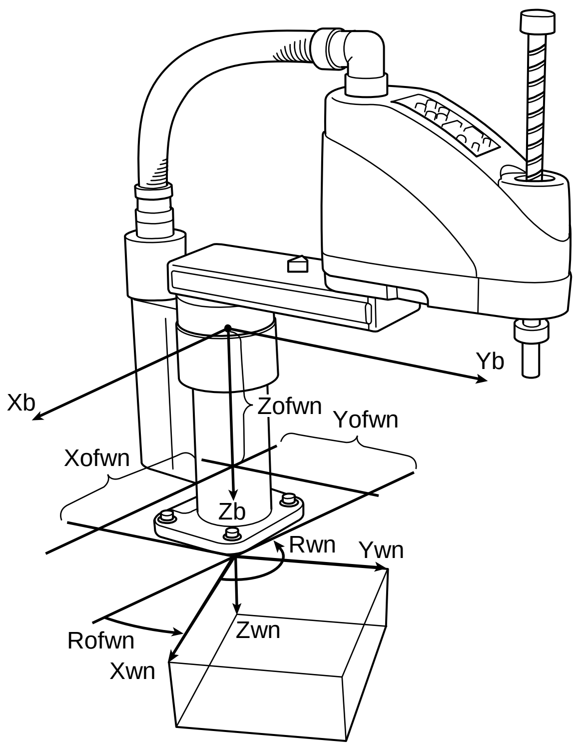


Program example

VELS	50	
ACCS	50	
SLWK	0	Select load coordinate system No. 0.
SLTL	0	Select tool coordinate system No. 0.
PTPR		Specify the right arm as the PTP target arm system.
MOVP	1	
MOVP	2	
MOVP	3	
EXIT		

3.2 Load Coordinate System (Dedicated SCARA Function)

This coordinate system provides 32 sets of three-dimensional cartesian coordinates and rotating-axis coordinates as defined by the offset of each axis with respect to the base coordinate system. Note that load coordinate system No. 0 is reserved by the system as the base coordinate system (= load coordinate system offsets are 0).



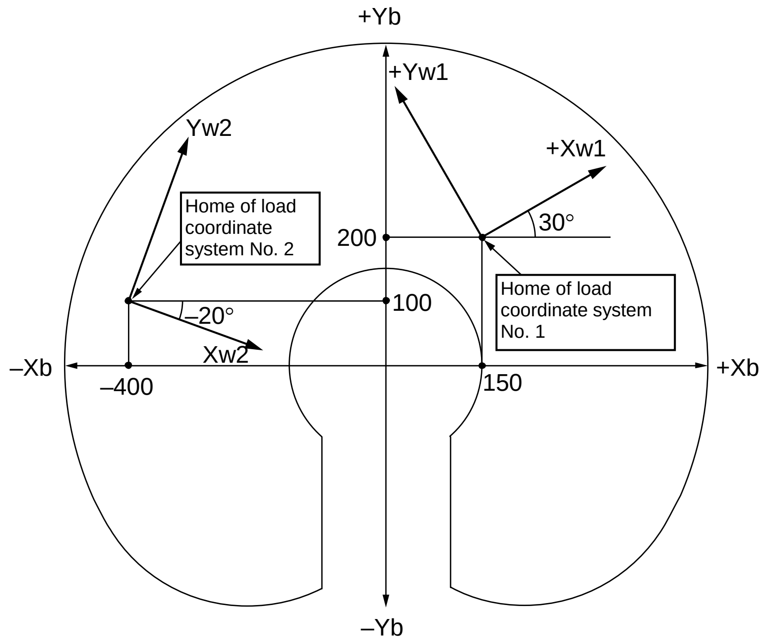
Xofwn: X load coordinate offset
Yofwn: Y load coordinate offset
Zofwn: Z load coordinate offset
Rofwn: R load coordinate offset

Xwn: Load coordinate system, X-axis
Ywn: Load coordinate system, Y-axis
Zwn: Load coordinate system, Z-axis
Rwn: Load coordinate system, R-axis

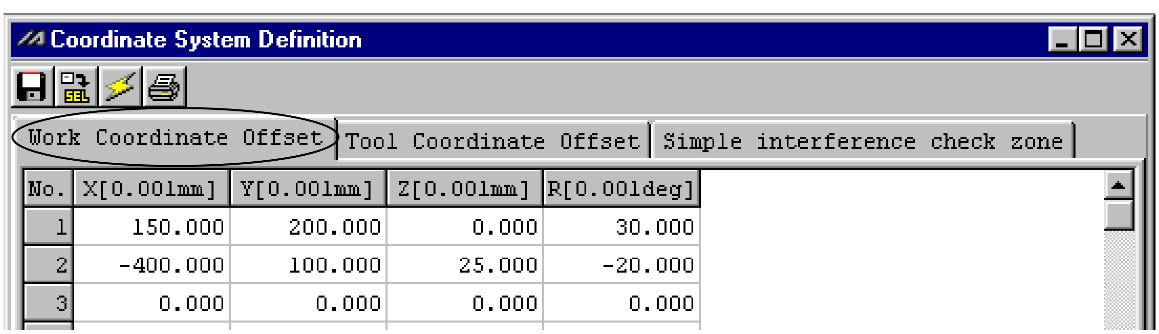
("n" indicates load coordinate system number.)

(1) Setting the load coordinate system
Set the offsets with respect to the base coordinate system.

- Setting example of load coordinate system
When defining load coordinate system Nos. 1 and 2 as shown below:



The offsets of load coordinate system No. 1 are set as Xofw1 = 150, Yofw1 = 200, Zofw1 = 0 and Rofw1 = 30.
The offsets of load coordinate system No. 2 are set as Xofw2 = -400, Yofw2 = 100, Zofw2 = 25 and Rofw2 = -20.
The figure below shows the edit screen for load coordinate system definition data on the PC software for horizontal articulated robot, where load coordinate system Nos. 1 and 2 are set:

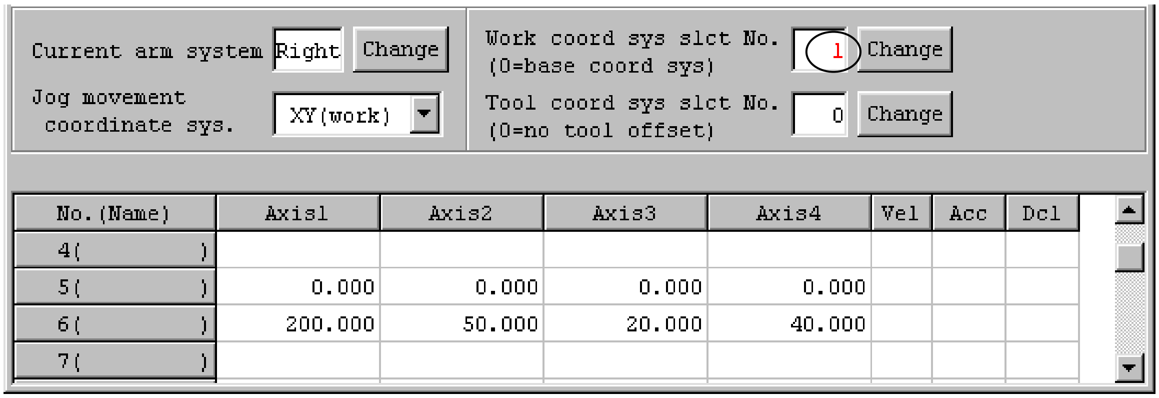


No.	X[0.001mm]	Y[0.001mm]	Z[0.001mm]	R[0.001deg]
1	150.000	200.000	0.000	30.000
2	-400.000	100.000	25.000	-20.000
3	0.000	0.000	0.000	0.000

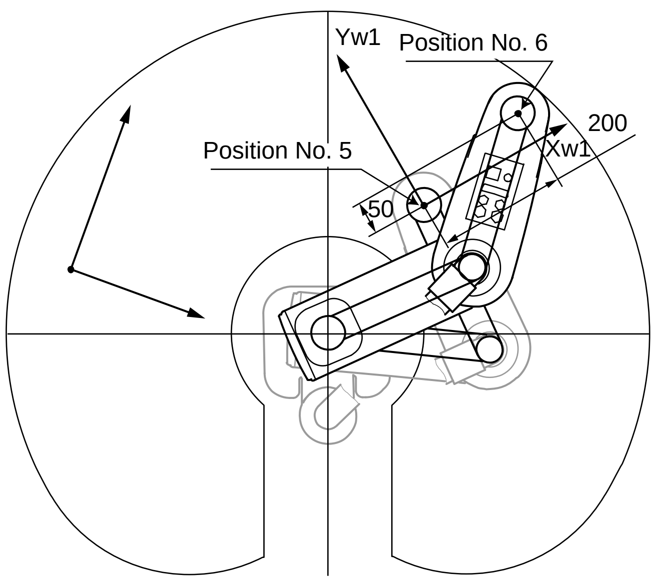
* Use a DFWK command to set load coordinate system offsets in a SEL program.

(2) Positioning on the load coordinate system
Perform positioning after selecting a desired load coordinate system.
Use a SLWK command to select a load coordinate system number in a SEL program.
The selected load coordinate system number will remain valid after the program ends, and even after reconnection of power if a system-memory backup battery is installed.

[1] When positioning to position Nos. 5 and 6 in PTP mode on load 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( )							

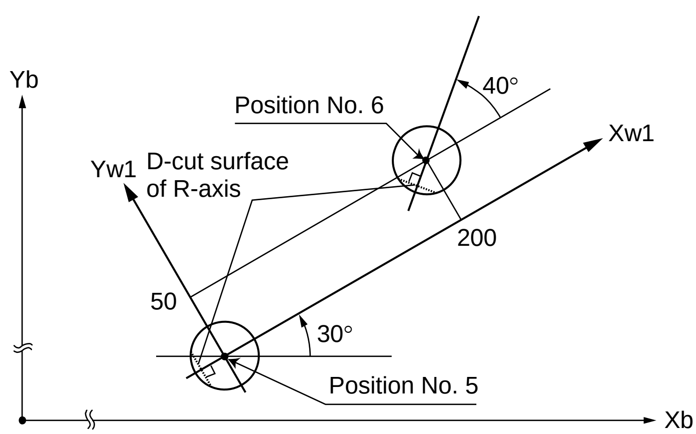


Program example

:
:
:

SLWK	1	Select load coordinate system No. 1.
SLTL	0	Select tool coordinate system No. 0.
PTPR		Specify the right arm as the PTP target arm system.
MOVP	5	Move to position No. 5.
MOVP	6	Move to position No. 6.

:
:
:

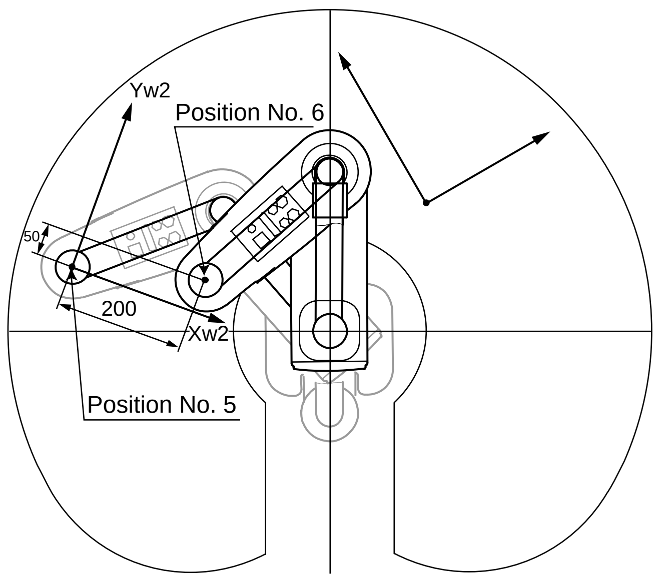


The R-axis position will be as shown in the figure at left (top view).
The Z-axis position will be as follows:
Position No. 5: Zb = 0
Position No. 6: Zb = 20

[2] When positioning to position Nos. 5 and 6 in PTP mode on load coordinate system No. 2

Current arm system: Right [Change]
Jog movement coordinate sys.: XY(work)
Work coord sys slct No. (0=base coord sys): 2 [Change]
Tool coord sys slct No. (0=no tool offset): 0 [Change]

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( )							

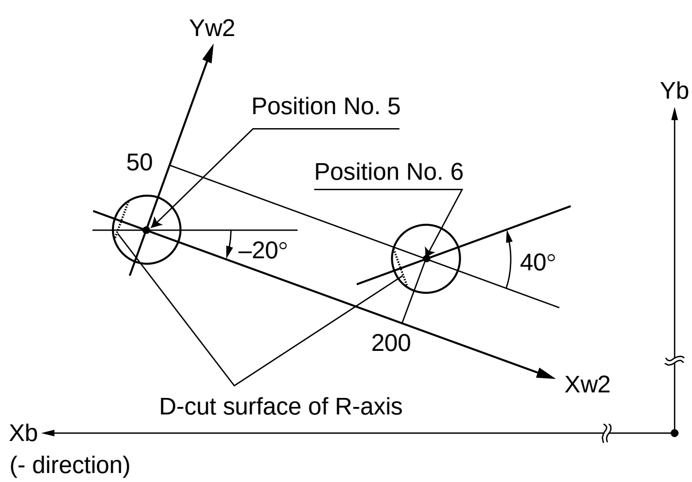


Program example

:
:
:

SLWK	2	Select load coordinate system No. 2.
SLTL	0	Select tool coordinate system No. 0.
PTPR		Specify the right arm as the PTP target arm system.
MOVP	5	Move to position No. 5.
MOVP	6	Move to position No. 6.

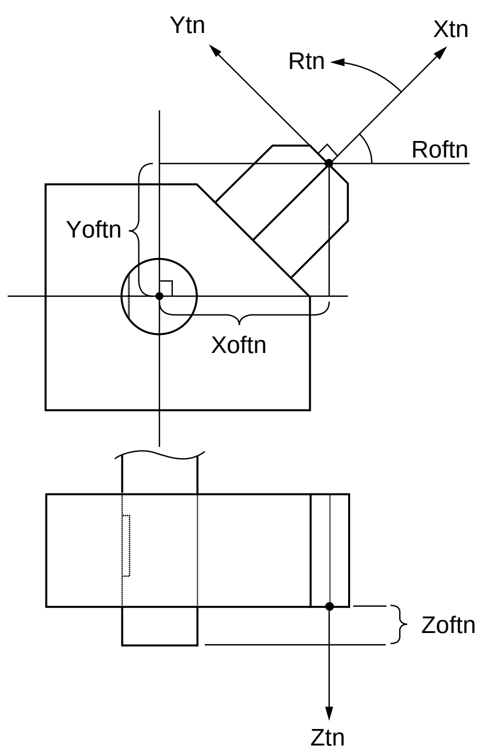
:
:
:

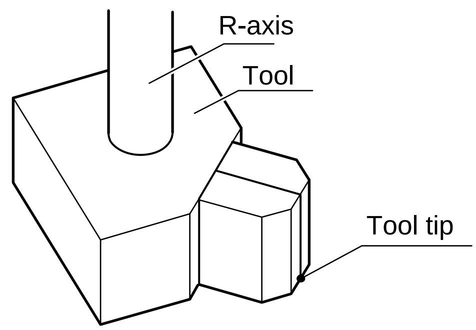


The R-axis position will be as shown in the figure at left (top view).
The Z-axis position will be as follows:
Position No. 5: Zb = 25
Position No. 6: Zb = 45

3.3 Tool Coordinate System (Dedicated SCARA Function)

This coordinate system provides 128 sets of three-dimensional cartesian coordinates and rotating-axis coordinates as defined by the dimensions (offsets) of a tool (hand, etc.) installed on the tool-mounting surface. Note that tool coordinate system No. 0 is reserved by the system as a tool coordinate system with zero offsets.
When any of the defined tool coordinate system numbers is selected, the tool tip, rather than the center of the tool-mounting surface, will be used as the reference point in moving to the target position.



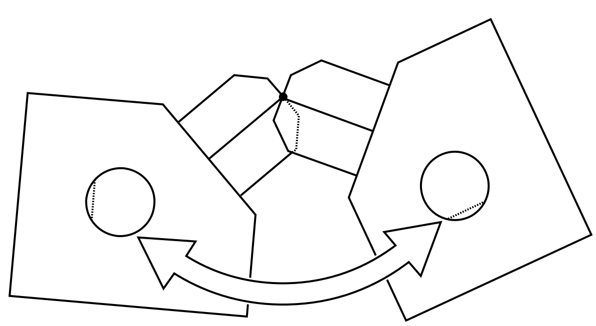


Xoftn: X tool coordinate offset
Yoftn: Y tool coordinate offset
Zoftn: Z tool coordinate offset
Roftn: R tool coordinate offset

Xtn: Tool coordinate system, X-axis
Ytn: Tool coordinate system, Y-axis
Ztn: Tool coordinate system, Z-axis
Rtn: Tool coordinate system, R-axis

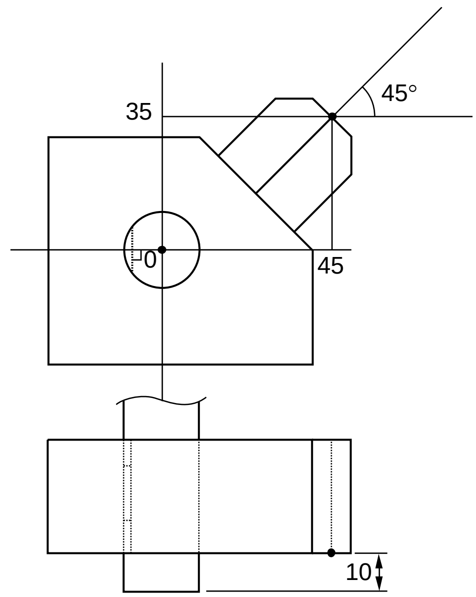
("n" indicates tool coordinate system number.)

Selecting a defined tool coordinate system and executing a jog command for the R-axis will result in the following operation:

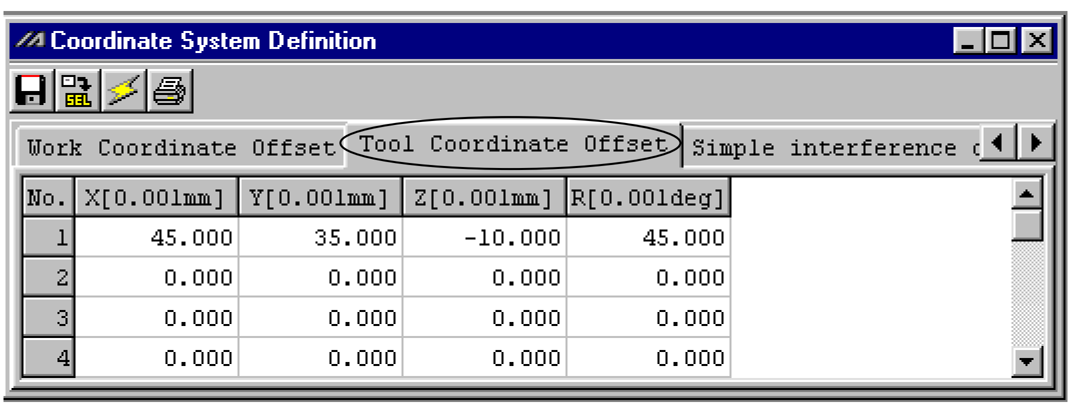


(1) Setting the tool coordinate system
Set the offsets from the center of the tool-mounting surface to the tool tip.

- Setting example of tool coordinate system
  When defining tool coordinate system No. 1 as shown below:



The offsets of tool coordinate system No. 1 are set as Xoft1 = 45, Yoft1 = 35, Zoft1 = -10 and Roft1 = 45.
The figure below shows the edit screen for tool coordinate system definition data on the PC software for horizontal articulated robot, where tool coordinate system No. 1 is set:

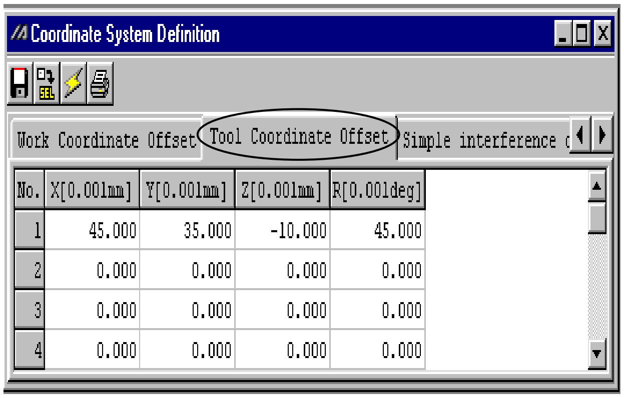


No.	X[0.001mm]	Y[0.001mm]	Z[0.001mm]	R[0.001deg]
1	45.000	35.000	-10.000	45.000
2	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000

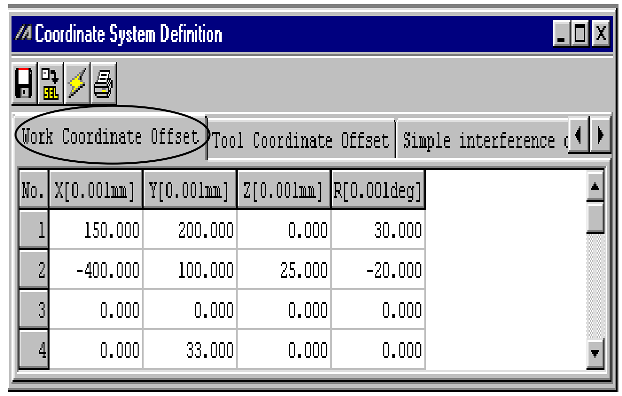
* Use a DFTL command to set tool coordinate system offsets in a SEL program.

(2) Positioning using tool coordinate system offsets
Perform positioning after selecting a desired tool coordinate system.
Use a SLTL command to select a tool coordinate system number in a SEL program.
The selected tool coordinate system number will remain valid after the program ends, and even after reconnection of power if a system-memory backup battery is installed.

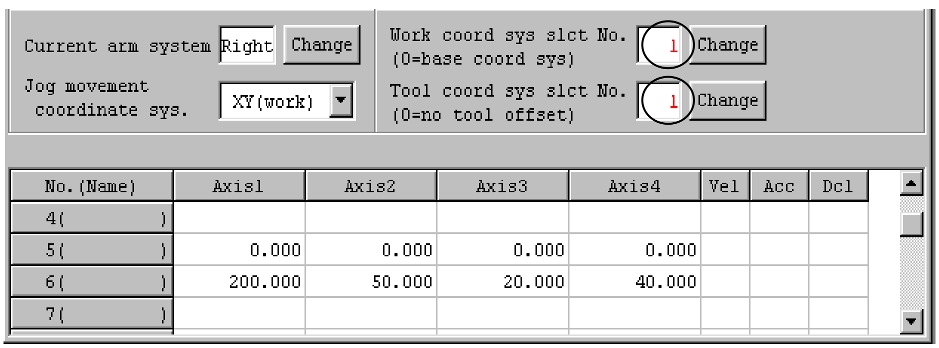
[1] When positioning the tool tip on tool coordinate system No. 1 to position Nos. 5 and 6 on load coordinate system No. 1 in PTP mode



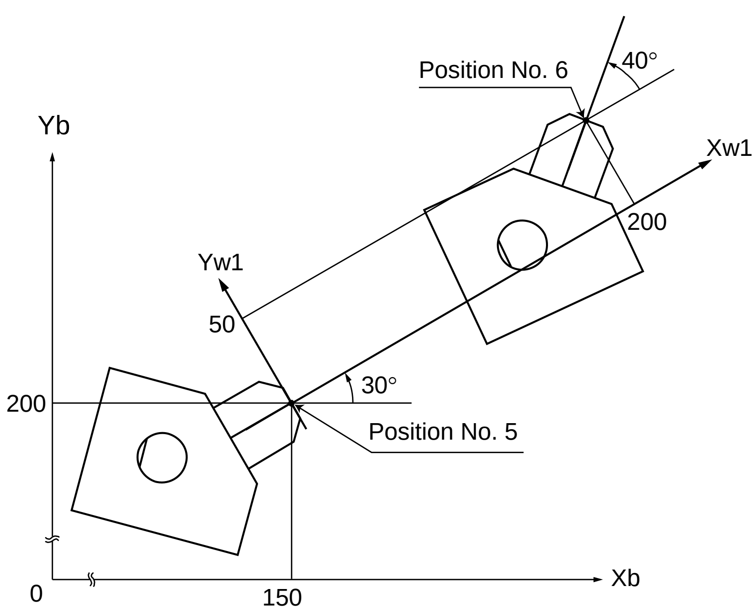
No.	X[0.001mm]	Y[0.001mm]	Z[0.001mm]	R[0.001deg]
1	45.000	35.000	-10.000	45.000
2	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000



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	33.000	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( )							



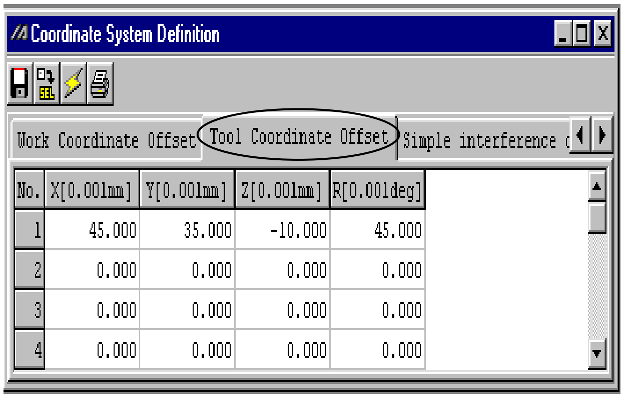
Program example
:
:
:

SLWK	1	Select load coordinate system No. 1.
SLTL	1	Select tool coordinate system No. 1.
PTPR		Specify the right arm as the PTP target arm system.
MOVP	5	Move to position No. 5.
MOVP	6	Move to position No. 6.

:
:
:

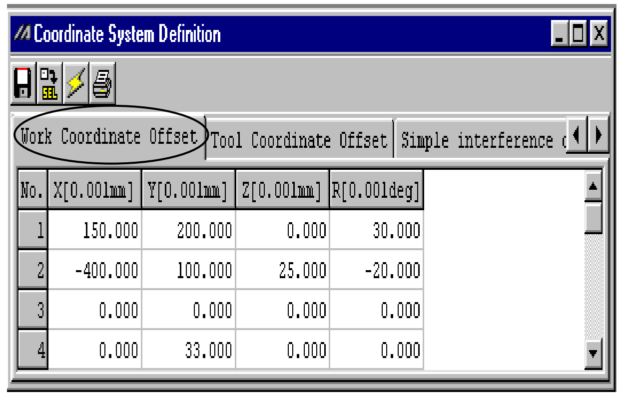
The Z-axis position of tool tip will be as follows:
Position No. 5: Zb = 0
Position No. 6: Zb = 20
The figure shown at left is a top view.

[2] When positioning the tool tip on tool coordinate system No. 2 to position Nos. 5 and 6 on load coordinate system No. 1 in PTP mode


Coordinate System Definition

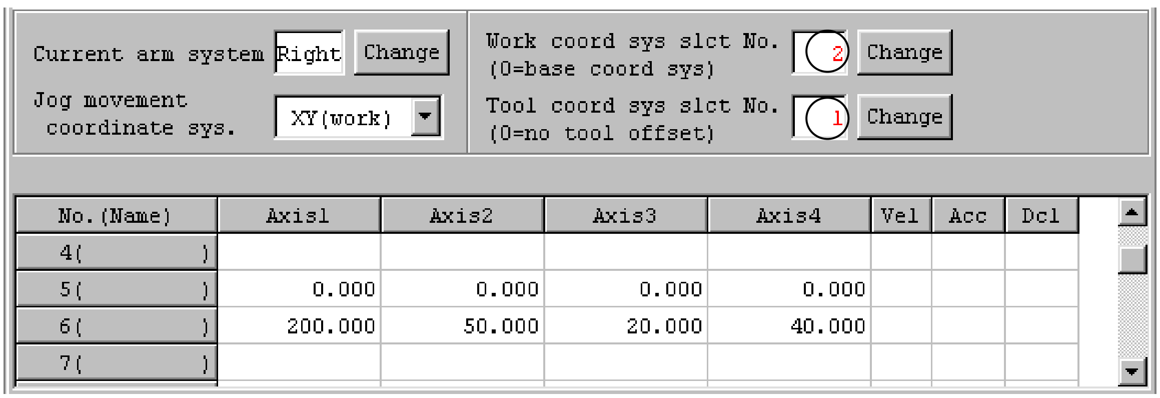
Work Coordinate Offset | Tool Coordinate Offset | Simple interference c

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


Coordinate System Definition

Work Coordinate Offset | Tool Coordinate Offset | Simple interference c

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	33.000	0.000	0.000


Current arm system Right Change

Jog movement coordinate sys. XY(work)

Work coord sys slct No. (0=base coord sys) 2 Change

Tool coord sys slct No. (0=no tool offset) 1 Change

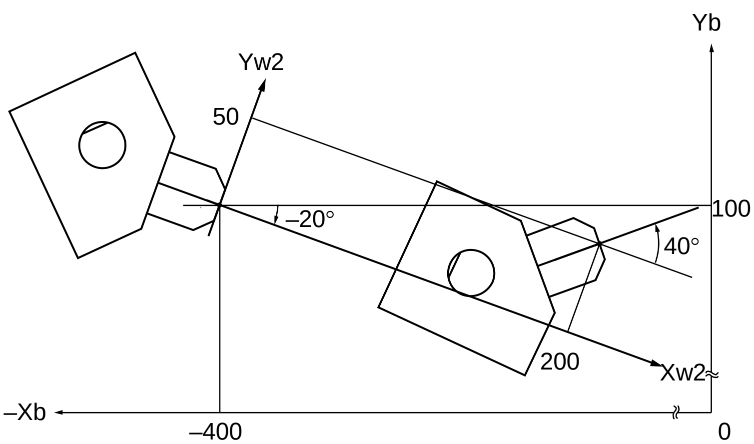
No.(Name)	Axis1	Axis2	Axis3	Axis4	Vel	Acc	Dcl
4( )							
5( )	0.000	0.000	0.000	0.000			
6( )	200.000	50.000	20.000	40.000			
7( )							

Program example

:
:
:

SLWK	2	Select load coordinate system No. 2.
SLTL	1	Select tool coordinate system No. 1.
PTPR		Specify the right arm as the PTP target arm system.
MOVP	5	Move to position No. 5.
MOVP	6	Move to position No. 6.

:
:
:



The Z-axis position of tool tip will be as follows:
Position No. 5: Zb = 25
Position No. 6: Zb = 45

4. Simple Interference Check Zone (Dedicated SCARA Function)

The simple interference check zone is an area set for the purpose of checking possible interference between the robot and peripherals.
In the case of tool coordinate system No. 0 (= tool coordinate system offsets are 0), entry into the simple interference check zone can be detected based on the center of the tool-mounting surface. In the case of tool coordinate system Nos. 1 to 127 (= tool coordinate offsets are valid), entry into the check zone can be detected based on the tool tip.

(1) Notes on use of simple interference check zone
Entry into the simple interference check zone of the center of the tool-mounting surface (when tool coordinate system No. 0 is selected) or the tool tip (when any of tool coordinate system Nos. 1 to 127 is selected) is detected. Entry of the R-axis periphery or parts other than the tool tip will not be detected.

This function does not prevent entry into the simple interference check zone. It only detects that the specified part has entered the zone.

Entry into the simple interference check zone cannot be detected reliably unless the entered part stays in the zone for at least 5 msec. The function is designed as a simple check during low-speed operation.

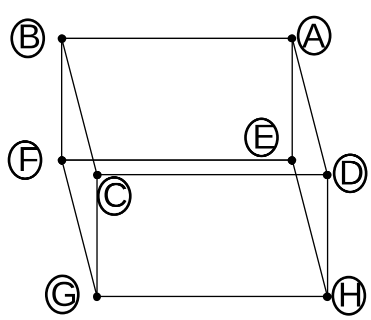
The locus is different between high-speed operation (operation at the actual operating speed) and low-speed operation. Provide a sufficient margin to prevent interference. (During high-speed operation, the locus tends to shift inward compared with during low-speed operation.)

The definition coordinates of simple interference check zone are always treated as data on the base coordinate system (load coordinate system No. 0). Therefore, changing the load coordinate system will not change the position of the simple interference check zone. Exercise caution.

After changing the definition coordinates of simple interference check zone, it will take at least 5 msec before the new settings are reflected in the check result.

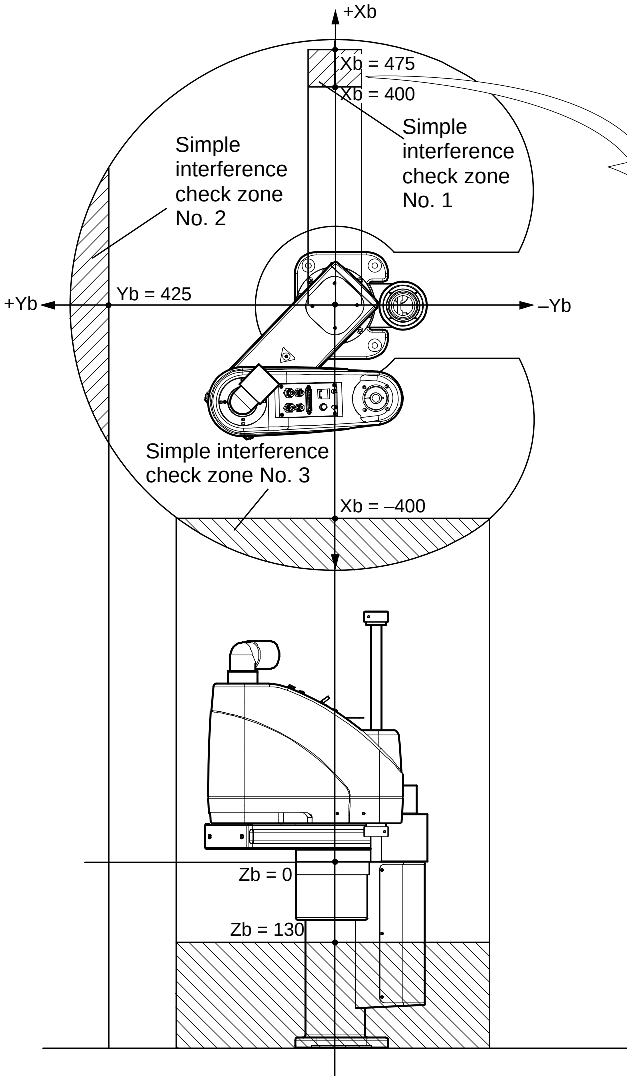
During PTP operation, movements will not follow specified paths. When moving near an interfering object (including the robot itself), always perform test operation at low speed and confirm absence of interference, and then gradually raise the speed to an appropriate level.

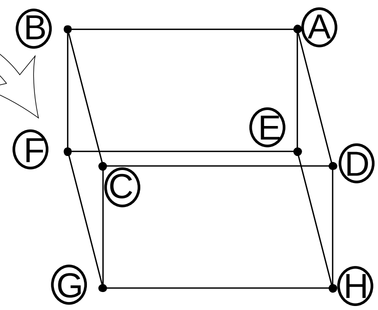
(2) Setting the simple interference check zone
The simple interference check zone is set using position data on the base coordinate system.
Enter the maximum and minimum values defining the simple interference check zone.
Set the boundaries of the simple interference check zone in parallel with the base coordinate axes.



To set the rectangular solid shown at left as a simple interference check zone, enter coordinates of two points corresponding to one of the combinations of (A)-(G), (B)-(H), (C)-(E) and (D)-(F).

Setting example of simple interference check zone
Define simple interference check zone Nos. 1, 2 and 3 as follows:



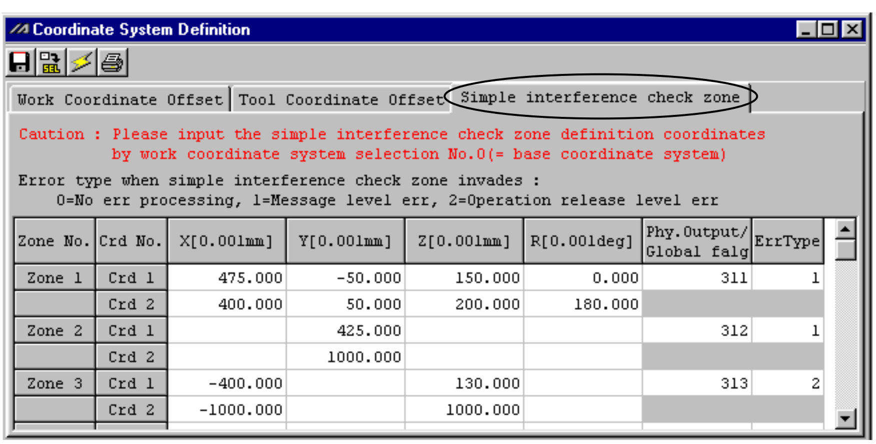


a. Set the area inside a rectangular solid as simple interference check zone No. 1.
(A): Xb = 475, Yb = –50, Zb = 150, Rb = 0
(G): Xb = 400, Yb = 50, Zb = 200, Rb = 180
If Rb is outside the range of 0 to 180 , entry into this rectangular solid area will not be detected.

b. Set an area with Yb of 425 mm or more as simple interference check zone No. 2.

c. Set an area with Xb of –400 mm or less and Zb of 130 mm or more as simple interference check zone No. 3.

The figure below shows the edit screen for definition data of simple interference check zone on the PC software for horizontal articulated robot, where simple interference check zone Nos. 1, 2, and 3 are set:



Zone No.	Crd No.	X[0.001mm]	Y[0.001mm]	Z[0.001mm]	R[0.001deg]	Phy.Output/ Global falg	ErrType
Zone 1	Crd 1	475.000	-50.000	150.000	0.000	311	1
	Crd 2	400.000	50.000	200.000	180.000		
Zone 2	Crd 1		425.000			312	1
	Crd 2		1000.000				
Zone 3	Crd 1	-400.000		130.000		313	2
	Crd 2	-1000.000		1000.000			

As for simple interference check zone No. 1, entry into this rectangular solid area will not be detected if Rb is outside the range of 0 to 180°. To enable detection regardless of the R-axis coordinate, do not enter anything in coordinates 1 and 2 in the R column for zone 1.

If either the maximum value or minimum value needs not be limited, as in the case of simple interference check zone No. 2 or 3, enter a value outside the operation area (1000 in zone 2, 1000 or -1000 in zone 3).

The maximum/minimum value may be set in either coordinate 1 or 2.

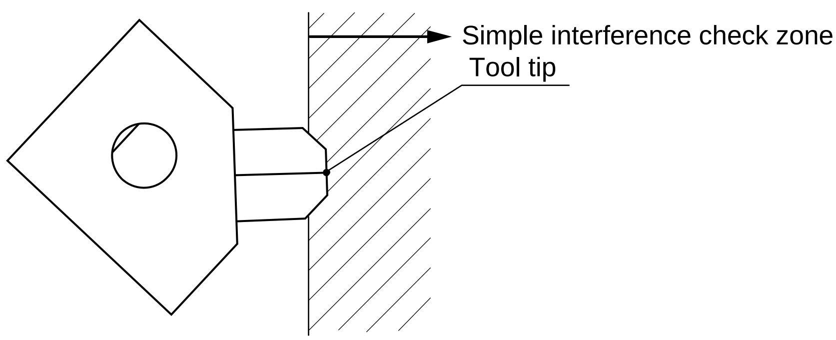
Entry into simple interference check zone No. 1, 2 or 3 will turn ON output port No. 311, 312 or 313, respectively.

Duplicate specifications of physical output numbers or global flag numbers will cause chattering and the result will become indeterminable. Do not set duplicate numbers.

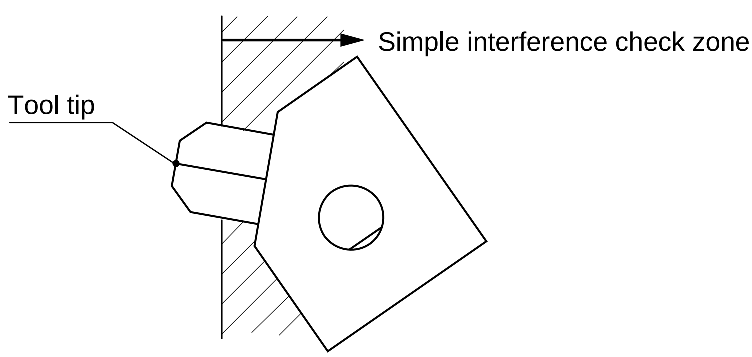
Use of simple interference check zones will reduce the CPU performance significantly. When simple interference check zones are not used, set “0” in "physical output port number/global flag number" and "error type" to disable the function.

* Use a DFIF command to set a simple interference check zone in a SEL program.

(3) Notes on operation when a tool coordinate system is selected
When a tool coordinate system is selected, entry of the tool tip into the simple interference check zone, not entry of the center of the mounting surface, will be detected.



Depending on the movement locus, a part other than the tool tip may enter the simple interference check zone, as shown below. In this case, however, detection will not occur until the tool tip enters the simple interference check zone. Exercise due caution.



5. Soft Limits of SCARA Axes

The soft limits of IX horizontal articulated robots are set in axis-specific parameter Nos. 7 and 8.
The figure below is a display example of soft limits for an IX5020 robot (arm length 500 mm, Z-axis 200 mm) in the PC software.

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

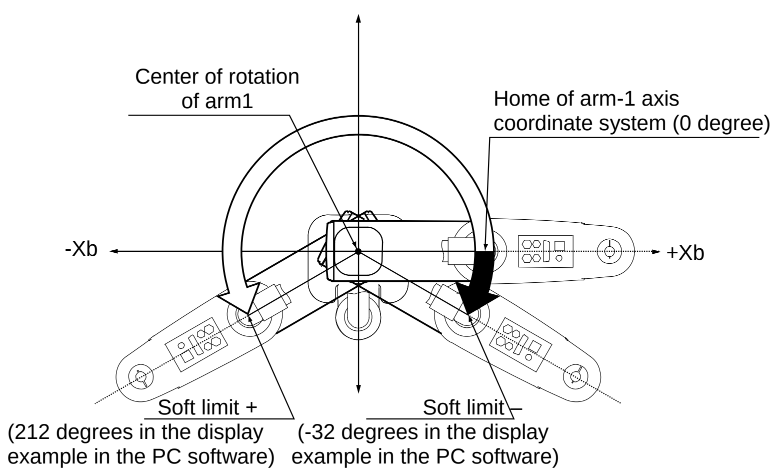
The soft limit parameters are set on each axis coordinate system.
Axis 1 and axis 2 correspond to arm 1 and arm 2, while axis 3 and axis 4 correspond to the Z-axis and R-axis, respectively.
The setting unit is 0.001 deg for arm 1, arm 2 and the R-axis (rotational movement axis), while the setting unit for the Z-axis is 0.001 mm.
The soft limits restrict the range of arm 1, arm 2, Z-axis or R-axis operation from the home of the applicable axis coordinate system. They are not influenced by the load coordinate system or tool coordinate system.

Note) The soft limits are set to the maximum limits of operating range when the controller is shipped. Accordingly, do not increase the limits in the direction of expanding the operating range.

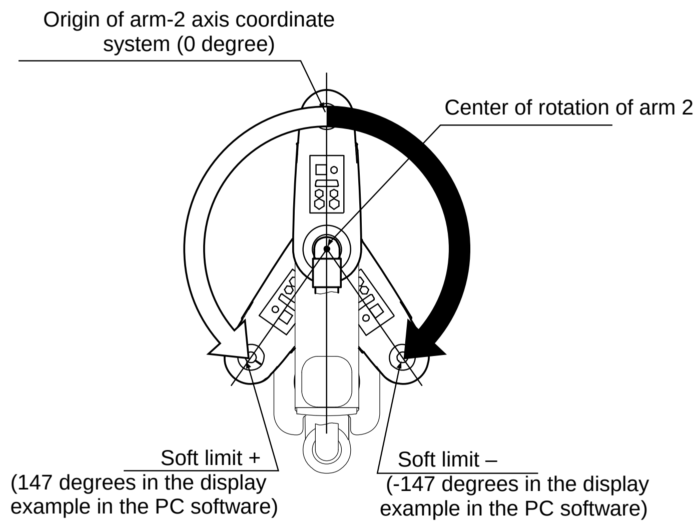
5.1 Axis Coordinate Systems and Soft Limits

(1) Soft limits of arm 1

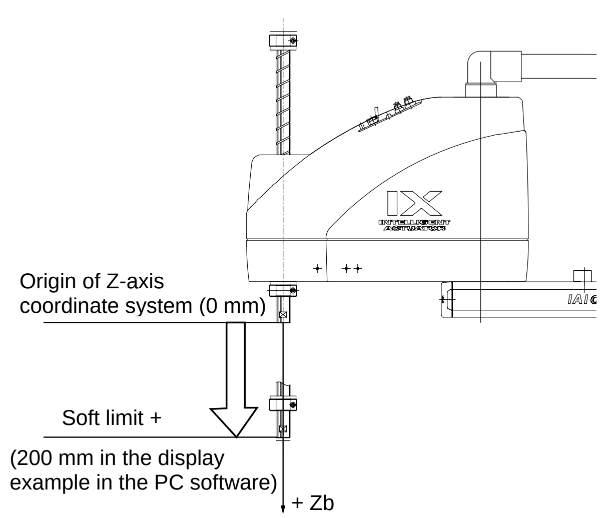
The position where arm 1 is facing toward the +Xb direction is the home of arm 1 on its axis coordinate system (0 degree).
It is not influenced by the position of arm 2.
The operating angle in the counterclockwise direction (positive direction) from this home defines the + soft limit (axis 1 in axis-specific parameter No. 7). The operating angle in the clockwise direction (negative direction) from the home defines the – soft limit (axis 1 in axis-specific parameter No. 8).



(2) Soft limits of arm 2
The position where arm 2 is crossing with arm 1 at right angles is the home of arm 2 on its axis coordinate system (0 degree).
It is not influenced by the angle position of arm 1.
The operating angle in the counterclockwise direction (positive direction) from this home defines the + soft limit (axis 2 in axis-specific parameter No. 7). The operating angle in the clockwise direction (negative direction) from the home defines the – soft limit (axis 2 in axis-specific parameter No. 8).

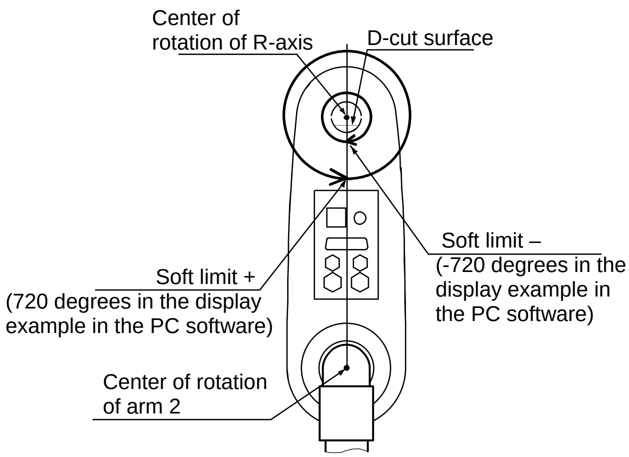


(3) Soft limits of the Z-axis
The position where the mechanical stopper attached to the Z-axis is approx. 5 mm below the mechanical end at the bottom of arm 2 is the home of the Z-axis on its axis coordinate system (0 mm). This is the same position as where axis 3, which defines the base coordinate system, is at 0 mm. (With cleanroom and dustproof/splash-proof specifications, the mechanical stoppers are housed inside the bellows and therefore not visible.)
The downward direction (positive direction) from this home defines the + soft limit (axis 3 in axis-specific parameter No. 7). The upward direction (negative direction) defines the – soft limit (axis 3 in axis-specific parameter No. 8). (The directions are reversed for inverse specifications.)



(4) Soft limits of the R-axis

The position where the D-cut surface at the tip of the R-axis is facing toward the center of rotation of arm 2 is the home of the R-axis on its axis coordinate system (0 degree). It is not influenced by the positions of arm 1 and arm 2.

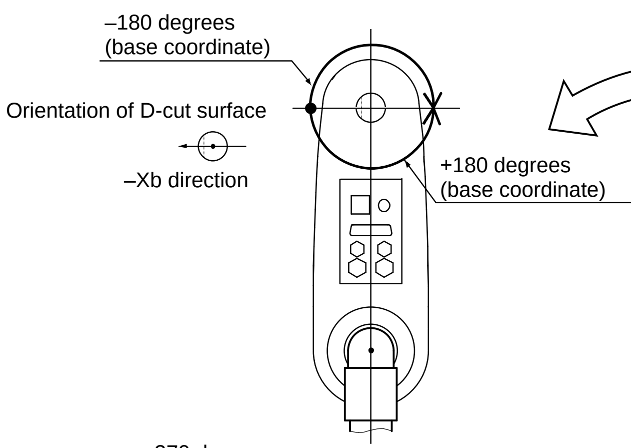


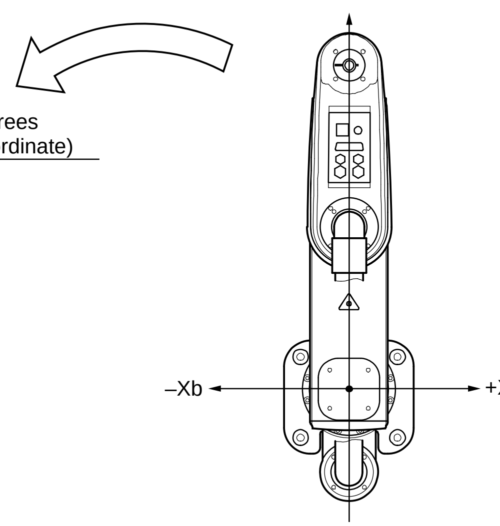
The operating angle in the counterclockwise direction (positive direction) from this origin defines the + soft limit (axis 4 in axis-specific parameter No. 7). The operating angle in the clockwise direction (negative direction) from the origin defines the – soft limit (axis 4 in axis-specific parameter No. 8).

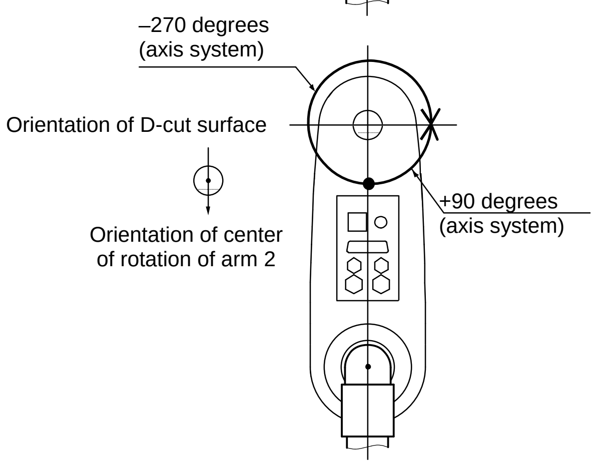
When limiting the operating range of the R-axis, the difference between the base coordinate system and the axis coordinate system must be noted.

Example)

Limit the operating range of the R-axis to ±180 degrees when the R-axis is currently positioned as shown below (= limit the R-axis range to ±180 degrees when axis 4 is at 0 on the base coordinate system).







In this case, operation of the R-axis is limited within a range of 90 degrees in the positive direction and 270 degrees in the negative direction from the origin of the R-axis coordinate system.

Accordingly, the respective parameters are set as follows:

Axis 4 in axis-specific parameter No. 7 = 90000

Axis 4 in axis-specific parameter No. 8 = -270000

5.2 Monitoring Coordinates on Each Axis System

Coordinates on each axis system can be monitored using the PC software or teaching pendant.
The figure below is a display example in the PC software. When a given axis system is selected as the jog coordinate system in the position data edit window, the current position display will change to reflect the coordinates on the selected axis system.

(When an IX5020 robot (arm length 500 mm, Z-axis 200 mm) is positioned at axis 1 = 0, axis 2 = 500, axis 3 = 0 and axis 4 = 0 on the base coordinate system)
Note) Position data cannot be captured separately for each axis system.

For details on the operating procedures, refer to the operation manual for the PC software or teaching pendant.

6. PTP Optimal Acceleration/Deceleration Function for SCARA Robot

Certain models such as the high-speed SCARA robot IX-NNN5020H perform PTP operation at an optimal acceleration/deceleration.

(Note) Conventional models such as IX-NNN5020 do not perform PTP operation at an optimal acceleration/deceleration. When a conventional model such as IX-NNN5020 performs PTP operation, the maximum acceleration and deceleration conform to axis-specific parameter No. 134 “Maximum PTP acceleration (SCARA axis)” and No. 135 “Maximum PTP deceleration (SCARA axis),” respectively.
The acceleration during PTP operation is determined by the ratio (%) set by ACCS and DCLS commands.

6.1 Function Overview

PTP optimal acceleration/deceleration for SCARA robot is a function to automatically adjust the acceleration and deceleration to optimal levels according to the tip load condition and other conditions of the applicable SCARA robot. To enable PTP optimal acceleration/deceleration for SCARA robot, the tip load mass must be set using a WGHT command, in addition to setting the acceleration/deceleration ratio by ACCS/DCLS commands, etc., as required on conventional models. Set an appropriate load mass according to the load, etc.

When PTP optimal acceleration/deceleration for SCARA is enabled, the acceleration and deceleration during PTP operation are calculated by the formulas below:

- PTP acceleration = Maximum acceleration determined by the load mass, etc. x ACCS command [%]
- PTP deceleration = Maximum deceleration determined by the load mass, etc. x DCLS command [%]

* The WGHT command is supported by main controller application version 0.45 or later.
It is valid in PC software version 7.5.0.0 or later and teaching pendant version 1.11 or later.

Notes

- With PTP optimal acceleration/deceleration for SCARA robot, the robot will not operate at an optimal acceleration/deceleration unless a mass corresponding to the actual load at the tip of the robot is set by a WGHT command. Be sure to set the tip load mass of the SCARA robot using a WGHT command.

- PTP optimal acceleration/deceleration for SCARA robot is valid only when the SCARA robot performs PTP operation. When the SCARA robot performs CP operation or linear operation, it will not operate at an optimal acceleration/deceleration.

- If an overload error occurs, make adjustments by lowering the set acceleration/deceleration as deemed appropriate or providing an appropriate stationary time after acceleration/deceleration, to prevent the overload error from occurring.

7. Horizontal move optimization function based on Z position for SCARA Robot

Certain models such as the high-speed SCARA robot IX-NNN5020H can use the Horizontal move optimization function based on Z position for SCARA.

(Note) Conventional models such as IX-NNN5020 cannot use the Horizontal move optimization function based on Z position for SCARA ("D8A: Optimal acceleration/deceleration, Horizontal move optimization function based on Z position internal parameter error" will generate).

7.1 Function Overview

Horizontal move optimization function based on Z position for SCARA robot is a function to optimize the horizontal move conditions based on the Z-axis position and tip load mass of the applicable SCARA robot.

This function is enabled or disabled using all-axis common parameter No. 51. To change the value set in this parameter, write a desired parameter value to the flash ROM and then perform a software reset or reconnect the power.

If the horizontal move optimization function for SCARA is enabled, the tip load mass of the SCARA robot must be set using a WGHT command. Set an appropriate load mass according to the load, etc.

- All-axis common parameters

No.	Parameter name	Default (reference)	Input range	Unit	Access right	Remarks
51	SCARA axis control 1	0H	0H ~ FFFFFFFFH		F	Bits 8 to 11: Z position → horizontal move optimization for SCARA (PTP) (0: Disable 1: Enable) (Available only on high-speed SCARA robots of main application version 0.45 or later.) Bits 12 to 15: Z position → horizontal move optimization for SCARA (CP) (0: Disable 1: Enable) * It is recommended to disable this function if CP operation must be performed at a constant speed with accurate locus and the set speed must be reached. (Available only on high-speed SCARA robots of main application version 0.45 or later.)

* The WGHT command is supported by main controller application version 0.45 or later.
It is valid in PC software version 7.5.0.0 or later and teaching pendant version 1.11 or later.

Notes

- When the Horizontal move optimization function based on Z position for SCARA robot is enabled, the tip load mass of the SCARA robot must be set using a WGHT command. An appropriate effect cannot be obtained unless a mass corresponding to the actual load at the tip of the robot is set.

- When the Horizontal move optimization function based on Z position for SCARA robot is enabled, the set speed may not be reached depending on the load mass and moving positions of the robot. If the set speed must be reached, disable the Horizontal move optimization function based on Z position for SCARA robot as necessary.

* Also when operand 1 is set to 0 (automatic division with priority on reaching set speed) in a DIS (set division distance at spline movement) or DIG command (set arc angle), the Horizontal move optimization function based on Z position for SCARA is given priority and the set speed may not be reached.

- In the case of a single operation with a PATH, CIR, ARC, CIRS, ARCS, PSPL or other command when the Horizontal move optimization function based on Z position for SCARA robot (CP) is enabled, the moving speed may not become constant while the command is being executed depending on the load mass and moving positions of the robot. During a continuous operation involving continuous move commands (PATH, PSPL, CIR2, ARC2, CIRS, ARCS, CIRS, ARCD, ARCC, CIR, ARC, etc.), the operating speed may not become constant between commands depending on the operating conditions. If the robot must operate at a constant speed, disable the Horizontal move optimization function based on Z position for SCARA robot (CP) as necessary.

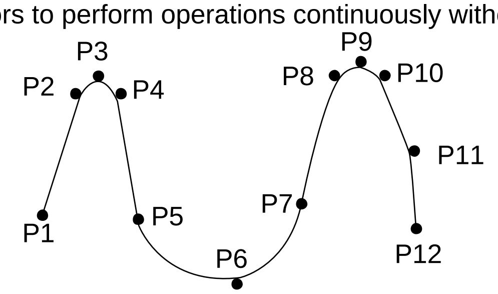
- When the Horizontal move optimization function based on Z position for SCARA robot (CP) is enabled, the CP operation locus may deviate slightly depending on the load mass and moving positions of the robot. If locus accuracy is required, disable the Horizontal move optimization function based on Z position for SCARA robot (CP) as necessary.

Chapter 4 Key Characteristics of Actuator Control Commands and Points to Note

1. Continuous Movement Commands [PATH, PSPL, CIR2, ARC2, CIRS, ARCS, ARCD, ARCC, CIR, ARC]

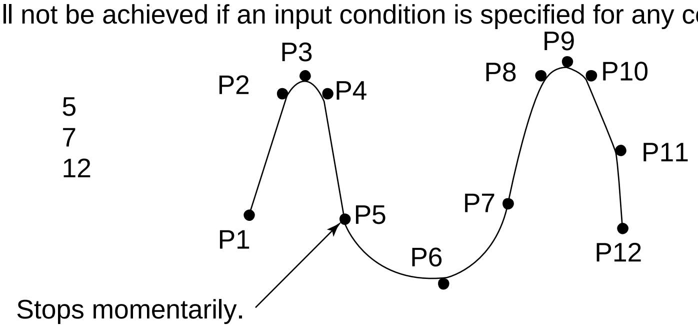
[1] By running a program with continuous movement commands input in a series of continuous program steps, you can allow the actuators to perform operations continuously without stopping between steps.

```
        PATH    1    5
        ARC2    6    7
        PATH    8    12
```

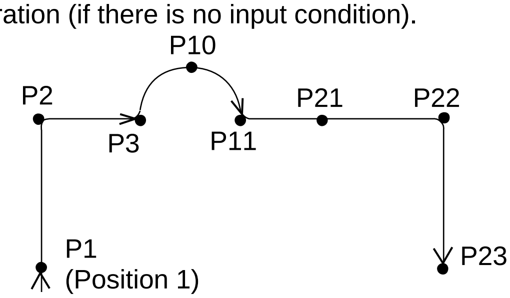


[2] Continuous movement will not be achieved if an input condition is specified for any continuous movement command.

```
        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
PATH    21    23    312
```

Output field	Timing
308	Turn ON as P3 approaches.
311	Turn ON as P11 approaches.
312	Turn ON when P23 operation is complete.

[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.

```
  |
  |
  |
PATH  1   5   ←  Actuator operation
ARC   6   7
PATH  8   12  ←  Step displayed on the PC software or teaching pendant
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.

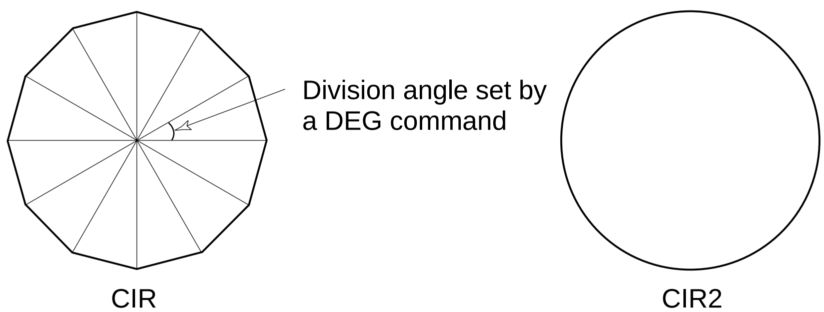
Do not create a program containing an indefinite loop of continuous movement commands using the TAG-GOTO syntax. (It will result in an accumulation of coordinate conversion errors.)

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.
This command is valid only on the XY plane.



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		All-axis parameter No. 11, Default CP acceleration of SCARA axis (All-axis parameter No. 12, Default CP deceleration of SCARA axis) All-axis parameter No. 200, Default acceleration of linear movement axis (All-axis parameter No. 201, Default deceleration of linear movement axis)

This command is valid only on the XY plane.

Chapter 5 Palletizing Function

The SEL language used by the IX 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.”

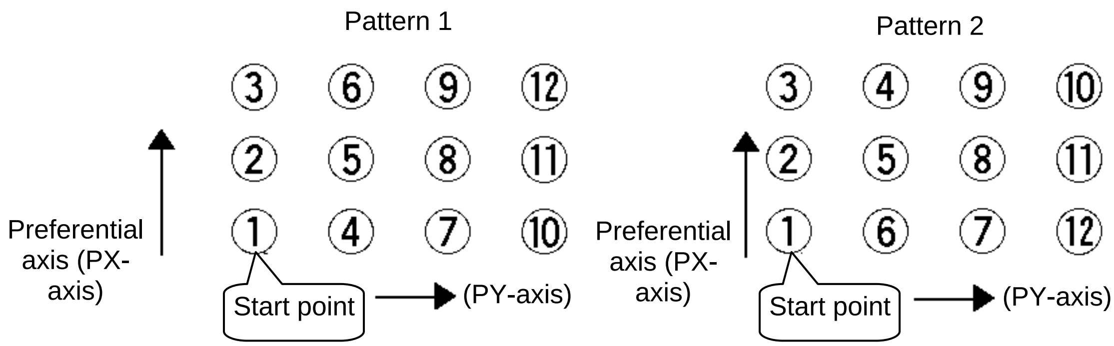


Fig. 1

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.

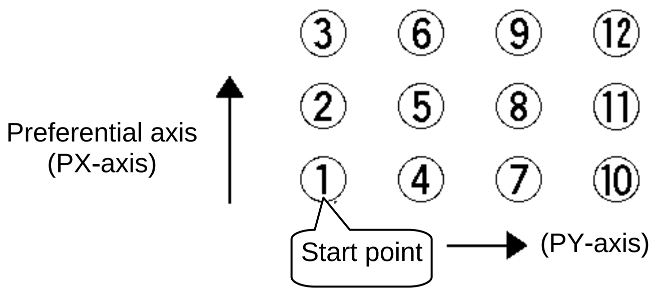
	Setting method	Commands
A	3-point teaching method Set three position-data points specifying the palletizing positions.	PAPS
B	Method to set palletizing positions in parallel with the actuators Set from the palletizing axes, palletizing reference point and palletizing pitches.	PASE, PAST, PAPT

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 load coordinate system axes 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]: Reference point
Position No. 12 [3]: The end point in the PX-axis direction
Position No. 13 [10]: The end point in the PY-axis direction
(Position No. 14 [12]: End point (4-point teaching))
The encircled numbers indicate palletizing position numbers (palletizing order).

Use a PAPS command to specify the position number corresponding to the start point.



The pitches are calculated automatically from the count set for each axis.
In 3-point teaching, you can specify position data for the X and Y-axes only or for X, Y and Z-axes. If data is specified for three axes, the palletizing plane will become a three-dimensional plane.

Fig. 1

```
PAPS    11
PEXT    14
```

Do no enter anything in the R-axis data column of the position data specified by a PAPS command. (Alternatively, disable the R-axis using a GRP command.)
Use a PEXT command to set the R-axis coordinate of a given palletizing position.

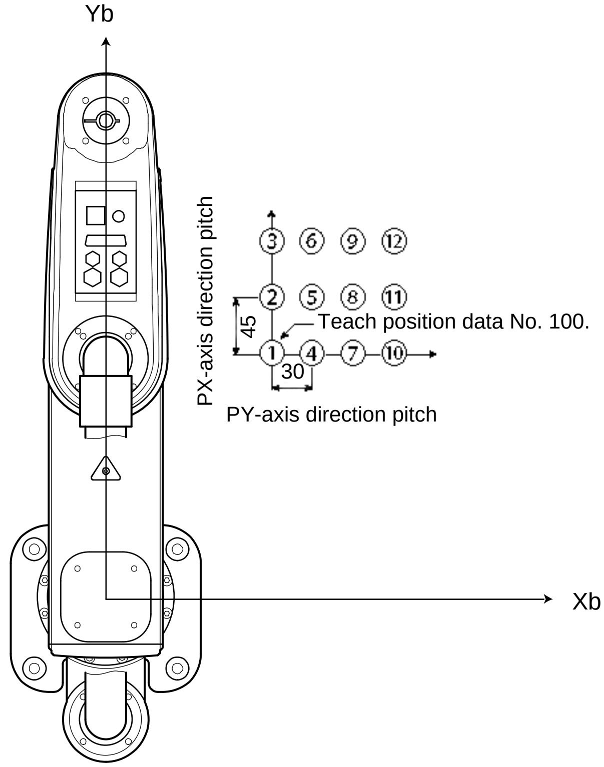
B. Method to set palletizing positions in parallel with the load coordinate system axes

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.
Use a PEXT command to set the R-axis coordinate of a given palletizing position.

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 (Y-axis) as the preferential axis (PX-axis) and axis 1 (X-axis) as the axis perpendicular to the preferential axis.

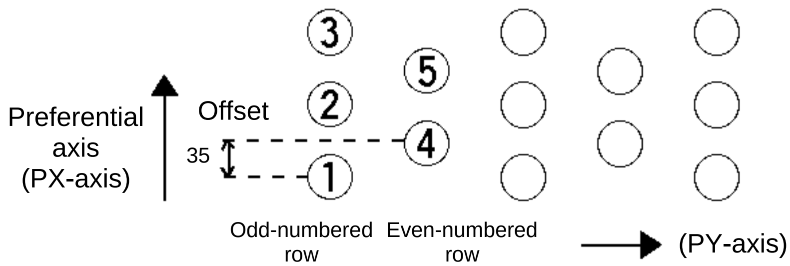
(Note) When the palletizing axes, palletizing pitches and palletizing reference point are used, the PX-axis and PY-axis must be parallel with the load coordinate system axes and crossing with each other. In the example shown above, load coordinate system No. 0 (base coordinate system) is selected.

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.

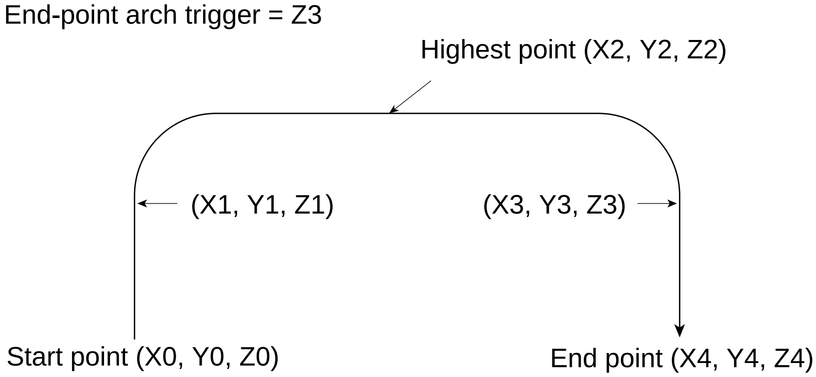
Zigzag offset: Offset amount in the preferential-axis direction, which will be applied when even-numbered rows are placed.
"Even-numbered rows" refer to the rows occurring at the even numbers based on the row placed first representing the first row.

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 (Dedicated SCARA command)

(b) Palletizing Z-axis offset --- Command: OFPZ (Dedicated SCARA command)

(c) Palletizing composition --- Command: PEXT (Dedicated SCARA command)

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. Use a PEXT command to set the R-axis position coordinates of a given palletizing position.

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 (Dedicated SCARA command)

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 positive value if axis 1 is used as the reference for angle calculation.

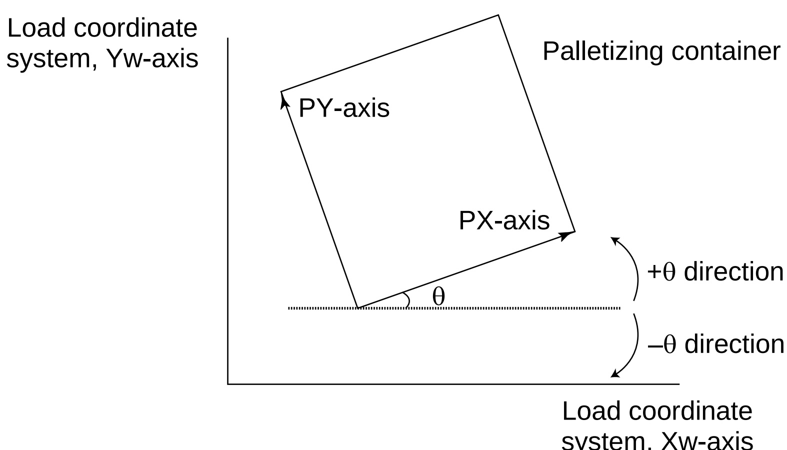


Fig. 4

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.
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 (PCHZ).

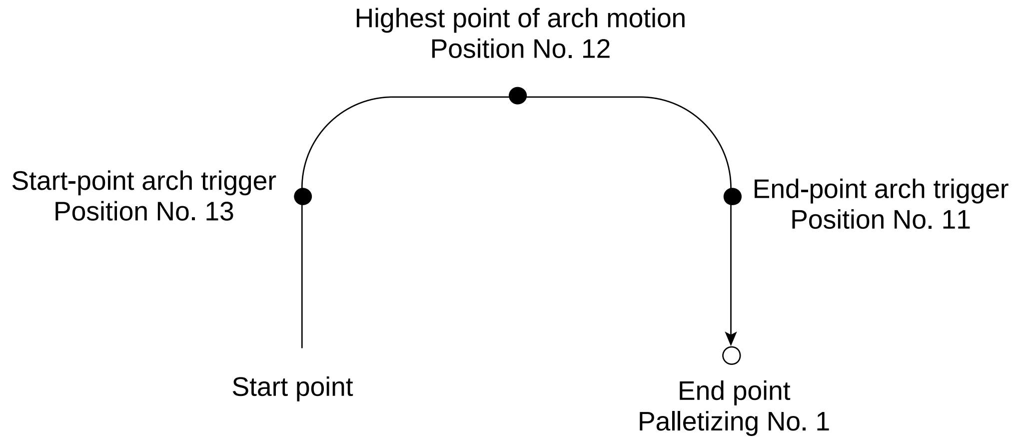
(3) Palletizing calculation data   Command --- PAPG
When a palletizing position number is set, this data refers to the position coordinate data of the palletizing point corresponding to that palletizing position number.
Note that this position coordinate data does not reflect normal offset or palletizing 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.

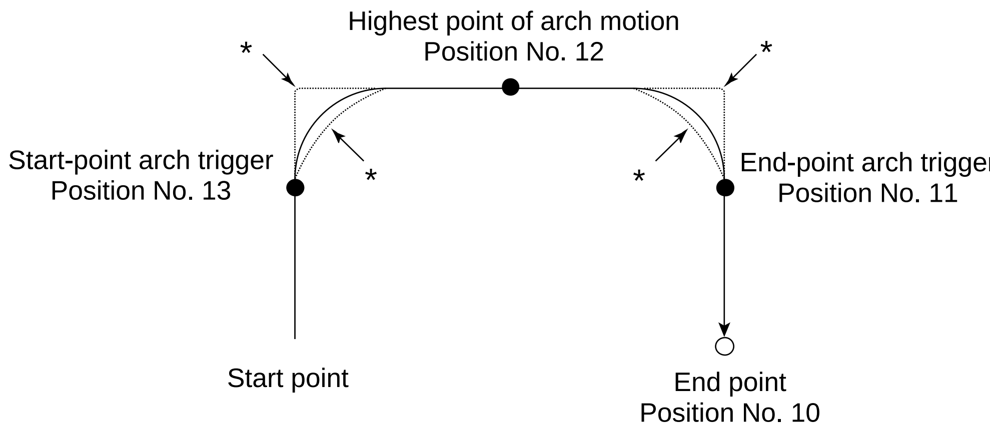
(1) Movement commands to palletizing point --- PMVP, PMVL (Dedicated linear movement axis command), PACH (Dedicated SCALA command)
Position coordinates of a two-dimensionally or three-dimensionally placed palletizing point are calculated and movement is performed using the calculated point as the end point. (The axes will move to the palletizing point of the palletizing position number specified in the executed command.)

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

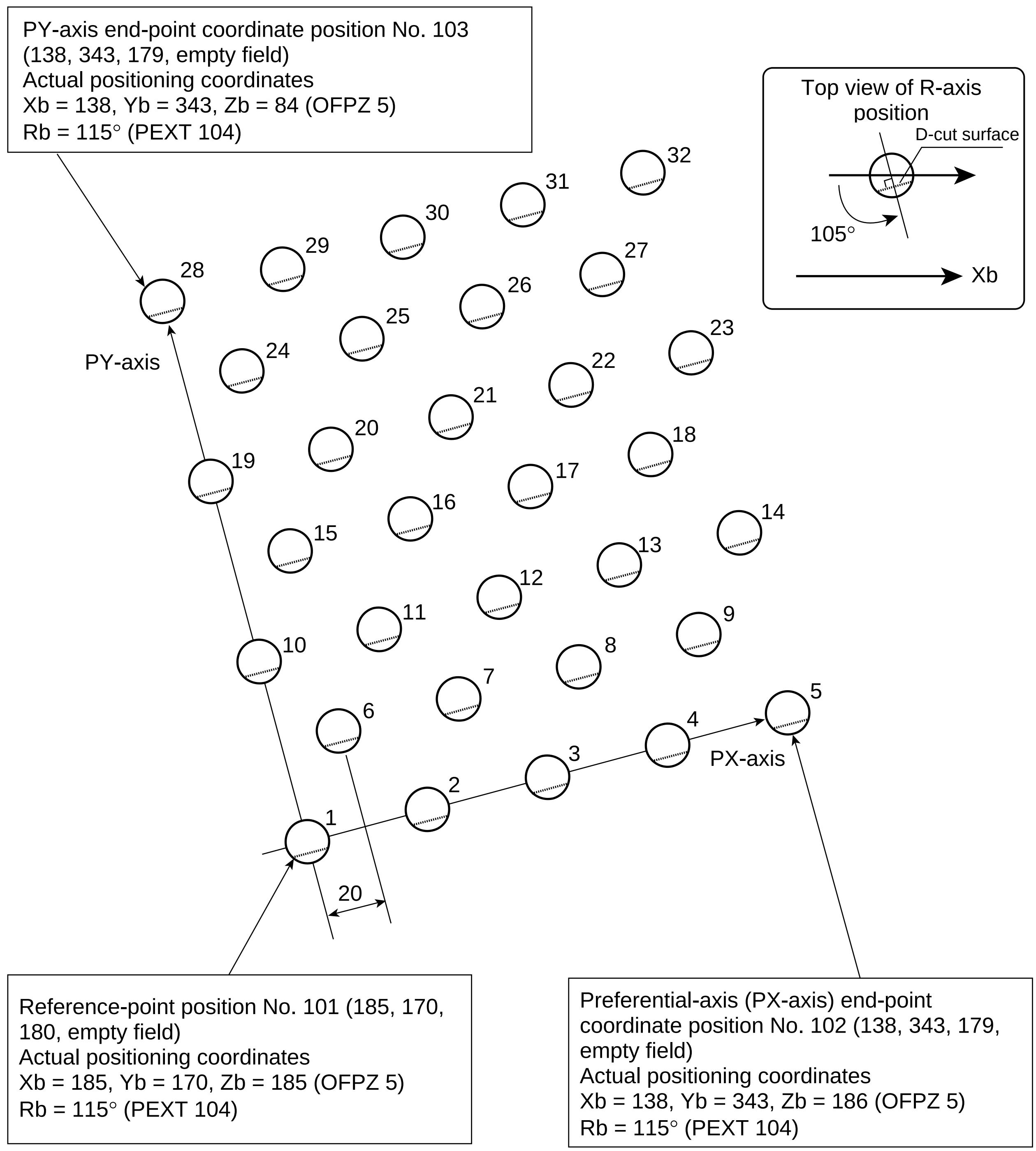
(1) Program example using PAPS (set by 3-point teaching)
The example below specifies movement only and does not cover picking operation.

Step	E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
1				VELS	80			PTP travel speed: 80%
2				ACCS	50			PTP travel acceleration: 50%
3				DCLS	50			PTP travel deceleration: 50%
4				VEL	100			CP travel speed: 100 mm/sec
5				ACC	0.3			CP travel acceleration: 0.3 G
6				DCL	0.3			CP travel deceleration: 0.3 G
7				SLWK	0			Select load coordinate system No. 0.
8				SLTL	0			Select tool coordinate system No. 0.
9								
10				BGPA	1			Start setting palletizing No. 1.
11				PAPI	5	7		Palletizing counts: 5 x 7
12				PAPS	101			Set by 3-point teaching.
13				PEXT	104			Set palletizing R-axis coordinate.
14				PSLI	20	4		Zigzag offset = 20 mm
15				PAPN	1			Palletizing pattern 1
16				PCHZ	3			Palletizing Z-axis = Axis 3
17				PTRG	105	105		Set palletizing arch triggers.
18				OFPZ	5			PZ-axis offset = 5 mm
19				EDPA				
20								
21				ATRG	105	105		Set arch triggers.
22				ACHZ	3			Arch-motion Z-axis = Axis 3
23								
24				PTPL				Perform positioning in PTP mode using left arm.
25				MOVP	110			Move to picking position in PTP mode.
26				PSET	1	1		Set palletizing position number to 1.
27				TAG	1			Beginning of loop processing
28				PACH	1	106		Palletizing arch motion
29				ARCH	110	106		Arch motion
30				PINC	1		600	Increment palletizing position number by 1.
31			600	GOTO	1			Beginning of loop when PINC is successful.
32				MOVL	109			Move to standby position in CP mode.
33				EXIT				End

Position data (Stroke with arm length 500)

No.(Name)	Axis1	Axis2	Axis3	Axis4	
101( )	185.000	170.000	180.000		Reference-point position
102( )	340.000	211.000	181.000		PX-axis end point
103( )	138.000	343.000	179.000		PY-axis end point
104( )				105.000	Palletizing R-axis position
105( )			100.000		Arch/palletizing trigger position
106( )			80.000		Highest position (Z point)
107( )					
108( )					
109( )	0.000	160.000	0.000	0.000	Standby position
110( )	-200.000	330.000	180.000	0.000	Pickup position

Schematic diagram of palletizing positions based on the above program



The number shown at top right of each cycle indicates the corresponding palletizing position number.
Count in PX-axis direction = 5, count in PY-axis direction = 7
Zigzag offset: 20, zigzag count: 4

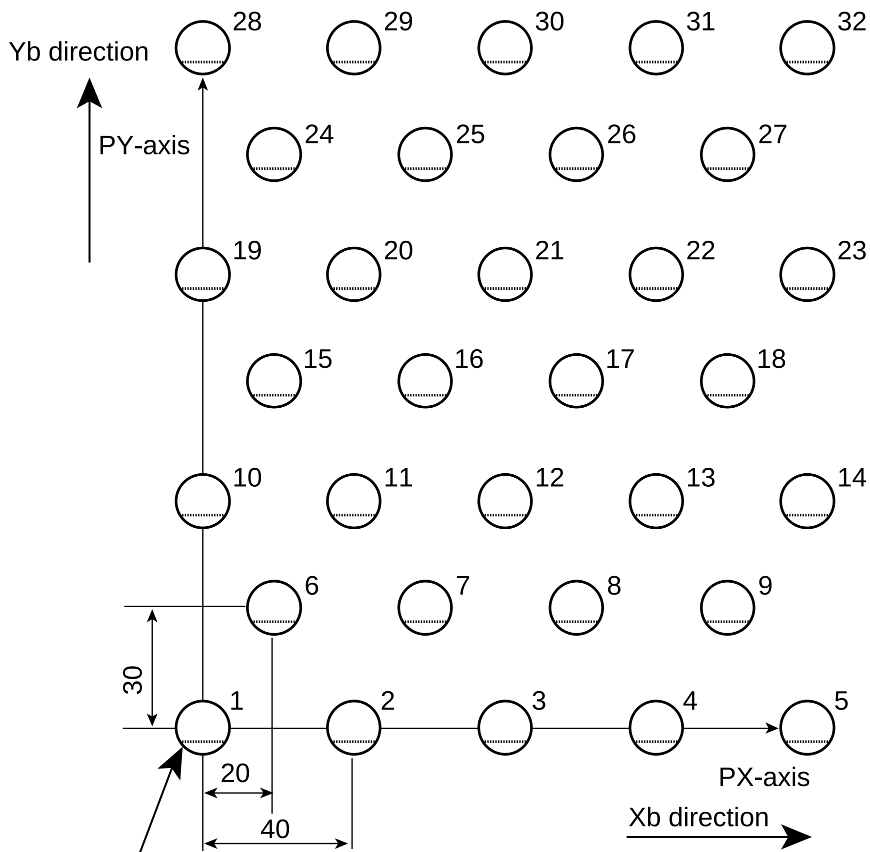
(2) Program example using PASE, PAPT and PAST
The example below specifies movement only and does not cover picking operation.

Step	E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
1				VELS	80			PTP travel speed: 80%
2				ACCS	50			PTP travel acceleration: 50%
3				DCLS	50			PTP travel deceleration: 50%
4				VEL	100			CP travel speed: 100 mm/sec
5				ACC	0.3			CP travel acceleration: 0.3 G
6				DCL	0.3			CP travel deceleration: 0.3 G
7				SLWK	0			Select load coordinate system No. 0.
8				SLTL	0			Select tool coordinate system No. 0.
9								
10				BGPA	1			Start setting palletizing No. 1.
11				PAST	201			Set reference-point data.
12				PASE	1	2		PX-axis = X-axis, PY-axis = Y-axis
13				PAPT	40	30		Pitch PX: 40, PY: 30
14				PAPI	5	7		Palletizing counts: 5 x 7
15				PSLI	20	4		Zigzag offset = 20 mm, count = 4
16				PEXT	202			Set palletizing R-axis coordinate.
17				PCHZ	3			Palletizing Z-axis = Axis 3
18				PTRG	203	203		Set palletizing arch triggers.
19				OFPZ	5			PZ-axis offset = 5 mm
20				EDPA				
21								
22				ATRG	203	203		Set arch triggers.
23				ACHZ	3			Arch-motion Z-axis = Axis 3
24								
25				PTPL				Perform positioning in PTP mode using left arm.
26				MOVP	208			Move to picking position in PTP mode.
27				PSET	1	1		Set palletizing position number to 1.
28				TAG	1			Beginning of loop processing
29				PACH	1	204		Palletizing arch motion
30				ARCH	208	204		Arch motion
31				PINC	1		600	Increment palletizing position number by 1.
32			600	GOTO	1			Beginning of loop when PINC is successful.
33				MOVL	207			Move to standby position in CP mode.
34				EXIT				End

Position data (Stroke with arm length 500)

No.(Name)	Axis1	Axis2	Axis3	Axis4	
201( )	185.000	170.000	180.000		Reference-point position
202( )				90.000	Palletizing R-axis position
203( )			100.000		Arch/palletizing trigger position
204( )			80.000		Highest position (Z point)
205( )					
206( )					
207( )	0.000	160.000	0.000	0.000	Standby position
208( )	-200.000	330.000	180.000	0.000	Pickup position

Schematic diagram of palletizing positions based on the above program
(The PX and PY-axes are parallel with Xb and Yb (base coordinates), respectively.)



Reference-point position No. 101 (185, 170, 180, empty field)
Actual positioning coordinates
Xb = 185, Yb = 170, Zb = 185 (OFPZ 5)
Rb = 90° (PEXT 202)

The number shown at top right of each cycle indicates the corresponding 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 6 Pseudo-Ladder Task

With the X-SEL Controller, a pseudo-ladder task function can be used depending on the command and extension condition.
The input format is shown below.

1. Basic Frame

Extension condition	Input condition		Command	Operand 1	Operand 2	Output	
E	N	Cnd				Pst	
LD		7001	CHPR	1			
			TPCD	1			
			TAG	1			
I I I I I I		I I I I I I	I I I I I I	I I I I I I			Ladder statement field
LED		7001	TSLP	1 ~ 100			
I I I I I I		I I I I I I	I I I I I I	I I I I I I			Ladder statement field
LD		7001	TSLP	1 ~ 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

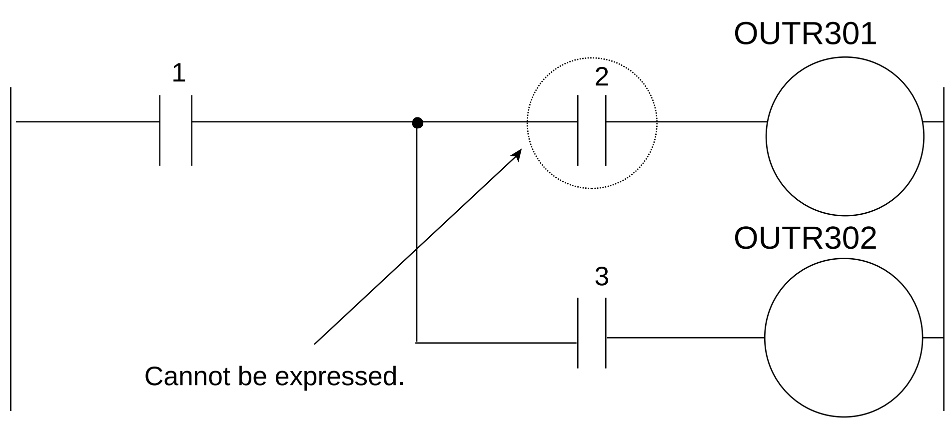
All of the above extension conditions can be used in non-ladder tasks.

[2] Ladder commands

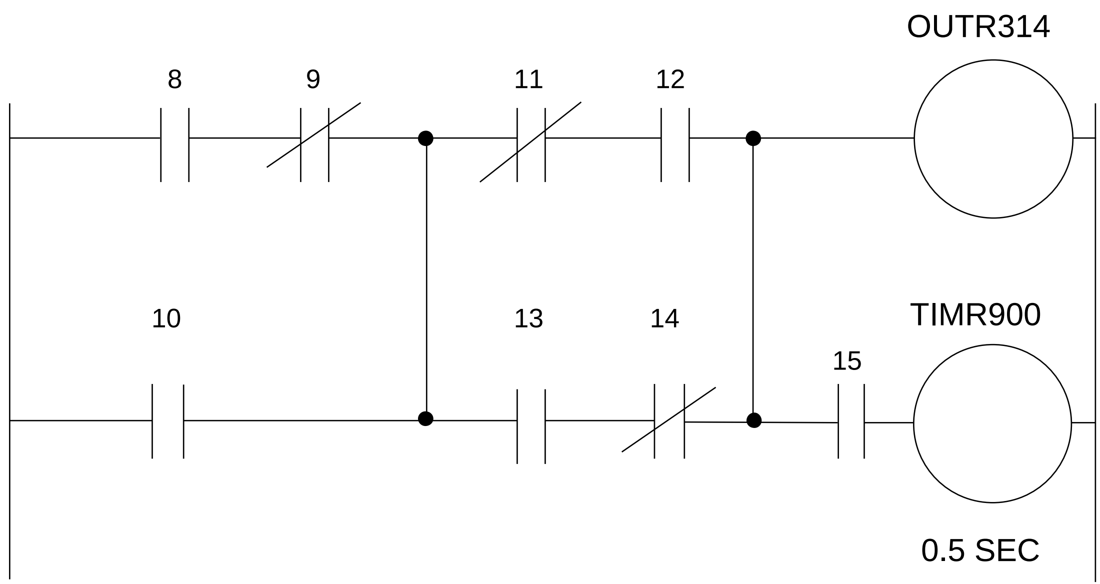
OUTR .... Ladder output relay (Operand 1 = Output, flag number)
TIMR .... Ladder timer relay (Operand 1 = Local flag number, Operand 2 = Timer setting (sec))

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
- The following circuit cannot be expressed. Create an equivalent circuit.



4. Program Example



	Extension condition		Input condition	Command	Operand 1	Operand 2	Output
No.	E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst
1	LD		7001	CHPR	1		
2			TPCD	1			
3			TAG	1			
4							
5	LD		8				
6	A	N	9				
7	O		10				
8	LD	N	11				
9	A		12				
10	LD		13				
11	A	N	14				
12	OB						
13	AB			OUTR	314		
14	A		15	TIMR	900	0.5	
15							
16	LD		7001	TSLP	3		
17	LD		7001	GOTO	1		
18	LD		7001	EXIT			

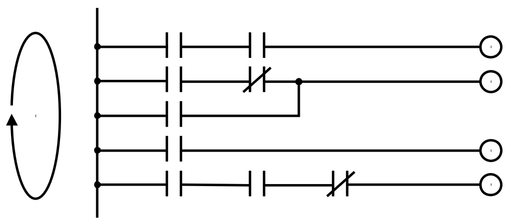
Chapter 7 Multi-Tasking

“Multi-tasking” operation means running several programs in parallel.

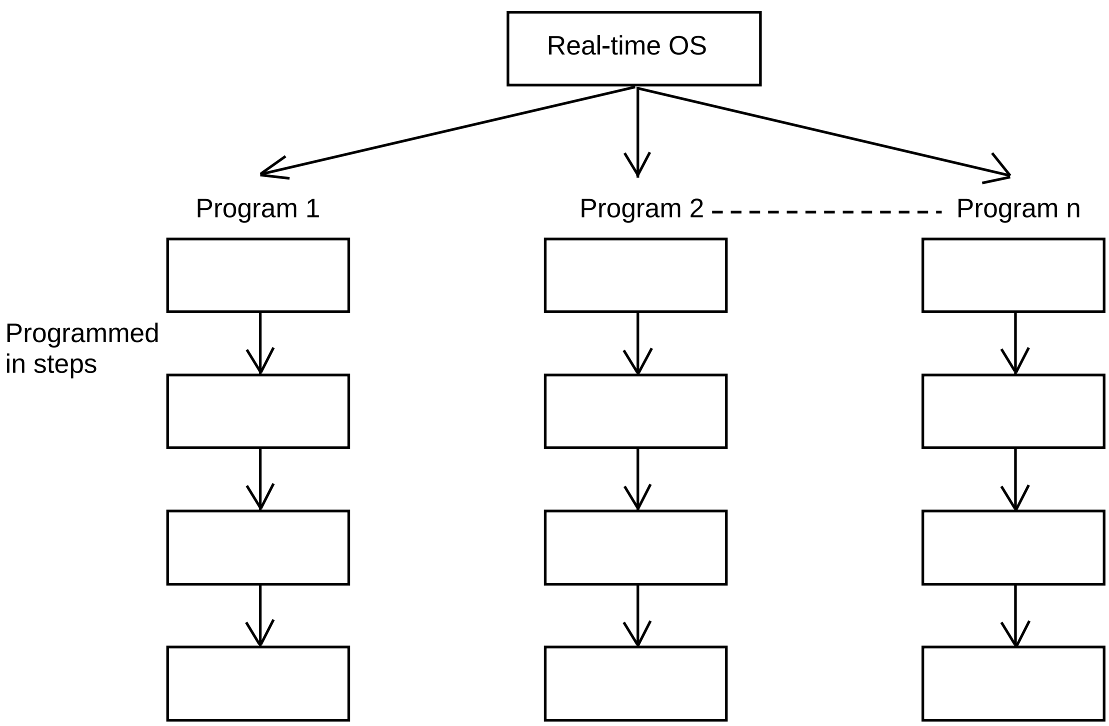
1. Difference from a Sequencer

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.

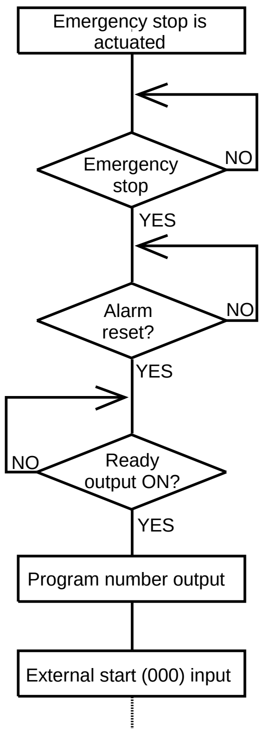


The programmer need not worry about running all programs in parallel, which is controlled by the real-time operating system.

2. Release of Emergency Stop

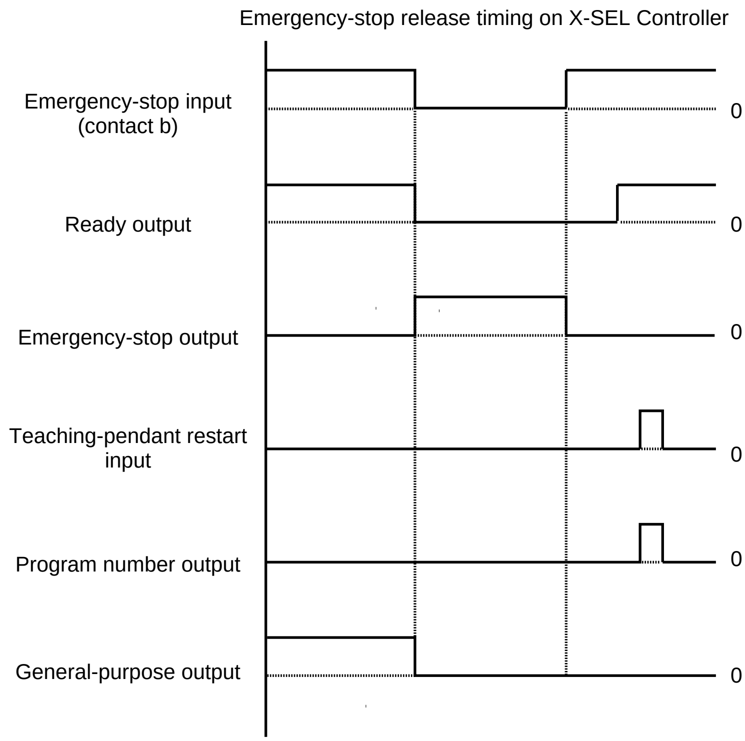
Default factory settings of parameters
"Other parameter No. 10, Emergency-stop recovery type" = 0
"Other parameter No. 11, Enable switch (deadman switch/enable switch) recovery type" = 0
"Other parameter No. 12, Recognition type during automatic operation" = 0
An emergency stop is actuated by turning 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.

3. 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.

Appendix

List of Additional Linear Movement Axis Specifications

	Model	Stroke (mm) and maximum speed (mm/sec) (Note 1) 50–1200	Load capacity (Note 2) Horizontal (kg)	Load 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 / 960 / 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 band indicates the maximum speed for each applicable stroke.
(Note 2) The load capacity is based on operation at the rated acceleration.
(Note 3) RCS2-R**7, LS and LSA-series actuators cannot be used as axis 5 or 6.

	Model	Stroke (mm) and maximum speed (mm/sec) (Note 1) (50–1200)	Load capacity (Note 2) Horizontal (kg)	Load 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 / 960 / 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 / 960 / 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 (dust-proof/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

(Note 1) The figure in each band indicates the maximum speed for each applicable stroke.
(Note 2) The load capacity is based on operation at the rated acceleration.

	Model	Stroke (mm) and maximum speed (mm/sec) (Note 1)	Load capacity (Note 2) Horizontal (kg)	Load 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	

Stroke scale: 50, 100, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 700, 800, 900, 1000

(Note 1) The figure in each band indicates the maximum speed for each applicable stroke.
(Note 2) The load capacity is based on operation at the rated acceleration.
(Note 3) RCS-RB75-series actuators cannot be used as axis 5 or 6.

	Model	Stroke (mm) and maximum speed (mm/sec) (Note 1)	Load capacity (Note 2) Horizontal (kg)	Load 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 band indicates the maximum speed for each applicable stroke.
(Note 2) The load capacity is based on operation at the rated acceleration.
(Note 3) RCS2-R**7, LS and LSA-series actuators cannot be used as axis 5 or 6.

	Model	Stroke (mm) and maximum speed (mm/sec) (Note 1)															Load capacity (Note 2)		Rated acceleration	
		100~500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700~2000	2100~2500	3000	Horizontal (kg)	Vertical (kg)	Horizontal (G)	Vertical (G)
ISA ISPA	ISA (ISPA)-LXM-□-200-40-□□□	1000			1000	830	690	585	500								40	9	0.3	0.3
	ISA (ISPA)-LXM-□-200-20-□□□	500			470	385	320	270	235								80	19		
	ISA (ISPA)-LXM-□-400-40-□□□	2000			2000	1660	1380	1170	1000								40	9		
	ISA (ISPA)-LXM-□-400-20-□□□	1000			1000	830	690	585	500								80	19		
	ISA (ISPA)-LXMX-□-200-20-□□□						1000					950	830	740~540	490~340		40	–	0.3	–
	ISA (ISPA)-LXMX-□-400-40-□□□						2000					1900	1660	1480~1080	980~680		40	–		
	ISA (ISPA)-LXMX-□-400-20-□□□						1000					950	830	740~540	490~340		80	–		
	ISA (ISPA)-LXUWX-□-200-20-□□□						1000					950	830	740~540	490~340		40	–		
	ISA (ISPA)-LXUWX-□-400-40-□□□						2000					1900	1660	1480~1080	980~680		40	–		
	ISA (ISPA)-LXUWX-□-400-20-□□□						1000					950	830	740~540	490~340		80	–		
	ISA (ISPA)-LYM-□-200-20-□□□	1000			1000	830	690	585	500								40	9	0.3	0.3
	ISA (ISPA)-LYM-□-200-10-□□□	500			470	385	320	270	235								80	19		
	ISA (ISPA)-LYM-□-400-40-□□□	2000			2000	1660	1380	1170	1000								40	9		
	ISA (ISPA)-LYM-□-400-20-□□□	1000			1000	830	690	585	500								80	19		
	ISA (ISPA)-LZM-□-200-10-□□□	500			470	385	320	270	235								–	19		
	ISA (ISPA)-LZM-□-400-10-□□□	500			470	385	320	270	235								–	39		
ISP	ISP-WXM-□-600-40-□□□	2000				1670	1390	1170	1000	865							60	14	0.3	0.3
	ISP-WXM-□-600-20-□□□	1000				835	695	585	500	430							120	29		
	ISP-WXM-□-600-10-□□□	500				415	345	290	250	215							150	60		
	ISP-WXM-□-750-40-□□□	2000				1670	1390	1170	1000	865							75	18		
	ISP-WXM-□-750-20-□□□	1000				835	695	585	500	430							150	37		
	ISP-WXMX-□-600-40-□□□					2000					1965	1725	1530	1365~1005	915~655		60	–		–
	ISP-WXMX-□-600-20-□□□					1000					980	860	765	680~500	455~325		120	–		
	ISP-WXMX-□-750-40-□□□					2000					1965	1725	1530	1365~1005			75	–		
	ISP-WXMX-□-750-20-□□□					1000					980	860	765	680~500			150	–		
ISD	ISD-S-□-60-16-□□□	800	760														12	3	0.3	0.3
	ISD-S-□-60-8-□□□	400	380														25	6		
	ISD-S-□-60-4-□□□	200	190														50	14	0.15	0.15
	ISD-M-□-100-20-□□□	1000		915	735	600	500										20	5	0.3	0.3
	ISD-M-□-100-10-□□□	500		455	365	300	250										40	9		
	ISD-M-□-100-5-□□□	250		225	180	150	125										80	19	0.15	0.15
	ISD-M-□-200-20-□□□	1000		915	735	600	500										40	9	0.3	0.3
	ISD-M-□-200-10-□□□	500		455	365	300	250										80	19		
	ISD-MX-□-200-20-□□□				1000						950	800	700				40	–	0.3	–
	ISD-L-□-200-20-□□□	1000			930	765	640	545	465								40	9	0.3	0.3
	ISD-L-□-200-10-□□□	500			465	380	320	270	230								80	19		
	ISD-L-□-400-20-□□□	1000			930	765	640	545	465								80	19		
	ISD-LX-□-200-20-□□□						1000					950	830				40	–	0.3	–
	ISD-LX-□-400-20-□□□						1000					950	830				80	–		
IF	IF-SA□□-□-60-□□□	1750															5	–	0.3	–
	IF-SA□□-□-100-□□□	1750															10	–		
	IF-MA□□-□-200-□□□	1750															20	–		
	IF-MA□□-□-400-□□□	1750															40	–		
FS	FS-11NM-□-60-□□□	1250															2	–	0.3	–
	FS-12NM-□-60-□□□	1250															5~9	–		
	FS-11NM-□-100-□□□	1250															3	–		
	FS-12NM-□-100-□□□	1250															9~15	–		
	FS-11WM-□-100-□□□	1250															3	–		
	FS-12WM-□-100-□□□	1250															9~15	–		
	FS-11WM-□-200-□□□	1250															6	–		
	FS-12WM-□-200-□□□	1250															18~30	–		
	FS-11LM-□-400-□□□						1250										15	–		
	FS-12LM-□-400-□□□						1250										28~60	–		
	FS-11HM-□-400-□□□						2000										10	–		
	FS-12HM-□-400-□□□						2000										20~40	–		

(Note 1) The figure in each band indicates the maximum speed for each applicable stroke.
(Note 2) The load capacity is based on operation at the rated acceleration.
(Note 3) RCS2-R**7, LS and LSA-series actuators cannot be used as axis 5 or 6.

How to Write Programs

1. Position Table

Position Table

With X-SEL controllers of PX/QX types, 4000 position points can be registered if the memory size has not been increased. If the memory size has been increased, 20000 positions can be registered.
Positions are registered using the PC software or teaching pendant.

(Example of 6-axis System)

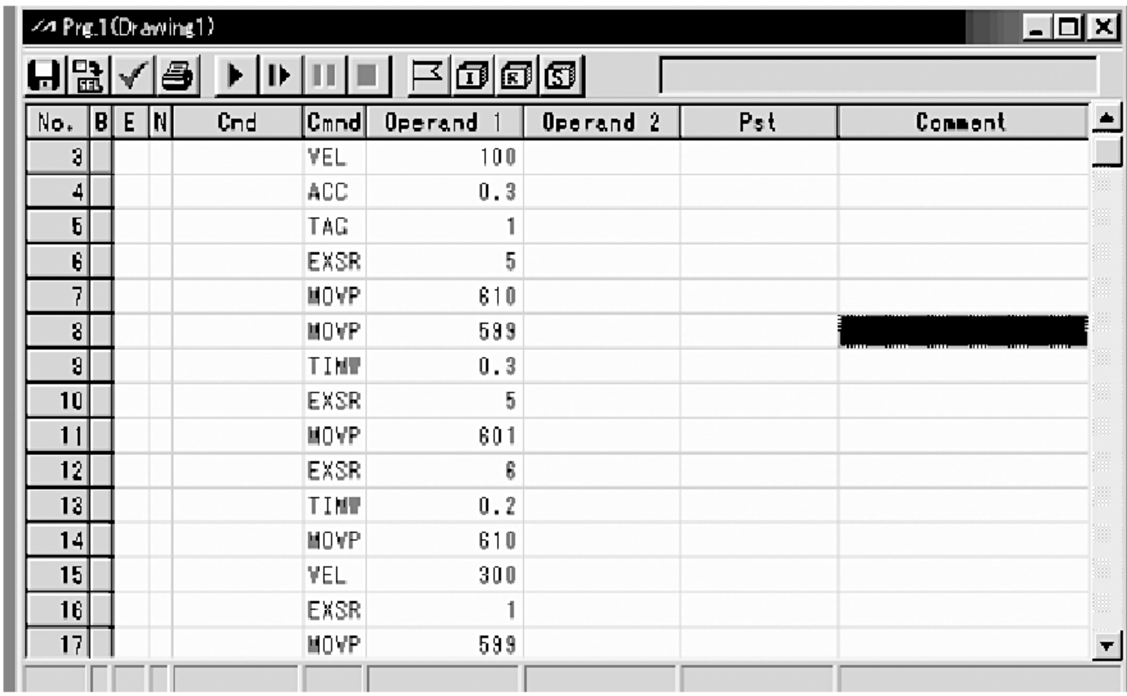
No.	Axis1	Axis2	Axis3	Axis4	Axis5	Axis6	Vel	Acc	Dcl
1	0.000	250.000	0.000	0.000	10.000	10.000			
2	0.000	200.000	0.000	30.000	20.000	20.000			
3	10.000	190.000	50.000	40.000					
4	23.000	298.000	40.000	20.000	0.000				
5	50.000	170.000	30.000	10.000					
6									
	⋮	⋮	⋮	⋮	⋮	⋮			
3994									
3995									
3996									
3997									
3998									
3999									
4000									

No.: The actuator moves to the registered position corresponding to the number specified by a program command here.
Axis 1 to 6: Enter the position you want to move each axis to, under each position number.
Vel: Set a speed. The speed set here will be given precedence over the speed specified by the program. This means that when the axis is moved by specifying this position number, it will move at the speed set here.
Acc: Set an acceleration. The acceleration here will be given precedence over the acceleration specified by the program or acceleration set by a parameter.
Dcl: Set a deceleration. The deceleration here will be given precedence over the deceleration specified by the program or acceleration set by a parameter.

2. Program Format

Program Edit Screen (PC Software)

With X-SEL controllers, a program consisting of up to 6000 steps can be created if the memory size has not been increased. If the memory size has been increased, a program consisting of up to 9999 steps can be created.
Programs are edited using the PC software or teaching pendant.



No.	B	E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
3					VEL	100			
4					ACC	0.3			
5					TAG	1			
6					EXSR	5			
7					MOVP	610			
8					MOVP	599			
9					TIMW	0.3			
10					EXSR	5			
11					MOVP	601			
12					EXSR	6			
13					TIMW	0.2			
14					MOVP	610			
15					VEL	300			
16					EXSR	1			
17					MOVP	599			

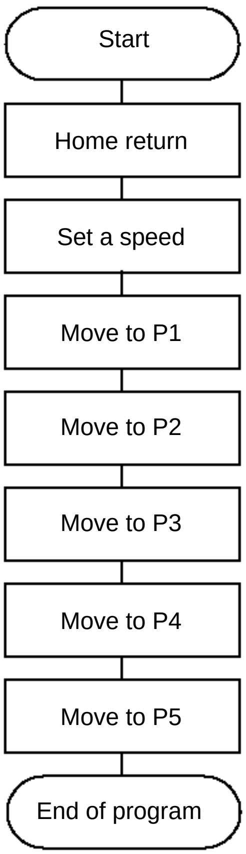
No.: The step number is indicated.
B: Set a breakpoint. (Breakpoints become effective during online editing.)
Click with the mouse a given field under "B" where you want to set a breakpoint. Once a breakpoint has been set, "B" will be shown in the line.
* Breakpoint --- Set a breakpoint in a step at which you want to temporarily pause the program run by the PC software.
E: Enter an extended condition (A, O, LD, AB, OB).
N: Specify "N" to negate 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 (using up to 18 single-byte characters), if necessary.

3. Positioning to 5 Positions (for Linear Axes)

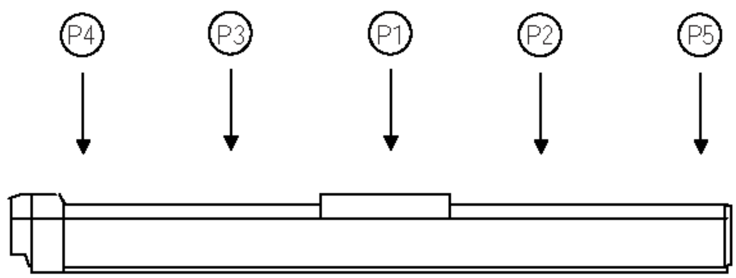
Description

Move the actuator to positions 1 through 5 at a speed of 100 mm/sec after completing a home return. Axis 1 is used.

Flow Chart



- Home return must be performed and a speed set, in order to operate the actuator.
- The actuator moves to the coordinates corresponding to the position data specified by each movement command.
- Home return (issuance of a HOME command) is not required when the actuator is of absolute specification.



Application Program

No.	B	E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
1					HOME	1			Axis 1 returns home.
2					VEL	100			Set the speed to 100 mm/sec.
3					MOVL	1			Move to P1
4					MOVL	2			Move to P2
5					MOVL	3			Move to P3
6					MOVL	4			Move to P4
7					MOVL	5			Move to P5
8					EXIT				End of program
9									

Position Data

No.	Axis1
1	100.000
2	150.000
3	50.000
4	0.000
5	200.000
6	
7	
8	
9	

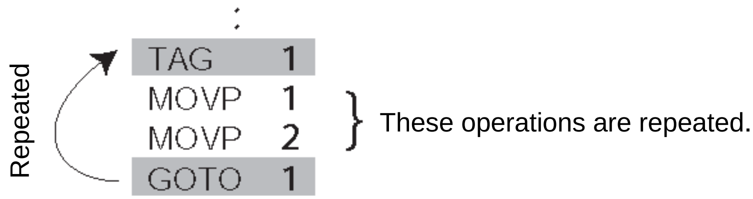
4. How to Use TAG and GOTO

Description

If you want to repeat the same operations in the program or skip steps when a given condition is met, use a GOTO command together with a TAG command. TAG can be specified in a step either before or after the one containing a GOTO command.

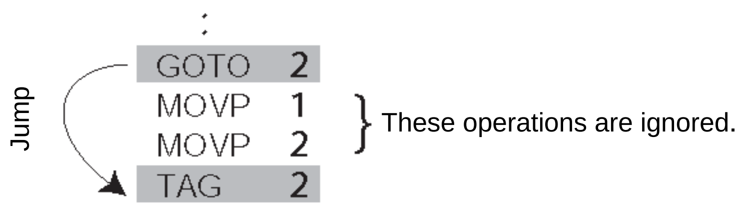
Example of Use 1

Repeat the same operations.



Example of Use 2

Skip steps.

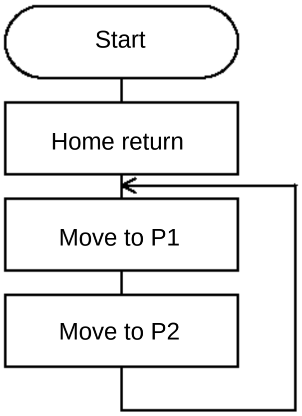


5. Back-and-Forth Operation between 2 Points (for Linear Axes)

Description

Move the actuator back and forth repeatedly between two points.

Flow Chart



- The actuator moves back and forth between P1 and P2 infinitely.
- Axis 1 is used.
- Specify TAG in the first of the repeated steps and specify GOTO in the last of the repeated steps.

Application Program

No.	B	E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
1					HOME	1			Axis 1 returns home.
2					VEL	100			Set the speed to 100 mm/sec.
3					TAG	1			
4					MOVL	1			Move to P1
5					MOVL	2			Move to P2
6					GOTO	1			
7									

Position Data

No.	Axis1
1	100.000
2	150.000
3	
4	
5	
6	
7	

6. Path Operation

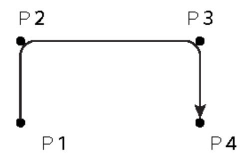
Description

Move the actuator through four arbitrary points continuously without stopping (PATH operation).

The actuator moves along the path shown to the right, without stopping at P2 or P3.
Since precise positioning is not performed at P2 and P3, the tact time of movement can be shortened compared to when MOVP or MOVL is used to achieve the same movement.
Execute the following command while the actuator is stopped at P1:

    PATH 2 4

The actuator will depart P1 and pass near P2 and P3 to move to P4.
(The passing points can be brought closer to the specified positions when the acceleration is raised.)



The actuator will also move in the same manner as under a “PATH 2 4” command, when the following commands are input consecutively:

    PATH 2 3
    PATH 4 4

Execute the following command while the actuator is stopped at P4:

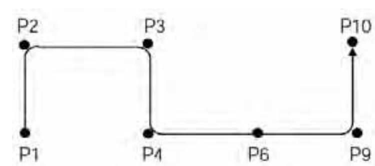
    PATH 4 1

The actuator will move in the reverse direction. (P4 → P3 → P2 → P1)

It is also possible to move the axis continuously along a path that passes one discontinuous position.

PATH	1	4	
PATH	6	6	Discontinuous position
PATH	9	10	

As shown above, specify No. 6 corresponding to the discontinuous position for both the start position number and end position number in the PATH command.
[Example] The axis will move continuously in the sequence of P1 → P2 → P3 → P4 → P6 → P9 → P10.



7. Output Control during Path Movement

Description

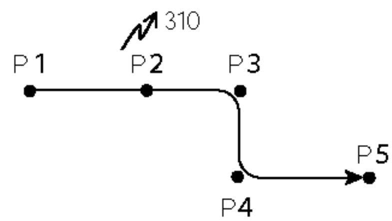
In coating application, etc., output control may become necessary while the actuator is moving. X-SEL controllers let you issue outputs while the actuator is moving according to a PATH command.

How to Use

Before issuing a PATH command, declare a POTP command to permit output during movement.
If any 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 when the actuator approaches via path movement the position specified by the PATH command.

Example of Use 1

The actuator moves through the positions shown to the right, or from P1 to P5, without stopping and by turning output port 310 ON as it passes near P2.



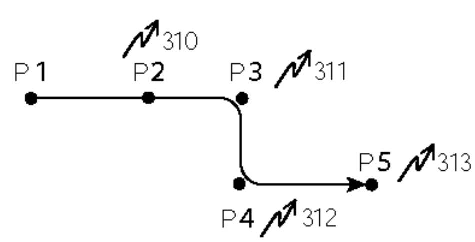
Cmnd	Operand 1	Operand 2	Pst	
VEL	100			
POTP	1			← A declaration command to permit output during path movement
PATH	1	1		
PATH	2	2	310	← Turn 310 ON at the position P2 specified in this step.
PATH	3	5		

The output or flag can only be controlled to an ON state. Turn it OFF using the program (via a BTOF command) after the path operation has completed.

Example of Use 2

Outputs 310 to 313 can be turned ON sequentially at points P2 to P5.

Cmnd	Operand 1	Operand 2	Pst	
VEL	100			
POTP	1			← A declaration command to permit output during path movement
PATH	1	1		
PATH	2	5	310	← Outputs 310 to 313 are turned ON sequentially at the respective positions P2 to P5 specified in this step.



8. Circular, Arc Operation

Description

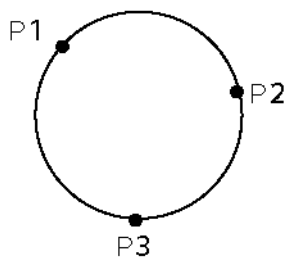
The actuator operates along a two-dimensional circle or arc.

How to Use

To specify a circle, specify three passing points. To specify an arc, also specify three points, specifically the start point, passing point and end point.

Example of Use 1

Circle



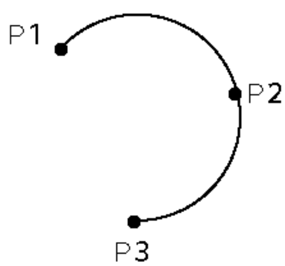
- Specify “CIR2 2 3” after the actuator has completed its movement to P1.
- When “CIR2 2 3” is specified based on the layout shown to the left, the actuator will move clockwise along the circle.

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst
			VEL	100		
			MOVP	1		
			CIR2	2	3	

- Specify “CIR2 3 2” if you want to move the actuator counterclockwise.

Example of Use 2

Arc



- Specify “ARC2 2 3” after the actuator has completed its movement to P1.

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst
			VEL	100		
			MOVP	1		
			ARC2	2	3	

Reference

Some circle and arc commands can be executed not only two-dimensionally (involving two actuator axes) but also three-dimensionally (involving three actuator axes).

CIRS --- Three-dimensional circular movement
ARCS --- Three-dimensional arc movement

9. Output of Home Return Complete Signal (for Linear Axes)

Description

Output a signal to confirm completion of home return (Incremental specification or quasi-absolute specification)
X-SEL controllers can output a home return complete signal via setting of an I/O parameter, but the following explains how to output a home return complete signal in a program using a general-purpose output.
When a general-purpose output is used, once the output is turned ON it will remain ON even after the program ends or other program is started. (The output will turn OFF under certain conditions such as actuation of an emergency stop. It is also possible to hold the output using an I/O parameter (I/O parameter No. 70 or 71)).

Example of Use

a. Output a home return complete 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 complete signal to prevent the actuator from performing home return again after it has been completed once.

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	
	N	303	HOME	11			Execute home return if output 303 is OFF.
			BTON	303			Output a home return complete signal.

c. Use the output field instead of a BTON command.

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst
	N	303	HOME	11		303

The same processes implemented by the above two steps are performed.

Reference

If I/O parameter No. 50 is set to “2,” output port No. 304 can be used as a home return complete output (dedicated output).

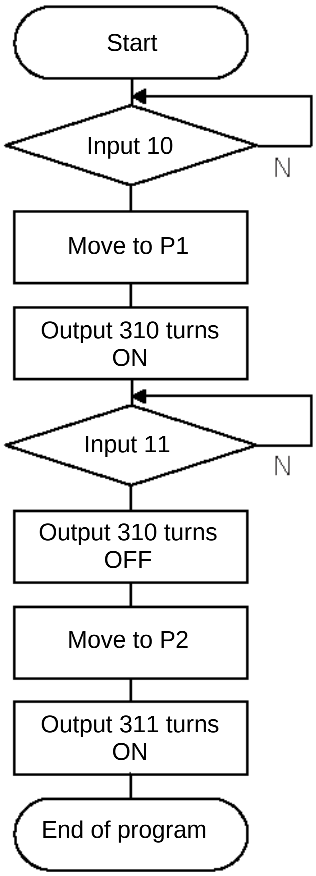
⚠ Caution: Take note that if you are using the linear servo actuator LSAS-N10/N15 of quasi-absolute type, after completing a home return operation following power on the actuator moves in a range of approx. 16 mm from the stopped position to confirm the current position.

10. Axis Movement by Input Waiting and Output of Complete Signal

Description

How to perform an input waiting process and output a processing complete signal is explained.

Flow Chart



Example of Use

The actuator waits until input port 10 turns ON, upon which it will move to P1.
The actuator waits until input port 11 turns ON, upon which it will move to P2.
A complete signal for movement to P1 is provided by 310, while a complete signal for movement to P2 is provided by 311.

Application Program

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
			VEL	100			Set the speed to 100 mm/sec.
			WTON	10			Wait for input 10 to turn ON.
			MOVP	1			Move to P1.
			BTON	310			Output 310 turns ON.
			WTON	11			Wait for input 11 to turn ON.
			BTOF	310			Output 310 turns OFF.
			MOVP	2			Move to P2.
			BTON	311			Output 311 turns ON.
			EXIT				End of program

11. Change of Moving Speed (for Linear Axes)

Description

Change the moving speed.

How to Use

With X-SEL controllers, speed can be set in the following two ways:
a: Use a VEL command in the application program.
b: Use a speed set 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 based on the above program
Position at 100 mm --- Move at 100 mm/sec
Position at 200 mm --- Move at 500 mm/sec
Position at 300 mm --- Move at 1000 mm/sec
Position at 400 mm --- Move at 50 mm/sec

As the above example suggests, if a speed is set in the position data table the setting in the position data table will be given precedence even when a speed is specified in the application program. In general, speeds are set using VEL in the application program.

VEL in Position Data Table and PATH Command

The speed can be changed without stopping the actuator by using a PATH command in combination with VEL in the position data table. (Refer to the next page.)

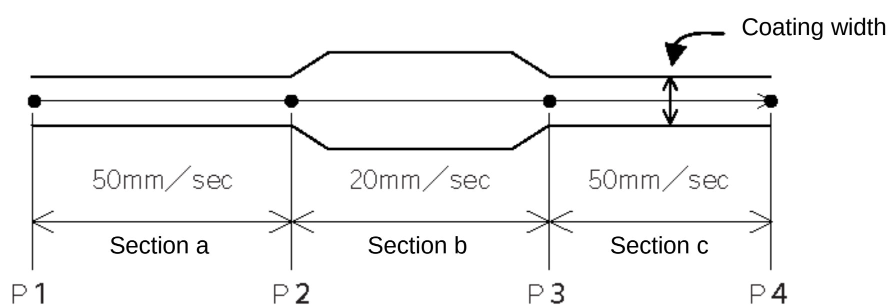
12. Speed Change during Operation

Description

Use a PATH command to change the speed while the actuator is moving.
This function is useful in dispensing applications where the dispensing amount, such as coating amount, changes in the middle of operation.

Example of Use

Operate the actuator via linear movement through section a at a speed of 50 mm/sec, section b at a speed of 20 mm/sec, and section c at a speed of 50 mm/sec, without stopping. (PATH operation)



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.

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst
			PATH	1	4	

Reference

It is also possible to change the speed from other program using CHVL (change speed). (Multi-tasking mode)

13. Local/Global Variables and Flags

Description

Internal variables and flags used in the SEL language are classified into the local type and global type. Data areas used commonly by all programs are called “Global Areas,” while independent data areas used only by each program are called “Local Areas.” Global areas must be used when aligning the timings among multi-tasking programs or allowing these programs to cross-reference the values of their variables.

Example of Use

Handshake between Programs

Program A

Cmnd	Operand 1
MOVL	1
BTON	600
WTON	601
MOVL	3

Program B

Cmnd	Operand 1
WTON	600
MOVL	2
BTON	601

As shown in the above example of two programs, use of global flags enables handshake between the programs, or specifically allows program B to execute “MOVL 2” after program A has completed the movement based on “MOVL 1,” and then allows program A to execute “MOVL 3” after the completion of movement by program B.

Backup by Battery

X-SEL controllers have a built-in battery to retain the conditions of variables and flags used by the program. With both variables and flags, their conditions will be retained even after the controller power is cut off, if they are stored in global areas. The conditions of variables and flags saved in local areas will be cleared (= the variables will return to “0” and flags will turn OFF) when the program is started.

14. How to Use Subroutines

Description

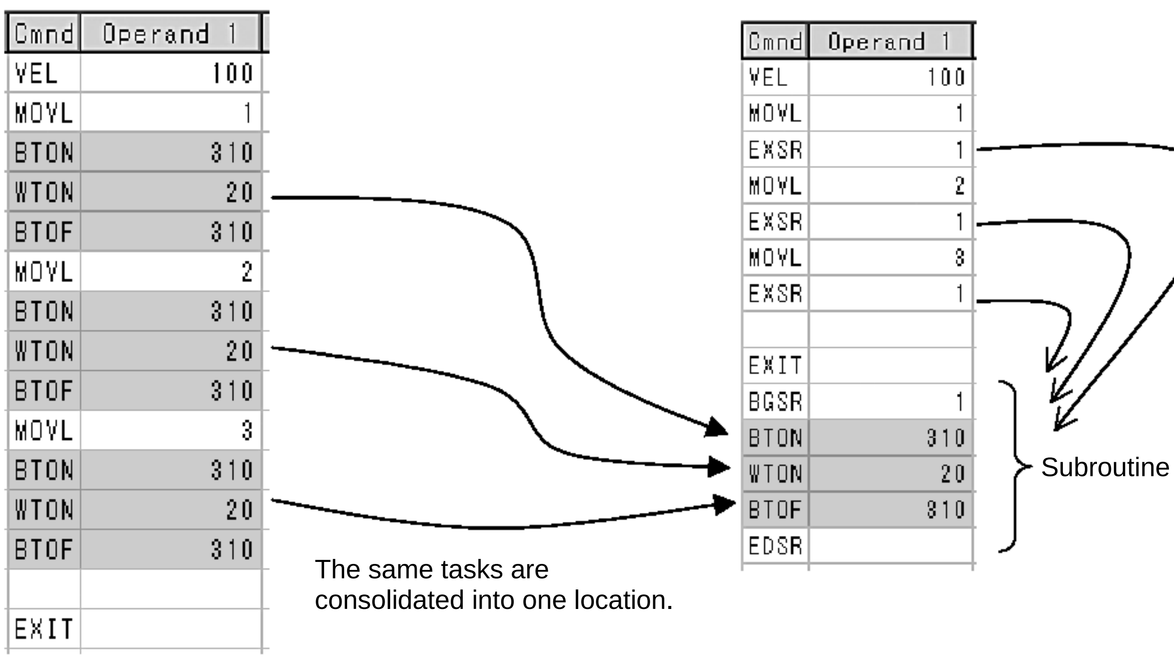
When the same processes are performed several times in one program, a group of these steps that are isolated from others and called together as a set is called a “Subroutine.” Subroutines are used to reduce program steps and make the program less convoluted. Up to 99 subroutines can be used in one program. Subroutine calls can be nested by up to 15 times.

How to Use

The following commands are used to declare/call subroutines:

EXSR Call subroutine
BGSR Declare start of subroutine (declaration of start a group of steps)
EDSR Declare end of subroutine (declaration of start of a group of steps)

Example of Use



Note

Using a GOTO command to jump out of a subroutine to TAG outside the subroutine is prohibited.

15. Pausing of Operation

Description

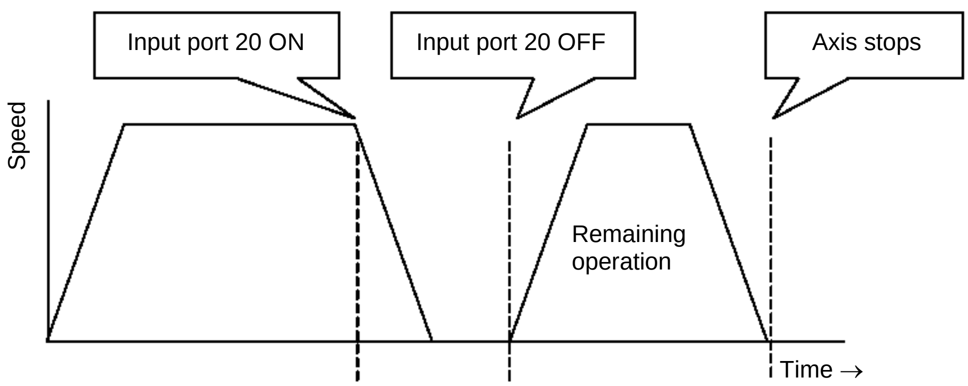
Use a declarative command HOLD to pause the moving axis via an external input.

How to Use

You can interrupt and pause the movement of the axis (= cause the axis to decorate to a stop) by declaring a HOLD command in the program. While HOLD is input, all movement commands issued in the same program are paused (all moving axes decelerate to a stop).

Example of Use

HOLD   20   Declare that if general-purpose input 20 turns ON, a pause process will be performed.



Application

In addition to an input port, you can also specify a global flag in operand 1 of the HOLD command. It is also possible to implement a pause from other program using a global flag.
When operand 2 is used, you can select a desired pattern of input signal as well as a stopping pattern.

0 = Contact a (Deceleration to a stop) ⇒ Same as when operand 2 is not specified
1 = Contact b (Deceleration to a stop)
2 = Contact b (Deceleration to a stop, followed by servo OFF ⇒ Drive power is not turned off)

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
			HOLD	20	2		SVOF input: 20 = Contact b

Note

If the axis was paused during home return, when the operation is resumed the home return sequence will be performed from the beginning.

16. Aborting of Operation 1 (CANC)

Description

Use a declarative command CANC to cause the moving axis to decelerate a stop and cancel the remaining operation of the axis.

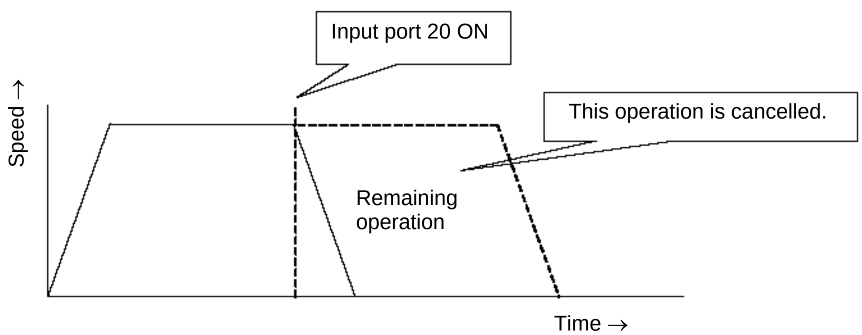
How to Use

While CANC is input, all movement commands issued in the same program are paused are aborted.

CANC command

```
CANC    20      Abort the movement command in the middle when input port 20 turns ON.
                (Declaration)
    :
MOVP    1
MOVP    2
    :
WTON    21
    :
```

* Declare this command in a step before a movement command.
* While CANC is input, all operation commands are cancelled one by one, but non-operation commands (such as I/O processes and calculation processes) are performed according to the specified sequence.



Caution

Since which program step is currently executed becomes indeterminable, it is recommended that a WTON command be used to create a step to wait for input.

Application

With a CANC command, you can select a desired pattern of input signal by using operand 2.

0 = Contact a (Deceleration to a stop) ⇒ Same as when operand 2 is not specified
1 = Contact b (Deceleration to a stop)

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
			CANC	20	1		Cancellation input: 20 = Contact b

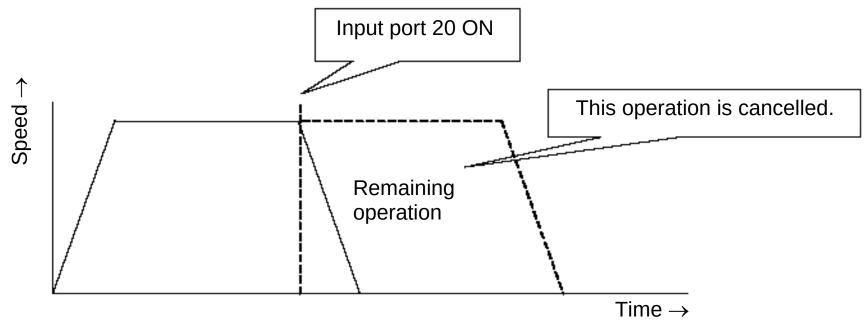
17. Aborting of Operation 2 (STOP)

Description

Cause the moving axis to decelerate a stop and cancel the remaining operation of the axis. (STOP)

How to Use

Implement an abort using a STOP command issued from other program. (Multi-tasking mode)
Use an axis pattern to specify the axis you want to abort.



Example of Use 1

STOP command

Main program

```
EXPG    n     Start an aborting program.
   :
MOVL    1
MOVL    2
   :
```

Aborting control program

```
WTON    20    Wait for an abort input.
STOP    11    Abort axes 1 and 2.
```

If “STOP 11” is executed while “MOVL 1” is still being executed, “MOVL 1” will be cancelled and operation will continue from “MOVL 2.”

Example of Use 2

Main program

```
EXPG    n
   :
MOVP    1
MOVP    2
   :
```

Aborting control program

```
WTON    20    Wait for an abort input.
STOP    10    Abort axis 2.
```

If “STOP 10” is executed while “MOVP 1” is still being executed, only axis 2 corresponding to “MOVP 1” will be cancelled. Both axes 1 and 2 will operate from “MOVP 2.”

Caution

In the operation being performed is a CP operation (interpolation operation) started by MOVL, etc., the operation of all axes will be cancelled regardless of the axis pattern specified by the STOP command.

18. Movement by Position Number Specification

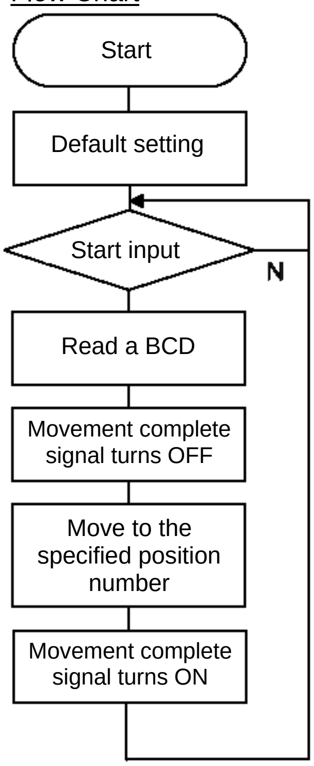
Description

Read an external BCD code input as a position number to move the actuator.

How to Use

Use an INB command to read a position number as a BCD code via an input port. A position number consisting of up to three digits can be specified.

Flow Chart



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

Completion of movement by 303

Application Program

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
			VEL	100			Set a speed.
			TAG	1			Destination of GOTO
			WTON	1			Wait for a start input.
			INB	15	3		Read a position number.
			BTOF	303			Moving complete signal turns OFF
			MOVL	*99			Move to the position number.
			BTON	303			Movement complete signal turns ON
			GOTO	1			Jump to TAG1.

19. Movement by External Position Data Input (for Linear Axes)

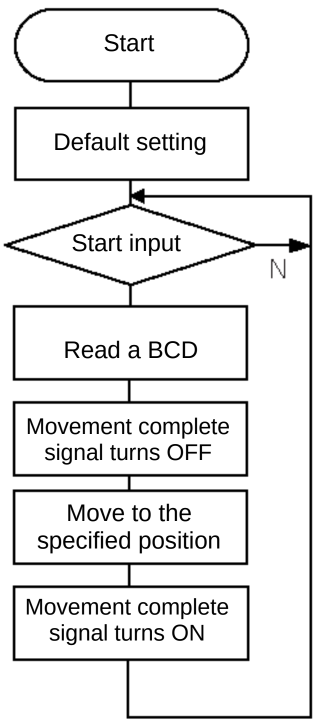
Description

Receive from the host device an absolute value indicating the position data to be used in the movement, and move the actuator accordingly.

Example of Use

Use an INB command to read position data as a BCD via an input port. The BCD value to be received has four digits, with the last digit specifying a decimal place. Axis 1 is moved.
Example: If the value of BCD is "1234," the axis will move to the position at 123.4 mm.

Flow Chart



Input assignment

Port	Description
1	Start input
15	0.1 mm
16	0.2 mm
17	0.4 mm
18	0.8 mm
19	1 mm
20	2 mm
21	4 mm
22	8 mm
23	10 mm
24	20 mm
25	40 mm
26	80 mm
27	100 mm
28	200 mm
29	400 mm
30	800 mm

Output

Completion of movement by 303

Application Program

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
			HOME	11			Home return
			VEL	100			Set a speed.
			TAG	1			Destination of GOTO
			WTON	1			Wait for a start input.
			INB	15	4		Read the position to move to.
			LET	199	*99		Copy to a real variable to add a decimal point.
			DIV	199	10		Divide by 10 to add a decimal point.
			PPUT	1	1000		Assign the data to axis 1 corresponding to position No. 1000.
			BTOF	303			Moving complete signal turns OFF
			MOVL	1000			Move to the assigned position.
			BTON	303			Movement complete signal turns ON
			GOTO	1			Jump to TAG1.

20. Output of Coordinate Values

Description

Read the current coordinates of the actuator in real time and output BCD data via an output port.

Example of Use

Use a PRDQ command to read the current coordinate position of axis 1.
Output the current coordinate data of axis 1 as a BCD every 0.2 second.
The output range is 0.00 to 999.99 mm.

Assignment of BCD output

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	
			TAG	1			
			PRDQ	1	101		Assign the current position of axis 1 to variable 101.
			MULT	101	100		Round off the third and subsequent decimal places.
			LET	99	*101		Copy to an integer variable.
			OUTB	324	5		Output 5 BCD digits.
			TIMW	0.2			Sampling time
			GOTO	1			

* Use a PRDQ command to write the current position coordinates to variable 101.
Since the value read to the variable is in the format of “XXX.XXX,” the digits not used in the BCD output are moved to decimal places.
In this example, the third and subsequent decimal places are not used, and thus the value is multiplied by 100 to be converted to data in the format of “XXXXX.X.”
Next, the aforementioned variable is copied to a dedicated variable for BCD output, or variable 99.
At this point, all decimal digits are rounded off.
Thereafter, the remaining part of data is output to an external device using an OUTB command.
This program is used as a subprogram in the multi-tasking mode.

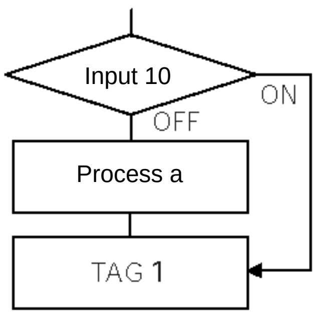
21. Conditional Jump

Description

Select the destination of jump specified by GOTO, using the state of an external input, output or internal flag as each condition. The actuator waits for one of multiple inputs and performs a different process according to the input received.

Example of Use 1

If input 10 is ON, the actuator jumps to TAG 1. If input 10 is OFF, the actuator performs the subsequent processes.

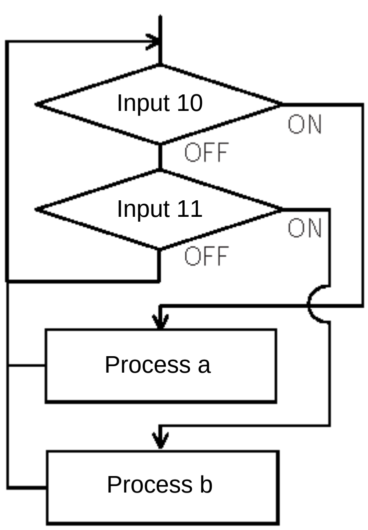


E	N	Cnd	Cmnd	Operand 1	
		10	GOTO	1	If input 10 is ON, GOTO 1
		Process a			
			TAG	1	
		Process b			

* If input 10 is ON, process a is skipped and process b is performed. If input 10 is OFF, process a is performed and then process b is performed.

Example of Use 2

The actuator waits for an input from either input 10 or 11, and performs process a if an input is received from 10, or process b if an input is received from 11.



E	N	Cnd	Cmnd	Operand 1
			TAG	1
		10	GOTO	2
		11	GOTO	3
			GOTO	1
			TAG	2
		Process a		
			GOTO	1
			TAG	3
		Process b		
			GOTO	1

——— No input
-------- Input 10 is ON
········· Input 11 is ON

If both inputs 10 and 11 are ON, process a is performed.

22. Waiting for Multiple Inputs

Description

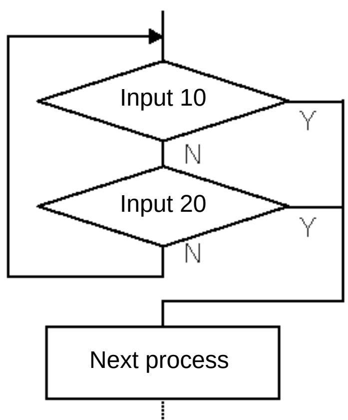
The actuator waits for one of several different inputs, and proceeds to an applicable process when a given input is received.

Point

With a WTON command, the actuator cannot perform any process unless one of the specified inputs is received. In other words, the actuator cannot wait for multiple inputs.

Example of Use

Inputs 10 and 11 are monitored and when an input is received from either of the two (OR gate), the actuator will proceed to the next step.



Program a

E	N	Cnd	Cmnd	Operand 1
			TAG	1
		10		
O		20	GOTO	2
			GOTO	1
			TAG	2

Next process

Program b

E	N	Cnd	Cmnd	Operand 1
			TAG	1
	N	10		
A	N	20	GOTO	1

Next process

* The same process is performed by both programs a and b.

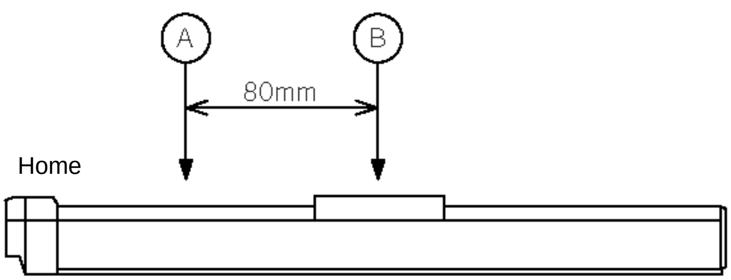
As shown in the sample, the actuator can be made to wait for input without using a WTON command. This approach can also be used when multiple input conditions must be combined.

23. How to Use Offsets (for Linear Axes)

Description

If you want to move (offset) all teaching points by several millimeters to compensate for the deviation resulting from the installation of the actuator, you can specify an offset amount for position data using an OFST command. It is also possible to perform pitch feed operation using an OFST command. (Refer to 25, "Constant Pitch Feed Operation.")

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
			VEL	100			
			MOVP	1			Move to point A.
			OFST	1	80		Offset axis 1 by 80 mm.
			MOVP	1			Move to point B.



Note

All movement commands issued after an offset has been set will be processed by applying the offset. To cancel the offset, issue an OFST command again, this time by specifying "0 mm." Offsets will not be reflected in other programs (even in the multi-tasking mode). If an offset must be applied to all programs, it must be set separately in each program.

24. Execution of Operation n Times

Description

Execute a specific operation n times.

Example of Use

The actuator repeats going back and forth between P1 and P2 10 times, after which the program ends.
Use a CPEQ command to compare the number of times the operation has actually been 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 a speed.
			LET	1	0		Clear a variable.
			TAG	1			
			MOVP	1			Move to P1
			MOVP	2			Move to P2.
			ADD	1	1		Increment variable 1 by 1.
			CPEQ	1	10	900	Check the number of times the operation has been repeated.
	N	900	GOTO	1			Go to TAG1 if the number is less than 10.
			EXIT				End of program

Reference

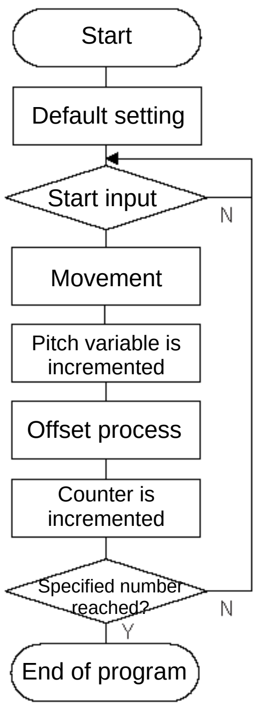
You can also perform the same operation using a DWEQ command.

25. Constant Pitch Feed Operation (for Linear Axes)

Description

Move the actuator at a specified pitch n times from a given reference point.
The pitch amount and number of movements are specified using variables in advance.

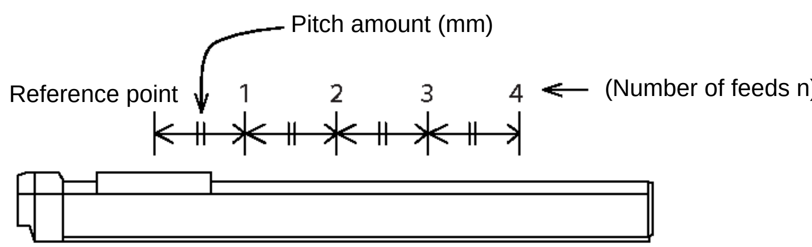
Flow Chart



Example of Use

Use an OFST command to perform pitch feed.
Count the number of times the actuator has been fed by using a variable as a counter.
The X-axis is used. The axis is fed at a constant pitch in the positive direction.

Points
An OFST command is reflected only in movement commands.
The axis will not move only by executing an OFST command.



Application Program

E	N	Cnd	Cmnd	Operand 1	Operand 2	Pst	Comment
			LET	1	4		Assign a number of times the actuator will be fed (n = 4).
			LET	100	80		Assign a pitch (80 mm).
			LET	2	0		Clear a variable (counter).
			LET	101	0		Clear a variable (offset value).
			HOME	1			Home return
			VEL	100			Set a speed.
			TAG	1			
			WTON	1			Wait for a start input.
			MOVP	1			Movement
			ADD	101	*100		Add the pitch to the offset value.
			OFST	1	*101		X-axis offset process
			ADD	2	1		Increment the counter variable by 1.
			CPGT	2	*1	900	Check if the actuator has been fed the specified number of times.
	N	900	GOTO	1			If not, repeat a feed.
			EXIT				End of program

Reference

Pitch feed can also be performed using MVPI/MVLI commands.

26. Jogging (for Linear Axes)

Description

The slider moves forward or backward while an input is ON or OFF.
In addition to an input, an output or global flag can also be used.
If the specified input does not meet the condition when this command is executed, nothing is done and the program will move to the next step.
Regardless of the input status, the slider stops when it reaches to its soft limit and the command will move to the next stop.

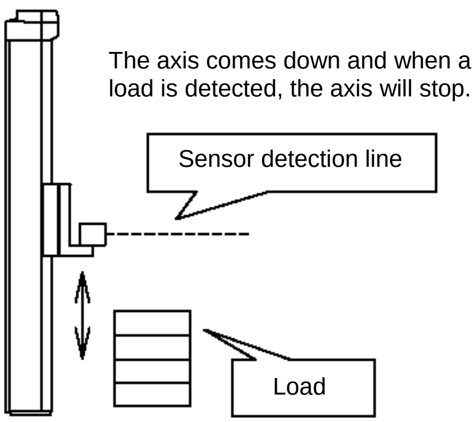
How to Use

- Explanation of command

JFWN	1	20	Axis 1 moves forward while input 20 is ON.
JFWF	1	21	Axis 1 moves forward while input 21 is ON.
JBWN	10	22	Axis 2 moves backward while input 22 is ON.
JBWF	10	23	Axis 2 moves backward while input 23 is ON.

Example of Use 1

- Stop the axis movement when a sensor input is received.



:			
VEL	50		Specify a low speed.
JFWF	1	20	Move until a sensor input (20) is received.
EXIT			End of program

Example of Use 2

- Jog the actuators just like you do with a teaching pendant (operation of two axes).

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			

Note

The HOLD, STOP and CANC commands are effective even during jogging.

27. Program Switching

Description

Use an EXPG/ABPG command to switch programs from within a program.

Example 1

Start program 2 when the processing by program 1 is completed, and end program 1.

Program 1	Program 2
:	:
EXPG 2	:
EXIT	

Example 2

Start a program via an external signal and end other program.

Program 1	Program 2
ABPG 2	ABPG 1
:	:

If program 2 is started while program 1 is operating, program 1 will be aborted.
If program 1 is started while program 2 is operating, program 2 will be aborted.

Application

By specifying a program number in operand 2, you can simultaneously start (EXPG) or end (ABPG) all of the programs corresponding to the program number specified in operand 1 through the number specified in operand 2.

Note

- X-SEL controllers support multi-tasking. By starting other program while a program is currently running and repeating this process, you can start a total of up to 16 programs. If there are more than 16 programs to be used, switch programs and end unnecessary programs.
- If a program is executing a movement command when an ABPG command is issued to end the program, any axis moving at the time will immediately decelerate to a stop.

28. Aborting of Program

Description

Abort a program currently running.
In the multi-tasking mode, execute an ABPG command (abort other program) from other program.

Note

* If the program to be aborted is executing a movement command, any axis moving at the time will immediately decelerate to a stop.

Example of Use

Main program (Prg. 1)

```
EXPG    n     Start an aborting control program.
WTON    10
MOVP    1
BTON    303
    :
    :
```

Aborting control program (Prg. n)

```
WTON    20    Wait for an abort input.
ABPG    1     Abort Prg. 1.
EXIT          End of program
```

* If ABPG is executed while an axis is still moving via a MOVP command, the axis will immediately decelerate to a stop, after which the program will end.

General-purpose RS232 (2-channel RS232 Unit)

(1) Specifications

The 2-channel RS232 unit is a dedicated D-sub, 9-pin RS232 interface.
It can be used when a general-purpose RS232 device is connected.

RS232C Connector Specifications

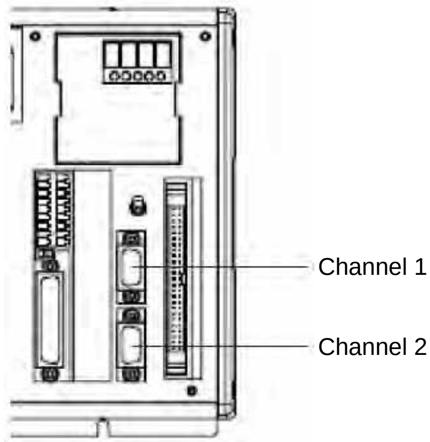
Item	Overview			Detailed explanation
Applicable connector	D-sub, 9-pin (DTE)			XM2C-0942-502L (OMRON)
Connector name	S1/S2			
Maximum connection distance	10M			38400 bps
Applicable interface protocol	RS232			
Connected unit	AT-compatible PC, etc.			Half-duplex communication
Connection cable				PC-AT standard 232C cross cable
Terminal assignments	1	in	(CD)	(Carrier detection: Not used)
	2	In	RD	Receive data (RXD)
	3	Out	SD	Transmission data (TXD)
	4	Out	ER	Data terminal 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 (CTR): Not used)
	9		NC	Not used

(2) Communication Cable

Use a cross cable to connect a PC to the port on the RS232 unit.

(3) Parameter Settings

The SIO channel numbers and specifications are set as follows according to the factory-set parameters.



Specifications
Baud rate: 38.4 kbps
Data length: 8
Stop bit: 1
Parity type: None
Communication mode: RS232

For advanced settings, set the following parameters sequentially:
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 (mount standard)	28100001H	0H to FFFFFFFFH	None
213	Attribute 2 of SIO channel 1 opened to user (mount standard)	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 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 extension
Bits 8 to 11: For future extension
Bits 4 to 7: For future extension
Bits 0 to 3: Use selection (0: Do not use, 1: Use)

Baud rate 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 extension
For future extension
For future extension
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 (mount standard)	00000001H	0H to FFFFFFFFH	None
214	Attribute 2 of SIO channel 2 opened to user (mount standard)	00000001H	0H to FFFFFFFFH	None

- Set Values

Bits 28 to 31: For future extension
Bits 24 to 27: Reserved by the system.
Bits 20 to 23: Reserved by the system.
Bits 16 to 19: Character send 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)

No.	Parameter name	Default value	Input range	Unit
203	Attribute 3 of SIO channel 1 opened to user (mount standard)	01118040H	0H to FFFFFFFFH	None
215	Attribute 3 of SIO channel 2 opened to user (mount standard)	01118040H	0H to FFFFFFFFH	None

- Set Values

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 less. Specifying a higher baud rate may generate an overrun error, etc.

Bits 24 to 27: Xon send selection when send after SIO-CPU reset is enabled
(0: Do not send, 1: Send)
* Valid only in full-duplex communication with Xon/Xoff flow control.

Bits 20 to 23: Send enable selection when the port is open
(0: Disable, 1: Enable)
* Valid only in full-duplex communication with Xon/Xoff flow control.

Bits 16 to 19: Xon/Xoff send selection when the port is closed
(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 (byte)
Bits 0 to 7: Flow control low limit (byte)
* If the specified value satisfies the condition “Flow control low limit ≥ SCI receive buffer size – flow control high limit,” both the flow control high limit and low limit will be replaced by values corresponding to 1/4 of the SCI receive buffer size before the applicable processing is performed.

(4) Program

[1] String process commands

A “string” refers to a series of characters. This controller supports global strings and local strings. Global strings can be read or written commonly from any program, while local strings are effective only within a given program and cannot be used in other programs. Numbers in different ranges are assigned to global strings and local strings, respectively:

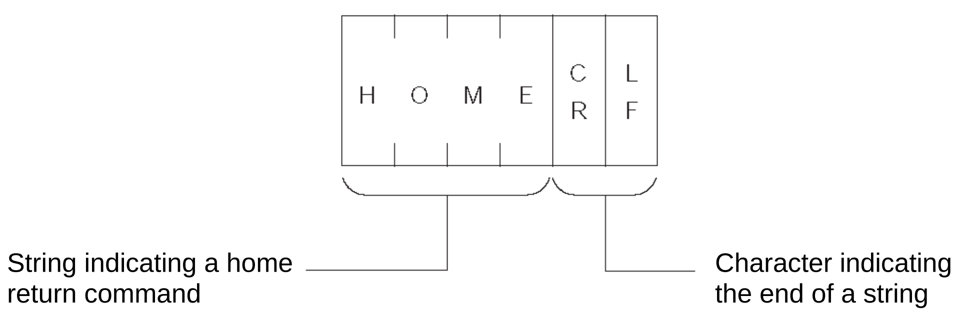
Global areas	300 to 999 (700)
Local areas	1 to 229 (229)

String commands are needed because normally controllers communicate with external devices by means of serial communication, and serial communication data must be processed as strings. This controller supports serial communication. In operations performed via serial communication, strings may have to be compared against each other, moved, or converted. This controller provides a set of commands to do all these.

[2] Explanation of transmission format

Communication by this system is basically implemented through exchange of strings.
Rules about these strings are set beforehand, such has which strings are used in which operations, so that the receiving side can recognize each string and perform a corresponding operation.
A combination of these strings, and characters indicating the end of a string, is called a “Transmission Format.” The user can define desired transmission formats freely.
For example, let’s say a 4-character string “HOME” is defined as a command to perform home return. This string is followed by a character indicating the end of a string. In theory, any character can be used to serve this role. In reality, however, “CR” and “LF” must be used according to the definitions used by the PC.

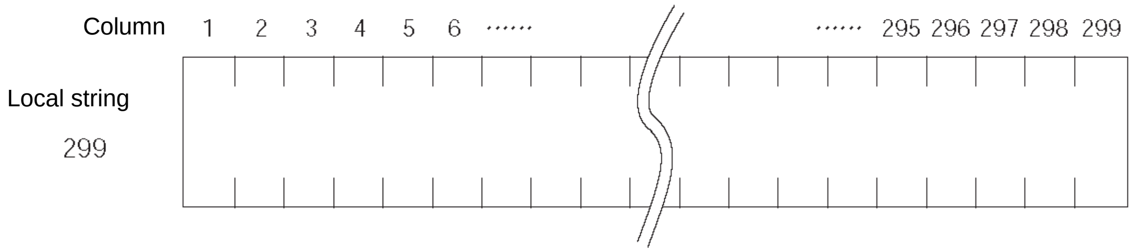
Example of transmission format

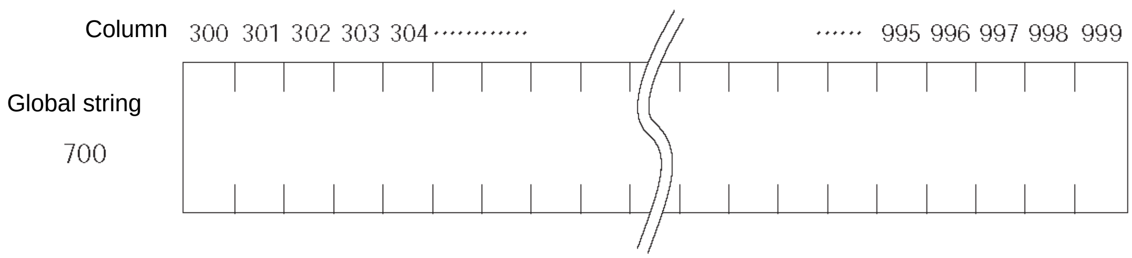


[3] Explanation of string

Strings sent by the aforementioned transmission format can be used freely in a program. To put it in simple words, each string is stored in boxes.

Strings are classified into two types: global strings that can be read or written by all programs, and local strings that can be read or written only in an individual program. These strings are differentiated by column numbers.

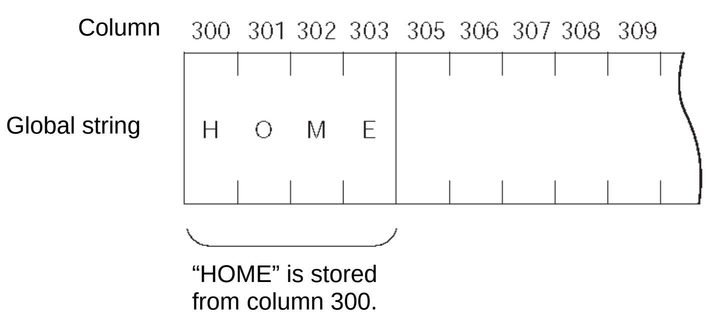




Each character in a string is stored in one box.

The position of a given box storing a part of a string is indicated by a column number, and which columns should be used to store the string can be set freely for each command.

For example, assume a string “HOME” indicating a home return command was received from the PC. If this string is to be used in several programs, it can be stored in columns starting from 300.



[4] Definition of transmission format

In the sample application program provided here, only three types of transmission formats, or namely home return command, movement command and movement complete, are required. These formats are defined as follows.

Take note that these definitions are only examples and the user can define each format freely.

A. Format for home return command

This format is used to issue a home return command from the PC to the controller.

H	O	M	E	CR	LF

B. Format for movement command

This format is used to issue an axis movement command from the PC to the controller.

M	O	V	E	Speed			Position of axis 1							Position of axis 2							CR	LF
				9	9	9	9	9	9	.	9	9	9	9	9	9	.	9	9	9		

C. Format for movement complete

This format is sent from the controller to the PC upon completion of home return or movement.

O	K	CR	LF

[5] Processing procedure

The processing procedure to be followed to program this sample application is explained.

A. Set “LF” as a character to indicate the end of a string (terminator character).
B. Open channel 1 so that channel 1 of the RS232 unit can be used.
C. If data is sent to channel 1, the data is received in columns starting from local string column 1.
D. If the received data is “MOVE,” the speed data is converted to binary data and set in variable 10, while the position data is converted to binary data and set in position No. 1, and the actuator is moved accordingly. 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 a terminator character.
2			OPEN	1			Open SIO channel 1.
3			TAG	1			
4			READ	1	1		Read from SIO1 column 1.
5							
6			ISEQ	1	‘HOME’		Home return command
7			HOME	11			Home return
8			EXSR	1			Send OK.
9			EDIF				
10							
11			ISEQ	1	‘MOVE’		In the case of a movement command:
12			SLEN	3			Length: 3 digits
13			VAL	10	5		Speed → Variable 10
14			VEL	* 10			Set a speed.
15							
16			PCLR	1	1		Clear position 1.
17			SLEN	3.3			
18			VAL	199	8		Position of axis 1 → Variable 199
19			PPUT	1	1		Set data for axis 1.
20							
21			VAL	199	15		Position of axis 2 → Variable 199
22			PPUT	2	1		Set data for axis 2.
23			MOVL	1			Movement
24			EXSR	1			Send OK.
25			EDIF				
26							
27			GOTO	1			
28							-----------
29			BGSR	1			Subroutine for sending OK
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				

Battery Backup Function

The X-SEL controller uses the following two types of batteries.

- System-memory backup battery
  This coin battery is used to back up the position data, SEL program variables, etc., in the controller. Each controller ships with the system-memory backup battery.

- Absolute-encoder 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-encoder backup battery.

Each battery is explained in details below.

1. System-Memory Backup Battery

So that the various data stored in the system memory (SRAM) inside the X-SEL controller can be retained even after the power has been cut off, a coin battery holder is provided in the panel on the front face of the controller to enable backup operation.
The data backed up in the system memory (SRAM) includes SEL global data, position data, coordinate system definition data and user-data backup memory of the controller with increased memory size (with gateway function). The above data can be retained even after the power has been cut off.
Note, however, that position data and user-data backup memory are also stored in the flash ROM, so if the operation is always resumed using the data in the flash ROM following a cutoff of power or software reset, you need not install a battery. (Other parameter No. 20 must be set to "0" (no backup memory).)

Note: On controllers with increased memory size (with gateway function), the position data to be backed up are position Nos. 1 to 10000. To retain position data of position No. 10001 onward in the event of power cutoff, write the position data to the flash ROM before the power is cut off.

The system-memory backup battery uses a coin battery (Model 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 products similar to this battery are 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 a surrounding air temperature of 40°C for one and a half years, 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 a surrounding air 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 battery in the battery holder.
It is recommended that the battery be replaced regularly in accordance with the frequency/duration of controller usage.
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 a surrounding air 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 at all, 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. Remember to complete the battery replacement within 30 minutes.
To prevent 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 to 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 at all. 10 days at 40°C based on continuous operation; 2.5 days if the power is not supplied at all.	
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 at all. 4 days at 40°C based on continuous operation; 1 day if the power is not supplied at all.	
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 a standardized product and can be used with products by any manufacture.

2. Absolute-Encoder Backup Battery

If the X-SEL controller is to drive an absolute-type actuator, an absolute-encoder backup battery must be installed in the robot or controller.
An absolute encoder is designed to retain rotation data and detect rotations using the power supplied from the absolute-encoder backup battery, even when the controller's control power is not supplied. This allows 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-encoder backup battery is two to three years. It means that if the battery is left at a surrounding air temperature of 40°C (with the power not supplied at all), it will retain the stored data for two to three years. In normal operating conditions, the battery can retain data for a longer period. As a guide, the battery will last for around twice the specified period if the controller is used at a surrounding air temperature of 40°C where the controller powered up 50% of the time.

<Battery Replacement>
It is recommended that the battery be replaced regularly in accordance with the frequency/duration of controller usage.
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 a surrounding air 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 at all, 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. Remember to complete the battery replacement within 15 minutes.

The absolute-encoder backup battery is replaced differently depending on whether a battery error has generated or not. If an error has not been detected yet, the battery needs to be replaced and the absolute encoder must be reset. If an abnormal absolute-encoder backup battery voltage error has been detected (error No. 914, CA2), an absolute encoder reset will be required.

The X-SEL-PX/QX controller provides an absolute-encoder backup battery enable switch for each linear movement axis. When replacing any absolute-encoder backup battery following a battery error, turn OFF the absolute-encoder backup battery enable/disable switch corresponding the applicable axis (the controller power should be turned off during the battery replacement). Once a new battery has been installed, turn on the controller power, and then reset the absolute-encoder backup battery enable/disable switch to the ENB (enable) position. If this procedure (turn on the controller power → enable the switch) is not followed, the absolute encoder data will not be backed up and the absolute-encoder backup battery will consume abnormally large amounts of power. In the worst condition, the battery voltage may drop to zero in several weeks.
There is no absolute-encoder backup battery enable/disable switch for SCARA axes.

Reference Battery Replacement Intervals

		Battery model	Reference battery replacement interval (at 40°C)	
			Power ON time 0%	Power ON time 50%
SCARA axis	ARM length 120/150/180	AB-6	3 years	5 years
	ARM length 250 ~ 800	AB-3		
Linear movement axis		AB-5	2 years	4 years

List of Absolute-Encoder Backup Battery Functions

Battery voltage	3.6 V
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 ~ 2.2 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 at all. 10 days at 40°C based on continuous operation; 2.5 days if the power is not supplied at all.
Minimum data retention voltage	Min 2.7 V (Varies depending on the encoder characteristics)
Data protection time during battery replacement (Retained by the super capacitor)	15 minutes (Maximum retention time when no battery is installed in the battery holder)

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 apply to expansion I/O1 (I/O2).

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

◎ Number of Regenerative Units to be Connected

Regenerative energy produced when a linear movement axis decelerates to a stop or moves downward in a vertical installation is absorbed by means of the capacitor and resistor in the controller. If the produced regenerative energy is not fully absorbed internally, an overvoltage error will occur and the controller cannot operate any more. The specific error that will generate in this condition is “Error No. 60C, Power-system overheat error.”
Should this error occur, the following measures must be taken:

- Connect an external regenerative unit or units. (Refer to the table below “Guide for Determining Number of Regenerative Units to be Connected”).
- Increase the cycle time.
- Decrease the speed.
- Shorten the travel distance (in a vertical installation).
- Reduce the load capacity.
- Do not perform synchronous operation (when multiple axes are connected).
  An axis produces regenerative energy when it decelerates to a stop in a horizontal installation, or mainly when it moves downward in a vertical installation. When two or more axes are connected, therefore, regenerative energy can be reduced by making sure the axes are operated in a manner not performing the above operations at the same time.

Guide for Determining Number of Regenerative Units to be Connected

SCARA axes (high-speed models)

Type	Number of external regenerative unit(s)
IX-NNN2515H/3515H, IX-NNW2515H/3515H, TNN (UNN) 3015H/3515H, IX-NNC2515H/3515H	1
IX-NNN50□□H/60□□H, IX-NNW50□□H/60□□H, IX-HNN (INN) 50□□H/60□□H, IX-NNC50□□H/60□□H	3
IX-NNN70□□H/80□□H, IX-NNW70□□H/80□□H, IX-HNN (INN) 70□□H/80□□H, IX-NNC70□□H/80□□H	4
IX-NSN5016/6016	3

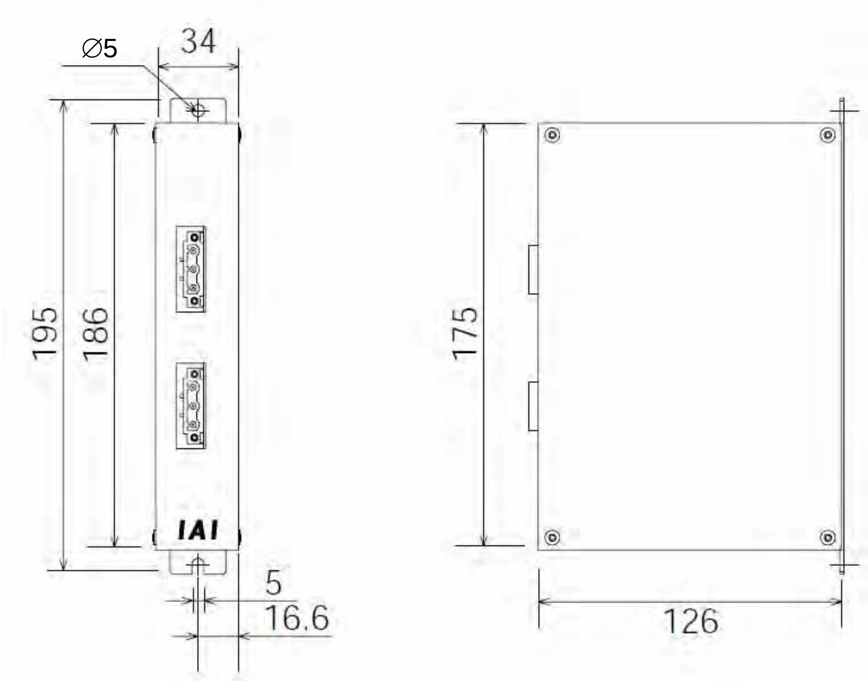
SCARA axes (conventional models)

Type	Number of external regenerative unit(s)
IX-NNN1205/1505/1805, IX-NNC1205/1505/1805	0
IX-NNN2515/3515, IX-NNW2515/3515, TNN (UNN) 3015/3515, IX-NNC2515/3515	0
IX-NNN50□□/60□□, IX-NNW50□□ /60□□, IX-HNN (INN) 50□□/60□□, IX-NNC50□□/60□□	1
IX-NNN70□□/80□□, IX-NNW70□□/80□□, IX-HNN (INN) 70□□/80□□, IX-NNC70□□/80□□	1
IX-NSN5016/6016	1

Single axes, orthogonal axes

Vertical installation (total motor wattage)	Horizontal installation (total motor wattage)	Number of external regenerative unit(s)
~ 100 W	~ 200 W	0
~ 800 W	~ 1000 W	1
~ 1200 W	~ 1500 W	2
~ 1500 W	---	3

* Conditions for the above guide table
  Actuator series: ISA (400 W or below) or ISP (600/750 W)
  Stroke: Maximum stroke at which the maximum speed can be output (600 to 800 mm depending on the wattage)
  Speed: Rated speed, Acceleration: 0.3 G, Load capacity: Rated load capacity
  Operating condition: Synchronous reciprocating operation at a duty of 50%
* The maximum number of external regenerative resistors that can be connected is eight.
* In certain conditions such as when the operating duty is high or acceleration/deceleration is high, more regenerative resistors may be needed than the applicable number specified in the table above.


∅5
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186
IAI
5
16.6
175
126

⊙ 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 input range is based on the maximum and minimum limits of values that can be input using the teaching pendant or PC software. In practice, enter the values defined in the Remarks field.

Note: Values other than those defined in the Remarks field, including values inside the applicable input range, are reserved for future extension. Do not enter values other than those defined in the Remarks field.

1. I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
1	I/O port assignment type	1	0 ~ 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 ~ 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 ~ 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 ~ 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 ~ 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 ~ 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 ~ 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 ~ 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 ~ 599		300 + (Multiple of 8) (Invalid if a negative value is set)
10	Standard I/O error monitor (I/O1)	1	0 ~ 5		0: Do not monitor 1: Monitor 2: Monitor (Do not monitor 24-V I/O power-supply errors) 3: Monitor (Monitor 24-V I/O power-supply errors only) * Some exceptions apply. * If 0 (= Do not monitor) or 2 (= Monitor (Do not monitor 24-V I/O power-supply errors)) is selected, a system error will not generate when a 24-V I/O power-supply error occurs. To protect the controller, however, the actual outputs of the digital I/O board will be cut off by a circuit later.
11	Expanded I/O1 error monitor (I/O2)	1	0 ~ 5		0: Do not monitor 1: Monitor 2: Monitor (Do not monitor 24-V I/O power-supply errors) 3: Monitor (Monitor 24-V I/O power-supply errors only) * Some exceptions apply. (Slot next to the standard I/O slot) * If 0 (= Do not monitor) or 2 (= Monitor (Do not monitor 24-V I/O power-supply errors)) is selected, a system error will not generate when a 24-V I/O power-supply error occurs. To protect the controller, however, the actual outputs of the digital I/O board will be cut off by a circuit later.
12	Expanded I/O2 error monitor (I/O3)	1	0 ~ 5		0: Do not monitor 1: Monitor 2: Monitor (Do not monitor 24-V I/O power-supply errors) 3: Monitor (Monitor 24-V I/O power-supply errors only) * Some exceptions apply.. * If 0 (= Do not monitor) or 2 (= Monitor (Do not monitor 24-V I/O power-supply errors)) is selected, a system error will not generate when a 24-V I/O power-supply error occurs. To protect the controller, however, the actual outputs of the digital I/O board will be cut off by a circuit later.

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
13	Expanded I/O3 error monitor (I/O4)	1	0 ~ 5		0: Do not monitor 1: Monitor 2: Monitor (Do not monitor 24-V I/O power-supply errors) 3: Monitor (Monitor 24-V I/O power-supply errors only) * Some exceptions apply. * If 0 (= Do not monitor) or 2 (= Monitor (Do not monitor 24-V I/O power-supply errors)) is selected, a system error will not generate when a 24-V I/O power-supply error occurs. To protect the controller, however, the actual outputs of the digital I/O board will be cut off by a circuit later.
14	Number of ports using network I/F module remote input	0	0 ~ 256		Multiple of 8
15	Number of ports using network I/F module remote output	0	0 ~ 256		Multiple of 8
16	Input port start number when network I/F module assignments are fixed	-1	-1 ~ 599		0 + (Multiple of 8) (Invalid if a negative value is set)
17	Output port start number when network I/F module assignments are fixed	-1	-1 ~ 599		300 + (Multiple of 8) (Invalid if a negative value is set)
18	Network I/F module error monitor	1	0 ~ 5		0: Do not monitor 1: Monitor * Some exceptions apply.
19	(For extension)	0			
20	Input filtering periods	2	1 ~ 9	msec	Input signal is recognized when the status is held for twice the period set by this parameter.
21	For future extension (Change prohibited)	0	1 ~ 9		
22	Remote-I/O-card fieldbus ready timeout value	2000	0 ~ 99999	msec	Timeout check is not performed if "0" is set.
23	Input specification for detection of overcurrent/abnormal power supply for multi-point DIO external terminal block	0H	0H ~ 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 input error detection signal 1: Input error detection signal = IN023 in card 2: Input error detection signal = IN047 in card 3: Input error detection signal = IN023/47 in card) * Set this parameter after confirming the specification of the multi-point DIO terminal block unit to be connected. * Input ports used for error detection input cannot be used as general-purpose input ports.

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
24	I/O setting bit pattern 1 (Related to global specifications)	10000H	0H ~ 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 be 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) (melted drive-source cutoff relay) signal enable selection (0: Disable, 1: Enable) Bits 12 to 15: Drive-source cutoff relay DET (MELT) error level (when low voltage cannot be checked) (0: Cold start, 1: Message) Bits 16 to 19: Drive-source cutoff relay DET (MELT) error level (when low voltage cannot be checked) (0: Cold start, 1: Message)
25	I/O setting bit pattern 2 (Related to global specifications)	0H	0H ~ FFFFFFFFH		Bits 0 to 3: For future extension Bits 4 to 7: For future extension
26~ 28	(For extension)	0			
29	Physical output port number for drive-source cutoff (SDN) notification	0	0 ~ 599		Turn the output port OFF when the drive source is cut off (* Important: This is only a software notification output) (Invalid if “0” is set) * Note: Enter a hexadecimal value if the tool (PC software or TP) is of a version where input areas are indicated by “h” notation.

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
30	Input function selection 000	1	0 ~ 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 0.36 or later) Note: The function of “I/O parameter No. 44: Input function selection 014” (drive-source cutoff reset related) 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 start specified program number) is assigned to “I/O parameter No. 44: Input function selection 014.” To specify a program number in 7 bits, all of the functions from “I/O parameter No. 38: Input function selection 008” to “I/O parameter No. 44: Input function selection 014” must be set to “1: Program start specified program number.” 4: Program start signal (ON edge) (Input port Nos. 008 to 014: Binary specified program number) (Main application version 0.36 or later) Note: he function of “I/O parameter No. 44: Input function selection 014” (drive-source cutoff reset related) 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 start specified program number) is assigned to “I/O parameter No. 44: Input function selection 014.” To specify a program number in 7 bits, all of the functions from “I/O parameter No. 38: Input function selection 008” to “I/O parameter No. 44: Input function selection 014” must be set to “1: Program start specified program number.” * If this parameter is used as a program start signal, turn ON the signal for at least 100 msec so that the program will start without fail. * In the case of a controller with increased memory size (with gateway), only program Nos. 1 to 79 can be started via BCD specification, while only program Nos. 1 to 127 can be started via binary specification. Program No. 128 cannot be started using this signal.
31	Input function selection 001	0	0 ~ 5		0: General-purpose input 1: Software reset signal (restart) signal (1 second ON) * If continued operation is specified as the action upon emergency stop, enable the software reset signal (to provide a means of canceling the operation).
32	Input function selection 002	0	0 ~ 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)
33	Input function selection 003	1	0 ~ 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.

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
34	Input function selection 004	0	0 ~ 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)
35	Input function selection 005	0	0 ~ 5		0: General-purpose input, 1: Operation-pause reset signal (ON edge)
36	Input function selection 006	0	0 ~ 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.
37	Input function selection 007	1	0 ~ 5		0: General-purpose input, 1: Program number specified for program start (least significant bit)
38	Input function selection 008	1	0 ~ 5		0: General-purpose input, 1: Program number specified for program start
39	Input function selection 009	1	0 ~ 5		0: General-purpose input, 1: Program number specified for program start
40	Input function selection 010	1	0 ~ 5		0: General-purpose input, 1: Program number specified for program start
41	Input function selection 011	1	0 ~ 5		0: General-purpose input, 1: Program number specified for program start
42	Input function selection 012	1	0 ~ 5		0: General-purpose input, 1: Program number specified for program start
43	Input function selection 013	1	0 ~ 5		0: General-purpose input 1: Program number specified for program start 2: Error reset (ON edge)
44	Input function selection 014	0	0 ~ 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 axes whose drive-source cutoff circuit is not controlled by this controller.
45	Input function selection 015	0	0 ~ 5		0: General-purpose input 1: Move/return all linear movement axes to the absolute reset position/home (ON edge) (Each servo must be turned ON first = I/O parameter No. 32, axis-specific parameter No. 13) * Valid only for the 6-axis type. (Main application version 0.15 or later) 2: Return all incremental linear movement axes to the home (ON edge) (Each servo must be turned ON first = I/O parameter No. 32, axis-specific parameter No. 13) * Valid only for the 6-axis type. (Main application version 0.15 or later)
46	Output function selection 300	2	0 ~ 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)
47	Output function selection 301	3	0 ~ 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)

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
48	Output function selection 302	2	0 ~ 20		0: General-purpose output 1: Emergency-stop output (ON) 2: Emergency-stop output (OFF)
49	Output function selection 303	0	0 ~ 5		0: General-purpose output 1: AUTO mode output 2: Output during automatic operation (Other parameter No. 12)
50	Output function selection 304	0	0 ~ 5		0: General-purpose output 1: Output when all valid linear movement axes are at the home (= 0) * Valid only for the 6-axis type. (Main application version 0.15 or later) 2: Output when all valid linear movement axes have completed home return (coordinates are confirmed) * Valid only for the 6-axis type. (Main application version 0.15 or later) 3: Output when all valid linear movement axes are at the preset home coordinates * To move an absolute-encoder linear movement axis to coordinate 0 or to the preset home coordinates, use a MOVP command instead of a HOME command. * Valid only for the 6-axis type. (Main application version 0.15 or later)
51	Output function selection 305	0	0 ~ 5		0: General-purpose output 1: For future extension 2: Output when axis-1 servo is ON (System monitor task output) 3: For future extension
52	Output function selection 306	0	0 ~ 5		0: General-purpose output 1: For future extension 2: Output when axis-2 servo is ON (System monitor task output) 3: For future extension
53	Output function selection 307	0	0 ~ 5		0: General-purpose output 1: For future extension 2: Output when axis-3 servo is ON (System monitor task output) 3: For future extension
54	Output function selection 308	0	0 ~ 5		0: General-purpose output 1: For future extension 2: Output when axis-4 servo is ON (System monitor task output) 3: For future extension
55	Output function selection 309	0	0 ~ 5		0: General-purpose output 1: For future extension 2: Output when axis-5 servo is ON (F-ROM 16-Mbit version only) 3: For future extension * The synchro slave axis will follow the synchro master axis. * Valid only for the 6-axis type.
56	Output function selection 310	0	0 ~ 5		0: General-purpose output 1: For future extension 2: Output when axis-6 servo is ON (F-ROM 16-Mbit version only) 3: For future extension * The synchro slave axis will follow the synchro master axis. * Valid only for the 6-axis type.
57	Output function selection 311	0	0 ~ 5		0: General-purpose output, 1 to 3: For future extension
58	Output function selection 312	0	0 ~ 5		0: General-purpose output ,1 to 3: For future extension
59	Output function selection 313	1	0 ~ 5		0: General-purpose output 1: System-memory backup battery voltage-low warning level or lower

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
60	Output function selection 314	1	0 ~ 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.)
61	Output function selection 315	0	0 ~ 5		0: General-purpose output
62	For future extension (Change prohibited)	0	0 ~ 299		
63	For future extension (Change prohibited)	0	0 ~ 299		
64	Physical input port number for axis-3 brake forced release	0	0 ~ 299		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.
65	Physical input port number for axis-4 brake forced release	0	0 ~ 299		Forcibly unlock the brake when the applicable port is ON (be ware 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.
66	Physical input port number for axis-5 brake forced release	0	0 ~ 299		Forcibly unlock the brake when the applicable port is ON (be ware of a falling load). * Invalid if “0” is set (Invalid if input port No. 0 is specified) * Valid only for the 6-axis type.
67	Physical input port number for axis-6 brake forced release	0	0 ~ 299		Forcibly unlock the brake when the applicable port is ON (be ware of a falling load). * Invalid if “0” is set (Invalid if input port No. 0 is specified) * Valid only for the 6-axis type.
68~ 69	(For extension)	0			
70	Unaffected general-purpose output area number (MIN) when all operations/ programs are aborted	0	0 ~ 599		* 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)
71	Unaffected general-purpose output area number (MAX) when all operations/programs are aborted	0	0 ~ 599		
72	Unaffected general-purpose output area number (MIN) when all operations are paused (servo-axis soft interlock + output-port soft interlock)	300	0 ~ 599		* 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)
73	Unaffected general-purpose output area number (MAX) when all operations are paused (servo-axis soft interlock + output-port soft interlock)	599	0 ~ 599		
74	Number of TP user output ports used (hand, etc.)	0	0 ~ 8		Referenced by TP. (Invalid if “0” is set)
75	TP user output port start number (hand, etc.)	0	0 ~ 599		Referenced by TP.
76	AUTO-mode physical output port number	0	0 ~ 599		(Invalid if “0” is set)
77	Input port number for acceptance permission of PC/TP servo movement command	0	0 ~ 299		* Important: Invalid after operation has started. (Invalid if “0” is set)

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
78	Input target axis pattern for acceptance permission of PC/TP servo movement command	0	0B ~ 11111111B		
79	Input port number for remote mode control	0	0 ~ 299		The system mode is MANU when the specified DI is ON or the AUTO/MANU switch is set to MANU. (Invalid if "0" is set) * Debug filter is invalid for remote-mode control input ports.
80	(PC/TP SIO usage)	1	1 ~ 1		Switching of DIP switches
81	(PC/TP SIO station code)	153	Reference only		Fixed to 153 (99H).
82	(PC/TP SIO reservation)	0			
83	(PC/TP SIO reservation)	0			
84	(PC/TP SIO reservation)	0			
85	(PC/TP SIO reservation)	0			
86	(PC/TP SIO reservation)	0			
87	(PC/TP SIO reservation)	0			
88	(PC/TP SIO reservation)	0			
89	(PC/TP SIO reservation)	0			
90	Usage of SIO channel 0 opened to user (AUTO mode)	0	0 ~ 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 ~ 255		Valid only with IAI protocol.
92	Baud rate type of SIO channel 0 opened to user	0	0 ~ 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 ~ 8		
94	Stop bit length of SIO channel 0 opened to user	1	1 ~ 2		
95	Parity type of SIO channel 0 opened to use	0	0 ~ 2		0: None 1: Odd 2: Even
96	Receive operation type of SIO channel 0 opened to user	0	0 or 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 ~ 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	Used by the SIO system (SP3) (extended)	28100010H	0H ~ 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	(For SIO system (SP3) extension (extension))	0	0H ~ FFFFFFFFH		
102	Used by the SIO system (SP4) (extended)	28100020H	0H ~ FFFFFFFFH		(Same as with I/O parameter No. 100)
103	(For SIO system (SP4) extension (extension))	0	0H ~ FFFFFFFFH		
104	Used by the SIO system (SP5) (extended)	28100010H	0H ~ FFFFFFFFH		(Same as with I/O parameter No. 100)
105	(For SIO system (SP5) extension (extension))	0	0H ~ FFFFFFFFH		
106	Used by the SIO system (SP6) (extended)	28100020H	0H ~ FFFFFFFFH		(Same as with I/O parameter No. 100)
107	(For SIO system (SP6) extension (extension))	0	0H ~ FFFFFFFFH		
108	Used by the SIO system (SP7) (extended)	28100010H	0H ~ FFFFFFFFH		(Same as with I/O parameter No. 100)
109	(For SIO system (SP7) extension (extension))	0	0H ~ FFFFFFFFH		
110	Used by the SIO system (SP8) (extended)	28100020H	0H ~ FFFFFFFFH		(Same as with I/O parameter No. 100)
111	(For SIO system (SP8) extension (extension))	0	0H ~ FFFFFFFFH		
112	Used by the SIO system (SP9) (extended)	28100030H	0H ~ FFFFFFFFH		(Same as with I/O parameter No. 100)
113	(For SIO system (SP9) extension (extension))	0	0H ~ FFFFFFFFH		
114	Used by the SIO system (SP10) (extended)	28100040H	0H ~ FFFFFFFFH		(Same as with I/O parameter No. 100)
115	(For SIO system (SP10) extension (extension))	0	0H ~ FFFFFFFFH		
116~ 119	(For extension)	0			
120	Network attribute 1	1H	0H ~ 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.
121	Network attribute 2	0	0H ~ FFFFFFFFH		
122	Network attribute 3	0	0H ~ FFFFFFFFH		

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
123	Network attribute 4	0H	0H ~ FFFFFFFFH		Bits 0 to 3: Ethernet TCP/IP message communication IP address of connection destination on server Whether to permit 0.0.0.0 (IP address of connection destination can be ignored) (0: Do not permit 1: Permit (<u>not recommended</u>)) * Note: Number of clients that can be connected simultaneously to one server port channel = 1
124	Network attribute 5	0H	0H ~ 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 <u>not recommended</u> 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 in the IAI protocol B/TCP MANU or AUTO mode, the connection will be cut off when the MANU/AUTO mode is switched.
125	Network attribute 6	31E32H	0H ~ 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 time upon 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 ~ 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 ~ 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	10000H	0H ~ FFFFFFFFH		Ethernet TCP/IP message communication attribute Bits 0 to 15: SEL server open timeout value (sec) (No timeout check when "0" is set) Bits 16 to 23: Connection retry interval (Tracking vision system I/F) (sec)
129	Network attribute 10	0H	0H ~ FFFFFFFFH		Ethernet operation requirement Bits 0 to 3: Modbus/TCP (Remote I/O) (0: Not in use 1: Use (Disable exception status) 2: Use (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. 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 the lower two bytes are valid.
131	Own MAC address (L)	0H	Reference only (HEX)		
132	Own IP address (H)	192	1 ~ 255		* Setting of "0" and "127" is prohibited.
133	Own IP address (MH)	168	0 ~ 255		
134	Own IP address (ML)	0	0 ~ 255		
135	Own IP address (L)	1	1 ~ 254		* Setting of "0" and "255" is prohibited.
136	Subnet mask (H)	255	0 ~ 255		
137	Subnet mask (MH)	255	0 ~ 255		
138	Subnet mask (ML)	255	0 ~ 255		
139	Subnet mask (L)	0	0 ~ 255		
140	Default gateway (H)	0	0 ~ 255		
141	Default gateway (MH)	0	0 ~ 255		
142	Default gateway (ML)	0	0 ~ 255		
143	Default gateway (L)	0	0 ~ 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 ~ 65535		* Important note: Always set a unique number for each own port number. (Duplication of own 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 ~ 65535		
146	Channel 32 opened to user (TCP/IP): Own port number	64513	1025 ~ 65535		
147	Channel 33 opened to user (TCP/IP): Own port number	64514	1025 ~ 65535		
148	Channel 34 opened to user (TCP/IP): Own port number	64515	1025 ~ 65535		
149	IAI protocol B/TCP: IP address of connection destination (MANU mode) (H)	192	0 ~ 255		* Setting of “0” and “127” is prohibited.
150	IAI protocol B/TCP: IP address of connection destination (MANU mode) (MH)	168	0 ~ 255		
151	IAI protocol B/TCP: IP address of connection destination (MANU mode) (ML)	0	0 ~ 255		
152	IAI protocol B/TCP: IP address of connection destination (MANU mode) (L)	100	0 ~ 254		* Setting of “0” and “255” is prohibited.
153	IAI protocol B/TCP: Port number of connection destination (MANU mode)	64611	0 ~ 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 ~ 255		* Setting of “0” and “127” is prohibited.
155	IAI protocol B/TCP: IP address of connection destination (AUTO mode) (MH)	168	0 ~ 255		
156	IAI protocol B/TCP: IP address of connection destination (AUTO mode) (ML)	0	0 ~ 255		
157	IAI protocol B/TCP: IP address of connection destination (AUTO mode) (L)	100	0 ~ 254		* Setting of “0” and “255” is prohibited.
158	IAI protocol B/TCP: Port number of connection destination (AUTO mode)	64611	0 ~ 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 ~ 65535		* Important note: Always set a unique number for each own port number. (Duplication of own port numbers is permitted only in the IAI protocol B/TCP MANU/AUTO modes.)
		0			
		0			
160	IP address of vision system I/F connection destination (H)	192	0 ~ 255		* Setting of “0” and “127” is prohibited.
160~ 169	(For network extension)	0			
170~ 200	(For extension)	0			

PC: PC software
TP: Teaching pendant

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
201	Attribute 1 of SIO channel 1 opened to user (mount standard)	28100000H	0H ~ 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, specify 38.4 kbps or less Specifying 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 extension Bits 8 to 11: For future extension Bits 4 to 7: For future extension 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 (mount standard)	00000001H	0H ~ FFFFFFFFH		Bits 28 to 31: For future extension Bits 24 to 27: For future extension Bits 20 to 23: For future extension Bits 16 to 19: Character send 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 (mount standard)	01118040H	0H ~ 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, specify 38.4 kbps or less Specifying a higher baud rate may generate an overrun error, etc. Bits 24 to 27: Xon send selection when send after SIO-CPU reset is enabled (0: Do not send, 1: Send) * Valid only in full-duplex communication with Xon/Xoff flow control. Bits 20 to 23: Send enable selection when the port is open (0: Disable, 1: Enable) * Valid only in full-duplex communication with Xon/Xoff flow control. Bits 16 to 19: Xon/Xoff send selection when the port is closed (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 (byte) Bits 0 to 7: Flow control low limit (byte) * If the specified value satisfies the condition “Flow control low limit ≥ SCI receive buffer size - flow control high limit,” both the flow control high limit and low limit will be replaced by values corresponding to 1/4 of the SCI receive buffer size before the applicable processing is performed.

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
204	Attribute 4 of SIO channel 1 opened to user (mount standard)	00000000H	0H ~ FFFFFFFFH		
205	Attribute 5 of SIO channel 1 opened to user (mount standard)	00000000H	0H ~ FFFFFFFFH		
206	Attribute 6 of SIO channel 1 opened to user (mount standard)	00000000H	0H ~ FFFFFFFFH		
207	Attribute 7 of SIO channel 1 opened to user (mount standard)	00000000H	0H ~ FFFFFFFFH		
208	Attribute 8 of SIO channel 1 opened to user (mount standard)	00000000H	0H ~ FFFFFFFFH		
209	Attribute 9 of SIO channel 1 opened to user (mount standard)	00000000H	0H ~ FFFFFFFFH		
210	Attribute 10 of SIO channel 1 opened to user (mount standard)	00000000H	0H ~ FFFFFFFFH		
211	Attribute 11 of SIO channel 1 opened to user (mount standard)	00000000H	0H ~ FFFFFFFFH		
212	Attribute 12 of SIO channel 1 opened to user (mount standard)	00000000H	0H ~ FFFFFFFFH		
213	Attribute 1 of SIO channel 2 opened to user (mount standard)	28100001H	0H ~ 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, specify 38.4 kbps or less Specifying 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 effective only for channel 2. (Main application version 0.65 or later/controller with increased memory size (with gateway function) only) Bits 8 to 11: For future extension Bits 4 to 7: For future extension 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 (mount standard)	00000001H	0H ~ FFFFFFFFH		Bits 28 to 31: For future extension Bits 24 to 27: For future extension Bits 20 to 23: For future extension Bits 16 to 19: Character send 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 (mount standard)	01118040H	0H ~ 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, specify 38.4 kbps or less Specifying a higher baud rate may generate an overrun error, etc. Bits 24 to 27: Xon send selection when send after SIO-CPU reset is enabled (0: Do not send, 1: Send) * Valid only in full-duplex communication with Xon/Xoff flow control. Bits 20 to 23: Send enable selection when the port is open (0: Disable, 1: Enable) * Valid only in full-duplex communication with Xon/Xoff flow control. Bits 16 to 19: Xon/Xoff send selection when the port is closed (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 (byte) Bits 0 to 7: Flow control low limit (byte) * If the specified value satisfies the condition "Flow control low limit ≥ SCI receive buffer size - flow control high limit," both the flow control high limit and low limit will be replaced by values corresponding to 1/4 of the SCI receive buffer size before the applicable processing is performed.
216	Attribute 4 of SIO channel 2 opened to user (mount standard)	00000000H	0H ~ FFFFFFFFH		* This parameter is effective 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 OFF the servo for all axes) 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 increased memory size (with gateway function) only)
217	Attribute 5 of SIO channel 2 opened to user (mount standard)	00000000H	0H ~ FFFFFFFFH		RC gateway link axis pattern (Axis Nos. 15 to 8) (Main application version 0.65 or later/controller with increased memory size (with gateway function) only)
218	Attribute 6 of SIO channel 2 opened to user (mount standard)	00000000H	0H ~ FFFFFFFFH		RC gateway link axis pattern (Axis Nos. 7 to 0) (Main application version 0.65 or later/controller with increased memory size (with gateway function) only)
219	Attribute 7 of SIO channel 2 opened to user (mount standard)	00000000H	0H ~ FFFFFFFFH		
220	Attribute 8 of SIO channel 2 opened to user (mount standard)	00000000H	0H ~ FFFFFFFFH		
221	Attribute 9 of SIO channel 2 opened to user (mount standard)	00000000H	0H ~ FFFFFFFFH		
222	Attribute 10 of SIO channel 2 opened to user (mount standard)	00000000H	0H ~ FFFFFFFFH		
223	Attribute 11 of SIO channel 2 opened to user (mount standard)	00000000H	0H ~ FFFFFFFFH		
224	Attribute 12 of SIO channel 2 opened to user (mount standard)	00000000H	0H ~ FFFFFFFFH		
225~ 400	(For extenstion)	0			

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
401~ 500	(For extenstion)				(Main application version 0.65 or later/controller with increased memory size (with gateway function) only)
501	Number of RC gateway position data points	128	0 ~ 512		Number of position data points used in the X-SEL in the RC position data use mode (Main application version 0.65 or later/controller with increased memory size (with gateway function) only)
502	Maximum axis number for RC gateway position data definition RC gateway position	0	0 ~ 15		Maximum axis number for allocating RC axis position data area in the user-data backup memory (Main application version 0.65 or later/controller with increased memory size (with gateway function) only)
503	Number of position data points for data definition	0	0 ~ 512		Number of position data points for allocating RC axis position data area in the user-data backup memory * Area not yet allocated, if 0. * If a value other than 0 is set, an area will be allocated regardless of whether the RC gateway function is enabled or disabled. (Main application version 0.65 or later/controller with increased memory size (with gateway function) only)
504, 505	(For extenstion)				(Main application version 0.65 or later/controller with increased memory size (with gateway function) only)
506	RC gateway RC PC software connection communication timeout period	3000	0 ~ 99999		Set the timeout period for RC PC software connection. (Main application version 0.65 or later/controller with increased memory size (with gateway function) only)
507~ 510	(For extenstion)				(Main application version 0.65 or later/controller with increased memory size (with gateway function) only)
511	Forced brake release input port number for RC axis 0	0	0 ~ 3999		Forcibly release the brake when the applicable port is ON. (Beware of dropping object, etc.) * Invalid, if 0. (Invalid, if input port No. 0 is specified.) (Main application version 0.65 or later/controller with increased memory size (with gateway function) only)
512	Forced brake release input port number for RC axis 1	0	0 ~ 3999		Forcibly release the brake when the applicable port is ON. (Beware of dropping object, etc.) * Invalid, if 0. (Invalid, if input port No. 0 is specified.) (Main application version 0.65 or later/controller with increased memory size (with gateway function) only)
513	Forced brake release input port number for RC axis 2	0	0 ~ 3999		Forcibly release the brake when the applicable port is ON. (Beware of dropping object, etc.) * Invalid, if 0. (Invalid, if input port No. 0 is specified.) (Main application version 0.65 or later/controller with increased memory size (with gateway function) only)
514	Forced brake release input port number for RC axis 3	0	0 ~ 3999		Forcibly release the brake when the applicable port is ON. (Beware of dropping object, etc.) * Invalid, if 0. (Invalid, if input port No. 0 is specified.) (Main application version 0.65 or later/controller with increased memory size (with gateway function) only)
515	Forced brake release input port number for RC axis 4	0	0 ~ 3999		Forcibly release the brake when the applicable port is ON. (Beware of dropping object, etc.) * Invalid, if 0. (Invalid, if input port No. 0 is specified.) (Main application version 0.65 or later/controller with increased memory size (with gateway function) only)
516	Forced brake release input port number for RC axis 5	0	0 ~ 3999		Forcibly release the brake when the applicable port is ON. (Beware of dropping object, etc.) * Invalid, if 0. (Invalid, if input port No. 0 is specified.) (Main application version 0.65 or later/controller with increased memory size (with gateway function) only)
517	Forced brake release input port number for RC axis 6	0	0 ~ 3999		Forcibly release the brake when the applicable port is ON. (Beware of dropping object, etc.) * Invalid, if 0. (Invalid, if input port No. 0 is specified.) (Main application version 0.65 or later/controller with increased memory size (with gateway function) only)

I/O Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
518	Forced brake release input port number for RC axis 7	0	0 ~ 3999		Forcibly release the brake when the applicable port is ON. (Beware of dropping object, etc.) * Invalid, if 0. (Invalid, if input port No. 0 is specified.) (Main application version 0.65 or later/controller with increased memory size (with gateway function) only)
519	Forced brake release input port number for RC axis 8	0	0 ~ 3999		Forcibly release the brake when the applicable port is ON. (Beware of dropping object, etc.) * Invalid, if 0. (Invalid, if input port No. 0 is specified.) (Main application version 0.65 or later/controller with increased memory size (with gateway function) only)
520	Forced brake release input port number for RC axis 9	0	0 ~ 3999		Forcibly release the brake when the applicable port is ON. (Beware of dropping object, etc.) * Invalid, if 0. (Invalid, if input port No. 0 is specified.) (Main application version 0.65 or later/controller with increased memory size (with gateway function) only)
521	Forced brake release input port number for RC axis 10	0	0 ~ 3999		Forcibly release the brake when the applicable port is ON. (Beware of dropping object, etc.) * Invalid, if 0. (Invalid, if input port No. 0 is specified.) (Main application version 0.65 or later/controller with increased memory size (with gateway function) only)
522	Forced brake release input port number for RC axis 11	0	0 ~ 3999		Forcibly release the brake when the applicable port is ON. (Beware of dropping object, etc.) * Invalid, if 0. (Invalid, if input port No. 0 is specified.) (Main application version 0.65 or later/controller with increased memory size (with gateway function) only)
523	Forced brake release input port number for RC axis 12	0	0 ~ 3999		Forcibly release the brake when the applicable port is ON. (Beware of dropping object, etc.) * Invalid, if 0. (Invalid, if input port No. 0 is specified.) (Main application version 0.65 or later/controller with increased memory size (with gateway function) only)
524	Forced brake release input port number for RC axis 13	0	0 ~ 3999		Forcibly release the brake when the applicable port is ON. (Beware of dropping object, etc.) * Invalid, if 0. (Invalid, if input port No. 0 is specified.) (Main application version 0.65 or later/controller with increased memory size (with gateway function) only)
525	Forced brake release input port number for RC axis 14	0	0 ~ 3999		Forcibly release the brake when the applicable port is ON. (Beware of dropping object, etc.) * Invalid, if 0. (Invalid, if input port No. 0 is specified.) (Main application version 0.65 or later/controller with increased memory size (with gateway function) only)
526	Forced brake release input port number for RC axis 15	0	0 ~ 3999		Forcibly release the brake when the applicable port is ON. (Beware of dropping object, etc.) * Invalid, if 0. (Invalid, if input port No. 0 is specified.) (Main application version 0.65 or later/controller with increased memory size (with gateway function) only)
527~600	(For extenstion)				(Main application version 0.65 or later/controller with increased memory size (with gateway function) only)

2. Parameters Common to All Axes

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
			~		
1	Valid axis pattern	1111B	00B ~ 11111111B		Existence of an OFF bit is considered an indication that no driver is installed. * SCARA axes (axes 1 to 4) are valid only when all bits are ON (xx1111B) (if all bits are not ON, all SCARA axes are invalid (xx0000B)).
2	Default override	100	1 ~ 100		Used if not specified in program. (Invalid for SIO operation) * Common to SCARA axes (axes 1 to 4) and linear movement axes (axes 5 and 6 (6-axis type)).
3~8	(For extension)	0	~		
9	Physical axis pattern for which enable switch (deadman switch/enable switch) is effective	11111111B	Reference only		For adjustment by the manufacturer
10	(For extension)	0			
11	Default CP acceleration of SCARA axis	10	1 ~ 200	0.01 G	Used if not specified in position data, program or SIO message, etc.
12	Default CP deceleration of SCARA axis	10	1 ~ 200	0.01 G	Used if not specified in position data, program or SIO message, etc.
13	Default CP speed of SCARA axis	30	1 ~ 250	mm/s	Used if not specified in SIO message or position data, etc.
14	Valid selection when operation point data deceleration is 0	0	0 ~ 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 of linear movement axis before confirmation of coordinates/home return	30	1 ~ 250	mm/s	* Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.12 or later)
16~19	(For extension)	0	~		
20	For future extension (Change prohibited)	0	0H ~ FFFFFFFFH		
21	Maximum CP speed of SCARA axis	3000	1 ~ 9999	mm/s	
22	Maximum CP acceleration of SCARA axis	200	1 ~ 999	0.01 G	
23	Maximum CP deceleration of SCARA axis	200	1 ~ 999	0.01 G	
24	Minimum CP emergency deceleration of SCARA axis	50	1 ~ 999	0.01 G	
25	For future extension (Change prohibited)	0	0H ~ FFFFFFFFH		
26	For future extension (Change prohibited)	0	0H ~ FFFFFFFFH		
27	For future extension (Change prohibited)	0	0H ~ FFFFFFFFH		
28	Inching → jog auto-switching prohibition selection for linear movement axis	0	Reference only		For adjustment by the manufacturer

PC: PC software
TP: Teaching pendant

Parameters Common to All Axes

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
29	All-axis setting bit pattern 1	10000H	0H ~ FFFFFFFFH		Bits 0 to 3: (For future extension) Bits 4 to 7: Overrun (servo) error level (0: Operation-cancellation level 1: Cold-start level 2: Operation-cancellation level at reset, thereafter cold-start level) Bits 8 to 11: "Actual-position soft limit over (servo)" error level (0: Operation-cancellation level, 1: Cold-start level, 2: Operation-cancellation level at reset, thereafter cold-start level) Bits 12 to 15: For future extension Bits 16 to 19: Absolute-data backup battery voltage error level (0: Operation-cancellation level 1: Message level (Main application version 0.17 or later)
30	Default division angle	150	0 ~ 1200	0.1 deg	
31	Default division distance	0	0 ~ 10000	mm	
32	Arch-trigger start-point check type	0	0 ~ 5		0: Check operation amount and actual position (A1c/A2c during SCARA-axis PTP) 1: Check operation amount only
33	CP safety speed of SCARA axis in manual mode	250	1 ~ 250	mm/s	
34	PTP safety speed of SCARA axis in manual mode	3	1 ~ 10	%	
35	Maximum jog speed for each SCARA axis system	5	1 ~ 10	%	
36	Maximum jog speed for each SCARA axis system before confirmation of coordinates	3	1 ~ 10	%	
37	Maximum SCARA axis speed under J□W□ command	250	1 ~ 500	mm/s	
38~ 43	(For extension)	0	~		
44	PTP SM control ratio for SCARA axis	3	0 ~ 50	%	
45	Radius of circle prohibiting entry of tool reference point for SCARA axis	150000	0 ~ 999999	0.001 mm	For simple check. (Radius of a circle centered around the axis of arm 1)
46	CPxy check tolerance for SCARA axis	2000	100 ~ 9999	0.001 mm	
47	Default PTP acceleration of SCARA axis	20	1 ~ 100	%	Used if not specified in position data, program or SIO message, etc.
48	Default PTP deceleration of SCARA axis	20	1 ~ 100	%	Used if not specified in position data, program or SIO message, etc.
49	Default PTP speed of SCARA axis	2	1 ~ 100	%	Used if not specified in SIO message or during continuous recovery movement, etc.
50	Width of SCARA-axis CP-operation restriction zone near arm 1/2 straight-line point	500	Reference only	0.001 mm	For adjustment by the manufacturer

Parameters Common to All Axes

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
51	SCARA axis control 1	0H	0H ~ FFFFFFFFH		Bits 8 to 11: Z position → horizontal move optimization for SCARA (PTP) (0: Disable 1: Enable) (Available only on high-speed SCARA robots of main application version 0.45 or later.) Bits 12 to 15: Z position → horizontal move optimization for SCARA (CP) (0: Disable 1: Enable) * It is recommended to disable this function if CP operation must be performed at a constant speed with accurate locus and the set speed must be reached. (Available only on high-speed SCARA robots of main application version 0.45 or later.)
52 ~ 60	(For extension)	0			
61 ~ 109	(For extension)				
110 ~ 130	(For extension)		~		
131	Reserved by the system (Change prohibited)	0	0 ~ 5		
132	Maximum loading capacity for load at tip (SCARA axis)	10000	1 ~ 99999999	9	
133	Maximum allowable tip load inertial moment (SCARA axis)	60000	1 ~ 99999999	kg-mm^2	
134	Reserved by the system (Change prohibited)	0	0 ~ 5		
135	Reserved by the system (Change prohibited)	0	0 ~999		
136	Reserved by the system (Change prohibited)	0H	0H ~ FFFFFFFFH		
139	Reserved by the system (Change prohibited)	50891	1 ~ 99999999		For adjustment by the manufacturer.
140	Reserved by the system (Change prohibited)	98000	1 ~ 99999999		For adjustment by the manufacturer.
141~ 199	(For extension)		~		
200	Default acceleration of linear movement axis	30	1 ~ 200	0.01 G	Used if not specified in position data, program or SIO message, etc. * Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.12 or later)
201	Default deceleration of linear movement axis	30	1 ~ 200	0.01 G	Used if not specified in position data, program or SIO message, etc. * Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.12 or later)
202	Default speed of linear movement axis	30	1 ~ 250	mm/sec	Used if not specified in SIO message or position data or during continuous recovery movement, etc. * Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.12 or later)
203	Maximum acceleration of linear movement axis	100	1 ~ 999	0.01 G	* Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.12 or later)

PC: PC software
TP: Teaching pendant

Parameters Common to All Axes

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
204	Maximum deceleration of linear movement axis	100	1 ~ 999	0.01 G	* Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.12 or later)
205	Minimum emergency deceleration of linear movement axis	30	1 ~ 300	0.01 G	* Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.12 or later)
206	Safety speed of linear movement axis in manual mode	250	1 ~ 250	mm/s	* Handled as a value equal to or below the smallest value of "Axis-specific parameter No. 29, VLMX speed of linear movement axis" applicable to all valid linear movement axes. * Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.12 or later)
207~ 300	(For extension)		~		
301~ 400	(For extension)		~		(Main application version 0.65 or later/controller with increased memory size (with gateway function) only)

PC: PC software
TP: Teaching pendant

3. Axis-Specific Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
1	Axis operation type	1, 1, 0, 1, 0, 0	0 or 1 Reference only for SCARA axes (axes 1 to 4)		0: Linear movement axis, 1: Rotational movement axis (angle control) (Change is prohibited for SCARA axes (axes 1 to 4))
2 ~ 5	(For extension)	0		~	
6	Coordinate/physical operation direction selection	1, 1, 0, 0, 1, 1	0 or 1 Reference only for SCARA axes (axes 1 to 4)		0: Motor CCW → Positive direction on the coordinate system 1: Motor CCW → Negative direction on the coordinate system
7	Soft limit +	210000, 145000, 200000, 720000, 50000, 50000	-99999999 ~ 99999999	0.001 mm, 0.001 deg	Fixed to 359.999 degrees internally for linear movement axes (axes 5 and 6 (6-axis type)) in the index mode Invalid in the infinite-stroke mode.
8	Soft limit –	-30000, -145000, 0, -720000, 0, 0	-99999999 ~ 99999999	0.001 mm, 0.001 deg	Fixed to degree internally for linear movement axes (axes 5 and 6 (6-axis type)) in the index mode Invalid in the infinite-stroke mode.
9	Soft-limit actual position margin	1000, 1000, 1000, 1000, 2000, 2000	0 ~ 9999	0.001 mm, 0.001 deg	This parameter indicates the actual position margin for the critical positioning boundary zone for linear movement axes (axes 5 and 6 (6-axis type)) in the infinite-stroke mode.
10	Method of movement to absolute reset position/home return	0	0 ~ 5 Reference only for SCARA axes (axes 1 to 4)		0: Search for phase Z after end search 1: Current position = 0 home (This can be specified for an incremental encoder only. Pay attention to interference.) 2: Set the current position as the preset home (This can be specified for an incremental encoder only. Pay attention to interference.) (Change is prohibited for SCARA axes (axes 1 to 4))
11	End-search direction selection at movement to absolute reset position/home return	0	0 or 1 Reference only for SCARA axes (axes 1 to 4)		0: Negative end of the coordinate system 1: Positive end of the coordinate system (Used for SCARA axis 3 (Zc) and linear movement axes (axes 5 and 6 (6-axis type)))
12	Home preset value	90000, 0, 0, -90000, 0, 0	-99999999 ~ 99999999 Reference only for SCARA axes (axes 1 to 4)	0.001 mm, 0.001 deg	
13	Sequence of SIO/PIO movement to absolute reset position/home return	0	0 ~ 16 Reference only for SCARA axes (axes 1 to 4)		Executed sequentially from the smallest number. * Valid for linear movement axes (axes 5 and 6 (6-axis type)) only.

Axis-Specific Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
14	Home-sensor input polarity	0	0 ~ 2 Reference only for SCARA axes (axes 1 to 4)		0: Not used, 1: Contact a, 2: Contact b
15	Overrun-sensor input polarity	0	0 ~ 2 Reference only for SCARA axes (axes 1 to 4)		0: Not used, 1: Contact a, 2: Contact b
16	Creep-sensor input polarity	0	0 ~ 2 Reference only for SCARA axes (axes 1 to 4)		0: Not used, 1: Contact a, 2: Contact b
17	Default home-sensor pullout speed at movement to absolute reset position/home return	0, 0, 10, 0, 10, 10	1 ~ 100 Reference only for SCARA axes (axes 1 to 4)	mm/sec	
18	Creep speed at movement to absolute reset position/home return	0, 0, 100, 0, 100, 100	1 ~ 500 Reference only for SCARA axes (axes 1 to 4)	mm/sec	End-search speed in the creep sensor non-detection section when a creep sensor is used.
19	End-search speed at movement to absolute reset position/home return	0, 0, 20, 0, 20, 20	1 ~ 100 Reference only for SCARA axes (axes 1 to 4)	mm/sec	(Used for SCARA axis 3 (Zc) and linear movement axes (axes 5 and 6 (6-axis type)))
20	Phase-Z search speed at movement to absolute reset position/home return	0, 0, 3, 0, 3, 3	1 ~ 10 Reference only for SCARA axes (axes 1 to 4)	mm/sec	Exercise caution, since limitations apply depending on the read/encoder pulse count. (Used for SCARA axis 3 (Zc) and linear movement axes (axes 5 and 6 (6-axis type)))
21	Offset travel distance at movement to absolute reset position/home return	0, 0, 0, 0, 1000, 1000	-99999999 ~ 99999999 Reference only for SCARA axes (axes 1 to 4)	0.001 mm	(Positive value = Direction of moving away from the end) (Used for SCARA axis 3 (Zc) and linear movement axes (axes 5 and 6 (6-axis type))) (Fixed to “0” for axis 1 (A1c), axis 2 (A2c) and axis 4 (Rc).) *Point to note when an absolute encoder is used If a value near an integer multiple of the phase-Z interval distance (including offset travel distance 0) is set for this parameter, servo lock will occur over phase Z upon when an absolute reset is performed. As a result, the coordinates may shift by the phase-Z interval pulses. Never set a value near an integer multiple of the phase-Z interval distance. (Provide a sufficient margin with respect to the servo amplitude.)

Axis-Specific Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
22	Phase-Z position at home return	1000, 1000, 500, 1000, 500, 500	0 ~ 99999999	0.001 mm, 0.001 deg	[SCARA axes (axes 1 to 4)] Minimum allowable value of actual distance (angle) between [search end (axis 3 (Zc)) or reference position (eye mark) (axis 1 (A1c), axis 2 (A2c) or axis 4 (Rc))] and phase Z [Linear movement axes (axes 5 and 6) (6-axis type)] With a rotary encoder, this parameter indicates the minimum allowable actual distance between the end (mechanical end or LS) and phase Z. With a linear encoder, it indicates the phase-Z search limit.
23	Phase Z count per encoder rotation	1	1 ~ 8 Reference only for SCARA axes (axes 1 to 4)		Only “1” can be set, if an absolute encoder is used.
24	Push-motion stop confirmation time at movement to absolute reset position/home return	700	1 ~ 5000	msec	Used for confirmation of push motion operation at movement to absolute reset position/home return. (Used for SCARA axis 3 (Zc) and linear movement axes (axes 5 and 6) (6-axis type)))
25	Push stop check time at positioning	500	1 ~ 5000	msec	Used for confirmation of push motion operation effected by a PUSH command.
26	For future extension (Change prohibited)	0	0H ~ FFFFFFFFH		
27	Maximum motor speed	5000	Reference only	rpm, mm/sec	For adjustment by the manufacturer
28	Maximum PTP speed (SCARA axis)/maximum operating speed of each axis (linear movement axis)	480, 480, 1393, 1200, 1000, 1000	1 ~ 9999	mm/sec, deg/sec	* Maximum SCARA PTP speed for SCARA axes (axes 1 to 4) (The maximum SCARA CP speed is set by all-axis parameter No. 21)
29	VLMX speed of linear movement axis	0, 0, 0, 0, 1000, 1000	1 ~ 9999	mm/s	* Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.12 or later)
30	Servo ON check time	150	0 ~ 5000	msec	Brake is installed: Time after acquisition of servo ON start response until start of brake unlock Brake is not installed: Time after acquisition of servo ON start response until transition to operation-enabled status
31	Offset travel speed at movement to absolute reset position/home return	0, 0, 3, 0, 3, 3	1 ~ 500 Reference only for SCARA axes (axes 1 to 4)	mm/sec	Used for SCARA axis 3 (Zc) and linear movement axes (axes 5 and 6 (6-axis type))
32	Actual distance between phase Z and end	-1	-1 ~ 99999	0.001 mm	Absolute distance from the search end. Obtained automatically if the distance is a negative value. When multiple actuators are combined, it is recommended to write the flash ROM after automatic acquisition. (Used for SCARA axis 3 (Zc) and linear movement axes (axes 5 and 6 (6-axis type)))
33	Ideal distance between phase Z and end	0	0 ~ 99999	0.001 mm	Absolute distance from the search end. (Used for SCARA axis 3 (Zc) and linear movement axes (axes 5 and 6 (6-axis type)))

Axis-Specific Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
34	Brake equipment specification	0, 0, 1, 1, 0, 0	0 or 1		0: Not equipped, 1: Equipped
35	Brake unlock check time	150	0 ~ 3000	msec	Time after receiving a brake-unlock start response until transition to an operation-enabled status
36	Brake lock check time	300	0 ~ 1000	msec	Time after receiving a brake-lock start response until start of servo OFF
37	For future extension (Change prohibited)	0	0 or 1 Reference only for SCARA axes (axes 1 to 4)		
38	Encoder absolute/incremental type	1, 1, 1, 1, 0, 0	0 or 1 Reference only for SCARA axes (axes 1 to 4)		0: INC, 1: ABS (Change is prohibited for SCARA axes (axes 1 to 4))
39	For future extension (Change prohibited)	0	0H ~ FFFFFFFFH		
40	For future extension (Change prohibited)	0	0H ~ FFFFFFFFH		
41	For future extension (Change prohibited)	0	0H ~ FFFFFFFFH		
42	Encoder resolution	131072	0 ~ 99999999 Reference only for SCARA axes (axes 1 to 4)	Pulse/rev, 0.001 μm Pulse	Pulses (before division)/rev, in the case of a rotary encoder
43	Encoder division ratio	2, 2, 2, 2, 3, 3	-7 ~ 7 Reference only for SCARA axes (axes 1 to 4)		Pulses are multiplied by ("n"th power of 1/2).
44	Length measurement correction	0	-99999999 ~ 99999999	0.001 mm/1M	Valid only for linear movement axes. (Coordinates other than the encoder reference Z point will change proportionally.) (Used for SCARA axis 3 (Zc) and linear movement axes (axes 5 and 6 (6-axis type)))
45~46	(For extension)	0			
47	Screw lead	20000	1 ~ 99999999 Reference only for SCARA axes (axes 1 to 4)	0.001 mm	Valid only for linear movement axes. (Used for SCARA axis 3 (Zc) and linear movement axes (axes 5 and 6 (6-axis type)))
48~49	(For extension)	0			
50	Gear ratio numerator	1, 1, 11, 1, 1, 1	1 ~ 99999999 Reference only for SCARA axes (axes 1 to 4)		

Axis-Specific Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
51	Gear ratio numerator	50, 50, 10, 15, 1, 1	1 ~ 99999999 Reference only for SCARA axes (axes 1 to 4)		
52	(For extension)	0			
53	Setting bit pattern 1 of each axis	0	0H ~ FFFFFFFFH		Bits 0 to 3: For future extension
54	Travel distance for push-motion stop detection at movement to absolute reset position/home return	20	1 ~ 99999	0.001 mm	Used for confirmation of push motion operation at movement to absolute reset position/home return. (Used for SCARA axis 3 (Zc) and linear movement axes (axes 5 and 6 (6-axis type)))
55	Travel distance for push-motion stop detection at positioning	30	1 ~ 99999	0.001 mm	Used for confirmation of push motion operation effected by a PUSH command. (Used for SCARA axis 3 (Zc) and linear movement axes (axes 5 and 6 (6-axis type)))
56	Deviation ratio for forced push-motion completion at movement to absolute reset position/home return	5000	1 ~ 99999		Deviation is compared against “Steady-state deviation of push speed + Push-speed pulse speed x Abort deviation ratio.” (Used only for axis 3 (Zc))
57	Push-abort deviation ratio at positioning	3000	1 ~ 99999		Deviation is compared against “Steady-state deviation of push speed + Push-speed pulse speed x Abort deviation ratio.”
58	Positioning band	50, 50, 100, 150, 100, 100	1 ~ 9999	0.001 mm, 0.001 deg	
59	Allowable deviation error ratio (Maximum speed pulse ratio)	85	Reference only		For adjustment by the manufacturer
60	PPG (Position gain)	60, 60, 60, 60, 30, 30	1 ~ 9999		* Change is prohibited for SCARA axes (axes 1 to 4) unless instructed by the manufacturer.
61	PFAG	0	0 ~ 999		* Change is prohibited for SCARA axes (axes 1 to 4) unless instructed by the manufacturer.
62	Linear movement axis synchro FB gain	0, 0, 0, 0, 77, 77	1 ~ 1000 Reference only for SCARA axes (axes 1 to 4)		* Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.12 or later)
63	Stop special output range	1	0 ~ 9999	Pulse	Invalid if “0” is set.
64	Stop special output value	1	0 ~ 999	DRVVR	
65	Mating synchro-axis number (linear movement axis)	0	0 ~ 8 Reference only for SCARA axes (axes 1 to 4)		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.) (Invalid if “0” is set) * Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.15 or later)
66	Mode selection for rotational movement axis (linear movement axis)	0	0 ~ 5 Reference only for SCARA axes (axes 1 to 4)		0: Normal, 1: Index mode * Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.12 or later)

Axis-Specific Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
67	Short-cut control selection for rotational movement axis (linear movement axis)	0	0 ~ 5 Reference only for SCARA axes (axes 1 to 4)		0: Do not select, 1: Select (Valid only in the index mode AND when an incremental encoder is used) * Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.12 or later)
68	Mode selection for linear movement axis (linear movement axis)	0	0 ~ 5 Reference only for SCARA axes (axes 1 to 4)		0: Normal, 1: Infinite-stroke mode (Note: Positioning boundary applies. This parameter can be specified only when an incremental encoder is used.) * Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.12 or later)
69	(For extension)	0	~		
70	For future extension	0	Reference only		For adjustment by the manufacturer
71	For future extension	0	Reference only		For adjustment by the manufacturer
72	For future extension (Change prohibited)	0	Reference only	DRVVR	For adjustment by the manufacturer
73	For future extension (Change prohibited)	0	Reference only	DRVVR	For adjustment by the manufacturer
74	For future extension	0	Reference only		For adjustment by the manufacturer
75	For future extension	0	Reference only		For adjustment by the manufacturer
76	For future extension (Change prohibited)	0	0H ~ FFFFFFFFH		(Change prohibited) 0: P21 = Phase-Z evacuation distance at incremental home return P12 = Ideal phase-Z position coordinate 1: Automatically acquire P32 even when P33 = 0. P33 = 0 "= Actual distance" P21 = Offset travel distance at home return P12 = Coordinate after offset travel at home return P26 is invalid (to make adjustment easy).
77	Synchro S pulse of linear movement axis	0, 0, 0, 0, 3, 3	0 ~ 99999 Reference only for SCARA axes (axes 1 to 4)	Pulse	* Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.12 or later)
78	Maximum takeoff command amount	0	-3000 ~ 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. (This setting is valid only when a brake is equipped.)
79	Actual takeoff check distance	5	0 ~ 3000	0.001 mm	Absolute value input
80	Maximum forced-feed range of linear movement axis	0	0 ~ 9999 Reference only for SCARA axes (axes 1 to 4)	0.001 mm	For reduction of settling time. (Invalid range if "0" is set) (Approx. 1.000 mm as a guideline) * Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.12 or later)
81	Minimum forced-feed range of linear movement axis	0, 0, 0, 0, 200, 200	0 ~ 9999 Reference only for SCARA axes (axes 1 to 4)	0.001 mm	* Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.12 or later)

Axis-Specific Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
82	Middle forced-feed range of linear movement axis	0, 0, 0, 0, 600, 600	0 ~ 9999 Reference only for SCARA axes (axes 1 to 4)	0.001 mm	* Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.12 or later)
83	Cancellation of absolute synchro slave-axis coordinate initialization (linear movement axis)	0	0 ~ 5 Reference only for SCARA axes (axes 1 to 4)		Valid only for the synchro slave axis. * Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.15 or later)
84	Maximum synchronization correction speed of synchro slave axis (linear movement axis)	0, 0, 0, 0, 5, 5	0 ~ 100 Reference only for SCARA axes (axes 1 to 4)	mm/sec	Maximum travel speed for synchronization position correction of the slave axis. Valid only for the synchro slave axis. * Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. * Note: Not limited by the safety speed. (Main application version 0.15 or later)
85	Acceleration/deceleration at movement to absolute reset position/home return	0, 0, 15, 0, 15, 15	1 ~ 300 Reference only for SCARA axes (axes 1 to 4)	0.01 G,	(Used for SCARA axis 3 (Zc) and linear movement axes (axes 5 and 6 (6-axis type)))
86	Zone 1 MAX of linear movement axis	0	-99999999 ~ 99999999 Reference only for SCARA axes (axes 1 to 4)	0.001 mm	Valid only when MAX > MIN. * Must be inside the range for at least 3 msec. * Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.15 or later)
87	Zone 1 MIN of linear movement axis	0	-99999999 ~ 99999999 Reference only for SCARA axes (axes 1 to 4)	0.001 mm	Valid only when MAX > MIN. * Must be inside the range for at least 3 msec. * Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.15 or later)
88	Zone 1 output number for linear movement axis	0	0 ~ 899 Reference only for SCARA axes (axes 1 to 4)		Physical output port or global flag (Output is invalid if “0” is input; multiple specification is invalid) * Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.15 or later)
89	Zone 2 MAX of linear movement axis	0	-99999999 ~ 99999999 Reference only for SCARA axes (axes 1 to 4)	0.001 mm	Valid only when MAX > MIN. * Must be inside the range for at least 3 msec. * Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.15 or later)
90	Zone 2 MIN of linear movement axis	0	-99999999 ~ 99999999 Reference only for SCARA axes (axes 1 to 4)	0.001 mm	Valid only when MAX > MIN. * Must be inside the range for at least 3 msec. * Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.15 or later)
91	Zone 2 output number for linear movement axis	0	0 ~ 899 Reference only for SCARA axes (axes 1 to 4)		Physical output port or global flag (Output is invalid if “0” is input; multiple specification is invalid) * Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.15 or later)
92	Zone 3 MAX of linear movement axis	0	-99999999 ~ 99999999 Reference only for SCARA axes (axes 1 to 4)	0.001 mm	Valid only when MAX > MIN. * Must be inside the range for at least 3 msec. * Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.15 or later)

Axis-Specific Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
93	Zone 3 MIN of linear movement axis	0	-99999999 ~ 99999999 Reference only for SCARA axes (axes 1 to 4)	0.001 mm	Valid only when MAX > MIN. * Must be inside the range for at least 3 msec. * Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.15 or later)
94	Zone 3 output number for linear movement axis	0	0 ~ 899 Reference only for SCARA axes (axes 1 to 4)		Physical output port or global flag (Output is invalid if “0” is input; multiple specification is invalid) * Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.15 or later)
95	Zone 4 MAX of linear movement axis	0	-99999999 ~ 99999999 Reference only for SCARA axes (axes 1 to 4)	0.001 mm	Valid only when MAX > MIN. * Must be inside the range for at least 3 msec. * Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.15 or later)
96	Zone 4 MIN of linear movement axis	0	-99999999 ~ 99999999 Reference only for SCARA axes (axes 1 to 4)	0.001 mm	Valid only when MAX > MIN. * Must be inside the range for at least 3 msec. * Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.15 or later)
97	Zone 4 output number for linear movement axis	0	0 ~ 899 Reference only for SCARA axes (axes 1 to 4)		Physical output port or global flag (Output is invalid if “0” is input; multiple specification is invalid) * Valid for linear movement axes (axes 5 and 6 (6-axis type)) only. (Main application version 0.15 or later)
98~ 116	(For extension)	0	~		
117	PIG	0	Reference only		For adjustment by the manufacturer
118	PDG	0	Reference only		For adjustment by the manufacturer
119	PFSG	50, 50, 50, 50, 0, 0	0 ~ 100		* Change is prohibited unless instructed by the manufacturer.
120	PFF	10	0 ~ 100		* Change is prohibited unless instructed by the manufacturer.
121~ 130	(For extension)	0	~		
131	For future extension (Change prohibited)	0	0H ~ FFFFFFFFH		
132	For future extension (Change prohibited)	0	0H ~ FFFFFFFFH		
133	For future extension (Change prohibited)	0	0H ~ FFFFFFFFH		
134	Maximum PTP acceleration of SCARA axis	2700, 5400, 160, 11000, 0, 0	1 ~ 99999999	0.01 G, deg/sec^2	Set in units of 0.01 G only for axis 3 (Zb). Set in deg/sec^2 for other SCARA axes.
135	Maximum PTP deceleration of SCARA axis	2700, 5400, 160, 11000, 0, 0	1 ~ 99999999	0.01 G, deg/sec^2	Set in units of 0.01 G only for axis 3 (Zb). Set in deg/sec^2 for other SCARA axes.

Axis-Specific Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
136	Minimum PTP emergency deceleration of SCARA axis	2700, 5400, 160, 11000, 0, 0	1 ~ 99999999	0.01 G, deg/sec^2	Set in units of 0.01 G only for axis 3 (Zb). Set in deg/sec^2 for other SCARA axes.
137	For future extension (Change prohibited)	0	0H ~ FFFFFFFFH		
138	Arm length	250000, 250000, 0, 0, 0, 0	1 ~ 99999999	0.001 mm	(Used only for axis 1 (A1c) and axis 2 (A2c))
139	Rear entry prohibition area MAX (Xb) for SCARA axis	100000, 0, 0, 0, 0, 0	-99999999 ~ 99999999	0.001 mm	For simple check. (Used only for axis 1 (Xb))
140	Rear entry prohibition area MIN (Xb) for SCARA axis	-100000, 0, 0, 0, 0, 0	-99999999 ~ 99999999	0.001 mm	For simple check. (Used only for axis 1 (Xb))
141	Reference position coordinates at automatic update of home preset value	90000, 0, 0, -90000, 0, 0	-99999999 ~ 99999999	0.001 mm	
142	Selection of SCARA R-axis → Z-axis correction coordinate direction	0	0 or 1		0: Correction from positive direction of R-axis coordinate to positive direction of Z-axis coordinate 1: Correction from positive direction of R-axis coordinate to negative direction of Z-axis coordinate (Used only for axis 3 (Zc))
143	Limit entry angle into SCARA-axis CP-operation restriction zone based on actual position (A2c)	0, 0, 0, 0, 0, 0	Reference only	0.001 deg	For adjustment by the manufacturer
144	End-offset travel distance at standby in reference position	0, 0, 5500, 0, 0, 0	-99999999 ~ 99999999	0.001 mm	(Positive value = Direction of moving away from the end) (Used only for axis 3 (Zc))

Axis-Specific Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
145	SIO current-arm-system change speed default value (A2c)	0, 3, 0, 0, 0, 0	1 ~ 10	%	(Used only for axis 2 (A2c))
146	Reserved by the system (Change prohibited)	5000, 5000, 5000, 5000, 0, 0	Reference only	rpm	For adjustment by the manufacturer
147~170	(For extension)	0	~		
171	Reserved by the system (Change prohibited)	2900, 13100, 611, 0, 0, 0,	0 ~ 99999999		For adjustment by the manufacturer
172	Reserved by the system (Change prohibited)	108200, 108600, 0, 0, 0, 0	- 99999999 ~ 99999999		For adjustment by the manufacturer
173	Reserved by the system (Change prohibited)	0	- 99999999 ~ 99999999		For adjustment by the manufacturer
174	Reserved by the system (Change prohibited)	0	0 ~ 99999999		For adjustment by the manufacturer
175	Reserved by the system (Change prohibited)	0	0 ~ 99999999		For adjustment by the manufacturer
176	Reserved by the system (Change prohibited)	36575, 138028, 44, 0, 0, 0	0 ~ 99999999		For adjustment by the manufacturer
177	Reserved by the system (Change prohibited)	0	0 ~ 99999999		For adjustment by the manufacturer
178	Reserved by the system (Change prohibited)	0	0 ~ 99999999		For adjustment by the manufacturer
179	Reserved by the system (Change prohibited)	34000, 18000, 116660, 19980, 0, 0	0 ~ 99999999		For adjustment by the manufacturer
180	Reserved by the system (Change prohibited)	70, 70, 70, 0, 0	0 ~ 100		For adjustment by the manufacturer

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
183	Reserved by the system (Change prohibited)	0	0 ~ 99999999		For adjustment by the manufacturer
184	Reserved by the system (Change prohibited)	0	0 ~ 99999999		For adjustment by the manufacturer
185	Reserved by the system (Change prohibited)	8000, 15000, 460, 17000, 0, 0	0 ~ 99999999		For adjustment by the manufacturer
186	Reserved by the system (Change prohibited)	8000, 15000, 460, 17000, 0, 0	0 ~ 99999999		For adjustment by the manufacturer
187	Reserved by the system (Change prohibited)	80, 80, 80, 80, 0, 0	0 ~100		For adjustment by the manufacturer
188 ~ 220	(For extension)				
221 ~ 250	(For extension)				(Main application version 0.65 or later/controller with increased memory size (with gateway function) 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		For adjustment by the manufacturer
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	1 ~ 30		Encoder cable length (m) ☆ Be sure to change this parameter when 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	(Configuration information)	70	0 ~ 200	%	* Linear axis (valid with axis 5 or 6) (Main application version 0.35 or later)
38	Push torque limit during positioning	70	0 ~ 200	%	
39	Push torque limit at home return	100	0 ~ 150	%	
40	Maximum torque limit	300	10 ~ 400	%	* The maximum value that can be set varies depending on the motor, etc.
41	Dynamic brake operation specification	0	0 ~ 1		0: Disable, 1: Enable
42	Software DB operation specification	0	0 ~ 1		0: Enable, 1: Disable
43	Speed loop gain	500	1 ~ 32767		Proportional gain
44	Speed loop integration time constant	30	1 ~ 1000		Integral gain
45	Torque filter time constant	0	0 ~ 2500		
46	Current control band number	4	0 ~ 4		
47 ~ 52	(For extension)	0H	0000H ~ 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 ~ FFFFH		Bits 0 to 15: Reserved bits
60	Current control word 8	0H	0000H ~ FFFFH		Bits 0 to 15: Reserved bits

Driver Card Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
61 ~ 67	(For extension)	0H	0000H ~ 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	Configured capacity (rated motor output) (compatible with X-E) (function information)	003CH	Reference only		For adjustment by the manufacturer
10	Configured 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 characteristics 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 = temp.)	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
23~30	Card parameter (by board type)	0000H	Reference only		For adjustment by the manufacturer

6. I/O Device 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)	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 ~ 52	Device parameter (by board type)	0000H	Reference only		For adjustment by the manufacturer
53~ 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 ~ 64		(Invalid if "0" is set)
2	I/O processing program number at operation/program abort	0	0 ~ 64		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 ~ 64		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 ~ 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, servo OFF or all-axis servo OFF, 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 ~ 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 ~ 99999	msec	* The setting will become effective after the controller, PC software or TP is restarted.
7~8	(For extension)	0			
9	For future extension (Change prohibited)	0	0 ~ 9		
10	Emergency-stop recovery type	0	0 ~ 4		0: Abort operations/programs 1: Recovery after reset 2: Operation continued (Only during automatic operation. * Operation commands from the PC software/TP will be aborted from the PC software/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 $\neq$ 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.)
11	Enable switch (deadman switch/enable switch) recovery type	0	0 ~ 2		0: Abort operations/programs 1: Recovery after reset 2: Operation continued (Only during automatic operation. * Operation commands from the PC software/TP will be aborted from the PC software/TP side.)

PC: PC software
TP: Teaching pendant

Other Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
12	Automatic operation recognition type	0	0 ~ 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~ 19	(For extension)	0			
20	System-memory backup battery installation function type	2	0 ~ 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 operation type	0	0 ~ 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 ~ 99		0: J, 1: E, 2: EU
23	PSIZ command function type	0	0 ~ 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 ~ 99, 1001 ~ 1099		
25~ 29	(For extension)	0			
30	Option Password 00	0H	0H ~ FFFFFFFFH		HOME command option (Change prohibited) * Change is prohibited unless instructed by the manufacturer.
31	Option Password 01	0H	0H ~ FFFFFFFFH		Reserved (Change prohibited) * Change is prohibited unless instructed by the manufacturer.
32	Option Password 02	0H	0H ~ FFFFFFFFH		Reserved (Change prohibited) * Change is prohibited unless instructed by the manufacturer.
33~ 35	(For extension)	0	0H ~ FFFFFFFFH		

Other Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
36	PC/TP data protect setting (Program)	0H	0H ~ 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
37	PC/TP data protect setting (Position)	0H	0H ~ 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
38	PC/TP data protect setting (Symbol, parameter)	0H	0H ~ FFFFFFFFH		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

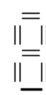
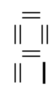
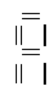
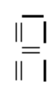
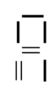
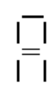
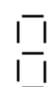
Other Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
39	PC/TP data protect setting (Coordinate system)	0H	0H ~ FFFFFFFFH		Bits 0 to 3: Protect type (Tool coordinate offset) (0: Read/write, 1: Read only, 2: No read/write) Bits 4 to 7: Protect release method (Tool coordinate offset) (0: Special operation) Bits 8 to 11: Protect type (Load coordinate offset) (0: Read/write, 1: Read only, 2: No read/write) Bits 12 to 15: Protect release method (Load coordinate offset) (0: Special operation) Bits 16 to 19: Protect type (Definition coordinates of simple interference check zone) (0: Read/write, 1: Read only, 2: No read/write) Bits 20 to 23: Protect release method (Definition coordinates of simple interference check zone) (0: Special operation) * Referenced by the PC/TP
40	For future extension (Change prohibited)	83H	Reference only		For adjustment by the manufacturer
41	For future extension (Change prohibited)	0H	Reference only		For adjustment by the manufacturer
42	For future extension (Change prohibited)	6H	Reference only		For adjustment by the manufacturer
43	For future extension	0H	0H ~ FFFFFFFFH		
44	(For extension)	0			
45	Special start condition setting	0	0H ~ FFFFFFFFH		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: For future extension 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 ~ FFFFFFFFH		Bits 0 to 3: Variable-value format type in response message to real-number/variable query (0: Big endian with four upper/lower binary-converted 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 extension * Change is strictly prohibited unless instructed by the manufacturer. Bits 12 to 15: Command processing selection when subroutine step 1 input condition is not specified at specification of TPCD command = 1 (0: Do not execute, 1: Execute, 2: Error) Bits 16 to 19: Reserved by the system. Bits 20 to 23: Continuous recovery movement/resumption operation timing type (0: Resume after completion of continuous recovery movement of a group of axes used in the same task (Same as before) 1: Resumption operation is put on hold while any axis is still performing continuous recovery operation (This is different from waiting for completion of continuous recovery movement.)) (Main application version 0.47 or later)
47~ 48	(For extension)	0			

Other Parameters

No.	Parameter name	Default value (Reference)	Input range	Unit	Remarks
49	Panel 7-segment display data type	0	0 ~ 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.”
50	Auxiliary specification for panel 7-segment display data type	0	-99999999 ~ 99999999		* Refer to the Remarks field for “Other parameter No. 49.”
51~ 120	(For extension)	0			
121 ~ 200	(For extension)				(Main application version 0.65 or later/controller with increased memory size (with gateway function) only)

8. 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.

9. 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.

<table>
<tr><th>Description</th><th>Action</th><th>Parameter setting</th><th>Manipulation/operation</th></tr>
<tr><td>Want to execute home return for all incremental linear movement axes using an external input signal.</td><td>Input port No. 15 can be used as a home return input.</td><td>I/O parameter No. 45 = 2</td><td>Home return will be executed at the ON edge of input port No. 15. (Servo ON must be executed beforehand.)</td></tr>
<tr><td>Want to input program numbers from input ports in binary. (The default setting is BCD input.)</td><td>Program numbers can be input from input port Nos. 7 to 13 in binary.</td><td>I/O parameter No. 30 = 2</td><td></td></tr>
<tr><td>Want to check the level of the present error from an output port.
Want to check for emergency stop status from an output port.</td><td>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.</td><td>I/O parameter No. 46 = 2
I/O parameter No. 47 = 3
I/O parameter No. 48 = 2
(Parameter settings at shipment)</td><td>ON/OFF of output port Nos. 300 and 301 and corresponding error levels
<table>
<tr><th></th><th>300</th><th>301</th></tr>
<tr><td>Message level or lower</td><td>○</td><td>○</td></tr>
<tr><td>Operation-cancellation level</td><td>●</td><td>○</td></tr>
<tr><td>Cold-start level</td><td>●</td><td>●</td></tr>
</table>
○: ON ●: OFF
Output port No. 302 being OFF indicates an emergency stop status.
<table>
<tr><th></th><th>302</th></tr>
<tr><td>Emergency stop actuated</td><td>●</td></tr>
<tr><td>Emergency stop not actuated</td><td>○</td></tr>
</table>
Note) Parameter settings at shipment</td></tr>
<tr><td>Want to output signal during the AUTO mode.</td><td>Output port No. 303 can be set as an AUTO mode output signal.</td><td>I/O parameter No. 49 = 1</td><td>Output port No. 303 will turn ON during the AUTO mode.</td></tr>
<tr><td>Want to output signal during automatic operation.</td><td>Output port No. 303 can be set as an automatic operation output.</td><td>I/O parameter No. 49 = 2</td><td>Output port No. 303 will turn ON during automatic operation.</td></tr>
<tr><td>Recognition of automatic operation: Recognition of automatic operation can be changed using the setting of other parameter No. 12.</td><td>• 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.</td><td>• 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).</td><td></td></tr>
</table>

Description	Action	Parameter setting	Manipulation/operation
Want to output signal when all valid linear movement axes are at their home.	Output port No. 304 can be set as a signal indicating that all valid linear movement 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 linear movement axes are at their home.
Want to output signal when all valid linear movement axes have completed home return.	Output port No. 304 can be set as a signal indicating that all valid linear movement axes have completed home return.	I/O parameter No. 50 = 2	Output port No. 304 will turn ON when all valid linear movement axes have completed home return.
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 3: I/O parameter No. 64 Axis 4: I/O parameter No. 65 Axis 5: I/O parameter No. 66 Axis 6: I/O parameter No. 67 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. 305 through 315 will be retained while emergency-stop signal is input or the safety gate is open.

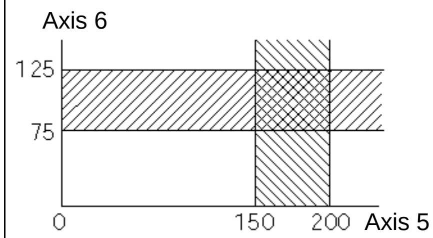
Description	Action	Parameter setting	Manipulation/operation
Want to start programs while emergency-stop signal is input or the safety gate is open. Programs to be started are I/O processing or calculation programs that do not command actuator operation (PIO processing programs).	A PIO processing program 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.

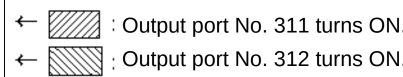
Description	Action	Parameter setting	Manipulation/operation
Want to continue actuator operation after the emergency stop is reset (want to resume actuator operation from the part stopped due to emergency stop input). Programs other than the one commanding actuator operation remain running while emergency-stop 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 a linear movement axis enters a specified area (zone).</td>
<td>A desired zone can be set for each linear movement 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 5: Output port No. 311 will turn ON when the axis enters the area between 150 and 200 mm.
Axis 6: Output port No. 312 will turn ON when the axis enters the area between 75 and 125 mm.

<table><tr><th></th><th>Axis 5</th><th>Axis 6</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.

</td>
</tr>
</table>

Before changing a parameter, be sure to read the corresponding section in the List of Parameters.

Combination Table of X-SEL PX/QX Axis 5/6 Linear/Rotary Control Parameter (Other than SCARA Axes)

<table>
<tr><th rowspan="2">Axis-specific parameter No. 1, Axis operation type</th><th rowspan="2">Axis-specific parameter No. 68, Mode selection for linear movement axis</th><th rowspan="2">Axis-specific parameter No. 66, Mode selection for rotational movement axis</th><th rowspan="2">Axis-specific parameter No. 67, Short-cut control selection for rotational movement axis</th><th colspan="3">Permitted encoder processing method</th><th rowspan="2">Expression of current position (approx.)</th><th rowspan="2">Axis-specific parameter No. 7, Soft limit +</th><th rowspan="2">Axis-specific parameter No. 8, Soft limit –</th><th rowspan="2">Axis-specific parameter No. 44, Length measurement correction</th><th rowspan="2">Axis-specific parameter No. 47, Screw lead</th><th rowspan="2">Axis-specific parameter No. 50, Gear ratio numerator</th><th rowspan="2">Axis-specific parameter No. 51, Gear ratio denominator</th><th rowspan="2">Input unit</th></tr>
<tr><th>ABS</th><th>Simulated INC</th><th>INC</th></tr>
<tr><td rowspan="2">0
(Linear movement axis)</td><td>0
(Normal mode)</td><td rowspan="2">Invalid</td><td rowspan="2">Invalid</td><td>○</td><td>○</td><td>○</td><td>Counter range</td><td>Valid</td><td>Valid</td><td rowspan="2">Valid</td><td rowspan="2">Valid</td><td rowspan="2">Valid</td><td rowspan="2">Valid</td><td rowspan="2">• Distance mm
• Speed mm/sec
• Acceleration/ deceleration G</td></tr>
<tr><td>1
(Infinite-stroke mode)
* Duty cycle timeout check must be reviewed.</td><td>x</td><td>○</td><td>○</td><td>-10000 ~ 9999.999 (Rotary)</td><td>Invalid (Note)</td><td>Invalid (Note)</td></tr>
<tr><td rowspan="3">1
(Rotational movement axis)</td><td rowspan="3">Invalid</td><td>0
(Normal mode)</td><td>0
(Short-cut control not selected)
* “0” must be specified if the normal mode is selected.</td><td>○</td><td>○</td><td>○</td><td>Counter range</td><td>Valid</td><td>Valid</td><td rowspan="3">Invalid</td><td rowspan="3">Invalid</td><td rowspan="3">Valid</td><td rowspan="3">Valid</td><td rowspan="3">• Angle mm → deg
• Angular speed mm/sec → deg/sec
• Angular acceleration/deceleration G = 9807 mm/sec2 → 9807 deg/sec2 = 9807 x 2π/360 rad/sec2
* A “deg” value indicates the angle of the rotating body at the end.</td></tr>
<tr><td rowspan="2">1
(Index mode)</td><td>0
(Short-cut control not selected)</td><td>○</td><td>○</td><td>○</td><td>Counter range</td><td rowspan="2">Invalid (fixed to 359.999 internally)</td><td rowspan="2">Invalid (fixed to 0 internally)</td></tr>
<tr><td>1
(Short-cut control selected)</td><td>x</td><td>○</td><td>○</td><td>0 ~ 359.999 (Rotary)</td></tr>
</table>

(Note): Any positioning command other than “JXWX” exceeding a coordinate range from approx. -9990 to 9990 will generate an “Error No. CBE, Target-path 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.”

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)		Error reset (Application only)	Remarks
						Other parameter No. 4 = 0	Other parameter No. 4 = 1		
Secret level	MAIN application	800 ~ 88F		○					Special error level provided for maintenance purposes
	MAIN core	890 ~ 8AF							
	PC	8B0 ~ 8DF							
	TP	8E0 ~ 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 ~ 24F							
	MAIN core	-							
	PC	250 ~ 29F							
	PC (Update tool)	2A0 ~ 2CF							
	TP	2D0 ~ 2FF							
	MAIN application	900 ~ 93F							
	MAIN core	940 ~ 97F							
	PC	980 ~ 9AF							
	PC (Update tool)	9B0 ~ 9BF							
	TP	9C0 ~ 9FF							
	MAIN application	A00 ~ A6F							
	MAIN core	A70 ~ A9F							
	PC	AA0 ~ ACF							
	TP	AD0 ~ 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. (Main application version 0.17 or later)	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 ~ 4CF							
	MAIN core								
	PC	4D0 ~ 4DF							
	PC (Update tool)	4E0 ~ 4EF							
	TP	4F0 ~ 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)		Error reset (Application only)	Remarks
						Other parameter No. 4 = 0	Other parameter No. 4 = 1		
Operation-cancellation level	MAIN application	B00 ~ 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. (Main application version 0.17 or later)	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 ~ BBF							
	PC	BC0 ~ BDF							
	TP	BE0 ~ BFF							
	MAIN application	C00 ~ CCF							
	MAIN core	CD0 ~ CDF							
	PC	CE0 ~ CEF							
	TP	CF0 ~ 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 ~ 6CF							
	MAIN core	-							
	PC	6D0 ~ 6DF							
	PC (Update tool)	6E0 ~ 6EF							
	TP	6F0 ~ 6FF							
	MAIN application	D00 ~ D8F							
	MAIN core	D90 ~ DAF							
	PC	DB0 ~ DCF							
	PC (Update tool)	DD0 ~ DDF							
	TP	DE0 ~ DFF							
	MAIN application	E00 ~ E8F							
	MAIN core	E90 ~ EBF							
	PC	EC0 ~ EDF							
	TP	EE0 ~ 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 (Update tool)								
	PC								
	TP								
	MAIN application	FF0 ~ F8F							
	MAIN core	FC0 ~ FCF							
	PC	FD0 ~ FDF							
	TP	FE0 ~ 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	There may be a broken pin inside the controller, among other reasons.
202	ENB logic error	There may be a broken pin inside the controller, among other reasons.
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.
220	RC axis multiple use error (SIO)	An attempt was made to acquire the right to use a RC axis already in use.
221	RC axis right-of-use acquisition error (SIO)	The RC axis use management area has no free space.
223	RC gateway operation mode error	Operation is not possible in the current RC gateway operation mode.
224	RC gateway status command error	Operation is not possible in the current RC gateway status
225	RC axis number error	The specified RC axis number is invalid.
226	RC position number error	The specified RC position number is invalid.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
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.
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).
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	Initialization of the vision system is not yet complete. Check the input port number setting in all-axis parameter No. 88, and also check if the vision system has been initialized, among others.
40D	Vision system response timeout error	Communication response from the vision system cannot be confirmed. Check bits 4-7 of I/O parameter No. 129, I/O parameter Nos. 160 to 164, all-axis parameter Nos. 62, 63 and 89, and also check if the vision system is sending data in response to imaging commands, among others.
40E	Tracking parameter error	Invalid tracking parameter. Check if the tracking parameters in all-axis parameter Nos. 61 to 95, etc., are set correctly. If conveyor tracking adjustment has not been completed successfully, perform conveyor tracking adjustment first.
40F	Tracking load coordinate system error	The current definition data for the load coordinate system is different from the definition data for the load coordinate system used in conveyor tracking adjustment. Before performing tracking action, select the load coordinate system used in conveyor tracking adjustment.
410	Tracking system initialization incomplete error	Initialization of the vision system is not yet complete. Check if the tracking system type specified in all-axis parameter No. 61 is not set to “Do not use system.”
411	Tracking system in use by other task error	The tracking system is being used by other task. Use the tracking system within the same task.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
412	Exclusive mode specification error	Modes that cannot be specified simultaneously are specified at the same time. Check if the quick return mode and tracking mode are specified at the same time, among others.
413	Prohibited-command execution during tracking operation error	An attempt was made to execute a command prohibited during tracking operation. Execute the command after completing the tracking operation with a TRAC command.
414	Detected-load held-up count over error	The number of detected loads waiting for tracking operation (number of loads waiting for TRAC command execution), existing between the camera (vision system) and robot or between the load detection sensor and robot, exceeded the allowable held-up count. Reduce the number of loads on the conveyor, shorten the distance from the sensor (vision sensor or photoelectric sensor) to the start position of tracking operation, shorten the tracking operation time or take other appropriate action to reduce the number of held-up loads. This error may also generate if a TRAC command is not executed promptly upon detection of a load.
415	Unsupported ID code reception error (tracking data communication)	An unsupported ID code was received from the vision system. Check the data sent.
416	Tracking received message error (tracking data communication)	Invalid data was received from the vision system. Check if data of a wrong format has been sent, among other.
417	Received tracking load count error (tracking data communication)	The load count received from the vision system exceeds the maximum number of loads allowed per imaging. Increase the interval between loads on the conveyor or take other appropriate action to prevent the maximum limit from being exceeded.
420	Steady-state (non-push) torque limit over error	The steady-state (non-push) torque limit is exceeded. Unexpected load and locked operation are among the possible causes.
421	SCARA/linear movement axis simultaneous specification error	SCARA and linear movement axes were specified simultaneously. SCARA and linear movement axes cannot be specified or operated at the same time. Check the axis pattern, position data, etc. * SCARA only.
425	Mounted SIO communication mode error	Invalid communication mode
430	UBM management area checksum error	The flash ROM data is corrupted. Save the user-data backup memory to the flash ROM.
431	UBM data checksum error	The flash ROM data is corrupted. Save the user-data backup memory to the flash ROM.
432	UBM SRAM data corruption error	Data in the user-data backup memory is corrupted. Check the battery.
433	RC gateway minor failure error	The RC gateway experienced a minor failure.
434	RC gateway RC axis detachment detection error	Detachment of a RC axis was detected. Check the cable connection.

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Error No.	Error name	Description, action, etc.
435	RC gateway RC axis continuation disable error	The RC axis generated an alarm that disables continuation of operation. Example: • A RC position number outside the allowable range was directed. (RC position data specification mode in RC) • A speed, acceleration/deceleration or other setting outside the allowable range was directed. (RC position data specification mode in X-SEL)
436	RC gateway command alarm error	A gateway command generated an alarm.
437	RC axis number error	The specified RC axis number is invalid.
438	RC position number error	The specified RC position number is invalid.
439	RC gateway operation mode error	Operation is not possible in the current RC gateway operation mode.
43A	RC gateway status command error	Operation is not possible in the current RC gateway status
43B	RC axis pattern not-yet-set error	The RC axis pattern is not yet set. Issue a RAXS command.
43C	RC axis in-use servo OFF error	The servo of a RC axis currently in use (under processing) was turned OFF.
43D	RC axis multiple use error	An attempt was made to acquire the right to use a RC axis already in use.
43E	RC axis with error use error	An attempt was made to use the RC axis with error.
43F	RC axis right-of-use acquisition error	The RC axis use management area has no free space.
440	Servo-OFF RC axis use error	An attempt was made to use a RC axis whose servo was OFF.
441	RC axis home return incomplete error	The RC axis has not yet completed home return.
442	Bad RC axis position complete position error	The RC axis position attained upon completion of RC axis positioning is bad.

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Error No.	Error name	Description, action, etc.
601	EMG logic error	There may be a broken pin inside the controller, among other reasons.
602	ENB logic error	There may be a broken pin inside the controller, among other reasons.
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 if the axis set in all-axis parameter No. 61 can be used as a tracking encoder axis.
674	Tracking encoder open error	The tracking encoder cable is open. Reconnect the power.
675	Tracking absolute encoder logic error	An abnormal power level pattern was detected for the tracking encoder phase A/B. Reconnect the power.
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.
6A0	UBM flash ROM status error	The user-data backup memory was not properly written to the flash ROM, or the data was written in an incompatible old version.

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Error No.	Error name	Description, action, etc.
6A1	UBM data configuration change error	Data configuration in the user-data backup memory was changed. Initialize the memory.
6A2	UBM size overflow error	Settings exceeded the user-data backup memory size. • Too many RC gateway position points
6A3	UBM use function over error	The user-data backup memory is used by too many functions. Limit the applicable functions to 8 or less.
6A4	RC axis position data setting error	Invalid RC axis position data setting. Example: • The value of other parameter No. 501 is greater than the value of other parameter No. 503. • An axis outside the range of other parameter No. 502 is enabled.
6A5	RC axis position data enable address error	An attempt was made to access an invalid RC axis position data.
6A6	RC gateway DPRAM access error (main)	A DPRAM access violation error occurred between the main and SIO board. (Main CPU side)
6A7	RC gateway DPRAM access error (mounted SIO)	A DPRAM access violation error occurred between the main and SIO board. (Mounted SIO)
6A8	RC gateway major failure error	The mounted SIO experienced a major failure. Example: • All enabled RC axes have detached (due to cable disconnection, broken wire, etc.) • The power-supply switch on the main CPU board is receiving 0 V. • The mounted SIO could not acquire the DPRAM access right for a specified period or longer. • The mounted SIC generated a CPU error or other major error.
6A9	RC gateway link initialization timeout error	A timeout occurred in the initialization of a RC axis link.
6AA	RC gateway DPRAM access right timeout error	The DPRAM access right could not be acquired for a specified period or longer.
6AB	RC gateway command issuance timeout error	A gateway command cannot be issued.
6AC	RC axis control job logic error	Invalid RC axis control job logic.
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 RC gateway initialization logic.
6B1	RC gateway unsupported error (mounted SIO)	Invalid RC gateway system configuration.
6B2	RC gateway I/O assignment parameter error	Invalid assignment setting in the PLC through mode.
6B3	RC axis control job timeout error	No response was returned from the RC axis for a specified period.
6B4	RC gateway emergency-stop mismatch error	The emergency stop status of the X-SEL control does not match the emergency stop status of the RC controller. Check the connection.
6B5	Belt breakage error	The drive belt in the actuator broke.

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Error No.	Error name	Description, action, etc.
6B6	“Allowable time to exceed maximum continuous operation torque” over error	A condition where the torque command exceeds the “maximum continuous operation torque” has continued for the “allowable time to exceed maximum continuous operation torque” or more.
6BB	Deviation overflow error (when home return is not yet completed)	The command cannot be performed. Check for locked operation and also check the wiring, encoder, motor, etc. The electrical angle may be inconsistent.
6BC	Stop deviation overflow error (when home return is not yet completed)	The actuator may have moved while stationary due to an external force or its operation may have been locked during deceleration. This error may also occur when the operation is locked while jogging (due to contact with an obstacle, contact with the mechanical end while jogging before home return, etc.) or as a result of wiring error, encoder failure or motor failure occurring during deceleration. The electrical angle may be inconsistent.
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.)
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.

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Error No.	Error name	Description, action, etc.
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.)
821	Tracking system adjustment-type specification error	The specified tracking system adjustment type is invalid. Specify only the type allowed. * SCARA only.
822	Belt rupture error	Drive power belt in the actuator was ruptured.

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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 extension)
911	Message conversion error (IAI protocol HT reception)	The transmitted message does not match the message format or contains invalid data. (For future extension)
912	PC/TP-servo movement command acceptance permission input OFF error	No command can be accepted for the target axis of I/O parameter No. 78 from the PC or TP while the input port specified by I/O parameter No. 77 is OFF. (Important: The permission input port becomes invalid once operation has started. Cartesian axis only.)
913	Multiple-program simultaneous start prohibition error	Simultaneous starting of multiple programs is prohibited.
914	Abnormal absolute-data backup battery voltage	Check/replace the absolute-encoder backup battery and check the encoder cable connection, and then execute an absolute reset.
930	Coordinate system number error	The coordinate system number is invalid. * SCARA only.
931	Coordinate system type error	The coordinate system type is invalid. * SCARA only.
932	Coordinate system definition data count-specification error	The specified number of coordinate system definition data is invalid. * SCARA only.
933	Axis number error	The axis number is invalid. * SCARA only.
934	Operation type error for SCARA ABS-reset special movement	The operation type for SCARA ABS-reset special movement is invalid. * SCARA only.
935	Positioning operation type error	The positioning operation type is invalid. * SCARA only.
936	Simple interference check zone number error	The simple interference check zone number is invalid. * SCARA only.

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Error No.	Error name	Description, action, etc.
938	Simple interference check zone data count-specification error	The specified number of simple interference check zone data is invalid. * SCARA only.
939	Detection of entry into simple interference check zone (Message level specification)	Entry into the simple interference check zone was detected. (Message level specification) * SCARA only.
93A	R-axis CP jog prohibition error when out of operation range (When tool XY offset is valid)	Move into the operation range by jogging each axis. * SCARA only.
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 detection)	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.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
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.
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.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
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.
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.

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Error No.	Error name	Description, action, etc.
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.
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.

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Error No.	Error name	Description, action, etc.
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.
A6F	Driver monitor type mismatch error	The support monitor type based on the Standard DIO Board Support Monitor Type/Main CPU Board FROM Procedure does not match the monitor type set in the PC software (monitor screen selection).
A8E	Unit type error (core detection)	The unit type in the message received with the command 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.)
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.
B10	Phase-Z search timeout error	Phase Z 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	A variable number error occurred regarding the SEL-command return code storage variable.
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 socket open-without-close error	An attempt was made to open the socket again without closing it.
B1C	Ethernet channel in-use error	An attempt was made to open a channel already opened by other task.

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Error No.	Error name	Description, action, etc.
B1D	Ethernet non-open error	An attempt was made to use a channel not yet opened by own task.
B1E	Ethernet multiple WRIT execution error	WRIT commands were executed simultaneously in multiple tasks for the same channel, or a WRIT command had failed (due to a communication error, etc.) and then was retried without executing a CLOS command → OPEN command first.
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.
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.
B44	Load mass setting error	The load mass exceeds the maximum loading capacity of the robot. Check the set mass.
B4B	"Load mass change prohibited while servo is in use" error	The load mass currently used by the servo system cannot be changed.
B70	Checksum error in coordinate system definition data	The flash ROM data is damaged. * SCARA only.
B71	Coordinate system number error	The coordinate system number is invalid. * SCARA only.
B72	Coordinate system type error	The coordinate system type is invalid. * SCARA only.

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Error No.	Error name	Description, action, etc.
B73	Error due to prohibition of change of coordinate system data used by servo	Changing of coordinate system data currently used by the servo system is prohibited. * SCARA only.
B74	CP-operation restriction zone entry error (PTP/jogging of each axis enabled)	Entry into the CP-operation restriction zone was detected. PTP operation and jogging operation of each axis are enabled. * SCARA only.
B75	Singular-point calculation error	CP calculation cannot be performed due to the singular point. Check for invalid coordinate caused by an inappropriate home of arm 2, etc. * SCARA only.
B77	Current arm system setting error	The target arm system to be set does not match the actual angle of arm 2, or coordinates are not yet determined. * SCARA only.
B78	Current arm system indetermination error	The current arm system is indeterminable. * SCARA only.
B79	R-axis servo OFF detection error during position control correction	R-axis servo OFF was detected during position control correction. * SCARA only.
B7A	Z-axis servo OFF detection error during RZ mechanism correction	Z-axis servo OFF was detected during RZ mechanism correction. * SCARA only.
B7B	Error due to target locus inside rear entry prohibition area	The target position or movement locus is inside the rear entry prohibition area. * SCARA only.
B7C	Error due to target locus inside CP-operation restriction zone (PTP/jogging of each axis enabled)	The target position or movement locus is inside CP-operation restriction zone. PTP operation and jogging operation of each axis are enabled. * SCARA only.
B7D	Physically unrealizable target error	The specified target is unrealizable based on the arm length composition of axes 1 and 2. Check "Axis-specific parameter No. 138, Arm length" and the target value. * SCARA only.
B7F	Servo use purpose error	The use purpose of servo is invalid. * SCARA only.
B80	Specification-prohibited axis error	Specification of the axis is prohibited. Set an axis that can be specified. * SCARA only.
B81	Axis-specific PTP multiple-axis specification error	Axis-specific PTP operation was specified for multiple axes. Axis-specific PTP operation can be specified only for a single axis. * SCARA only.
B82	Jogging multiple-axis specification error	Jogging/inching was specified for multiple axes. Jogging/inching can be specified only for a single axis. * SCARA only.

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Error No.	Error name	Description, action, etc.
B83	Rc = 0 wait timeout error upon Zc-axis home return	Timeout of R-axis 0 positioning has occurred. Check for operation restriction, wiring, encoder, motor, etc. * SCARA only.
B84	Arm length error	The arm length is invalid. Check "Axis-specific parameter No. 138, Arm length." * SCARA only.
B85	Operation start-position acquisition error inside work area using application servo	Operation start position cannot be obtained inside the work area using the application servo. * SCARA only.
B86	SEL PTRQ command preparation error	The set value of the PTRQ command is invalid. Check if the set value is outside the specified range, among others.
B87	Error due to target locus error inside tool-center entry prohibition circle	The target position or movement locus is inside the circle where entry of the tool reference point is prohibited. * SCARA only.
B88	Logic error during calculation of valid target data	An internal logic error generated during calculation of valid target data. * SCARA only.
B89	SCARA CP logic error	An internal logic error was detected during SCARA CP processing. * SCARA only.
B8C	Detection of entry into simple interference check zone (Operation-cancellation level specification)	Entry into the simple interference check zone was detected. (Operation-cancellation level specification) * SCARA only.
B8D	SLPR parameter type specification error	The specified SLPR parameter type is invalid. * SCARA only.
B8E	SEL STPR command preparation error	An error equivalent to error No. A3A, A39 or A35 was detected. * SCARA only.
B8F	Positioning time calculation error	A positioning time calculation error occurred. * SCARA only.
B90	Passing distance calculation error	A passing distance calculation error occurred. * SCARA only.
B91	Main overspeed requirement error	An excessive speed is required. This error may also occur when passing near the singular point (where arms 1 and 2 form a straight line) during CP operation. Program CP operation by avoiding movements near the singular point. This error may be prevented by lowering the specified speed. * SCARA only.
C02	Run program count over error	Requests were made to run too many programs exceeding the number of programs that can be run simultaneously.
C03	Non-registered program specification error	The specified program is not registered.
C04	Program entry point non-detection error	An undefined supported program number was specified via I/O or in a program.

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Error No.	Error name	Description, action, etc.
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.
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 stuck has failed.
C17	Extension-condition code error	Input program step error. The extension condition code is invalid.
C18	Extension-condition LD simultaneous processing over error	The number of LDs processed simultaneously exceeds the limit value.
C19	Extension-condition LD shortage error 1	There is not enough LD when extension condition A or O is used.
C1A	Extension-condition LD shortage error 2	There is not enough LD when extension condition AB or OB is used.

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Error No.	Error name	Description, action, etc.
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 extension condition AB or OB.
C1F	Input-condition CND shortage error	The necessary input condition is not found when an extension 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	An undefined supported program number 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. Cartesian axis only.
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 channel number error	The channel number of the 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.

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Error No.	Error name	Description, action, etc.
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.
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	SIO invalid usage OPEN error	The usage of serial channel 1 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

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Error No.	Error name	Description, action, etc.
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
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.
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 generate when the actuator is operated after changing an encoder parameter, executing an absolute reset or resetting an encoder error, without executing a software reset or reconnecting the power first.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
C70	Absolute coordinate non-confirmation error	Absolute coordinates have not been confirmed. The power must be reconnected. This error may also generate when the actuator is operated after changing an encoder parameter, executing an absolute reset or resetting an encoder error, without executing a software reset or reconnecting the power first.
C71	Synchro slave-axis command error	A command was issued to the synchro slave axis. Cartesian axis only.
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. * If this error occurred on a SCARA axis, the axis may not have position data.
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 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, with an absolute encoder specification, this error occurred after relocating the system or when an “Error No. C74, Actual-position soft limit over error” is also present, a servo packet calculation overflow may have occurred due to an invalid current position because an absolute reset was not executed correctly. Execute an absolute reset again by following the procedure in the operation manual. (“Resetting an encoder error” in the absolute reset window alone will not cause the controller to recognize the current position correctly. Always execute an absolute reset by 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.

(In the panel window, the three digits after "E" indicate an error number.)

Error No.	Error name	Description, action, etc.
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 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.
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 to operate a system output (a port for which an output function selection is specified by an I/O parameter, port used for zone output per an axis-specific parameter, etc.) Cartesian axis only.
C94	PIO program number error	The program number specified via PIO does not correspond to a supported program.
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 no longer generates due to the specification change.)
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	Phase Z non-detection error	Phase Z 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.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
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.
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 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 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.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
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.
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 track boundary over error	The target position or movement locus exceeds the positioning boundary in the infinite-stroke mode. Cartesian axis only.
CBF	Positioning distance overflow error	The positioning distance is too large. If, with an absolute encoder specification, this error occurred after relocating the system or when an “Error No. C74, Actual-position soft limit over error” is also present, a servo packet calculation overflow may have occurred due to an invalid current position because an absolute reset was not executed correctly. Execute an absolute reset again by following the procedure in the operation manual. (“Resetting an encoder error” in the absolute reset window alone will not cause the controller to recognize the current position correctly. Always execute an absolute reset by 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.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
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. Reconnect the power.
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 is already running at a specified speed or more when the power is 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 status of the monitor LED on the front face of the board by referring to the operation manual for your field network.
D51	Fieldbus error (FBMIRQ reset)	A FBMIRQ reset error was detected. Check the status of the monitor LED on the front face of the board by referring to the operation manual for your field network.
D52	Fieldbus error (FBMBSY)	A FBMBSY was detected. Check the status of the monitor LED on the front face of the board by referring to the operation manual for your field network.
D53	Fieldbus error (BSYERR)	A BSYERR was detected. Check the status of the monitor LED on the front face of the board by referring to the operation manual for your field network.
D54	Window lock error (LERR)	A LERR was detected. Check the status of the monitor LED on the front face of the board by referring to the operation manual for your field network.
D55	Fieldbus error (Min busy)	A Min busy error was detected. Check the status of the monitor LED on the front face of the board by referring to the operation manual for your field network.
D56	Fieldbus error (MinACK timeout)	A Min ACK timeout was detected. Check the status of the monitor LED on the front face of the board by referring to the operation manual for your field network.
D57	Fieldbus error (MoutSTB timeout)	A Mout STB timeout was detected. Check the status of the monitor LED on the front face of the board by referring to the operation manual for your field network.

(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 status of the monitor LED on the front face of the board by referring to the operation manual for your field network.
D59	Fieldbus error (DPRAM write/read)	A DPRAM write/read error was detected. Check the status of the monitor LED on the front face of the board by referring to the operation manual for your field network.
D5A	Fieldbus error (TOGGLE timeout)	A TOGGLE timeout was detected. Check the status of the monitor LED on the front face of the board by referring to the operation manual for your field network.
D5B	Fieldbus error (Access-privilege retry over)	An access-privilege retry over error was detected. Check the status of the monitor LED on the front face of the board by referring to the operation manual for your field network.
D5C	Fieldbus error (Access-privilege open error)	An access-privilege open error was detected. Check the status of the monitor LED on the front face of the board by referring to the operation manual for your field network.
D5D	Fieldbus error (FBRS link error)	A FBRS link error was detected. Check the status of the monitor LED on the front face of the board by referring to the operation manual for your field network.
D5E	Fieldbus error (Mailbox response)	A mailbox response error was detected. Check the status of the monitor LED on the front face of the board by referring to the operation manual for your field network.
D60	Expanded-SIO 2/4 CH insulation power error	An Expanded-SIO insulation power error was detected.
D61	Expanded-SIO 1/3 CH insulation power error	An Expanded-SIO insulation 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.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
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.
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.
D80	SCARA unsupported function error	An attempt was made to use a function not supported by SCARA. * SCARA only.
D81	Parameter error during calculation of valid target data	An invalid parameter value was detected during calculation of valid target data. Check axis-specific parameter Nos. 7, 8, 138, etc. * SCARA only.
D82	Simple interference check zone output-number specification error	A value other than an output port/global flag number (0 is allowed) may have been input, or the specified number may be already used as a system output number via the I/O parameter for output function selection. * SCARA only.
D83	Simple interference check zone number error	The simple interference check zone number is invalid. * SCARA only.
D8A	Optimal acceleration/deceleration, Horizontal move optimization function based on Z position internal parameter error	The value set in the internal parameter for optimal acceleration/deceleration function or Horizontal move optimization function based on Z position for SCARA is abnormal. The optimal acceleration/deceleration function or Horizontal move optimization function based on Z position for SCARA cannot be used.
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.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
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.
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 an output number specified as system output in an I/O parameter for output function selection may be duplicated, among other reasons. Cartesian axis only.
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.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
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.
E39	No encoder EEPROM error	The encoder is not equipped with EEPROM.
E3A	Absolute encoder non-installation specification	It is specified that the absolute encoder is not installed.
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.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
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.
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.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
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 melted. This error occurs on QX type controllers. When turning on the power, turn on the control power first, confirm that the SDN contacts are closed, and then turn on the drive power. (This error will occur if the control power and drive power are 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.
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 brake installation specification in the system’s axis-specific parameter and that of the installed encoder do not match.
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.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, 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).
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)	The flash ROM is malfunctioning. The flash ROM remains busy.

(In the panel window, the three digits after “E” indicate an error number.)

Error No.	Error name	Description, action, etc.
FF0 ~ FF0	Shutdown error (hi_sysdwn () definition)	A shutdown error (hi_sysdwn () definition) was detected.
F03 ~ 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 ~ 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 ~ FFF	Shutdown error (in relation to the definition of hi_sysdwn())	A shutdown error (in relation to the definition of hi_sysdwn()) 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, device number and other settings in the updating PC tool.
A8D	Flash busy reset timeout (Core detection)	Error occurred erasing/writing the flash ROM.
CD0	Drive unit 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 "X-SEL 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 "X-SEL only" or "SCARA only" is not specified in the "Description, action, etc." field, basically the error is common to both specifications.

Troubleshooting of X-SEL Controller

The X-SEL 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. The power specification of X-SEL-PX/QX controllers is three-phase, 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.
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 if foreign object has entered the linear movement axis. Check if any of the mounting bolts for the linear movement axis is contacting the slider.
914 CA2	Abnormal absolute-data backup battery voltage	The PG cable for the linear movement axis was disconnected from the controller. Absolute reset has not been executed for the linear movement axis 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 if any of the mounting bolts for the linear movement axis is contacting inside the axis, or if the slider attachment is contacting any surrounding mechanical part. Replace the board.

Error No.	Error name	Cause	Countermeasure
C6b	Deviation overflow error	Operation is mechanically disabled.	Check if any of the mounting bolts for the linear movement axis is contacting inside the axis, or if the slider attachment is contacting any surrounding mechanical part.
d03	Faulty encoder or attachment of dust	The encoder is faulty or dust is attached.	Remove the motor cover of the linear movement axis 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.
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 for Linear Movement Axis

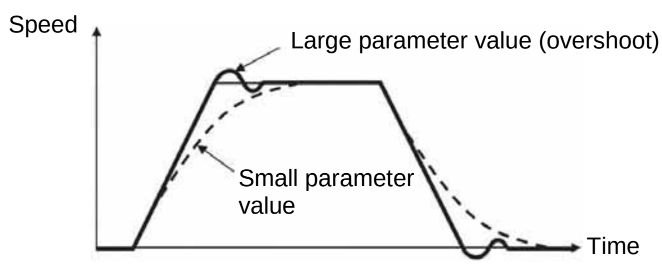
Caution: Do not adjust the servo gains of SCARA axes.

The servo has been adjusted at the factory according to the standard actuator specification, so the servo gains need not be changed in a normal condition.
However, vibration or abnormal noise may occur depending on how the actuator is affixed, load conditions, etc. Accordingly, the servo adjustment parameters are disclosed so that the user can take prompt actions upon encountering such conditions.
In particular, vibration or abnormal noise is more likely to occur on custom specifications (longer ball screw lead or stroke compared to the standard specification, etc.) due to external conditions.
In this case, the following parameters must be changed. Contact IAI.

- Position gain

Axis-specific parameter number	Unit	Input range	Default (reference)
60	/sec	0 ~ 9999	30

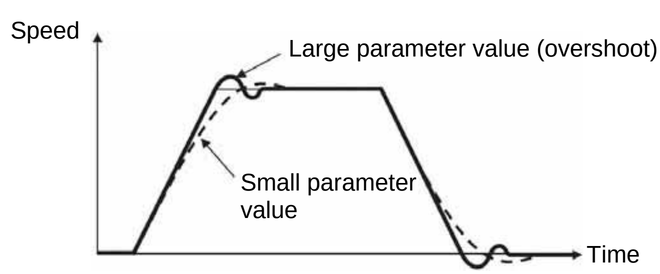
This parameter determines the response of the position control loop.
Increasing the value set in this parameter improves the conformance with the position command.
Take note, however, that increasing the parameter value excessively increases the tendency of the actuator to overshoot.
If the parameter value is small, the conformance with the position decreases and the positioning time becomes longer.



- Speed loop gain (parameter list 1)

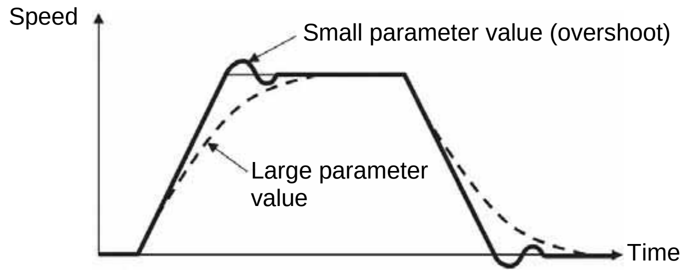
Driver card parameter number	Unit	Input range	Default (reference)
43	-	1 ~32767	500

This parameter determines the response of the speed control loop.
Increasing the value set in this parameter improves the conformance with the speed command (= increases the servo rigidity).
Increase the parameter value if the load inertia is high.
Take note, however, that increasing the parameter value excessively increases the tendency of the actuator to overshoot or oscillate, resulting in mechanical vibration.



- Speed loop integral time constant (parameter list 1)

Driver card parameter number	Unit	Input range	Default (reference)
44	-	1 ~ 1000	30



- Current loop control band number

Driver card parameter number	Unit	Input range	Default (reference)
46	-	0 ~ 4	4

This parameter sets the control band for the PI current control system.
It need not be changed in a normal condition.
Changing this parameter setting carelessly may impair the safety of the control system, in which case a very dangerous situation can occur.
This parameter is useful under certain situations such as when the actuator generates resonance noise, in which case this parameter can be changed to suppress resonance noise.
Should you require changing this parameter, consult IAI.

- Torque filter time constant (parameter list 1)

Driver card parameter number	Unit	Input range	Default (reference)
45	-	1 ~ 2500	0

This parameter determines the filter time constant for the torque command.
The motor vibrates if the resonance frequency of the machine is equal to or lower than the response frequency of the servo loop.
This resonance of the mechanical system can be suppressed by increasing the value set in this parameter.
Take note, however, that increasing the parameter value excessively may impair the safety of the control system.

Trouble Report Sheet

<table>
<tr><td colspan="4">Trouble Report Sheet</td><td colspan="3">Date:</td></tr>
<tr><td>Company name</td><td></td><td>Department</td><td></td><td>Reported by</td><td></td></tr>
<tr><td>TEL</td><td>(Ext)</td><td>FAX</td><td colspan="3"></td></tr>
<tr><td>IAI agent</td><td></td><td>Purchase date</td><td colspan="3"></td></tr>
<tr><td>Serial number</td><td></td><td>Manufacture date</td><td colspan="3"></td></tr>
<tr><td colspan="6">[1] Number of axes ☐ axis(es)
Type</td></tr>
<tr><td colspan="6">[2] Type of problem
1. Disabled operation 2. Position deviation 3. Runaway machine
4. Error Error code = ☐☐☐
5. Other ( )</td></tr>
<tr><td colspan="6">[3] Problem frequency and condition
Frequency =
Condition ____</td></tr>
<tr><td colspan="6">[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))</td></tr>
<tr><td colspan="6">[5] Operating direction
1. SCARA only 2. SCARA + Linear movement axis</td></tr>
<tr><td colspan="6">[6] Load condition
1. Load transfer 2. Push-motion operation 3. Load: Approx. ________ kg
4. Speed: Approx. _________ mm/sec</td></tr>
<tr><td colspan="6">[7] Special specification (option, etc.)</td></tr>
</table>

Change History

Revision Date	Description of Revision
	First edition
February 2008	Second edition
May 2008	Third edition
April 2009	Fourth edition
August 2009	Fifth edition
June 2010	Sixth edition ▪ Added “Before Using the Product” on the first page after the cover. ▪ Deleted “Safety Precautions” before the table of contents and added “Safety Guide” immediately after the table of contents. ▪ Deleted “Before Using the Product” before the table of contents. ▪ Added “Revision History” on the last page. ▪ Updated the back cover. (Changed the head office and sales office addresses, specified that Eight customer service was available 24 hours, etc.)
December 2010	Seventh edition ▪ P.2: Added explanations on the Axis 5 [4] and Axis 6 [5] portions of the model number. ▪ P.228, P.395: Added a note regarding the home return operation of the linear servo actuator LSAS-N10/N15 of quasi-absolute type.
April 2011	Eighth edition ▪ Swapped over the page for CE Marking

Manual No.: ME0152-8A (April 2011)

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