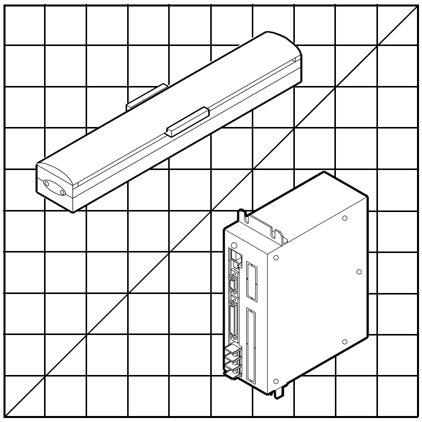
Shibaura Machine



COMPO ARM

BA-III SERIES

BA-II SERIES

BA-C SERIES

CONTROLLER

MODEL:CA20-M00/M01

Operating Manual (Basic Section)

SHIBAURA MACHINE CO., LTD.

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

Introduction

Thank you for selecting the COMPO ARM BA III, BA II and BA-C series.
To ensure correct usage, read this instruction manual before starting use of the COMPO ARM BA III, BA II and BA-C series. Here, keep in mind that "Master Unit" described in this manual represents all "High-function Master Unit CA20-M00 and CA20-M01".

For information on the actuators in COMPO ARM BA III, BA II and BA-C series, refer to the Actuator Operating Manual supplied with the actuator.

PRECAUTION

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

Contents

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Chapter 1 General Safety Instruction

■ 1.1 Important Safety Information

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

Be sure to always follow the safety information to ensure safe usage of the ARM ROBOT/COMPO ARM.

The signal words below indicate important safety information and instructions displayed on this product (controller) and in this operating manual for preventing injuries to the operator and others and property damage and for ensuring safe usage of this equipment.
Be sure that you fully understand these signal words before reading the safety information.

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

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

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

? : The terminology description and reference page are instructed.

WARNING
• A safety fence must be installed to prevent entry into the range of motion of the robot. If a door or other entrance is provided in the safety fence, an emergency stop must be applied to the robot when the door is opened.
• In case of emergencies, an emergency stop pushbutton switch must be connected to the emergency stop input terminal of the controller and installed in an easily accessible location. The emergency stop pushbutton is designed so that it does not reset automatically and cannot be unintentionally reset by the operator.
• All wiring work must be performed safely and in strict compliance with the electrical equipment technical standards and internal wiring codes. Improper wiring can result in an electric shock or fire.
• Do not repair or modify this equipment without permission of the manufacturer. This can result in an accident or damage to this equipment.
• Be sure to ground this equipment before using. Failure to ground this equipment can result in electric shock and increase the effects of electrical noise.
• Before maintenance and inspection work, turn off the main power supply switch to the controller and implement measures to prevent users other than the operator engaged in the robot adjustment work from accidentally turning on the power. (Lock-out and tag-out system) Also, wait at least three minutes before touching the internal components of the controller after the power is turned off. An electric shock can occur due to the residual voltage in the capacitor.
• Do not touch the heatsink and cement resistors inside the controller or the motor. These components can become extremely hot, and a burn can result. Before inspecting, be sure to wait sufficient time until the components cool down.
• Do not block the ventilation holes of this equipment. Blocking the ventilation holes can cause heat to build up inside this equipment and can result in a fire.
• Do not splash water in or outside this equipment, and do not wipe it with water or other liquids. This can result in an electric shock or breakdown of this equipment. [If this equipment is dirty, wipe off the dirt with a cloth that has been firmly wrung out. Do not use thinners, benzene, or other organic solvents.]
• Do not insert or drop metals, flammable items, or other foreign objects into the machine from the ventilation holes. This can result in a fire or electric shock.
• When using a safety category-compliant controller (CA20-M01), a driving power shut-off circuit in the emergency stop and enable circuit must be installed outside this equipment. The CA20-M01 can be combined with an external safety circuit for enabling compliance with the safety category.

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

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

<IMPORTANT>

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

Controller warning label
Part code: 55560020

WARNING

- To ensure safety, be sure to read the Operating Manual before installation, programming, operation, maintenance, and inspection.
- Before maintenance and inspection work, turn off the main power supply switch to the controller and implement measures to prevent users other than the operator engaged in the robot adjustment work from accidentally turning on the power.
  Also, wait at least three minutes before touching the internal components of the controller after the power is turned off.
  An electric shock can occur due to the residual voltage in the capacitor.
- A safety fence must be installed to prevent entry into the range of motion of the robot.
- In case of emergencies, an emergency stop pushbutton switch must be connected to the emergency stop input terminal of the controller and installed in an easily accessible location.
- Be sure to ground this equipment before using.
  Failure to ground this equipment can result in electric shock and increase the effects of electrical noise.
- Never modify this equipment.

Axis warning label
Part code: 55620157

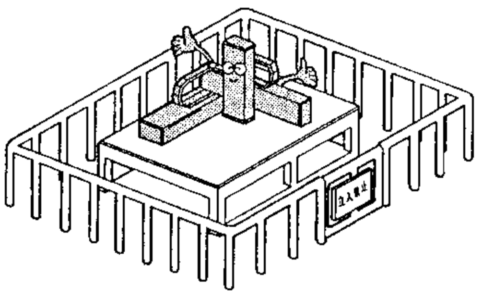
WARNING	• To ensure safety, be sure to read the Operating Manual before installation, programming, operation, maintenance, and inspection. • A safety fence must be installed to prevent entry into the range of motion of the robot. • Do not insert your fingers or hands into the openings or moving parts. This can result in an injury. • When using at an orientation other than the horizontal mounting, an axis with brake must be used. When the power is turned off, the slider can drop, and this can result in an injury.

■ 1.2 Safe Operation

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

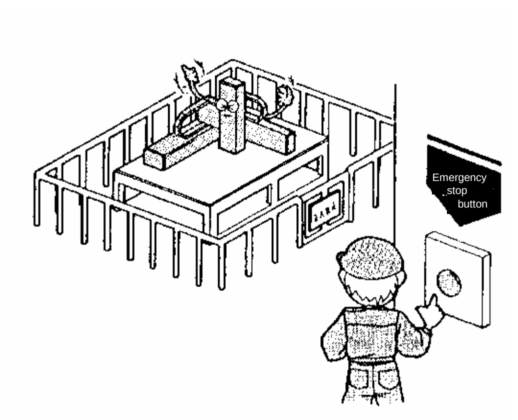
■ 1.2.1 Auxiliary safety precautions before robot installation

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



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

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



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

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

■ 1.2.2 Precautions for installing the robot

Pay attention to the following points when installing the robot.

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

■ 1.2.3 Precautions for operation of the robot

Pay attention to the following points when operating the robot.

[Operation inside the actuator operating area]

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

(2) Install notices on robot switches to alert personnel that work is underway in the robot operation area and lock the cover to the operator's station.

(3) To secure the zone of robot operation, take measures such as but not limited to the following.
   1. Assign a guard to watch the robot operating area to prevent unauthorized persons from entering the operating zone. The guard should be trained to activate emergency stop devices.
   2. Personnel working inside the operating zone should carry emergency stop switches.
   3. The operator should use a portable operator's station that can be used to turn ON or OFF power to the robot, oil pressure devices, and pneumatic devices.

(4) Make the following inspections before teaching or other operations:
   1. Turn the power switch OFF, and check the power cable for damage.
   2. Test the actuator to make sure it moves properly.
   3. Inspect the control devices and emergency stop devices.
   4. Check for leakage in pneumatic pressure lines and hydraulic oil lines.

(5) Procedures for cleaning robot hand tools, such as paint spray nozzles, should be automated so operators do not have to enter the actuator's operating area.

(6) Release residual pressure before disassembling or changing parts in a pneumatic system.

(7) Do not enter the actuator's operating area zone to confirm proper operation.

(8) Maintain proper lighting at the work site.

[Automatic operation]

(1) Notice at the start
   Before beginning operation, confirm the following items and confirm communication procedures including hand signals among operators.
   1. Make sure no one is inside the actuator operating area.
   2. Portable operator stations, tools and devices are located at their assigned sites.
   3. Indicators on the robot and auxiliary devices are normal.

(2) Procedures for automatic operation and malfunctions
   1. After start, confirm that the indicator shows automatic operation is underway.
   2. Before personnel enter the robot's zone of operation to recover the robot or related devices from a malfunction, the operator must activate the emergency stop device and attach an "under repair" message to operation switches and take other measures to prevent others from starting the robot.

■ 1.2.4 Safety category 3 support

CA20-M01 can support safety Category 3. Use CA25-S10 if BA III is operated, CA20-S10 if BA II is operated, CA01-S05 if BA-C is operated.

■ 1.3 Warranty

■ 1.3.1 Warranty period

The warranty period is one year from the date of delivery at the location designated by the order or 3000 hours of operation, whichever comes first. The terms of this warranty apply for usage in Japan only. The numerical values presented in the technical documents are calculated values only and are not intended as a guideline of durability or a guarantee of any kind. Note that differences will arise based on the actual usage conditions.

■ 1.3.2 Warranty scope

In the event that a breakdown occurs that is the responsibility of the manufacturer during the above warranty period, the manufacturer will be responsible for replacing or repairing the defective part of this equipment.

However, the following cases are outside the scope of the warranty

(1) Breakdowns due to improper operation or usage by the operator

(2) Breakdowns due to causes not due to the manufacturer

(3) Breakdowns due to modifications or repairs not performed by the manufacturer

(4) Breakdowns due to other causes, such as natural disasters and accidents, that are outside the responsibility of the manufacturer

■ 1.3.3 Service scope

The price of the delivered product does not include the service fees for service visits by engineers and other costs. Therefore, a separate fee is charged in the following cases.

(1) Mounting adjustment instruction and test operation witness inspection

(2) Maintenance inspection, adjustment, and repairs

(3) Technical instruction and technical training (operation, programming, wiring methods, safety training, etc.)

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Chapter 2 Devices

■ 2.1 Features

■ 2.1.1 System configuration

This equipment is a new concept controller for arm robots that incorporates design features of the Built Block System (BBS) into the popular COMPO ARM Series.

[Features of axis unit]

- Combinations with BBS method
  A built block method (building block method) combination is possible by selecting unit parts such as the axis unit, angle bracket and cable. A system upgrade is possible by further adding optional parts.
- Importance on basic functions
  Importance has been laid on achievements and reliability for the main components that configure the robot axis such as the compact AC servo, highly rigid linear guide and grinding ball screw, etc. Downsizing has been pursued amid accurate movement.
- Cable connection
  Inter-axis cables are necessary but often become obstacles.
  With the CN box and special shape flexible tube, the wiring and piping can be stored and vertical or horizontal layout is possible.
- Corresponding to the needs of the time - Q. C. D.
  High quality, short delivery and low cost is realized by the units standardized with the BBS method.
- Absolute encoder compatible
  The BA III, BA II and BA-C series includes an absolute encoder motor in its standard configuration. The absolute encoder will constantly monitor the motor operation through battery backup even when the power is shut off, so return to origin does not need to be repeated when the system is started.

[Features of controller]

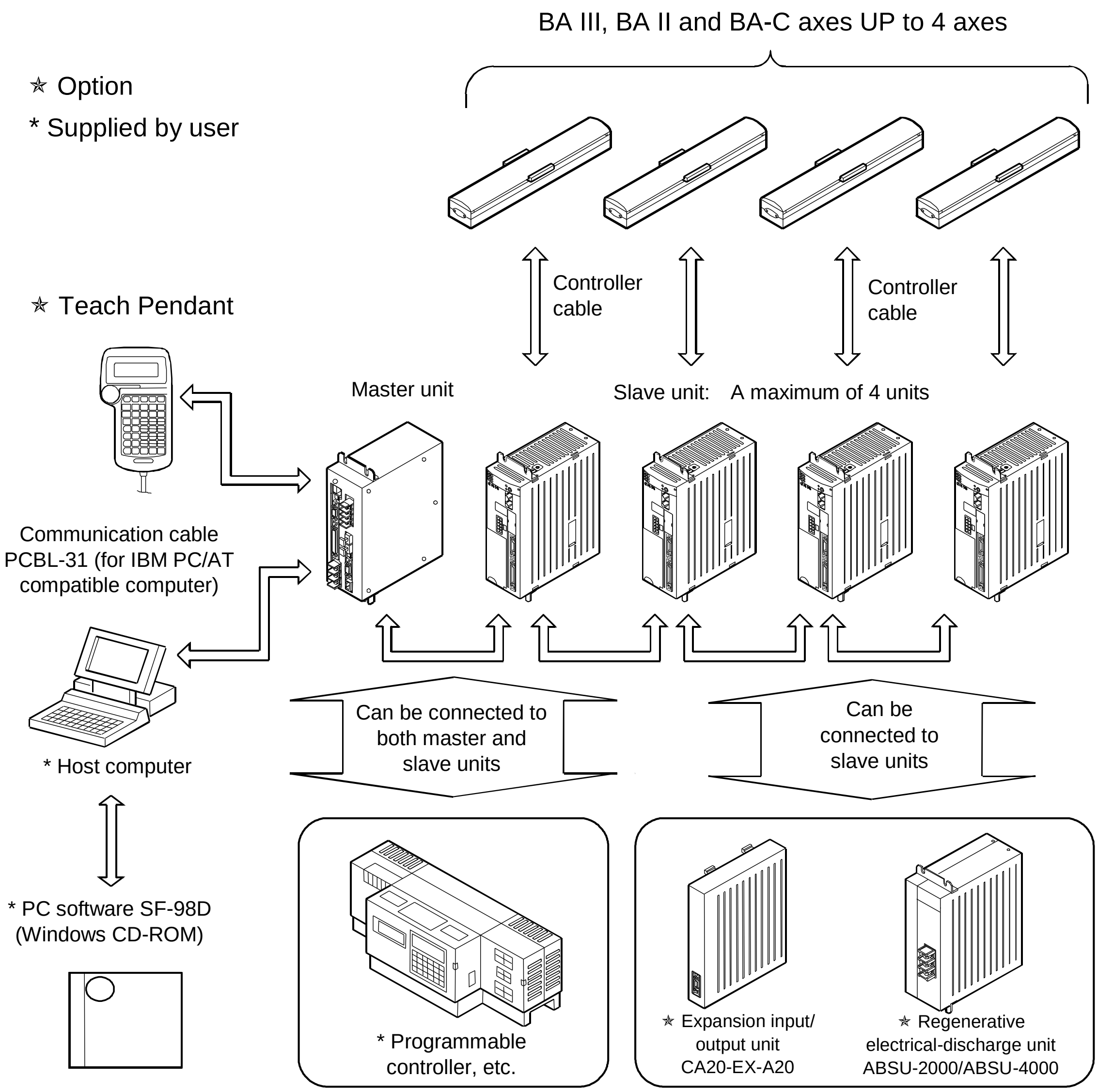
- In addition to X, Y and Z axes, 4 axes including R axis can be simultaneously controlled.
- In addition to 3-dimensional linear interpolating function, 3-dimensional circular interpolation is also possible, thus resulting in achievement of smooth movement.
- Compact appearance
  The unit sizes of 65W × 170H × 150D (master unit) and 55W × 160H × 134D (slave unit) are as small as that of the compact AC servo driver which fits neatly into a panel.
- Simple program
  The "Easy Mode" for which basic pick and place operation patterns are created as modes is mounted as a standard.
- Corresponding to globalized production bases
  Input voltages from 100 to 120VAC or 200 to 240VAC can be handled. (Slave unit)
  * The CA20-S40 supports input voltages from 200 to 230VAC.
- Incorporation of Robot language popular for its simple teaching method
  Besides teaching with a personal computer, the robot Series Teach Pendant (TPH-4C, TPX-4A) can be used to overcome the robot language and correspond to multitasking.

- Compatible with safety category 3
  Usage of the master unit CA20-M01 enables building of a safety circuit compatible with safety category 3.

■ 2.2 System Components and Specifications

■ 2.2.1 System components

(1) CA20-M00

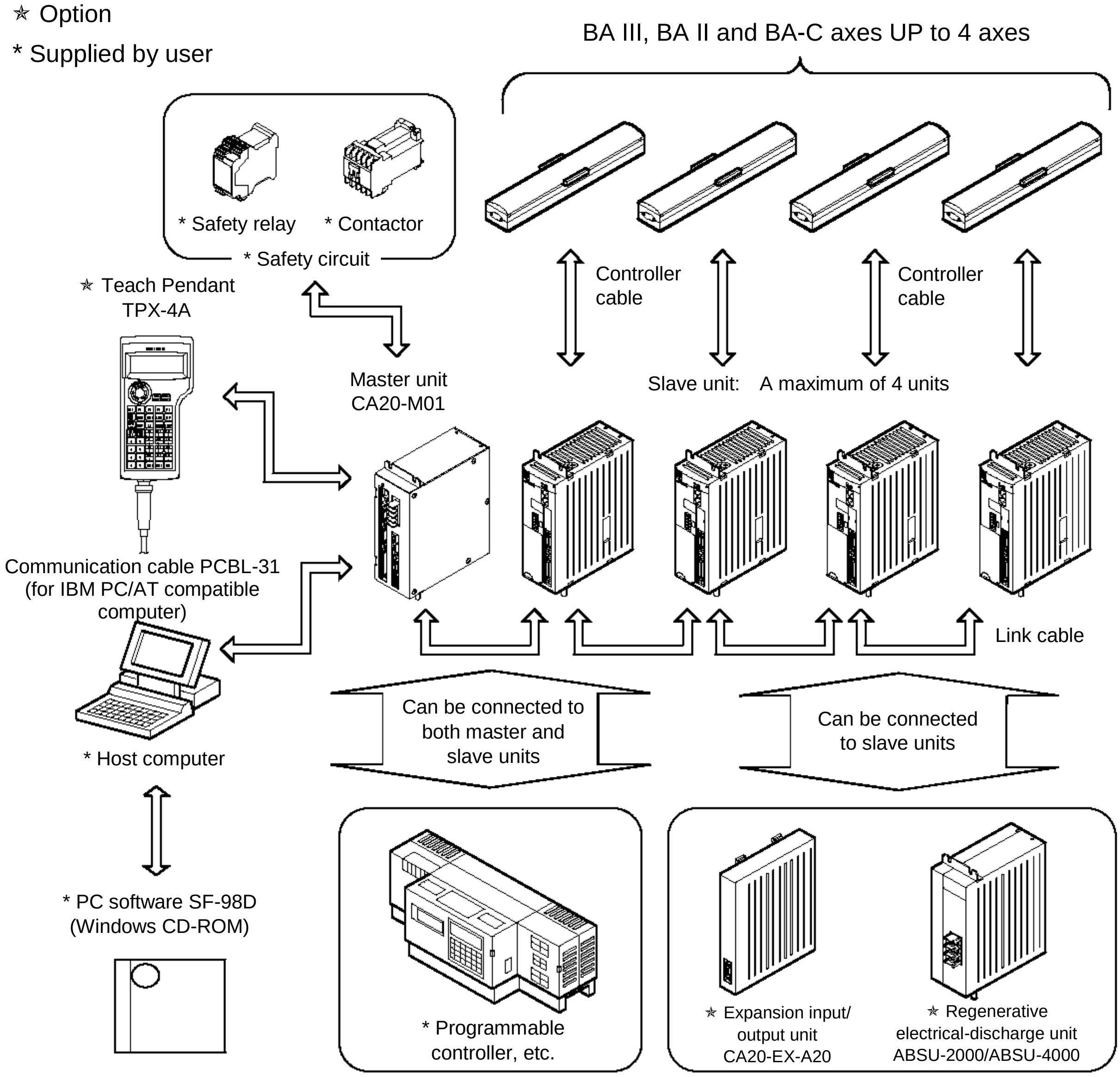


Note: The expansion input/output unit (CA20-EX-A20) and regenerative electrical-discharge unit are connected to slave units only.

(2) CA20-M01

☆ Option

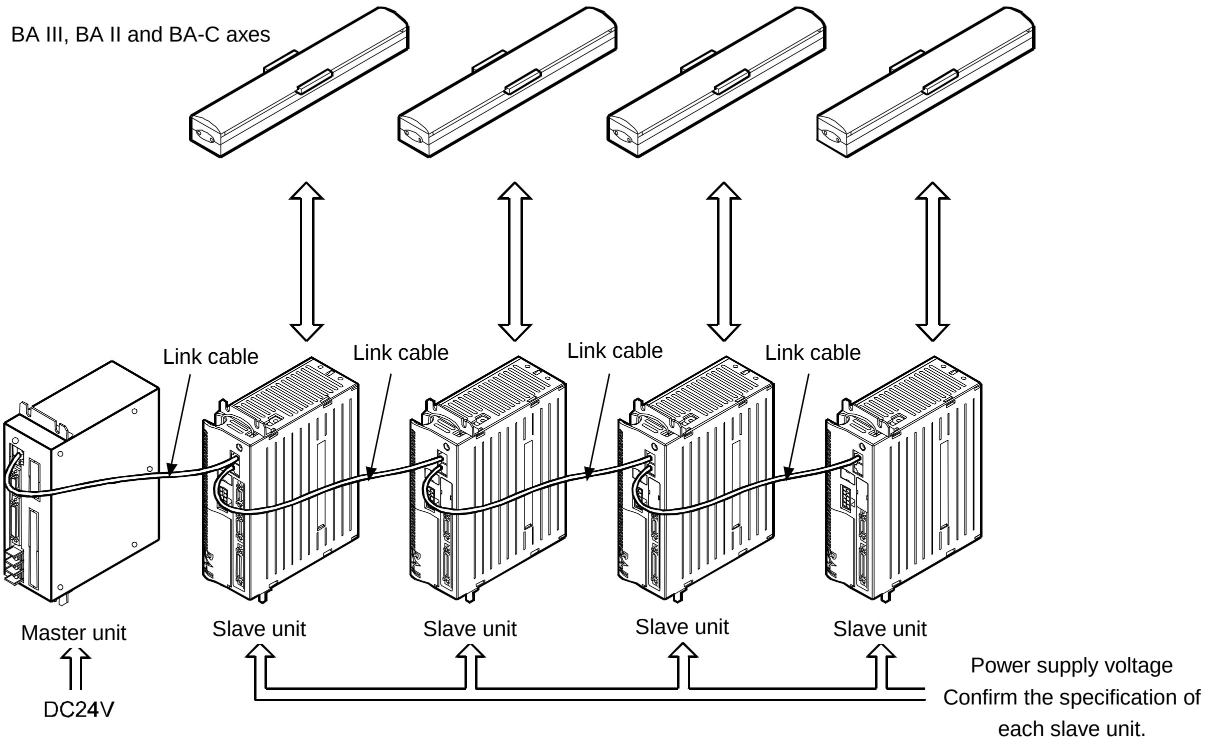
* Supplied by user



Note: The expansion input/output unit (CA20-EX-A20) and regenerative electrical-discharge unit are connected to slave units only.
The PC software SF-98D is supported by version 2.3.0 and later. Due to the properties of the safety category-compatible controller, the robot cannot be operated from the SF-98D.
The software supports the sending and receiving of files only.

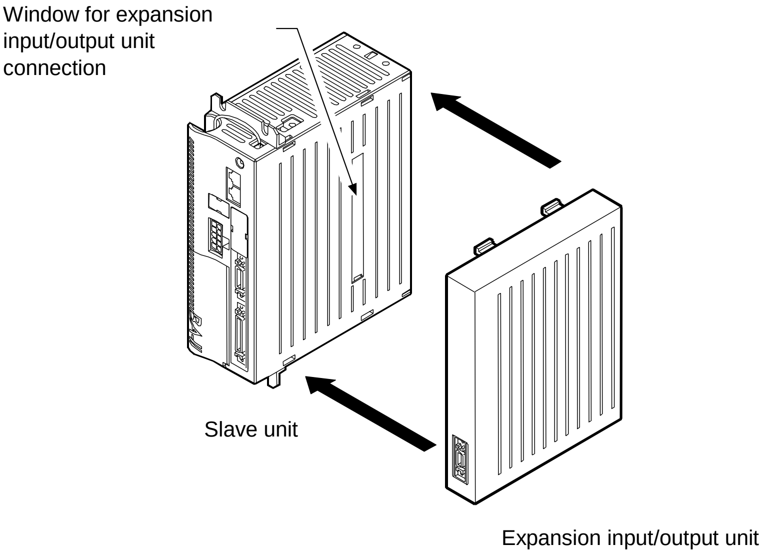
■ 2.2.2 Controller specifications

The COMPO ARM BA III, BA II and BA-C Series controller can control a maximum of 4 axes when the salve unit is connected to the master unit with the link cable. For the specifications of the slave unit, refer to section 2.2.2 (2).



Outline drawing

By directly coupling the expansion input/output unit to the slave unit, the general-purpose input/output can be increased.



(1) Master unit specifications

Applicable robot	COMPO ARM BA III BA II and BA-C series	
Controller type	CA20-M00, CA20-M01	
Number of controllable axes	Simultaneous control of one to four axes through slave unit connection	
Control method	PTP, CP, Semi-closed loop control	
Teaching method	Remote teaching, Direct teaching or MDI	
Speed setting	10 steps (variable)	
Acceleration setting	20 steps (variable)	
Operation mode	Sequential, Palletizing, External point designation, Easy	
Operation method	Step, Continuous, Single robot movement	
CPU type	32-bit RISC·CPU SH7085	
Self-diagnostic function	CPU error by WDT, Memory error, Driver error, Power voltage error, Program error, etc.	
Number of programs	Sequential 16, Palletizing 16, Easy 8	
Number of program steps	Max. 2500 steps + coordinate table × 999 (Note 1)	
Memory method	FRAM	
Number of counters	99	
Number of timers	9	
Error signal	Error display lamp lights (front panel), Teach Pendant	
External input	System input	24V 7mA 4 points
	General-purpose input	24V 7mA 20 points (Note 2)
External output	System output	24V max. 20mA 4 points
	General-purpose output	24V max. 300mA 12 points (Note 2)
Communication function	1 channel for Teach Pendant (RS-232-C)	
Power supply	24VDC ±10% 0.5A	
Operation conditions	Installation place	Indoors
	Working ambient temperature	0 to 40°C
	Working ambient humidity	30% to 90%RH With no dew condensation
	Working ambient atmosphere	With no corrosive gases
	Storage ambient temperature	–20 to 70°C
	Storage ambient humidity	30% to 90%RH With no dew condensation
	Storage ambient atmosphere	With no corrosive gases
	Vibration	$9.8m/s^2$ or less
Dimensions	65 (W) × 170 (H) × 150 (D) (Excluding screw protrusions and installation fittings)	
Mass	CA20-M00: 1.2 kg, CA20-M01: 1.1 kg (Excluding optional boards)	

(Note 1) In sequential mode, the maximum number of steps varies depending on the mode.

(Note 2) The number of general-purpose input/output points will be reduced when the signals using the general-purpose input/output terminals are assigned.

(2) Slave unit specifications

<table>
<tr><td>Applicable robot</td><td colspan="4">COMPO ARM BA II series</td></tr>
<tr><td>Controller type</td><td colspan="3">CA20-S10</td><td>CA20-S40 Note 1</td></tr>
<tr><td>Number of controllable axes</td><td colspan="4">One axis (with connection to master unit)</td></tr>
<tr><td>Motor capacity Note 2</td><td>50W</td><td>100W</td><td>200W</td><td>400W</td></tr>
<tr><td>Drive method</td><td colspan="4">AC servomotor</td></tr>
<tr><td>Error signal</td><td colspan="4">Error display lamp lights (front panel),
Teach Pendant (Connect to master unit)</td></tr>
<tr><td rowspan="2">External input output</td><td>General-purpose input</td><td colspan="3">24V max. 10mA 8 points</td></tr>
<tr><td>General-purpose output</td><td colspan="3">24V max. 300mA 8 points</td></tr>
<tr><td>Power supply</td><td colspan="3">100VAC to 120VAC, 200VAC to 240VAC, ±10% 50/60Hz
Change between the 100V system and 200V system using the short bar on the front terminal board</td><td>200VAC to 230VAC, ±10% 50/60Hz</td></tr>
<tr><td>Power capacity</td><td>100VA</td><td>160VA</td><td>450VA</td><td>700VA</td></tr>
<tr><td rowspan="8">Operation conditions</td><td>Installation place</td><td colspan="3">Indoors</td></tr>
<tr><td>Working ambient temperature</td><td colspan="3">0 to 40°C</td></tr>
<tr><td>Working ambient humidity</td><td colspan="3">30% to 90%RH
With no dew condensation</td></tr>
<tr><td>Working ambient atmosphere</td><td colspan="3">With no corrosive gases</td></tr>
<tr><td>Storage ambient temperature</td><td colspan="3">–20 to 70°C</td></tr>
<tr><td>Storage ambient humidity</td><td colspan="3">30% to 90%RH With no dew condensation</td></tr>
<tr><td>Storage ambient atmosphere</td><td colspan="3">With no corrosive gases</td></tr>
<tr><td>Vibration</td><td colspan="3">9.8m/s^2 or less</td></tr>
<tr><td>Dimensions</td><td colspan="3">55 (W) × 160 (H) × 134 (D)
(Excluding installation fittings)</td><td>85(W)×160(H)× 134(D)
(Excluding installation fittings)</td></tr>
<tr><td>Mass</td><td colspan="3">0.91kg</td><td>1.34kg</td></tr>
</table>

(Note 1) Be sure to always use the regenerative electrical-discharge unit ABSU-4000 whenever using the CA20-S40.

(Note 2) The applicable motor capacity is displayed on the controller front panel.
Never connect with a motor having a different capacity. This can result in burnout of the motor or other problems.

Applicable robot	COMPO ARM BA III series				
Controller type	CA25-S10			CA25-S40 [Note 1]	CA25-S80 [Note 2]
Number of controllable axes	One axis (with connection to master unit)				
Motor capacity [Note 2]	50W	100W	200W	400W	750W
Drive method	AC servomotor				
Error signal	Error display lamp lights (front panel), Teach Pendant (Connect to master unit)				
External input output	General-purpose input		24V max. 10mA 8 points		
	General-purpose output		24V max. 300mA 8 points		
Power supply	100VAC to 115VAC, 200VAC to 230VAC, ±10% 50/60Hz Change between the 100V system and 200V system using the short bar on the front terminal board			200VAC to 230VAC, ±10% 50/60Hz	
Power capacity	140VA	210VA	600VA	1.2kVA	1.6kVA
Operation conditions	Installation place		Indoors		
	Working ambient temperature		0 to 40°C		
	Working ambient humidity		30% to 90%RH With no dew condensation		
	Working ambient atmosphere		With no corrosive gases		
	Storage ambient temperature		–20 to 70°C		
	Storage ambient humidity		30% to 90%RH With no dew condensation		
	Storage ambient atmosphere		With no corrosive gases		
	Vibration		$9.8 m/s^2$ or less		
Dimensions	55 (W) × 160 (H) × 150 (D) (Excluding installation fittings)			85(W)×160(H)×150(D) (Excluding installation fittings)	
Mass	0.92kg			1.58kg	

(Note 1) Be sure to always use the regenerative electrical-discharge unit ABSU-4000 whenever using the CA25-S40.

(Note 2) Be sure to always use the regenerative electrical-discharge unit ABSU-8000 whenever using the CA25-S80.

(Note 3) The applicable motor capacity is displayed on the controller front panel.
Never connect with a motor having a different capacity. This can result in burnout of the motor or other problems.

(3) Various units and options

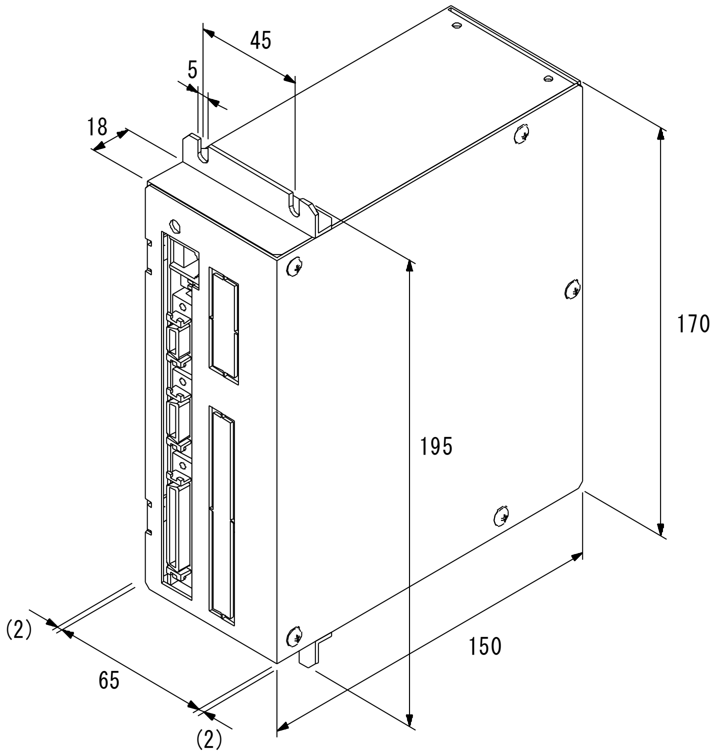
The following units and options are available for this unit.

Part name	Type	Application
Teach Pendant	TPH-4C	For programming CA20-M00
	TPX-4A	For programming CA20-M01
Expansion input/output unit (for slave)	CA20-EX-A20	Expanded input: 12 points, output: 8 points
Input/output cable (for slave)	CA10-IC-A□0	For slave unit
Input/output cable (for master)	ICBL-□00	For master unit
Input/output cable (for expansion input/output)	CA10-IC-B□0	For expansion input/output unit
Link cable	CA10-LC-A□□	Between master unit and each slave
Personal computer software	SF-98D(CD-ROM)	Program authoring and data maintenance tools (for Windows)
Communication cable (for PC/AT compatible computer))	PCBL-31	RS-232C connection cable between personal computer and controller
Regenerative electrical-discharge unit	ABSU-2000	Electrical-discharge unit for regenerative voltage suppression (for 50 to 200W)
	ABSU-4000	Electrical-discharge unit for regenerative voltage suppression (for 400W)
FIELD·BUS unit	CA20-M00-C□	CC-Link compatible
	CA20-M00-D□	DeviceNet compatible
VL·BUS unit	CA20-M00-□V	For connecting BS servo amplifier
Fiber-optical cable	CV23A-□00A	Between master unit and each BS servo amplifier
BS relay module	BSIFU-□	External circuit BS servo amplifier needs
External reverse-current absorption resistor	RGH□00A 30Ω	External reverse-current absorption resistor for BS servo amplifier
Lithium battery	LRV03	Battery for absolute encoder for BS servo amplifier

■ 2.3 Explanation of Each Part

■ 2.3.1 Explanation of master unit

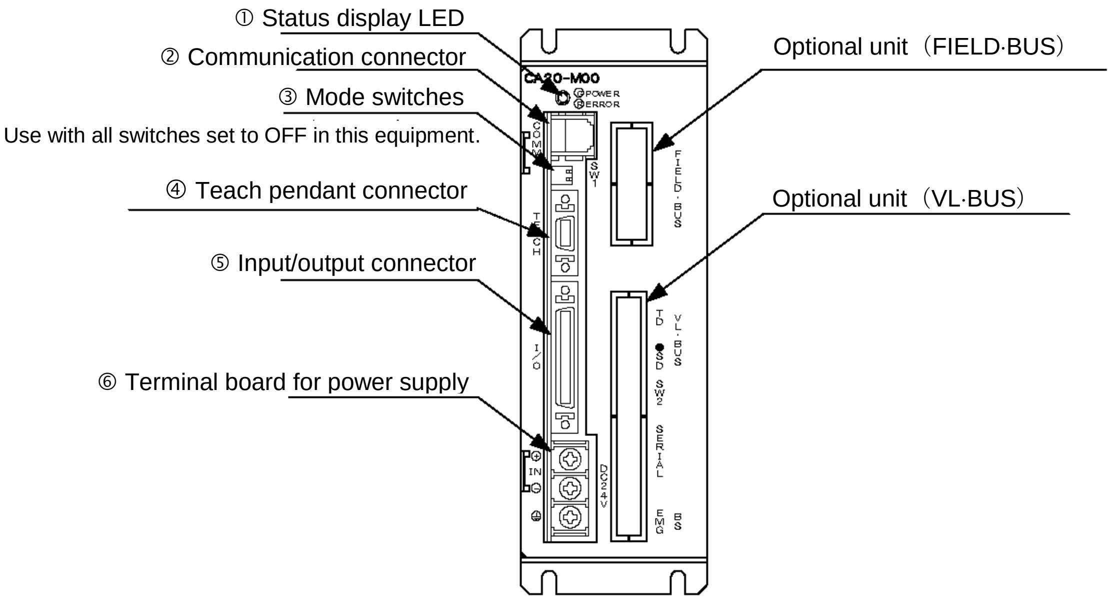
(1) External dimensions



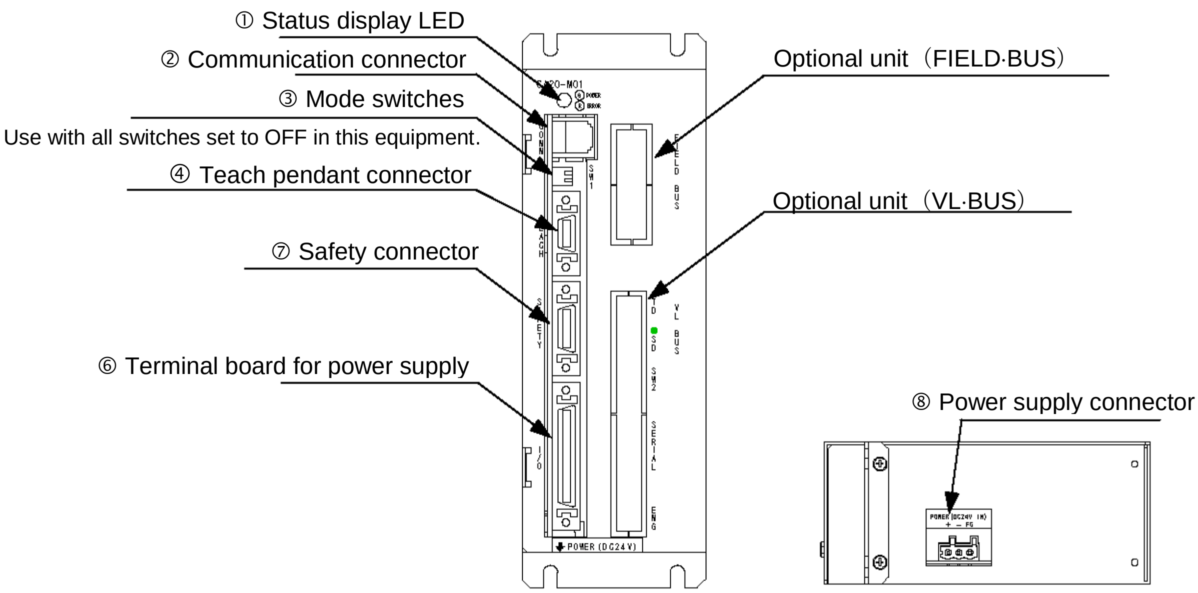
- The figure above shows the CA20-M01, but the external dimensions are also identical to the CA20-M00.
- The numbers in parentheses are the dimensions of the screw heads.

(2) Names of each part

(i) When optional units are not installed



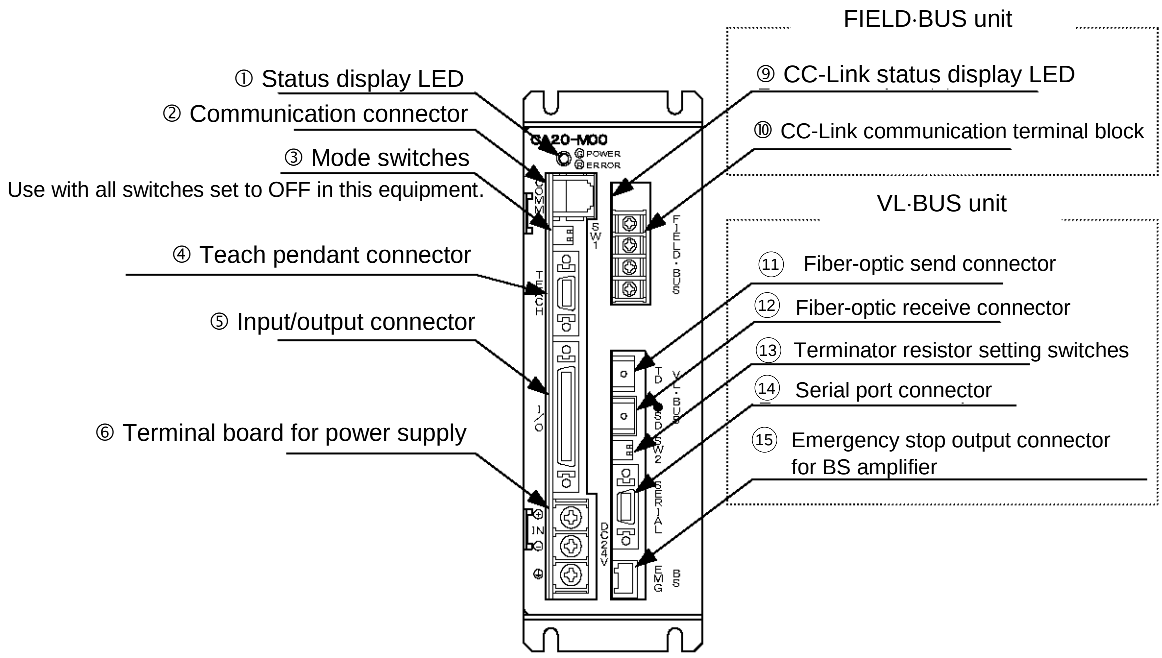
ＣＡ２０－Ｍ００



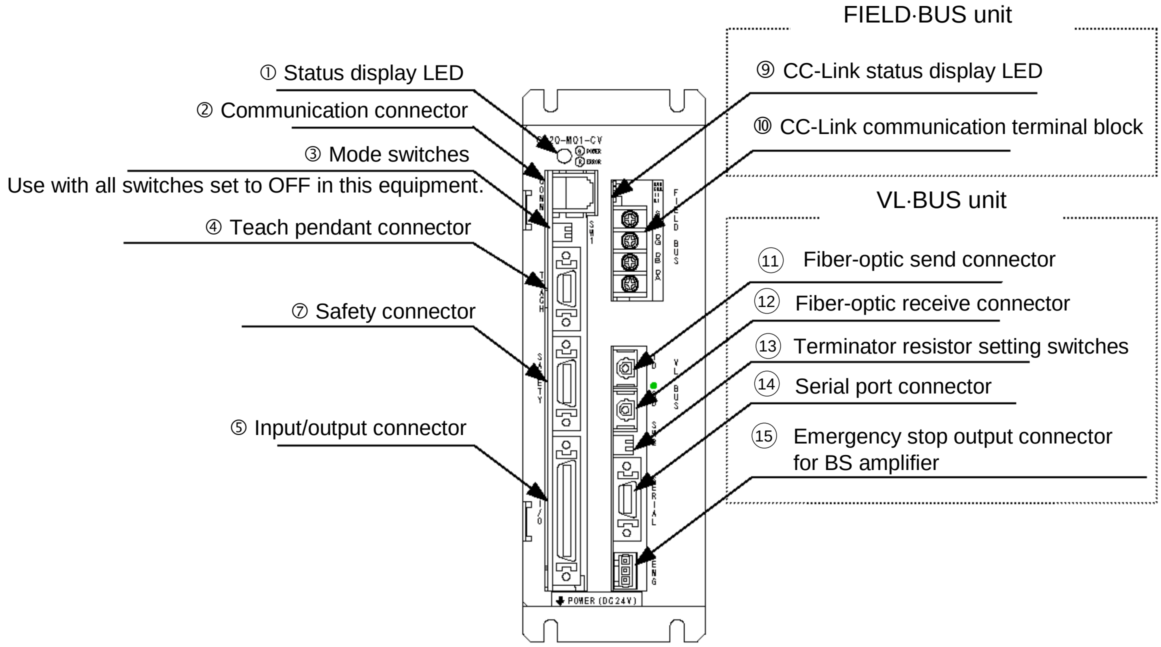
Front view　　Bottom view

ＣＡ２０－Ｍ０１

(ii) When optional units are installed (FIELD·BUS (CC-Link) unit and VL·BUS unit)



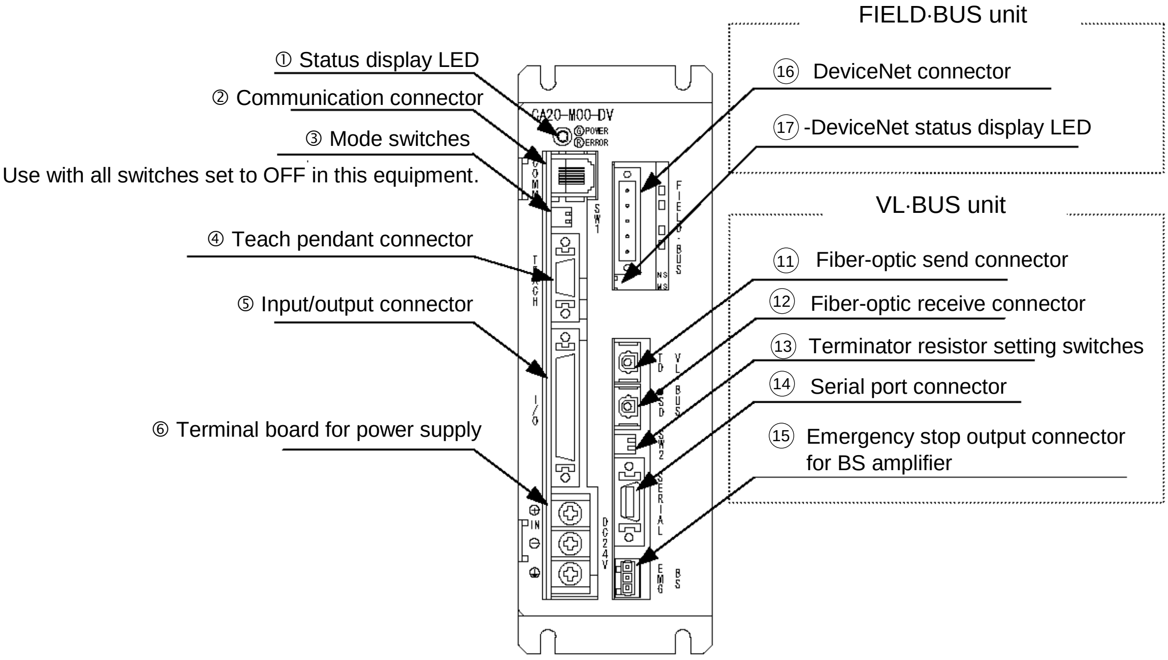
CA20−M00



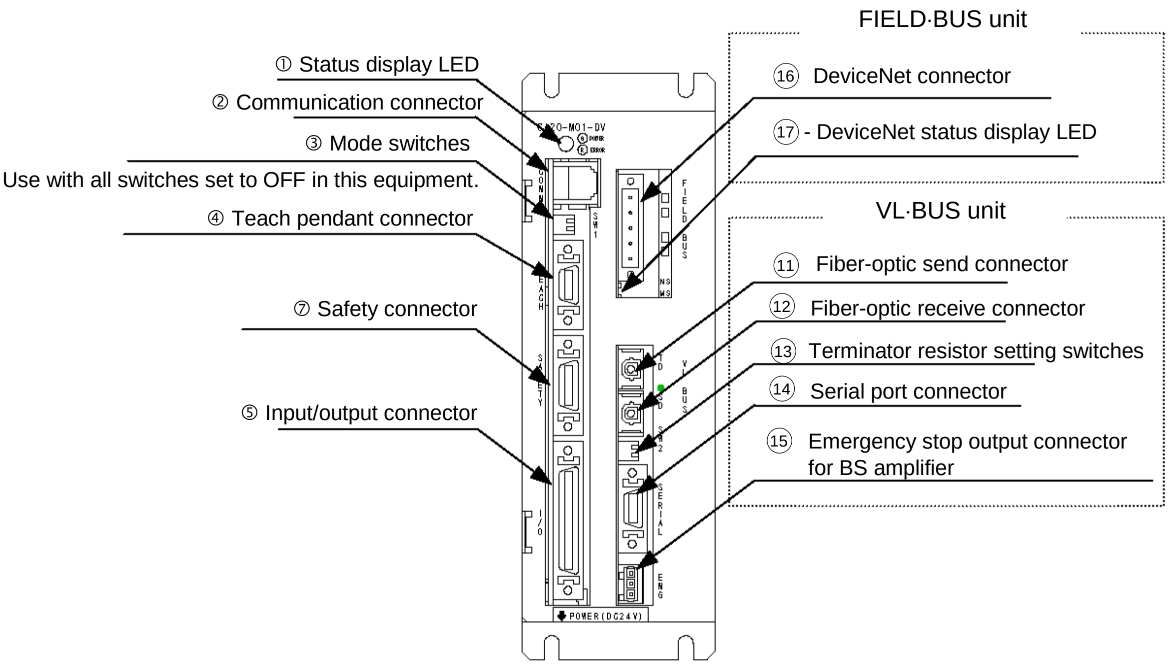
CA20−M01

Note The FIELD·BUS unit and VL·BUS unit are options available separately.

(iii) When optional units are installed (FIELD·BUS (DeviceNet) unit and VL·BUS unit)



CA20－M00



CA20－M01

Note The FIELD·BUS unit and VL·BUS unit are options available separately.

① Status display LED
This LED displays the status of the controller. The green LED lights when the power is ON, and the red LED lights when an error has occurred. The LED flashes during other phenomena (Refer to section 20.5).

② Communication connector
The slave unit (option) link cable is connected to this connector.

③ Mode switches
These are not used in this equipment. Use with all switches set to OFF.

④ Teach Pendant connector
This connector is used to connect a Teach Pendant or a communication cable (option) for connecting a personal computer.

CAUTION When using the CA20-M01, connect the supplied dummy connector when the Teach Pendant is not connected. This equipment is in the emergency stop state if nothing is connected.
The personal computer connection cable (option) does not include an emergency stop short-circuit connection. As a result, connecting this cable activates the emergency stop state. Using the serial port connector (⑭) does not activate the emergency stop state.

⑤ Input/output connector
An external control unit (sequencer (programmable controller), etc.) is connected to this connector.

CAUTION Incorrect wiring of the power supply, incorrect connection (mismatch of supplied power voltage and FG nogrounding) or incorrect connection of input/output connector could cause the trouble or malfunction of the controller or the malfunction of the entire system. Therefore, securely connect them.

⑥ Terminal board for power supply
The power input terminal and FG (Frame Ground) terminal are provided on this board.

CAUTION Be sure to always wire the power supply correctly. Incorrect wiring of the power supply, incorrect connections (mismatching of the supplied power voltage or unconnected frame ground (FG)), and incorrect connections of input/output connectors can cause a breakdown or malfunction of the controller, or a malfunction of the entire system.

⑦ Safety connector
The safety circuit is connected to this connector. For details, refer to section 2.4.12.

⑧ Power supply connector
The power supply is connected to this connector.

⑨ CC-Link status display LED (option)
This LED indicates the CC-Link status.

⑩ CC-Link communication terminal block (option)
The exclusive CC-Link cables are connected to this terminal block for establishing a data link.

⑪ Fiber-optic send connector (TD) (option)
The fiber-optic cable for the BS servo amplifier is connected to this connector.

⑫ Fiber-optic receive connector (SD) (option)
The fiber-optic cable for the BS servo amplifier is connected to this connector.

⑬ Terminator resistor setting switches (option)
These switches are used to connect a terminator resistor for communication when using a serial port.

⑭ Serial port connector (option)
The personal computer communication cable (option) is connected to this connector.

⑮ BS motor emergency stop connector (option)
This connector outputs an emergency stop signal to the BS servo amplifier.

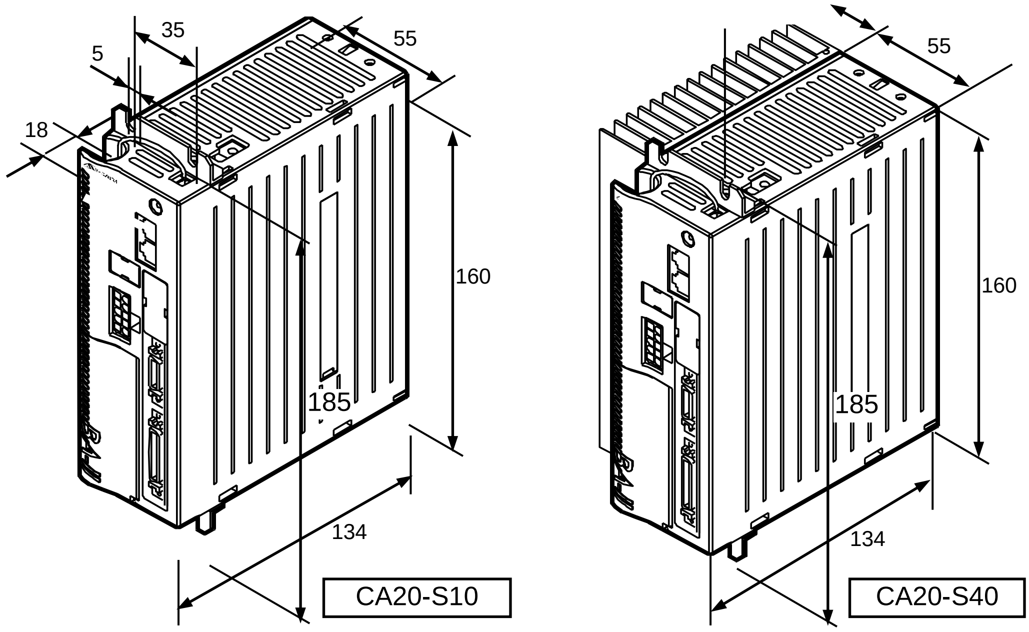
⑯ DeviceNET connector (option)
The exclusive DeviceNet cable is connected to this connector for establishing a data link.

⑰ DeviceNET status display LED (option)
This LED indicates the DeviceNet status.

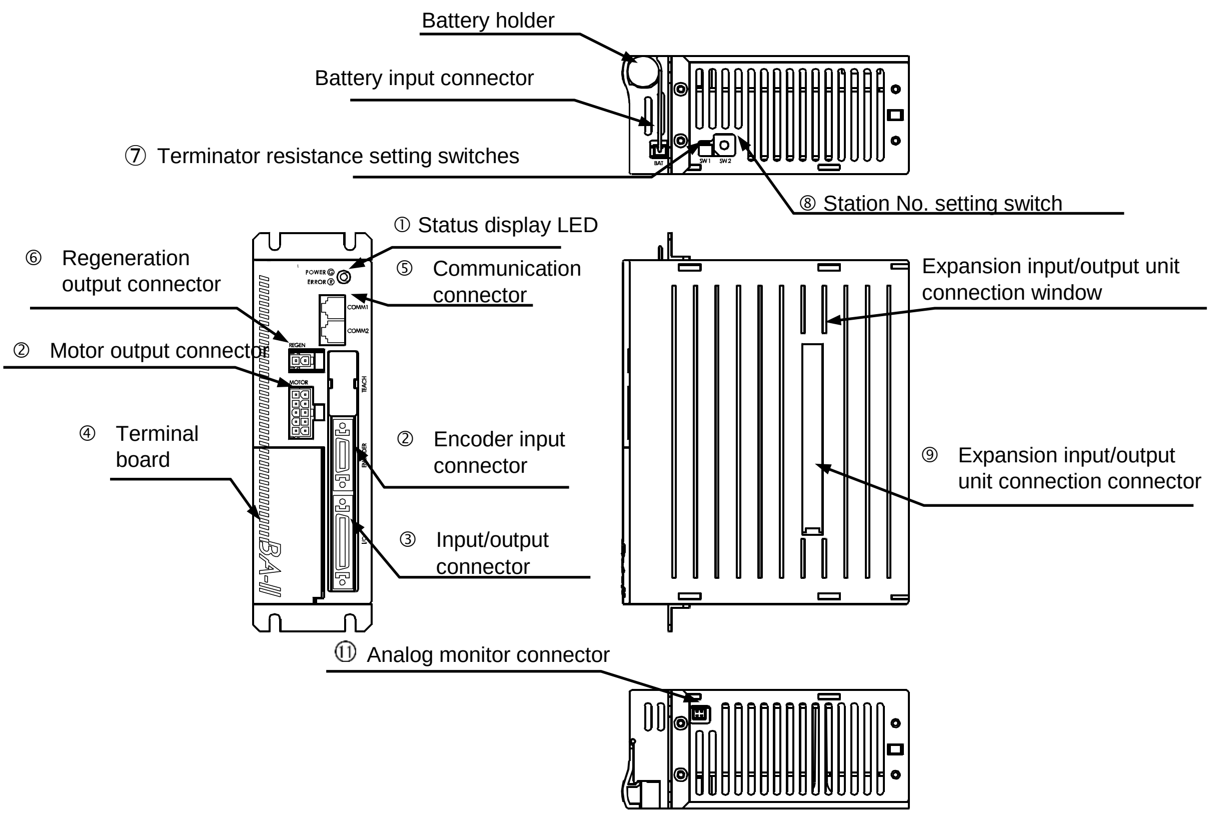
■ 2.3.2 Explanation of slave unit

- CA20-S**

(1) External dimensions



(2) Names of each part



① Status display LED
This LED displays the status of the controller. The green LED lights when the power is ON, and the red LED lights when an error has occurred.

② Motor output connector and encoder input connector
A controller cable is connected to this connector.

③ Input/output connector
An external control unit (programmable controller, etc.) is connected to this connector.

CAUTION Turn the controller power OFF before connecting or disconnecting the motor output, encoder input or input/output connectors. If a connection is made while the power is ON, the controller could malfunction.

④ Terminal board
The power input terminal, power voltage changeover terminal, FG (Frame Ground) and LG (Line Ground) terminals are provided on this board.

CAUTION Incorrect wiring of the power supply, incorrect connections (mismatch of supplied power voltage and power voltage changeover terminal, disconnection of LG and FG, nogrounding), and incorrect connections of input/output connectors could cause controller faults, malfunctioning, or malfunctioning of the entire system.

⑤ Communication connector
The slave unit (option) link cable is connected to this connector.

⑥ Regeneration output connector
The regenerative electrical-discharge unit (option) is connected to this connector.

⑦ Terminator setting switch
This switch is used to connect a terminator for communication when a slave unit is connected.

⑧ Station No. setting switch
This switch is used to set the station No. of each slave unit when a slave unit is connected and multiple axes are controlled.

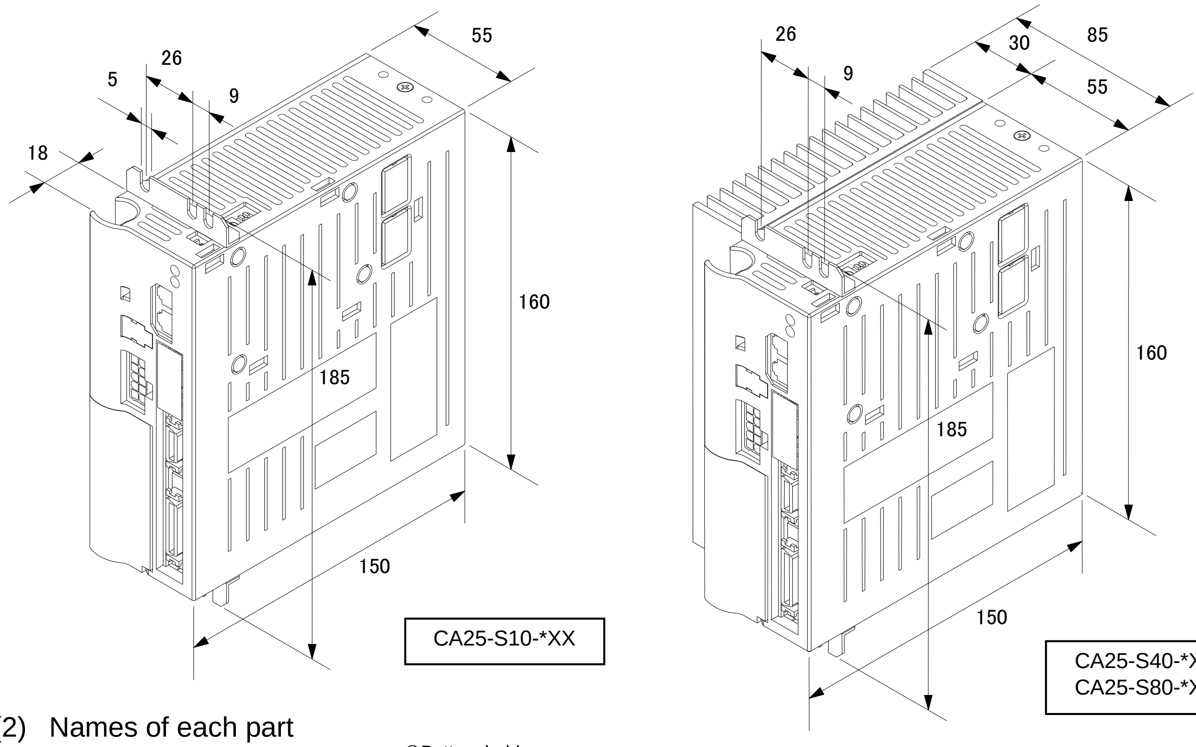
⑨ Expansion input/output connection connector
The expansion input/output unit (option) is connected to this connector.

⑩ Battery input connector
The battery harness (option) is connected to the connector. It is used when the absolute encoder is used.

⑪ Analog monitor connector
Note: This is for manufacturer adjustment. Do not connect devices here.

● CA25-S**-*XX

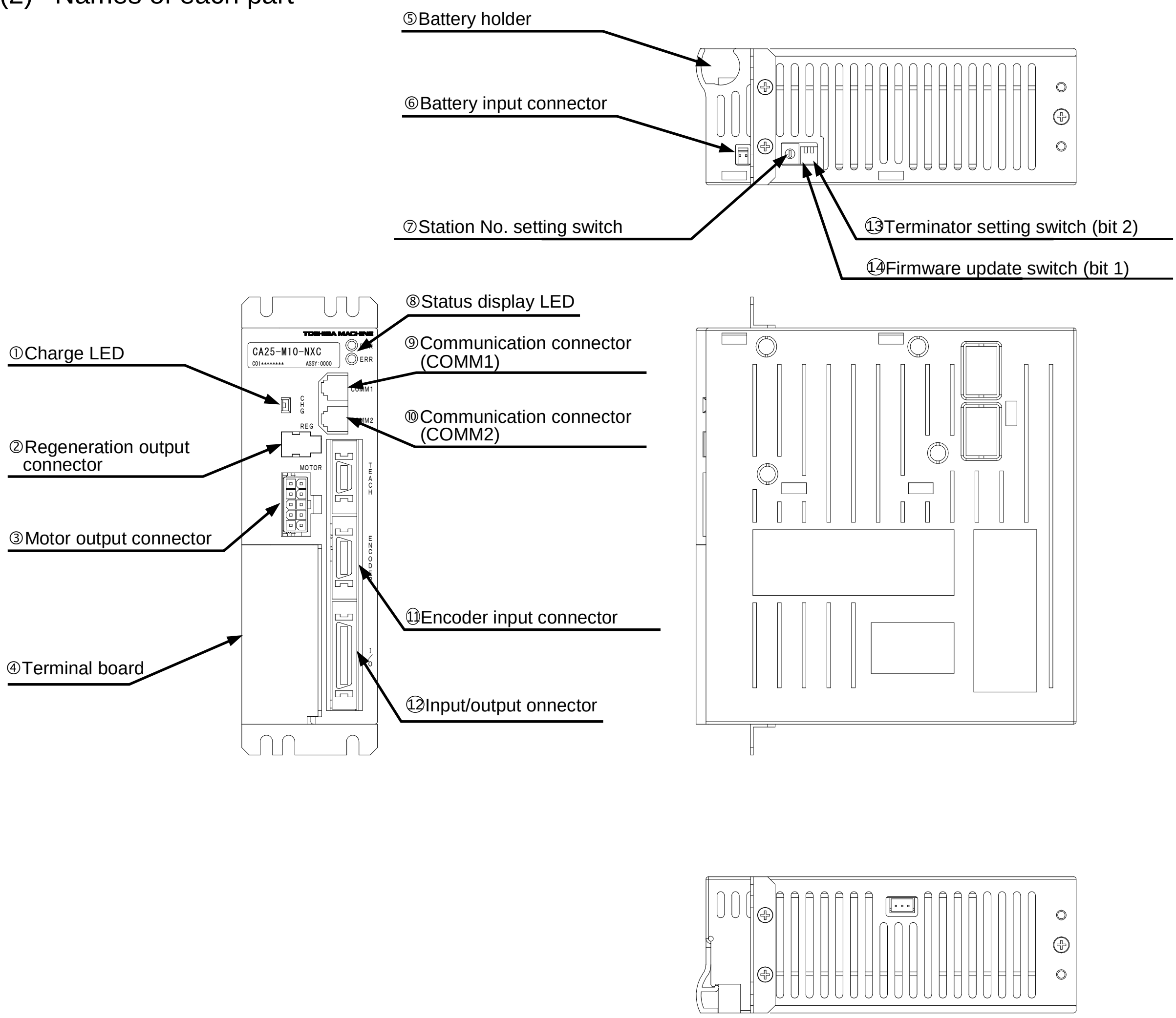
(1) External dimensions



CA25-S10-*XX

CA25-S40-*XX
CA25-S80-*XX

(2) Names of each part



① Charge LED
This LED displays remaining voltage of the main circuit smoothing capacitor.

CAUTION Even after turning OFF the power, do not touch the inside of the controller if the charge LED is lit. Otherwise electric shock caused by remaining voltage in the capacitor may occur.

② Regeneration output connector
This connector is used to connect an optional regenerative discharge unit. The connector is covered by the blank plate. Remove the blank plate when using the connector.

③ Motor output connector
This connector is used to connect the motor cable.

CAUTION Do not connect or disconnect the motor output connector during servo-lock condition. Connection or disconnection of the motor output connector during servo-lock condition may cause surge voltage and unstable operation.

④ Terminal board
The power input terminal, power voltage changeover terminal, FG (Frame Ground) and LG (Line Ground) terminals are provided on this board.

CAUTION Incorrect wiring of the power supply, incorrect connections (mismatch of supplied power voltage and power voltage and power voltage changeover terminal, disconnection of LG and FG, and other disconnections), and incorrect connections of input/output connectors could cause controller faults, malfunctioning, or malfunctioning of the entire system.

⑤ Battery holder
This battery holder stores a lithium battery for backup of the encoder.

⑥ Battery input connector
This connector is used to connect the battery harness.

⑦ Station No. setting switch
This switch is used to set the station No. of each slave unit when a slave unit is connected and multiple axes are controlled. The master unit is set to 0.

⑧ Status LED
This LED displays the status of the controller. The green LED lights when the power is ON, and the red LED lights when an error has occurred.

⑨ Communication connector (COMM1)
This connector is used to connect a link cable from a upper controller.

⑩ Communication connector (COMM2)
This connector is used to connect a link cable to a lower controller.

⑪ Encoder input connector
This connector is used to connect an encoder cable.

⑫ Input/output connector
An external control unit (sequencer (programmable controller), etc.) is connected to this connector.

CAUTION Connect or disconnect the motor output connector, the encoder input connector, or the input/output connector only when the controller is turned OFF. Never connect or disconnect the connector when the controller is ON, or failure of the controller may be caused.

⑬ Terminator setting switch (bit 2)
This switch is used to set a terminator for communication when a slave unit is connected.

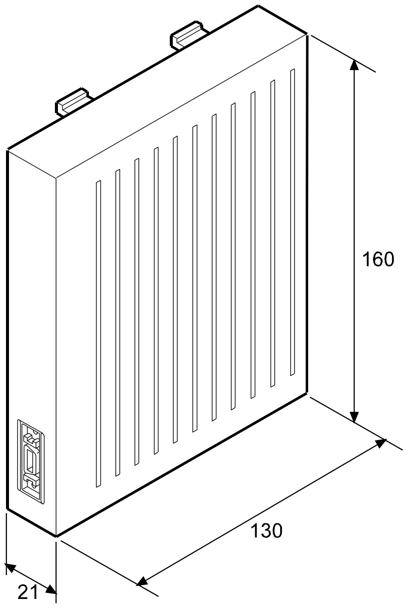
⑭ Firmware update switch (bit 1)
This switch is used to update the controller firmware. Normally this switch should be turned OFF. If this switch is turned ON, the controller cannot start properly.

■ 2.3.3 Explanation of expansion input/output unit

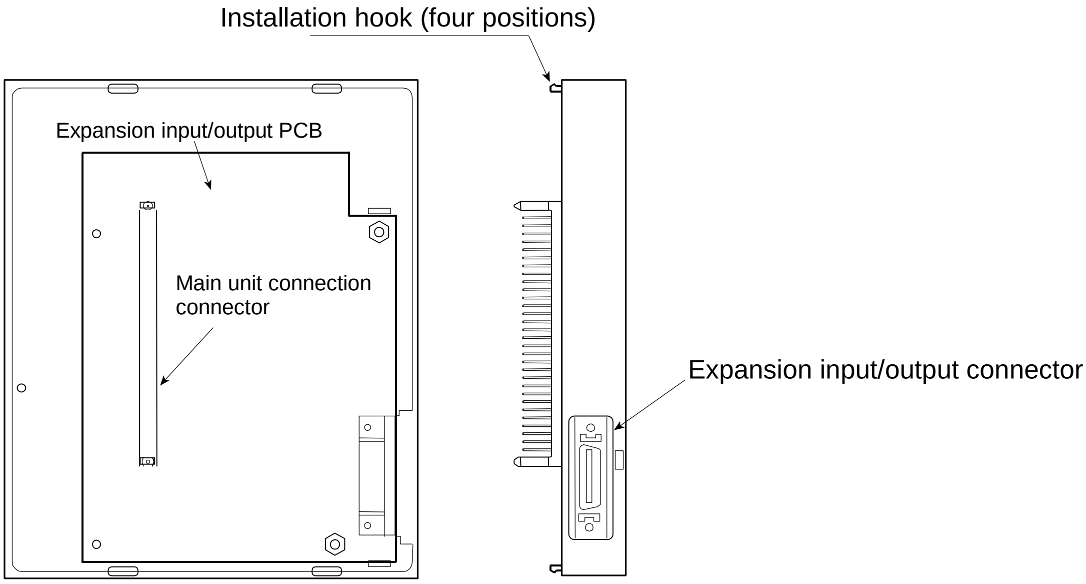
The expansion input/output unit can be connected to slave units only.
The external dimensions and part names are shown below.

- Slave unit type (Model: CA20-EX-A20)

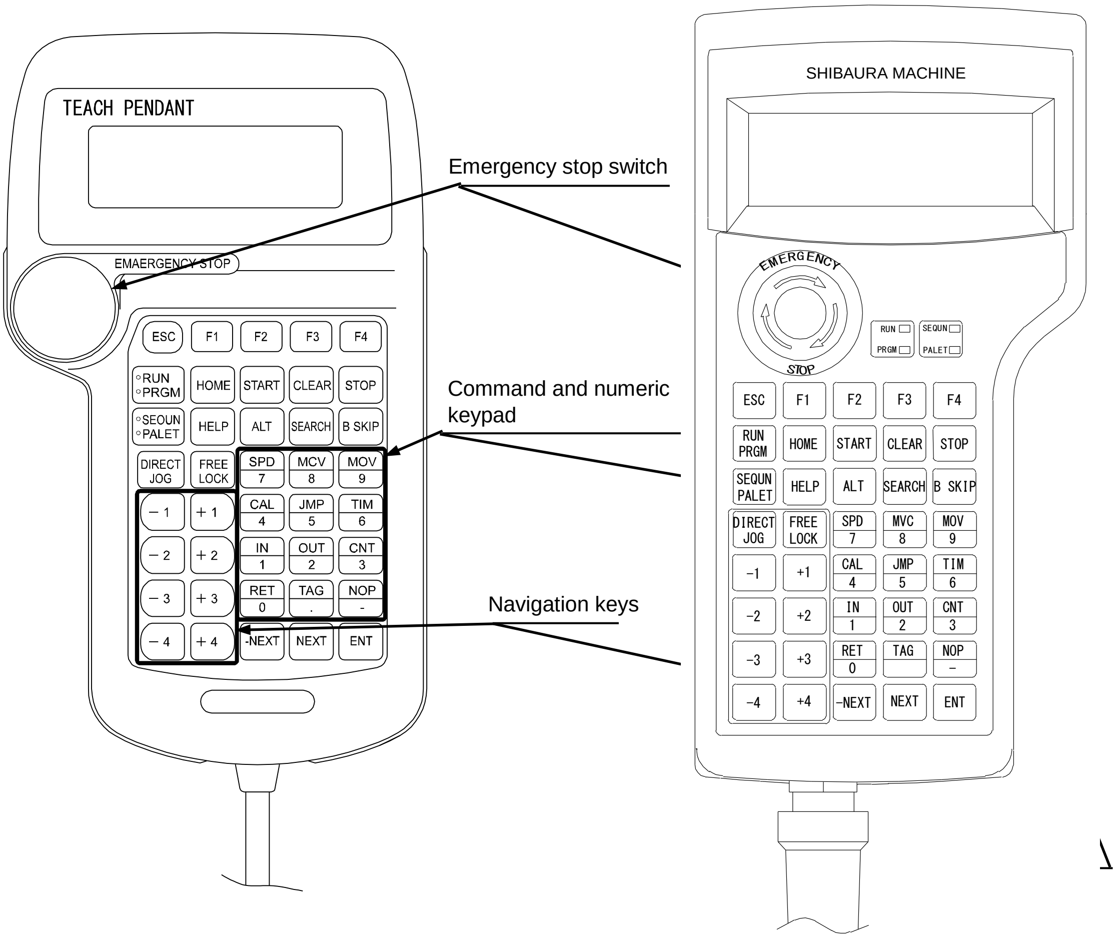
(1) External dimensions



(2) Name of each part



■ 2.3.4 Explanation of teach pendant



TPH-4C (for CA20-M00)

TPX-4A (for CA20-M01)

- ESC key
  The operator can use this key to exit the function key mode.
- F1 to F4 key
  These keys perform various functions.
- RUN/PRGM key
  This key is used to toggle between run and program modes.
- HOME key
  This key executes return to origin.
- START key
  The key executes the program from the displayed step.
- CLEAR key
  The key clears the input item, and release alarms.
- STOP key
  Program execution is terminated after the current step is completed.
- SEQUN/PALET key
  This key is used to toggle between the sequential mode and palletizing mode. When the key is pressed, the mode will alternate.

- HELP key
  An explanation of the current function is displayed.
- ALT key
  This key is used to change and select input data other than values in program or parameter mode.
- SEARCH key
  This key is used to search for step No., tag No., parameter No. and table No. palletizing program No., and palletizing program sub No., counter No., and error No.
- B SKIP key
  The key is used to reversely shift the cursor.
- DIRECT/JOG key
  When this key is pressed in servo-lock condition, JOG mode (manual operation mode) is enabled, and JOG operation of the axis can be executed by using Move keys. When this key is pressed in servo-free condition, Direct Teaching is enabled.
- FREE/LOCK key
  This key is used to set the robot in servo-lock condition or release it.
- MOVE keys
  These keys are used to move each axis of the robot in the jog mode (manual mode). While the key is pressed, its corresponding axis is moved. Thus the robot can be moved. Each key corresponds to the axis 1 or axis 4. The plus and minus on the keys indicate the direction of movement.
- Commands and ten keys
  These keys are used for programming. Main commands and numbers are indicated on the keys. When a key is pressed the command or number is entered at the position of the cursor.
- -NEXT key
  This key is used to display the step and the parameter preceding the one currently on display.
  Holding down this key moves continuously to previous screens.
- NEXT key
  Displays the step and the parameter ahead of the one currently on display.
  Holding down this key moves continuously to next screens.
- ENT key
  Writes commands and other data into a step in the program.
- Emergency stop switch
  This is a push-lock/turn-reset type switch. Pressing this switch applies an emergency stop to the robot. The emergency stop is cleared by turning the switch clockwise to release the switch lock, and then pressing the CLEAR key.
- Enable switch
  This 3-position enable switch enable safe operation of the robot.
  When this switch is not held (position 1), the axis is in servo-free status.
  When this switch is held lightly (position 2), the axis is in servo lock status.
  When this switch is held tighter (position 3) the axis is in servo-free status.

? In servo-free condition, the robot is separated electrically from the control system, and the axis arm can be moved freely by hand. In the servo-lock condition, the robot axis is connected electrically to the controller, which controls the robot's position. It cannot be easily moved by hand.

NOTE Though the teach pendant displays axis 1 to axis 4, it is invalid if any other number except the axis numbers of the robot body is displayed.

■ 2.4 Procedures from Installation to Operation

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

Procedure	Reference page
1) Installing the axis	Axis installation section
2) Installing the controller	Section 2.4.1
3) Connecting the emergency stop circuit	Section 2.4.5
4) Connecting the safety circuit (Note 1)	Section 2.4.12
5) Connecting the axis and controller	Section 2.4.4
6) Connecting with the external control unit (programmable controller, etc.)	Section 9.1.5
7) Checking supply power and grounding wires	Section 2.4.2
8) Checking each wiring (Make sure that none of the polarities are mistaken.)	
9) Connecting the Teach Pendant to controller	Section 2.4.4
10) Supplying the designated power supply. (POWER ON)	Section 2.4.2
11) Setting the robot type	Section 2.4.7
12) Setting the task and axis combination	Section 10.4.19
13) Setting the software limit	Section 2.4.8
14) Return to origin	Section 2.4.8
15) Adjusting the servo gain	Section 2.4.9
16) Entering program mode and starting program write	Section 3.2
17) Completing the program (Check that there are no mistakes.)	
18) Confirming program with step operation (STEP mode)	
19) Trial operation	
20) Adjustment	
21) Operation	

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

Note 1: The safety circuit connection is required only when the master controller CA20-M01 is used.

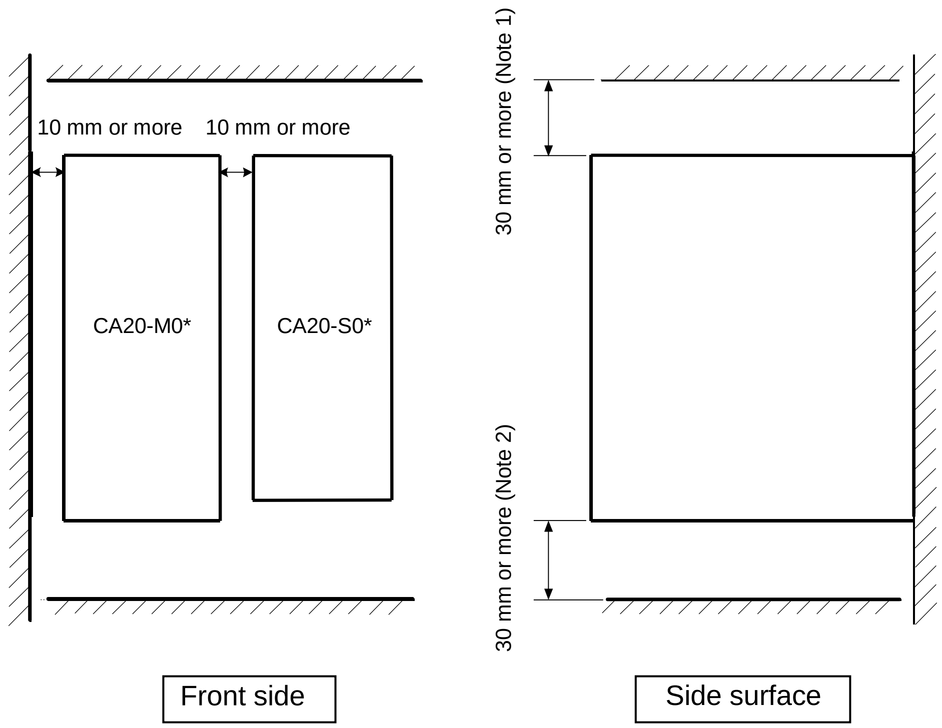
■ 2.4.1 Installing the controller

The controller uses a natural cooling method through convection. When installing the controller, place it in the vertical orientation as shown in the figure below, and leave a space of at least 30 mm above and below it.
If the ventilation is insufficient, the sufficient performance will not be achieved, and faults could occur.

* If connected in parallel with the regenerative electrical-discharge unit ABSU-4000, the installation dimensions for the ABSU-4000 apply.

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

(1) CA20-M0* and CA20-S*0 installation

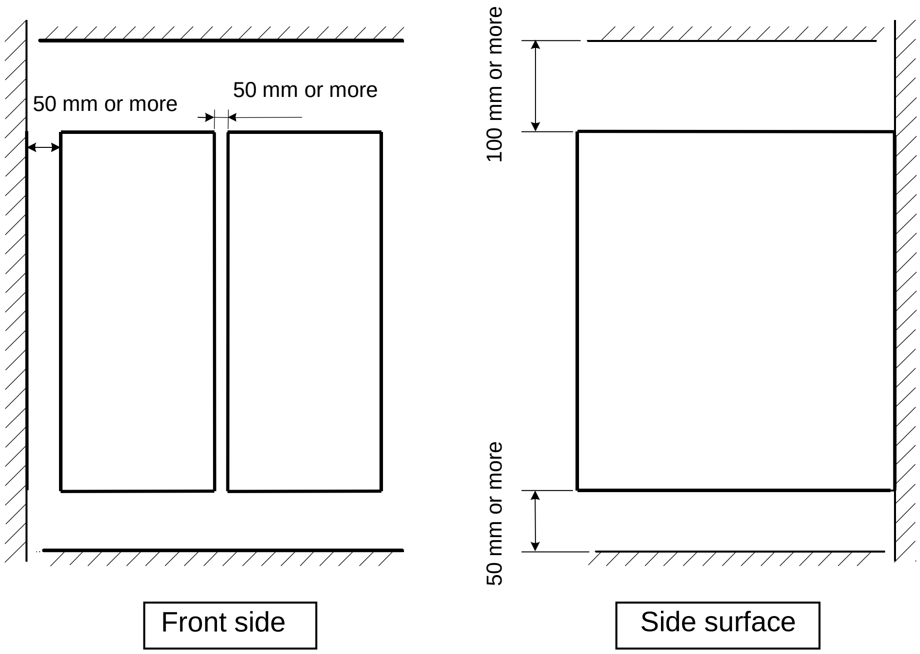


Notes (Note 1) When installing a slave unit, it is recommended that a space of at least 40 mm be left for facilitating battery changes.

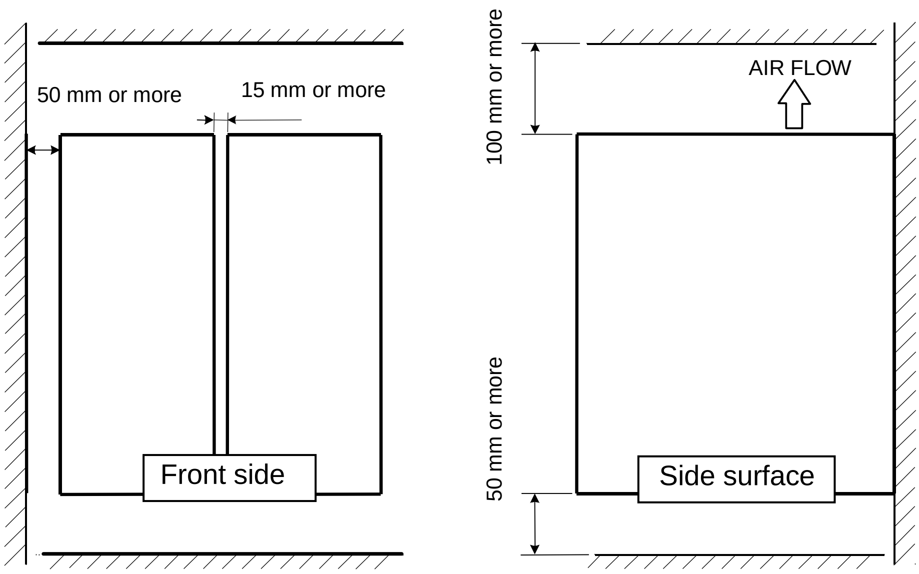
(Note 2) When installing the CA20-M01, it is recommended that a space of at least 60 mm be left for connection of the power supply connectors.

(2) BS servo amplifier installation

006P, 012P



025P

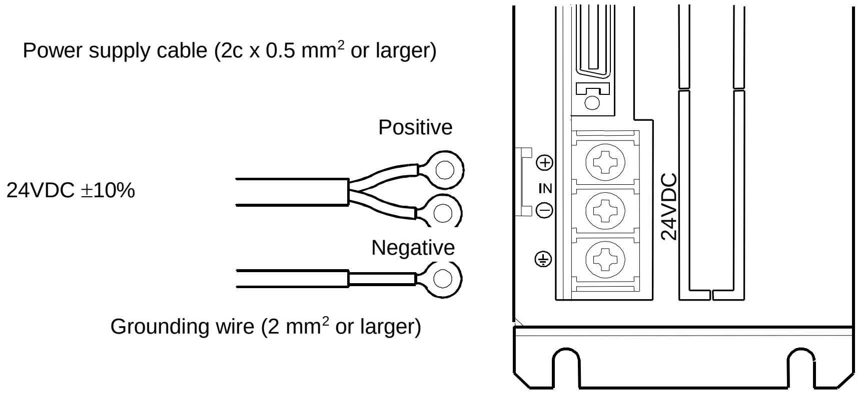


■ 2.4.2 Supply power and grounding

(1) Master unit

The power supply cable of the controller (master unit) is connected as shown below.

CA-20-M00



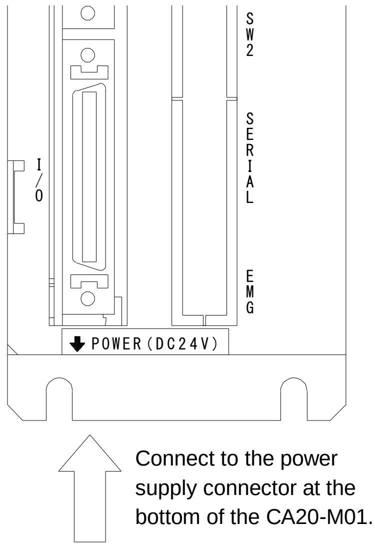
CA-20-M01

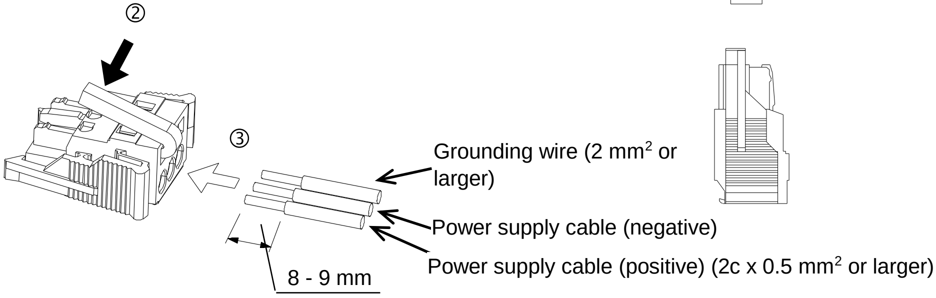
Power supply connector wiring procedure

① Peel off the covering of the wires.
Uncovered wire length: 8 to 9 mm

② Open the wire terminal pockets of the power supply connector.
Fit on the connection lever supplied with the controller, and press it in the direction of the arrow in the figure below to open.

③ Insert the uncovered wire section into the opening.
After inserting, release the pressure of the connection lever.



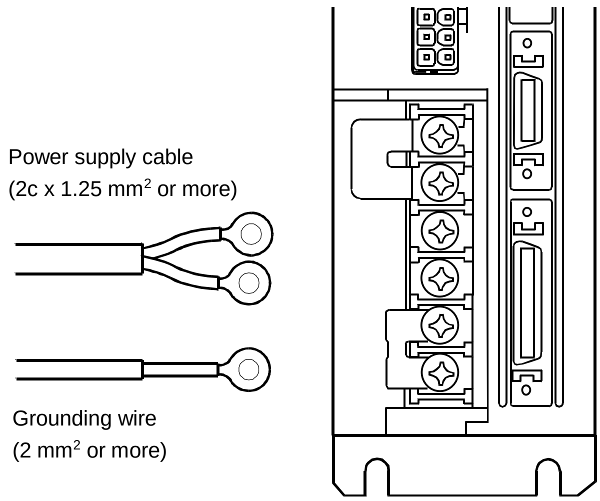


- Power input terminal (DC IN)
  The supplied voltage is 24VDC±10%. During connection, take care for the polarities.
- Frame ground (FG)
  This terminal is connected to the cabinet. To prevent electric shocks, carry out Class 3 grounding by connecting the exclusive wire.

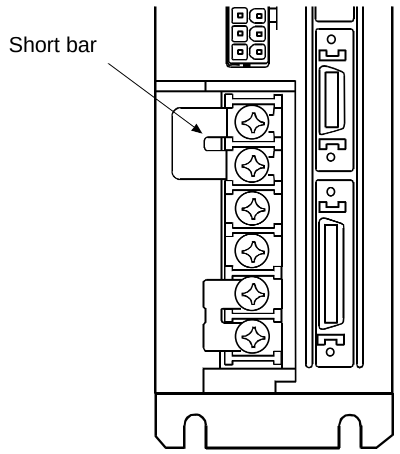
The wiring connectors do not have any displayed pin number indicators.
Wire indicators are shown on the power supply connector at the bottom of the controller unit, and so refer to this to ensure that the wires are connected correctly.

(2) Slave unit
The power voltage supplied to the CA20-S10 can be set to either 100VAC or 200VAC by changing the short-circuit bar of the VOLTAGE SELECT terminal on the terminal block. The CA20-S40 is compatible with a 200VAC power supply voltage only.

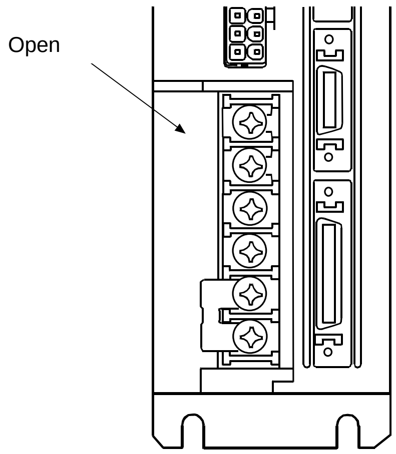
CA20-S10	100V AC system:	Single-phase 100V AC - 120V ±10%	50/60Hz
	200V AC system:	Single-phase 200V AC - 240V ±10%	50/60Hz
CA20-S40	200V AC system:	Single-phase 200V AC - 230V ±10%	50/60Hz



- Power input terminal (AC IN)
  When used in Japan, the supply voltage is normally ±10% in respect to the nominal voltage. However, if the voltage fluctuation is particularly large, connect a constant voltage device externally.
  To change between the 100VAC system and 200VAC system, short circuit the VOLTAGE SELECT terminal with the enclosed short bar to select 100VAC, and leave the terminal opened to select the 200VAC system.
  Use the 200VAC system (open) for the CA20-S40.



(a) For 100VAC system



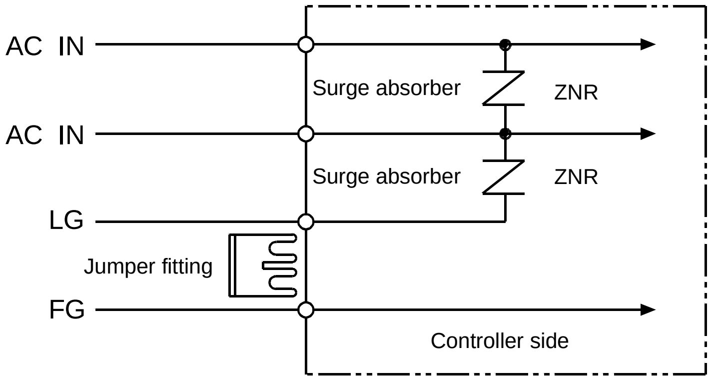
(b) For 200VAC system

- Frame ground (FG)
  This terminal is connected to the cabinet. To prevent electric shocks, carry out Class 3 grounding by connecting the exclusive wire.

⚠ CAUTION

A surge absorbing element is provided between the controller's power line and cabinet. Confirm that the supply power is 290V or less between the power line and grounding, and then connect.
If the power between the power line and grounding is 290V or more, the absorbing element could be damaged and the controller could be damaged.

- Surge absorber exclusive terminal (LG)
  This terminal is provided in addition to the FG terminal to protect the circuit from external lightening surges or noise, etc.



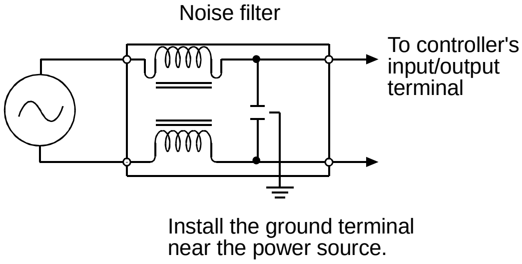
When installing the controller, short circuit the LG and FG terminals with the enclosed jumper fitting so as to protect the circuit from external lightening surges and noise, etc.

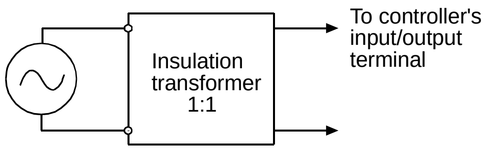
⚠ CAUTION Normally (when shipped from the factory) LG and FG are short circuited with a jumper fitting. When carrying out a insulation resistance test (500V megger test) or withstand voltage test (1000VAC), the results may appear faulty due to the current leaked by the surge absorber. In this case, remove the jumper fitting between LG and FG before carrying out the tests.

■ 2.4.3 Improvement of noise resistance

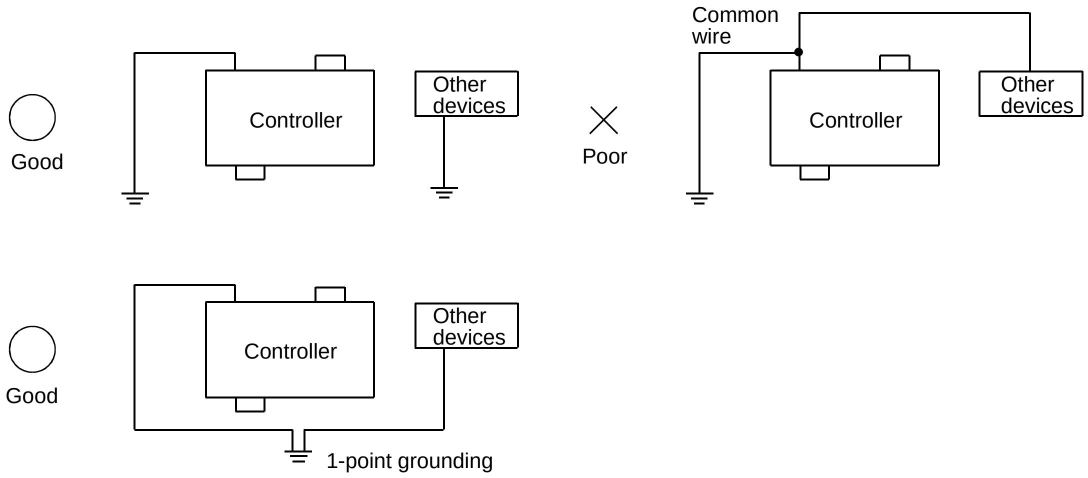
Using the following measures to further improve the noise resistance is recommended.

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

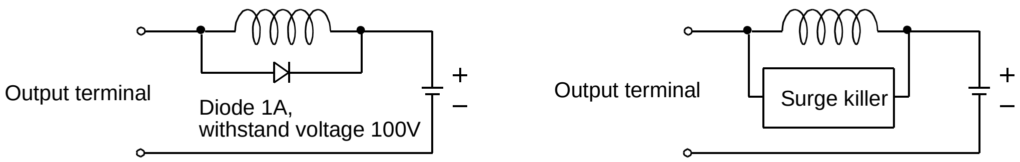




- Avoid installing the controller near high-voltage devices (induction hardening machines, electric welding machines, etc.).
- Install the controller at a position 200mm or more away from the power wire.
- When treating the input/output signal and controller cables, if the high voltage wires and power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



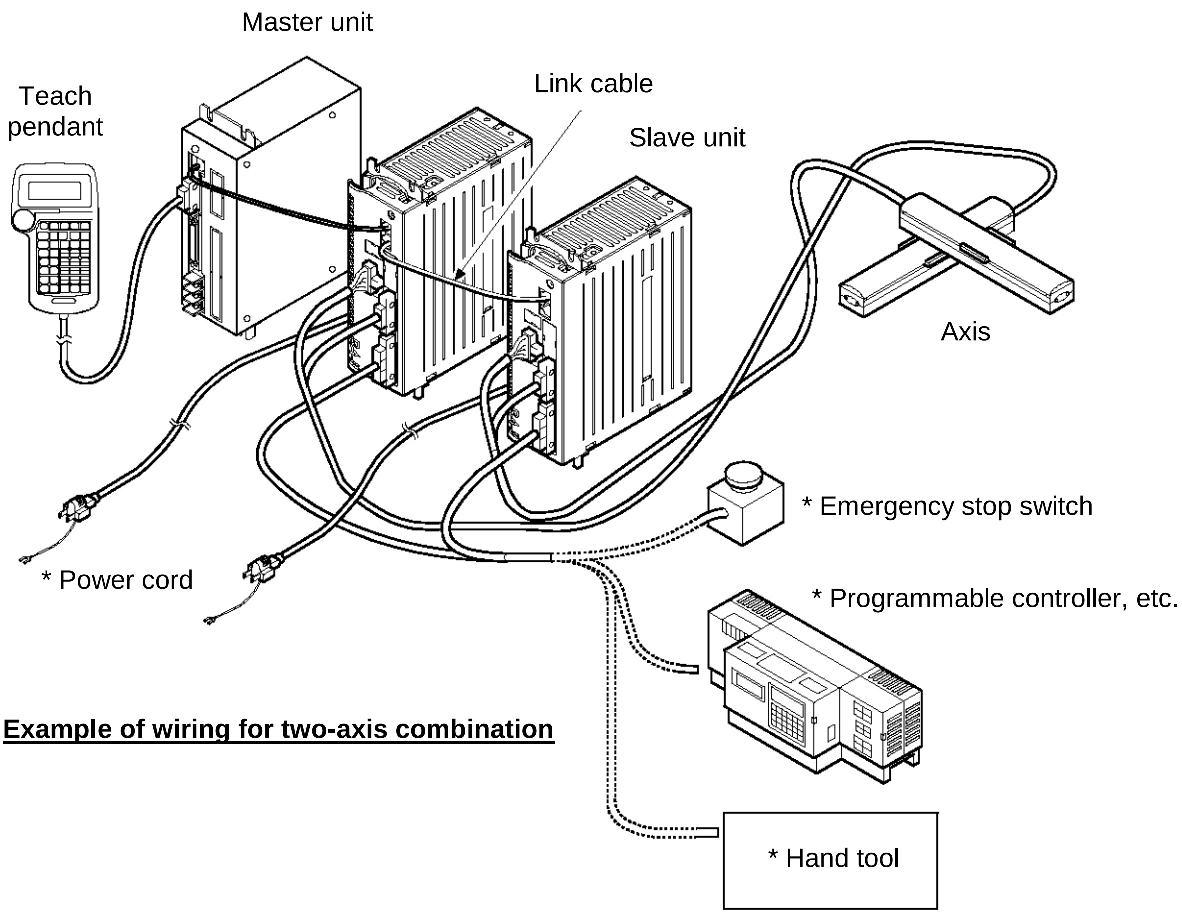
- When connecting induction load to the output, connect a diode or surge killer in parallel.



■ 2.4.4 Connecting the axis and controller

Connect the axis and Teach Pendant to the controller as shown below.

- The above figure shows the axis connection method when the master unit is the CA20-M00, and the axis connection method for the CA20-M01 is identical.



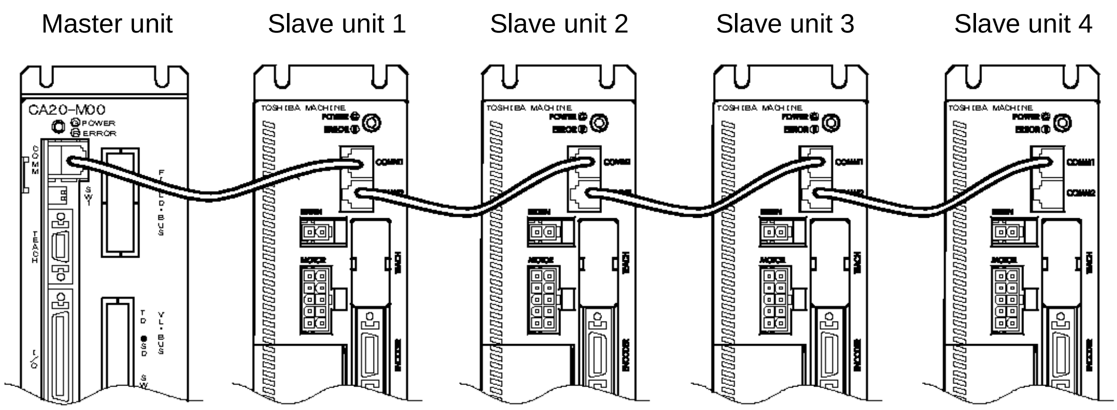
Example of wiring for two-axis combination

Items marked with a * are to be prepared by the user.

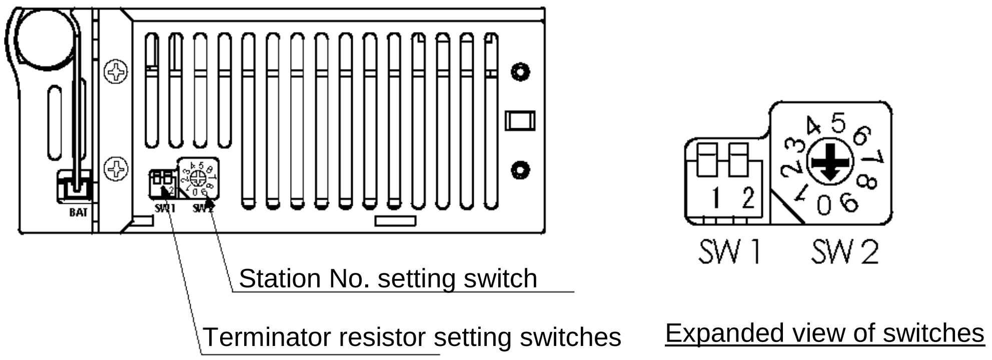
- When the master unit is the CA20-M00, use the TPH-4C as the teach pendant. When the master unit is the CA20-M01, use the TPX-4A as the teach pendant.

- Control of multiple axis
  When it is connected to the slave units of axis 1 to axis 4 with the link cables, the master unit can control one axis to max. four axes.

(1) Connecting the controller
To connect the master unit and slave unit, use the communication connectors (COMM1, COMM2) on the front side, and connect a link cable between COMM on the master unit to COMM1 on slave unit 1, and between COMM2 on salve unit 1 to COMM1 on slave unit 2.



(2) Setting station No.
The station No. must be set with the station No. setting switch on the top of the unit so that the hardware of each slave unit can recognize the station No. Set each slave unit station No. to "1" to "4". If other settings are made, or if the same No. if set for the slave units, a communication error will occur.



Top view of slave unit

(3) Setting of task and axis combination
This setting is made with parameter 2. Refer to the task and axis combination settings given in section 14.4.19.

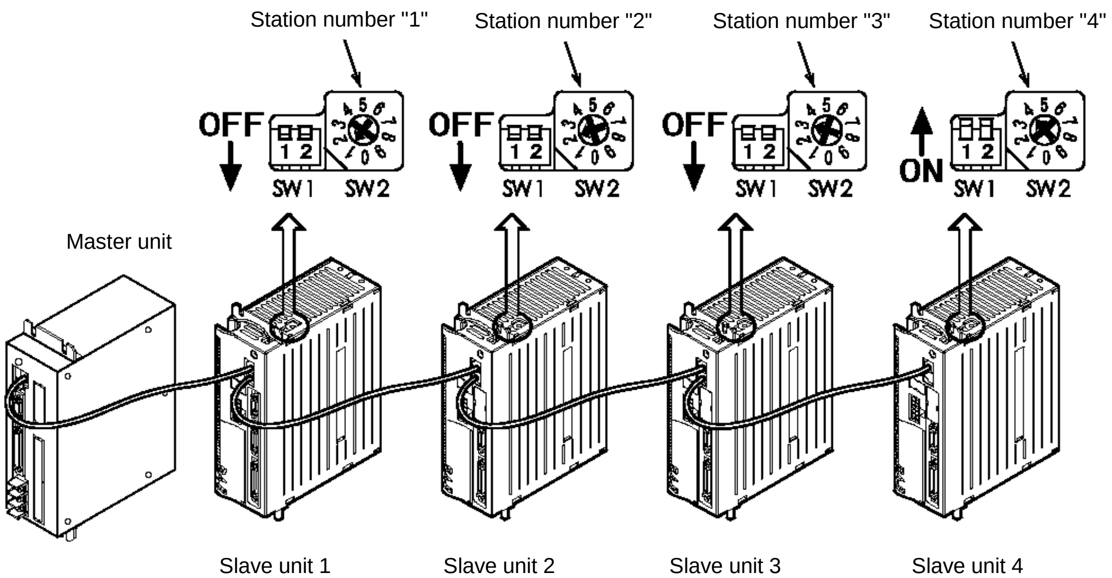
(4) Setting terminator

When multiple units are connected, the end of the communication line must be treated so that the communication will be accurate. This end treatment is possible by setting a terminator and setting the terminator setting switch on the slave unit to ON. Turn ON bit 1 and bit 2 of the terminator setting switch on the slave unit at the end of the communication line. Leave the switches set to OFF for all other units.

⚠ CAUTION If the terminator resistor is not set correctly, a slave communication error can occur.

Example of four-axis combination

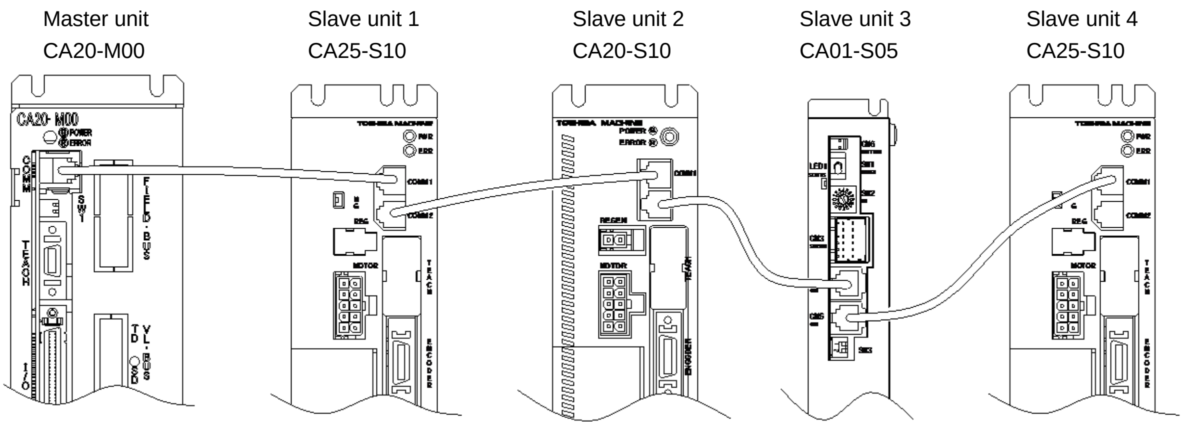
The terminator resistor setting switches for slave unit 4 only at the end of the connection as viewed from the master unit is set to ON.



- Connection with BA III series or BA-C series.

  Slave units of the succeeding BA III series or the small controller BA-C series can be used. For the method to connect with BA III series, refer to the instruction manual of Q3276. For method to connect with BA-C series, refer to section ■ 21.8.

  The following figure shows a connection example for the case using CA20-M00 for master unit, CA25-S10 for the axis 1, CA20-S10 for the axis 2, CA01-S05 for the axis 3 and CA25-S10 for the axis 4.

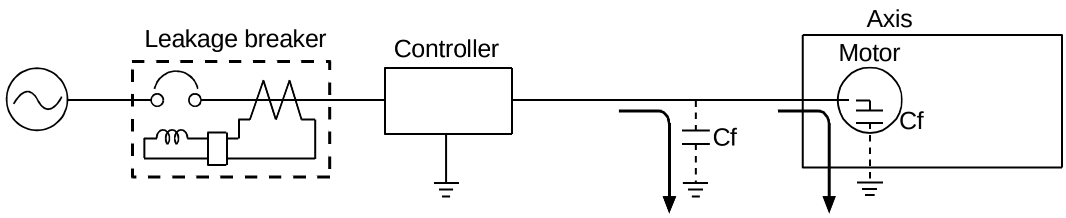


■ 2.4.5 Connecting the emergency stop circuit

Before using this unit, connect the emergency stop circuit to the input/output connector of the master unit. Unless the circuit is connected, the controller will be in the emergency stop state.
For details, refer to section 10.1.2 (1).

■ 2.4.6 Effect of leakage current

This equipment (slave unit) controls the motor assembled into the axis with PWM (Pulse Width Modulation). Thus, a high frequency leakage current (Cf·dV/dt) that do not affect the human body will flow through the cable from the controller to motor and the motor's floating capacity (Cf). General leakage breakers, excluding those for high frequencies, normally detect the leakage current at the same level between the low frequency and high frequency regardless of the frequency zone. Thus, the leakage breaker will function when the leakage current in the high frequency zone exceeds the operating frequency of the leakage breaker.



Measures when leakage breaker functions needlessly by high frequency leakage current

(1) Use a high frequency and surge corresponding leakage breaker.
Use a leakage breaker that is sensitive to the high frequency element leakage breaker contained in the controller's leakage current to prevent needless functioning.

(2) Decrease the floating capacity between the controller and ground.
Select as short a controller cable as possible to be used between the controller and axis.

⚠ WARNING Always ground the controller with Class 3 or higher grounding to prevent electric shock accidents.

⚠ CAUTION Needless functioning of the leakage breaker could occur in a separate system that is not directly related to the circuit connected to the controller because of leading in of the leakage current.

■ 2.4.7 Setting the robot type

Inputting the Robot Type enables you to automatically set various parameter values according to the axis to be used.

```
TEACHING PENDANT
TPH-4C Ver.2.10
```

STEP 1 When the power switch is turned ON, the first display is shown for two seconds.

* The display format and version may vary depending on the teach pendant to be used.

```
POWER  F1:T/P ON
   -ON F2:
       F3:CHANG TASK
       F4:EXTENSION
```

STEP 2 After the first screen, the display at left is shown. Press [=▲].

```
POWER  F1:MONITOR
   -ON F2:ROBOT TYPE
       F3:VERSION
       F4:PAGE
```

STEP 3 Press [F2] to select the Robot type.

Press [ESC] to return to STEP 2.

```
[PARA]K19
TASK COMBINATION
        T1 T2 T3 T4
        [1][0][0][0]
```

Axis setting for task 1
Axis setting for task 2
Axis setting for task 3
Axis setting for task 4

STEP 4 Before inputting the robot type of each axis, input the combination of the task and axis. (Refer to the table in the next page.)

Using the numeric keypad, input the axis setting which is used for each task, and press [ENT] .

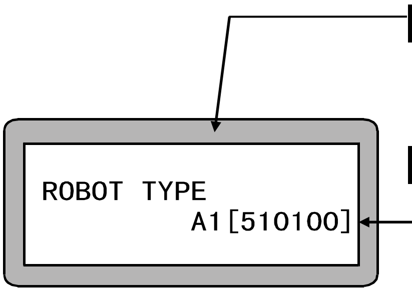
(A setting other than 0 to 5 will be invalid.)

Press [ALT] or [NEXT] to display the next screen.

Press [ESC] to return to STEP 3.

- Refer to section 14.4.19 for details.
- Set the axis setting as shown below.

Axis setting	Setting	Description
0	0-axis specifications	No control axis
1	1-axis specifications	1-axis setting
2	2-axis specifications (Two-dimensional circular interpolation)	Under 2-axis setting, two-dimensional circular interpolation is possible.
3	3-axis specifications (Two-dimensional circular interpolation)	Under 3-axis setting, two-dimensional circular interpolation is possible for axes 1 and 2. Simultaneous arrival is applied for 3rd axis.
4	3-axis specifications (Three-dimensional circular interpolation)	Under 3-axis setting, three-dimensional circular interpolation is possible.
5	4-axis specifications (Three-dimensional circular interpolation)	Under 4-axis setting, three-dimensional circular interpolation is possible for axes 1, 2 and 3. Simultaneous arrival is applied for 4th axis.



STEP 5 Use the ALT or NEXT key to select the station No. (1 to 4).
Press ALT or NEXT to return to STEP 4.

STEP 6 Use the numeric keypad to enter the Robot type and press ENT . The robot type will be set.
Press ESC to return to STEP 3.

- The station No. is a number assigned to each unit. (Refer to section 2.4.4)
- Refer to the Instruction Manual (Axis Installation Section) of each axis for details on the robot type (six-digit figure).

NOTE

- To confirm the robot type, do not press ENT at STEP 5 and instead press ESC to return to STEP 3.

```
PLEASE POWER OFF !!
```

STEP 7 This screen will appear when [ENT] and [ESC] are pressed after changing the robot type in STEP 6.

Follow the instructions on the display and turn OFF the controller power.

NOTE

- After the Robot type has been entered, turn OFF the controller switch to write the data into the controller.
- If a nonexistent Robot type is entered, a buzzer sounds and the error message "ROBOT NO. ERROR" is displayed.
- In the cases of the followings, "PLEASE POWER OFF!!" may be displayed after turning ON the power again. In such a case, turn OFF the power again. When the power is turned ON again, the set parameter 2 will be validated.

① When the power is turned ON for the first time after the axis setting is changed in setting of the combination of the task and the axis (refer to STEP 4) and the power is turned OFF.

② When the link cable is connected and the power is turned ON for the first time after the robot type of the slave unit of the station No. to which the link cable is not connected is changed and the power is turned OFF.

③ When the power is turned ON for the first time after the slave unit is changed following change of the robot type.

■ 2.4.8 Setting the software limit and return to origin

Software limits can be defined to prevent this unit from overrunning its maximum safe operating limits within the range of the axes.
The software limit is set to the positive and negative range of movement of a motor drive shaft. The limits on the movement range can be changed easily by software, but it is not easy to do so using hardware.
To set the software limits, use the Teach Pendant and follow the directions below.

STEP 1

```
POWER   F1:T/P ON
   -ON  F2:
        F3:CHANG TASK
        F4:EXTENSION
```

Turn ON the power. After the first display at left is shown, press the [F1] key.

Then, press the [RUN PRGM] key to set the program mode.

STEP 2

```
[PRGM]
0001
NOP
```

Press [HELP] .

STEP 3

```
[PRGM]  F1:EXTENSION
 HELP   F2:DIRECT OUT
        F3:EDIT
        F4:PARAMETER
```

Press [=4] to set the parameter mode.

STEP 4

```
[PARA]  F1:SET MODE
        F2:PARAMETER1
        F3:PARAMETER2
1/2     F4:TABLE
```

Press [F2] to set parameter 1.

STEP 5

```
[PARA]P01A1= 0000.00
 UPPER   A2= 0000.00
 LIMIT   A3= 0000.00
         A4= 0000.00
```

Use the numeric keypad to enter the plus soft limit coordinates and press ENT . Next, press NEXT .

STEP 6

```
[PARA]P02A1= 0000.00
 LOWER   A2= 0000.00
 LIMIT   A3= 0000.00
         A4= 0000.00
```

Use the numeric keypad to enter the minus soft limit coordinates and press ENT . (Normally 0 is input for the minus soft limit.)
Next, press ESC twice, enter the program mode, press ◦RUN ◦PRGM and enter the RUN mode.

? The station No. is a number assigned to each unit and the soft limit is a value set for each unit. (Refer to section 2.4.4.)

STEP 7 Press HOME to execute return to origin.

```
[AUTO]
0001
NOP
```

NOTE

- The software limits must be within the maximum stroke of the actuator(s) installed. After completion of the setting, the stroke range of the slider (hereafter called the work area) is from the software upper limit to the software lower limit.
- If software limit zero and return to origin are executed twice in succession, a software limit over error will be generated, so use caution.
- The software upper limit is the maximum and the software lower limit is the minimum moving distance of the axis.

■ 2.4.9 Servo gain adjustment

There are two kinds of gain in the servo mechanism of this unit: position gain and speed gain. They are set through parameter 1. Generally, a larger servo gain enables higher speed response in the servo mechanism and a smaller servo gain enables smooth movement. An inappropriate gain setting can cause overshoot or undershoot. It can also result in vibration and noise. Normally, the appropriate servo gain is set automatically when the Robot Type (six-digit figure) is entered. However, when you have to adjust the gain according to actual load conditions, adjust it following the instruction below.

NOTE There are 100 gain settings, 0 to 99. To change the gain, change the Robot Type's preset value one setting at a time while checking the movement.

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

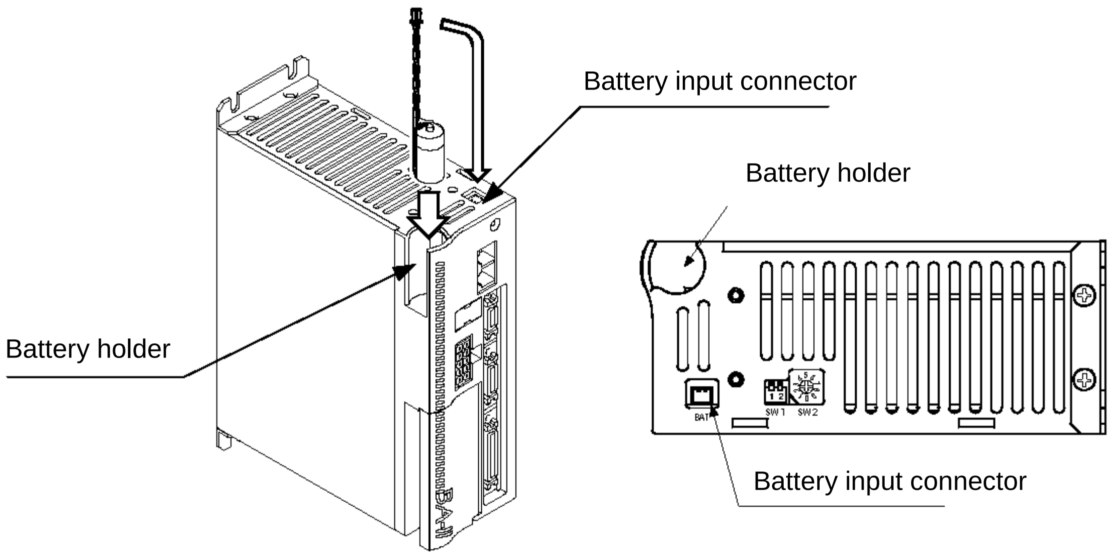
- Servo gain (speed)
  Set the servo gain for speed at a value one lower than the level at which the motor begins to generate small vibration in servolock condition (the motor is stopped with the power ON.)
  When the value is set too large, beat noise will be caused by small vibration of the motor. In this case, set it to a smaller value.
  When the servo gain for speed is too low, low frequency hunting (oscillation) occurs in the motor. In this case, set the gain to a larger value. When the value is set too small, an overflow error can be generated because of the delayed response to a command of the motor.

■ 2.4.10 Absolute encoder backup

All models of the BA III, BA II and BA-C axis AC servomotor include an absolute encoder. Backup power is supplied to the encoder by a battery or other power source to enable constant monitoring of motor operation even when the power supply to the controller is cut off and to allow smooth startup without returning to the origin when starting the system and recovering from an emergency stop.

NOTE When the encoder type setting parameter (section 14.4.17) is set to incremental encoder, the absolute encoder function does not operate even if the backup power supply is connected.

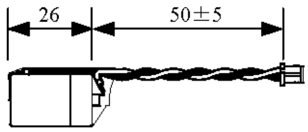
- Installing the lithium battery
  One lithium battery for backup of the encoder is supplied for each unit in this equipment. As shown in the figure below, the lithium battery is stored in the battery holder at the top of the controller, and it is connected to the battery input connector.



Controller top view

? Install a lithium battery in all controllers.

- Lithium battery specifications

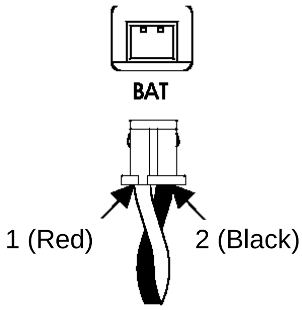
<table>
<tr><th colspan="3">Item</th><th>Description</th><th>Remarks</th></tr>
<tr><td colspan="3">Part name</td><td>Lithium battery</td><td>Thionyl chloride lithium battery</td></tr>
<tr><td colspan="3">Model</td><td>CA20-EB-05</td><td>Battery: ER3V (manufactured by Toshiba Battery)</td></tr>
<tr><td rowspan="4">Specification</td><td colspan="2">Nominal voltage/capacity</td><td>3.6V 1000mAh</td><td rowspan="4"></td></tr>
<tr><td rowspan="2">Dimensions</td><td>Battery body</td><td>φ14.5 × 26mm
(excluding protrusions)</td></tr>
<tr><td>Harness length</td><td>50±5mm
(excluding connectors)</td></tr>
<tr><td colspan="2">Weight</td><td>Approx. 10 g</td></tr>
<tr><td colspan="3">Backup connection time (Note 1)</td><td>Approx. 50,000 hours
(Note 2)</td><td>25°C, backup current 20 μA</td></tr>
</table>

(Note 1) This is the cumulative time that the controller unit power remains in the OFF state.
(Note 2) The retention time of the battery varies depending on the temperature and other factors. Use these figures as a general guide only.

- Battery input connector signal names and pin Nos

No.	Signal name	Meaning
1	EBAT	Backup power +
2	EBA0	Backup power –

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



- Controller-side connector model
  L header DF3-2P-2DS(01) (Hirose Electric)

- Harness-side connector model
  Crimp socket DF3-2S-2C (Hirose Electric)
  Socket crimp terminal DF3-2428SCFC (Hirose Electric)
  [Compatible wire size: AWG22 to 28 (0.33 to 0.1 mm^2)]

- Backup specification

Item		Specification	Remarks
Backup voltage		3.6 V DC (Standard) 6.5 V DC (Maximum) 2.5 V DC (Minimum)	Controller front LED flashes when at 2.7 VDC or less (low voltage warning)
Consumption current	When controller is in non conducting state	20 μA (Standard) 30 μA (Maximum)	25°C Maximum instantaneous current: 2 mA
	When controller is in conducting state	3 μA (Standard)	
Maximum response rotation speed during backup		5000 min^{-1}	

- Encoder-related errors

(1) Low backup voltage warning

When the backup power supply drops below 2.7 V, the status display LED on the controller front will flash green as a warning. When multiple axes are used, only the controller LED for the corresponding axis will flash green. Also, the error output does not turn on.

(2) Encoder backup error

An encoder backup error occurs in the following cases. The error can be cleared by using the reset input or the CLEAR key on the teach pendant.

- When the power was turned on for the first time after the controller axis unit (motor) was connected
- When the connector of the encoder cable was disconnected temporarily during backup
- When the backup power supply dropped below 2.5 V while power was not being supplied to the controller, and the backup could not be performed properly.

(3) Encoder error

An encoder error occurs in the following cases. Turn the power off and then on again to clear the error. The error cannot be cleared by using the reset input or the CLEAR key on the teach pendant.

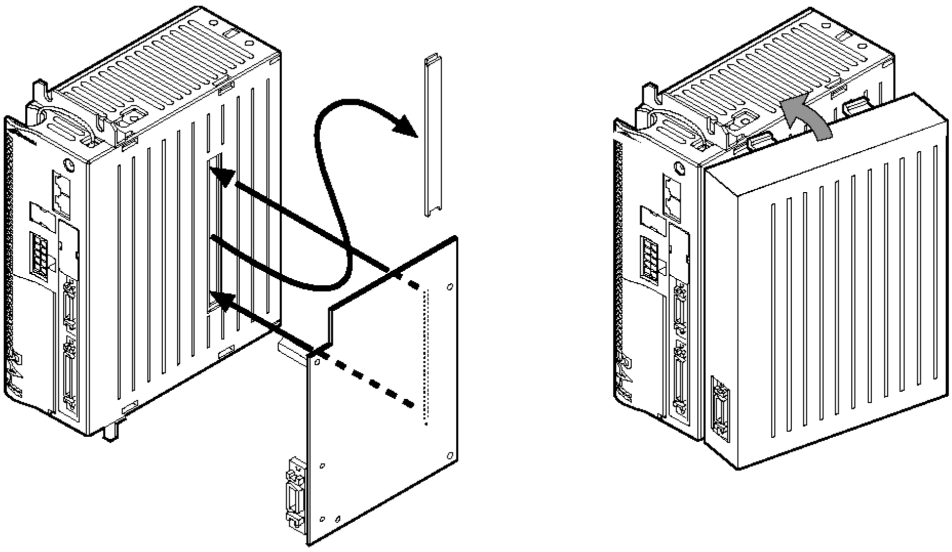
- Backup could not be performed properly because the motor rotation speed exceeded 5000 min^{-1}
- The motor rotation speed exceeded 200 min^{-1} when the power was turned on
- While the power was supplied to the controller, the connector of the encoder cable was disconnected, or a wire in the encoder cable was broken

Once an encoder error or encoder backup error occurs, the value of the absolute counter is no longer reliable, and so movement operations of the axes are disabled until the return to origin operation is performed. When these errors occur, the movement operation is disabled not only for the axis where the error occurred, but for all axes until the return to origin operation is performed.

If an encoder error or encoder backup error occurs together with another error (such as an emergency stop), an error other than the encoder error may be displayed depending on the order that they occurred, and it will not be apparent that an encoder-related error had occurred.
If the error message "RETURN TO HOME NOT COMPLETED!" is displayed when moving the axis after clearing the error, an encoder error or encoder backup error may have also occurred.

■ 2.4.11 Installation of expansion input/output unit

Installation of master unit
Install the master unit, aligning its installation holes to the installation hooks (4 places) of the unit on which the master unit is installed.
(The board is in the proper position even when it is tilted slightly with respect to the controller.)
After installation, install the push rivets into the four upper and lower holes, and fasten the unit.



■ 2.4.12 Connection of safety circuit (CA20-M01 only)

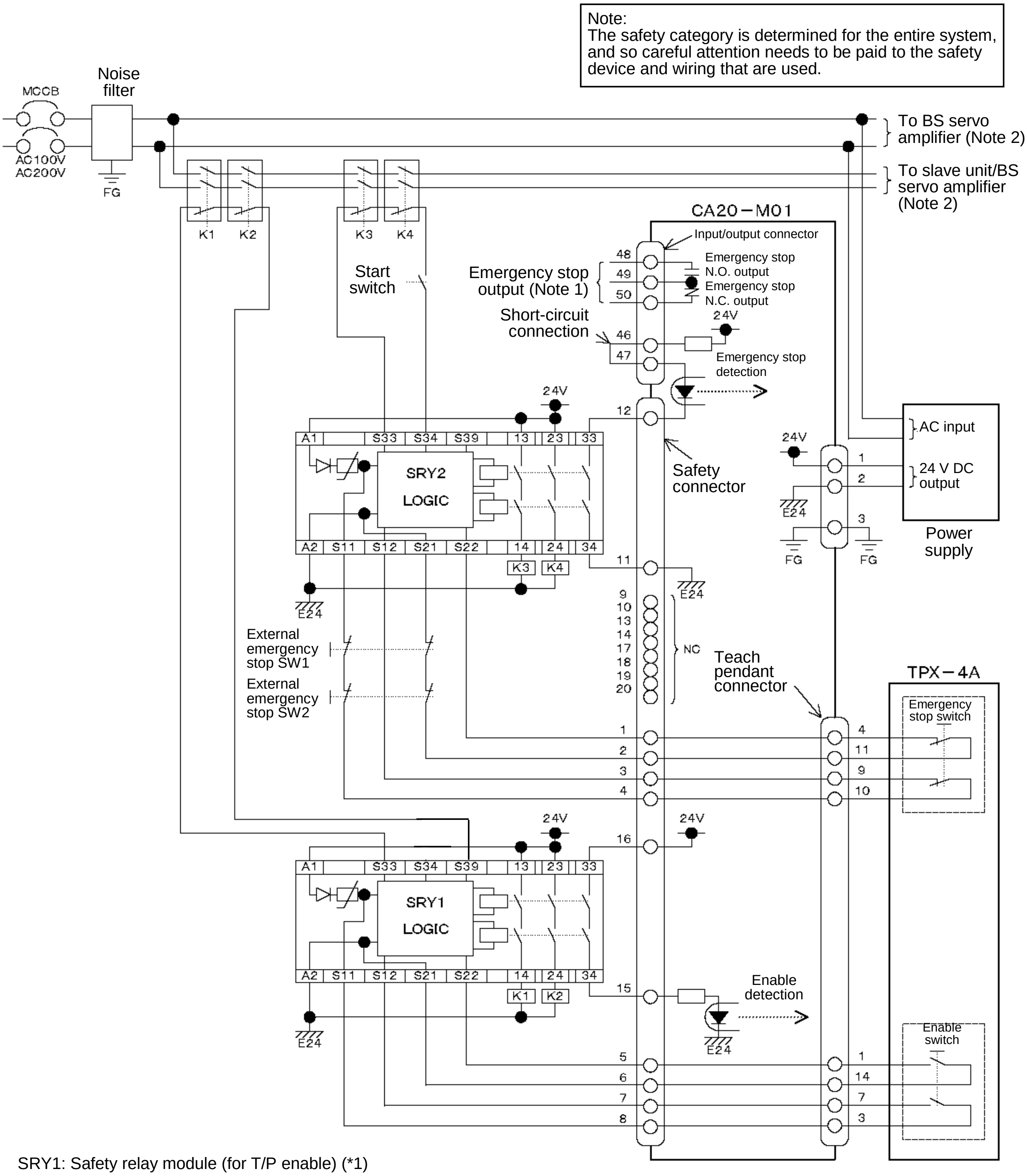
CA20-M01 can be combined with an external safety circuit for providing support of safety category 3. The safety category is determined for the entire system, and so careful attention needs to be paid to the safety device and wiring that are used.
The connection to the safety device is made using the safety connector.

Safety connector (SAFETY)

Pin no.	Description	Connected to
1	T/P emergency stop SW1-Contact 1	This connects to the input of the safety relay module for emergency stop.
2	T/P emergency stop SW1-Contact 2	
3	T/P emergency stop SW2-Contact 1	
4	T/P emergency stop SW2-Contact 2	
5	T/P enable SW1-Contact 1	This connects to the input of the safety relay module for the enable switch.
6	T/P enable SW1-Contact 2	
7	T/P enable SW2-Contact 1	
8	T/P enable SW2-Contact 2	
9	Not used	
10	Not used	
11	Emergency stop input	This connects to the contact output of the safety relay module for emergency stop.
12	Emergency stop input	
13	Not used	
14	Not used	
15	Enable input	This connects to the contact output of the safety relay module for the enable switch.
16	Enable input	
17	Not used	
18	Not used	
19	Not used	
20	Not used	

? The external safety circuit must be obtained by the customer.

(1) Safety category 3-compatible circuit connection example

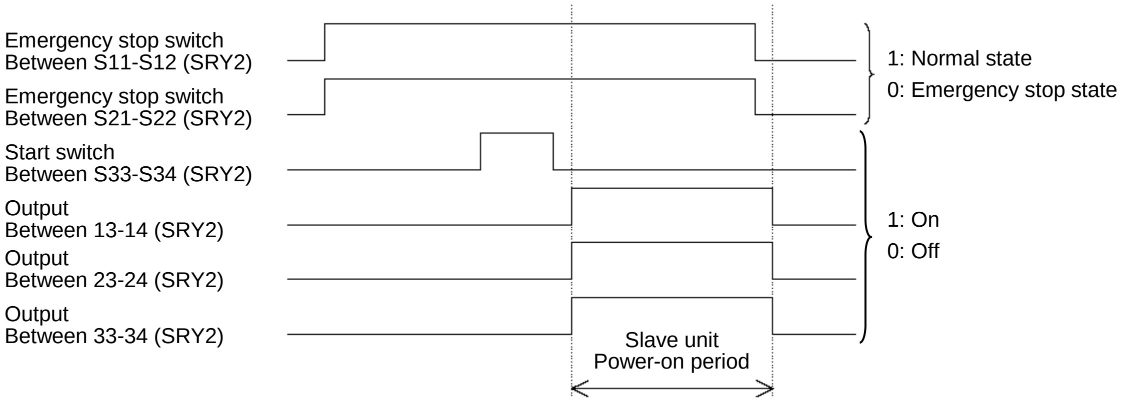


SRY1: Safety relay module (for T/P enable) (*1)
SRY2: Safety relay module (for T/P and external emergency stop) (*1)
K1, K2: Safety compatible contactor (for T/O enable)
K3, K4: Safety compatible contactor (for T/P and external emergency stop)
*1) HR1S-AF5130B (IDEC)
Note 1: This is not a safety-related circuit.
Do not use it for input of the safety relay module.
Note 2: For the wiring method to the BS servo amplifier, refer to section 11.3 or 11.5.2.

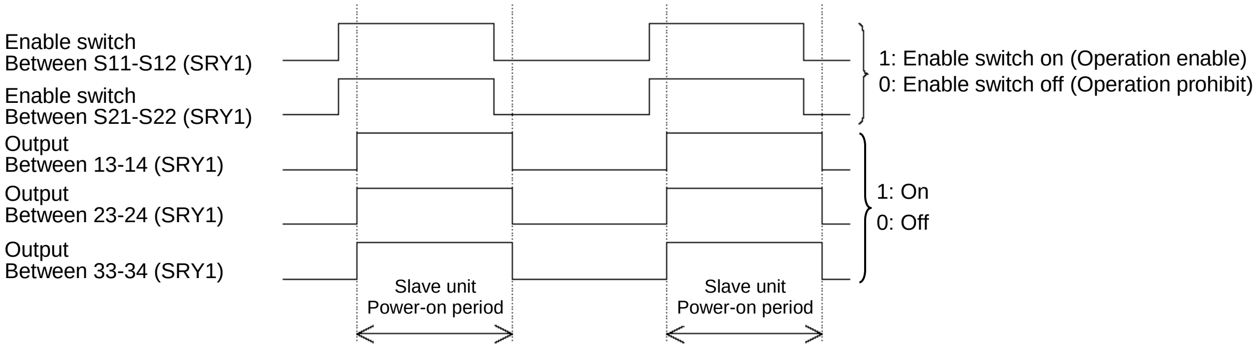
* When using a delay-type safety relay module
Usage of a delay-type safety relay module enables more reliable stoppage.
- Set the delay time from 0.5 to 1.0 second.
- The circuit to be delayed must be a safety-compatible contactor only.
(Do not delay the circuits for the safety connector pin numbers 11, 12, 15, or 16.)
* The safety relay module in the above circuit example is not a delay type.

- Operation chart

① T/P and external emergency stop switch (SRY2)

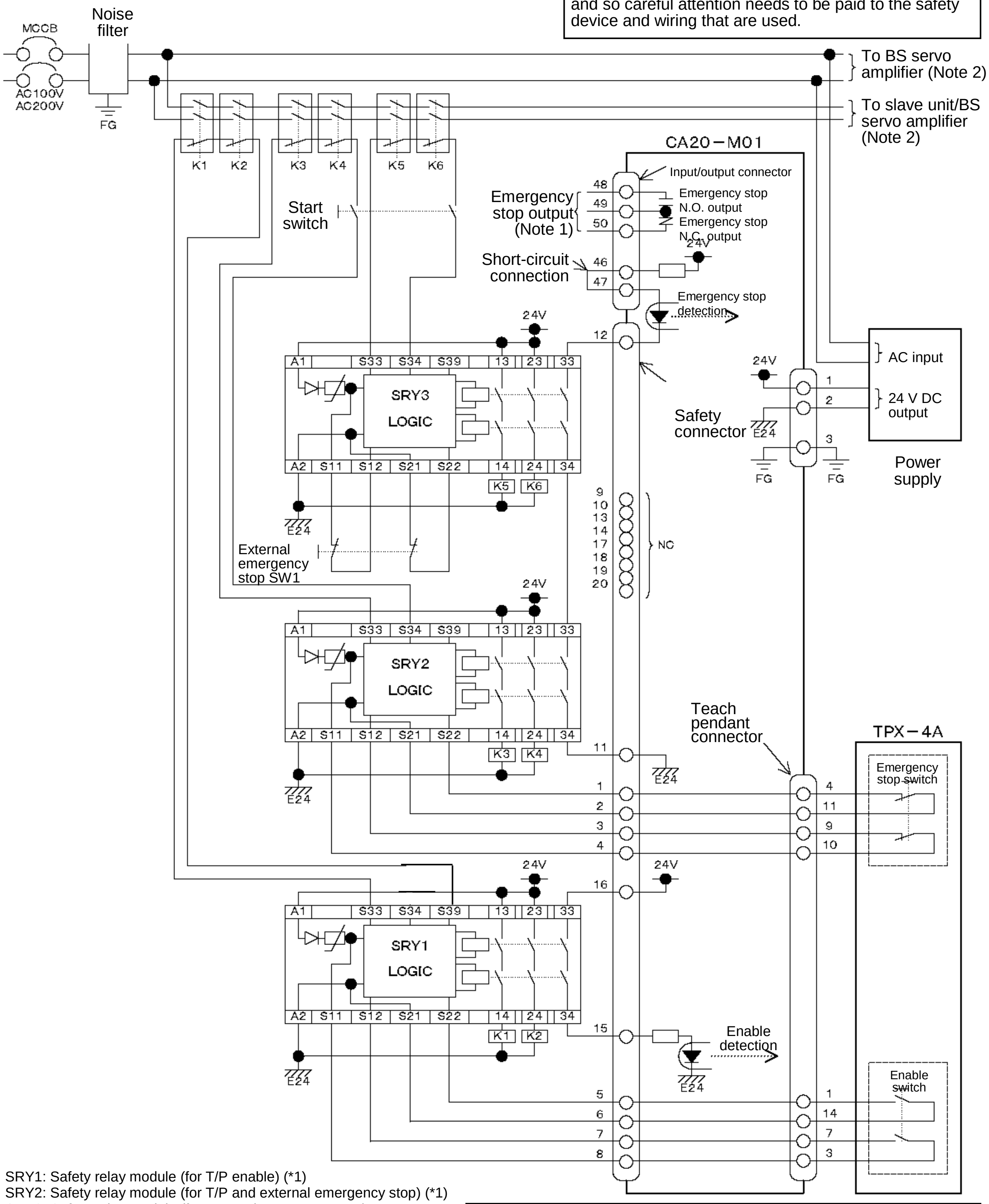


② T/P enable switch (SRY1)



(2) Safety category compatible circuit connection example (including individual fault detection function)

Note:
The safety category is determined for the entire system, and so careful attention needs to be paid to the safety device and wiring that are used.

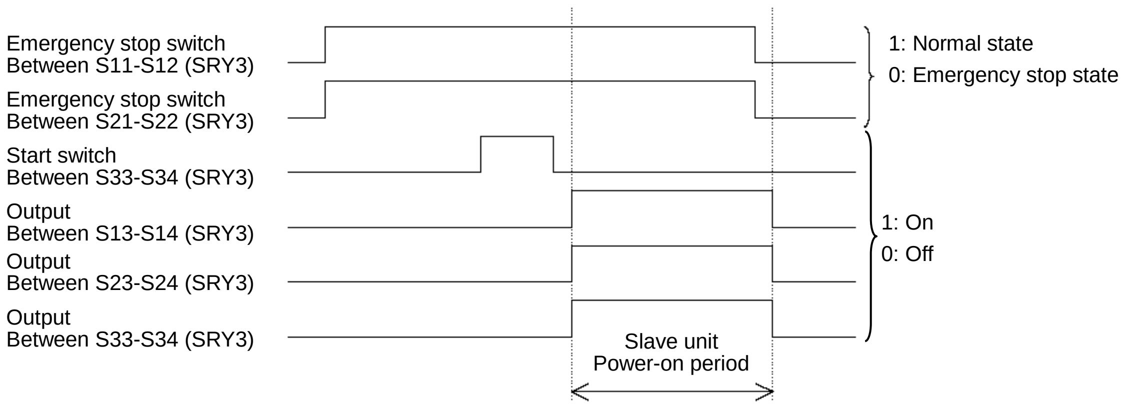


SRY1: Safety relay module (for T/P enable) (*1)
SRY2: Safety relay module (for T/P and external emergency stop) (*1)
SRY3: Safety relay module (for external emergency stop)
K1, K2: Safety compatible contactor (for T/O enable)
K3, K4: Safety compatible contactor (for T/P and external emergency stop)
K5, K6: Safety compatible connector (for external emergency stop)
*1) HR1S-AF5130B (IDEC)
Note 1: This is not a safety-related circuit.
Do not use it for input of the safety relay module.
Note 2: For the wiring method to the BS servo amplifier, refer to section 11.3 or 11.5.2.

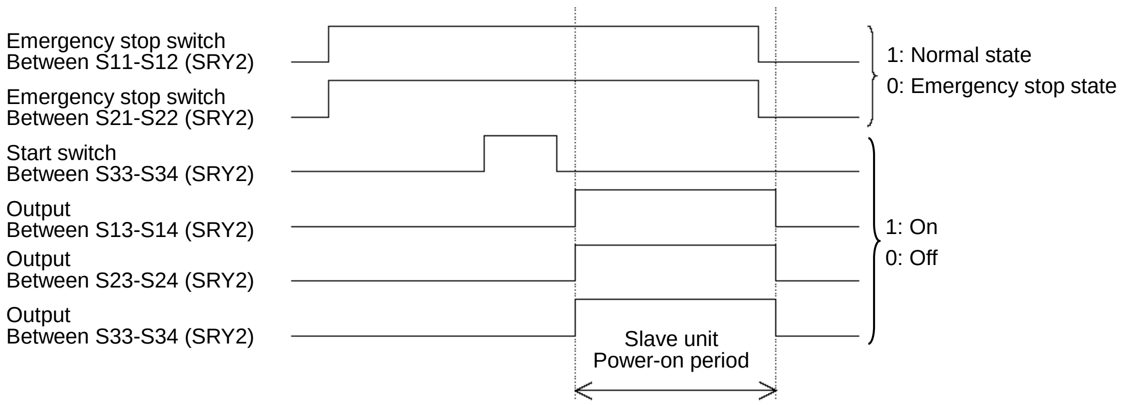
* When using a delay-type safety relay module
Usage of a delay-type safety relay module enables more reliable stoppage.
- Set the delay time from 0.5 to 1.0 second.
- The circuit to be delayed must be a safety-compatible contactor only.
(Do not delay the circuits for the safety connector pin numbers 11, 12, 15, or 16.)

* The safety relay module in the above circuit example is not a delay type.

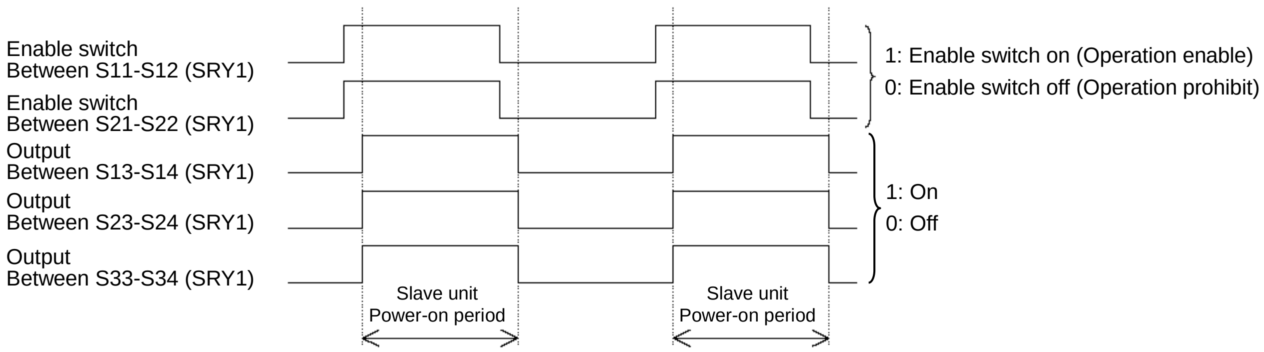
① External emergency stop switch (SRY3)



② T/P emergency stop switch (SRY2)

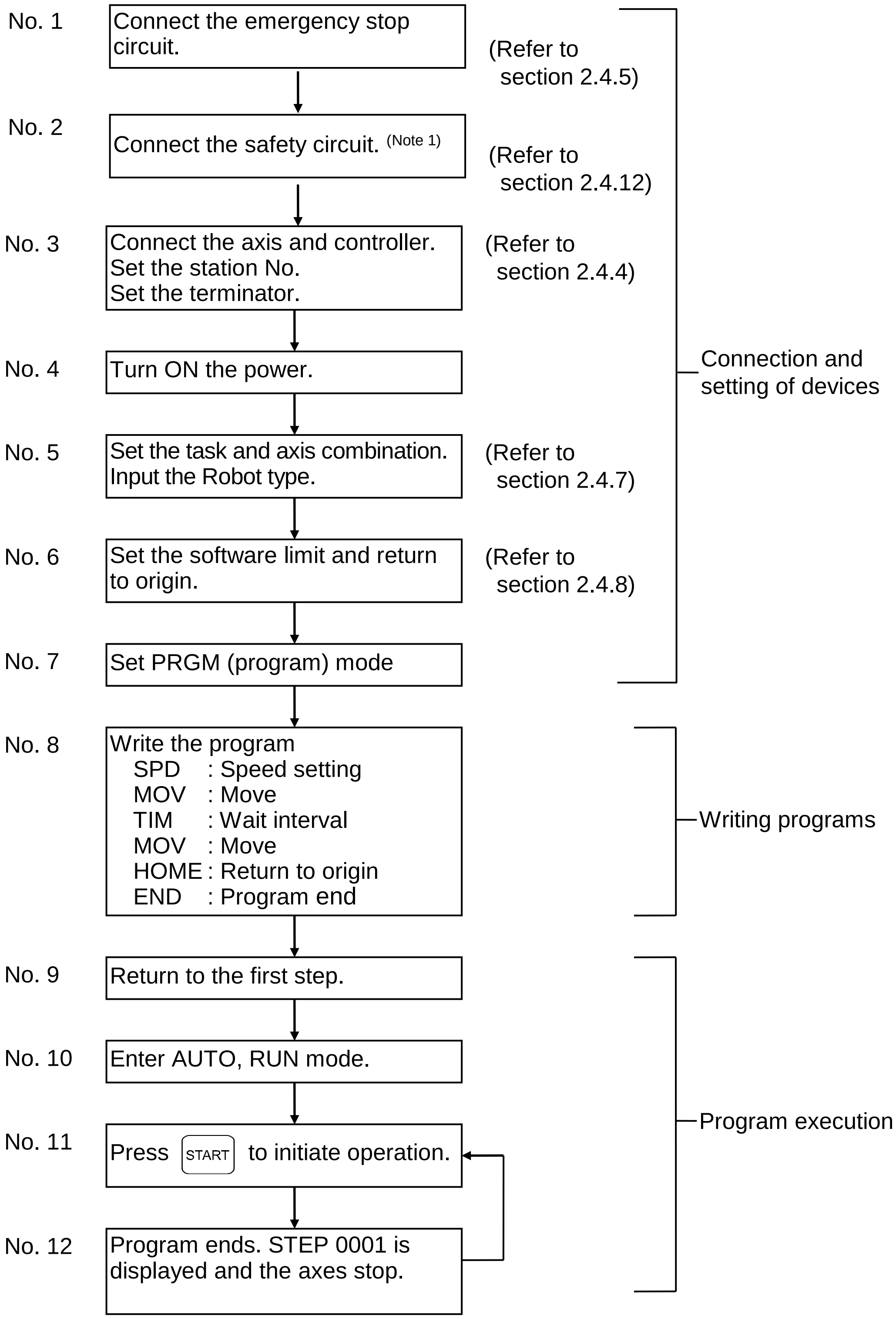


③ T/P enable switch (SRY1)



■ 2.5 Moving the axes

Now, let's try moving the axes with a simple program following the flow chart below.



(Note 1) The safety circuit connection is required only when the master controller CA20-M01 is used.

When the software limit is set and return to origin movement is completed following the key operation procedures explained in section 2.4.9, the display below is shown. The display indicates that the controller is now in sequential AUTO mode corresponding to the No. 6 stage of the flow chart.
Let's try moving the axes with a simple program.

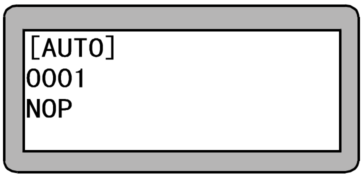
When writing a program press [ENT] to move the cursor forward.

Press the [NEXT] key to move to the step ahead of the one currently displayed. Press the [-NEXT] key to move to the step just before the one currently displayed.

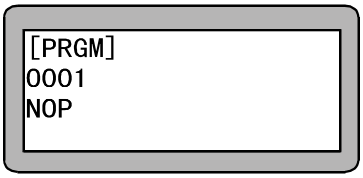
NOTE You can enter the data displayed on the screen into the controller by pressing the [NEXT] or [-NEXT] key when the display is changed.
Note that the [ENT] key does not enter data into the controller.

Writing programs

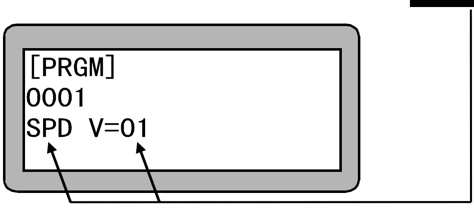
STEP 1 Press the [RUN/PRGM] key to set the program mode.



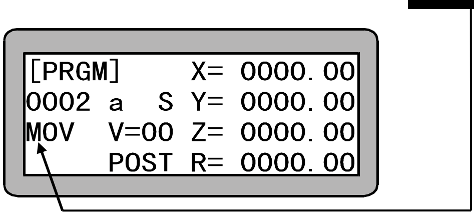
STEP 2 The screen shows an initial display of PRGM mode. This is stage No. 6 of the flow chart.



STEP 3 Press the [SPD 7] key to select the speed command, then press the [ENT] key. Input the speed No. 01 with the numeric keypad and [ENT] press. The speed is now defined.
Press the [NEXT] key to go to the next step.



STEP 3A Press the [MOV 9] key to select the MOV command and then press [ENT] .



STEP 3B

```
[PRGM]      X= 0000.00
0002 a   S Y= 0000.00
MOV  V=00  Z= 0000.00
     POST  R= 0000.00
```

The cursor moves to point a (absolute coordinate), so just press ENT .

STEP 3C

```
[PRGM]      X= 0300.00
0002 a   S Y= 0300.00
MOV  V=00  Z= 0000.00
     POST  R= 0000.00
```

Using the numeric keypad, enter the coordinate of X=300 and Y=300, and press ENT .

NOTE Every press of ENT moves the cursor to the next item.

STEP 3D

```
[PRGM]      X= 0300.00
0002 a   S Y= 0300.00
MOV  V=00  Z= 0000.00
     POST  R= 0000.00
```

The cursor moves to a point S (axes speed), so just press ENT .

STEP 3E

```
[PRGM]      X= 0300.00
0002 a   S Y= 0300.00
MOV  V=00  Z= 0000.00
     POST  R= 0000.00
```

The cursor moves to speed No. (V=00). Confirm V=00 and press ENT .

STEP 3F

```
[PRGM]      X= 0000.00
0002 a   S Y= 0000.00
MOV  V=00  Z= 0000.00
     POST  R= 0000.00
```

When the cursor moves to POST, press ENT .

After STEP3A through STEP3F, it moves to the point of X=300 and Y=300.

Now, press NEXT to display the next step.

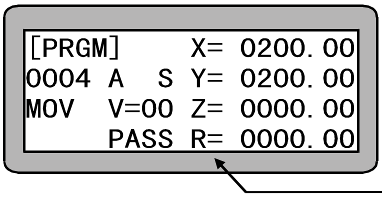
STEP 4

```
[PRGM]
0003
TIM  003. 0s
```

Press TIM/6 to select the TIM command and press ENT . Enter 3 with the numeric keypad and press ENT . This command will make the axes wait for three seconds.

Press NEXT to display the next step.

STEP 5

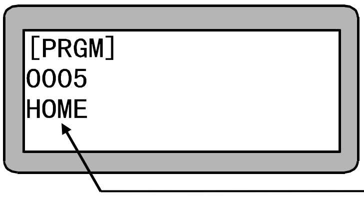


As in STEP 3A to STEP 3F, enter MOV as shown at left. Here, input 200 to the coordinates X and Y, but press [ALT] at POST to change it to PASS.

The axes pass the point of X=200 and Y=200 with this command, and moves to the next point (Origin).

Press [NEXT] to display the next step.

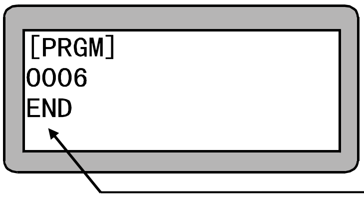
STEP 6



Press [F1] , [IN/1] and [MOV/9] , the select the HOME command, and press [ENT] . The axes will execute return to origin.

Press [NEXT] to display the next step.

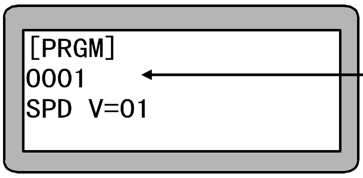
STEP 7



Press [RET/0] three times to select END command, and press [ENT] .

The command defines the program end.

STEP 8



Press [-NEXT] five times and program STEP 0001 will be displayed. This is stage No. 9 in the flow chart.

- You have now completed the program.

- Program execution

STEP 9 Press RUN PRGM to enter the sequential AUTO mode. Now, press START .

```
[AUTO]
0001
SPD   V=01
```

STEP 10 The program will be executed as it is displayed on the screen.

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

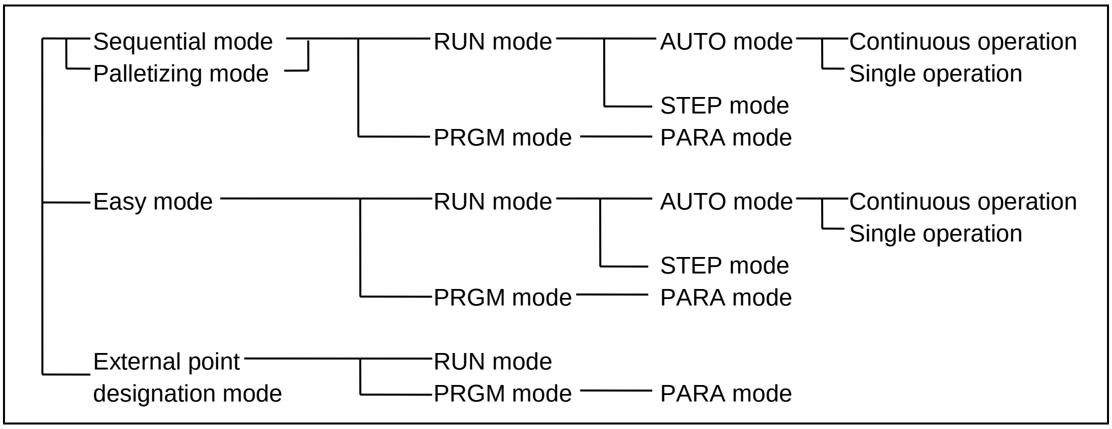
STEP 11 When program execution ends, program STEP 0001 will be displayed and axes will stop.

```
[AUTO]
0001
SPD   V=01
```

Chapter 3 General Programming

■ 3.1 Explanation of Operation Modes

The robot is provided with the following types of operation modes.



(1) Sequential mode

The sequential mode is a mode used to execute or program in order of steps. With the sequential mode, the operation program is structured from the beginning, so operations more complex than the easy mode or palletizing mode are possible.

By using multitasking, up to four sequential programs can be executed simultaneously.

Refer to Chapter 4 for details on the sequential mode, and Chapter 5 for details on multitasking.

(2) Easy mode

In the easy mode, after moving with a movement command, the hand operation subroutine is called and the next step to be executed is designated. With pairs of steps, programming and execution can be carried out easily without creating a complex structure.

(3) Palletizing mode

The palletizing is a mode exclusive for moving and loading. In this mode, operation is carried out using a mode program and by inputting matrix information that indicates the movement point and loading state, etc.

The following types of modes are prepared in the palletizing mode.

- 1 to M mode
  Movement from set position (source side: S) to matrix-type point configured with X, Y and Z axes (destination side: D)
- M to 1 mode
  Movement from matrix-type point configured with X, Y and Z axes (source side: S) to set position (destination side: D)
- M to M mode
  Movement from matrix-type point configured with X, Y and Z axes (source side: S) to matrix-type point configured with X, Y and Z axes (destination side: D)

Refer to Chapter 7 for details on the palletizing mode.

(4) External point designation mode
The external point designation mode does not use the controller's command language. The point table, speed table and acceleration/deceleration table are input beforehand with the Teach Pendant, and by directly designating these tables from an external source with general-purpose inputs, movement takes place.
Refer to Chapter 8 for details on the external point designation mode.

■ 3.1.1 Explanation of RUN mode

The RUN mode is a mode that operates the robot. The mode can be divided into the AUTO mode and STEP mode. Both the AUTO and STEP modes can be operated in the sequential, easy and palletizing modes.

(1) AUTO mode
By pressing the start key, the program displayed on the Teach Pendant will be executed in order of the step numbers.
Continuous operation normally takes place, but if the single mode setting is validated, single operation is also possible soon after movement operation.
In the single operation mode, when the start signal of the system input is input (or when the start key on the Teach Pendant is pressed), the single operation signal state (ON: single operation OFF: continuous operation) of I/O input is discriminated to select the following operation.

Mode	Operation in the single operation (single mode)
Sequential mode	Stopping after specific command (related to axis movement and output) (Refer to section 4.2.1.)
Easy mode	Stopping after movement operation
Palletizing mode	Stopping soon after movement to S (source side) and D (destination side)

(2) STEP mode
When the start key is pressed, one step of the program displayed on the Teach Pendant will be executed, and the operation will stop. To execute the following program, press the start key again.
When multiple tasks are operated using the multitasking function, one step of the task displayed on the Teach Pendant will be executed and then will stop. The other tasks will stop when the step being executed is stopped at the time the displayed tasks have stopped.

■ 3.1.2 Explanation of PRGM mode

The PRGM mode is used to program the various operations for sequential, easy and palletizing modes with the Teach Pendant or to set the point tables for the external point designation mode. The program screen differs for each mode, so follow the cursor that appears on the Teach Pendant and input the data.
Functions handy during programming such as copy, delete and search are provided. Refer to each chapter for details on the operation methods.

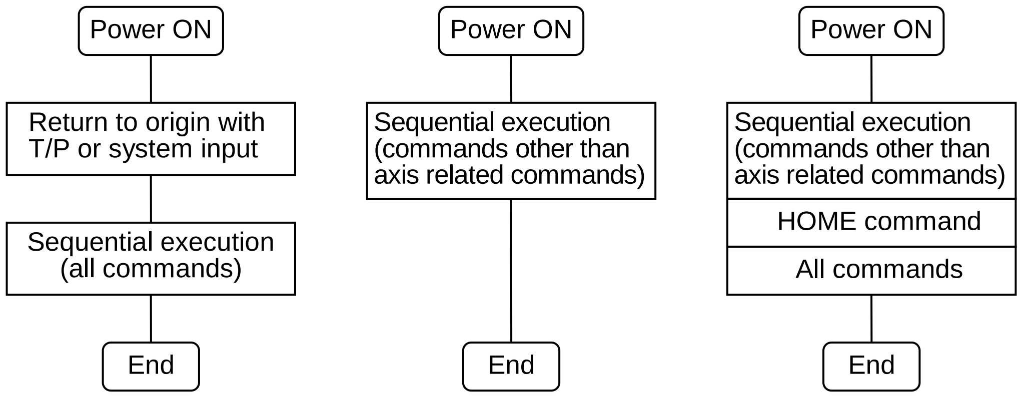
- PARA mode
  The various parameters related to operation of the robot are set in this mode. These parameter can also be set from the PRGM mode.
  There are some parameters that will not be validated until the power is turned OFF and ON after making a setting, and some that will be validated when the PARA mode is quit. Follow the screen displayed on the Teach Pendant and input the data.

■ 3.1.3 Return to origin

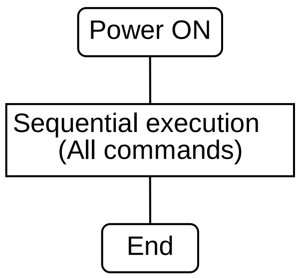
In the sequential RUN mode, if the absolute encoder is being used, the program can be executed without return to origin unless recovering from an encoder related error (Note).
When using the incremental encoder, the commands other than the commands that relate to axis movement can be executed even if return to origin is skipped, so if the program is programmed to execute a HOME command before the axis related command is executed, return to origin will not be required by pressing the HOME key or inputting return to origin before the program is executed.

(Note) Errors requiring return to origin even when absolute encoder is used.
- ENCODER BACKUP ERROR
  (Refer to Chapter 20 Error Messages for details.)

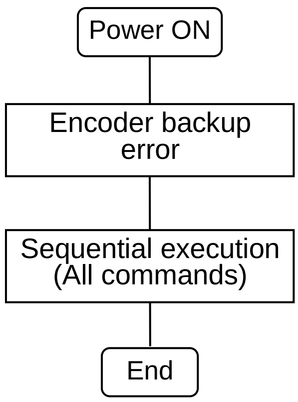
- Operation possible
  (using an incremental encoder)



- Operation not possible (Error)
  (using an incremental encoder)



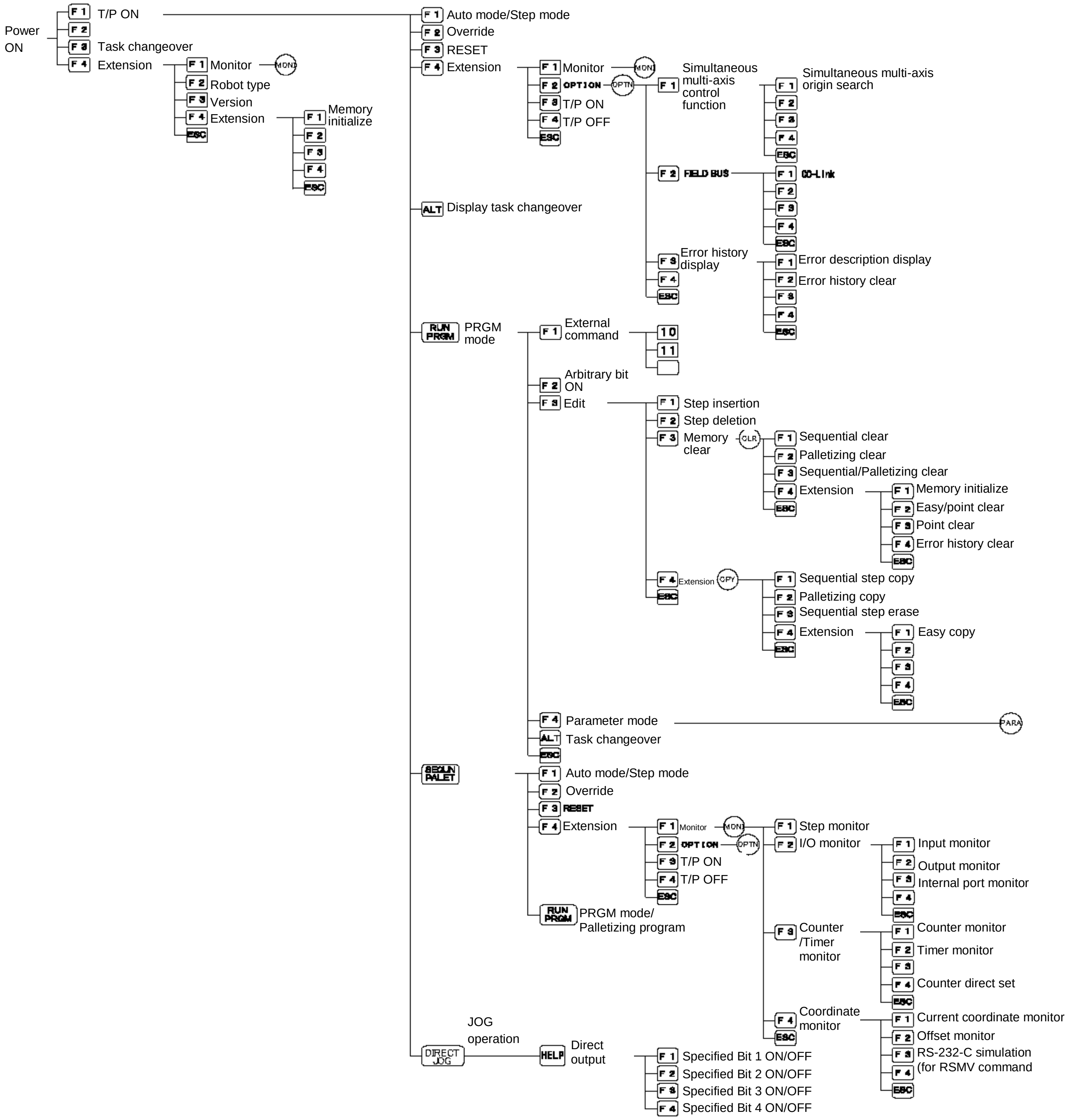
(using an absolute encoder)



■ 3.2 General Programming

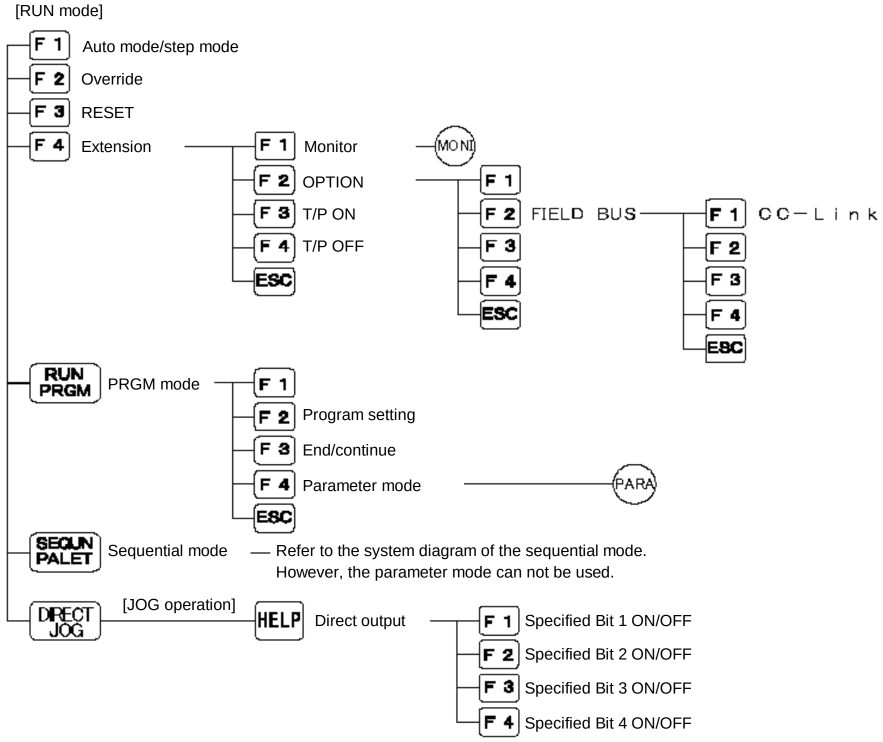
The operation system diagrams of the Teach Pendant in each mode are shown in this section.

[Sequential / palletizing mode]

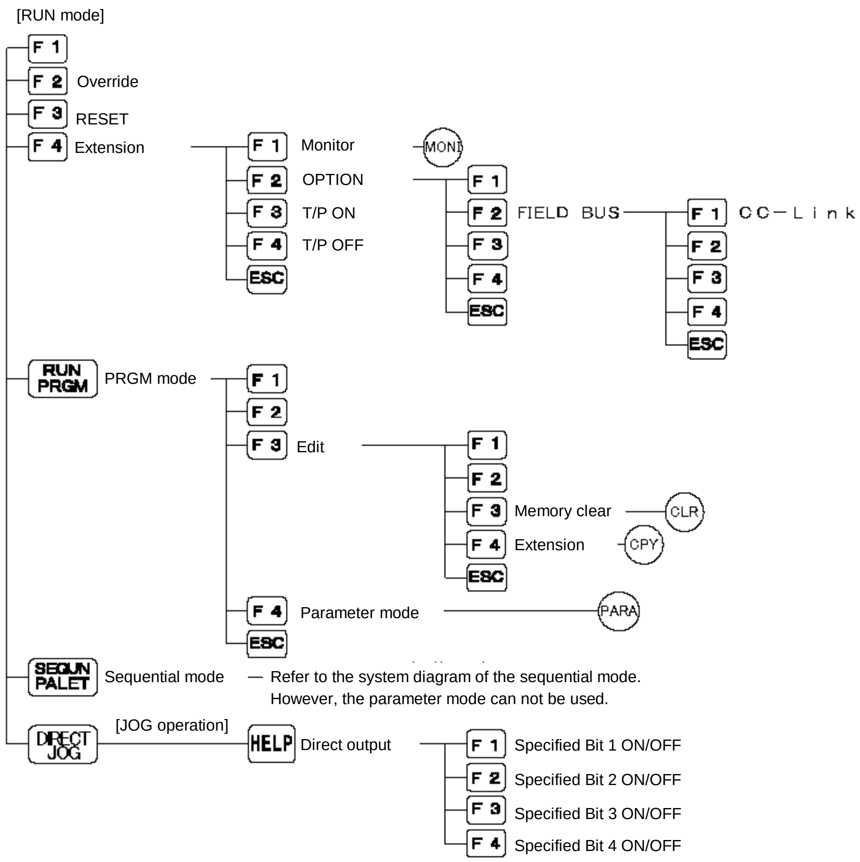


- PARA
  - 1/2
    - F1 Mode set
      - 1: Single mode input bit designation
      - 2: Continuous start input bit designation
      - 3: Escape input bit designation
      - 4: Pause input bit designation
      - 5: Program selection input bit designation
      - 6: Palletizing input bit designation
      - 7: In-pause output bit designation
      - 8: Input waiting output bit designation
      - 9: Teach pendant display language Japanese/English
      - 10: Disable/Easy/Point
      - 11: Clear at general-purpose output reset Enable/Disable
      - 12: Direct output designation
      - 13: READY output bit designation
      - 14: Task positioning output designation
      - 15: Task return to origin output designation
      - 16: BB amplifier sending fiber-optic cable length designation
      - 17: CC-Link setting
      - 18: DeviceNet setting
      - 19: Battery alarm output bit designation
      - 20: Moving coordinate table number output in external point designated mode
      - ESC
    - F2 Parameter 1
      - 1: Soft limit value (positive)
      - 2: Soft limit value (negative)
      - 3: Servo gain (position)
      - 4: Servo gain (speed)
      - 5: Pass area
      - 6: Origin offset value
      - 7: Return to origin sequence
      - 8: Jog speed (A1)
      - 9: Jog speed (A2)
      - 10: Jog speed (A3)
      - 11: Jog speed (A4)
      - 12: Jog inching amount
      - 13: Area output (A1) bit designation
      - 14: Area output (A2) bit designation
      - 15: Area output (A3) bit designation
      - 16: Area output (A4) bit designation
      - 17: Synchronized offset
      - 18: Synchronized error allowable value
      - ESC
    - F3 Parameter 2
      - 1: Axis indicator
      - 2: IN position data
      - 3: Overflow data
      - 4: Feed forward data
      - 5: Motor rotation direction
      - 6: Maximum speed data
      - 7: Return to origin speed data (A1)
      - 8: Return to origin speed data (A2)
      - 9: Return to origin speed data (A3)
      - 10: Return to origin speed data (A4)
      - 11: Return to origin method
      - 12: Origin sensor logic
      - 13: High-speed return to origin position
      - 14: Lead
      - 15: Encoder number of divisions
      - 16: Encoder pulse multiplier
      - 17: Encoder type
      - 18: Acceleration/deceleration time constant
      - 19: Task and axis combination
      - 20: Task priority order
      - 21: Task point table
      - 22: Number of task steps
      - 23: BA I/O compatibility mode
      - 24: Return to origin direction
      - 25: Dynamic brake
      - 26: Synchronized multi-axis
      - ESC
    - F4 Table
      - 1: Coordinate table
      - 2: Speed table
      - 3: Acceleration/deceleration table
      - 4: MVM table
      - ESC
    - ESC
  - F1 Parameter 3
    - 1: Resolver cable length
    - 2: External reverse-current absorption resistance value
    - 3: External reverse-current absorption resistance capacity value
    - ESC
  - F2
  - F3
  - F4
  - ESC

[Easy mode]

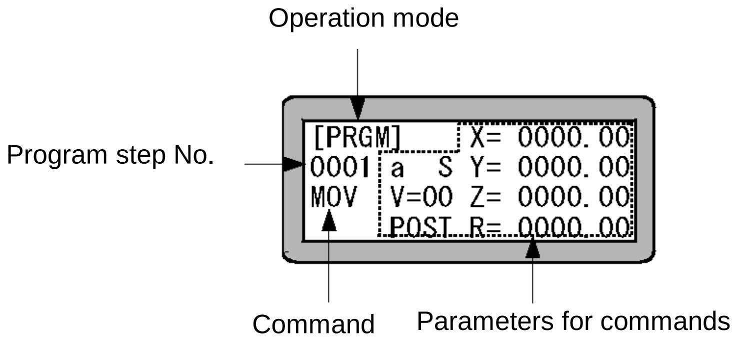


[External point designation mode]



■ 3.2.1 Basic programming

This section explains basic robot programming, using examples of a Teach Pendant display. The following illustration shows a display of sequential mode in PRGM (program) mode.



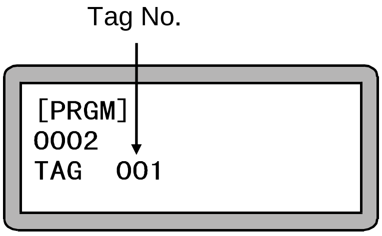
- Operation mode
  The mode selected by the Teach Pendant is displayed. [PRGM] is displayed for PRGM mode, and [RUN] is displayed for RUN mode.

- Program step No.
  The program with a maximum of 2,500 steps can be written in the sequential mode. The content of each step is displayed in four lines of 20 characters on the display of the Teach Pendant, but the next step can be displayed on the screen by pressing NEXT or -NEXT key.

- Commands
  Various commands are written. Select the command by pressing the command key, or numeric keypad and function key, and press ENT for writing.

- Parameters for commands
  When a command is being written, the cursor automatically moves to a field where a parameter should be entered. Write the parameter and press ENT . To correct the parameter, press B SKIP and ENT to move the cursor to the position of the relevant parameter, and reinput the data.

● Tag No.



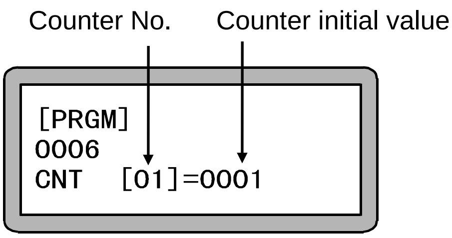
In sequential mode, the tag No. (1 to 999) can be written in steps from No. 0001 to No. 2500. Tag Nos. have the following uses:

(1) Designating the step to jump to in a JMP command.

(2) Fetching a subroutine. Enter a tag No. at the beginning of a subroutine, then you can fetch it by using a subroutine call command. To end a called subroutine, enter RET.

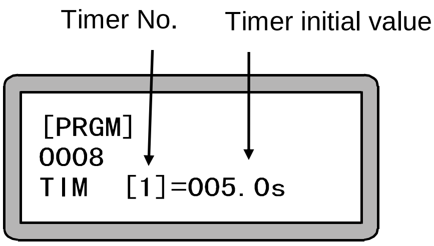
(3) Selecting a program No. A tag No. (1 to 16) can be selected by PSEL (program selection) command as a program No.

● Counter



A counter (01 to 99) is a type of variable. Counter contents can be added or subtracted in a rate of 0 to 9999. In the above example, counter No. 01 is defined at step No. 0006, and the counter initial value is set to 1.

● Timer



Four timers can be used to count time. The maximum value is 999.9 seconds. In the above example, timer No. 1 is used at program step No. 0008, and a 5-second wait is set.

■ 3.2.2 Position data input

The following three methods can be used to input the position data for MOV system commands, the coordinate table(used in the sequential mode, external point designation mode), easy mode and palletizing mode.

(1) Remote teaching
When you are programming while the robot is in servo-lock, use this method to move the robot to the desired location.

(2) Direct teaching
With this method, the servo lock is released during programming, and the position is directly taught by the operator directly moving the robot arm to the required position.
If the axis is provided with brakes, the brakes will be applied during the servo-free state, so direct teaching is not possible.

(3) MDI (Manual Data Input)
Use the Teach Pendant keys to enter the coordinates of the desired location.

The teaching methods will be described below using the Teach Pendant displays.

? In MOV system commands, the coordinate tables, easy mode and palletizing mode, the screens for entering the position data will differ. The screens in each mode will be used for explanations, but the operation methods are the same. For the palletizing mode, the M to M screen is used as an example.

(1) Remote teaching procedures

Remote teaching procedures of the position data are given below. These procedures can be executed during programming in PRGM mode.

[MOV system command input screen]

```
[PRGM]      X= 0000.00
0001 a   S  Y= 0000.00
MOV   V=00  Z= 0000.00
      POST  R= 0000.00
```

Cursor position

[Coordinate table input screen]

```
[PARA]      X= 0000.00
PNT-TBL     Y= 0000.00
NO.001      Z= 0000.00
            R= 0000.00
```

Cursor position

[Easy mode coordinate input screen]

```
[EASY]01    X= 0000.00
001   V=00  Y= 0000.00
  TAG:000   Z= 0000.00
            R= 0000.00
```

Cursor position

[Palletizing mode coordinate input screen]

```
[PRGM]02    SO ORG
01          X= 0000.00
M-M         Y= 0000.00
            Z= 0000.00
```

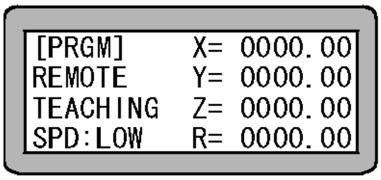
Cursor position

STEP 1 Move the cursor to the position shown at left, and press [DIRECT JOG] .

NOTE

- When the cursor is not located at the position shown in the above display, remote teaching cannot be executed.
  When [DIRECT JOG] is pressed when the cursor is not located at the position shown in the above display, jog operation to only move the axis will take place. (Refer to section 18.5.)
- If return to origin has not been executed before [DIRECT JOG] is pressed, an error alarm sounds and remote teaching mode cannot be entered.

Common screen



STEP 2 RT is displayed in the screen and JOG operation can be executed in remove teaching mode. Toggling between L (low speed) and H (high speed) in JOG operation can be executed by pressing ALT .

NOTE

- Movement of the axes in JOG operation is done by pressing the +1 and -1 keys for the axis 1 and the +2 and -2 keys for the axis 2 and the +3 and -3 keys for the axis 3 and the +4 and -4 keys for the axis 4. If the key is a plus key, the axis will move in the direction opposite the origin while the key is held down, and if it is a minus key will move in the direction of the origin.
- The JOG operation speed can be set with the JOG speed in parameter 1. (Refer to section 14.3.8 to 14.3.11.)
- Inching movement in JOG operation can be performed by pressing and quickly releasing the MOVE keys (+1 -1 +2 -2 +3 -3 +4 -4). The distance of an inching movement can be set by JOG increment of parameter 1. (Refer to section 14.3.12.)

[MOV system command input screen]

```
[PRGM]      X= 0096.00
0001 a   S  Y= 0000.00
MOV   V=00  Z= 0000.00
      POST  R= 0000.00
```

[Coordinate table input screen]

```
[PARA]      X= 0096.00
PNT-TBL     Y= 0000.00
NO.001      Z= 0000.00
            R= 0000.00
```

[Easy mode coordinate input screen]

```
[EASY]01    X= 0096.00
001   V=00  Y= 0000.00
   TAG:000  Z= 0000.00
            R= 0000.00
```

[Palletizing mode coordinate input screen]

```
[PRGM]02    SO ORG
01          X= 0096.00
M-M         Y= 0000.00
            Z= 0000.00
```

STEP 3 For example, hold down +1 until the controller moves to an appropriate point. Then, release the key to stop the axis and press ENT . The current coordinates will be input.

(2) Direct Teaching Procedures

The method to carry out direct teaching of the position data in the PRGM mode is described below.

[MOV system command input screen]

```
[PRGM]     X= 0000.00
0001 a   S Y= 0000.00
MOV  V=00  Z= 0000.00
FREE POST  R= 0000.00
```

[Coordinate table input screen]

```
[PARA]     X= 0000.00
PNT-TBL    Y= 0000.00
NO.001     Z= 0000.00
FREE       R= 0000.00
```

[Easy mode coordinate input screen]

```
[EASY]01   X= 0000.00
001  V=00  Y= 0000.00
  TAG:000  Z= 0000.00
FREE       R= 0000.00
```

[Palletizing mode coordinate input screen]

```
[PRGM]02   S0 ORG
01         X= 0000.00
M-M        Y= 0000.00
FREE       Z= 0000.00
```

STEP 1 Press [FREE LOCK] and the "FREE" will be displayed.

The axis will be in servo-free condition. Move the cursor to the point shown at left and press [DIRECT JOG] .

NOTE

- When the cursor is positioned at a point other than the one shown in the display above, Direct Teaching cannot be executed.
- The axis provided with brakes will be stopped when the [FREE LOCK] key is pressed.
- If return to origin has not been executed before the [DIRECT JOG] key is pressed, an error alarm sounds and Direct Teaching mode cannot be entered.

[Common screen]

```
[PRGM]     X= 0000.00
DIRECT     Y= 0000.00
TEACHING   Z= 0000.00
FREE       R= 0000.00
```

STEP 2 The display DT is shown on the screen, and Direct Teaching can be executed.

[MOV system command input screen]

```
[PRGM]     X= 0096.00
0001 a   S Y= 0000.00
MOV   V=00 Z= 0000.00
FREE POST  R= 0000.00
```

[Coordinate table input screen]

```
[PARA]     X= 0096.00
PNT-TBL    Y= 0000.00
NO.001     Z= 0000.00
FREE       R= 0000.00
```

[Easy mode coordinate input screen]

```
[EASY]01   X= 0096.00
001   V=00 Y= 0000.00
  TAG:000  Z= 0000.00
FREE       R= 0000.00
```

[Palletizing mode coordinate input screen]

```
[PRGM]02   SO ORG
01         X= 0096.00
M-M        Y= 0000.00
FREE       Z= 0000.00
```

STEP 3 Move the axis manually to a desired position and press ENT . The current coordinates will be entered.

[Common screen]

```
SERVO LOCK OK ?
 YES:ENT  NO:ESC
```

STEP 4 Press FREE LOCK to release the servo-free condition, and the display at left will appear. Then, press ENT and the axis will be servo-locked. The FREE signal lamp will go out. When ESC is pressed, the display returns to STEP 3.

NOTE
- Direct teaching cannot be used with an axis equipped with a brake, because the brake will be activated in servo-free condition. Use Remote Teaching for an axis equipped with brakes.

(3) MDI (Manual Data Input) method

The method to teach the position data in the PRGM mode with MDI is described below.

[MOV system command input screen]

```
[PRGM]     X= 0000.00
0001 a   S Y= 0000.00
MOV   V=00 Z= 0000.00
      POST R= 0000.00
```

Cursor position

[Coordinate table input screen]

```
[PARA]     X= 0000.00
PNT-TBL    Y= 0000.00
NO.001     Z= 0000.00
           R= 0000.00
```

Cursor position

[Easy mode coordinate input screen]

```
[EASY]01   X= 0000.00
001   V=00 Y= 0000.00
  TAG:000  Z= 0000.00
           R= 0000.00
```

Cursor position

[Palletizing mode coordinate input screen]

```
[PRGM]02   SO ORG
01         X= 0000.00
M-M        Y= 0000.00
           Z= 0000.00
```

Cursor position

STEP 1 Move the cursor to the point shown at the left, enter the set coordinates with the numeric keypad, and press [ENT] .

[MOV system command input screen]

```
[PRGM]     X= 0096.00
0001 a   S Y= 0000.00
MOV   V=00 Z= 0000.00
      POST R= 0000.00
```

Cursor position

[Coordinate table input screen]

```
[PARA]     X= 0096.00
PNT-TBL    Y= 0000.00
NO.001     Z= 0000.00
           R= 0000.00
```

Cursor position

[Easy mode coordinate input screen]

```
[EASY]01   X= 0096.00
001   V=00 Y= 0000.00
  TAG:000  Z= 0000.00
           R= 0000.00
```

Cursor position

[Palletizing mode coordinate input screen]

```
[PRGM]02   SO ORG
01         X= 0096.00
M-M        Y= 0000.00
           Z= 0000.00
```

Cursor position

STEP 2 Move the cursor to the point shown at the left, enter the set coordinates with the numeric keypad, and press ENT .

Inputting is similarly possible for Z and R axes.

NOTE

- Always set the coordinate value within the stroke of the axis being used.
- Press ENT , and the cursor will move to the next item. Press B SKIP , and the cursor will return to the last item.

■ 3.2.3 Memory clear (Initialization)

- The memory in the controller that stores the programs and parameters can be initialized (cleared).

NOTE When the memory is initialized, the various parameters in the memory will be initialized, and the sequential, palletizing and easy mode programs will all be cleared.

- The memory can be initialized by operations from the PRGM (program) mode or by not turning ON the Teach Pendant (T/P).

(1) Method to initialize the memory from the PRGM (program) mode
Enter the PRGM (program) mode and press HELP . The following will display. (Refer to section 4.1.1.)

```
[PRGM]  F1:EXTENSION
 HELP   F2:DIRECT OUT
        F3:EDIT
        F4:PARAMETER
```

STEP 1 Press F3 in this state.

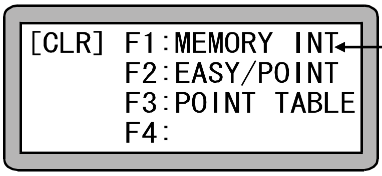
```
[EDIT]  F1:INS STEP
        F2:DEL STEP
        F3:CLEAR
        F4:PAGE
```

STEP 2 When F3 is pressed, the clear mode will be entered.
Press ESC to return to the initial screen of the program mode.

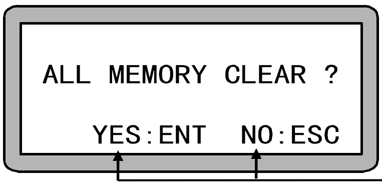
```
[CLR]   F1:SEQUN
        F2:PALTE
        F3:SEQ/PALTE
        F4:PAGE
```

STEP 3 To initialize the entire memory press F4 .
Press ESC to return to the previous screen.

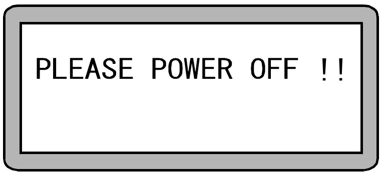
STEP 4 Press F1 in this state.



STEP 5 To clear the memory, press ENT , and to not clear the memory press ESC .



STEP 6 Follow the instructions on the screen, and turn the controller power OFF.



NOTE

- After the memory is initialized, the robot type "510100" (single axis specifications) parameter will be set. When using a type other than "510100", set the robot type again. Moreover, the task combination is initialized as follows.

T1	T2	T3	T4
[1]	[0]	[0]	[0]

- Refer to the Instruction Manual (Axis Installation Section) for how to set the robot type.

(2) Method to initialize the memory without turning the Teach Pendant ON (T/P ON) after turning the power ON

The memory of the robot can be initialized without turning the T/P ON after the main power is turned ON. Use this method when an error occurs and the memory cannot be initialized from the PRGM mode.

STEP 1 Turn the power switch ON. The initial screen will display for two seconds.

```
TEACHING PENDANT
TPH-4C Ver.2.10
```

STEP 2 After the initial screen ends, the following screen will display. Press F4 .

```
POWER  F1:T/P ON
   -ON F2:
       F3:CHANG TASK
       F4:EXTENSION
```

STEP 3 Press F4 .

Press ESC to return to the display of STEP 2.

```
POWER  F1:MONITOR
   -ON F2:ROBOT TYPE
       F3:VERSION
       F4:PAGE
```

STEP 4 Press F1 in this state.

```
[CLR]  F1:MEMORY INT
       F2:
       F3:
       F4:
```

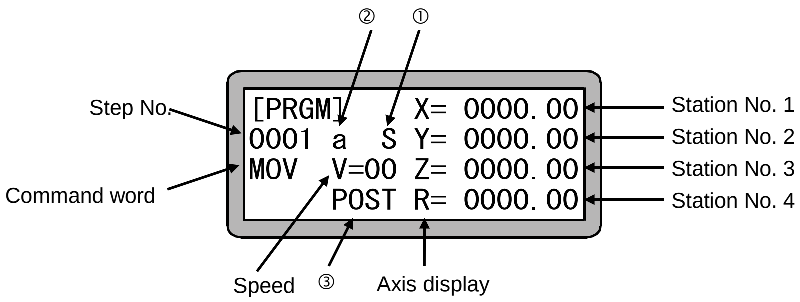
The following steps are the same as STEPS 5 and 6 on the previous page.

■ 3.2.4 MOV system command words and parameters

The MOV system commands and their parameters which can be used on the machine are herein described.
If any of the MOV system commands is commanded, the relevant axis will be moved as commanded, and there are 9 kinds of the commands as follows.

MOV ············ Linear interpolated movement
MOVP ·········· Linear interpolated movement (coordinate table assignment)
MVC ············ Circular interpolated movement
MVCP ·········· Circular interpolated movement (coordinate table assignment)
MVB ············ Last position movement (return to the last position)
MVE ············ Escape movement
MVM ············ Palletizing movement
RSMV ·········· Axis movement with RS-232-C
HOME ·········· Return to origin

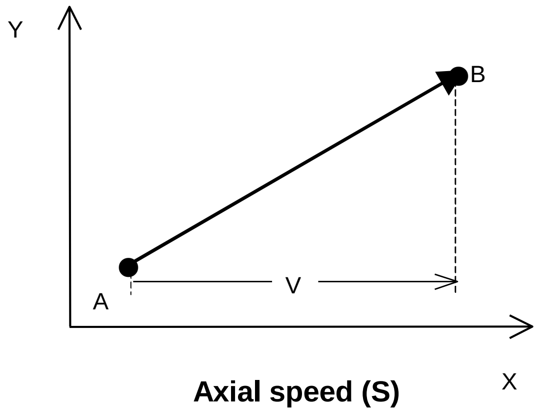
For the using method of the command words, refer to "Chapter 19 Commands".
To input MOV system command (excluding HOME), input Parameters ① to ③ as shown below. The coordinate input items at right 4 digits in the screen correspond to Station No. 1 to 4 in sequence from above. The axis indication corresponds to that set in "Setting of axis display" (section 14.4.1) in Parameter 2.



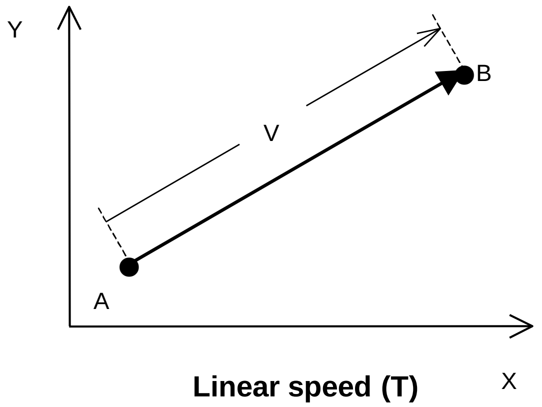
①: Axial speed (S) and linear speed (T)
②: Absolute coordinate position (a) and relative coordinate position (i)
③: Position (POST) and pass point (PASS)

The method to use ① through ③ is hereafter described.

① Axial speed (S) and linear speed (T)
For the movement from Point A to Point B as shown below, the X-axis speed of the longest movement stroke is instructed as the speed V when the axial speed (S) is selected, and the axis composed speed is instructed as the speed V when the linear speed (T) is selected.
However, if any axis exceeds the maximum speed set by the parameter, the movement speed of the axis will be at the maximum speed, and the other axes will move at such speeds as all axes simultaneously arrive at the target position.

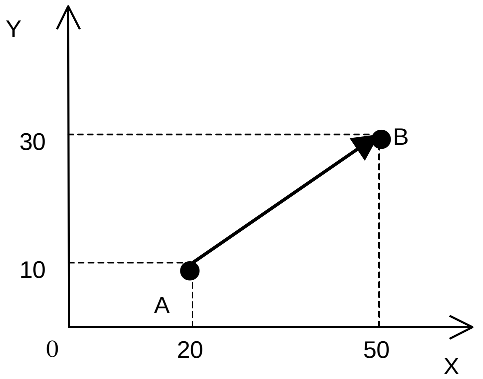


Axial speed (S)

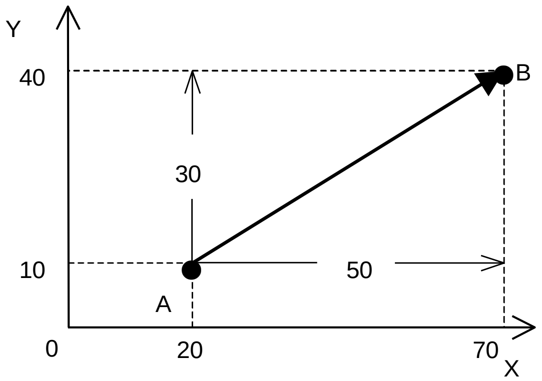


Linear speed (T)

② Absolute coordinate position (a) and relative coordinate position (i)
When the absolute coordinate position (a) is selected, the target position becomes the coordinate position according to the origin point (coordinate X=0, Y=0). When the relative coordinate position (i) is selected, the target position becomes the relative movement amount from the axis position at the time of the command execution start. For example, when the current position is Point A (coordinate X=20, Y=10) and the movement amount is X=50, Y=30, the target position of Point B becomes as shown below.



Absolute coordinate position (a)



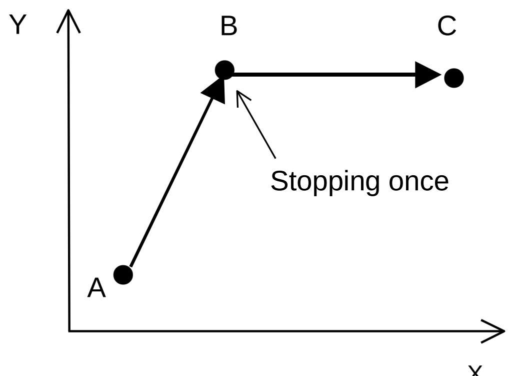
Relative coordinate position (i)

NOTE When OFS command is used, the absolute coordinate position is gained by adding the amount which is set with OFS command.

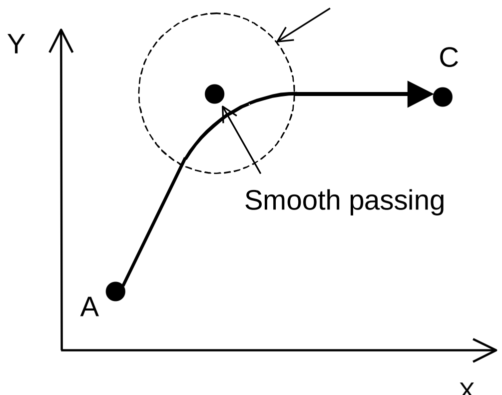
③ Position (POST) and pass point (PASS)

When MOV system commands are continuously executed to select the position (POST) during the target position movement on the way, it will stop at the target position once. If the pass point (PASS) is selected, the target position on the way will be regarded as the passing point, and it will move to the next point after smooth passing.

For an example of the movement of Point A → Point B → Point C as shown below, it will move as shown in the left figure when the position (POST) is selected, and as shown in the right figure when Point B is selected as the pass point (PASS).



Position (POST)



Pass point (PASS)

- For the pass area, refer to "Setting of pass area" (section 14.3.5).

Chapter 4 Sequential Mode

■ 4.1 Sequential PRGM Mode

Sequential programs are structured of a command words written in as series of steps.

■ 4.1.1 How to enter and leave PRGM (program) mode

The PRGM mode is used for programming, setting parameters, and for controlling direct output. The method for entering and leaving the PRGM mode (sequential mode) will be described in this section.

```
POWER  F1:T/P ON
  -ON  F2:
       F3:CHANG TASK
       F4:EXTENSION
```

STEP 1

Turn the power ON. When the display shown at left appears after the initial screen, press F1.

Then press RUN/PRGM to enter PRGM mode.

Refer to section 5.3.2 (1) when the task must be changed with multitasking.

```
[PRGM]
0001
NOP
```

STEP 2

A program can now be written. Press NEXT or -NEXT until the desired step is displayed.

To set parameters and edit the program, press HELP to display the screen in STEP 3.

When RUN/PRGM is pressed, the program editing will end, and the AUTO mode will be entered.

```
[PRGM] F1:EXTENSION
 HELP  F2:DIRECT OUT
       F3:EDIT
       F4:PARAMETER
```

STEP 3

From this step, it is possible to input the extension command inputting, control the direct output, edit the program and set various parameters.

Press ESC to return to STEP 2.

■ 4.1.2 Editing of steps in sequential program

In sequential programming, steps can be inserted or deleted either individually or as a block.

(1) Inserting and deleting steps

First, define the program step No. to be inserted or deleted, and display it on the screen. Refer to 16.1 for details on searching for the step No. Insert the new step before the displayed step and move down the remaining program steps in the controller's memory. For a deletion, erase the target step and move up all successive steps in memory. Press [HELP] in program mode to show the following display. (Refer to section 4.1.1.)

STEP 1 Press [F3] in this state.

```
[PRGM] F1:EXTENSION
 HELP  F2:DIRECT OUT
       F3:EDIT
       F4:PARAMETER
```

STEP 2 To insert a step, press [F1] .
Press [F2] to delete a step.
To return to the initial screen in the PRGM mode, press [ESC] .

```
[EDIT] F1:INS STEP
       F2:DEL STEP
       F3:CLEAR
       F4:PAGE
```

STEP 3A In inserting a new step, the instruction field will indicate a NOP instruction. When successive insertion is necessary, press [F1] again.

Press [ESC] to return to PRGM mode after the insertion.

```
[INS]
0005
NOP
```

STEP 3B When a step is deleted in delete mode, all successive steps are moved up. When successive deletions are necessary, press [F2] again.

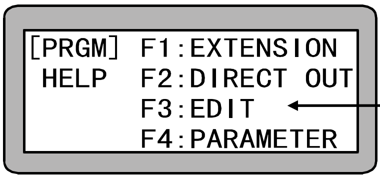
Press [ESC] to return to PRGM mode after the deletion.

```
[DEL]        X= 0100.00
0005 a   S   Y= 0100.00
MOV   V=00   Z= 0100.00
      POST   R= 0000.00
```

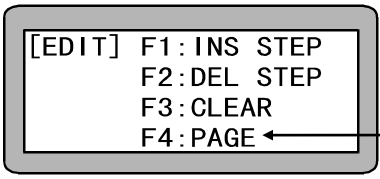
(2) Deleting blocks in steps

In sequential programming, a series of steps can be deleted in a block.
To delete a block, set the program mode and press HELP . The following display will appear.
(Refer to section 4.1.1.)

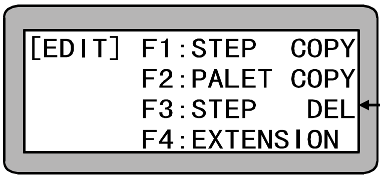
STEP 1 Press F3 in this state.



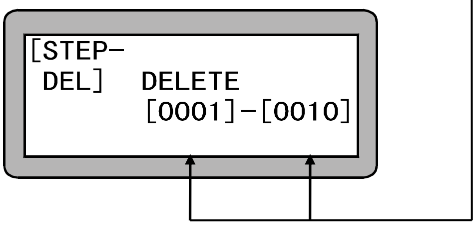
STEP 2 Next, press F4 .
Press ESC , and it will return to the initial screen of PRGM mode.



STEP 3 Press F3 .
Press ESC to return to STEP 2.



STEP 4 Use the numeric keypad to enter the Nos. of the first and last steps to be deleted.
Press ENT .
NOP instructions are indicated for all steps deleted, and the program returns to STEP 3.
Press ESC to return to STEP 3.



■ 4.1.3 Copy editing of sequential programs

A series of steps can be copied in a block from one program and entered into another.
Set the program mode and press HELP .

The following display will appear. (Refer to section 4.1.1.)

STEP 1 Press F3 in this state.

```
[PRGM] F1:EXTENSION
 HELP  F2:DIRECT OUT
       F3:EDIT
       F4:PARAMETER
```

STEP 2 Press F4 to continue.

Press ESC to return to the initial screen of the program mode.

```
[EDIT] F1:INS STEP
       F2:DEL STEP
       F3:CLEAR
       F4:PAGE
```

STEP 3 Press F1 to continue.

Press ESC to return to STEP 2.

```
[EDIT] F1:STEP  COPY
       F2:PALET COPY
       F3:STEP   DEL
       F4:EXTENSION
```

```
[SETP- COPY FROM[01]
 COPY][0001]-[0010]
       COPY TO
         [01]-[0020]
```

STEP 4 Use the numeric keypad to enter the task No. of the copy origin program. (Input range: 01 to 04)

STEP 5 Use the numeric keypad to enter the first and last steps of the copy origin.

STEP 6 Use the numeric keypad to enter the task No. of the copy designation program. (Input range: 01 to 04.)

STEP 7 Next use the numeric keypad to enter the copy destination step and then press ENT .

Copy will be executed, and the program will return to STEP 3.
When ESC is executed, the program will return to STEP 3.

NOTE ● To prevent a double tag error, change the tag Nos. after copying.

■ 4.1.4 Clearing of sequential programs

All of the sequential programs in the controller memory can be cleared (all steps can be returned to NOP).

For multitasking, the program of the currently displayed task will be cleared. Change the task before carrying out the following steps. (Refer to section 5.3.2 (1).)

Enter the PRGM mode and press HELP .

The following screen will display (Refer to section 4.1.1.)

STEP 1

```
[PRGM]  F1:EXTENSION
 HELP   F2:DIRECT OUT
        F3:EDIT
        F4:PARAMETER
```

Press F3 in this state.

STEP 2

```
[EDIT]  F1:INS STEP
        F2:DEL STEP
        F3:CLEAR
        F4:PAGE
```

When F3 is pressed, the clear mode will be entered.

Press ESC to return to the initial screen of the program mode.

STEP 3A

```
[CLR]   F1:SEQUN
        F2:PALET
        F3:SEQ/PALET
        F4:PAGE
```

To clear the sequential program alone, press F1 .

Press ESC to return to STEP 2.

STEP 4A

```
ALL SEQ.PROG CLEAR ?

    YES:ENT   NO:ESC
```

To clear the program, press ENT . To not clear the program, press ESC .

The sequential program that can be used from the palletizing program is the main task (task No.1), so the programs of tasks other than the main task will not be cleared with this operation.
In this case, press F3 at STEP 2, and display the following screen.

STEP 3B Press F3 . Press ESC to return to the previous screen.

```
[CLR]  F1:SEQUN
       F2:PALET
       F3:SEQ/PALET
       F4:PAGE
```

When F3 is pressed:

STEP 4B To clear the program, press ENT . To not clear the program, press ESC .

```
ALL PROG(S/P)CLEAR ?

   YES:ENT  NO:ESC
```

■ 4.1.5 HELP function in entering a command

When function keys are used to enter a command in PRGM mode, pressing HELP displays the input number of each command.

Press F1 . The following display appears:

STEP 1 Press HELP when this display is shown.

```
[PRGM]
0001
F_
```

Cursor

STEP 2 Press HELP again, when the command to be entered is not shown.

```
[HELP]        HELP:PAGE
 10:PSEL      11:OFS
 12:MVB       13:MINI
 14:MVM       15:LOOP
```

STEP 3 Press HELP again when the command to be entered is not shown.

```
[HELP]        HELP:PAGE
 16:MVE       17:SVON
 18:SVOF      19:HOME
 20:BRAC      21:CNTC
```

STEP 4 Press HELP again when the command to be entered is not shown.

```
[HELP]        HELP:PAGE
 22:OUTS      23:TSTR
 24:TSTO      25:TRSA
 26:TCAN      27:CANS
```

STEP 5 See the input number of the command to be entered. Pressing HELP returns to STEP 2.

Press ESC to return to STEP 1 and use numeric keypad to input the input number.

```
[HELP]        HELP:PAGE
 28:CWIT      29:RSMV
 30:INSP      31:IOUT
 32:          33:
```

■ 4.1.6 Method to restart operation of sequential mode after turning power OFF

With this robot, even if the power is turned OFF, the program can be restarted from the step where the program was stopped when the power was turned OFF. However, this is only limited to when the program was stopped with the Teach Pendant or by inputting stop with the system before the power was turned OFF.
Refer to section 10.2.6 for details on the data, etc., that is held until the program is restarted.
This function can also be used to restart operation that has been stopped with emergency stop input.

Use the following procedure to restart the operation.

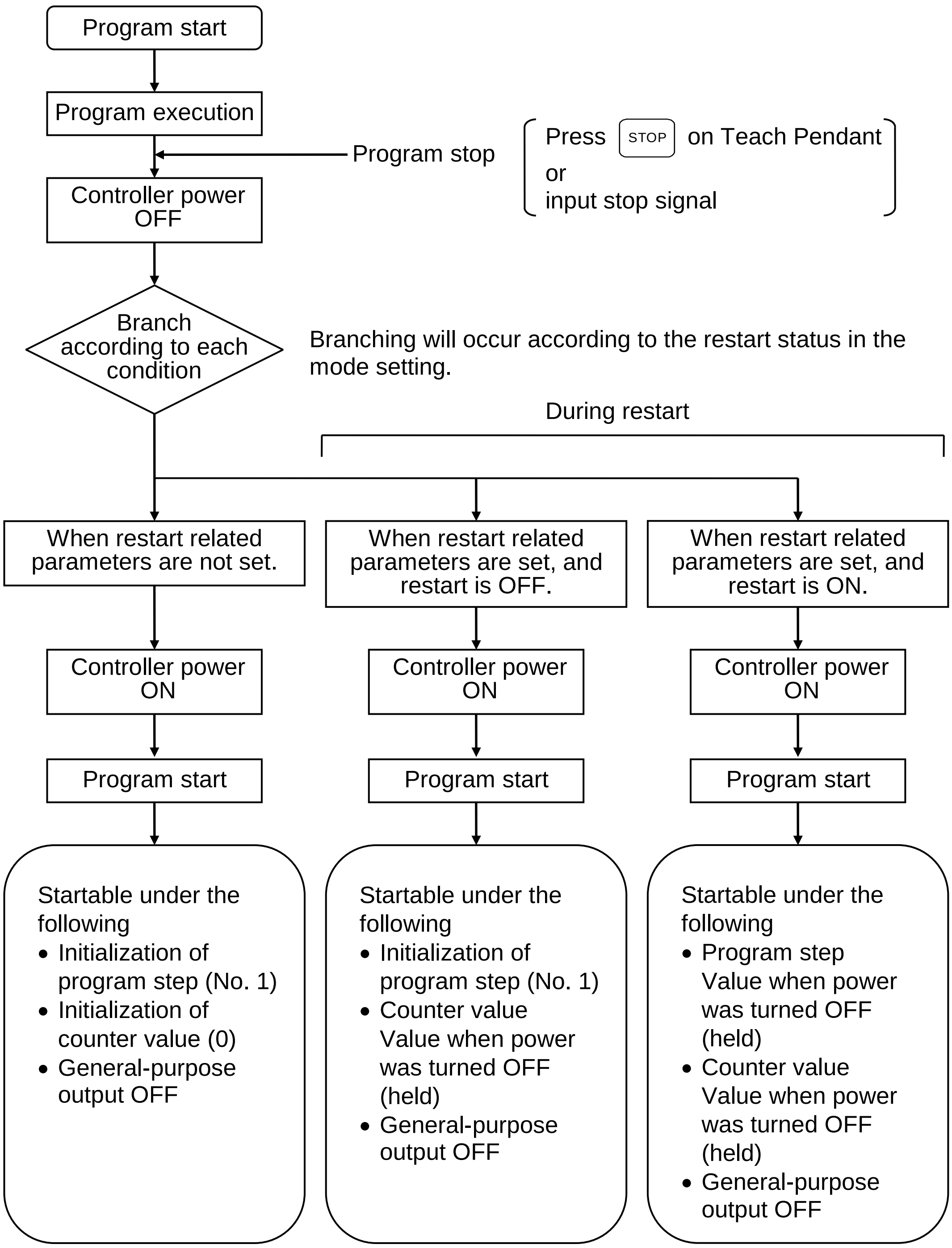
(1) Designate the restart input bit in the mode setting with the Teach Pendant.
(2) When the power is turned OFF and then ON again in the state with restart ON, the operation can be restarted after return to origin is completed.
On the absolute type, continuous start is possible.

NOTE

- If continuous start will not be used, the continuous start input bit must be set. (Refer to section 14.2.2.)
- Restart is not possible if the power is turned OFF while a program is being executed. An error will occur.
- During normal operation, the restart input functions as a general-purpose input.

<Example>

[Starting of sequential program]



■ 4.1.7 Palletizing work with MVM commands

In the palletizing mode described in Chapter 7, palletizing operation can be carried out by just setting various data and not using commands.
However, if a mode is used for the palletizing operation, there will be some restrictions to the degree of operation freedom. To cover for these demerits, the degree of operation freedom and complex palletizing operations can be used by creating a program using MVM commands. (Sequential movement operation such as 1 to M, M to 1, M to M and on matrix.)

[Example]

- Correspondence of pallet on which work are arranged in a zigzag pattern.
- Transferring of works on pallet according to passing and failing state, etc..

■ Procedure for carrying out palletizing work with MVM commands

1. Setting of MVM table details — Set the data such as the matrix (pallet, etc.) shape. (Refer to section 14.6.4.)

↓

2. Setting of coordinate table details — Set the data of the coordinate table used with the MVM table. (Refer to section 14.6.1.)

↓

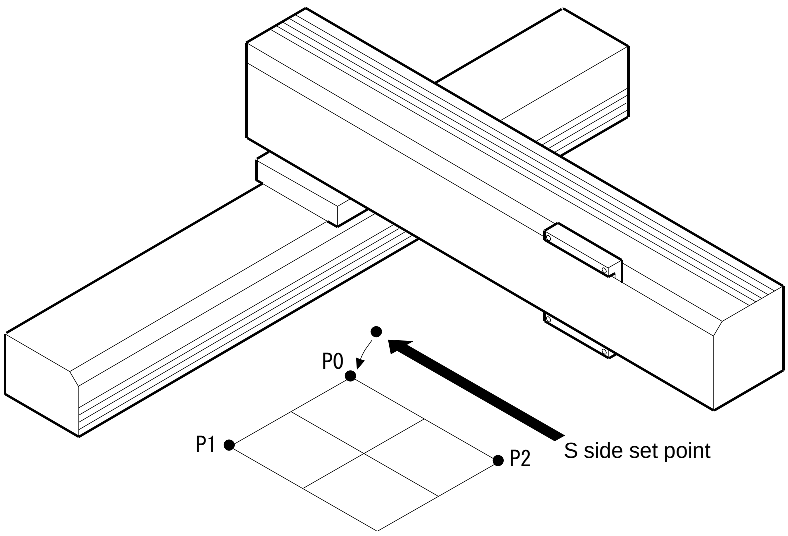
3. Creation of program in sequential mode — (Refer to section 4.1.)

↓

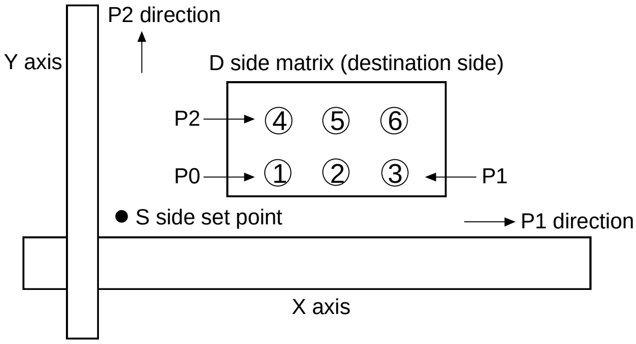
4. Execution of program — (Refer to section 4.2.)

Next, an example of 2-axis combination is described.
The basic concept is the same as that of the combination of 3 axes or more.

Combination of 2 axes



? S side : Source
D side : Destination



(1) Explanation of MVM table

The MVM table is used to set the matrix (pallet, etc.) shape, etc.

For the matrix shape as shown above, the parameters are set in the MVM table as shown below.

Point	Coordinate table No.
P0	① Point coordinate table No.(*1)
P1	③ Point coordinate table No.(*1)
P2	④ Point coordinate table No.(*1)
P3	—

Direction	No. of matrixes	Applicable counter No.
P1	3 (*2)	1 (*3)
P2	2 (*2)	2 (*3)
P3	—	—

One group (GRP)

The set of table data as shown above is called one group (GRP).
A total of 32 tables (GRP = No. 1 to 32) can be set.

*1: Explanation of coordinate table No.

- The P0, P1 and P2 coordinates set the points of each matrix end.
- The coordinates are set indirectly using the coordinate table No. so the actual coordinate data must be set in the coordinate table.
- To 999" can be set for the coordinate table No.
- If the matrix only has one row, set P0 and P1 to the normal values, and set P2 to "0".
- P0 does not always have to be set to the point closest to the origin. The operation order can be changed by changing the P0, P1 and P2 coordinate settings.

*2: Explanation of No. of matrixes

- Set the No. of matrixes in the P1 direction and in the P2 direction.
- "0 to 999" can be set for the No. of matrixes.
- If the matrix only has one row, set P1 to the normal value, and set P2 to "0".
- On the matrix of the plane (1 step), set P1 and P2 to the normal values, and set P3 to "0".

*3: Explanation of applicable counter

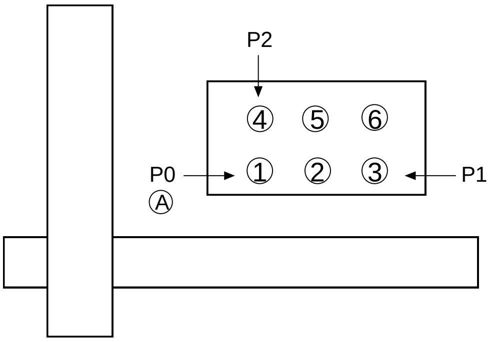
- The applicable counter is used to control the matrix movement (MVM command).
- "0 to 99" can be set for the applicable counter.
- If the matrix only has one row, set P1 to the normal value, and set P2 to "0".

(2) Relation of P0, P1, P2 coordinate setting and operation pattern

Even if the same program is executed, the operation pattern can be changed by changing the coordinate settings of P0, P1 and P2 set in the MVM table.

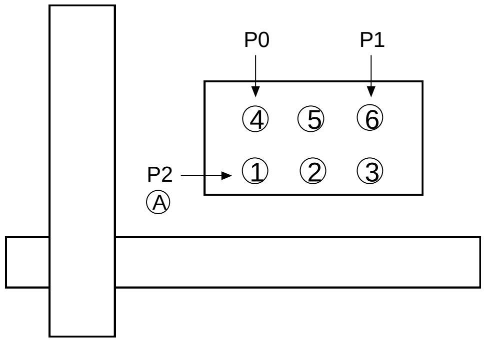
The following is an operation example of when the 1 to M program given on the next page is executed.

[Operation example]



Set the ① coordinates in P0.
Set the ③ coordinates in P1.
Set the ④ coordinates in P2.

[Operation pattern]
To execute the 1 to M program.
Ⓐ → ① → Ⓐ → ② → Ⓐ → ③
→ Ⓐ → ④ → Ⓐ → ⑤ → Ⓐ → ⑥



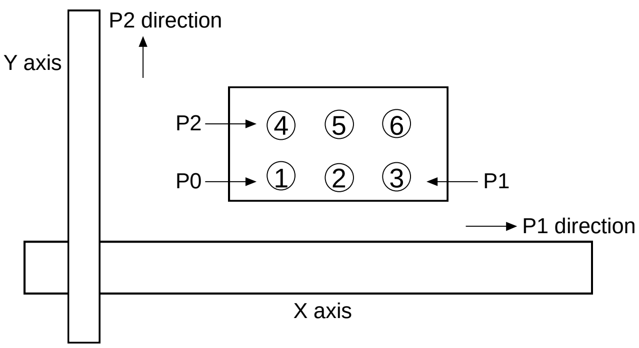
Set the ④ coordinates in P0.
Set the ⑥ coordinates in P1.
Set the ① coordinates in P2.

[Operation pattern]
To execute the 1 to M program.
Ⓐ → ④ → Ⓐ → ⑤ → Ⓐ → ⑥
→ Ⓐ → ① → Ⓐ → ② → Ⓐ → ③

(3) Relation of counter details and movement position

The MVM command is a command that looks at only the P1 and P2 direction counter details and moves the unit.

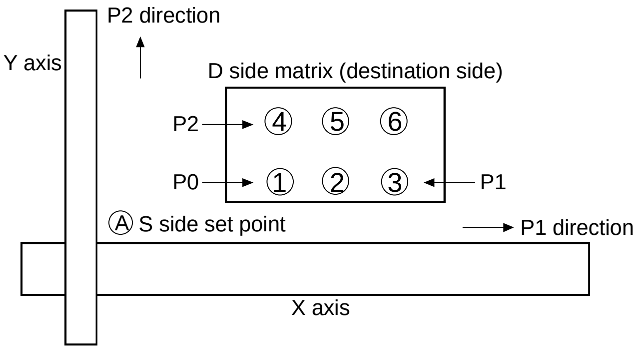
The relation of the counter details and movement point is shown below.



Details of MVM table
P0: ① point coordinates
P1: ③ point coordinates
P2: ④ point coordinates
No. in P1 direction: 3
No. in P2 direction: 2
P1 direction counter: No. 1
P2 direction counter: No. 2

MVM table setting counter		Movement destination point when MVM command is executed with the counter details given on the left
Details of counter No. 1	Details of counter No. 2	
1	1	①
2	1	②
3	1	③
1	2	④
2	2	⑤
3	2	⑥

(4) Example of palletizing work program using MVM commands

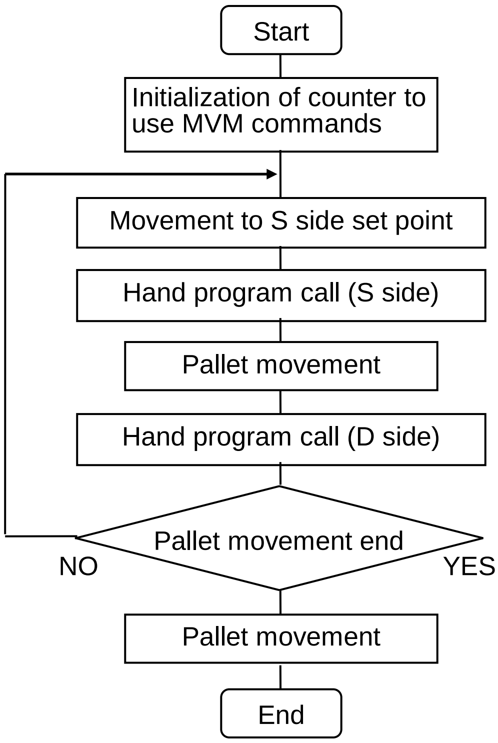


Details of MVM table
P0: ① point coordinates
P1: ③ point coordinates
P2: ④ point coordinates
No. in P1 direction: 3
No. in P2 direction: 2
P1 direction counter: No. 1
P2 direction counter: No. 2

[Operation pattern]

Ⓐ → ① → Ⓐ → ② → Ⓐ → ③ → Ⓐ → ④ → Ⓐ → ⑤ → Ⓐ → ⑥ → Origin

The flow of the 1 to M program example as shown above is given below.



[Usage commands]········Refer to Chapter 19.

MINI command

TAG command
MOVP command

CAL command

MVM command

CAL command

LOOP command
TAG command

HOME command

END command

[Explanation of changing counter details]
The counter details when the MINI command is executed are initialized to "1". When the MVM command is executed, point ① will be moved to.
The LOOP command will increment the counter No. 1 details by one during the movement from point ① to ③.
When moving from ③ to ④ the counter No. 1 details are initialized to "1", and the details of counter No. 2 are incremented by "1".
(Counter No. 2 details: 1 to 2.)
When moving from ④ to ⑥ the counter No. 1 details are incremented by "1".
When the pallet movement is completed, the program will jump to the tag No. set with the LOOP command.
The program example given on the previous page will be explained with the Teach Pendant screens.

- Writing of program

  Enter the sequential PRGM mode. Write the following command in STEP 0001.
  (For this example, the program will be written from STEP 0001.)
  The following screen will display. (Refer to section 4.1.1.)
  Refer to "Chapter 19 Commands" on how to input the commands.

```
[PRGM]
0001
MINI GRP=01
```

STEP 1 Set the details (value) of the counter to be used for the preset MVM table (group No. 1) to "1".

```
[PRGM]
0002
TAG   100
```

STEP 2 Assign a tag No.

```
[PRGM]
0003 a  S NO=000
MOVP V=00 CNT[00]
     POST
```

STEP 3 Move to the S side set point with the MOVP command.

```
[PRGM]
0004
CAL   200
```

STEP 4 Call the tag No. of the hand program on the S side set point side. The hand program is a subroutine program that carries out handling work.

```
[PRGM]
0005    S GRP=01
MVM  V=00
     POST DIST
```

STEP 5 Write the MVM command. With this command, the point on the D side (destination) will be moved to.

```
[PRGM]
0006
CAL  300
```

STEP 6 Call the tag No. of the D side hand program, and carry out the handling work.

```
[PRGM]
0007      IF LOOP END
LOOP GRP=01 THEN 400
            ELSE 100
```

STEP 7 The MVM table (GRP No. 01) counter will be incremented by 1. When the counter used for each axis reaches the No. of the MVM tables, tag No. 400 will be jumped to.
If the number is not reached, the program will jump to tag No. 100, and will realize the loading by carrying out STEP 2 to 6 following the counted counter.(There are cases where return to origin does not need to be carried out. Refer to section 3.1.3 Return to origin.)

? If the details of the designated counter reaches the set No. and the MVM loop is ended (LOOP END) immediately (ELSE), the program will jump to the THEN tag. If not ended immediately, the program will jump to the ELSE tag.
IF~THEN····· ELSE is configured of the jump commands with ELSE conditions attached.

```
[PRGM]
0008
TAG  400
```

STEP 8 Assign a tag No.

```
[PRGM]
0009
HOME
```

STEP 9 Carry out return to origin.

```
[PRGM]
0010
END
```

STEP 10 End the program.

■ 4.2 Sequential RUN Mode

This robot can be operated with the following methods.

- Continuous operation, signal operation of the AUTO mode
- STEP mode

■ 4.2.1 AUTO mode of sequential mode

(1) Continuous operation

Carry out operation in the STEP mode and confirm the operation before starting operation in the AUTO mode.

Operation using Teach Pendant

```
POWER  F1:T/P ON
  -ON  F2:
       F3:CHANG TASK
       F4:EXTENSION
```

STEP 1 Turn ON the power switch. After the initial screen displays, the following screen will display, so press F1 and HOME to carry out return to origin.

(There are cases where return to origin does not need to be carried out. Refer to section 3.1.3.)

```
[AUTO]
0001
NOP
```

STEP 2 In this state, the sequential mode's RUN mode will be entered.

Press NEXT or -NEXT to display the first step of the program to be executed.

```
[AUTO]
0005 a  S NO=002
MOVP V=00 CNT[00]
     POST
```

STEP 3 After displaying the step to be executed, press START .

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

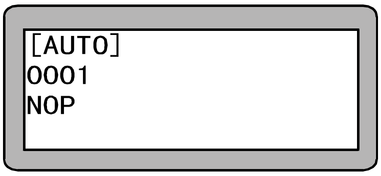
STEP 4 When the program is being executed.

The screen on the left will display.

If STOP is pressed, the program will stop after completing the step currently being executed.

To restart the program, press START again.

⚠ CAUTION If the EMERGENCY STOP button is pressed, a deceleration torque is generated on the robot to bring it to a stop. The stopping distance will differ according to the load size, speed and inertia.



STEP 5 When the program END command is completed, the program will return to step No. 0001, program STEP 1 will display, and the operation will stop.

Operation with external signals

Use the following procedure to carry out operation with the external signals. Refer to section 14.1 on how to disconnect the Teach Pendant.

[Operation procedures]

1. Carry out return to origin with the system input return to origin.
2. Input the start signal to execute the program from STEP 0001.If there are multiple tasks in the multitasking, the execution will start with STEP 0001 of the main task.
3. If the stop signal is input during operation, the program will stop after ending the program step currently being executed.
4. To restart from the step where the program was stopped, input the start signal.
5. To start from STEP 1, input the reset signal and then input the start signal. If the restart function is valid, the reset input will be ignored. (Refer to section 10.2.6.)

(2) Single operation

During single operation, the program will stop once after the axis movement or output related operation is executed. To start or restart the program, input the start signal or press START . Normally this is used to verify a program.

An example of single operation is given below.

1. Turn the single operation input signal ON.
2. The following operations are basically the same as continuous operation. (Refer to section 4.2.1 (1).)
3. When the program has stopped operation, press START or input the start signal to sequentially start the program.

- The single operation mode input bit setting in the mode setting must be set. (Refer to section 14.2.1.)
- Operation with either the Teach Pendant or external signal is possible.
- The single operation input signal must retain the ON state during single operation. If the single operation input signal is turned OFF during single operation, the remaining program will be continuously operated.
- Even if the single operation input signal is input during continuous operation, it will be ignored, and continuous operation will continue.
- The following commands can be used for stopping after execution.

  MOV, MOVP, MVC, MVCP, MVB, MVE, HOME, MVM, RSMV, OUT, OUTP, OUTC, IOUT

■ 4.2.2 STEP mode of sequential mode

The STEP mode is used to execute the program in the controller one step at a time.
When multiple tasks are operated using the multitasking function, one step of the task displayed on the Teach Pendant will be executed and then will stop. The other tasks will stop when the step being executed is stopped at the time the displayed tasks have stopped.
Use this mode to confirm the program operation, etc., before executing the program in the AUTO mode.

```
POWER  F1:T/P ON
  -ON  F2:
       F3:CHANG TASK
       F4:EXTENSION
```

STEP 1 Turn ON the power switch. After the initial screen displays, the following screen will display, so press F1 and HOME to carry out return to origin.

```
[AUTO]
0001
NOP
```

STEP 2 In this state, the sequential mode's RUN mode will be entered.

Press HELP .

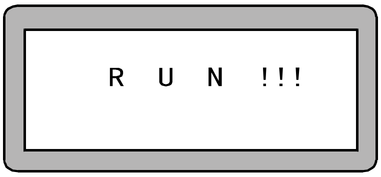
```
[RUN]  F1:AUTO/STEP
       F2:OVERRIDE
       F3:RESET
       F4:PAGE
```

STEP 3 When this screen displays, press F1 .

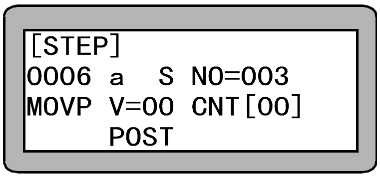
The STEP mode will be entered.

```
[STEP]
0005 a  S NO=002
MOVP V=00 CNT[00]
     POST
```

STEP 4 Press -NEXT or NEXT to display the first step of the program to be executed. After displaying the step to be executed, press START .



STEP 5 When the program is being executed. The screen on the left will display.



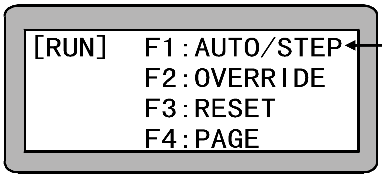
STEP 6 The next step will display and the robot will stop. When next step will be executed when the START key is pressed. After this, the program will be executed in the step order, and will stop after each executed.

The search function can be used in this mode. This is handy for confirming the jump conditions, etc., in the program by using the tag No. search. Refer to Chapter 16 for details on the search function.

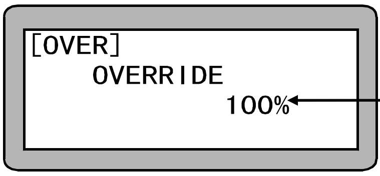
NOTE The timing of the input signal and output signal during operation with the STEP mode will be differ compared to operation during the AUTO mode.

■ 4.2.3 Changing of speed during operation (override)

The entire program execution speed can be delayed by using the override function. This allows the program to be confirmed at a low speed.



STEP 1 After the initial screen displays, enter the RUN mode and press HELP . This screen will display, so press F2 and enter the override mode.



STEP 2 Use the numeric keypad to enter the override value. When ENT is pressed, the speed will change to the set speed.

Press ESC to return to the RUN mode.

(Initial value: 100, Setting range: 1 to 100)

NOTE The override setting is valid only while the program is stopped.

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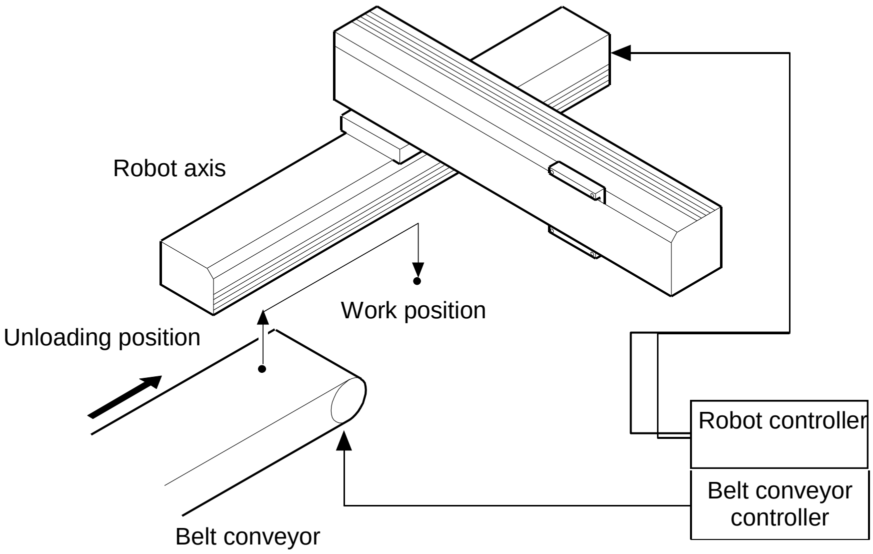
Chapter 5 Multi-task

■ 5.1 Multitasking

Multitasking refers to executing multiple tasks simultaneously. The multitasking referred to with this equipment refers to executing multiple programs simultaneously. This multiple execution of programs is asynchronous operation in which the programs do not interfere with each other.
However, the start of the command execution can be synchronized using commands exclusive for multitasking, and using counters and timers I/O common between the tasks.

■ 5.2 Merits of Multitasking

The explanation will follow the case of creating a system that unloads the part from the conveyor and places it on the work table.
When the axis is moving to move the part to the work table, the conveyor must be operated to supply the next part to the unloading position.



- When multitasking is not used
  In addition to the robot, a programmable logic controller (PLC) for controlling the conveyor will be required.
  Due to this, the system will become complicated as wiring for interlocks, etc., will be required. This will in turn lead to a larger and more expensive system.
  If the conveyor is controlled with the robot I/O instead of using a PLC, the conveyor cannot be used while the axis is moving, and thus the tact time will increase.

- When multitasking is used
  The I/O such as the conveyor control and the axis movement can be controlled simultaneously, so a system can be structured without using a PLC, etc. Thus, the wiring is simplified and the system is less expensive. Control can be carried out just with the controller program, so the system development and maintenance are simplified.

■ 5.3 Multitasking Usage Methods

Each task program is the same as the conventional sequential program. The multitasking settings and the programming methods will be described below.

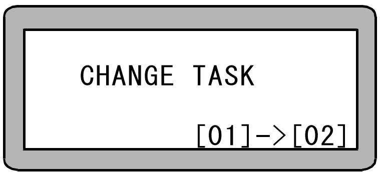
■ 5.3.1 Multitasking specifications

Mode	Only sequential mode
Max. No. of tasks	4 Note that the axis operation is possible for task number 1 only.
Max. No. of axes	4
No. of program steps	2,500 (total of all tasks) Note that the easy program area is used for STEP 2001 and following.

■ 5.3.2 Multitasking functions and settings

(1) Changing the task to be displayed and edited

The task switching operation can be used to display any selected task on the teach pendant's sequential program display.
To change the task targeted for display or editing, carry out the following operation while the RUN mode or PRGM mode sequential program step is displayed.



First press ALT .
Using the numeric keypad, enter the task No. (Input range: 01 to 04) in this state.
When ENT is pressed, the displayed task will change.

NOTE It is impossible to change to a task in which the step number is 0 (the error tone PPPP is generated if changed).

(2) Setting the task and axis combination

The CA-20-M00, CA20-M01 controllers can use up to four tasks, and up to four axes can be set per task.
General-purpose input and other commands can be executed as tasks with no axis designation for task numbers 2 to 4.
For the setting method, refer to section 14.4.19, "Setting of task and axis combination".

NOTE Axis-related commands (such as movement commands) cannot be executed for task numbers 2 to 4.

(3) Setting the No. of task steps

As the total for the four tasks, up to 2,500 steps can be set for the program.

If the total number of program steps is 2,001 or more, the easy program area will be cleared and used. As a result, the easy program will not be available.
Refer to section 14.4.22, “Setting the No. of task steps for the setting methods”.

■ 5.3.3 Available commands

In multitasking of the controller, axis operation is possible for task 1 only, and axis operation cannot be performed for tasks 2 to 4. Except for the axis operation commands, the commands below are available for tasks 2 to 4.

System	Command	Description
Control of I/O ports	OUT	General-purpose port output
	OUTP※1	General-purpose port pulse output
	OUTC	Counter value general-purpose port output
	IOUT	Internal port output
	IN	Input waiting
	INPC	Setting of general-purpose port input status to counter
	INSP	Internal port input waiting
Control of timer and counters	CWIT	Counter condition waiting
	TIM※1	Time wait
	TIMP	Timer preset
	CNT	Counter value preset
	CNT+	Add to counter value
	CNT-	Subtract from counter value
	CNTC	Clear all counters
Control of programs	NOP	No function
	RET	Return (subroutine end statement)
	STOP	Stop
	END	Program end
	TAG	Tag (jump address label)
	PSEL	Program select
Jump	JMP	Unconditional jump
	JMPI	Input condition jump
	JMPC	Counter condition jump
	JMPT	Timer condition jump
	BRAC	Counter jump
Calling of subroutines	CAL	Unconditional call
	CALI	Input condition call
	CALC	Counter condition call
	CALT	Timer condition call
Control of tasks	TSTR	Task start
	TSTO	Task stop
	TRSA	Task restart
	TCAN	Task terminate

*1: During execution of these commands, other tasks are in the ready status and do not proceed to the next step until the command has ended. If other tasks must be run during the command, use by combining the TIMP command and JMPT command.

■ 5.3.4 Starting and stopping tasks

One of the four tasks is the main task.

(1) Starting the tasks (TSTR Command)
If start is applied by the Teach Pendant or system input, task 1 (main task) will start.
The other tasks will start with the TSTR command.

(2) Stopping the task (TSTO Command)
If stop is applied by the Teach Pendant or system input, all task will stop when the command being executed at that point is completed. The step No. will remain that at the stopped time, and the task continues the execution from the step No. when start is applied again.
The other task can be stopped with the TSTO command. To stop the task itself, use the STOP command.

(3) Restarting the task (TRSA Command)
The task will restart from the step where the main task was stopped.

(4) Ending a task (TCAN Command)
If stop is applied by the system output, all task will stop when the command being executed at that point is completed. The step No. will remain that at the stopped time, but if reset is applied from the system No., step No. will change to 1 and be the same as the end state.
When the END command is executed, the task stops and ends, and the step number returns to 1.
The task will end (enter the stop state, and step No. will return to 1) when the END command is executed. However, if the main task executes the END command, all task will end when the command being executed at that time. To prevent this, use counters and internal port input/output commands to set the timing between tasks (refer to section 5.3.6), and create a program so that the main task does not execute the END command until the other tasks have ended.
The tasks other than the main task can be ended with the TCAN command.

■ 5.3.5 Multitasking operation

The method for creating and running a multitasking program will be explained in this section. The case for controlling two steps of 2-axis combinations such as X-Y and four controllers will be described.

```
[PARA]K19
 TASK COMBINATION
        T1 T2 T3 T4
       [5][0][0][0]
```

Set [1 to 5]. Set 0 only.

STEP 1 Set the task and axis combination with the task axis setting in the PARA mode. (Refer to section 14.4.19)
In the example on the left, the station No. 1, No. 2, No. 3, and No. 4 axes are controlled by task No. 1

```
[PARA]K22 T1=1000
TASK      T2=0500
STEP NUM. T3=0000
          T4=0000
```

STEP 2 Set the No. of steps in each task with the No. of task step setting in the PARA mode. (Refer to section 14.4.22)
In the example on the left, 1000 and 500 steps are assigned to each task No. 1 and No. 2.
Changing to a task with zero steps is not allowed.

```
   CHANGE TASK

        [01]->[01]
```

STEP 3 Next, enter the program in task No. 1.

Enter the sequential PRGM mode, and press ALT .

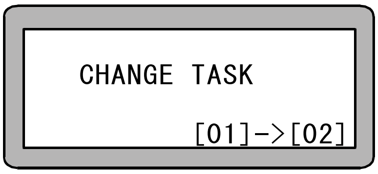
The display shown on the left will appear.
Use the numeric keypad to enter "1", and then press ENT to change the display task to "1".

```
[PRGM]
0001
TSTR  02
```

STEP 4 Enter the TSRT command for starting task No. 2.

When start is input from the Teach Pendant or system input, the main task (task No. 1) will start.

Task No. 2 will start with the TSTR command at the beginning of task No. 1.
Enter the task No. 1 program in sequential order for the steps that follow.



STEP 5 Next, enter the program in task No. 2.

Enter the sequential PRGM mode, and press (ALT) .

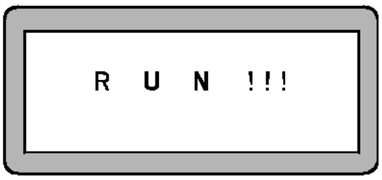
The display shown on the left will appear.

Use the numeric keypad to enter the task No. 2, and then press (ENT) .

The display task will change.

Sequentially enter the task No. 2 program in the following steps.

STEP 6 When completed entering the program, enter the RUN mode and press (START) .

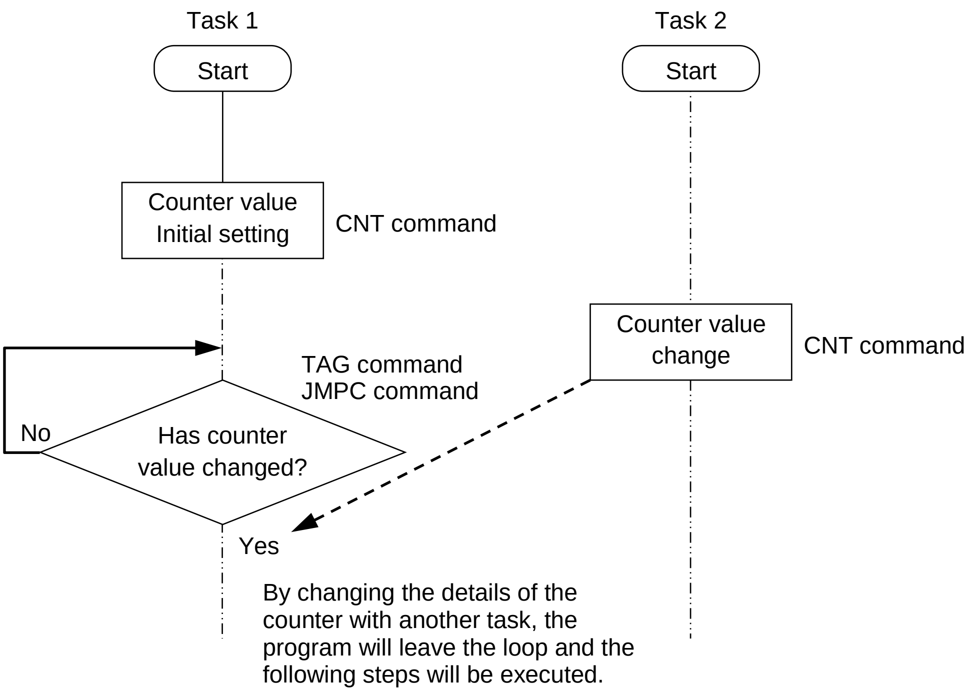


The program will start from the head of task No. 1.

Use the operation described in STEP 3 to change the task display.

■ 5.3.6 Applying timing between tasks

The timing is set for multiple tasks that run in coordination by using counters or internal port input/output commands (INSP, IOUT) as shown below.



■ 5.4 Details on Multitasking

Information important for efficiently using the multitask function is described below.

■ 5.4.1 Task status

With the multitasking, multiple task can be executed simultaneously by executing other task during the task's open time.
The following four task states exist.

(1) Stopped state
State in which nothing is occurring. (No tasks have been started.)
(2) Execution state
State in which task is being executed.
(3) Ready state
State waiting for task processing priority.
(4) Wait state
Status in which task is waiting.
Waiting refers to positioning complete waiting, input waiting.
Commands with wait states ··· MOV, MOVP, MVC, MVCP, MVB, MVE, MVM, RSMV, HOME, IN, CWIT, INSP

■ 5.4.2 Transition of states

(1) Starting the task
The main task (task 1) will start when start is input from the system, or when started with the Teach Pendant.
The task stopped from the execution state will enter the ready state with the task start command (TSTR).
(2) Ending the task
When the task being executed executes the END command, that task will end. The step No., for the ended task will change to 1, and the task will stop. If the END command is executed with the main task, all tasks will end when the commands for all tasks are completed.
If the task being executed executes the TCAN command, the task will end when the task command designated with that command is completed. The main task cannot be ended with the TCAN command.
(3) Restarting the task
The main task will enter the execution state from the stopped step, and the other task will enter the ready state.
(4) Execution state and ready state
Priority of the task in the ready state will enter the execution state in the following cases.

- When the execution state task enters the wait state.
  The task that is waiting will enter the ready state when a waiting occurs.

- When the execution state task executes a branch command.
  The task that executes the branch command will enter the ready state at the branch designation step.
- When the execution state of a task continues for one second or more.
  When one second or more has passed, the step being executed will end, and the ready state will be entered.

■ 5.4.3 Transfer of data between tasks

The same counters and timers are used for all tasks, so a value can be set with one task and referred to by another task, or the data or status can be transferred by using condition judgment commands such as JMPC, CALC, JMPT, or CALT.

■ 5.4.4 Task priority

If there are multiple tasks in the ready state and the execution state task enters the wait state or a branch command is executed, the priority to move the ready state task to the execution state is set. For the setting method, refer to section 14.4.20, "Setting the task priority order".

Chapter 6 Easy Mode

Easy mode is a mode in which movement to each point, and simple sequential operation such as operation of the hand after completing movement can be done without creating a program.
In other words, the movement commands, calling of the hand operation subroutine, and designation of the step to be executed next are configured as a pair of steps per program, allowing programming and execution to be carried out without a complicated configuration.

The easy mode program can have a maximum of 100 steps per program, and eight programs can be created.

No. of programs : Eight programs
No. of steps : 100 steps/program

The following subroutine programs used in the easy mode are created in the sequential program.

- Hand subroutine : Sequential program executed a point after to moving to it such as when operating the hand, etc.
- Start subroutine : Sequential program executed before moving to the point.
- End subroutine : Sequential program executed after the easy mode operation ends.

NOTE When it is used in the easy mode, a maximum of 2,000 steps can be used in the subroutine sequential programs above.

■ 6.1 PRGM Mode of Easy Mode

Before using the easy mode, validate the easy mode in the mode setting.
Refer to section 6.1.1 for the setting method.

■ 6.1.1 How to enter and leave the easy mode

Display the easy mode setting screen in the PARA mode. (Refer to section 14.2.10.)

STEP 1A [How to enter the easy mode]

Press [ALT] to display EASY and then press [ESC] twice.

The display will change when [ALT] is pressed.

```
[PARA]M10
 OFF/EASY/POINT
          ENTRY
            [OFF    ]
```

EASY → POINT

STEP 2A The easy mode will be validated and the initial screen of the PRGM mode (easy) will display.

```
[EASY]01   X= 0000.00
001   V=00 Y= 0000.00
  TAG:00   Z= 0000.00
           R= 0000.00
```

STEP 1B [How to leave the easy mode]

Press [F4] .

```
[EASY]01   X= 0000.00
001   V=00 Y= 0000.00
  TAG:00   Z= 0000.00
           R= 0000.00
```

STEP 2B Press [F1] and display the mode setting screen.

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

```
[PARA]M10
 OFF/EASY/POINT
          ENTRY
             [OFF    ]
```

EASY → POINT

STEP 3B Press [NEXT] nine times to display the STEP 1A screen.
Press [ALT], select another mode, and then press [ESC].

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

STEP 4B Leave the easy mode and display the screen shown on the left.

Press [ESC] and the PRGM mode screen for the selected mode will display.

■ 6.1.2 Editing easy mode program

The items input for the easy mode are as follow.

(1) Program No. 1 to No. 8 setting

Program No. 1	Program STEP 001 to 100
Program No. 2	Program STEP 101 to 200
Program No. 3	Program STEP 201 to 300
Program No. 4	Program STEP 301 to 400
Program No. 5	Program STEP 401 to 500
Program No. 6	Program STEP 501 to 600
Program No. 7	Program STEP 601 to 700
Program No. 8	Program STEP 701 to 800

(2) Setting of start tag No.
Set the tag No. of the start subroutine program to be executed before moving to the point.
No program will be designated if the tag No. is set to 000.

(3) Setting of point coordinates
Input the coordinate values in the point table No.
MDI, remote teaching or direct teaching can be used to input the coordinate values. (Refer to section 3.2.2.)

NOTE The coordinate data will be written into the coordinate table of the point table No. that is the same as the step No.

(4) Setting of speed
Set the speed to move to the point at.

(5) Setting of hand subroutine tag No.
Set the tag No. of the sequential program to be executed after moving to the point.
No program is designated if the tag No. is set to 000.

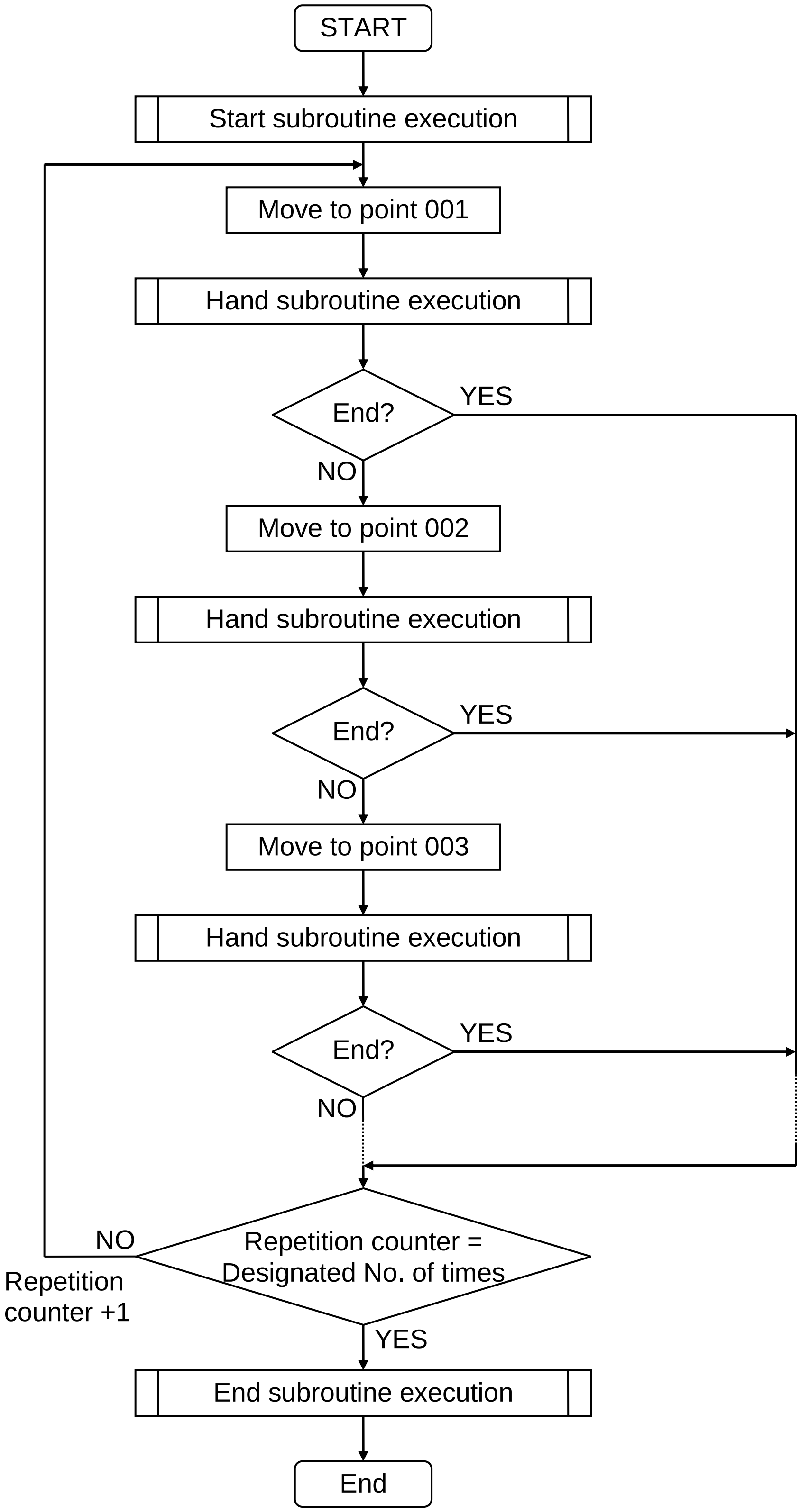
(6) Setting of number of repetitions
Set the number of times to execute the series of operations. (0 to 9999 times)
If 0 is designated, the operations will be repeated infinitely.

(7) Setting of end tag No.
Set the tag No. of the sequential program to be executed after the easy operation ends.
No program is designated if the tag No. is set to 000.

(8) Setting of end
Designate the end step of the easy operation. (Input and display "*".)

NOTE Always set the end. If an end is not set, a step No. error will occur during execution.

A flow chart of the easy mode operation is shown below.



(9) Setting of reservation tag No.

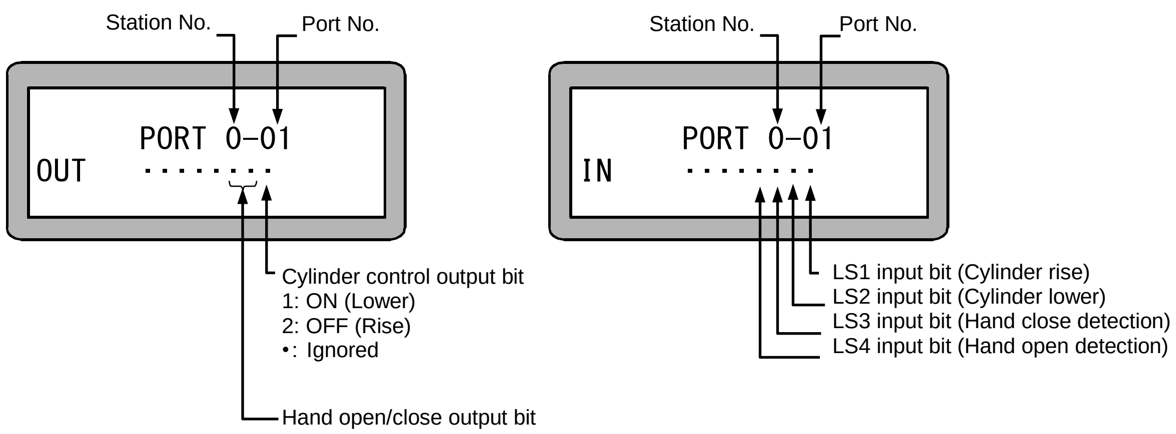
The hand subroutine creates a random program in the sequential program, but when carrying out predetermined operation such as pick & place of the work (operation to move the air cylinder vertically, pick up the work by opening/closing the chuck, and placing the work), a subroutine program with fixed details can be used.

The reservation tag No. refers to the tag No. of this fixed subroutine program. By designating the reservation tag No., a sequential program does not need to be created, and the required operations can be carried out.

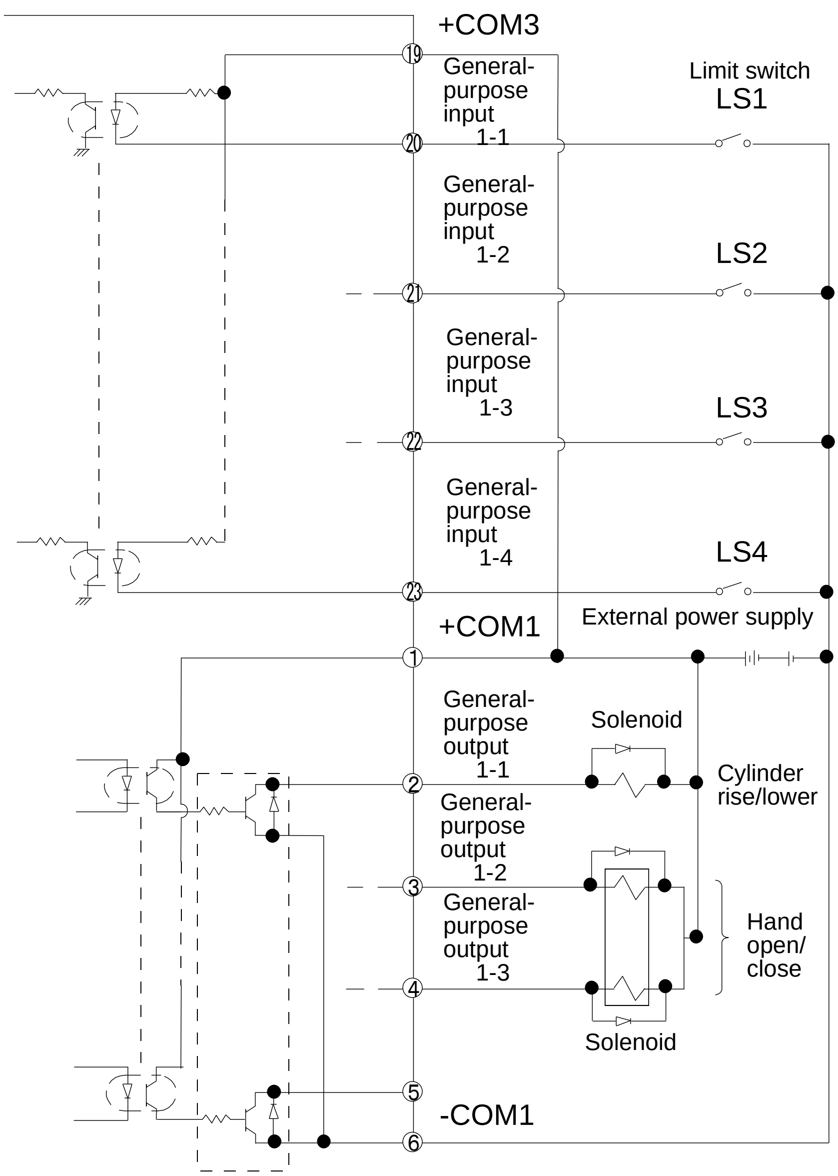
When using the reservation tag No., external devices such as a solenoid and limit switch must be connected beforehand to the assigned general-purpose input/output ports.

The general-purpose input/output ports for the external devices (air cylinder, hand, limit switch) used when using a reservation tag No. are shown

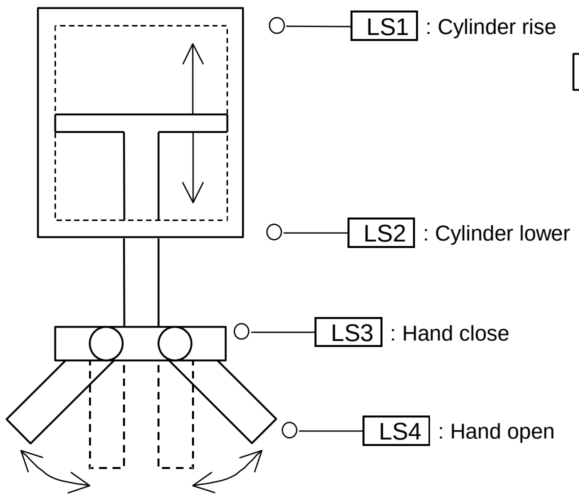
Assignment of general-purpose input/output ports when using reservation tag No.



Connection of external devices when using reservation tag No.



Layout of limit switches in reservation tag No.



NOTE Use normal open switches for the limit switches LS1 to LS4.

Reservation tag No. 900·····Subroutine program that goes to pick up work
Reservation tag No. 901·····Subroutine program that goes to place work

The details of the reservation tag No. hand subroutine are shown below.

Tag No. 900: Operation to go to pick work

Step No. display	Operation details	Details
*001	IN 0-01 • • • • 01• •	Chuck opening check
*002	OUT 0-01 • • • • • • • 1	Cylinder lower instruction
*003	IN 0-01 • • • • • • 10	Wait for cylinder lower completion
*004	TIM 0.1	Timer wait
*005	OUT 0-01 • • • • • 01•	Chuck close instruction
*006	IN 0-01 • • • • 10• •	Wait for chuck close completion
*007	TIM 0.1	Timer wait
*008	OUT 0-01 • • • • • • • 0	Cylinder rise instruction
*009	IN 0-01 • • • • • • 01	Wait for cylinder rise completion
*010	TIM 0.1	Timer wait
*011	RET	

Tag No. 901: Operation to go to place work

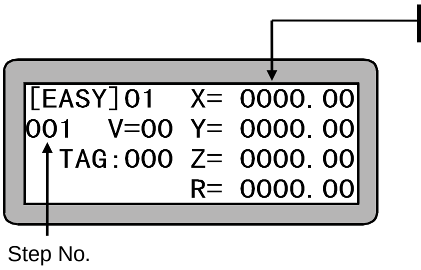
Step No. display	Operation details	Details
*001	OUT 0-01 • • • • • • • 1	Cylinder lower instruction
*002	IN 0-01 • • • • • • 10	Wait for cylinder lower completion
*003	TIM 0.1	Timer wait
*004	OUT 0-01 • • • • • 10•	Chuck opening instruction
*005	IN 0-01 • • • • 01• •	Wait for chuck open completion
*006	TIM 0.1	Timer wait
*007	OUT 0-01 • • • • • • • 0	Cylinder rise instruction
*008	IN 0-01 • • • • • • 01	Wait for cylinder rise completion
*009	TIM 0.1	Timer wait
*010	RET	

NOTE The details of the reservation tag No. cannot be confirmed on the Teach Pendant.

Programming in easy mode

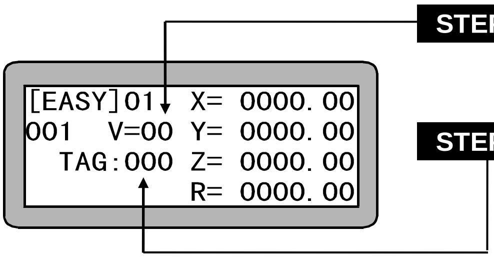
The method for programming the easy mode is given below.

- Input of point coordinates, speed and hand subroutine tag No.
  Select the easy mode with the mode setting, and display the initial screen of the PRGM mode (EASY). (Refer to section 6.1.1)
  Press SEARCH , and input the easy program No. of a desired program with the numeric keypad. Then, press ENT , and the relevant program will be displayed.



STEP 1 Use the numeric keypad to enter the X, Y, Z, R coordinates, and then press ENT . (Input range: –8000 to 8000)

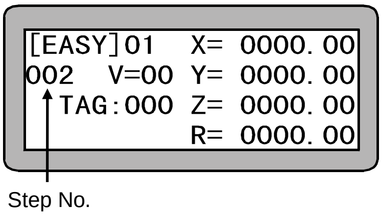
NOTE Remote teaching and direct teaching is also possible by pressing DIRECT JOG . (Refer to section 3.2.2)



STEP 2 Use the numeric keypad to enter the speed No., and then press ENT . (Input range: 0 to 10)

STEP 3 Use the numeric keypad to enter the tag No. (hand subroutine), and then press ENT . (Input range: 0 to 999)
If a determined operation is to be carried out by using the reservation tag No., use the reservation tag No. 900 and 901.
(Refer to section 6.1.2 (9).)
Press NEXT and move to the next step.

NOTE The hand subroutine program is written into the sequential program.
When entering the program, if SEQUN PALET is pressed, the sequential PRGM mode can be changed to. The easy mode PRGM mode will be returned to when SEQUN PALET is pressed again.

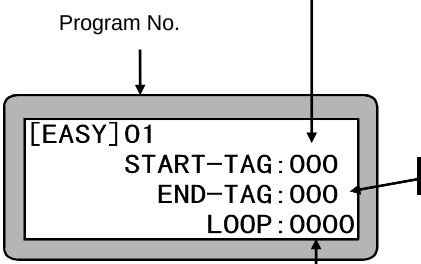


STEP 4 Use the numeric keypad and enter the point coordinates, speed No. and tag No. (hand subroutine) in the same manner as STEP 1 and STEP 2.

Press NEXT to move to the next step, and -NEXT to return to the previous step.

NOTE The easy mode coordinates are written into the coordinate table having the same point table No. as the step No.

- Setting of start subroutine, end subroutine and repetition conditions
  When F2 is pressed on the easy mode screen, the following setting and display screen will display.



STEP 1 Use the numeric keypad to enter the start tag No., and then press ENT . (Input range: 0 to 999)

If there is no designation, a start subroutine will not be executed. The reservation tag Nos. 900 and 901 can also be input.

STEP 2 Use the numeric keypad to enter the end tag No., and then press ENT . (Input range: 0 to 999)

If there is no designation, an end subroutine will not be executed. The reservation tag Nos. 900 and 901 can also be input.

STEP 3 Use the numeric keypad to enter the designated number of repetition conditions, and then press ENT . (Input range: 0 to 9999)

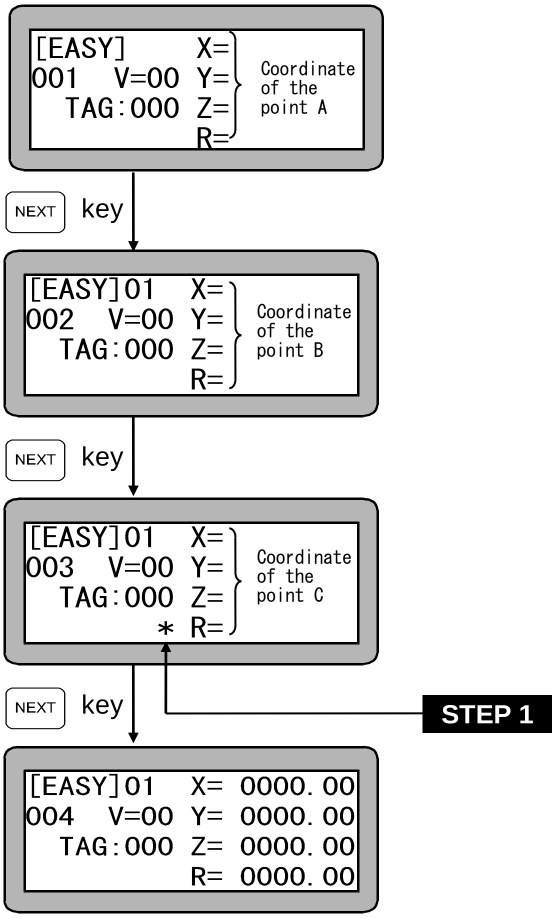
If 0 is designated, infinite repetition will occur.

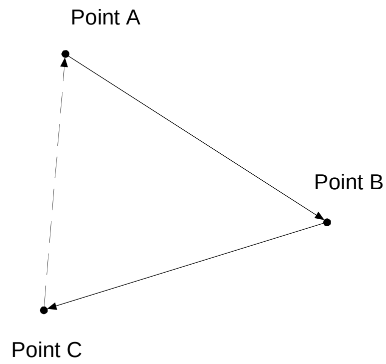
Press ESC to end the settings and return to the initial screen of the easy mode.

- End setting

In the easy mode, a setting to indicate the end of the operation at the final step of the series of operations (including cycle operation) must be set regardless of the operation pattern.

For example, with an operation pattern of point A to point B to point C is carried out as shown below, the step point C at the end of the cycle will be the end step.





Operation pattern

Display the end step screen and press F3 .
An "∗" to indicate the end will display, and the end setting will be completed.
To delete the end setting "∗", press F3 again.

NOTE Always set the end when using the easy mode. If the end is not set, a step No. error will occur when the program is executed.

■ 6.1.3 Copy editing of easy mode

A random program in the easy mode can be copied to another easy program.
Enter the PRGM mode (sequential) and press HELP . (Refer to section 6.1.1.)

The following screen will display.

STEP 1

```
[PRGM] F1:EXTENSION
 HELP  F2:DIRECT OUT
       F3:EDIT
       F4:PARAMETER
```

Press F3 in this state.
Press ESC to return to the initial screen of the PRGM mode.

STEP 2

```
[EDIT] F1:INS STEP
       F2:DEL STEP
       F3:CLEAR
       F4:PAGE
```

In this state, press F4 .
Press ESC to return to the initial screen of the PRGM mode.

STEP 3

```
[EDIT] F1:STEP  COPY
       F2:PALET COPY
       F3:STEP   DEL
       F4:EXTENSION
```

Press F4 .
Press ESC to return to STEP 2.

STEP 4

```
[EDIT] F1:EASY  COPY
       F2:
       F3:
       F4:CARD
```

Press F1 .
Press ESC to return to STEP 3.

STEP 5

```
[EASY-
 COPY] FROM[01]

         TO  [01]
```

Use the numeric keypad to enter the copy origin easy program No. and the copy destination easy program No.
Press ENT . The program will be copied, and STEP 4 will be returned to.
Press ESC to return to STEP 4.

■ 6.1.4 Clearing of easy mode programs

All of the easy programs in the controller can be cleared.

Enter the PRGM mode (sequential) and press [HELP] . (Refer to section 6.1.1.)
The following screen will display.

```
[PRGM] F1:EXTENSION
 HELP  F2:DIRECT OUT
       F3:EDIT
       F4:PARAMETER
```

STEP 1 Press [F3] in this state.
Press [ESC] to return to the initial screen of the PRGM mode.

```
[EDIT] F1:INS STEP
       F2:DEL STEP
       F3:CLEAR
       F4:PAGE
```

STEP 2 Then, press [F3] .
Press [ESC] to return to the initial screen of the PRGM mode.

```
[CLR]  F1:SEQUN
       F2:PALET
       F3:SEQ/PALET
       F4:PAGE
```

STEP 3 Next, press [F4] .
Press [ESC] to return to STEP 2.

```
[CLR] F1:MEMORY INT
      F2:EASY/POINT
      F3:POINT TABLE
      F4:
```

STEP 4 Next, press [F2] .
Press [ESC] to return to STEP 3.

```
EASY/POINT CLEAR ?

    YES:ENT  NO:ESC
```

STEP 5 To clear the program, press [ENT] . To not clear the program, press [ESC] .

NOTE The coordinate table Nos. 1 to 800 will be cleared.

■ 6.2 RUN Mode of Easy Mode

This unit can be operated with the following methods.

- Continuous operation, single operation of the AUTO mode
- STEP mode

NOTE Operation cannot be restarted after the power is turned OFF in the easy mode.

■ 6.2.1 AUTO mode of easy mode

Before using the easy mode, the easy mode must be validated with the mode setting. Refer to section 6.1.1 on how to make the setting.

(1) Continuous operation
Carry out operation in the STEP mode to verify the program operation before starting operation in the AUTO mode.

- Operation using Teach Pendant

STEP 1

```
POWER  F1:T/P ON
  -ON F2:
       F3:CHANG TASK
       F4:EXTENSION
```

Turn ON the power switch. After the initial screen displays, the following screen will display, so press F1 and HOME to carry out return to origin.

STEP 2

Easy program No.

```
[AUTO]01
STEP 001     TAG 000
         S-STEP 0000
           LOOP 0000
```

This state is the easy mode RUN mode.

Press SEARCH and then use the numeric keypad to enter the easy program No. to be executed. Then press ENT to display the corresponding program.

STEP 3

The program execution will start when START is pressed.

During execution, the easy mode operation state can be monitored as shown on the left.

Easy program No.
(1 to 8) is displayed

```
[AUTO]01
STEP 001     TAG 000
         S-STEP 0000
           LOOP 0000
```

The tag No. of the hand program being executed will display.
(000 will display when a program is not being executed.)

The step No. of the sequential program being executed will display.

The No. of repetitions will display.

No. of step (easy program) being executed will display.

If STOP is pressed, the program will stop after completing the step currently being executed. To restart the program, press START .

CAUTION If the EMERGENCY STOP button is pressed, a deceleration torque is generated on the robot to bring it to a stop.
The stopping distance will differ according to the load size, speed and inertia.

- Operation with external signals
  Use the following procedure to carry out operation with the external signals. Refer to section 18.1 on how to disconnect the Teach Pendant.
  The following settings must be made before carrying out operation.
  Set the controller mode setting to the easy mode. (Refer to section 14.2.10.)
  Set the program selection input bit designation to the general-purpose input. (Refer to section 14.2.5.)

[Operation procedures]

1. Carry out return to origin with the system input return to origin.
2. Designate the easy program No. to be executed with the system input program No. selection.
3. Input the start signal to execute the program.
4. If the stop signal is input during operation, the program will stop after ending the step currently being executed.
5. To restart from the step where the program was stopped, input the start signal.
6. To start from STEP 001, input the reset signal and then input the start signal. If the restart function is valid, the reset input will be ignored. (Refer to section 10.2.6.)

(2) Single operation

During single operation, the program will stop once after the axis movement or output related operation is executed. To start or restart the program, input the start signal or press START .

Normally this is used to verify a program.

An example of single operation is given below.

1. Turn the single operation input signal ON.
2. The following operations are basically the same as continuous operation. (Refer to section 6.2.1 (1).)
3. When the program has stopped operation, press START or input the start signal to sequentially start the program.

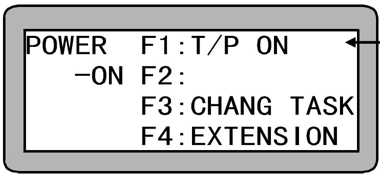
- The single operation mode input setting in the mode setting must be set. (Refer to section 14.2.1.)
- Operation with either the Teach Pendant or external signal is possible.
- The single operation input signal must retain the ON state during single operation.
  If the single operation input signal is turned OFF during single operation, the remaining program will be continuously operated.
- Even if the single operation input signal is input during continuous operation, it will be ignored, and continuous operation will continue.

- The following commands can be used for stopping after execution.
  MOV, MOVP, MVC, MVCP, MVB, MVE, HOME, MVM, RSMV, OUT, OUTP, OUTC, IOUT

■ 6.2.2 STEP mode of easy mode

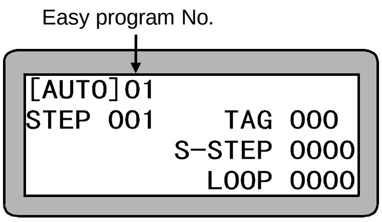
STEP mode is used to execute the program in the controller one step at a time.
Use this mode to confirm the easy program operation, etc., before executing the program in the AUTO mode.

STEP 1 Turn ON the power switch. After the initial screen displays, the following screen will display, so press F1 and HOME to carry out return to origin.



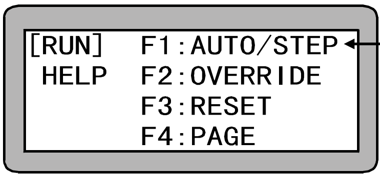
STEP 2 This is the easy mode's RUN mode.

Press SEARCH and then use the numeric keypad to enter the No. of the easy program to be executed.
Then, press ENT to display the corresponding program.
Then, press HELP .

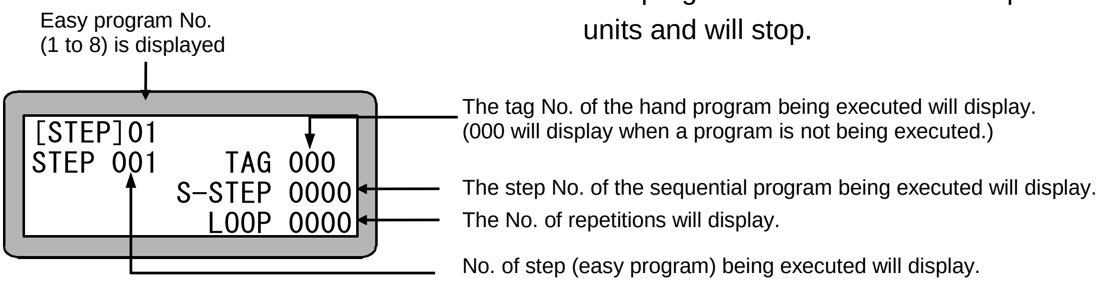


STEP 3 When this screen displays, press F1 .

The STEP mode will be entered.



STEP 4 Each time START is pressed, one step of the program will be executed.
The program will be executed sequentially in step units and will stop.



■ 6.2.3 Changing of speed during operation (override)

The whole speed of the movement command can be slowed down with the override function. This allows the program to be confirmed at a low speed.

STEP 1

```
[RUN]   F1:AUTO/STEP
 HELP   F2:OVERRIDE
        F3:RESET
        F4:PAGE
```

After the initial screen displays, press F1 to select the RUN mode, and press HELP . This screen will display, so press F2 and enter the override mode.

STEP 2

```
[OVER]
    OVERRIDE
            100%
```

Use the numeric keypad to enter the override value. When ENT is pressed, the speed will change to the set speed.
(Initial value: 100, Setting range: 1 to 100)
Press ESC to return to the RUN mode.

NOTE The override setting is valid only while the program is stopped.

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Chapter 7 Palletizing Mode

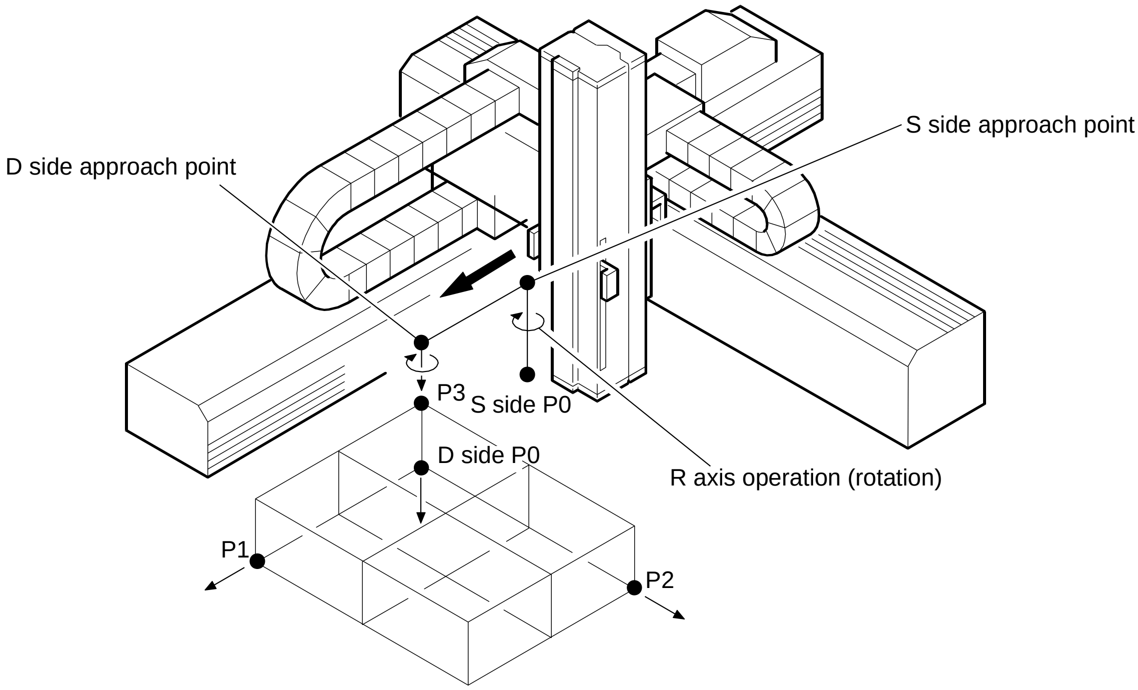
The palletizing is a mode exclusive for moving and loading. This program can be executed just by setting the parameters.
The following types of modes are prepared in the palletizing mode

- Movement from set position (P0) to matrix-type point on X, Y and Z axes direction (1 to M mode)
- Movement from matrix-type point in X, Y and Z axes direction to set position (M to 1 mode)
- Movement from matrix-type point in X, Y and Z axes direction to matrix-type point in X and Y axes direction (M to M mode)

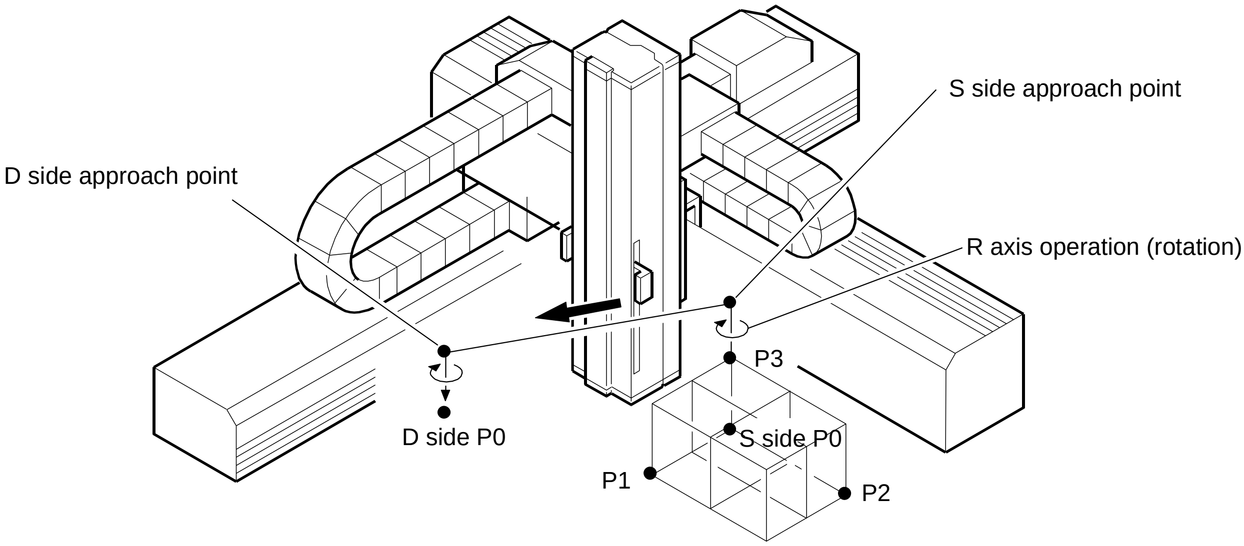
Palletizing operation is carried out in the P1 direction, P2 direction and P3 direction order.

The matrix work origin P0 does not always need to be near the origin. The matrix-shape P0 to P3 can be set at a random position, by that allowing the palletizing operation order to be changed. This unit's palletizing mode has the following procedures.

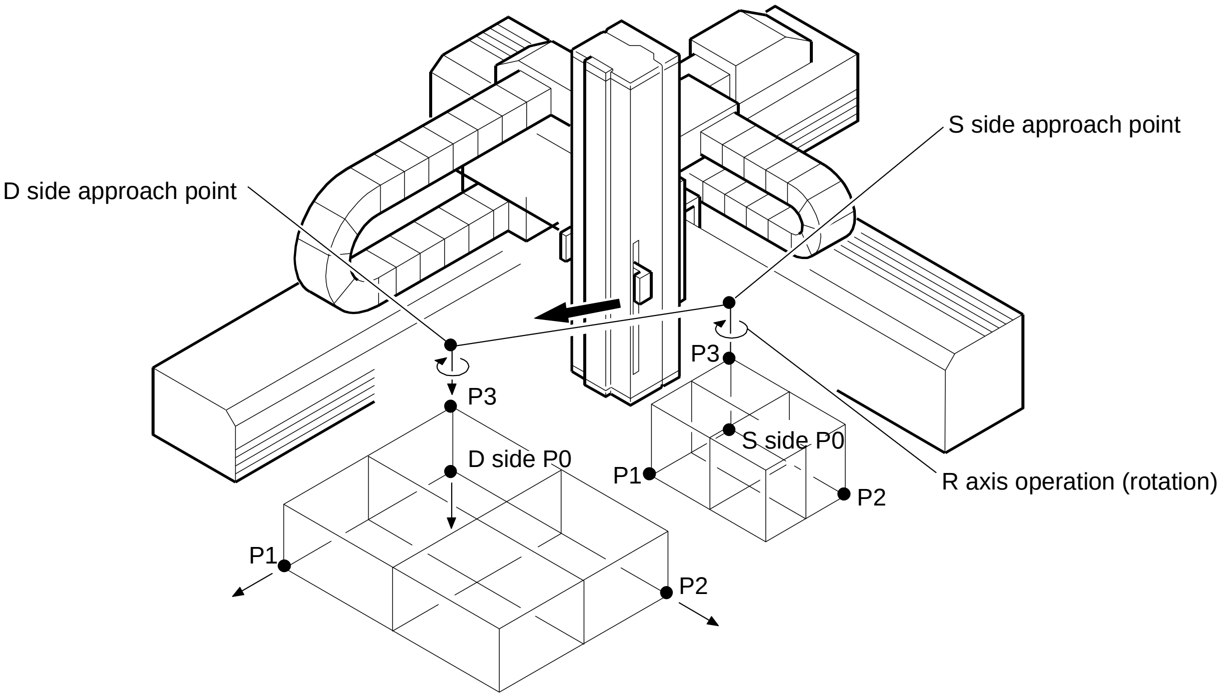
- The program position data can be input with remote teaching, direct teaching or MDI (manual data input).
- The approach point can be set.
- By writing in the tag No. of the start program and end program, a sequential program can be executed before and after the palletizing operation.
  Though the controller can execute plural sequential programs in the multitask mode, the sequential program which can be executed in the palletizing mode is limited at the task No. 1 alone.



● **1 to M mode**



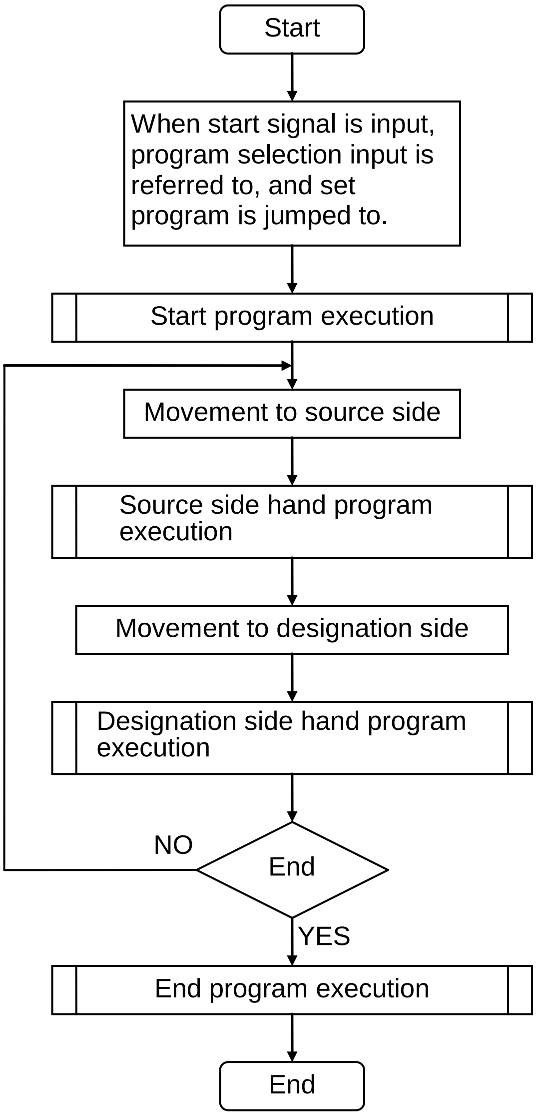
● **M to 1 mode**



● **M to M mode**

■ 7.1 Basic Flow Chart of Palletizing Mode

- The execution order of this palletizing mode is as follows. After the start signal is input, the start program tag No. is referred to. If the tag No. is "000", the start program is passed, and if it is other than "000", the program jumps to the step of the tag No. written in the sequential program. Then that subroutine is executed.
  After ending the palletizing operation, the end program tag No. is referred to, and the subroutine is executed and stopping in the same manner as the start program.



[Start program]

The tag No. of the sequential program to be executed before palletizing operation is indicated.

Tag No. 000 ················ Program is passed.
Tag No. other than "0" ··· The designated tag No. program is executed.

[Hand program]

- The hand program operates the chuck, etc., that is installed.
- Programs are made for both the source side (S side) and destination side (D side).

Tag No. 000 ················ Program is passed.
Tag No. other than "0" ··· The designated tag No. program is executed.

[End program]

The tag No. of the sequential program to be executed after palletizing operation is indicated.

Tag No. 000 ················ Program is passed.
Tag No. other than "0" ··· The designated tag No. program is executed.

NOTE

- The above three types of programs are written as subroutines in the appropriate steps of the sequential program.
- The tag No. must always be set at the first step of this subroutine, and "RET" written at the end.
- This subroutine tag No. is written in the palletizing program.

■ 7.2 PRGM Mode in Palletizing Mode

The PRGM (program) screen in the palletizing mode is configured of 16 screens. The screens are common in all modes, but the screens that do not need to be set for the 1 to M mode or M to 1 mode will not display. The positions indicated with an X in the following table are not displayed.

Screen No.	Details	M to M	1 to M	M to 1
01	Start tag program No.	○	○	○
02	S side matrix P0 coordinates	○	○	○
03	S side matrix P1 coordinates	○	×	○
04	S side matrix P2 coordinates	○	×	○
05	S side matrix P3 coordinates	○	×	○
06	No. of S side matrixes	○	×	○
07	S side approach coordinate	○	○	○
08	S side hand program tag No.	○	○	○
09	D side matrix P0 coordinates	○	○	○
10	D side matrix P1 coordinates	○	○	×
11	D side matrix P2 coordinates	○	○	×
12	D side matrix P3 coordinates	○	○	×
13	No. of D side matrixes	○	○	×
14	D side approach coordinate	○	○	○
15	D side hand program tag No.	○	○	○
16	End tag program No.	○	○	○

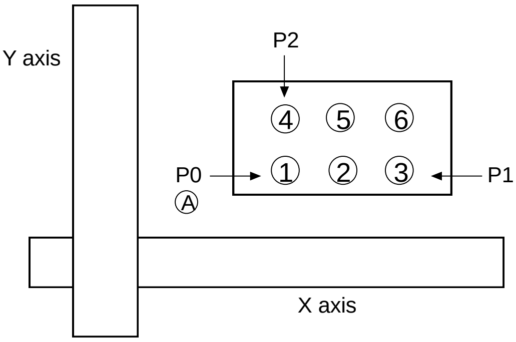
NOTE

- If any approach coordinate is set at 0, it will be regarded as no approach point (invalid).
- Inclined compensation is possible by setting each coordinate data P0 to P3. The matrix (pallet, etc.) does not need to be parallel to each axis, but each point coordinate of the matrix must not exceed the soft limit value.
- The operation pattern can be changed on the same matrix by changing the coordinate data P0, P1, P2 and P3 settings.

Operation example: 1 to M

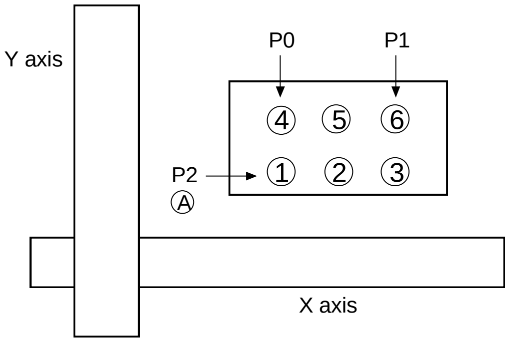
The place of 2-axis combination is shown below for example.

Set the ① coordinates in P0 on the D side.
Set the ③ coordinates in P1 on the D side.
Set the ④ coordinates in P2 on the D side.



[Operation pattern]
To execute the 1 to M program.
Ⓐ → ① → Ⓐ → ② → Ⓐ → ③
→ Ⓐ → ④ → Ⓐ → ⑤ → Ⓐ → ⑥

Set the ④ coordinates in P0 on the D side.
Set the ⑥ coordinates in P1 on the D side.
Set the ① coordinates in P2 on the D side.



[Operation pattern]
To execute the 1 to M program.
Ⓐ → ④ → Ⓐ → ⑤ → Ⓐ → ⑥
→ Ⓐ → ① → Ⓐ → ② → Ⓐ → ③

- In the palletizing program, counter Nos. 91 to 96 are used as the palletizing counter.

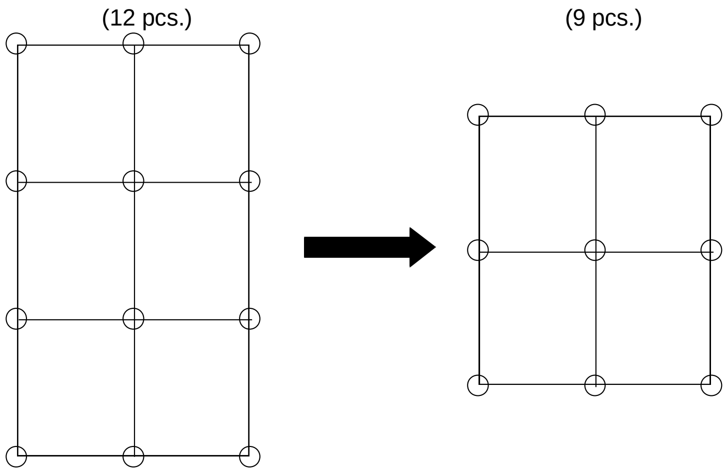
		Applicable counter
S side	Count in P0 to P1 direction	No. 91
	Count in P0 to P2 direction	No. 92
	Count in P0 to P3 direction	No. 93
D side	Count in P0 to P1 direction	No. 94
	Count in P0 to P2 direction	No. 95
	Count in P0 to P3 direction	No. 96

NOTE Counter Nos. 91 to 96 are counters exclusive for palletizing. Do not use these in programs other than the palletizing program.

- Refer to the relation of the counter details and movement position given in Section 4.1.7 (3) for details on the counter and movement position.
- The counter details are automatically processed (counted up, initialized) after the destination side hand program is executed.
- The S side and D side coordinate data P0 to P3 can be remotely taught or directly taught. However, direct teaching cannot be used for axes provided with brakes. (Refer to section 3.2.2.)

- If the No. of S sides and D sides differs in the M to M mode, the palletizing operation will be continuously repeated. (If the D side pallet is full, the first point of the D side pallet will be returned to.)
  This operation will be repeated until the work at the final point of the S side reaches the final point on the D side.

[Example]



(S side) **(D side)**

In the above example, after 36 works (least common multiple of 12 and 9) are palletized, the program will end.
(The palletizing operation is repeated three times on the S side pallet and four times on the D side pallet.)

■ 7.2.1 How to enter and leave the PRGM mode

The PRGM mode is used for programming. The method for entering and leaving the PRGM mode in the palletizing mode will be described in this section.

STEP 1

```
POWER  F1:T/P ON
  -ON  F2:
       F3:CHANG TASK
       F4:EXTENSION
```

Turn the power ON. When the display shown at the left appears after the initial screen press [F1] .
Then press [RUN PRGM] to enter the PRGM mode.

STEP 2

```
[PRGM]
0001
NOP
```

Press [SEQUN PALET] and enter the palletizing mode.

STEP 3

Palletizing program No.

```
[PRGM]01  START-TAG
01              000
M-1
```

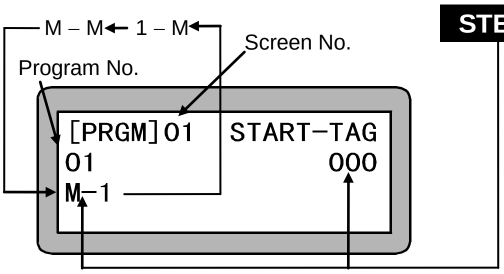
M to 1 mode   Screen No.   Start tag No.

The initial screen of the palletizing mode will display.
Press [NEXT] to display the next screen.
Press [SEQUN PALET] to leave the palletizing mode and return to the sequential mode.

■ 7.2.2 Editing palletizing mode program

The programming screen using the M to M mode is shown below.

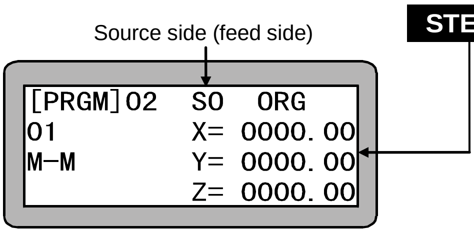
Enter the PRGM (program) mode and press [SEQUN/PALET] . (Refer to section 7.2.1.)



STEP 1

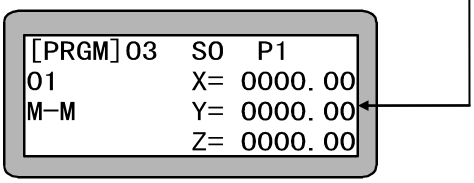
When [ALT] is pressed, the mode will alternate, so select the required mode and press [ENT] .
Next, use the numeric keypad to enter the tag No. and press [ENT] .
Press [NEXT] to display the next screen.

? If the start program is not used, set "0" at the start tag No.



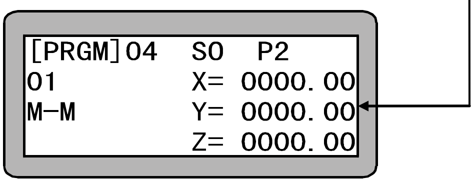
STEP 2

Use the numeric keypad to enter the S side P0 coordinates (absolute coordinates) and press [ENT] .
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.



STEP 3

Use the numeric keypad to enter the S side P1 coordinates (absolute coordinates) and press [ENT] .
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.



STEP 4

Use the numeric keypad to enter the S side P2 coordinates (absolute coordinates) and press [ENT] .
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.

? If the S side matrix is one row, set "0" for the X, Y and Z coordinates.

STEP 5

```
[PRGM]05   SO   P3
01          X=  0000.00
M-M         Y=  0000.00
            Z=  0000.00
```

Use the numeric keypad to enter the S side P3 coordinates (absolute coordinates) and press ENT .

Press NEXT to display the next screen and -NEXT to display the previous screen.

? If any S side matrix is the plane (1 step), set "0" for X, Y and Z coordinates.

STEP 6

```
[PRGM]06   SO  NUMBER
01              P1=0000
M-M             P2=0000
                P3=0000
```

Use the numeric keypad to enter the No. of pieces on the S side and then press ENT .

Press NEXT to display the next screen and -NEXT to display the previous screen.

? If the S side matrix is one row, set "0" at P2.
If any S side matrix is the plane (1 step), set "0" at P3.

STEP 7

```
         1  3                 2
[PRGM]07 SO APPROACH
01    a   S Z=  0000.00
M-M   V=00 POST
          a R=  0000.00
      4   5          6
```

1. Select a (absolute coordinate) or i (relative coordinate) for Z axis with ALT , and press ENT .
2. Input the coordinate of the approach point of Z axis, and press ENT .
3. Select S (axial speed) or T (linear speed) with ALT , and press ENT .
4. Input the speed No., and press ENT .
5. Select either POST (position) or PASS (pass point) with ALT , and press ENT .
6. Input the coordinate of the approach point of R axis, and press ENT . Display the next screen with NEXT . The last screen can be displayed with -NEXT .

NOTE

- On R axis, i (relative coordinate) can not be selected.
- S side approach point is set just above the place of S side matrix.
- If any approach point of Z axis is not input (case of Z=0000.00), the approach will not have any point (invalid).

STEP 8

```
[PRGM]08 SO HAND-TAG
01               000
M-M
        a R= 0000.00
```

Use the numeric keypad to enter the tag No. of the hand program on the S side and then press [ENT] .
Next, input the coordinate of R axis, and press [ENT] .
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.

? If any S side hand program is not used, set "0" at the hand tag No..

STEP 9

Destination side (receiving side)

```
[PRGM]09 DI ORG
01         X= 0000.00
M-M        Y= 0000.00
           Z= 0000.00
```

Use the numeric keypad to enter the D side P0 coordinates (absolute coordinates) and press [ENT] .
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.

STEP 10

```
[PRGM]10 DI P1
01         X= 0000.00
M-M        Y= 0000.00
           Z= 0000.00
```

Use the numeric keypad to enter the D side P1 coordinates (absolute coordinates) and press [ENT] .
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.

STEP 11

```
[PRGM]11 DI P2
01         X= 0000.00
M-M        Y= 0000.00
           Z= 0000.00
```

Use the numeric keypad to enter the D side P2 coordinates (absolute coordinates) and press [ENT] .
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.

? If the D side matrix is one row, set "0" for the X, Y, Z coordinates.

STEP 12

```
[PRGM]12 DI P3
01          X= 0000.00
M-M         Y= 0000.00
            Z= 0000.00
```

Use the numeric keypad to enter the D side P3 coordinates (absolute coordinates) and press [ENT] .

Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.

? If any D side matrix is the plane (1 step), set "0" for X, Y and Z coordinates.

STEP 13

```
[PRGM]13 DI NUMBER
01             P1=0000
M-M            P2=0000
               P3=0000
```

Use the numeric keypad to enter the No. of pieces on the D side and then press [ENT] .

Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.

? If the D side matrix is one row, set "0" at P2.
If any D side matrix is the plane (1 step), set "0" at P3.

STEP 14

```
[PRGM]14 DI APPROACH
01    a   S Z= 0000.00
M-M   V=00 POST
          a R= 0000.00
```

1. Select a (absolute coordinate) or i (relative coordinate) for Z axis with [ALT] , and press [ENT] .
2. Input the coordinate of the approach point of Z axis, and press [ENT] .
3. Select S (axial speed) or T (linear speed) with [ALT] , and press [ENT] .
4. Input the speed No., and press [ENT] .
5. Select either POST (position) or PASS (pass point) with [ALT] , and press [ENT] .
6. Input the coordinate of the approach point of R axis, and press [ENT] . Display the next screen with [NEXT] . The last screen can be displayed with [-NEXT] .

NOTE

- On R axis, i (relative coordinate) can not be selected.
- D side approach point is set just above the place of D side matrix.
- If any approach point of Z axis is not input (case of Z=0000.00), the approach will not have any point (invalid).

STEP 15

```
[PRGM]15 DI HAND-TAG
01              000
M-M
       a R= 0000.00
```

Use the numeric keypad to enter the tag No. of the hand program on the D side and then press ENT .

Next, input the coordinate of R axis, and press ENT .

Press NEXT to display the next screen and -NEXT to display the previous screen.

? If any D side hand program is not used, set "0" at the hand tag No..

STEP 16

```
[PRGM]16  END-TAG
01              000
M-M
```

Use the numeric keypad to enter the tag No. of the end program and then press ENT .

Press -NEXT to display the previous screen.

? If any end program is not used, set "0" at the end tag No..
If SEARCH is pressed during STEP 1 to 16, the program No. can be searched, and when pressed twice the screen No. can be searched (Input range: 1 to 16).
(Refer to sections 16.5 and 16.6.)

■ 7.2.3 Copy editing of palletizing mode

A random program in the palletizing mode can be copied to another palletizing program.
Enter the PRGM mode (sequential mode) and press HELP .

The following screen will display.(Refer to section 4.1.1.)

```
[PRGM] F1:EXTENSION
 HELP  F2:DIRECT OUT
       F3:EDIT
       F4:PARAMETER
```

STEP 1 Press F3 in this state.

```
[EDIT] F1:INS STEP
       F2:DEL STEP
       F3:CLEAR
       F4:PAGE
```

STEP 2 Press F4 .

Press ESC to return to the initial screen of the PRGM mode.

```
[EDIT] F1:STEP  COPY
       F2:PALET COPY
       F3:STEP   DEL
       F4:EXTENSION
```

STEP 3 Press F2 .

Press ESC to return to STEP 2.

```
[PALE-
 COPY] FROM[01]

       TO   [01]
```

STEP 4 Use the numeric keypad to enter the copy origin palletizing program No. and the copy destination palletizing program No.

Press ENT .

The program will be copied, and STEP 3 will be returned to. Press ESC to return to STEP 3.

■ 7.2.4 Clearing of palletizing mode programs

Enter the PRGM mode(sequential) and press HELP . (Refer to section 4.1.1.)
The following screen will display.

STEP 1

```
[PRGM] F1:EXTENSION
 HELP  F2:DIRECT OUT
       F3:EDIT
       F4:PARAMETER
```

Press F3 .

STEP 2

```
[EDIT] F1:INS STEP
       F2:DEL STEP
       F3:CLEAR
       F4:PAGE
```

Press F3 to enter the clear mode.
Press ESC to return to the initial screen of the PRGM mode.

[To clear only palletizing program]

STEP 3A

```
[CLR]  F1:SEQUN
       F2:PALET
       F3:SEQ/PALET
       F4:PAGE
```

Press F2 .
Press ESC to return to the previous screen.

STEP 4A

```
ALL PALET PROG CLEAR

   YES:ENT   NO:ESC
```

To clear the program, press ENT . To not clear the program, press ESC .
When the program is cleared, the palletizing program will be all initialized.

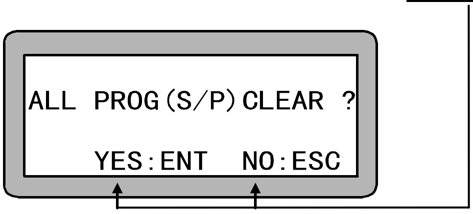
[To clear palletizing and sequential programs]

STEP 3B

```
[CLR]  F1:SEQUN
       F2:PALET
       F3:SEQ/PALET
       F4:PAGE
```

Press F3 .
Press ESC to return to the previous screen.

STEP 4B



To clear the program, press ENT . To not clear the program, press ESC .

When the program is cleared, both sequential program (task No. 1) and palletizing program applicable for palletizing will be all initialized.

■ 7.2.5 How to restart operation after turning power OFF in palletizing mode

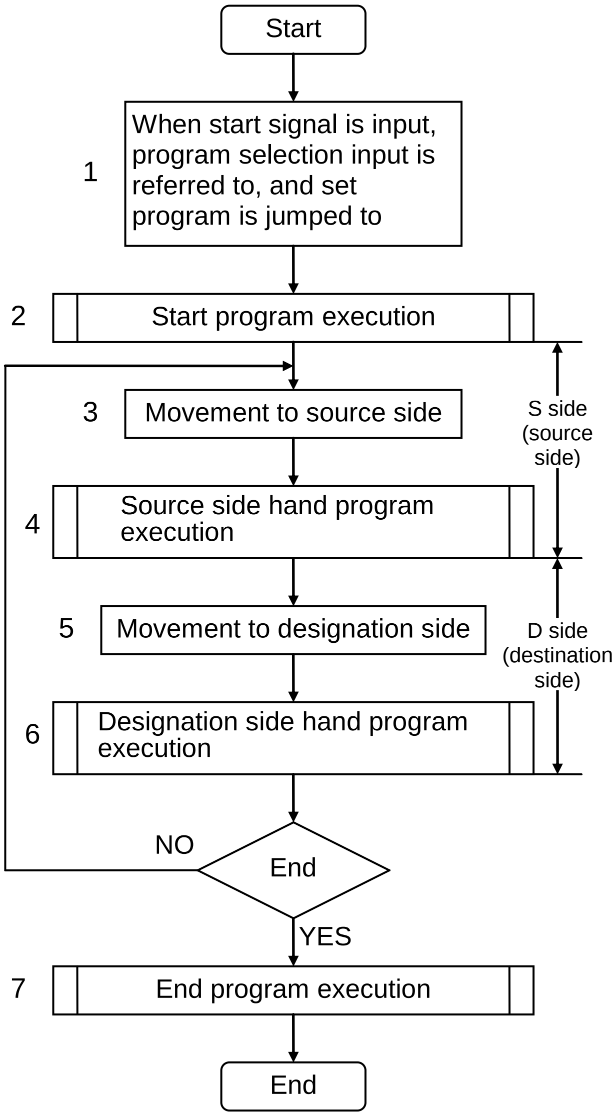
During palletizing mode, work can be restarted with the following conditions even if the power is turned OFF while the program execution is stopped.

Set the restart input bit in the mode setting. (Refer to section 14.2.2.)

After turning the power OFF, turn the restart input ON, and turn the power ON. After returning to the origin, the program will be restarted with the following conditions.

Palletizing flow chart

Process



Position where power is turned OFF	Restart method
At processes 1 to 2	Starts from process 1 (from beginning)
At processes 3 to 6	Starts from process 3 (continuing of operation)
At process 7	Starts from process 1 (It is interpreted that the process has been completed, so operation will start from process 1.)

NOTE

- If the operation is stopped between processes 3 and 6, the axis will stop at the S side or D side. However, if it is stopped at the D side (process 5 or 6), start again after returning one work to the S side pallet. When stopped at the S side (process 3 or 4), confirm that the work is at the S side pallet, and then start.

NOTE

- Resuming of operation is possible only when the power is turned OFF while the program execution is stopped (stopped in normal state). If the power is turned OFF during execution of a program (during operation), restarting will not be possible. A restarting not possible error will occur.

- The program execution halt means that output is OFF during operation of the system output, and the following cases are relevant.
  1) Stopping with the stop key or stop input.
  2) Stopping with the emergency stop button or emergency stop input.
  3) Stopping by executing STOP command.

■ 7.3 RUN mode of Palletizing Mode

This unit can be operated with the following methods.

- AUTO mode — Continuous operation / Single operation
- STEP mode

■ 7.3.1 AUTO mode of palletizing mode

(1) Continuous operation

Continuous operation will automatically execute the program in sequence. When running the program for the first time after creating it, verify the operation of the program using the STEP mode before starting continuous operation. (Refer to section 7.3.2.)

Operation using Teach Pendant

The operation procedures using the Teach Pendant are shown below.

STEP 1

```
POWER  F1:T/P ON
  -ON F2:
      F3:CHANG TASK
      F4:EXTENSION
```

Turn ON the power switch. After the initial screen displays, the following screen will display, so press F1 and HOME to carry out return to origin.

STEP 2

```
[AUTO]
0001
NOP
```

Press SEQUN/PALET in this state.

The palletizing mode will be entered.

STEP 3

```
[AUTO] P1=0000(0000)
01     P2=0000(0000)
M-M    P3=0000(0000)
     START  000 0000
```

Press SEARCH and then use the numeric keypad to enter the easy program No. to be executed.

Then press ENT to display the corresponding program.

STEP 4 The program execution will start when [START] is pressed.

```
[AUTO] P1=0000(0000)
01     P2=0000(0000)
M-M    P3=0000(0000)
    START  000 0000
```

The No. of pieces being executed will display.

The set No. of pieces will display.

The step No. (sequential program) being executed will display.
(0000 will display if no program is being executed.)

The tag No. of the hand program being executed will display.
(000 will display if no program is being executed.)

Display of execution state.
This will change according to the process.
START. (Start program)
↓
SOURCE. (Source side)
↓
DESTI. (Destination side)
↓
END (End program)

The execution program mode (M-1, 1-M, M-M) will display.

The program No. will display.
(1 to 16)

STEP 5 When the end program execution has completed, the display will change from END to START, and the initial state will be returned to.

```
[AUTO] P1=0000(0000)
01     P2=0000(0000)
M-M    P3=0000(0000)
    START  000 0000
```

Operation with external signals

Use the following procedure to carry out operation with the external signals.
The Teach Pendant must be disconnected from the controller or turned OFF to carry out operation with external signals. (Refer to section 18.1.)

1. Turn the palletizing input signal ON.
   The palletizing input signal must be set with the mode setting. (Refer to section 14.2.6.)
2. Turn the controller power ON.
3. If READY output is set with the mode setting, check the ON state and then input the input signal. (Refer to section 14.2.13.)
   If the READY signal is not set with the mode setting, the next input signal will be input approximately two seconds after the power is turned ON.
4. Turn the return to origin signal ON and return to the home.
5. Confirm that the return to origin signal is ON and then input the next signal.
6. Turn the start signal ON and start the program.
   The palletizing input signal state will be checked when the start signal is input. If the signal is ON, the palletizing mode program will be started.

NOTE The palletizing mode can be entered only from the sequential mode. Thus, the mode setting must be set to "Invalid" as shown in section 13.2.10. If a state other than "Invalid" is selected, the palletizing input signal will be ignored.

?

- If a stop signal is input during operation, the program will stop after ending the operation currently being executed.
- To restart the program after stopping with a stop signal or STOP command, input the start signal again. To start the program from the start again, input the reset signal and then input the start signal.
  Note that the restart mode setting and restart signal input state are related. (Refer to sections 10.2.6 and 14.2.2.)
- Refer to section 7.2.5 for how to restart operation after turning the power OFF.

(2) Single operation

During single operation, the program will stop once after the axis movement or output related operation is executed. To start or restart the program, input the start signal or press START .

Normally this is used to verify a program.

An example of single operation is given below.

1. Turn the single operation input signal ON.
2. The following operations are basically the same as continuous operation. (Refer to section 7.3.1 (1) Continuous operation.)
3. When the program has stopped operation, press START or input the start signal to sequentially start the program.

- The single operation mode input bit setting in the mode setting must be set. (Refer to section 14.2.1.)
- Operation with either the Teach Pendant or external signal is possible.
- The single operation input signal must retain the ON state during single operation.
  If the single operation input signal is turned OFF during single operation, the remaining program will be continuously operated.
- Even if the single operation input signal is input during continuous operation, it will be ignored, and continuous operation will continue.
- The palletizing input signal must be ON when the start signal is input.
- The following commands can be used for stopping after execution.

  MOV, MOVP, MVC, MVCP, MVB, MVE, HOME, MVM, RSMV, OUT, OUTP, OUTC, IOUT

■ 7.3.2 STEP mode of palletizing mode

The STEP mode is used to execute the program in the controller one step at a time using the teach pendant.
After creating a program, use this mode to verify the program, etc., before executing the program in the AUTO mode.

The operation procedures of the step mode are given below.

STEP 1

Turn ON the power switch. After the initial screen displays, the following screen will display, so press F1 and HOME to carry out return to origin.

```
POWER  F1:T/P ON
  -ON  F2:
       F3:CHANG TASK
       F4:EXTENSION
```

STEP 2 This is the sequential mode's RUN mode.
Press HELP .

```
[AUTO]
0001
NOP
```

STEP 3 When this screen displays, press F1 .

The STEP mode will be entered.
Press the SEQUN/PALET in this state.

```
[RUN]   F1:AUTO/STEP
 HELP   F2:OVERRIDE
        F3:RESET
        F4:PAGE
```

STEP 4 Press SEARCH and then use the numeric keypad to enter the program No. to be executed.
Then press ENT to display the corresponding program.

```
[STEP]  P1=0000(0000)
01      P2=0000(0000)
M-M     P3=0000(0000)
       START   000 0000
```

STEP 5 Press START to start the program.

```
[STEP]  P1=0001(0003)
01      P2=0001(0003)
M-M     P3=0001(0002)
       SOURCE  000 0000
```

STEP 6 The next step will display, and the robot will stop.
Press START to execute the next step.
The program will be executed sequentially in step units and will stop.

```
[STEP]  P1=0002(0003)
01      P2=0001(0003)
M-M     P3=0001(0002)
       SOURCE  000 0000
```

NOTE During the operation with the STEP mode, the input signal and output signal timings will differ compared to operation in the AUTO mode.

■ 7.3.3 Changing of speed during operation (override)

The whole speed of the movement command can be slowed down with the override function. This allows the program to be confirmed at a low speed.

STEP 1

```
[RUN]   F1:AUTO/STEP
 HELP   F2:OVERRIDE
        F3:RESET
        F4:PAGE
```

After the initial screen displays, enter the RUN mode and press HELP .
This screen will display, so press F2 and enter the override mode.

STEP 2

```
[OVER]
    OVERRIDE
            100%
```

Use the numeric keypad to enter the override value.
When ENT is pressed the speed will change to the set speed.
(Initial value: 100, Setting range: 1 to 100)
Press ESC to return to the RUN mode.

NOTE The override setting is valid only while the program is stopped.

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Chapter 8 External Point Designation Mode

■ 8.1 Explanation of External Point Designation Mode

The external point designation mode does not use the controller's command language and instead, the positioning movement takes place according to the signals input from the input/output connector. The signals input from the input/output connector are as follow.

	Number of tables	Input port
Coordinate table	10 bits (999 tables)	Station No. 0 General-purpose input/output ports 01-1 to 02-2
Speed table	Max. 4 bits (10 tables)	Designation is possible. *1
Acceleration/deceleration table	5 bits (20 tables)	Station No. 0 General-purpose input/output ports 02-3 to 02-7
Coordinate system	1 bit (Absolute coordinates/ relative coordinates)	Designation is possible. *2

*1 It is designated with "Designation of program selection input bit" of Mode Setting. (Refer to section 14.2.5.)

*2 It is designated with "Designation of palletizing input bit" of Mode Setting. (Refer to section 14.2.6.)

- To use the mode, select "external point designation mode" during selection of "invalid/easy/ point" of Mode Setting. (Refer to section 14.2.10.)

(1) Coordinate (point) table designation method

The coordinate (999 points) table is designated with 10 bits of the general-purpose input port of station No. 0 (master unit), 01-1 through 01-8, 02-1 and 02-2.

Table to be designated	General-purpose input port No. of station No. 0									
	02-2	02-1	01-8	01-7	01-6	01-5	01-4	01-3	01-2	01-1
	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
001	0	0	0	0	0	0	0	0	0	0
002	0	0	0	0	0	0	0	0	0	1
003	0	0	0	0	0	0	0	0	1	0
:	:	:	:	:	:	:	:	:	:	:
008	0	0	0	0	0	0	0	1	1	1
:	:	:	:	:	:	:	:	:	:	:
016	0	0	0	0	0	0	1	1	1	1
:	:	:	:	:	:	:	:	:	:	:
256	0	0	1	1	1	1	1	1	1	1
:	:	:	:	:	:	:	:	:	:	:
999	1	1	1	1	1	0	0	1	1	0

1: ON 0: OFF

Refer to section 14.6.1 for details on how to set the coordinate (point) table.

- If 1000 or more point tables are designated, an error will occur.
- The relation of the point table No. and input port is as follows.
  When the input port values are arranged in the order of 2^9, 2^8, ... 2^1, 2^0 and interpreted as binaries, the number achieved by adding 1 to that value is the table No.

<Example>

For table No. 16

$$16 = (2^9 \times 0 + 2^8 \times 0 + 2^7 \times 0 + 2^6 \times 0 + 2^5 \times 0 + 2^4 \times 0 + 2^3 \times 1 + 2^2 \times 1 + 2^1 \times 1 + 2^0 \times 1) + 1$$
$$= (8 + 4 + 2 + 1) + 1$$

(2) Speed table designation method

The speed table is designated with the general-purpose input port with "Designation of program selection input bit" of Mode Setting. (Refer to section 14.2.5.)

Though 10 tables of max. 4 bits can be selected, the number of the selected bits varies depending on the assigned bit position. (The continuous bits in the designated port become valid.)

<Example> When the head bit is designated at the port 02-7 of the expansion input/output unit of the slave unit, it is designated at 2 bits of 02-7 and 02-8.
When the head bit is designated at the port 03-1 of the station No. 0 (master unit), it becomes as shown in the following table.

Table to be designated	General-purpose input port No.			
	03-4	03-3	03-2	03-1
	2^3	2^2	2^1	2^0
01	0	0	0	1
02	0	0	1	0
03	0	0	1	1
04	0	1	0	0
05	0	1	0	1
06	0	1	1	0
07	0	1	1	1
08	1	0	0	0
09	1	0	0	1
10	1	0	1	0

1: ON 0: OFF

NOTE In the following cases, the default value (01) is designated on the speed table.

① The general-purpose input port is not assigned with "Designation of program selection input bit" of Mode Setting, or even if it is assigned, the designated bits are all 0 (off).

② The table 11 or more is designated.

? For the speed table setting method, refer to section 14.6.2.

(3) Acceleration/deceleration table designation method

The acceleration/deceleration table (20 tables) is designated at 5 bits of the general-purpose input ports 02-3 through 02-7 of the station No.0 (master unit).

Table to be designated	General-purpose input port No. of the station No. 0				
	02-7	02-6	02-5	02-4	02-3
	2^4	2^3	2^2	2^1	2^0
01	0	0	0	0	1
02	0	0	0	1	0
03	0	0	0	1	1
04	0	0	1	0	0
05	0	0	1	0	1
06	0	0	1	1	0
07	0	0	1	1	1
08	0	1	0	0	0
09	0	1	0	0	1
10	0	1	0	1	0

Table to be designated	General-purpose input port No. of the station No. 0				
	02-7	02-6	02-5	02-4	02-3
	2^4	2^3	2^2	2^1	2^0
11	0	1	0	1	1
12	0	1	1	0	0
13	0	1	1	0	1
14	0	1	1	1	0
15	0	1	1	1	1
16	1	0	0	0	0
17	1	0	0	0	1
18	1	0	0	1	0
19	1	0	0	1	1
20	1	0	1	0	0

1: ON 0: OFF

NOTE In the following cases, the default value (05) is designated on the acceleration/ deceleration table.

① 5 bits are all 0 (off).
② 21 or more tables are designated.

For the acceleration/deceleration setting method, refer to section 14.6.3.

(4) Coordinate designating method

The general-purpose input port is designated with "Designation of palletizing input bit" of Mode Setting. (Refer to section 14.2.6.)

Designation bit ON : Relative coordinate system
OFF : Absolute coordinate system

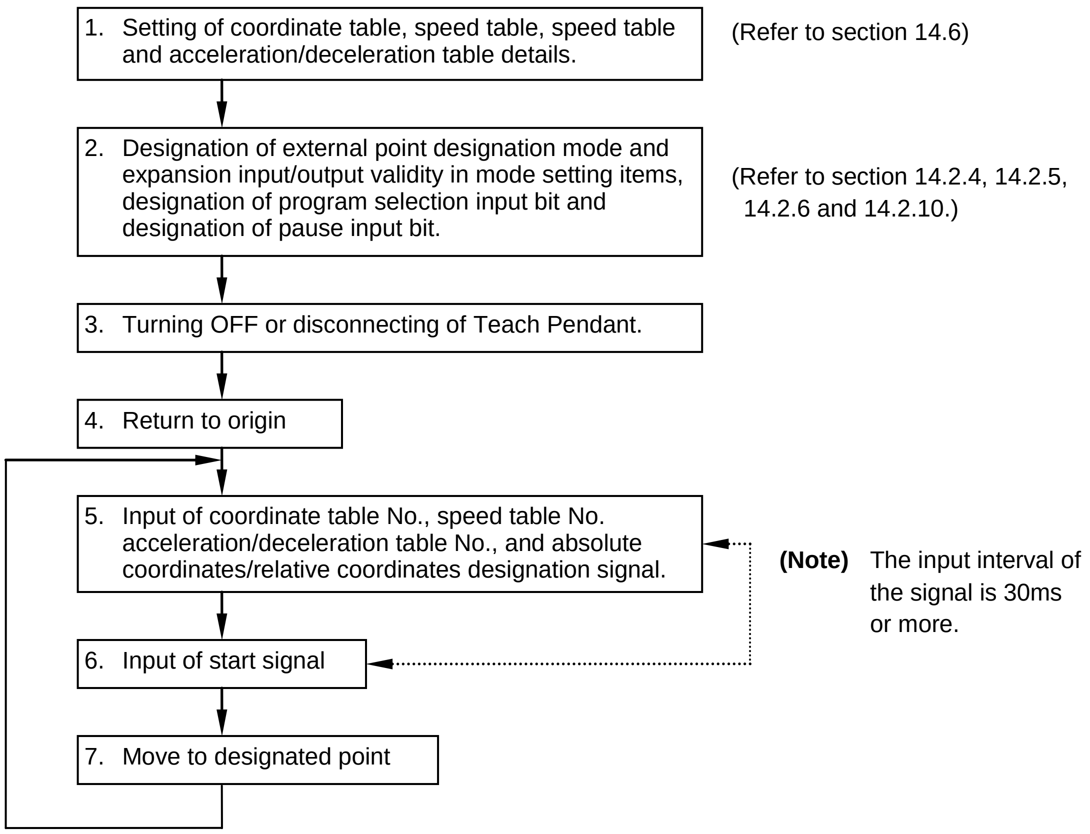
If the general-purpose input port is not assigned with "Designation of palletizing input bit", the absolute coordinate system will be selected.

■ 8.2 Operation Method of External Point Designation Mode

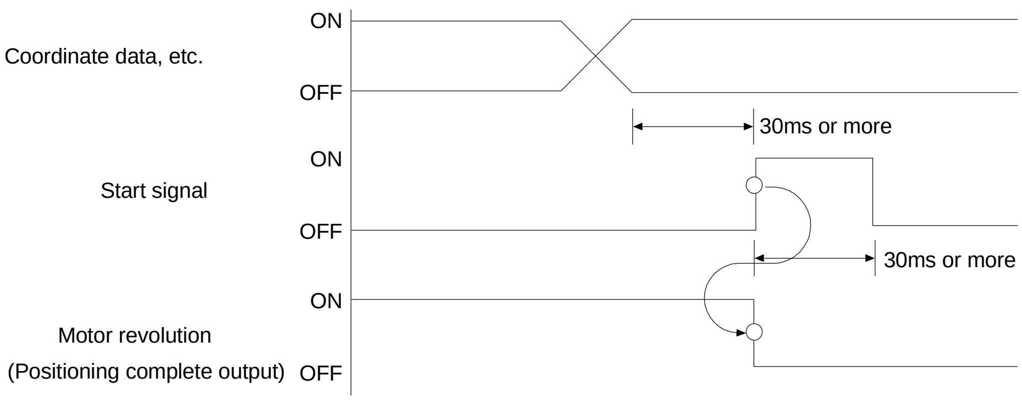
In the external point designation mode, operation can be carried out with system inputs and general-purpose inputs or with the Teach Pendant.

■ 8.2.1 Execution with input/output

An example of the settings and operation procedures in the external point designation mode is shown below.

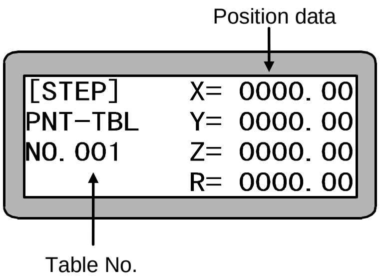


NOTE The start input must be turned ON 30 ms or longer after the input signal is designated.



■ 8.2.2 Operation with Teach Pendant

In this mode, each point can be moved to using the Teach Pendant.
When the Teach Pendant is turned ON in the external point designation mode, the following screen will display.



STEP 1 Display the coordinate table to be moved using NEXT , -NEXT ,or SEARCH .
Press START .

NOTE The following restrictions will apply when executing operation with the Teach Pendant.

Speed designation	: Fixed to table No. 1
Acceleration/deceleration designation	: Fixed to table No. 5
Coordinate system designation	: Fixed to absolute coordinates

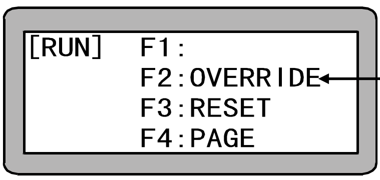
Other operations

The following operations can be done in the external point designation mode.

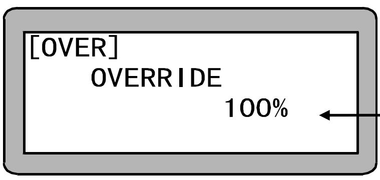
- Parameter setting
- Override setting
- RESET operations

■ 8.3 Changing of Speed During Operation (Override)

The entire execution speed can be delayed by using the override function. This allows the robot operation to be confirmed at a low speed.



STEP 1 After the initial screen displays, enter the RUN mode and press HELP .
This screen will display, so press F2 and enter the override mode.



STEP 2 Use the numeric keypad to enter the override value. When ENT is pressed, the speed will change to the set speed.

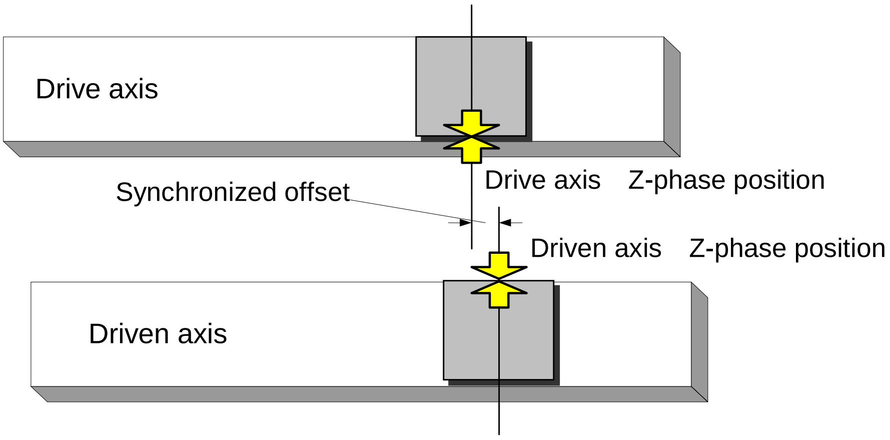
Press ESC to return to the RUN mode.
(Initial value: 100, Setting range: 1 to 100)

NOTE The override setting is valid only while the program is stopped.

Chapter 9 Synchronized Axes Control Function

■ 9.1 What is the Synchronized Axes Control Function?

This function enables two axes installed in parallel to be operated in synchronization.
The axis performing the main operation is called the "drive axis", and the axis performing the following-up operation is called the "driven axis".



The main functions of the synchronized axes control function are described below.

(1) Synchronized control
The two axes (drive axis and driven axis) designated by the parameters are operated in synchronization.

(2) Synchronized axes origin search function
The installation error amount (synchronized offset) of the drive axis and driven axis that occurs during installation is measured automatically.

(3) Synchronized axes return to origin function
The "synchronized offset" that was measured by the synchronized axes origin search is used to set the origin of the drive axis and driven axis.

■ 9.2 Conditions and Limitations

■ 9.2.1 Controller

The slave units are compatible with CA20-S10 (S40) only. (The BA amplifier is not supported.)

■ 9.2.2 Axis type

Use the same "Axis Format" and "Axis Length" for the drive axis and driven axis.
The synchronized axes control function cannot be used with the following axis types.

- Axis types with different formats
  (Axes with different leads, and combinations with a reversal axis and straight axis cannot be used together.)
- Axes where the return to origin system is "1" (mainly belt driven-type axes) and axes where the return to origin system is "2" (mainly BB05D, BB07D, and BBT axes)
- Axes driven by a BS amplifier

NOTE If the driven axis and drive axis are not connected, the driven axis can suddenly operate as soon as a servo lock is applied from a servo free state, and a collision can result.

■ 9.2.3 Programming

MVM cannot be used.
→ The error message "ER62: Not Executable" occurs during execution of a command.
MVC and MVCP cannot be used.
→ The error message "ER62: Not Executable" occurs during execution of a command.
Palletizing operation cannot be used.
→ The error message "ER62: Not Executable" occurs before axis movement.

■ 9.3 Preparation

■ 9.3.1 Installation

(1) Preliminary installation
Perform a preliminary installation of the drive axis and driven axis. When installing, leave the Coban bolts in a temporarily tightened state for holding the axes in place.

(2) Origin positioning
Return the driven axis and drive axis separately to the origin, and specify the origin position. To make the origin position easier to find, mark with a pencil or other writing instrument.

NOTE
- At this point, leave the synchronized axes setting parameter K26 unset (=0, 0, 0, 0).

(3) Axis position adjustment
Adjust the axis position so that the drive axis and driven axis are both parallel and at the origin position.

(4) Synchronized axes connection
Connect the drive axis and driven axis.

NOTE
- If the driven axis and drive axis are not connected, the driven axis can suddenly operate as soon as a servo lock is applied from a servo free state, and a collision can result.

(5) Parallelism confirmation
Move the synchronized axes (drive axis and driven axis) by hand to check that the axis moves smoothly. If it does not move smoothly, readjust the parallelism of the synchronized axes.

(6) Full installation
Fully tighten the Coban bolts for securing the synchronized axes (drive axis and driven axis).

<This completes the installation.>

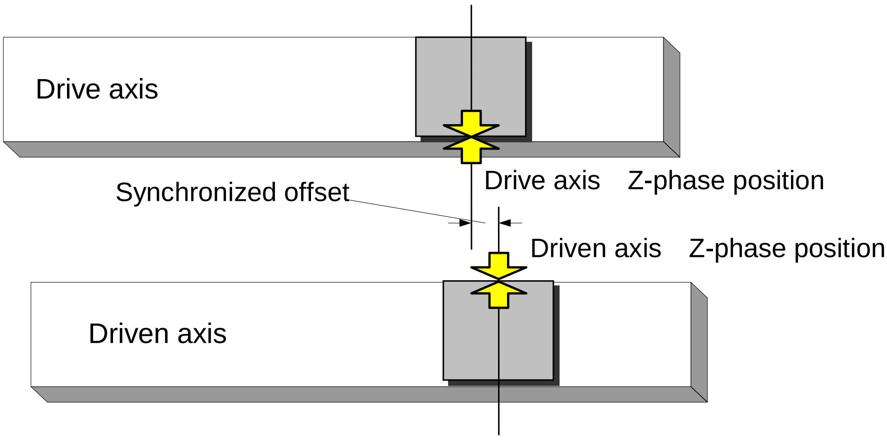
■ 9.3.2 Adjustment

(1) Parameter setting

Set the parameters that will be used in the synchronized axes control function. (For details on the parameter setting procedure, refer to Chapter 14, "Parameter Setting".)

- K26: Synchronized axes setting
  This sets the target axes for synchronized axes control. (Refer to section 14.4.26.)

- P17: Synchronized offset
  This specifies the installation error amount of the drive axis and driven axis in millimeters (mm).
  This parameter is set automatically when the synchronized axes origin search is executed.



Although fine adjustment of this parameter is also possible using the procedure described in "14.3.17 Synchronized offset", be sure to perform the synchronized axes origin search before performing adjustment.

- P18: Synchronized error allowable value
  The upper limit of the position error for the drive axis and driven axis that occurs during synchronized operation is specified in millimeter (mm) units. (Refer to section 14.3.18.)

(2) Synchronized axes origin search

Execute the synchronized axes origin search, and measure the installation error of the drive axis and driven axis. For the execution method of the synchronized axes origin search, refer to "9.4 Synchronized Axes Origin Search Function".

(3) Return to origin

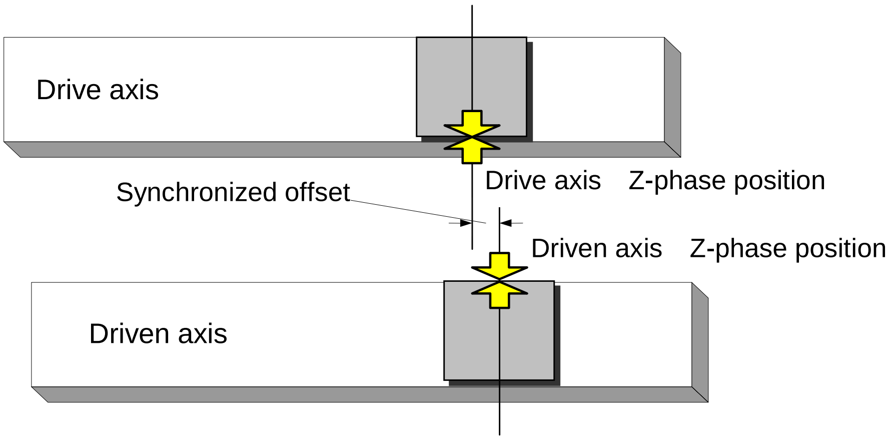
Perform the return to origin operation.

(4) Operation check

Use the jog operation to check that the synchronized axes are operating smoothly.

■ 9.4 Synchronized Axes Origin Search Function

The synchronized axes origin search function measures the positional error (synchronized offset) that occurs when installing the synchronized axes (drive axis and driven axis).



NOTE

- Before performing the synchronized axes origin search, be sure to perform the operation in "9.3 Preparation". Failure to perform the proper preparation can cause the robot to collide with the mechanical stopper.
- The synchronized axes origin search does not need to be performed each time. Execute it only when re-measuring the installation position error (synchronized offset) of the synchronized axes (drive axis and driven axis).
- Be sure to always perform the return to origin operation after executing the synchronized axes origin search.
  (If a program is run without performing the return to origin, the error message "ER61: Return to Origin Incomplete" occurs.)
- If the synchronized offset amount that was measured by the synchronized axes origin search exceeds one-quarter turn of the motor (for instance, exceeds 5 mm for a lead of 20 mm), the error message "ER67: Synchronized Axes Origin Search Error" occurs. Refer to "9.3 Preparation" and recheck the axis installation status (installation error amount).

■ 9.4.1 Operating procedure

The screen below is displayed in RUN mode.

```
[RUN] F1:MONITOR
      F2:OPTION
      F3:T/P ON
      F4:T/P OFF
```

STEP 1

Press the F4 PAGE key in the main screen of RUN mode to display the screen shown on the left.

Press the F2 OPTION key to display "OPT" (Option Function Selection screen).

```
[OPT] F1:SYNC.UTL.
      F2:FIELD BUS
      F3:ERR.HISTORY
      F4:
```

STEP 2

Press "F1:SYNC.UTL" to change to the Synchronized Axes Control Function Utility screen.

```
[SYNC  F1:SRCH.ORG.
 -UTL] F2:
       F3:
       F4:
```

STEP 3

Press "F1:SRCH.ORG." to change to the Synchronized Axes Origin Search screen.

The synchronized axes origin search operation is started using the operation below.

```
[SRCH-ORG]F1:A1-SRCH
          F2:*******
          F3:A3-SRCH
          F4:*******
```

STEP 4

F1 A1_SRCH:

Origin search for the first axis (drive axis) and second axis (driven axis)

F2 A2_SRCH:

Origin search for the second axis (drive axis) and third axis (driven axis)

F3 A3_SRCH:

Origin search for the third axis (drive axis) and fourth axis (driven axis)

F4 *****: Disabled

("*****" is displayed for the driven axis.)

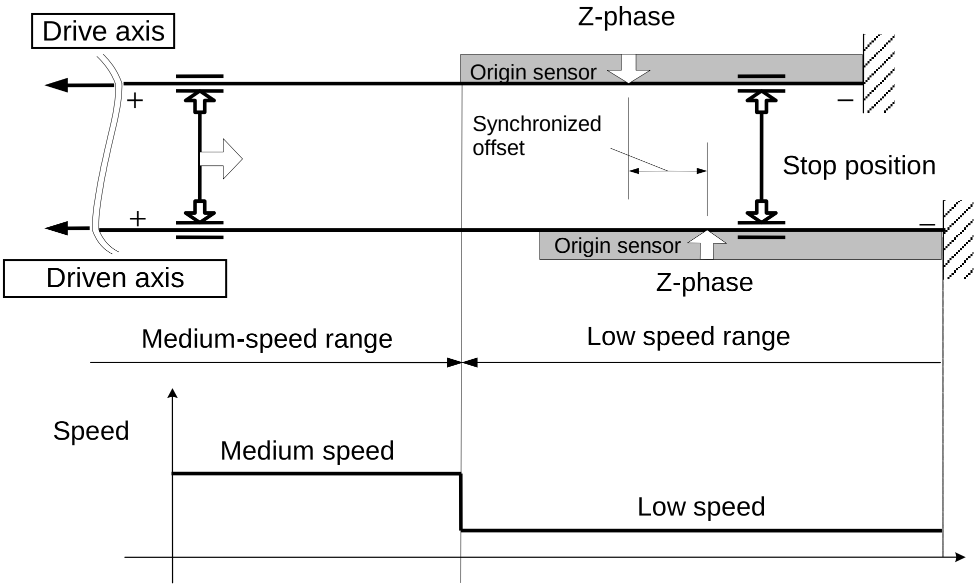
```
 SEARCH ORIGIN !!
```

STEP 5

During the synchronized axes origin search, the message shown on the left is displayed on the screen. When both axes detect the Z-phase position, the robot is stopped, and the synchronized axes origin search is completed. After completion, the screen returns to the Synchronized Axes Origin Search screen.

■ 9.4.2 Synchronized axes origin search operation sequence

When the synchronized axes origin search operation is started, the synchronized axes operate based on the sequence below.



(1) Medium-speed range
Operation moves to "Negative direction" at "Medium speed".

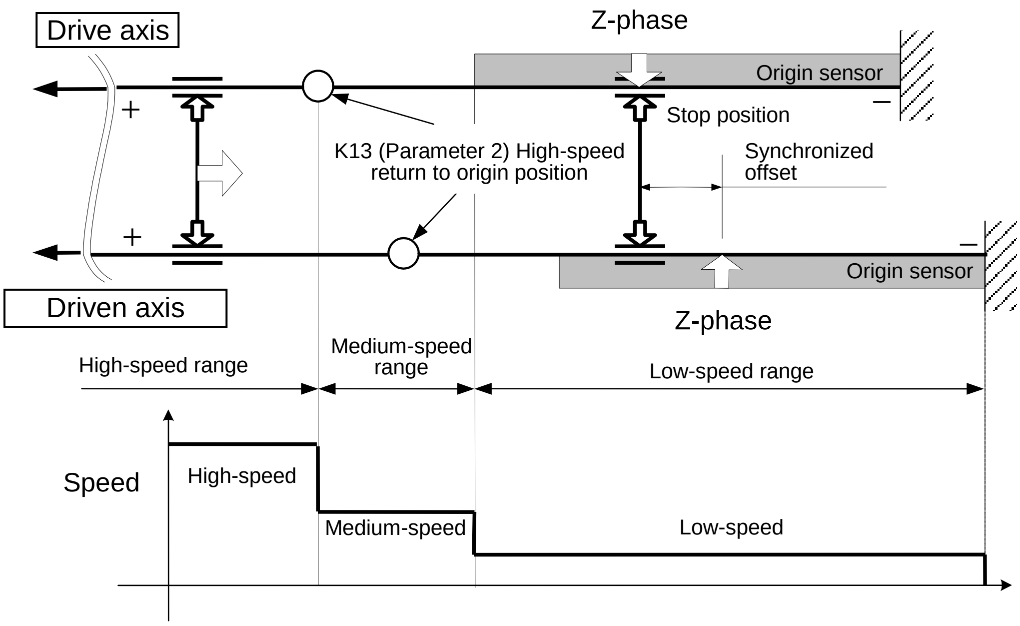
(2) Low-speed range
Operation moves to "Negative direction" at "Low speed".
However, note that if a synchronized axes origin search is started from the low-speed range, operation moves to "Positive direction" at "Low speed" until the origin sensors for both the drive and driven axes are set to OFF, and then operation moves to "Negative direction" at "Low speed".

(3) Origin search end
Operation stops after detection of the "Z-phase" for both the drive axis and driven axis.

■ 9.4.3 Synchronized axes return to origin sequence

NOTE

- Be aware that the return to origin operation sequence for axes that were set as synchronized axes is different from the normal axis operation sequence.
- If the return to origin operation is performed without performing the synchronized axes origin search, the error message "ER64: Synchronized Axes Origin Search Incomplete Error" occurs. In installation and adjustment work, be sure to always perform the synchronized axes origin search before performing the return to origin operation.



(1) High-speed range
Operation moves to "Negative direction" at "High speed". However, note that if the return to origin operation was not performed at all after the synchronized axes origin search, operation moves to "Negative direction" at "Medium speed".
* During synchronized axes operation, the high-speed origin position uses the value set for the drive axis.

(2) Medium-speed range
Operation moves to "Negative direction" at "Medium speed".

(3) Low-speed range
Operation moves to "Negative direction" at "Low speed". However, note that if the return to origin operation is started from the low-speed range, operation moves to "Positive direction" at "Low speed" until the origin sensors for both the drive and driven axes are set to OFF, and then operation moves to "Negative direction" at "Low speed".

(4) Origin search end
Operation stops after detection of the "Z-phase" for both the drive axis and driven axes, and then both axes move and stop at the Z-phase position of the drive axis.

Chapter 10 Connection with External Devices

■ 10.1 Input/Output Signal

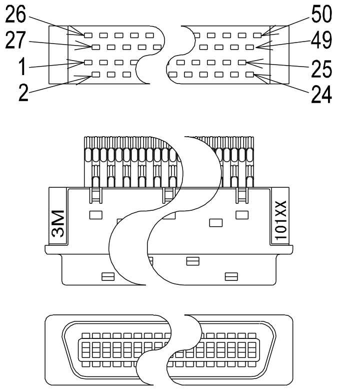
The input/output connector is configured of the system input/output and general-purpose input/output. The system input/output is basically connected to the programmable controller, etc., and is used to control the robot from an external source. The general-purpose input/output is connected to the hand sensor or proximity sensor, etc., and is mainly used to control the external peripheral devices.

■ 10.1.1 Master unit input/output connector signal names and pin numbers

No.	Signal name	No.	Signal name
1	+COM1 (Note 1)	26	General-purpose input port 1-1
2	General-purpose output port 1-1	27	General-purpose input port 1-2
3	General-purpose output port 1-2	28	General-purpose input port 1-3
4	General-purpose output port 1-3	29	General-purpose input port 1-4
5	General-purpose output port 1-4	30	General-purpose input port 1-5
6	General-purpose output port 1-5	31	General-purpose input port 1-6
7	General-purpose output port 1-6	32	General-purpose input port 1-7
8	General-purpose output port 1-7	33	General-purpose input port 1-8
9	General-purpose output port 1-8	34	General-purpose input port 2-1
10	General-purpose output port 2-1	35	General-purpose input port 2-2
11	General-purpose output port 2-2	36	General-purpose input port 2-3
12	General-purpose output port 2-3	37	General-purpose input port 2-4
13	General-purpose output port 2-4	38	General-purpose input port 2-5
14	–COM1 (Note 1)	39	General-purpose input port 2-6
15	–COM1 (Note 1)	40	General-purpose input port 2-7
16	+COM2 (Note 1)	41	General-purpose input port 2-8
17	Running output	42	General-purpose input port 3-1
18	Error output	43	General-purpose input port 3-2
19	Positioning complete output	44	General-purpose input port 3-3
20	Return to origin complete output	45	General-purpose input port 3-4
21	Return to origin input	46	Emergency stop input
22	Start input	47	Emergency stop input
23	Stop input	48	Emergency stop output (N.O)
24	Reset input	49	Emergency stop output (COM)
25	–COM2 (Note 1)	50	Emergency stop output (N.C)

NOTE

(Note 1) +COM1 and +COM2, and –COM1 and –COM2 are not connected internally.



Use the enclosed connector.

- Cable side connector type
  Plug 10150-3000VE (Sumitomo 3M)
  Shell kit 10350-52F0-008 (Sumitomo 3M)

- Panel side connector type
  Receptacle 10250-52A2JL (Sumitomo 3M)

Applicable wire size: AWG24 (0.22 mm^2)

■ 10.1.2 Slave unit input/output connector signal names and pin numbers

No.	Signal name	No.	Signal name
1	+COM1 (Note 1)	19	+COM3 (Note 1)
2	General-purpose output port 1-1 (Note 3)	20	General-purpose input port 1-1
3	General-purpose output port 1-2 (Note 3)	21	General-purpose input port 1-2
4	General-purpose output port 1-3 (Note 3)	22	General-purpose input port 1-3
5	General-purpose output port 1-4 (Note 3)	23	General-purpose input port 1-4
6	–COM1 (Note 2)	24	N.C
7	Emergency stop output (N.O)	25	N.C
8	Emergency stop output (COM)	26	N.C
9	Emergency stop output (N.C)	27	+COM4 (Note 1)
10	N.C	28	General-purpose input port 1-5
11	General-purpose output port 1-5 (Note 4)	29	General-purpose input port 1-6
12	General-purpose output port 1-6 (Note 4)	30	General-purpose input port 1-7
13	General-purpose output port 1-7 (Note 4)	31	General-purpose input port 1-8
14	General-purpose output port 1-8 (Note 4)	32	N.C
15	N.C	33	N.C
16	N.C	34	N.C
17	–COM2 (Note 2)	35	N.C
18	N.C	36	N.C

N.C: No Connection

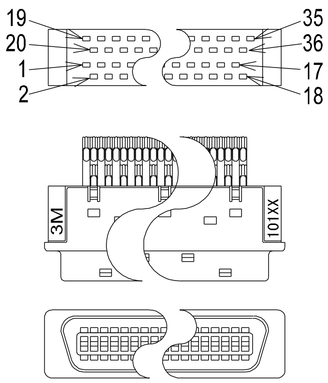
NOTE

(Note 1) +COM1, + COM3 and + COM4 are not connected internally.

(Note 2) –COM1 and –COM2 are not connected internally.

(Note 3) The rated current of general-purpose outputs 1-1 to 1-4 is 300 mA or less/point (open collector output)

(Note 4) The rated current of general-purpose outputs 1-5 to 1-8 is 20 mA or less/point (open collector output)



Use the enclosed connector.

- Cable side connector type
  Plug 10136-3000VE (Sumitomo 3M)
  Shell kit 10336-52F0-008 (Sumitomo 3M)

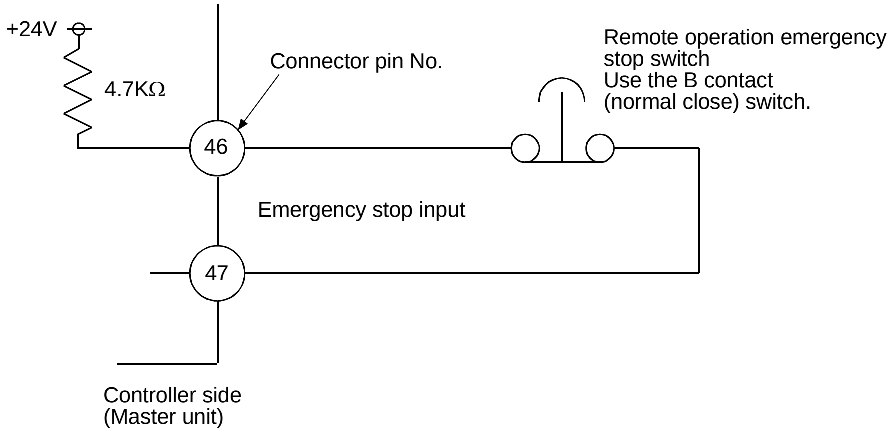
- Panel side connector type
  Receptacle 10236-52A2JL (Sumitomo 3M)

Applicable wire size: AWG24 (0.22 mm^2)

(1) Emergency stop input/output (Master unit input/out connector)

Before using this unit, connect the emergency stop circuit to the input/output connector of the master unit. Unless the circuit is connected, the controller will be in the emergency stop state.

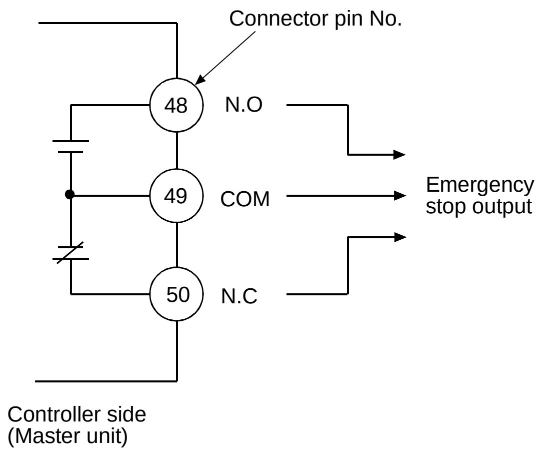
- Emergency stop input



CAUTION If the signal is turned OFF, the robot will enter the emergency stop. Keep in mind that the stopping distance will be different depending on the load size, speed, inertia and so on.

- Emergency stop output

  An output terminal is provided to notify the external source that the controller has entered the emergency stop state when this unit enters the emergency stop state. This is used to make a display to an external source or to activate an interlock with other devices, etc.



Output type: Relay contact output
(OMRON G6E-134P or equivalent)

	N.O	N.C
During emergency stop	Closed	Opened
Normal state	Opened	Closed

NOTE Use the emergency stop output within a voltage range of 5 to 30 V and current range of 10mA to 300mA.
The emergency stop output is also provided on the slave unit.
On the slave unit, N.O (pin 7), COM (pin 8) and N.C (pin 9) are used.
If power is not supplied to the controller, output is the same as the normal state regardless of the emergency stop state.

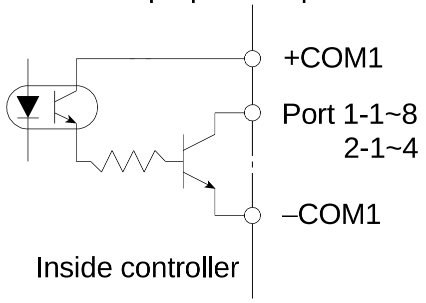
(2) General-purpose input/output

Master unit

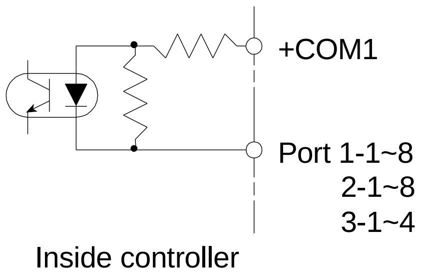
Master unit I/O connector pin assignment

No.	Signal name	No.	Signal name
1	+COM1 (Common for general-purpose input/output)	26	General-purpose input port 1-1
2	General-purpose output port 1-1	27	General-purpose input port 1-2
3	General-purpose output port 1-2	28	General-purpose input port 1-3
4	General-purpose output port 1-3	29	General-purpose input port 1-4
5	General-purpose output port 1-4	30	General-purpose input port 1-5
6	General-purpose output port 1-5	31	General-purpose input port 1-6
7	General-purpose output port 1-6	32	General-purpose input port 1-7
8	General-purpose output port 1-7	33	General-purpose input port 1-8
9	General-purpose output port 1-8	34	General-purpose input port 2-1
10	General-purpose output port 2-1	35	General-purpose input port 2-2
11	General-purpose output port 2-2	36	General-purpose input port 2-3
12	General-purpose output port 2-3	37	General-purpose input port 2-4
13	General-purpose output port 2-4	38	General-purpose input port 2-5
14	–COM1 (Common for general-purpose output)	39	General-purpose input port 2-6
15	–COM1 (Common for general-purpose output)	40	General-purpose input port 2-7
		41	General-purpose input port 2-8
		42	General-purpose input port 3-1
		43	General-purpose input port 3-2
		44	General-purpose input port 3-3
		45	General-purpose input port 3-4

General-purpose output circuit



General-purpose input circuit



1) Input signal: 7 mA
2) Output signal: The Rated current is 300 mA or less/point (open collector output)
3) This unit does not have an input/output power output (24VDC). Supply it from an external source.
4) The general-purpose input/output can be used for various system input/output signals by setting the mode. (Refer to section 14.2)

Slave unit

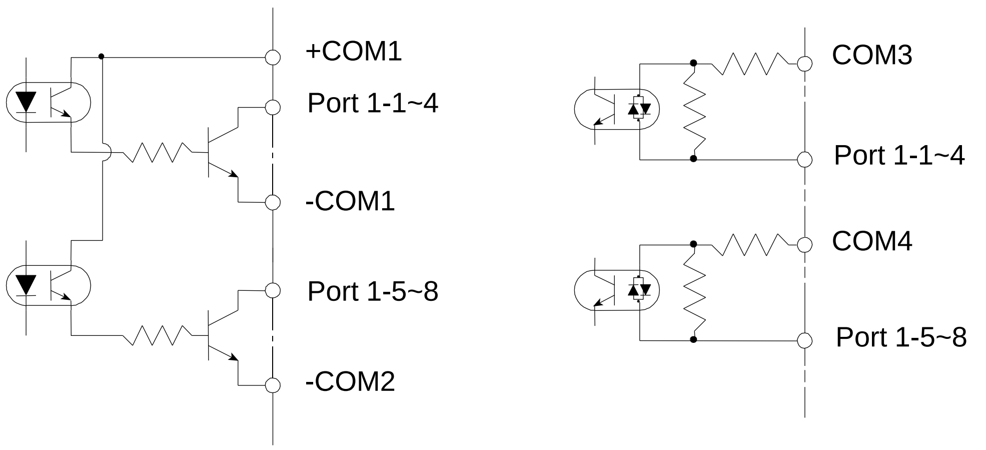
Slave unit I/O connector pin assignment

No.	Signal name	No.	Signal name
1	+COM1 (Common for output signal)	19	+COM3 (Common for input signal)
2	General-purpose output port 1-1	20	General-purpose input port 1-1
3	General-purpose output port 1-2	21	General-purpose input port 1-2
4	General-purpose output port 1-3	22	General-purpose input port 1-3
5	General-purpose output port 1-4	23	General-purpose input port 1-4
6	–COM1	27	+COM4 (Common for input signal)
11	General-purpose output port 1-5 (Note 1)	28	General-purpose input port 1-5
12	General-purpose output port 1-6 (Note 1)	29	General-purpose input port 1-6
13	General-purpose output port 1-7 (Note 1)	30	General-purpose input port 1-7
14	General-purpose output port 1-8 (Note 1)	31	General-purpose input port 1-8
17	–COM2		

(Note 1) The rated current is 20mA or less/point. (Open collector output)

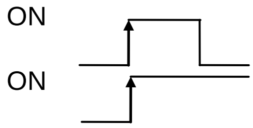
General-purpose output circuit

General-purpose input circuit in controller

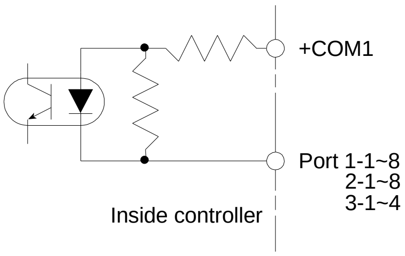


1) Input signal: 10 mA
2) Output signal: The rated current is 300 mA or less/point (open collector output).
3) This equipment does not have an input/output power output (24VDC). Supply it from an external source.
4) The general-purpose input/output can be used for various system input/output signals by setting the mode. (Refer to section 14.2)

(2) System input

Pin No.	Signal name	Normal mode	External point designation mode	Remarks
16	+COM2	Common for system input		
21	Return to origin	ON: Start return to origin	Return to origin	Rising edge detection
22	Start	ON: Restart from currently stopped step or temporarily stopped state	ON: Start movement according to information in currently designated table	
23	Stop	ON: Complete execution of current step and then stop	Invalid	When this input is ON, return to origin and start input are invalid
24	Reset	ON: Reset error state (Valid when program execution is stopped.)	ON: Reset error state	

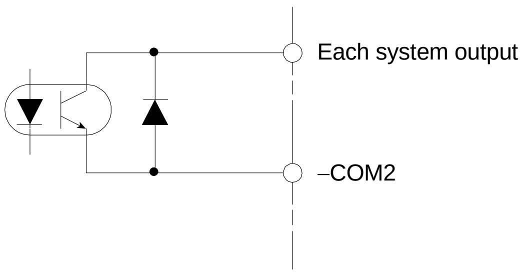
System input circuit



(3) System output

Pin No.	Signal name	Normal mode	External point designation mode	Reference page
17	Running	ON during controller execution/during return to origin	ON during robot operation	Section 10.2.11
18	Error	ON during error occurrence	Same as left	Section 10.2.12
19	Positioning complete	ON when robot positioning is completed OFF when robot is moving (Stays OFF when stopped with pause)	Same as left	Section 10.2.13
20	Return to origin complete	ON while return to origin is not needed due to execution of movement command OFF when return to origin is needed	Same as left	Section 10.2.14
25	–COM2	Common for system output		

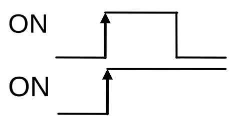
System output circuit



(4) Inputs and outputs that can be set for general-purpose input/output

Signal name	Input/ output	Details	Reference page
Robot single operation	Input	The single operation mode is entered when start is input or the start key is ON, and this input is ON. The commands that stop execution in this mode are the axis movement related and output related commands.	Section 10.2.5
Continuous start	Input	The data in the counter, etc., is held or cleared when the power is turned ON or when reset is input according to the status of this input.	Section 10.2.6
Escape	Input	If this input turns ON during execution of the MVE command, the movement will decelerate and stop, and the step will be completed.	Section 10.2.7
Pause (temporary stop)	Input	ON : Temporary stop (The axis will decelerate and stop) Restart : Input start Cancel : Input reset	Section 10.2.8
Program selection 2^0 Program selection 2^1 Program selection 2^2 Program selection 2^3	Input	Input signal for program No. designation. Program No. 1 to No. 16 is entered in binary format.	Section 10.2.9
Palletizing	Input	ON : Palletizing mode OFF : Sequential mode	Section 10.2.10
Servo on	Input	ON : Servo turns on. OFF : Servo turns off.	Section 10.2.21
Input wait output	Output	This turns ON when the program is waiting for an input.	Section 10.2.15
Pausing	Output	This turns ON when the pause input is recognized and the axis decelerates and stops. This will turn OFF when pause is canceled.	Section 10.2.16
READY	Output	The operation status of the controller, including the master unit and slave unit is indicated. Preparing for operation: OFF Operation preparation complete: ON	Section 10.2.17
Individual task positioning complete	Output	When positioning is completed for each task: ON	Section 10.2.18
Individual task return to origin complete	Output	When return to origin is completed for each task: ON	Section 10.2.19
Battery alarm	Output	Low voltage for encoder backup power supply: ON	Section 10.2.20

- Refer to section 14.2 for details on setting this function.
- The pause input, pausing output and READY output can also be used in the external point designation mode.
- The input signal is detected at the leading edge.



■ 10.1.3 Expansion input/output signal names and pin Nos.

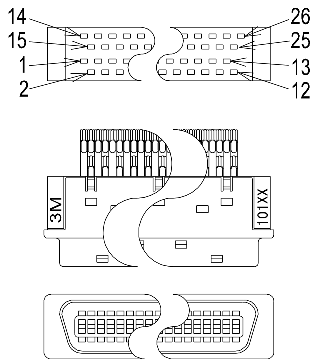
(1) Expansion input/output unit for slave unit

PIN No.	Signal name	PIN No.	Signal name
1	+COM5 (Note 1)	14	+COM6 (Note 1)
2	General-purpose output port 2-1	15	General-purpose input port 2-1
3	General-purpose output port 2-2	16	General-purpose input port 2-2
4	General-purpose output port 2-3	17	General-purpose input port 2-3
5	General-purpose output port 2-4	18	General-purpose input port 2-4
6	General-purpose output port 2-5	19	General-purpose input port 2-5
7	General-purpose output port 2-6	20	General-purpose input port 2-6
8	General-purpose output port 2-7	21	General-purpose input port 2-7
9	General-purpose output port 2-8	22	General-purpose input port 2-8
10	N.C	23	General-purpose input port 3-1
11	N.C	24	General-purpose input port 3-2
12	N.C	25	General-purpose input port 3-3
13	–COM5	26	General-purpose input port 3-4

N.C: No Connection

NOTE

(Note 1) +COM5 and + COM6 are not connected internally.



Use the enclosed connector.

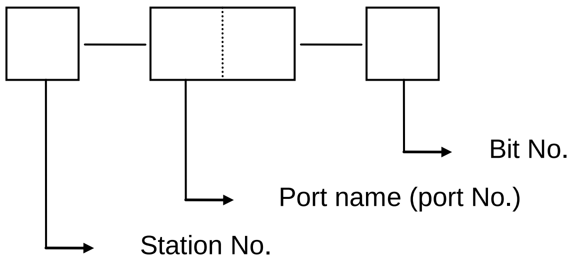
- Cable side connector type
  Plug 10150-3000VE (Sumitomo 3M)
  Shell kit 10350-52F0-008 (Sumitomo 3M)

- Panel side connector type
  Receptacle 10250-52A2JL (Sumitomo 3M)

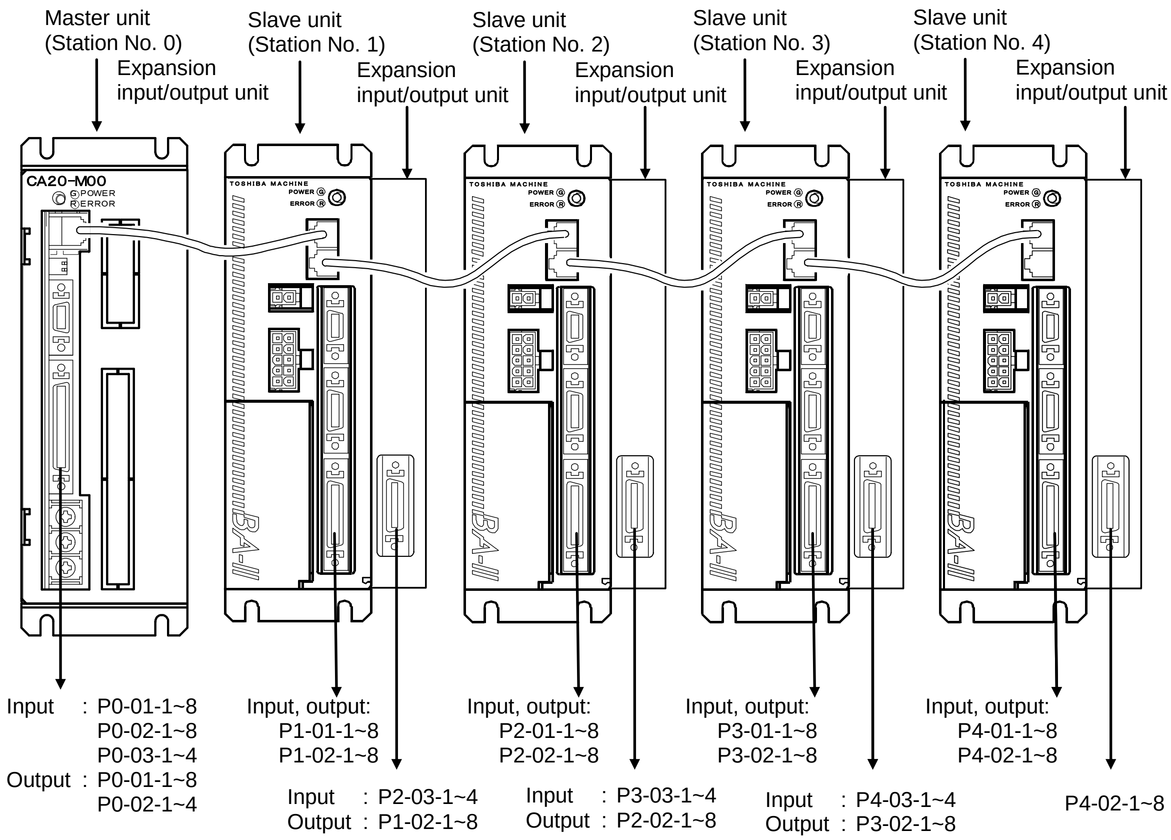
Applicable wire size: AWG24 (0.22 mm^2)

■ 10.1.4 Names of general-purpose input/output ports and teach pendant displays

In the controller's system configuration, there are master unit, slave unit and expansion input/output unit input/output ports. The No. of points will change according to the use of options. These input/output ports are displayed on the Teach Pendant as shown below.



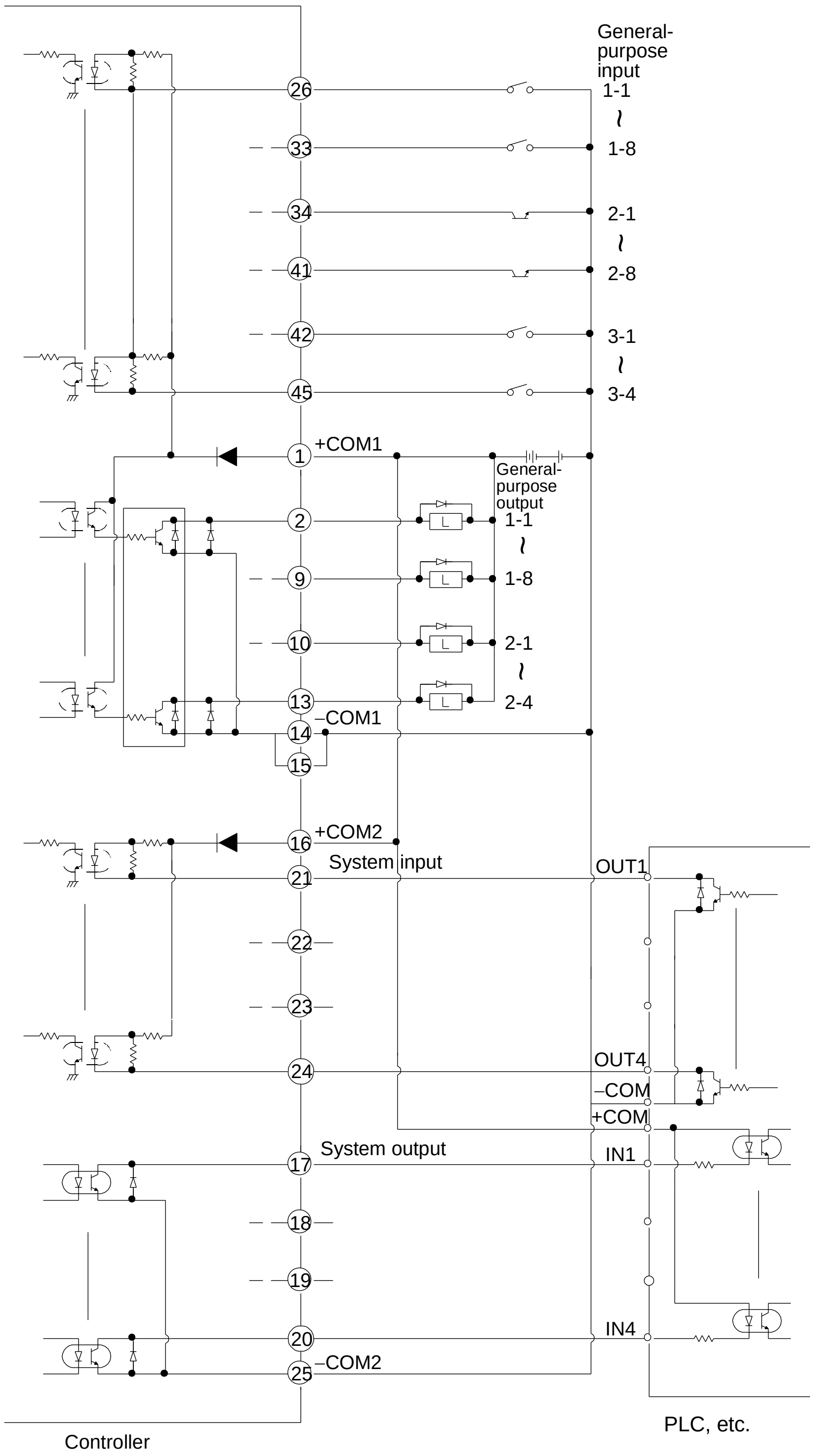
The figure below shows the name of the general-purpose input/output ports for the CA20-M00.



- The names of the general-purpose input/output ports for the CA20-M01 are identical to those in the figure above.

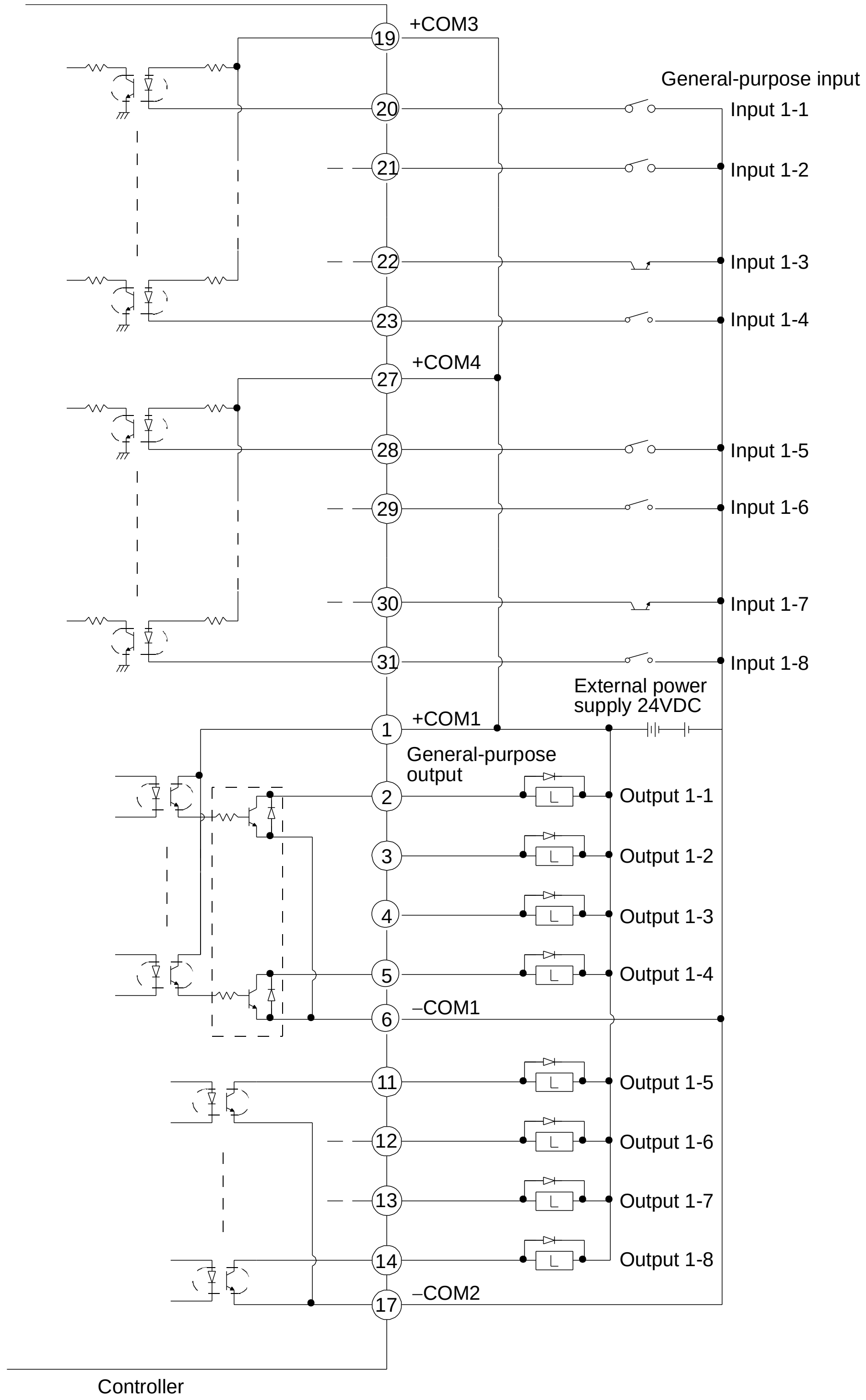
■ 10.1.5 Example of input/output signal connection

- Example of master unit connection



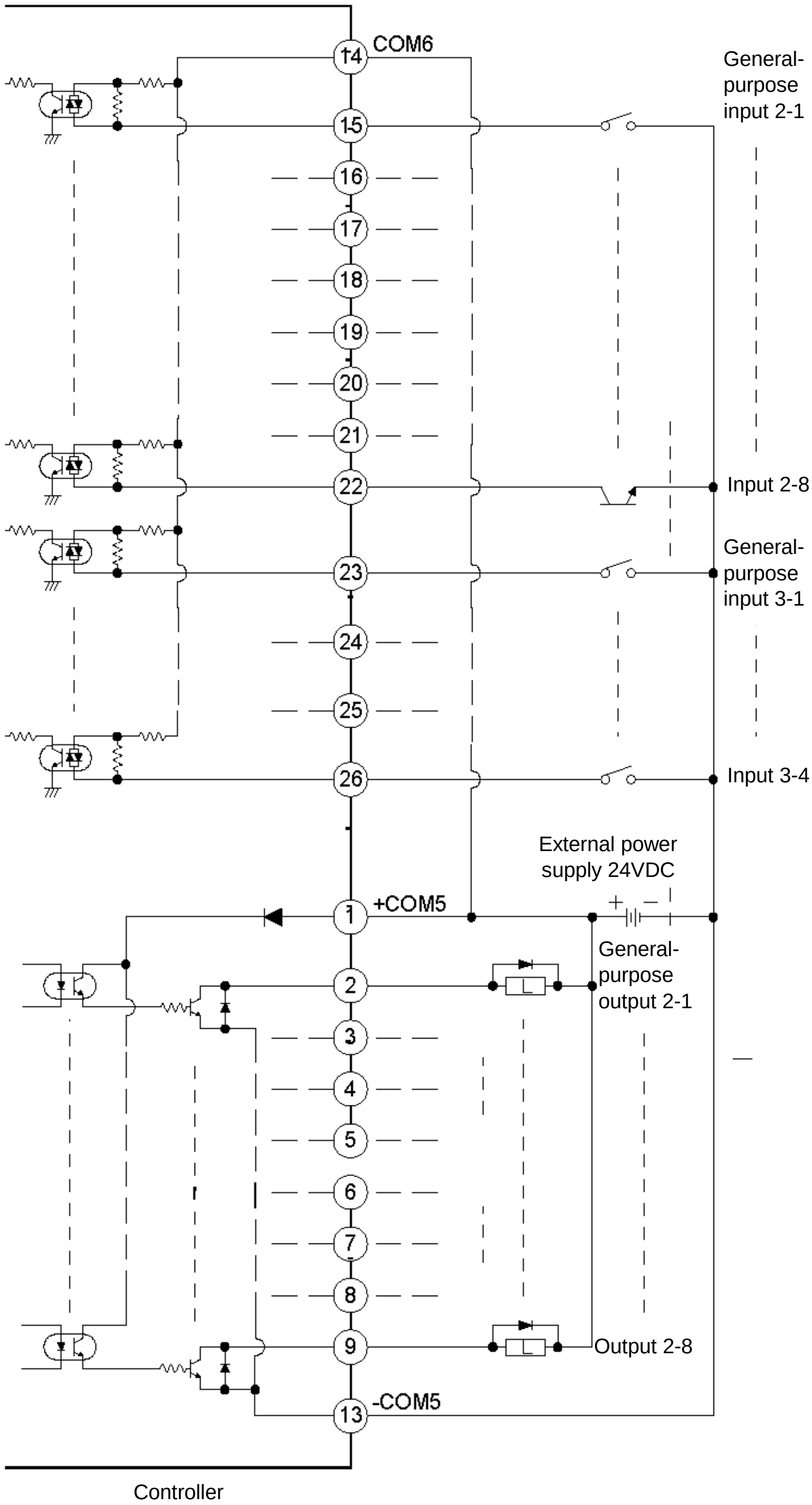
NOTE '+COM1, +COM2' and '–COM1 and –COM2' are not connected internally.
The rated current of general-purpose outputs 1-1 to 1-8, and 2-1 to 2-4 is 300mA or less/point (open collector output).
The rated current of system outputs S-1 to S-4 is 20mA or less/point (open collector output).

- Example of slave unit connection



NOTE ‘+COM1, +COM3 and +COM4’ and ‘–COM1 and –COM2’ are not connected internally.
The rated current of general-purpose outputs 1-1 to 1-4 is 300mA or less/point (open collector output).
The rated current of general-purpose outputs 1-5 to 1-8 is 20mA or less/point (open collector output).

- Example of expansion input/output unit connection for slave



NOTE +COM5 and +COM6 are not connected internally.

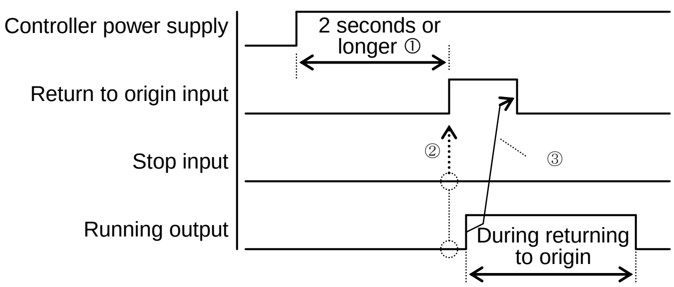
■ 10.2 Details of System Input/Output Function

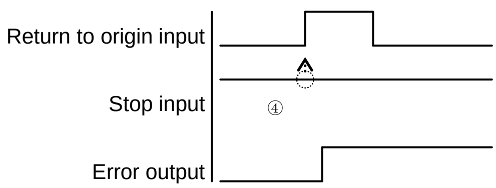
The detail of each system input/output function is explained.

NOTE ● Each logic of system input/output can be selected in M22 to M29(positive logic /negative logic selection (input 1 to 4, output 1 to 4)). (Refer to section 14.2.22 to 14.22.29.)

■ 10.2.1 Return to origin input

- This input starts the return to origin.
- This input can be accepted only when the Teach Pendant is not connected or is turned OFF.
- This input will be invalid for approx. two seconds after the controller power is turned ON. Thus, turn it ON after two seconds or more have passed.





① Set to ON after two or more seconds has elapsed after the power is turned on.

② Before setting the return to origin input to ON, check that the running output and stop input are OFF.

③ After setting the running output to ON, return the return to origin input to OFF.
Also, after setting the return to origin input to ON, set to OFF after 30 ms or longer has elapsed.

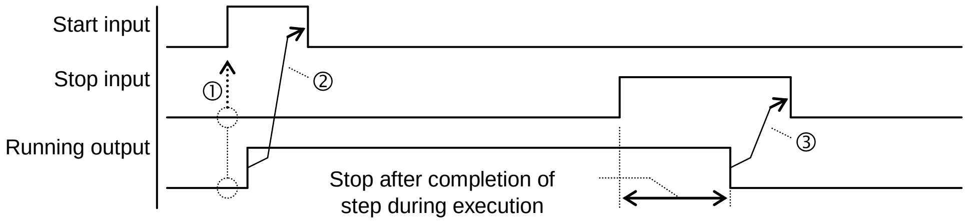
④ An error occurs if the return to origin input is set to ON while the stop input is set to ON.

■ 10.2.2 Start input

- This input restarts the operation from the currently stopped step or the temporarily stopped step.
- If operation is restarted with this input after inputting reset, in the sequential mode the program will start from STEP 0001. In the palletizing mode, the program No. selection input will be judged and then the program will start from the beginning. (Other than when holding of the step is designated with continuous start.)
- This input is valid only when the Teach Pendant is not connected or is turned OFF.
- When there are multiple tasks with the multitasking function, the program will start from the main task step that is currently stopped.

■ 10.2.3 Stop input

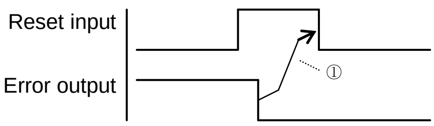
- This input is used for stopping after the step under execution is ended.
  - During execution of time wait-related commands, the step is considered to end at stop input.
  - If a step is waiting for a condition by the IN command, the step is not considered to be completed.
- After this input turns ON, return to origin and start input will be invalid.



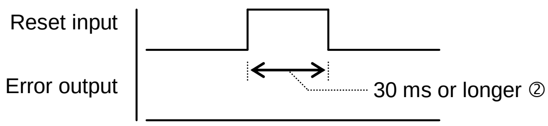
① Before setting the start input to ON, check that the running output and stop input are OFF.
② After setting the running output to ON, return the start input to OFF, or after setting the start input to ON, set to OFF after 30 ms or longer has elapsed.
③ After setting the running output to OFF, return the stop input to OFF, or after setting the stop input to ON, set to OFF after 30 ms or longer has elapsed.

■ 10.2.4 Reset input

- This input resets the error state when an error has occurred.
- This input can be accepted only when execution of the program in the controller has been stopped. (When the program is not running.)
- When reset is input, the step No. becomes 0001 and the counter becomes 0 in the sequential mode.
  If any plural tasks are present in the multitask mode, the step No. becomes 0001 and the counter becomes 0 on all tasks. Moreover, the step returns to the initialized state in the palletizing mode.
  However, it is concerned with the setting of the continuous start bit and the state of the continuous start input signal. (Refer to section 10.2.6.)



Clearing of error state

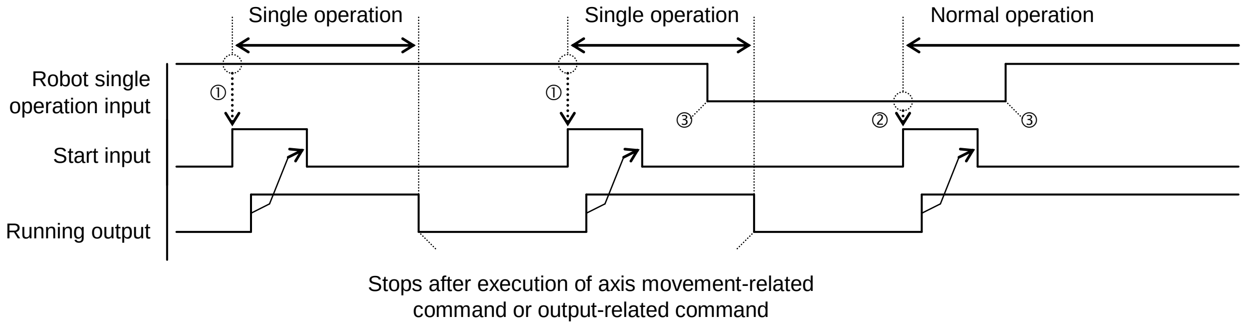


Clearing of steps and counter

① After the error output is set to OFF, return the reset input to OFF, or after setting the reset input to ON, set to OFF after 30 ms or longer has elapsed.
Note that the error output will not turn OFF unless the cause of the error is removed.
② When clearing the steps and counter, set to ON for 30 ms or longer.

■ 10.2.5 Robot single operation input

- The general-purpose input port designated for robot single operation input with the mode setting can be used for the robot single operation input. (Refer to section 14.2.1.)
- This input is used for program verification and other purposes. If this input is ON when start is input or the start key on the teach pendant is pressed, the program is stopped after execution of the axis movement-related command or output-related command.
- The robot single operation input is also led in as the general-purpose input data.



① Single operation is performed when robot single operation input is set to ON while start input is ON.

② Normal operation is performed when robot single operation input is set to OFF while start input is ON.

③ ON and OFF during operation (during program execution) are ignored.

■ 10.2.6 Continuous start input

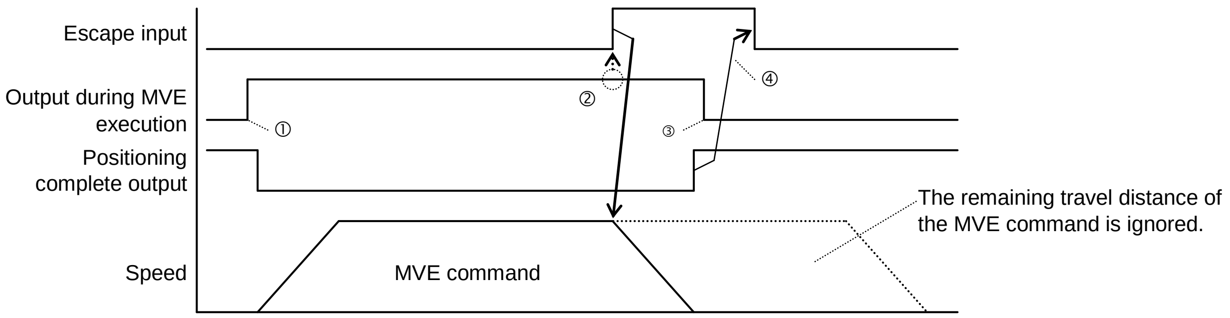
- The general-purpose input port designated for robot continuous start input with the mode setting can be used for the robot continuous start input. (Refer to section 14.2.2.)
- Depending on the status (ON, OFF) of the continuous start input when the power is turned ON or reset is input, the values for the step No., counter and general-purpose output will be held or cleared. Depending on the state of the continuous start input, data holding or clearing is set as shown in the following table.

	Mode setting	Valid (When bit is designated)		Invalid (When bit is not designated)
	Continuous start input	When ON	When OFF	—
Reset input	Step No.	Hold	Initialize	Initialize
	Counter	Hold	Hold	Clear
	General-purpose output	Clear	Clear	According to mode setting (initial value : Hold)
Power OFF→ON	Step No.	Hold	Initialize	Initialize
	Counter	Hold	Hold	Clear
	General-purpose output	Clear	Clear	Clear

- The continuous start input is also led in as the general-purpose input data.
- Resuming of operation is possible only when the power is turned OFF while the program execution is stopped (stopped in normal state). If the power is turned OFF during execution of a program (during operation) or if an error occurs, restarting will not be possible. A restarting not possible error will occur. (Continuing will be possible when the emergency stop is applied.)
- In the easy mode, continuous start cannot be used after the power is turned OFF.

■ 10.2.7 Escape input

- The general-purpose input port designated as the escape input with the mode setting can be used as the escape input. (Refer to section 14.2.3.)
- If the designated input port turns ON during execution of the MVE command, the robot will decelerate to a stop, and at the same time it will be interpreted that step has been completed. The next step will be executed.
- The escape input is valid only for the MVE command.

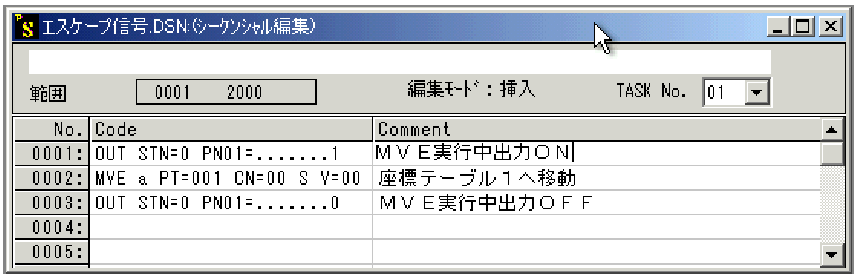


① To notify the upper-level controller that execution of an MVE command is in progress, set the output during MVE execution to ON. Use the general-purpose output port to output this signal by the OUT command. (Refer to the program example below.)

② Before setting the escape input to ON, check that the output during execution of the MVE command is in the ON status. (Refer to the program example below.)

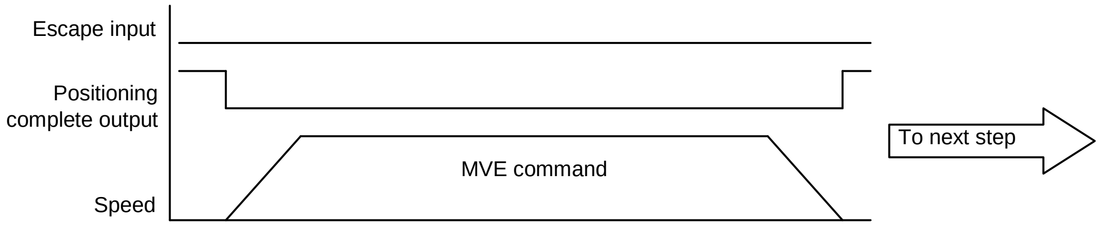
③ Writing a command (OUT command) that turns OFF the output during execution of the MVE command in the step following the MVE command will decelerate and stop operation, and then set execution to OFF.

④ After setting the positioning complete output to ON, return the escape input to OFF, or after setting the escape input to ON, set to OFF after 30 ms or longer has elapsed.



Program example

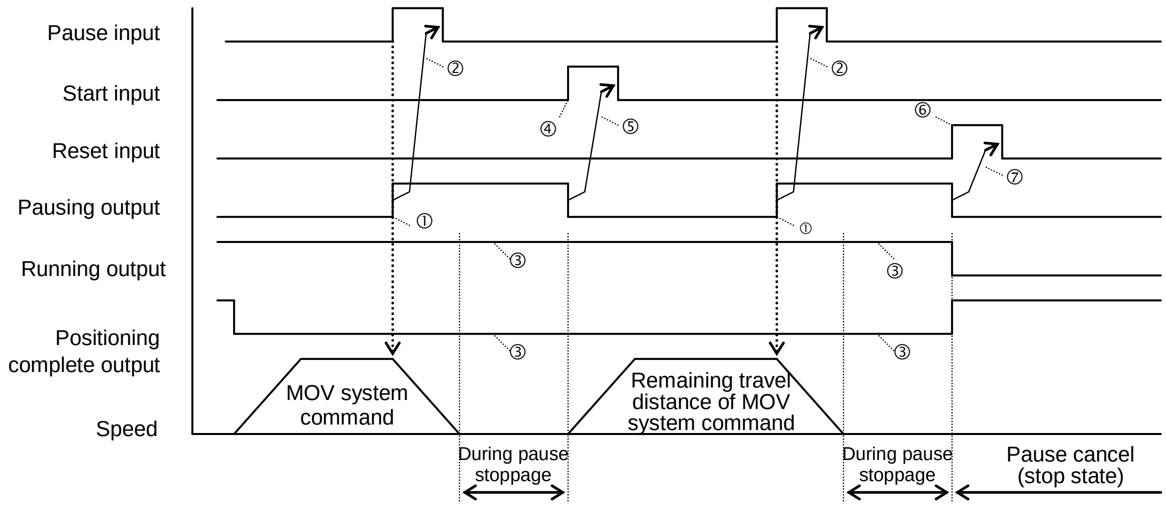
- If the escape input does not turn ON during execution of the MVE command, the program proceeds to the next step after reaching the target position.



- The escape input is also fetched as the general-purpose input data.
- The escape input has higher priority than step input. If the escape input is set to ON while the step input is set to ON, the robot will decelerate and stop, and the step is considered to have ended. If the step input remains at ON at this point, execution of the program is stopped.

■ 10.2.8 Pause (temporary stop) input

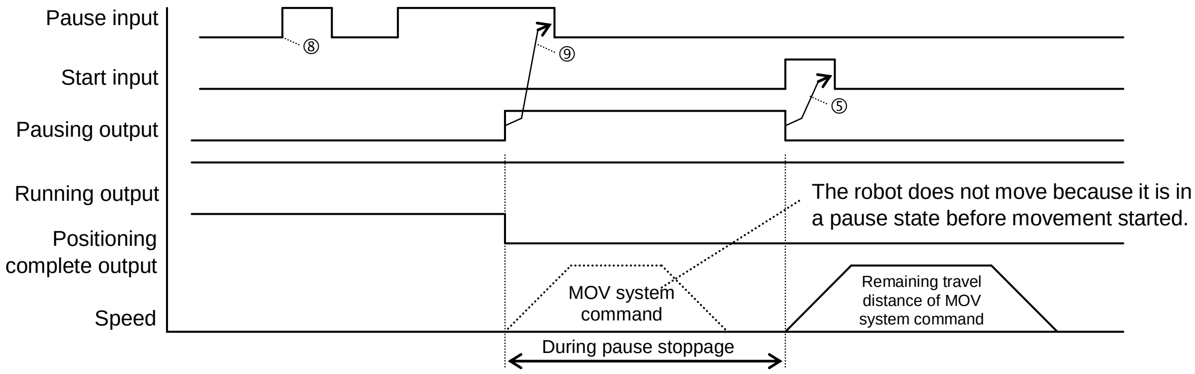
- The general-purpose input port designated as the pause input with the mode setting can be used as the pause input. (Refer to section 14.2.4.)
- If this input turns ON during execution of the MOV system command, the axis will decelerate and stop.
  The pause input is invalid in respect to commands other than the MOV system command.
- Pause input is invalid during return to origin with the return to origin input or during execution of the HOME command.
- To restart (start midway) after stopping temporarily, input start. - ④
  Note that the start input is invalid when the Teach Pendant is ON. In this case, use the start key on the Teach Pendant. Cancellation is also possible using reset. - ⑥
- The phase input has higher priority than step input. If the phase input is set to ON while the step input is set to ON, the axis will decelerate and stop.



① The pausing output is set to ON at the same time that deceleration starts.
② After pausing output is set to ON, return the pause input to OFF.
③ During pause, the running output and positioning complete output are not changed.

⑤ After the pausing output is set to OFF, set the start input to OFF, or after setting the start input to ON, set to OFF after 30 ms or longer has elapsed.

⑦ After the pausing output is set to OFF, set the reset input to OFF, or after setting the reset input to ON, set to OFF after 30 ms or longer has elapsed.



⑧ Pulse input during execution of a non-MOV system command is ignored.

⑨ After pausing output is set to ON, return the pause input to OFF.

NOTE Please be aware that the pause input function of this controller has the following limitations.

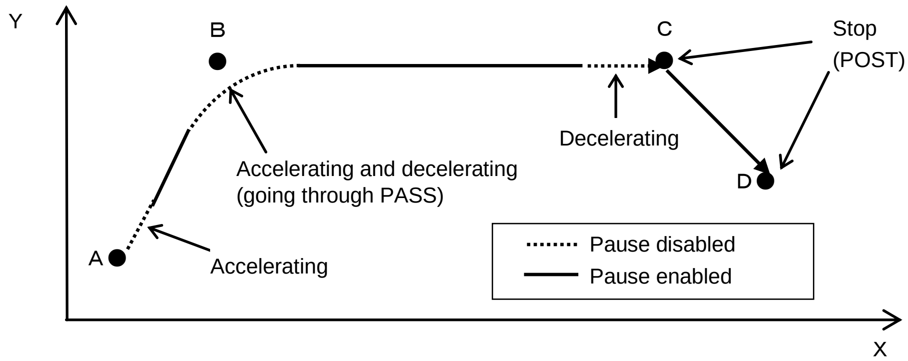
1. Pause input during pass operation

   If a pass point (PASS) operation is used in the MOV system command, pause input is disabled during acceleration or deceleration of the operation.

   The conditions where the above operation occurs are shown by the formula below.

   Acceleration/deceleration time (ACC) x Velocity (V) ÷ 2 = Acceleration/deceleration distance

   Example: When ACC=0.3 s and V=1000 mm/s, the pause input is disabled at a distance of 150 mm during acceleration and deceleration.



Pause input enable/disable range

■ 10.2.9 Program No. selection input

The general-purpose input port designated as the program selection input with the mode setting can be used as the program selection 2^0 to 2^3 input. (Refer to section 14.2.5.)
The program selection input is also fetched as the general-purpose input data.

(1) For sequential mode

- This input allows the program to be jumped to the required tag No. step by a 4-bit input signal from the external controller (programmable controller, digital switch, etc.). (Tag. No. 1 to 16)
- This input is valid only during execution of the PSEL command.

1 ... ON 0 ... OFF

Tag No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Program selection 2^0	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
Program selection 2^1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
Program selection 2^2	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
Program selection 2^3	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

[Example] If input pin 2^0 is ON, 2^1 is ON and 2^2 is OFF during PSEL execution.
The step for which tag No. "004" is input will be jumped to.

(2) For palletizing mode and easy mode

- This input is the palletizing program No. selection input.
- This input is valid only when the start signal is input.
- The input signal and selection program No. are as follow.

Tag No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Program selection 2^0	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
Program selection 2^1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
Program selection 2^2	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
Program selection 2^3	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

■ 10.2.10 Palletizing input

- The general-purpose input port designated as the palletizing input with the mode setting can be used as the palletizing input. (Refer to section 14.2.16.)
- This is the sequential and palletizing mode changeover input. After resetting or execution of the END command, when the start input is turned ON, the controller will judge this signal and change the mode.

  OFF : Sequential mode
  ON : Palletizing mode

- This input can be accepted only when the Teach Pendant is not connected or when the Teach Pendant and RS-232C are invalid.

■ 10.2.11 Running output

- This signal turns ON when the controller is executing a program or during return to origin.
  In the external point designation mode, this signal will turn ON during robot operation.
- This signal remains ON even when the operation is stopped with the pause (temporary stop) input. (Refer to section 10.2.8.)
- This signal will turn OFF when the program is stopped with the END command or stop input.

■ 10.2.12 Error output

- This signal turns ON when an error has occurred in the controller.
- Refer to Chapter 20 for details on the error types and processes.

■ 10.2.13 Positioning complete output

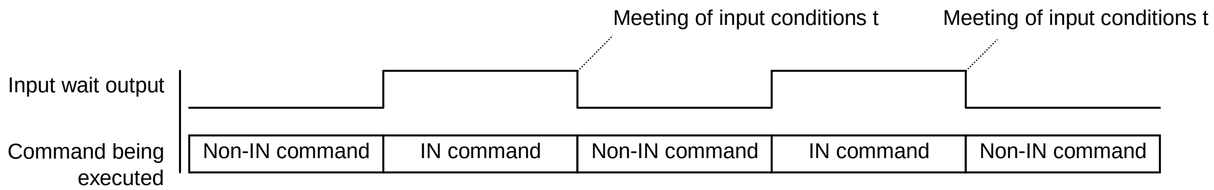
- This is the positioning complete signal used in the movement system commands.
- This signal turns OFF when the return to origin operation is needed.
  If the positioning complete output is OFF when stopped, perform the return to origin operation.
- This signal turns ON when at the position (in-position).
- If operation is stopped by pause (temporary stop) input, the signal stays at OFF.
- This signal will also turn ON when the origin is reached during return to origin.
- When using two to four axes, this signal will turn ON when all axes have completed positioning.

■ 10.2.14 Return to origin complete output

- This is the return to origin and HOME command execution completion signal.
- This signal is ON when the robot is aware of the current position, and return to the origin is not needed due to execution of a movement command.
- This signal is OFF when the return to origin operation is needed due to execution of a movement command such as after an encoder-related error.
- When using two to four axes, this signal turns ON after return to the origin is completed for all axes.
- During the absolute settings, the positioning complete output turns ON as soon as the power is turned on.

■ 10.2.15 Input wait output

- The general-purpose output port designated as input wait output with the mode setting can be used as the input wait output. (Refer to section 14.2.8.)
- This output turns ON during IN command execution (general-purpose wait state).

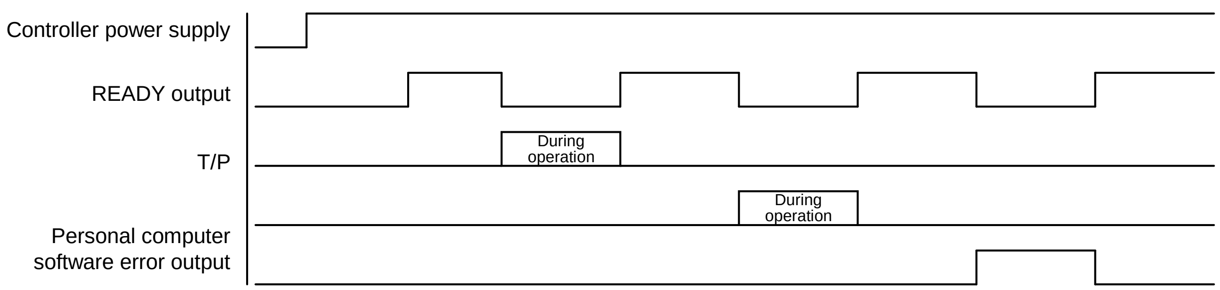


■ 10.2.16 Pausing (temporarily stopped) output

- The general-purpose output port designated as pause output with the mode setting can be used as the pause output. (Refer to section 14.2.7.)
- The pause input is recognized and the robot is decelerated and stopped. This output will turn OFF when the pause is canceled.
- For details on the signal timing, refer to section 10.2.8, "Pause (temporary stop) input".

■ 10.2.17 READY output

- The general-purpose output port designated as READY output with the mode setting can be used as the READY output. (Refer to section 14.2.13.)
- After the power is turned ON, this output is turned ON when the controller comprised of the master unit and slave unit is ready to receive the start input and return to origin input from an external source.
- This output is OFF during the following conditions. While it is OFF, start input and return to origin input are not received.
  - While the robot is being operated by the teach pendant (T/P)
    → When the teach pendant is connected, and operation is in the T/P ON state.
  - While the robot is being operated by the personal computer software
    → When the execution screen of the personal computer software is opened
  - While the error output is ON



■ 10.2.18 Individual task positioning complete output

- After a general-purpose output port is designated for the individual task positioning complete output by the mode setting, the port can be used for individual task positioning complete output. (Refer to section 14.2.14.)
- This setting can set the positioning complete output separately for each task.

■ 10.2.19 Individual task return to origin complete output

- After a general-purpose output port is designated for the individual task return to origin complete output by the mode setting, the port can be used for individual task return to origin complete output. (Refer to section 14.2.15.)
- This setting can set the return to origin complete output separately for each task.

■ 10.2.20 Battery alarm output

- After a general-purpose output port is designated for the battery alarm output by the mode setting, the port can be used for battery alarm output. (Refer to section 14.2.19.)
- This signal is turned ON when a voltage drop occurs in the encoder backup power supply.

■ 10.2.21 Servo-on input

After a general-purpose output port is designated for the servo-on input, the port can be used for the servo-on input. (Refer to section 14.2.21.)

■ 10.3 RS-232C Communication Specifications

This unit can communicate data with the host computer (personal computer, etc.) by using the optional communication cable.
Refer to the RS-232C communication specifications for details.

Chapter 11 BS Servo Amplifier

This controller uses a VL bus expansion unit for enabling connection with the BS servo amplifier. This chapter describes the connection with the BS servo amplifier.

■ 11.1 BS Servo Amplifier Specifications (X Series)

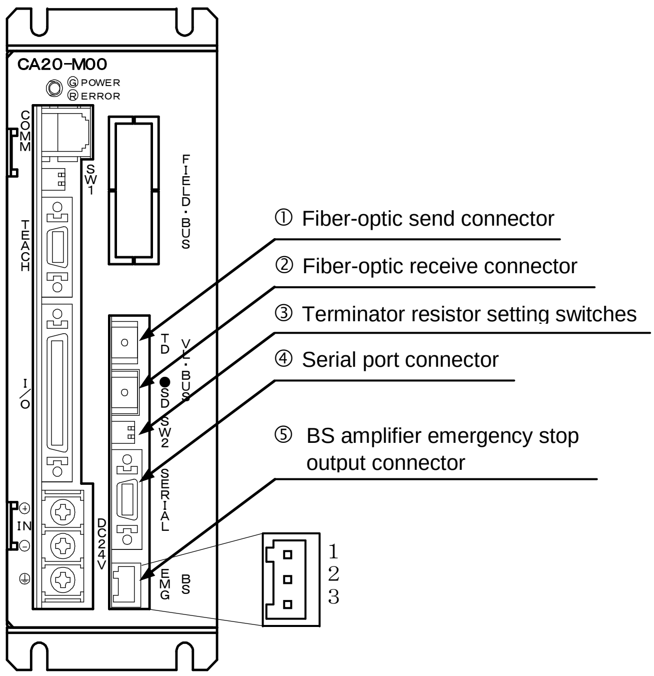
Amplifier model		008P2	012P2	025P2
Control system		PWM, 3-phase sine wave		
Main circuit	Supply voltage	Single phase, 200 V AC to 230 V AC -15% to +10% 50/60 Hz		
	Power capacity	250VA	1.2kVA	1.7kVA
Control circuit	Supply voltage	Single phase, 200 V AC to 230 V AC -15% to +10% 50/60 Hz		
	Power capacity	50VA	50VA	50VA
Applicable motor		100, 200W	400W	600, 750W
Continuous output current		2.2A (rms)	3.4A (rms)	5.7A (rms)
Instantaneous maximum current		5.7A (rms)	8.5A (rms)	17.7A (rms)
Speed position sensor		Resolver or 17-bit serial encoder (Both resolver and encoder can use the absolute specifications.)		
Speed control range		1:5000 (Ratio of lower limit speed and rated speed where output of motor rated current is possible)		
Speed fluctuation rate		±0.02% or less under a load of 0% to 100% or a power supply of -15% to 10%. ±0.2% or less at a temperature of 0°C to 55°C. (The specification values are obtained at the rated speed.)		
Heat loss	Main circuit	15W	22W	39W
	Control circuit	20W	20W	20W
Reverse-current absorption resistor capacity		20W	20W	30W
Weight (standard)		1.3 kg	1.3 kg	2.3 kg
External dimensions (W*H*D)		65*170*150	65*170*150	110*170*180
General-purpose input		24 V DC, 6 mA, 8 ports (For speed control: Operation, reset, MB check, enable CW rotation, enable CCW rotation, clear current value, origin stop, and PON input) Both sink ("-" common) and source ("+" common) connections are possible.		
General-purpose output		24 V DC, 50 mA, 5 ports (For speed control: Servo normal, servo ready, stop detection, warning, and MB output) Both sink ("-" common) and source ("+" common) connections are possible.		
Speed and current control	Speed command	0 to ±10 V DC, Maximum motor speed at ±10V (ratio setting is possible), Input resistance: 49 kΩ, AD resolution: 12 bit (speed limit in current control mode)		
	Current limit	0 to ±10 V DC, Maximum motor torque at ±10V (ratio setting is possible), Input resistance: 49 kΩ, AD resolution: 12 bit (current command in current control mode)		
Position control	No. of divisions	Resolver: 24,000 P/rev, Encoder: 131,072 P/rev (Travel distance per pulse can be set by 65535/65535.)		
	Command type	CW/CWW pulse (Phase A/Phase B pulse and CW/CCW signal/feed pulse are also permitted.) 3.5 V to 5.5 V DC, 16 mA photocoupler input, frequency: 500 Hz (max.)		
Pulse output	No. of divisions	Resolver: 24,000 P/rev, Encoder: 131,072 P/rev (Travel distance per pulse can be set by 65535/65535.)		
	Output type	Phase A/Phase B pulse (CW/CCW pulse), Vout: 3 V (typ.), 20 mA (max.), output equivalent to AM26LS31, frequency: 500 kHz (max.)		
Acceleration/deceleration	Soft start	Acceleration/deceleration time can be set separately for the speed command. Linear acceleration/deceleration ranges from 0.000 to 65.535 s in increments of 0.001 s.		
	S-shaped acceleration	Acceleration/deceleration time can be set for the speed command or pulse command. S-shaped acceleration ranges from 0.000 to 65.535 s in increments of 0.001 s.		
Monitor functions	Monitor output	Speed or current monitor, 0 to ±10 V output resistance, 330 Ω (protection against short-circuit), DA resolution: 12 bit		
	Display unit	5-digit LED (Various monitoring, check, adjustment, and parameter settings are possible.)		
	External display	DPA-80 (sold separately) can be connected. (This enables monitoring of the speed, amperage current, current value, electronic thermal, and other parameters.)		
Auto tuning function		Automatic gain setting by repeated tuning operation		
Protection functions		Overcurrent, overvoltage, voltage drop, motor overload (electronic thermal, instant thermal), fin overheat, reverse-current resistor overload, resolver breakage, encoder breakage, etc.		
General specifications	Operating environment	Temperature: 0 to 55°C (no freezing), humidity: 35% to 90% RH (no condensation) Atmosphere: Free of dust, metal powder, or corrosive gases. Installation altitude: 1,000 m or less		
	Vibration resistance	10 to 55 Hz, 1G or less		
	Storage environment	Temperature: 0 to 70°C (no freezing), humidity: 35% to 90% RH (no condensation) Atmosphere: Free of dust, metal powder, or corrosive gases. Installation altitude: 1,000 m or less		
	Protection class	IP10		
	Overvoltage classification	Category II		
	Protective insulation	Protective insulation for all interfaces (CN1, CN2, CN5, CN9) from the primary power supply.		

- The reverse-current absorption resistor capacity is the absorption capacity of the resistor built into the servo amplifier. This capacity can be increased by adding an external resistor.

■ 11.2 Explanation of Each Part

■ 11.2.1 VL bus expansion unit

(1) Names of each part



- The names of the parts in the VL bus expansion unit of the CA20-M01 are identical to those in the figure above.

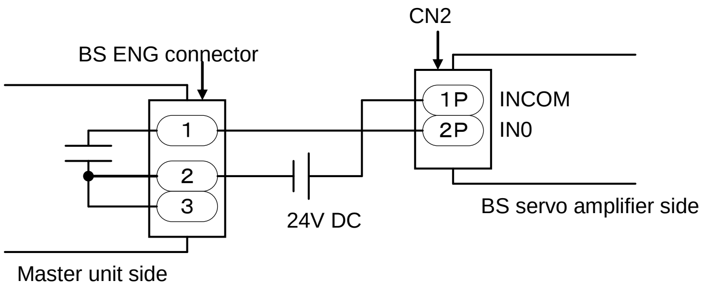
① Fiber-optic send connector (TD)
The fiber-optic cable for the BS servo amplifier is connected to this connector. Pay careful attention to the send and receive directions. An alignment mark is provided on the receive side.

② Fiber-optic receive connector (SD)
The fiber-optic cable for the BS servo amplifier is connected to this connector. Pay careful attention to the send and receive directions. An alignment mark is provided on the receive side.

③ Terminator resistor setting switches
These switches are used to connect a terminator resistor for using the RS485 serial port.
When multiple units are connected, a terminator port is required in the communication circuit for ensuring reliable communication.
When units have this terminator port, set 1 and 2 of the terminator resistor setting switch SW2 to ON for the unit at the end of the communication circuit for setting the terminator resistor. Set to OFF for all other units.

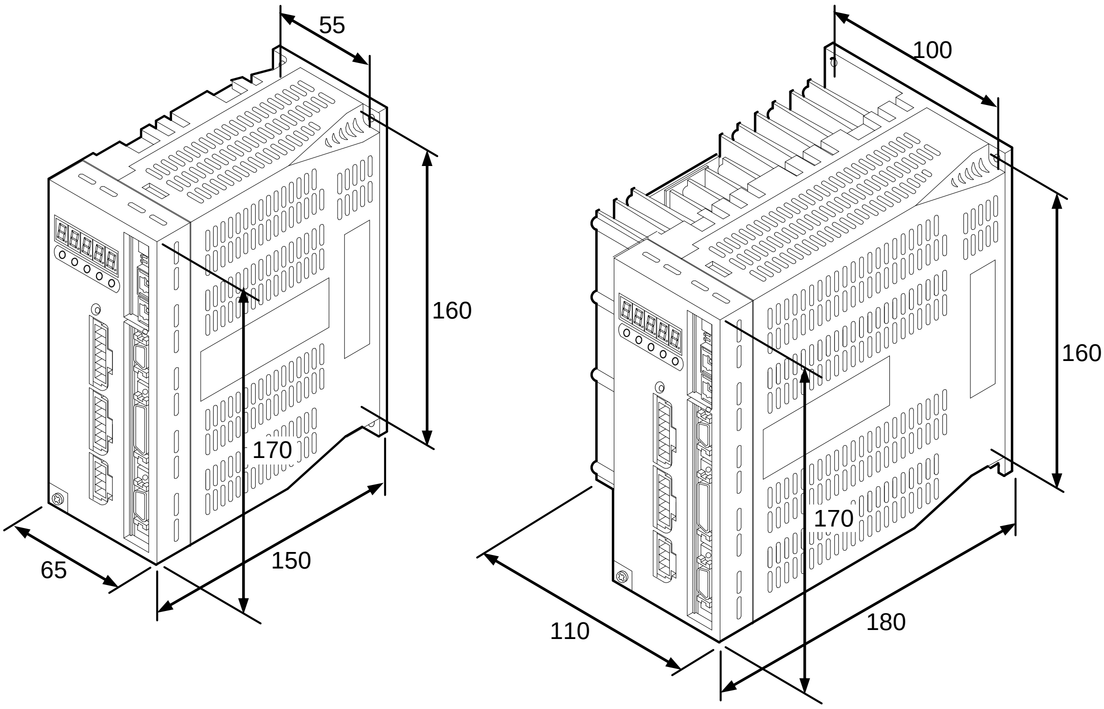
④ Serial port connector
The personal computer communication cable (option) is connected to this connector.

⑤ BS servo amplifier emergency stop connector (BS EMG)
This is a relay contact output connector that outputs an emergency stop signal to the BS servo amplifier. It is connected between the CN2-2 pin (IN0) and 24 V DC (GND) power supply of the BS servo amplifier. If this wiring is not connected, a PON error occurs.



■ 11.2.2 BS servo amplifier

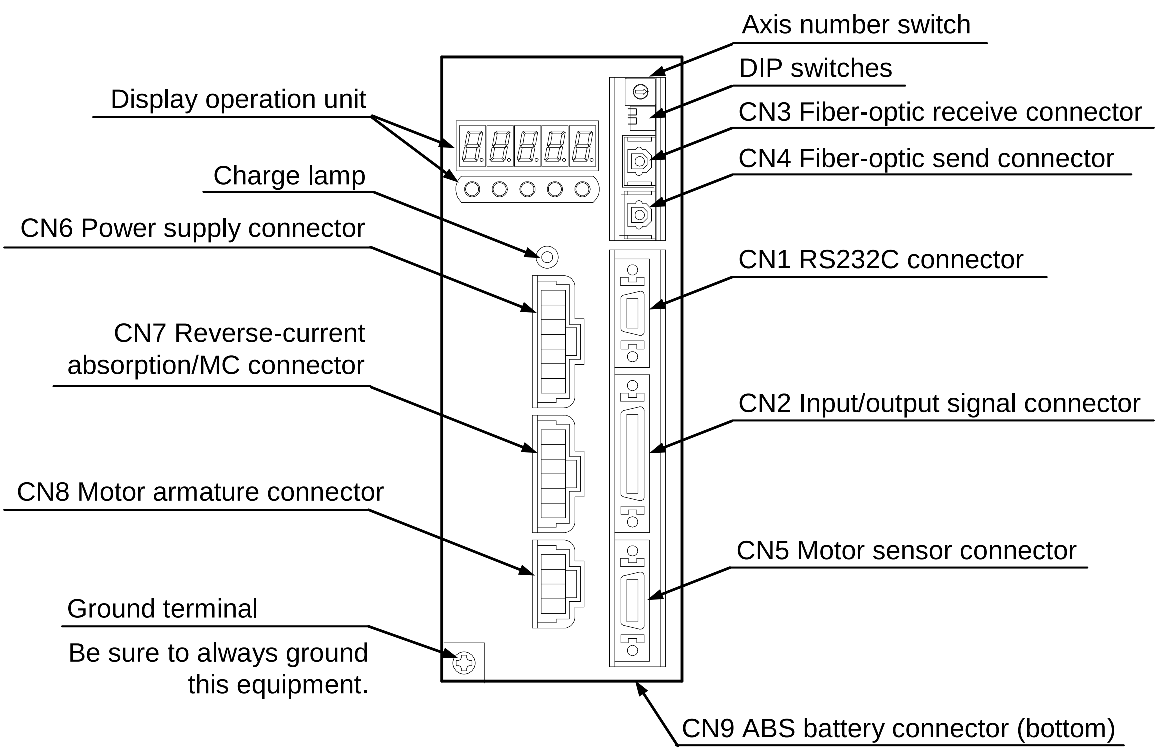
(1) External dimensions



VLASX-008P2,012P2

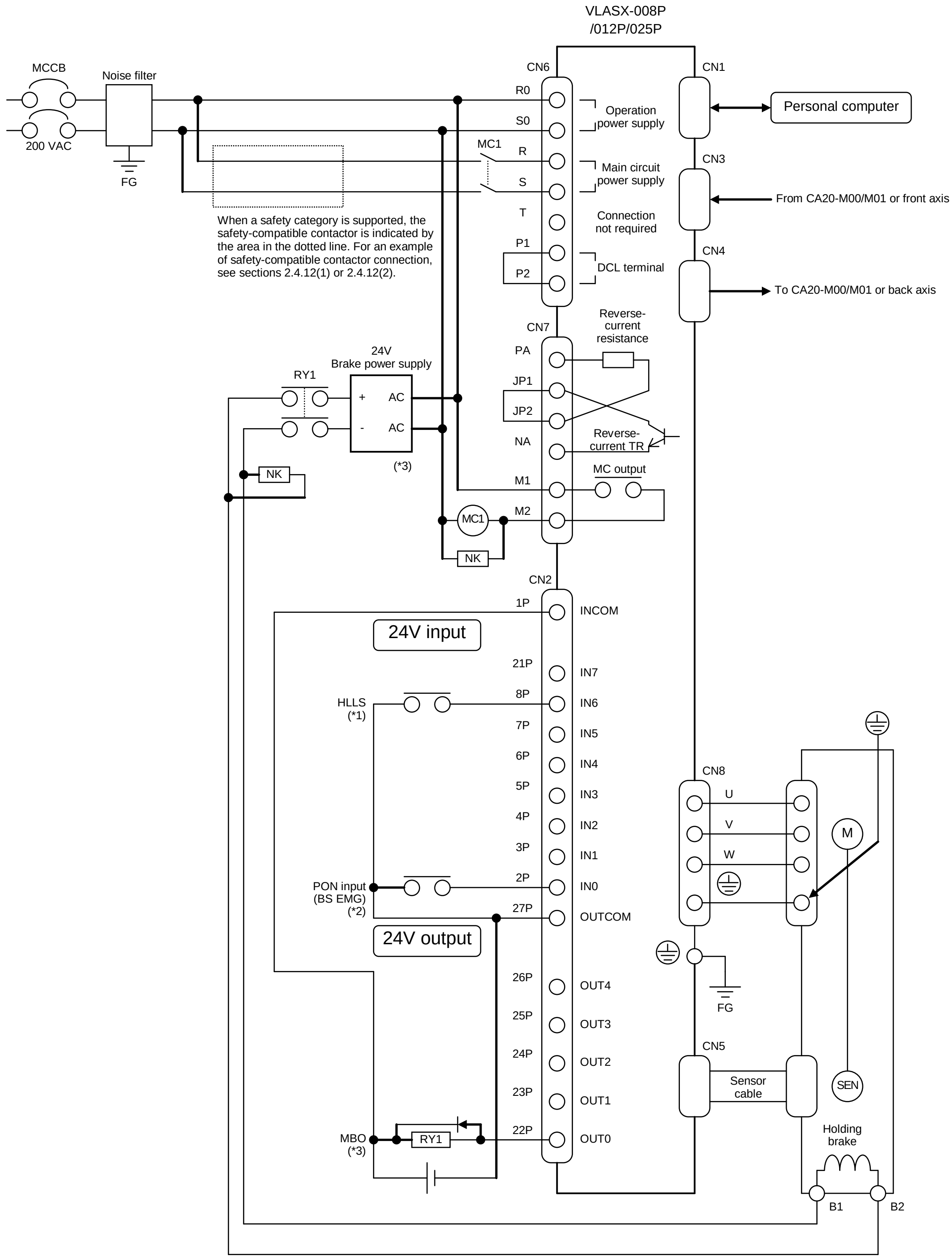
VLASX-025P2

(2) Names of parts



■ 11.3 BS Servo Amplifier Wiring

The BS servo amplifier is wired as shown in the figure below.



*1: HLLS: Origin sensor

*2: The emergency stop signal output relay contact inside the master unit is connected.
Refer to section 11.2.1 ⑤ for the wiring method.

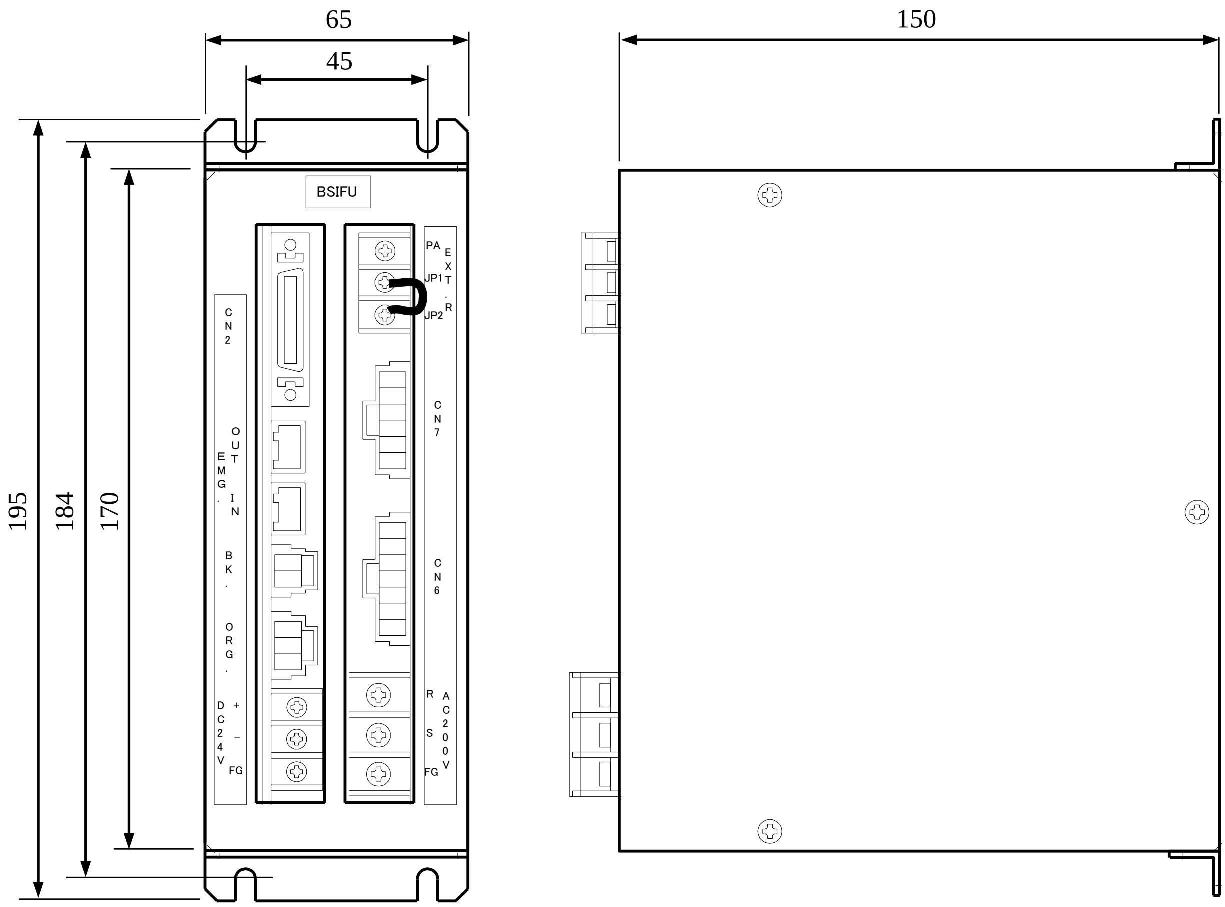
*3: No wiring is needed if using a motor without a holding brake.

■ 11.4 BS Relay Module (Option)

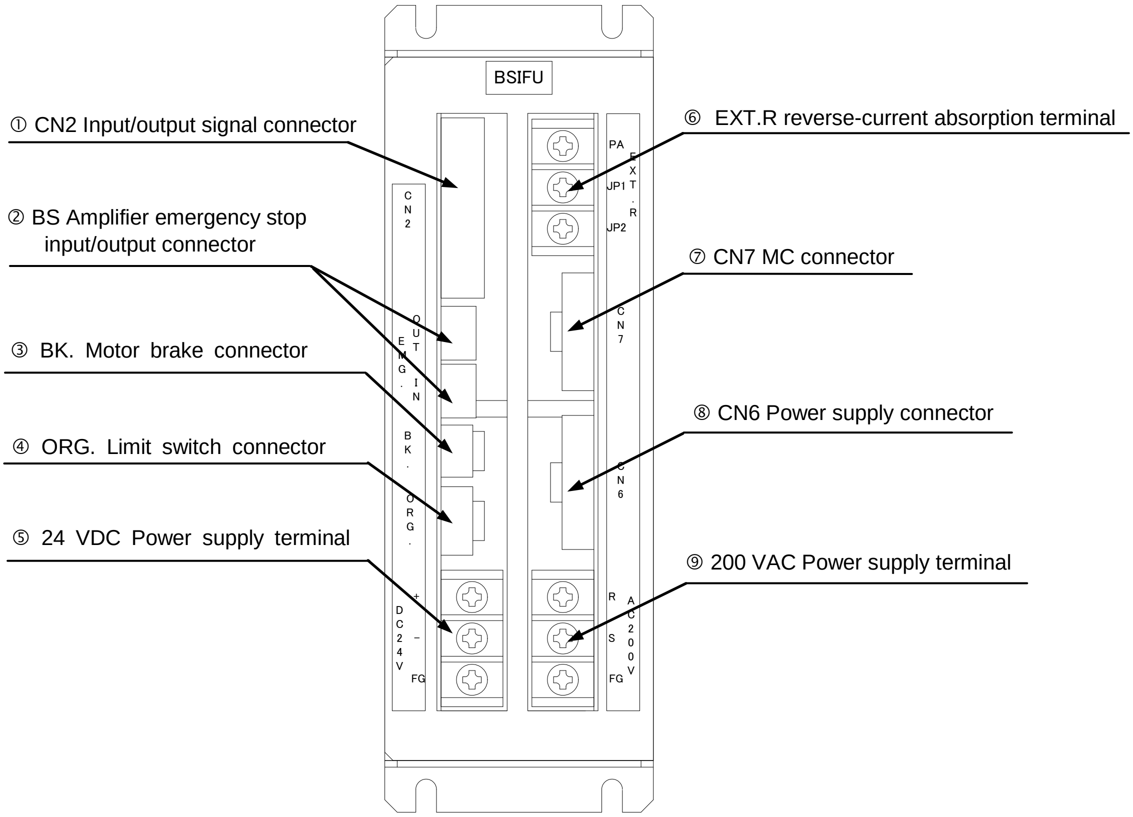
This module provides the external circuits (main conductor, brake release relay, etc.) required for the BS servo amplifier in a module. This section describes the connections with the CA20-M00/M01 and the BS servo amplifier.

■ 11.4.1 BSIFU unit

(1) External dimensions



(2) Names of parts



① CN2 Input/output signal connector
The CN2 cable is connected to this connector.

② BS amplifier emergency stop input/output connector
The EMG cable is connected to this connector. Connect the cable from the CA20-M00/M01 or front axis to the IN side, and connect the cable to the back axis to the OUT side.

③ BK. Motor brake connector
The motor holding brake is connected to this connector.

④ ORG. Limit switch connector
The origin sensor is connected to this connector.

⑤ 24 VDC Power supply terminal
This is the terminal block of the 24 VDC power supply input. This includes an FG (frame ground) terminal.

⑥ EXT.R Reverse-current absorption terminal
This is the terminal block that connects the external reverse-current absorption resistor.

⑦ CN7 MC connector
The CN7 cable is connected to this connector.

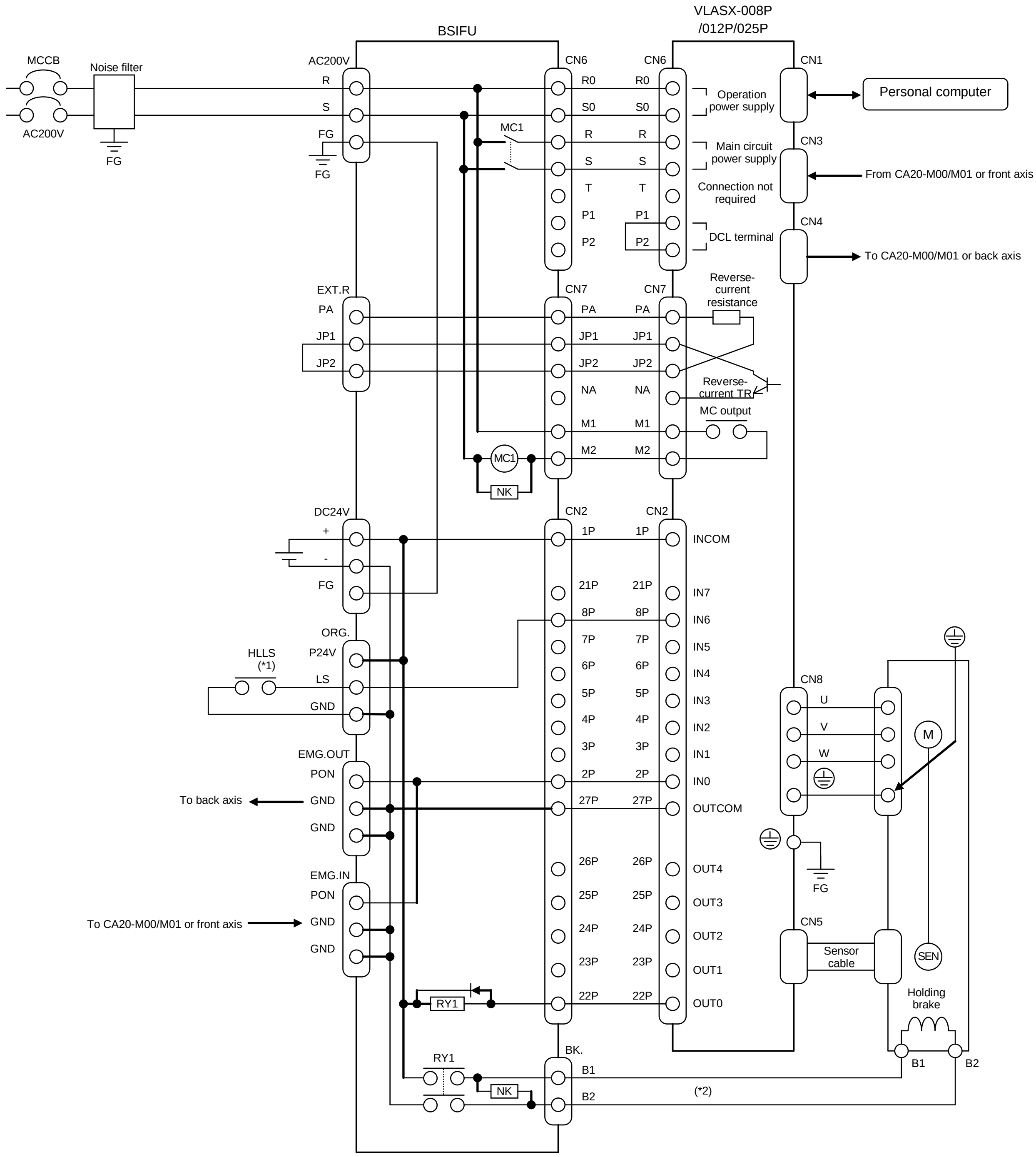
⑧ CN6 Power supply connector
The CN6 cable is connected to this connector.

⑨ 200 VAC Power supply terminal
This is the terminal block of the 200 VAC power supply input. This includes an FG (frame ground) terminal.

■ 11.4.2 Connection methods

(1) Wiring diagrams

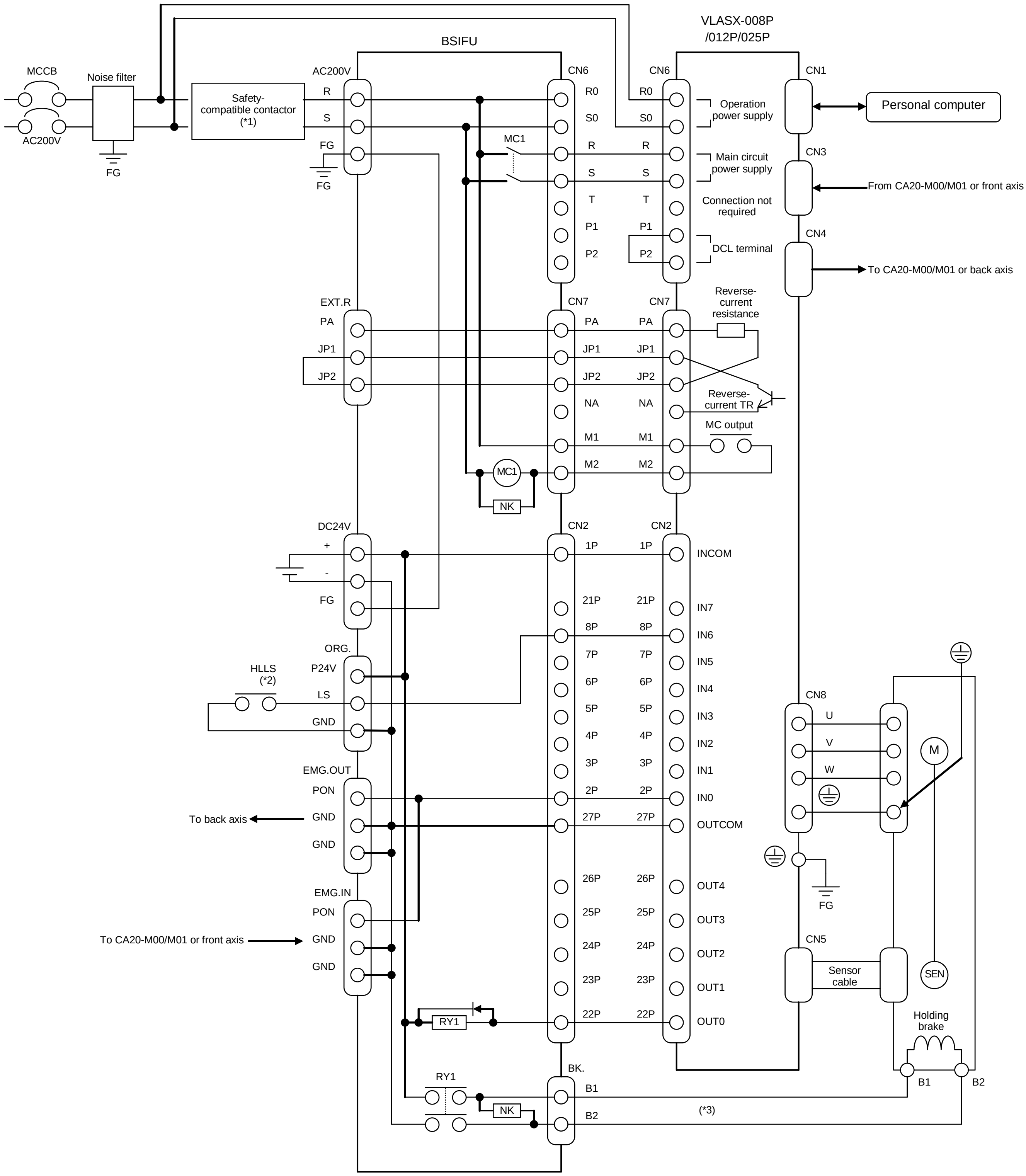
• Safety category 3 non-compatible circuit connection example



*1: HLLS: Origin sensor

*2: No wiring is needed if using a motor without a holding brake.

● Safety category 3 compatible circuit connection example



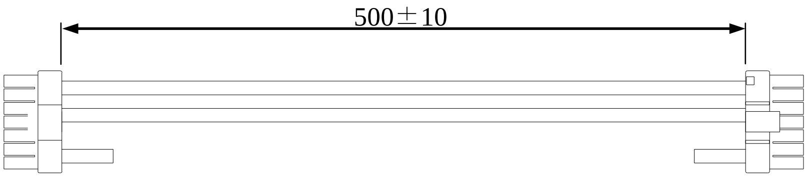
*1: For the safety-compatible contactor circuit, refer to sections 2.4.12(1) or 2.4.12(2).
*2: HLLS: Origin sensor
*3: No wiring is needed if using a motor without a holding brake.

(2) Cable descriptions

The cables attached to BSIFU are shown below.

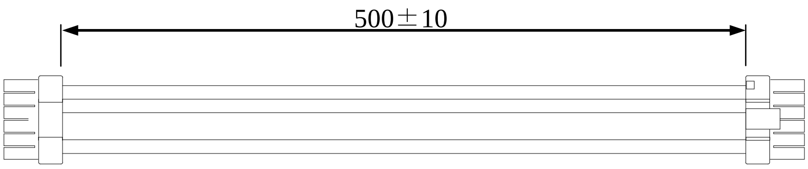
① CN6 cable

This is the power supply cable for BS servo amplifier. The DCL terminal (between P1 and P2) is connected with a short circuit. When safety category 3 compatible circuit is connected, cut R0 line and S0 line and then wire.



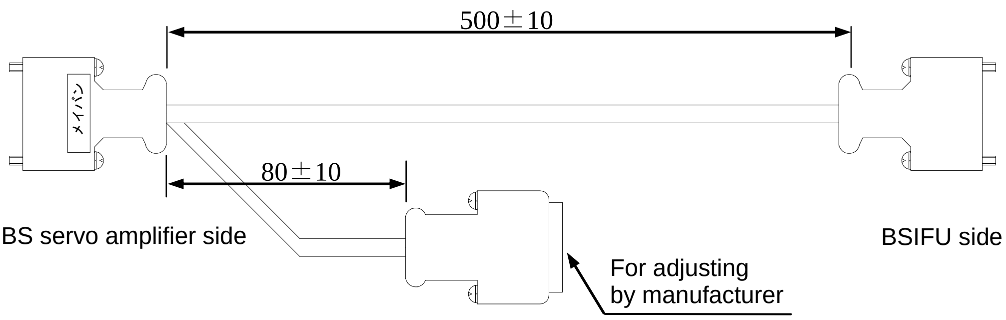
② CN7 cable

This is the reverse-current absorption/MC cable for BS servo amplifier.



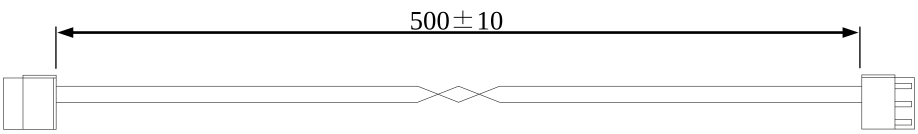
③ CN2 cable

This is the input/output signal cable for BS servo amplifier. The connector for adjusting by manufacturer is provided on BS servo amplifier side.



④ EMG cable

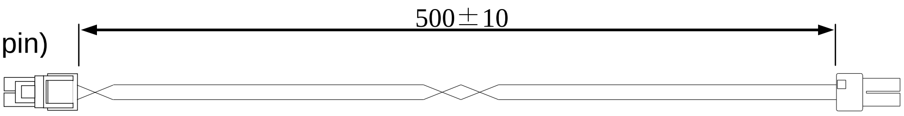
This is the emergency stop signal cable for BS servo amplifier.



⑤ BK cable

This is the brake cable for BS servo amplifier.

(2pin)



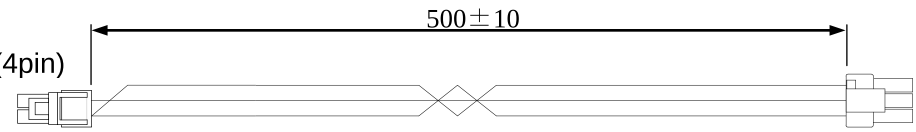
Controller cable side

BSIFU side

⑥ ORG cable

This is the origin sensor cable for BS servo amplifier.

(4pin)



Controller cable side

BSIFU side

■ 11.5 Connection of BS Servo Amplifier and Controller

The master unit is connected to the BS servo amplifiers for one to four axes for enabling control of one to a maximum of four axes with fiber-optic cables. Control is also possible in combination with the slave units CA20-S10 and CA20-S40.

■ 11.5.1 Connection of BS servo amplifier only

(1) Controller connection

① The master unit and BS servo amplifier are connected to the fiber-optic communication connectors (TD, SD) on the front with fiber-optic cables from the master unit TD port to the BS servo amplifier 1 CN3 port, from the BS servo amplifier 1 CN4 port to the BS servo amplifier CN3 port, and so on, and then to connect the final BS servo amplifier to the master unit SD port.
Pay careful attention to the send and receive directions. An alignment mark is provided on the receive side.

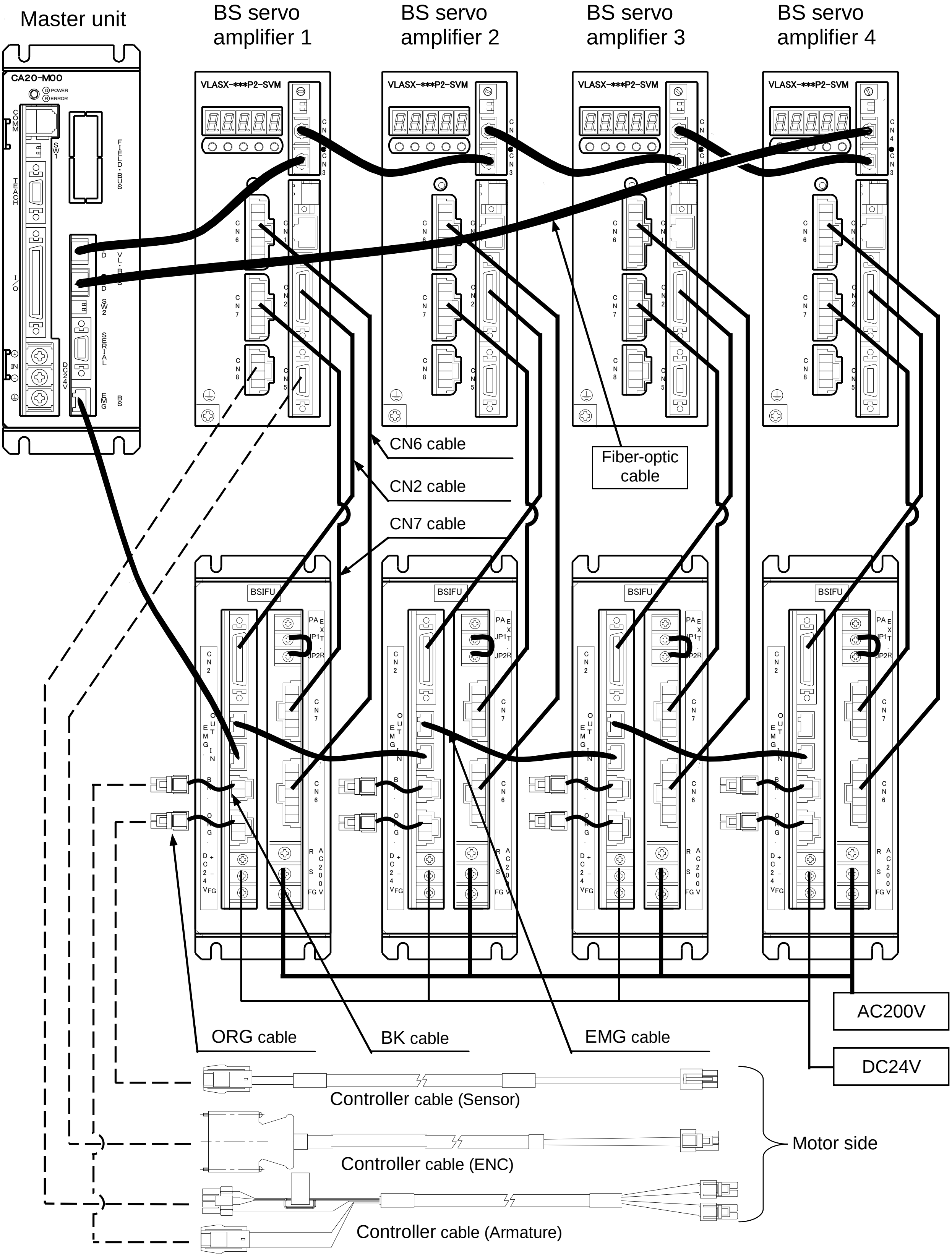
② CN6 cables, CN7 cables and CN2 cables are connected to CN6 connector, CN7 connector and CN2 connector of BS servo amplifier and BSIFU respectively.

③ EMG cables are connected from emergency stop output connector (BS EMG) of CA20-M00/M01 to “IN” of emergency stop input/output connector of BSIFU, from “OUT” of emergency stop input/output connector of the BSIFU to “IN” of emergency stop input/output connector of other BSIFU similarly.

④ BK cables are connected to motor brake connector (BK) of BSIFU and controller cable.

⑤ ORG cables are connected to limit switch connector (ORG) of BSIFU and controller cable.

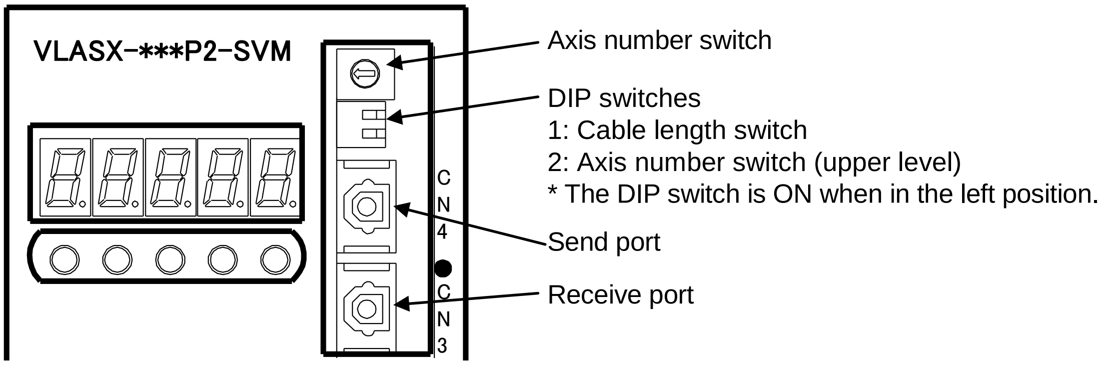
The figure below shows a connection example where the axes 1 to 4 use BS servo amplifiers.
Wire the controller cables to BS servo amplifier 2 or more the same as BS servo amplifier 1.



●The connection method is identical when the master unit is the CA20-M01.

(2) Axis number settings

The axis numbers must be assigned for the servo amplifier. Also, a fiber-optic cable is used to connect to the BS servo amplifier, but the switch setting must be changed to match the cable length. Follow the procedure in the figure below. (The maximum cable length is 20 meters.) Always set the axis numbers starting from 0 to the total number of axes – 1. An error will occur if a number is skipped (such as 0, 1, 3, …) or the same number is set twice. The cable connection numbers and axis numbers do not need to be matched together.



(3) Switch settings for axis numbers

Axis No.	Axis No. switch	DIP switch 2
1	0	OFF
2	1	OFF
3	2	OFF
4	3	OFF

(Note) The power must be turned off and on again for new axis number settings to be enabled.

(4) Switch settings for cable length (BS servo amplifier)

Cable length	DIP switch 1
Up to 10 m	OFF
From 10 m to 20 m	ON

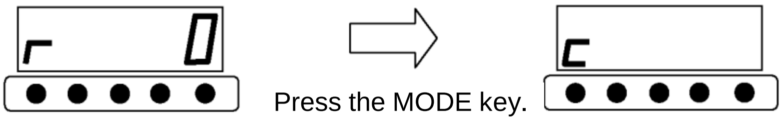
The cable length is the length of the cable to CN4 (send port).

The master unit is set by the mode setting M16 (send fiber-optic cable length).

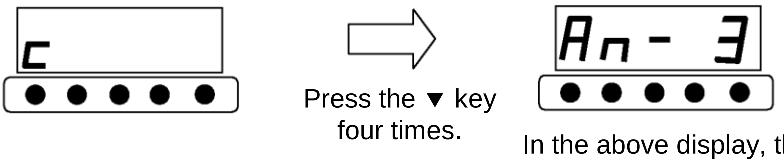
(5) Axis number check

After assigning the axis number, check the number on the operation display unit.
The axis number is the number after "An-". If the number is flashing, the axis number setting has not been enabled, and so turn the power off and then on again.

Change the display to "c".



Set the display to "An-**".



In the above display, the axis number setting is "3".

(6) Fiber-optic cable usage notes

General specifications	
Operating environment temperature	0°C to 60°C
Operating environment humidity	10% to 90% RH
Tensile strength	7 kg
Minimum bending radius	50 mm
Plug removal strength	3 kg

1. Do not apply a force that exceeds the maximum allowable tensile force. This can cause reduced performance or damage to the cables.
2. Do not install with a smaller bending radius than the minimum bending radius. This can cause reduced performance or damage to the cables.
3. Do not twist the fiber-optic cables. This can cause reduced performance or damage to the cables.
4. If the fiber-optic cables are installed inside a conduit pipe or when they are bundled together with other cable wires, the plasticizing material contained in the conduit pipe and wire can be transferred to the fiber-optic cable and cause reduced performance. Do not allow the fiber-optic cables to come into direct contact with soft PVC materials.
5. Be sure to always grasp the connector when inserting and removing the fiber-optic connector. Failure to do this can cause reduced performance or damage to the cables.
6. Do not apply excessive force, or subject the cable to shocks such as by dropping tools on a cable. This can cause reduced performance or damage to the cables.
7. Exposing the fiber-optic cables to high-temperature, high-humidity environments can accelerate reduced performance of the cables.

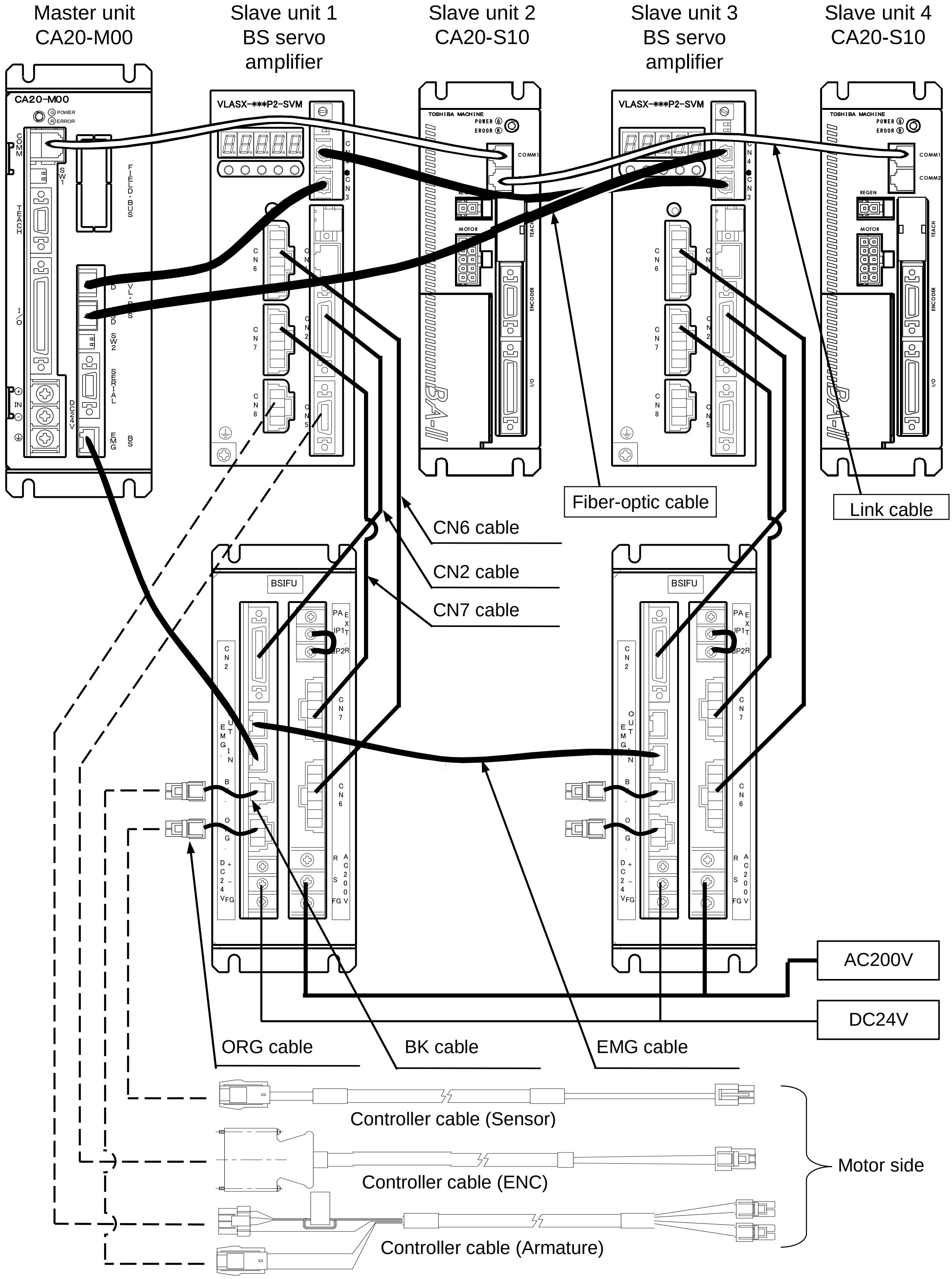
8. Applying a side pressure to the fiber-optic cables can cause reduced performance or damage to the cables. Avoid stepping on and securing the cables with excessive force.
9. Performance of the fiber-optic cables can be reduced by ultraviolet rays, X-rays, and other radiation. Therefore, avoid using the cables outdoors and in environments exposed to radiation.
10. Do not use in applications where the cables can come into direct contact with food products.
11. The fiber-optic cables are flammable objects. Use and store the cables within the operating and storage temperature and humidity ranges.
12. Leaving dust and other debris on the fiber-optic ends and connectors can cause reduced performance and damage to the cables.
13. Use water or a diluted neutral detergent to clean the fiber-optic cables.
14. Solvents that remain on fiber-optic cables can cause reduced performance or damage to the cables.
15. Request disposal of the fiber-optic cables by an industrial waste disposal company with incinerator facilities capable of handling hydrofluoric gas and chlorine gas.

■ 11.5.2 Usage with the slave units CA20-S10 and CA20-S40

(1) Controller connection example

If using the master unit together with the BS servo amplifier, CA20-S10, or CA20-S40, the BS servo amplifier uses the fiber-optic communication connectors (TD, SD), and the CA20-S10 and CA20-S40 use the communication connectors (COMM1, COMM2).

The figure below shows a connection example where the axes 1 and 3 use BS servo amplifiers and the axes 2 and 4 use CA20-S10 units. Wire the controller cables to slave unit 3 the same as slave unit 1.



- The connection method is identical when the master unit is the CA20-M01.

(2) Axis number settings

When the BS servo amplifier and CA20-S10 or CA20-S40 are used together, always set the axis numbers of the BS servo amplifiers starting from 0 to the total number of BS servo amplifiers – 1. An error will occur if a number is skipped (such as 0, 1, 3, …) or the same number is set twice. For the axis numbers of the CA20-S10 and CA20-S40 units, assign the same number as the axis number. Communication cannot be performed properly if a different number is set.
For the setting method of the BS servo amplifier axis numbers, refer to section 11.5.1. For the setting method of the CA20-S10 and CA20-S40 axis numbers, see section 2.4.4.

* In some cases, the same number will be entered for the setting value of the BS servo amplifier and the CA20-S10, but an error will not occur. Set the same number.

Connection example 1

The table below shows a setting example when the axes 1 and 3 use BS servo amplifiers and the axes 2 and 4 use CA20-S10 units.

Axis No.	Slave unit type	Axis No. switch	
1	BS servo amplifier	0	← BS servo amplifier starts from 0
2	CA20-S10	2	← Set to same number as axis number
3	BS servo amplifier	1	← Second BS servo amplifier
4	CA20-S10	4	← Set to same number as axis number

Connection example 2

The table below shows a setting example when the axes 1 and 2 use BS servo amplifiers and the axes 3 and 4 use CA20-S10 units.

Axis No.	Slave unit type	Axis No. switch	
1	BS servo amplifier	0	← BS servo amplifier starts from 0
2	BS servo amplifier	1	← Second BS servo amplifier
3	CA20-S10	3	← Set to same number as axis number
4	CA20-S10	4	← Set to same number as axis number

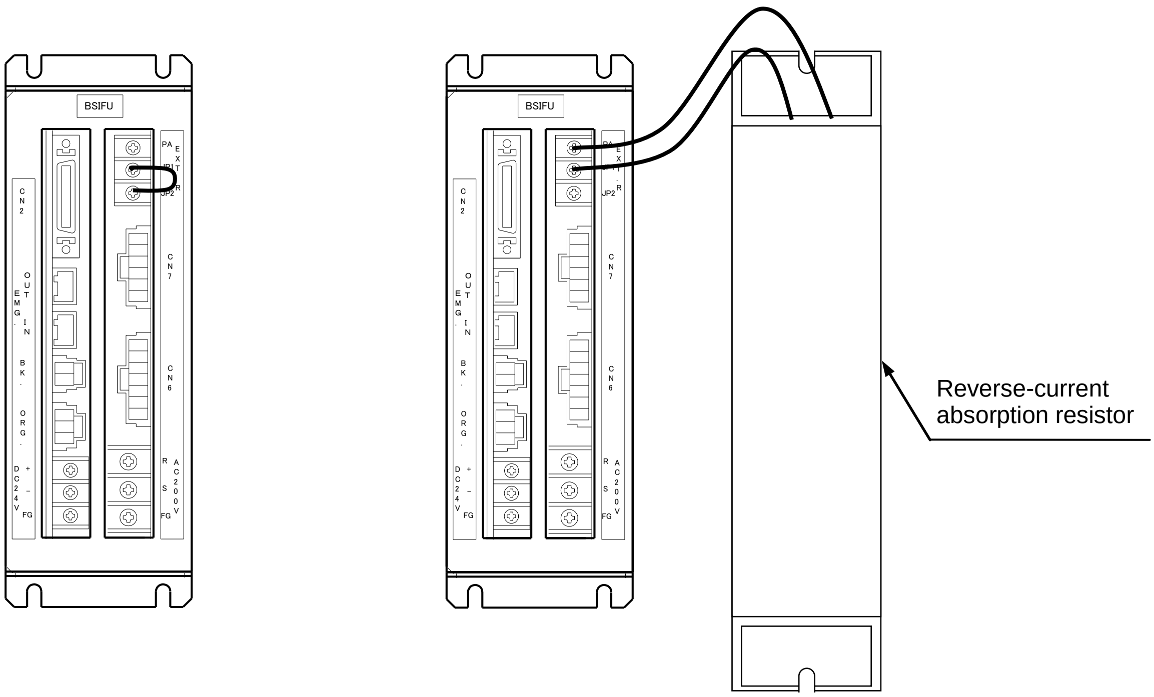
Connection example 3

The table below shows a setting example when the axes 1 and 2 use CA20-S10 units and the axes 3 and 4 use BS servo amplifiers.

Axis No.	Slave unit type	Axis No. switch	
1	CA20-S10	1	← Set to same number as axis number
2	CA20-S10	2	← Set to same number as axis number
3	BS servo amplifier	0	← BS servo amplifier starts from 0
4	BS servo amplifier	1	← Second BS servo amplifier

■ 11.6 Mounting the reverse-current absorption resistor

A reverse-current absorption resistor is built into the servo amplifier, but when an absorption resistor is mounted externally, it cannot be used together with the internal resistor. As a result, the short-circuit connection mounted between JP1 and JP2 must be removed, and the reverse-current absorption resistor must be connected between PA and JP1. Moreover, set the value and the capacity of external reverse-current absorption resistor in U21 (Setting of external reverse-current absorption resistance value) and U22 (Setting of external reverse-current absorption resistor allowable value). (Refer to section 14.5.2 and 14.5.3)
For details, refer to the BS servo amplifier operating manual.
The figure below shows the connection method of external reverse-current absorption resistor when BSIFU is used.



When internal resistor is used
(When shipped from the factory)

When external reverse-current
absorption resistor is used

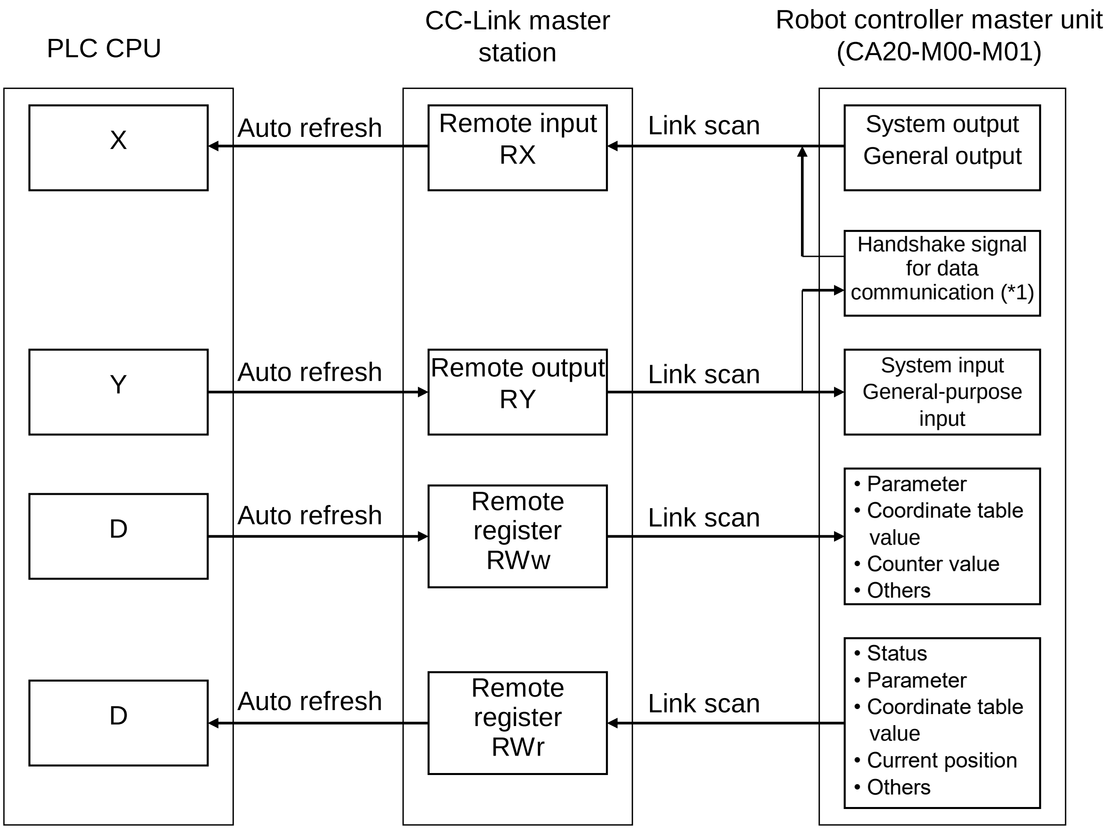
Chapter 12 CC-Link

■ 12.1 CC-Link Function

This controller enables adding of a CC-Link function as a Fieldbus interface option for external devices. This chapter describes the CC-Link interface.
CC-Link (Control & Communication Link) is a field network interface that features a minimized wiring design and enables high-speed data communication. The CC-Link interface enables data communication for various input/output, coordinate tables, statuses, and jog operation.

■ 12.1.1 Outline of CC-Link

This controller serves as the remote device station (Fixed at four (4) stations) and allows communication of I/O data and other data.
Data communication is performed through remote registers RWw and RWr, and some of remote inputs RX and remote outputs RY are used.



?

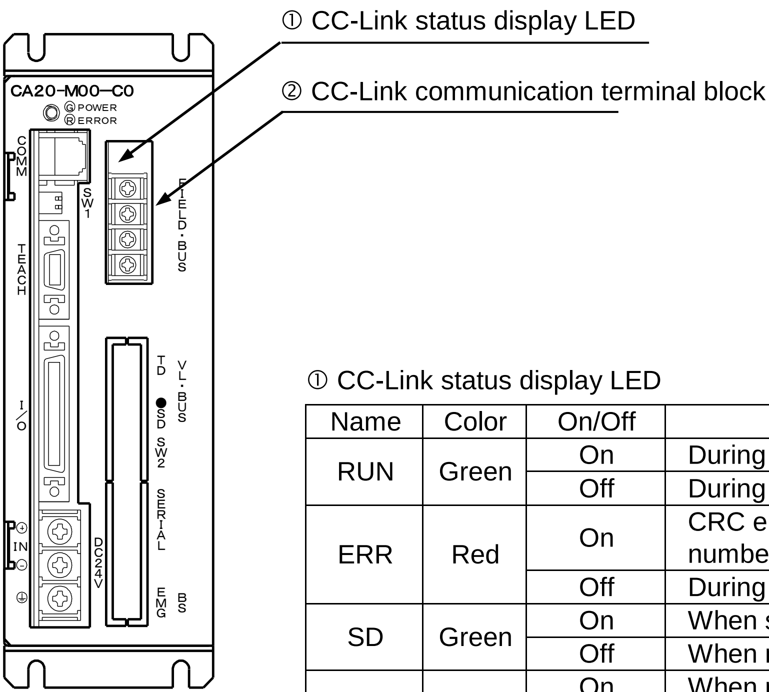
*1 The data communication handshake signal on the robot controller side is created by the robot controller automatically.

■ 12.1.2 CC-Link specifications

Item	Specification
Transmission specifications	CC-Link Ver 1.10
Communication speed	10M/5M/2.5M/625k/156kbps (Set by parameter)
Station type	Remote device station
Number of occupied stations	Fixed at 4 stations (RX/RY: 128 points each, RWw/RWr: 16 points each)
Station number setting	1 – 64 (Set by parameter)
Number of input/output points	System input: 4 points, System output: 4 points
	General-purpose input: 64 points, General-purpose output: 64 points
	Jog input: 8 points, Jog output: 8 points
	Handshake input: 1 point, Handshake output: 2 points
	Data selection input: 4 points, Data selection check output: 4 points
Data communication functions	Coordinate table sending and receiving, current position monitor, error code request, status request, etc.

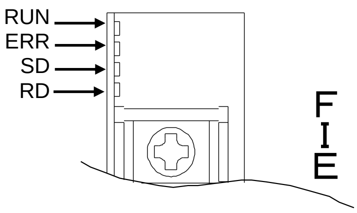
*: The input and output are based on the direction viewed from the robot controller.

■ 12.1.3 Explanation of CC-Link component



① CC-Link status display LED

This displays the CC-Link status.



① CC-Link status display LED

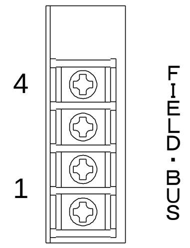
Name	Color	On/Off	Description
RUN	Green	On	During normal operation
		Off	During timeout or network stoppage
ERR	Red	On	CRC error, error speed, error station number setting
		Off	During normal operation
SD	Green	On	When sending data
		Off	When not sending data
RD	Green	On	When receiving data
		Off	When not receiving data

- The CC-Link components for the CA20-M01 are identical to the figure above.

② CC-Link connection terminal block

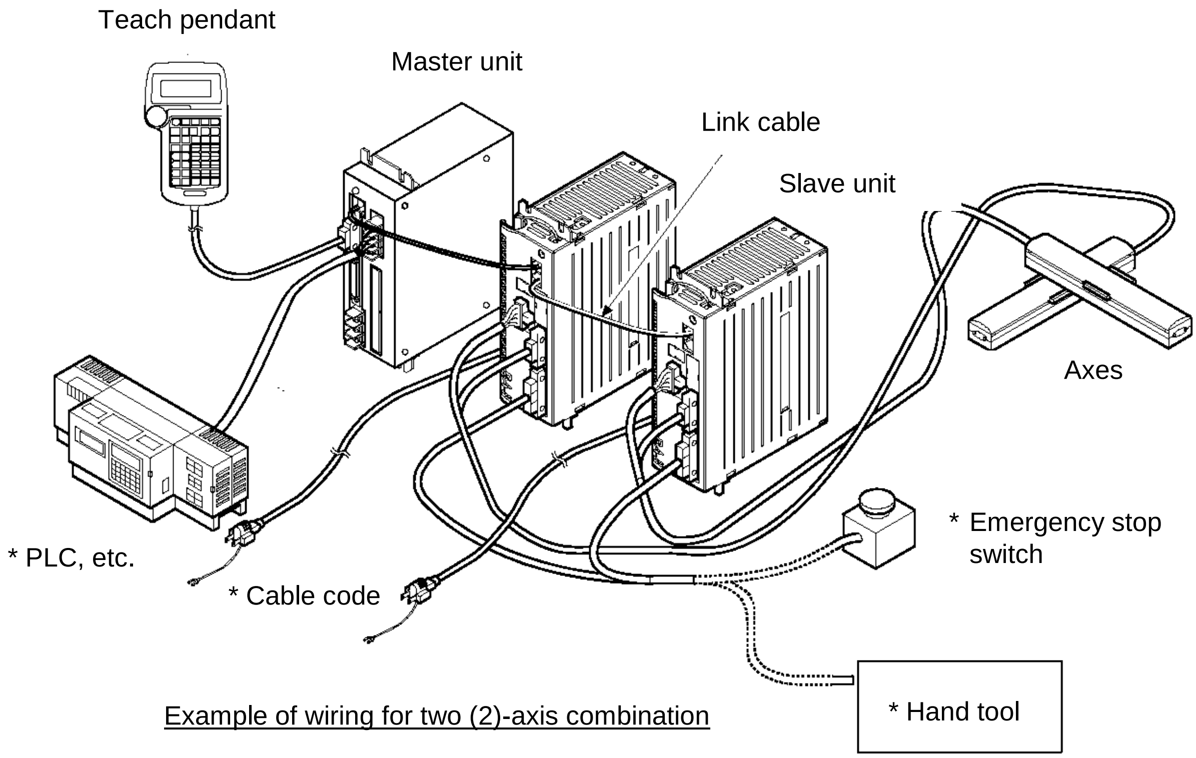
The exclusive CC-Link cable for data linkage is connected to this terminal block.

Pin No.	Signal name	Wire color
4	Shield (SLD)	Shield
3	Digital ground (DG)	Yellow
2	Communication line (DB)	White
1	Communication line (DA)	Blue



■ 12.1.4 Connecting the axis and controller

Connect the PLC, etc. to the controller as shown below.



Example of wiring for two (2)-axis combination

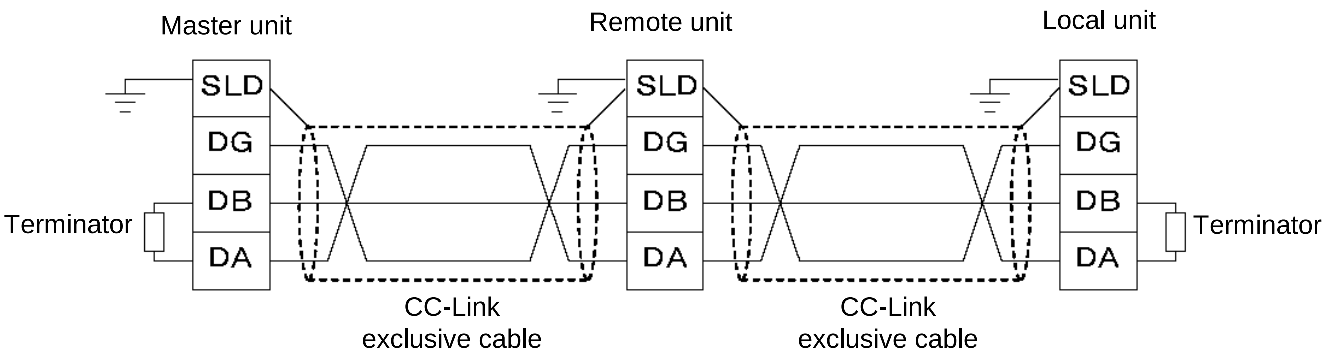
* Items marked * are to be provided by the customer.

■ 12.1.5 Connection of CC-Link exclusive cable

The order of cable connection is unrelated to the station number.
Be sure to connect the terminators for the units located at both ends of the CC-Link system.
Connect each terminator between DA and DB.
In the CC-Link system, the terminator to be connected differs with the cable to be used.

Type of cable	Terminator
CC-Link exclusive cable	110 Ω, 1/2 W (Brown, brown, brown)
CC-Link exclusive cable designed for Ver 1.10	
CC-Link exclusive high-performance cable	130 Ω, 1/2 W (Brown, orange, brown)

No terminator is attached to this controller.
The master unit can be located at other than the both ends.
Star-connection is not possible.
The connecting method is shown below.



For details on the cable connection, see the master station instruction manual and CC-Link cable wiring manual (published by the CC-Link Partner Association).

■ 12.1.6 CC-Link settings

(1) Setting of CA20-M00/M01
The CC-Link station number and transmission speed are specified in "CC-Link Settings" in the mode settings. (Refer to section 14.2.17.)

(2) Setting of CC-Link master station
Set the CC-Link master station according to the master station instruction manual. The type of CA20–M00–M01 is the remote device station, and the number of exclusive stations is four (4).

■ 12.2 Connection with External Devices

■ 12.2.1 List of master unit I/O signals

Signal direction: CC-Link master station ← CA20–M00/M01		Signal direction: CC-Link master station → CA20–M00/M01	
Device No. (Input)	Signal name	Device No. (Output)	Signal name
RXn0	"Running" output	RYn0	Return to origin input
RXn1	Error output	RYn1	Start input
RXn2	Positioning finish output	RYn2	Stop input
RXn3	Return to origin finish output	RYn3	Reset input
RXn4~RXn7	Use prohibited	RYn4~RYn7	Use prohibited
RXn8~RXnF	General output port 1–1 ~ 8	RYn8~RYnF	General input port 1–1 ~ 8
RX(n+1)0~RX(n+1)7	General output port 2–1 ~ 8	RY(n+1)0~RY(n+1)7	General input port 2–1 ~ 8
RX(n+1)8~RX(n+1)F	General output port 3–1 ~ 8	RY(n+1)8~RY(n+1)F	General input port 3–1 ~ 8
RX(n+2)0~RX(n+2)7	General output port 4–1 ~ 8	RY(n+2)0~RY(n+2)7	General input port 4–1 ~ 8
RX(n+2)8~RX(n+2)F	General output port 5–1 ~ 8	RY(n+2)8~RY(n+2)F	General input port 5–1 ~ 8
RX(n+3)0~RX(n+3)7	General output port 6–1 ~ 8	RY(n+3)0~RY(n+3)7	General input port 6–1 ~ 8
RX(n+3)8~RX(n+3)F	General output port 7–1 ~ 8	RY(n+3)8~RY(n+3)F	General input port 7–1 ~ 8
RX(n+4)0~RX(n+4)7	General output port 8–1 ~ 8	RY(n+4)0~RY(n+4)7	General input port 8–1 ~ 8
RX(n+4)8~RX(n+4)F	Jog output (*3)	RY(n+4)8~RY(n+4)F	Jog input (*3)
RX(n+5)0~RX(n+5)7	Reserved (*1)	RY(n+5)0~RY(n+5)7	Reserved (*1)
RX(n+5)8~RX(n+5)F		RY(n+5)8~RY(n+5)F	
RX(n+6)0~RX(n+6)7		RY(n+6)0~RY(n+6)7	
RX(n+6)8	Command processing finish (*2)	RY(n+6)8	Request for command processing (*2)
RX(n+6)9	Command error (*2)	RY(n+6)9	Use prohibited
RX(n+6)A~RX(n+6)B	Use prohibited	RY(n+6)A~RY(n+6)B	Use prohibited
RX(n+6)C~RX(n+6)F	Data selection check output	RY(n+6)C~RY(n+6)F	Data selection input
RX(n+7)0~RX(n+7)7	Use prohibited	RY(n+7)0~RY(n+7)7	Use prohibited
RX(n+7)8~RX(n+7)F	Use prohibited	RY(n+7)8~RY(n+7)F	Use prohibited

n: Address assigned to the master unit by station number setting.

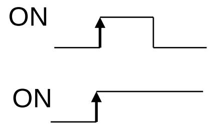
*1 Area reserved for future extension of function.

*2 Handshake signal for data transmission.

*3 Refer to sections 12.2.3 and 12.2.4.

■ 12.2.2 System I/O

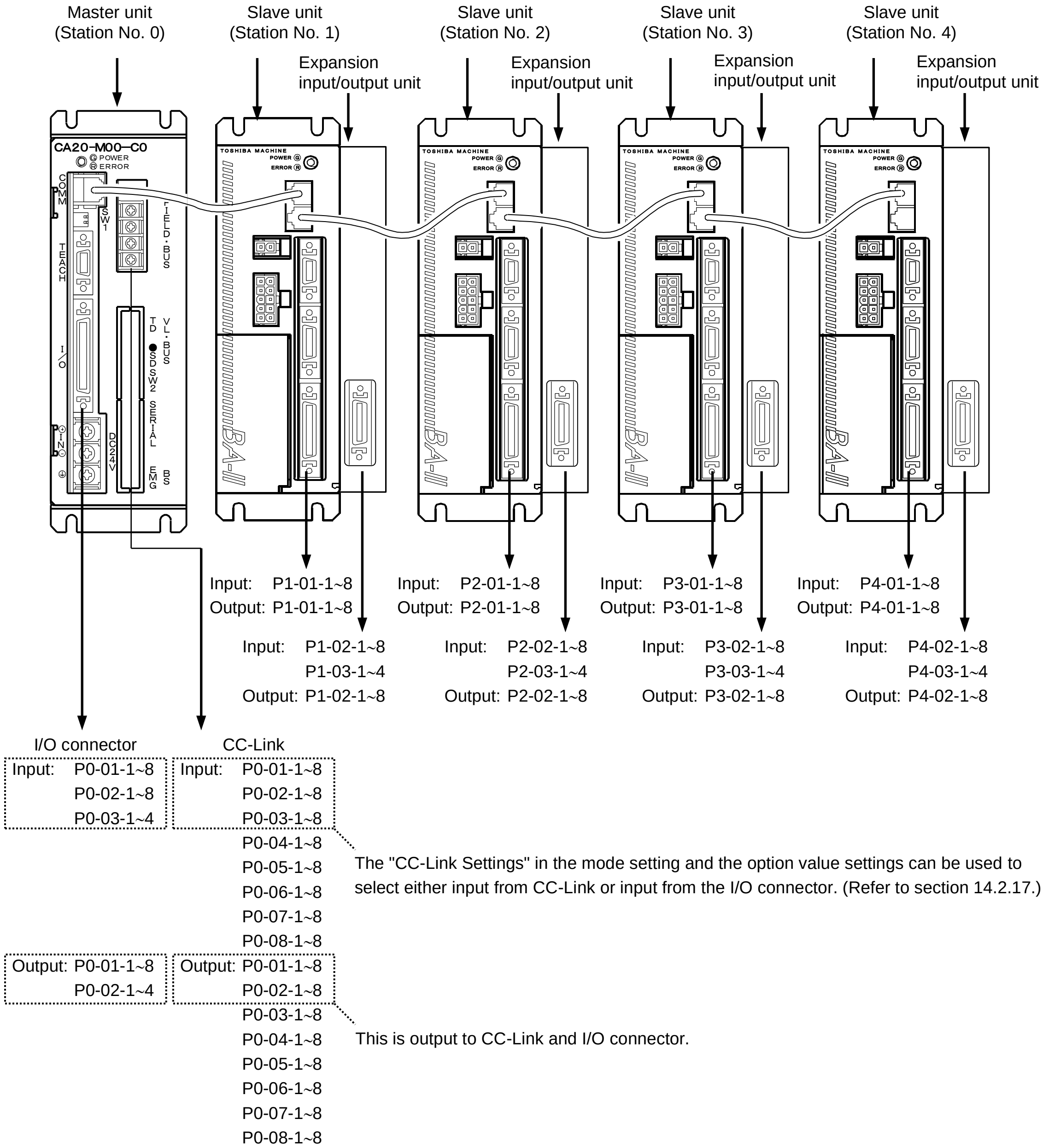
(1) System input (CC-Link master station → CA20–M00/M01)

Signal name	Remote output	Normal mode	External point designation mode	Remarks
Return to origin	RYn0	ON: Start of return to origin operation.	Return to origin	Detection of leading edge
Start	RYn1	ON: Restart from currently stopped step or from feed hold state.	ON: Starts moving based on currently specified table information.	
Stop	RYn2	ON: Stops after current step has been executed.	Invalid	When this input is ON, return to origin and start input are invalid.
Reset	RYn3	ON: Cancels an error status. (Valid while program execution is stopped.)	ON: Cancels an error status.	
Jog input	RY(n+4)8 ~ RY(n+4)F	A selected axis is moved by jogging after the motion mode (jog, low-speed or high-speed) and travel direction are specified.		Section 12.2.4.

(2) System output (CA10–M01–CC → CC-Link master station)

Signal name	Remote input	Normal mode	External point designation mode	Ref.
Running	RXn0	ON during controller operation and during return to origin.	ON during robot operation.	Section 10.2.11
Error	RXn1	ON at error generation.	ON at error generation.	Section 10.2.12
Positioning finish	RXn2	ON when the robot has been located at a predetermined position. OFF while the robot is moving. (Remains OFF when it is paused.)	ON when the robot has been located at a predetermined position. OFF while the robot is moving. (Remains OFF when it is paused.)	Section 10.2.13
Return to origin finish	RXn3	ON when each axis is located at the home position after finish of return to origin and HOME command execution.	ON when the return to origin has finished with each axis located at the home position.	Section 10.2.14
Jog output	RX(n+4)8 ~ RX(n+4)F	Acceptance or rejection of jog, active status, etc. are displayed.		Section 12.2.4

■ 12.2.3 Name of General-Purpose I/O Port and Teach Pendant Display



- For details on the port numbers and support for remote input (RX) and remote output (RY), refer to section 12.2.1.
- The names of the general-purpose input/output ports in CA20-M01 are identical to those in the figure above.

■ 12.2.4 Jog Input/Output

(1) List of jog input/output signals

Signal direction: CC-Link master station ← CA20–M00–01		Signal direction: CC-Link master station → CA20–M00–M01	
Device No. (Input)	Signal name	Device No. (Output)	Signal name
RX(n+4)8	"Axis 1 jogging" output	RY(n+4)8	"Request axis 1 jog" input
RX(n+4)9	"Axis 2 jogging" output	RY(n+4)9	"Request axis 2 jog" input
RX(n+4)A	"Axis 3 jogging" output	RY(n+4)A	"Request axis 3 jog" input
RX(n+4)B	"Axis 4 jogging" output	RY(n+4)B	"Request axis 4 jog" input
RX(n+4)C	Jog-ready output	RY(n+4)C	"Request inching" input
RX(n+4)D	Unused	RY(n+4)D	"Request low-speed jog" input
RX(n+4)E	Unused	RY(n+4)E	"Request high-speed jog" input
RX(n+4)F	Unused	RY(n+4)F	"Designate jog direction" input OFF: + direction, ON: – direction

- While the jog conditions (inching, high-speed travel, low-speed travel) and travel direction are specified and the "request jog" input is ON, corresponding axis moves at jogging. (See Fig. 12.2.4–1.)
- Jogging by I/O signal is not accepted as long as the jog accept signal is OFF. The jog accept signal is OFF under the following conditions.
  - While the robot is controlled through the teach pendant (T/P).
    → While the T/P is connected and turned on.
  - While the robot is controlled by the personal computer software.
    → While the execution screen of the personal computer software is opened.
  - While the "running" output (RXn0) is ON.
  - While the error output (RXn1) is ON.
- When the multiple bits for the "request inching" input, "request low-speed jog" input and "request high-speed jog" input are ON, the motions are executed according to the following order.
  Inching > Low-speed jog > High-speed jog
- It is not possible to simultaneously move two (2) or more axes at jogging. Move each axis separately.
- The axis stops if the communication through the CC-Link has been severed during jogging.

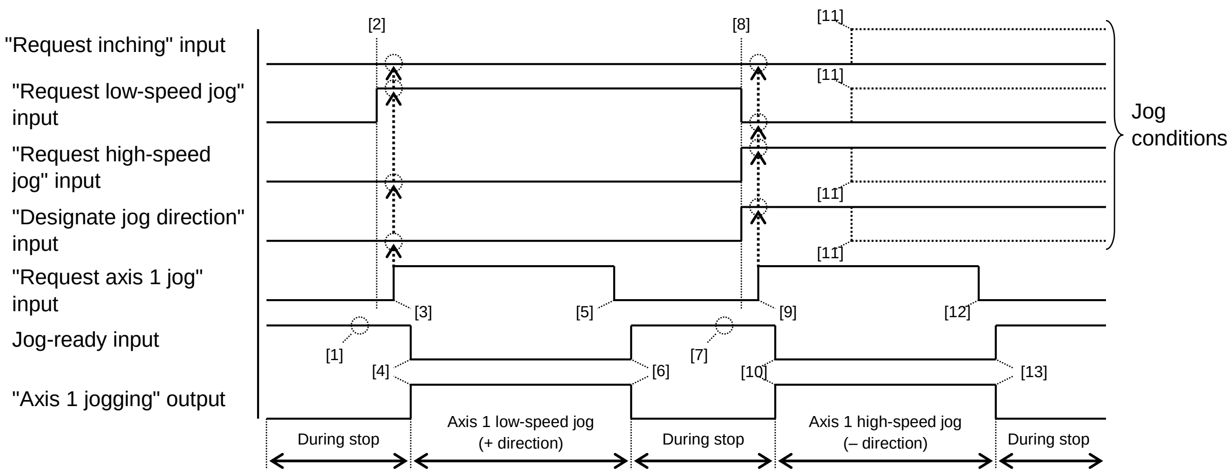


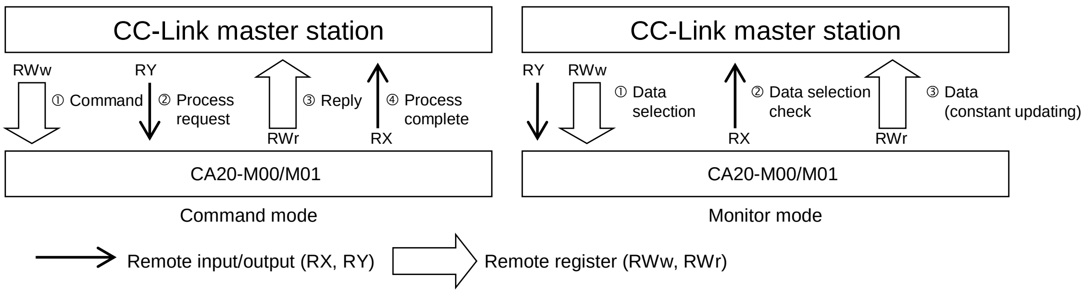
Fig. 12.2.4–1 Example of axis 1 travel

① Make sure that the jog-ready signal is ON.
② Set the jog conditions. (In the above figure, low-speed jog and plus "+" direction are specified.)
③ Turn on the "request axis 1 jog" input. (With this timing, the jog conditions are input.)
④ The jog-ready output turns off and the "axis 1 jogging" output turns on. Then the axis 1 starts jogging at low speed in the plus "+" direction.
⑤ To stop the axis, turn off the "request axis 1 jog" input signal.
⑥ The jog-ready output turns on and the "axis 1 jogging" output turns off. Then the axis 1 jogging at low speed in the plus "+" direction stops.
⑦ Make sure that the jog-ready signal is ON.
⑧ Set the jog conditions. (In the above figure, high-speed jog and "–" direction are specified.)
⑨ Turn on the "request axis 1 jog" input. (With this timing, the jog conditions are input.)
⑩ The jog-ready output turns off and the "axis 1 jogging" output turns on. Then the axis 1 starts jogging at high speed in the minus "–" direction.
⑪ Even if the jog conditions have been changed during travel, they are neglected.
⑫ To stop the axis, turn off the "request axis 1 jog" input signal.
⑬ The jog-ready output turns on and the "axis 1 jogging" output turns off. Then the axis 1 jogging at high speed in the minus "–" direction stops.

■ 12.3 Data Communication

■ 12.3.1 Overview of data communication

Two types of data communication are available: Command mode and Monitor mode.
In Command mode, the CA20-M00/M01 returns reply to commands from the CC-Link master station. Although this enables complex data communication, its characteristic of returning replies to commands requires a certain amount of time for the data updating cycle.
In Monitor mode, the data selected by data selection input [RY(n+6)C to RY(n+6)F] and RWw(n) is constantly updated. This eliminates the need for complex handshake signals for realizing high-speed updating cycles.

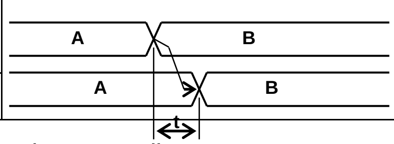


In Command mode, set all the data selection input [RY(n+6)C to RY(n+6)F] to 0. In Monitor mode, set from 0001 to 1111 based on the monitoring content.

No	RY(n+6)F	RY(n+6)E	RY(n+6)D	RY(n+6)C	Mode	Description
1	0	0	0	0	Command mode (section 12.3.2)	Status request Writing/Reading of coordinate table Current position request (monitor) Current offset value request (monitor) Counter value request (monitor) Counter set Writing/Reading of speed table (Note 2) Writing/Reading of acceleration/deceleration table (Note 2) Writing/Reading of override (Note 2)
2	0	0	0	1	Monitor mode (section 12.3.3)	Status monitor
3	0	0	1	0		Current position monitor
4	0	0	1	1		Counter monitor (Note 1) ① Arbitrary selection mode (RWw(n) = 0000h) ② Designated sequence number mode (RWw(n) = 0001h)
	···	···	···	···		Reserved
16	1	1	1	1		Reserved

Note 1: The counter monitor is controlled by a controller in version 4.25 or later.
Note 2: The counter monitor is controlled by a controller in version 4.33 or later.

The value of the data selection input [RY(n+6)C to RY(n+6)F] is output unchanged to the data selection check output [RX(n+6)C to RX(n+6)F]. During this output, a time difference (t = several 10 mSEC) occurs, and so pay attention to the timing when changing.

Signal name	Device	Timing
Data selection input signal	RY(n+6)C～RY(n+6)F	
Data selection check output signal	RX(n+6)C～RX(n+6)F	

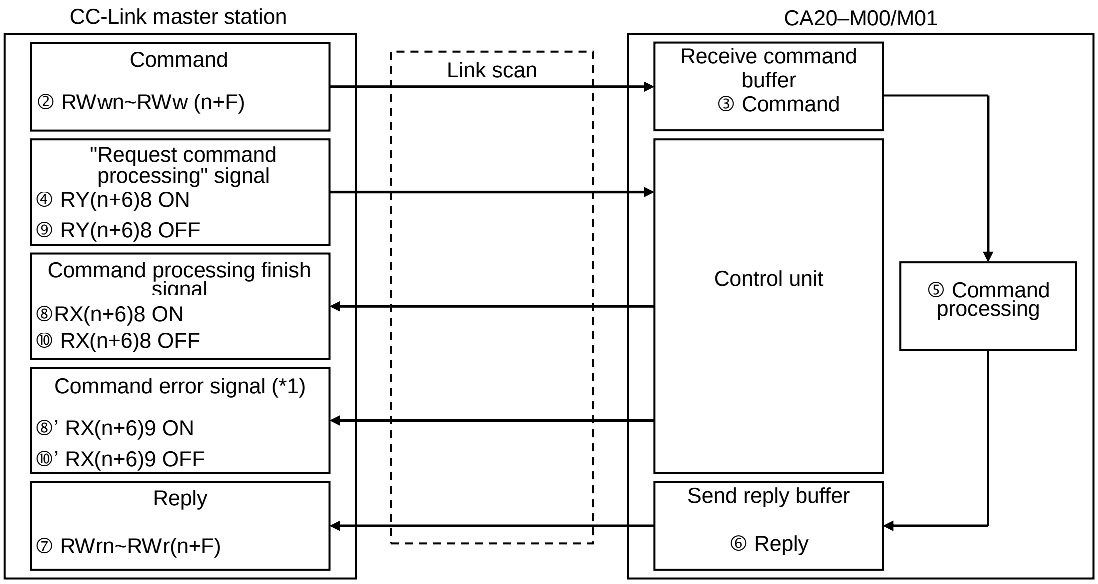
*: The input and output are based on the direction viewed from the robot controller.

■ 12.3.2 Command mode

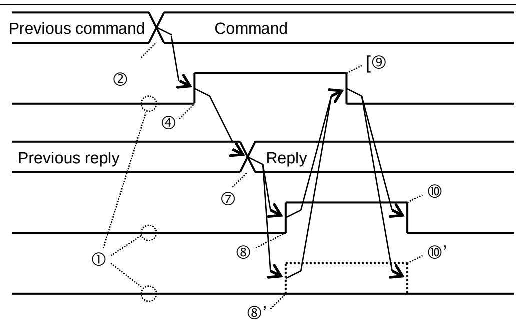
In the relationship between the CA20-M00/M01 and CC-Link master station, the CC-Link master station is always the main station, and the CA20-M00/M01 is the secondary station. Communication uses a half-duplex system where the CC-Link master station issues commands and the CA20-M00/M01 sends back a reply.
When the CA20-M00/M01 receives a command that can be processed, an affirmative response or the necessary data is returned. If the process is not possible because the CA20-M00/M01 is busy or other reasons, an error reply is returned.

■ 12.3.2.1 Transmitting and receiving data

(1) Data flow and timing



(*1) Only when an error has occurred.

Signal name	Device	Timing
Command	RWwn ~ RWw(n+F)	
"Request command processing" signal	RY(n+6)8	
Reply	RWrn ~ RWr(n+F)	
Command processing finish signal	RX(n+6)8	
Command error signal	RX(n+6)9	
Data selection input signal	RY(n+6)C～RY(n+6)F	0000
Data selection check output signal	RX(n+6)C～RX(n+6)F	0000

Set the data selection input RY(n+6)C to RY(n+6)F to 0000.

① Before sending a command, make sure that all handshake signals ("request command processing" signal, command processing finish signal and command error signal) are set OFF.
② Set the command in the remote register.
③ The command set in the remote register is transferred to the CA10–M01–CC "receive command" buffer via the link scan of the CC-Link.
④ The "request command processing" signal is turned on.
⑤ The command is processed based on the data in the "receive command" buffer in Step ③ above.
⑥ The results are set in the "send reply" buffer.
⑦ The response set in the "send reply" buffer is transferred to the remote register of the CC-Link master station via the link scan of the CC-Link.
⑧ The command processing finish signal turns on.
⑧' If an error has occurred, the command error signal turns on at the same time.
⑨ The "request command processing" signal turns off.
⑩ The command processing finish signal turns off.
⑩' If the command error signal is ON, it turns off at the same time.

■ 12.3.2.2 Command table

No.	Description	Mode	Command/ reply	Remote register (Command = RWwn, Reply = RWrn)					
				+0	+1	+2	+3	+4 ~ +B	+C ~ +F
1	Request status	∓	Command	B900H	Status No.				Reserved (0 fixed)
			Reply			Status value	Error code		Reserved (0 fixed)
2	Write coordinate table	∓	Command	C2C1H	Table No.	0 (fixed)	0 (fixed)	Axis 1 ~ Axis 4 coordinates	Reserved (0 fixed)
			Reply		0 (fixed)	0 (fixed)	Error code		Reserved (0 fixed)
3	Read coordinate table	∓	Command	C3C1H	Table No.				Reserved (0 fixed)
			Reply			0 (fixed)	Error code	Axis 1 ~ Axis 4 coordinates	Reserved (0 fixed)
4	Request current position (monitor)	∓	Command	E300H					Reserved (0 fixed)
			Reply		0 (fixed)	0 (fixed)	Error code	Axis 1 ~ Axis 4 coordinates	Reserved (0 fixed)
5	Request current offset value (monitor)	∓	Command	E400H					Reserved (0 fixed)
			Reply		0 (fixed)	0 (fixed)	Error code	Axis 1 ~ Axis 4 coordinates	Reserved (0 fixed)
6	Request counter value (monitor)	∓	Command	E500H	Counter No.				Reserved (0 fixed)
			Reply			Counter value	Error code		Reserved (0 fixed)
7	Set counter	∓	Send	E700H	Counter No.	Counter value			Reserved (0 fixed)
			Reply		0 (fixed)	0 (fixed)	Error code		Reserved (0 fixed)
8	Write speed table	∓	Send	C2C2H	Table No.	0 (fixed)	0 (fixed)	Speed	Reserved (0 fixed)
			Reply		0 (fixed)	0 (fixed)	Error code		Reserved (0 fixed)
9	Read speed table	∓	Send	C3C2H	Table No.				Reserved (0 fixed)
			Reply			0 (fixed)	Error code	Speed	Reserved (0 fixed)
10	Write acceleration/ deceleration table	∓	Send	C2C3H	Table No.	0 (fixed)	0 (fixed)	Acceleration/ deceleration time	Reserved (0 fixed)
			Reply		0 (fixed)	0 (fixed)	Error code		Reserved (0 fixed)
11	Read acceleration/ deceleration table	∓	Send	C3C3H	Table No.				Reserved (0 fixed)
			Reply			0 (fixed)	Error code	Acceleration/ deceleration time	Reserved (0 fixed)
12	Write override	∓	Send	D900H	Override				Reserved (0 fixed)
			Reply		0 (fixed)	0 (fixed)	Error code		Reserved (0 fixed)
13	Read override	∓	Send	DA00H					Reserved (0 fixed)
			Reply		Override	0 (fixed)	Error code		Reserved (0 fixed)

∓ Can be accepted at all times.
ℓ Can be accepted only when the program is stopped. (If data is transmitted during program execution, an error occurs.)

Error code
- 0000H Normal
- 1000H Command analysis error (An error is found in the command.)
- 20**H Command cannot be executed. (See the explanation of each command.)

■ 12.3.2.3 Descriptions on each command

(1) "Request Status" Command (B900H)

Command (CC-Link master station → CA20-M00 / M01)			
Remote register	b15------b8	b7------b0	Remarks
RWwn	B9H	00H	Command
RWw(n+1)	K0-K2		Status number
RWw(n+2) ~ RWw(n+F)	Fixed at "K0"		Use prohibited

Response (CC-Link master station ← CA20-M00 / M01)			
Remote register	b15------b8	b7------b0	Remarks
RWrn	B9H	00H	Same value as command
RWr(n+1)	K0-K2		Status number
RWr(n+2)	00	**H	Status value (*1)
RWr(n+3)	Error code		
RWr(n+4) ~ RWr(n+F)	Fixed at "K0"		Unused

? *1 The status value is saved in the lower byte. The upper byte is always fixed at "00".
Error code
0000H Normal
1000H Command analysis error (An error is found in the command.)

Details of each status

Status 0	
BIT	Description
0	1: Error is found.
1	1: During execution
2	1: During pause
3	1: During return to origin
4	1: Return to origin finish
5	1: Positioning finish
6	
7	1: Change in Parameter 2.

Status 1	
BIT	Description
0	Error code (See section 20.3.)
1	
2	
3	
4	
5	
6	
7	

Status 2	
BIT	Description
0 1	00: Sequential mode 01: Palletizing mode 10: External point designation mode 11: Easy mode
2 3	00: Auto mode 01: Step mode 10: Program mode
4	1: Single operation mode
5	1: Pulse frequency input mode
6	1: Teach pendant ON
7	1: Host computer ON

(2) "Write coordinate table" command (C2C1H)

<table>
<tr><th colspan="4">Command (CC-Link master station → CA20-M00 / M01)</th><th colspan="4">Response (CC-Link Master station ← CA20-M00 / M01)</th></tr>
<tr><td>Remote register</td><td>b15------b8</td><td>b7------b0</td><td>Remarks</td><td>Remote register</td><td>b15------b8</td><td>b7------b0</td><td>Remarks</td></tr>
<tr><td>RWwn</td><td>C2H</td><td>C1H</td><td>Command</td><td>RWrn</td><td>C2H</td><td>C1H</td><td>Same value as command</td></tr>
<tr><td>RWw(n+1)</td><td colspan="2">K1-K999</td><td>Table number</td><td>RWr(n+1)</td><td colspan="2">Fixed at "K0"</td><td>Unused</td></tr>
<tr><td>RWw(n+2)</td><td colspan="2">Fixed at "K0"</td><td>Use prohibited</td><td>RWr(n+2)</td><td colspan="2">Fixed at "K0"</td><td>Unused</td></tr>
<tr><td>RWw(n+3)</td><td colspan="2">Fixed at "K0"</td><td>Use prohibited</td><td>RWr(n+3)</td><td colspan="2">Error code</td><td></td></tr>
<tr><td>RWw(n+4)</td><td colspan="2" rowspan="2">K-800000～K+800000</td><td rowspan="2">Axis 1 coordinate</td><td rowspan="11">RWr(n+4)
～
RWr(n+F)</td><td colspan="2" rowspan="11">Fixed at “K0”</td><td rowspan="11">Unused</td></tr>
<tr><td>RWw(n+5)</td></tr>
<tr><td>RWw(n+6)</td><td colspan="2" rowspan="2">K-800000～K+800000</td><td rowspan="2">Axis 2 coordinate</td></tr>
<tr><td>RWw(n+7)</td></tr>
<tr><td>RWw(n+8)</td><td colspan="2" rowspan="2">K-800000～K+800000</td><td rowspan="2">Axis 3 coordinate</td></tr>
<tr><td>RWw(n+9)</td></tr>
<tr><td>RWw(n+A)</td><td colspan="2" rowspan="2">K-800000～K+800000</td><td rowspan="2">Axis 4 coordinate</td></tr>
<tr><td>RWw(n+B)</td></tr>
<tr><td>RWw(n+C)
～
RWw(n+F)</td><td colspan="2">Fixed at “K0”</td><td>Use prohibited</td></tr>
</table>

- Data length of coordinate value: 32 bits
- Unit of coordinate value: 0.01 [mm] (Ex.: +100.00 [mm] → K+10000)
- When wiring "********", specify H7FFFFFFF.

  Error code

  0000H Normal

  1000H Command analysis error (An error is found in the command.)

  2000H Command cannot be executed. (During command execution or during return to origin)

(3) "Read coordinate table" command (C3C1H)

Command (CC-Link master station → CA20-M00 / M01)			
Remote register	b15------b8	b7------b0	Remarks
RWwn	C3H	C1H	Command
RWw(n+1)	K1-K999		Table number
RWw(n+2) ~ RWw(n+F)	Fixed at “K0”		Use prohibited

Response (CC-Link master station ← CA20-M00 / M01)			
Remote register	b15------b8	b7------b0	Remarks
RWrn	C3H	C1H	Same value as command
RWr(n+1)	K1-K999		Table number
RWr(n+2)	Fixed at “K0”		Unused
RWr(n+3)	Error code		
RWr(n+4) RWr(n+5)	K-800000～K+800000		Axis 1 coordinate
RWr(n+6) RWr(n+7)	K-800000～K+800000		Axis 2 coordinate
RWr(n+8) RWr(n+9)	K-800000～K+800000		Axis 3 coordinate
RWr(n+A) RWr(n+B)	K-800000～K+800000		Axis 4 coordinate
RWr(n+C) ~ RWr(n+F)	Fixed at “K0”		Unused

- Data length of coordinate value: 32 bits
- Unit of coordinate value: 0.01 [mm] (Ex.: +100.00 [mm] → K+10000)
- When wiring "********", reply H7FFFFFFF.

  Error code

  0000H Normal

  1000H Command analysis error (An error is found in the command.)

  2003H Access to coordinate table is not possible. (During writing of EEPROM)

(4) "Request current position" (monitor) command (E300H)

Command (CC-Link master station → CA20-M00 / M01)				Response (CC-Link master station ← CA20-M00 / M01)			
Remote register	b15------b8	b7------b0	Remarks	Remote register	b15------b8	b7------b0	Remarks
RWwn	E3H	00	Command	RWrn	E3H	00H	Same value as command
RWw(n+1)				RWr(n+1)	Fixed at “K0”		Unused
RWw(n+2)				RWr(n+2)	Fixed at “K0”		Unused
RWw(n+3)				RWr(n+3)	Error code		
RWw(n+4)				RWr(n+4)	K-800000～K+800000		Axis 1 coordinate
RWw(n+5)				RWr(n+5)			
RWw(n+6)				RWr(n+6)	K-800000～K+800000		Axis 2 coordinate
RWw(n+7)				RWr(n+7)			
RWw(n+8)	Fixed at “K0”		Use prohibited	RWr(n+8)	K-800000～K+800000		Axis 3 coordinate
RWw(n+9)				RWr(n+9)			
RWw(n+A)				RWr(n+A)	K-800000～K+800000		Axis 4 coordinate
RWw(n+B)				RWr(n+B)			
RWw(n+C)				RWr(n+C)	Fixed at “K0”		Unused
RWw(n+D)				RWr(n+D)			
RWw(n+E)				RWr(n+E)			
RWw(n+F)				RWr(n+F)			

- Data length of coordinate value: 32 bits
- Unit of coordinate value: 0.01 [mm] (Ex.: +100.00 [mm] → K+10000)

Error code

0000H Normal

1000H Command analysis error (An error is found in the command.)

2003H Access to coordinate table is not possible. (During writing of EEPROM)

(5) "Request current offset value" (monitor) command (E400H)

<table>
<tr><th colspan="4">Command (CC-Link master station → CA20-M00 / M01)</th><th colspan="4">Response (CC-Link master station ← CA20-M00 / M01)</th></tr>
<tr><th>Remote register</th><th>b15------b8</th><th>b7------b0</th><th>Remarks</th><th>Remote register</th><th>b15------b8</th><th>b7------b0</th><th>Remarks</th></tr>
<tr><td>RWwn</td><td>E4H</td><td>00</td><td>Command</td><td>RWrn</td><td>E4H</td><td>00H</td><td>Same value as command</td></tr>
<tr><td>RWw(n+1)</td><td colspan="2" rowspan="15">Fixed at “K0”</td><td rowspan="15">Use prohibited</td><td>RWr(n+1)</td><td colspan="2">Fixed at “K0”</td><td>Unused</td></tr>
<tr><td>RWw(n+2)</td><td>RWr(n+2)</td><td colspan="2">Fixed at “K0”</td><td>Unused</td></tr>
<tr><td>RWw(n+3)</td><td>RWr(n+3)</td><td colspan="2">Error code</td><td></td></tr>
<tr><td>RWw(n+4)</td><td>RWr(n+4)</td><td colspan="2" rowspan="2">K-800000～K+800000</td><td rowspan="2">Axis 1 coordinate</td></tr>
<tr><td>RWw(n+5)</td><td>RWr(n+5)</td></tr>
<tr><td>RWw(n+6)</td><td>RWr(n+6)</td><td colspan="2" rowspan="2">K-800000～K+800000</td><td rowspan="2">Axis 2 coordinate</td></tr>
<tr><td>RWw(n+7)</td><td>RWr(n+7)</td></tr>
<tr><td>RWw(n+8)</td><td>RWr(n+8)</td><td colspan="2" rowspan="2">K-800000～K+800000</td><td rowspan="2">Axis 3 coordinate</td></tr>
<tr><td>RWw(n+9)</td><td>RWr(n+9)</td></tr>
<tr><td>RWw(n+A)</td><td>RWr(n+A)</td><td colspan="2" rowspan="2">K-800000～K+800000</td><td rowspan="2">Axis 4 coordinate</td></tr>
<tr><td>RWw(n+B)</td><td>RWr(n+B)</td></tr>
<tr><td>RWw(n+C)</td><td>RWr(n+C)</td><td colspan="2" rowspan="4">Fixed at “K0”</td><td rowspan="4">Unused</td></tr>
<tr><td>RWw(n+D)</td><td>RWr(n+D)</td></tr>
<tr><td>RWw(n+E)</td><td>RWr(n+E)</td></tr>
<tr><td>RWw(n+F)</td><td>RWr(n+F)</td></tr>
</table>

?

- Data length of coordinate value: 32 bits
- Unit of coordinate value: 0.01 [mm] (Ex.: +100.00 [mm] → K+10000)
- When wiring "********", reply H7FFFFFFF.

  Error code

  0000H Normal

  1000H Command analysis error (An error is found in the command.)

(6) "Request counter value" (monitor) command (E500H)

Command (CC-Link master station → CA20-M00 / M01)				Response (CC-Link master station ← CA20-M00 / M01)			
Remote register	b15------b8	b7------b0	Remarks	Remote register	b15------b8	b7------b0	Remarks
RWwn	E5H	00H	Command	RWrn	E5H	00H	Same value as command
RWw(n+1)	K1-K99		Counter number	RWr(n+1)	K1-K99		Counter number
RWw(n+2)	Fixed at “K0”		Use prohibited	RWr(n+2)	K0-K9999		Counter value
RWw(n+3)				RWr(n+3)	Error code		
RWw(n+4)				RWr(n+4)	Fixed at “K0”		Unused
RWw(n+5)				RWr(n+5)			
RWw(n+6)				RWr(n+6)			
RWw(n+7)				RWr(n+7)			
RWw(n+8)				RWr(n+8)			
RWw(n+9)				RWr(n+9)			
RWw(n+A)				RWr(n+A)			
RWw(n+B)				RWr(n+B)			
RWw(n+C)				RWr(n+C)			
RWw(n+D)				RWr(n+D)			
RWw(n+E)				RWr(n+E)			
RWw(n+F)				RWr(n+F)			

Error code

0000H Normal

1000H Command analysis error (An error is found in the command.)

(7) "Set counter" command (E700H)

Command (CC-Link master station → CA20-M00 / M01)				Response (CC-Link master station ← CA20-M00 / M01)			
Remote register	b15------b8	b7------b0	Remarks	Remote register	b15------b8	b7------b0	Remarks
RWwn	E7H	00H	Command	RWrn	E7H	00H	Same value as command
RWw(n+1)	K1-K99		Counter number	RWr(n+1)	Fixed at "K0"		Unused
RWw(n+2)	K0-K9999		Counter value	RWr(n+2)	Fixed at "K0"		Unused
RWw(n+3)	Fixed at "K0"		Use prohibited	RWr(n+3)	Error code		
RWw(n+4)				RWr(n+4)	Fixed at "K0"		Unused
RWw(n+5)				RWr(n+5)			
RWw(n+6)				RWr(n+6)			
RWw(n+7)				RWr(n+7)			
RWw(n+8)				RWr(n+8)			
RWw(n+9)				RWr(n+9)			
RWw(n+A)				RWr(n+A)			
RWw(n+B)				RWr(n+B)			
RWw(n+C)				RWr(n+C)			
RWw(n+D)				RWr(n+D)			
RWw(n+E)				RWr(n+E)			
RWw(n+F)				RWr(n+F)			

Error code

0000H Normal

1000H Command analysis error (An error is found in the command.)

(8) "Write speed table" command (C2C2H)

Command (CC-Link master station → CA20-M00 / M01)			
Remote register	b15------b8	b7------b0	Remarks
RWwn	C2H	C2H	Command
RWw(n+1)	K1-K10		Table number
RWw(n+2)	Fixed at "K0"		Use prohibited
RWw(n+3)	Fixed at "K0"		Use prohibited
RWw(n+4)	K10～K99999		Speed
RWw(n+5)			
RWw(n+6) ～ RWw(n+F)	Fixed at “K0”		Use prohibited

Response (CC-Link Master station ← CA20-M00 / M01)			
Remote register	b15------b8	b7------b0	Remarks
RWrn	C2H	C2H	Same value as command
RWr(n+1)	Fixed at "K0"		Unused
RWr(n+2)	Fixed at "K0"		Unused
RWr(n+3)	Error code		
RWr(n+4) ～ RWr(n+F)	Fixed at “K0”		Unused

- Data length of speed value: 32 bits
- Unit of speed value: 0.1 [mm/sec] (Ex.: +100.0 [mm/sec] → K1000)

  Error code

  0000H Normal

  1000H Command analysis error (An error is found in the command.)

(9) "Read speed table" command (C3C2H)

Command (CC-Link master station → CA20-M00 / M01)			
Remote register	b15------b8	b7------b0	Remarks
RWwn	C3H	C2H	Command
RWw(n+1)	K1-K10		Table number
RWw(n+2) ～ RWw(n+F)	Fixed at “K0”		Use prohibited

Response (CC-Link master station ← CA20-M00 / M01)			
Remote register	b15------b8	b7------b0	Remarks
RWrn	C3H	C2H	Same value as command
RWr(n+1)	K1-K10		Table number
RWr(n+2)	Fixed at “K0”		Unused
RWr(n+3)	Error code		
RWr(n+4)	K10～K99999		speed
RWr(n+5)			
RWr(n+6) ～ RWr(n+F)	Fixed at “K0”		Unused

- Data length of speed value: 32 bits
- Unit of speed value: 0.1 [mm/s] (Ex.: +100.0 [mm/s] → K1000)

  Error code

  0000H Normal

  1000H Command analysis error (An error is found in the command.)

  2003H Access to speed table is not possible. (During writing of EEPROM)

(10) "Write acceleration/deceleration table" command (C2C3H)

Command (CC-Link master station → CA20-M00 / M01)

Remote register	b15------b8	b7------b0	Remarks
RWwn	C2H	C3H	Command
RWw(n+1)	K1-K20		Table number
RWw(n+2)	Fixed at "K0"		Use prohibited
RWw(n+3)	Fixed at "K0"		Use prohibited
RWw(n+4)	K1～K999		acceleration/ deceleration time
RWw(n+5)			
RWw(n+6) ～ RWw(n+F)	Fixed at "K0"		Use prohibited

Response (CC-Link Master station ← CA20-M00 / M01)

Remote register	b15------b8	b7------b0	Remarks
RWrn	C2H	C3H	Same value as command
RWr(n+1)	Fixed at "K0"		Unused
RWr(n+2)	Fixed at "K0"		Unused
RWr(n+3)	Error code		
RWr(n+4) ～ RWr(n+F)	Fixed at "K0"		Unused

- Data length of acceleration/deceleration time value: 32 bits
- Unit of acceleration/deceleration time value: 0.01 [sec] (Ex.: +0.30 [sec] → K+30)

  Error code

  0000H Normal

  1000H Command analysis error (An error is found in the command.)

(11) "Read acceleration/deceleration table" command (C3C3H)

Command (CC-Link master station → CA20-M00 / M01)

Remote register	b15------b8	b7------b0	Remarks
RWwn	C3H	C3H	Command
RWw(n+1)	K1-K20		Table number
RWw(n+2) ～ RWw(n+F)	Fixed at "K0"		Use prohibited

Response (CC-Link master station ← CA20-M00 / M01)

Remote register	b15------b8	b7------b0	Remarks
RWrn	C3H	C3H	Same value as command
RWr(n+1)	K1-K20		Table number
RWr(n+2)	Fixed at "K0"		Unused
RWr(n+3)	Error code		
RWr(n+4)	K1～K999		acceleration/ deceleration time
RWr(n+5)			
RWr(n+6) ～ RWr(n+F)	Fixed at "K0"		Unused

- Data length of acceleration/deceleration time value: 32 bits
- Unit of acceleration/deceleration time value: 0.01 [sec] (Ex.: +0.30 [sec] → K+30)

  Error code

  0000H Normal

  1000H Command analysis error (An error is found in the command.)

  2003H Access to acceleration/deceleration table is not possible.

  (During writing of EEPROM)

(12) "Write override" command (D900H)

Command (CC-Link master station → CA20-M00 / M01)			
Remote register	b15------b8	b7------b0	Remarks
RWwn	D9H	00H	Command
RWw(n+1)	K1-K100		Override value
RWw(n+2) ~ RWw(n+F)	Fixed at “K0”		Use prohibited

Response (CC-Link Master station ← CA20-M00 / M01)			
Remote register	b15------b8	b7------b0	Remarks
RWrn	D9H	00H	Same value as command
RWr(n+1)	Fixed at "K0"		Unused
RWr(n+2)	Fixed at "K0"		Unused
RWr(n+3)	Error code		
RWr(n+4) ~ RWr(n+F)	Fixed at “K0”		Unused

- Unit of override value: [%]

  Error code

  0000H Normal

  1000H Command analysis error (An error is found in the command.)

(13) "Read override" command (DA00H)

Command (CC-Link master station → CA20-M00 / M01)			
Remote register	b15------b8	b7------b0	Remarks
RWwn	DAH	00H	Command
RWw(n+1) ~ RWw(n+F)	Fixed at “K0”		Use prohibited

Response (CC-Link master station ← CA20-M00 / M01)			
Remote register	b15------b8	b7------b0	Remarks
RWrn	DAH	00H	Same value as command
RWr(n+1)	K1-K100		Table number
RWr(n+2)	Fixed at “K0”		Unused
RWr(n+3)	Error code		
RWr(n+4) ~ RWr(n+F)	Fixed at “K0”		Unused

- Unit of override value: [%]

  Error code

  0000H Normal

  1000H Command analysis error (An error is found in the command.)

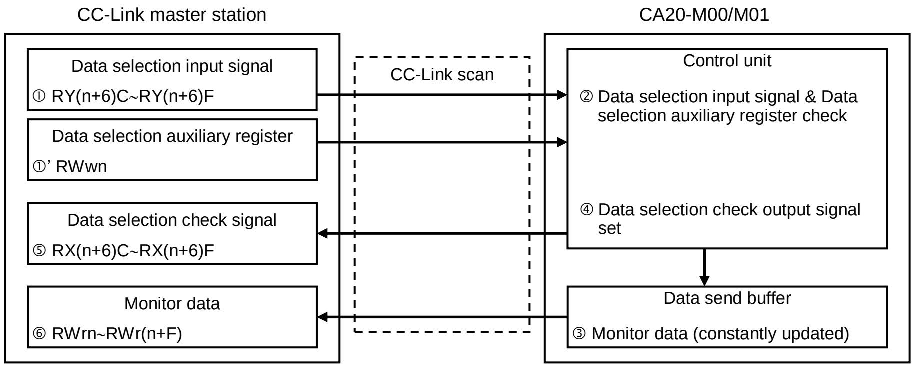
  2003H Access to override is not possible. (During writing of EEPROM)

■ 12.3.3 Monitor mode

In Monitor mode, the data selected by data selection input [RY(n+6)C to RY(n+6)F] is constantly updated for realizing high-speed updating cycles.

■ 12.3.3.1 Data receiving method

(1) Data flow and timing



Signal name	Device	Timing
Data selection input signal	RY(n+6)C~RY(n+6)F	A ① B
Data selection auxiliary register	RWwn	A' ①' B'
Monitor data	RWrn~RWr(n+F)	Previous data ③ Monitor data (constantly updated)
Data selection check output signal	RX(n+6)C~RX(n+6)F	A ④ B

- For the values of the data selection signal and data selection check signal, refer to section 12.3.3.2.
- The data selection auxiliary register may not be used depending on a selected monitor.

① Set the data selection signal and data selection auxiliary register.
② The data selection signal is transferred to CA20-M00/M01 by the CC-Link scan.
③ The data selected by the data selection signal and data selection auxiliary register is set to the data send buffer. The data send buffer is updated at 1-ms cycles.
④ Set the data selection check signal. Set the value of the data selection check signal to the same value as the data selection signal.
⑤ The data selection check signal that was set in step ④ is transferred to the remote input (RX) of the CC-Link master station by the CC-Link scan.
⑥ The data that was set in step ③ is transferred to the remote register (RWr) of the CC-Link master station by the CC-Link scan.

■ 12.3.3.2 List of monitor types

No.	Description	Data selection input signal				Auxiliary register	Remarks
		RY(n+6)F	RY(n+6)E	RY(n+6)D	RY(n+6)C	RWwn	
1	Status monitor	0	0	0	1	Unused	
2	Current position monitor	0	0	1	0	Unused	
3	Counter monitor *1	0	0	1	1	0000h	Arbitrary selection mode
						0001h	Designated sequence number mode
4	Reserved	0	1	0	0	-	
···	Reserved	···	···	···	···	-	
15	Reserved	1	1	1	1	-	

Note 1: The counter monitor is controlled by a controller in version 4.25 or later.

■ 12.3.3.3 Explanation of monitors

(1) Status monitor

Remote register	b15------b8	b7------b0	Remarks
RWrn	00H	01H	Data selection check (*1)
RWr(n+1)	Fixed at K0		Use prohibited
RWr(n+2)	Fixed at K0		Use prohibited
RWr(n+3)	Fixed at K0		Use prohibited
RWr(n+4)	00H	**H	Status 0 (*2)
RWr(n+5)	00H	**H	Status 1 (*2)
RWr(n+6)	00H	**H	Status 2 (*2)
RWr(n+7)	00H	**H	Status 3 (*2)
RWr(n+8)	00H	**H	BS error code (*3)
RWw(n+9) RWr(n+F)	Fixed at K0		Use prohibited

*1: The same value as the data selection check output signal RX(n+6)C to RX(n+6)F is stored.

*2: The status value is stored to the lower byte.
The upper byte is constantly fixed at 00.

*3: This is set only when status 1 is 25H, 35H, 45H, or 55H.

Status descriptions

Status 0	
BIT	Description
0	1: Error occurred
1	1: Execution in progress
2	1: Pause in progress
3	1: Return to origin in progress
4	1: Return to origin complete
5	1: Positioning complete
6	
7	1: Parameter 2 modified

Status 1	
BIT	Description
0	Error code (Refer to section 20.3)
1	
2	
3	
4	
5	
6	
7	

Status 2	
BIT	Description
0	00: Sequential mode 01: Palletizing mode 10: Point mode 11: Easy mode
1	
2	00: Auto mode 01: Step mode 10: Program mode
3	
4	1: Single operation mode
5	1: Pulse train input mode
6	1: Teach pendant ON
7	1: Host computer ON

Status 3	
BIT	Description
0	1: Servo ON
1	
2	
3	
4	
5	
6	
7	

BS error code	
BIT	Description
0	BS alarm code (Refer to section 20.4)
1	
2	
3	
4	
5	
6	
7	

(2) Current position monitor

Remote register	b15------b8	b7------b0	Remarks
RWrn	00H	02H	Data selection check (*1)
RWr(n+1)	Fixed at K0		Use prohibited
RWr(n+2)	Fixed at K0		Use prohibited
RWr(n+3)	Fixed at K0		Use prohibited
RWr(n+4)	K-800000～K+800000		Axis 1 coordinate
RWr(n+5)			
RWr(n+6)	K-800000～K+800000		Axis 2 coordinate
RWr(n+7)			
RWr(n+8)	K-800000～K+800000		Axis 3 coordinate
RWr(n+9)			
RWr(n+A)	K-800000～K+800000		Axis 4 coordinate
RWr(n+B)			
RWr(n+C)	00_H	$**_H$	Status 0 (*2)
RWr(n+D)	00_H	$**_H$	Status 1 (*2)
RWr(n+E)	00_H	$**_H$	Status 2 (*2)
RWr(n+F)	00_H	$**_H$	Status 3 (*2)

- Coordinate data length: 32 bits
- Coordinate units: 0.01 mm (Example: +100.00 mm → K +10000)
- The current coordinates for four axes are stored regardless of task combination [K19].

*1: The same value as the data selection check output signal RX(n+6)C to RX(n+6)F is stored.

*2: The status values are stored at low byte.
High bytes are always fixed at OO.
Refer to section 12.3.3.3(1) for the status description.

(3) Counter monitor

The counter monitor can be operated in two modes: arbitrary selection mode for monitoring arbitrary seven counters; and designated subsequent number mode for monitoring 14 coupled counters. Either of two modes can be selected using the data selection auxiliary register RWwn.

① Arbitrary selection mode (RWwn = 0000H)

Monitoring up to seven arbitrary counters set to RWw(n+2, 4, 6, 8, A, C, E)

Monitor (CC-Link master station → CA20-M00/M01)				Response (CC-Link master station ← CA20-M00/M01)			
Remote register	b15------b8	b7------b0	Remarks	Remote register	b15------b8	b7------b0	Remarks
RWwn	00_H	00_H	Mode selection	RWrn	00_H	03_H	Arbitrary selection mode [*1]
RWw(n+1)	Fixed at K0		Use prohibited	RWr(n+1)	Fixed at K0		Use prohibited
RWw(n+2)	K1-K99[*2]		Counter number 1	RWr(n+2)	K1-K99		Counter number 1
RWw(n+3)	Fixed at K0		Use prohibited	RWr(n+3)	K0-K9999		Value of counter number 1
RWw(n+4)	K1-K99[*2]		Counter number 2	RWr(n+4)	K1-K99		Counter number 2
RWw(n+5)	Fixed at K0		Use prohibited	RWr(n+5)	K0-K9999		Value of counter number 2
RWw(n+6)	K1-K99[*2]		Counter number 3	RWr(n+6)	K1-K99		Counter number 3
RWw(n+7)	Fixed at K0		Use prohibited	RWr(n+7)	K0-K9999		Value of counter number 3
RWw(n+8)	K1-K99[*2]		Counter number 4	RWr(n+8)	K1-K99		Counter number 4
RWw(n+9)	Fixed at K0		Use prohibited	RWr(n+9)	K0-K9999		Value of counter number 4
RWw(n+A)	K1-K99[*2]		Counter number 5	RWr(n+A)	K1-K99		Counter number 5
RWw(n+B)	Fixed at K0		Use prohibited	RWr(n+B)	K0-K9999		Value of counter number 5
RWw(n+C)	K1-K99[*2]		Counter number 6	RWr(n+C)	K1-K99		Counter number 6
RWw(n+D)	Fixed at K0		Use prohibited	RWr(n+D)	K0-K9999		Value of counter number 6
RWw(n+E)	K1-K99[*2]		Counter number 7	RWr(n+E)	K1-K99		Counter number 7
RWw(n+F)	Fixed at K0		Use prohibited	RWr(n+F)	K0-K9999		Value of counter number 7

*1: The same value as the data selection check output signal RX(n+6)C to RX(n+6)F is stored. "00H" is stored at high byte.

*2: In the case where a number other than "K1 to K99" is designated for counter number, 0 will be returned to that counter number.

② Designated subsequent mode (RWwn =0001H)

Monitoring subsequent counters (up to 14) starting with the counter number set to RWw(n+1).

Monitor (CC-Link master station → CA20-M00/M01)				Response (CC-Link master station ← CA20-M00/M01)			
Remote register	b15------b8	b7------b0	Remarks	Remote register	b15------b8	b7------b0	Remarks
RWwn	00_H	01_H	Mode selection	RWrn	01_H	03_H	Arbitrary selection mode *1
RWw(n+1)	K1-K99※2		First counter number	RWr(n+1)	K1-K99		First counter number
RWw(n+2)	Fixed at 0		Use porhibited	RWr(n+2)	K0-K9999		Value of first counter
RWw(n+3)				RWr(n+3)	K0-K9999		Value of first counter +1
RWw(n+4)				RWr(n+4)	K0-K9999		Value of first counter +2
RWw(n+5)				RWr(n+5)	K0-K9999		Value of first counter +3
RWw(n+6)				RWr(n+6)	K0-K9999		Value of first counter +4
RWw(n+7)				RWr(n+7)	K0-K9999		Value of first counter +5
RWw(n+8)				RWr(n+8)	K0-K9999		Value of first counter +6
RWw(n+9)				RWr(n+9)	K0-K9999		Value of first counter +7
RWw(n+A)				RWr(n+A)	K0-K9999		Value of first counter +8
RWw(n+B)				RWr(n+B)	K0-K9999		Value of first counter +9
RWw(n+C)				RWr(n+C)	K0-K9999		Value of first counter +10
RWw(n+D)				RWr(n+D)	K0-K9999		Value of first counter +11
RWw(n+E)				RWr(n+E)	K0-K9999		Value of first counter +12
RWw(n+F)				RWr(n+F)	K0-K9999		Value of first counter +13

*1: The same value as the data selection check output signal RX(n+6)C to RX(n+6)F is stored at low byte of RWwn. "01H" is stored at high byte.

*2: In the case where a number other than "K1 to K99" is designated for counter number, 0 will be returned to that counter number. In the case where a number above K87 is designated for the first counter number, 0 will be returned to the values after counter number 99.

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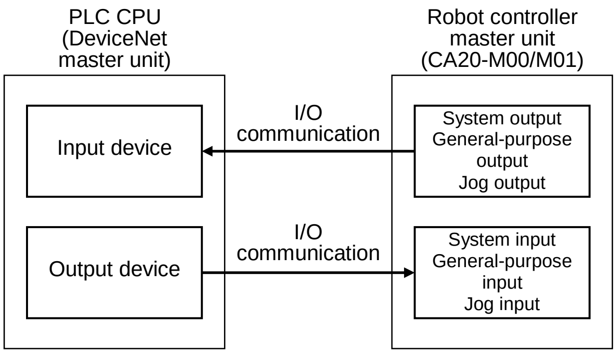
Chapter 13 DeviceNet

■ 13.1 DeviceNet Function

This controller enables adding of a DeviceNet function as a Fieldbus interface option for external devices. This chapter describes the DeviceNet interface.
DeviceNet is a field network interface that features a minimized wiring design in a low-cost structure and high-speed data communication. The DeviceNet interface allows data communication for various input/output and jog operation.

■ 13.1.1 Overview

This controller can be handled as a DeviceNet slave station for enabling I/O data communication. For details of the DeviceNet system specifications and various limitations, refer to the document published by ODVA (Open DeviceNet Vendor Association, Inc.) or the document supplied with the master station unit of the DeviceNet system.

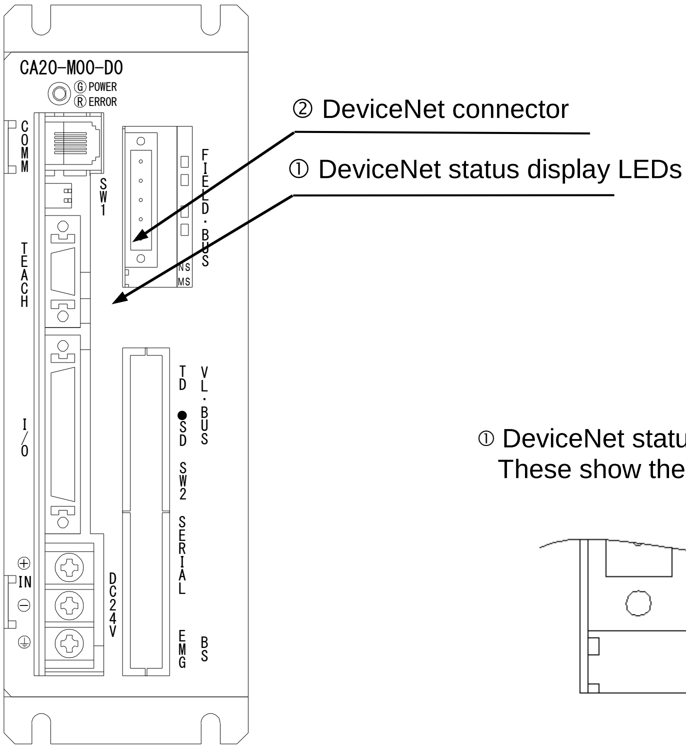


■ 13.1.2 DeviceNet specifications

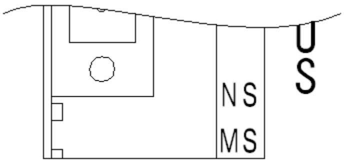
<table>
<tr><th>Item</th><th colspan="3">Specification</th></tr>
<tr><td>Communication protocol</td><td colspan="3">Compliant with DeviceNet</td></tr>
<tr><td>Support connection</td><td colspan="3">I/O connection (polling)</td></tr>
<tr><td>Communication speed</td><td colspan="3">125k / 250k / 500kbps (Set by parameter)</td></tr>
<tr><td>Station number setting</td><td colspan="3">0 – 63 (Set by parameter)</td></tr>
<tr><td rowspan="4">Cable lengths</td><td>Baud rate</td><td>Thick cable</td><td>Thin cable</td></tr>
<tr><td>125k</td><td>500m</td><td rowspan="3">100m</td></tr>
<tr><td>250k</td><td>250m</td></tr>
<tr><td>500k</td><td>100m</td></tr>
<tr><td>Number of occupied points</td><td colspan="3">Send: 128 points Receive: 128 points</td></tr>
<tr><td rowspan="3">Number of input/output points</td><td colspan="3">System input: 4 points, System output: 4 points</td></tr>
<tr><td colspan="3">General-purpose input: 64 points, General-purpose output: 64 points</td></tr>
<tr><td colspan="3">Jog input: 8 points, Jog output: 8 points</td></tr>
<tr><td>Vendor ID</td><td colspan="3">733</td></tr>
<tr><td>Device type</td><td colspan="3">0 (Generic Device)</td></tr>
<tr><td>Product code</td><td colspan="3">5 (CA20-M00)</td></tr>
</table>

*1: The input and output are based on the direction viewed from the robot controller.

■ 13.1.3 Explanation of DeviceNet component



① DeviceNet status display LEDs
These show the DeviceNet status.



- The DeviceNet components for the CA20-M01 are identical to those in the figure above.

① DeviceNet status display LEDs

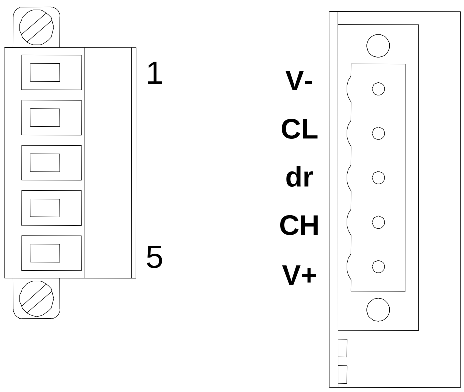
Name	Color	On/Off		Cause/Remedy
MS	Green	● On	Normal	Normal status
		★ Flashing	Unset status	An error has occurred in the setting value in the CA20-M10. Check the settings and restart. This can also indicate standby status. Check if the master unit has started normally.
	Red	● On	Critical fault	A hardware error has occurred (such as DPRAM, internal ROM, internal RAM, EEPROM, CAN error, or WDT error). Restart. If the error occurs again, replace the unit.
		★ Flashing	Minor fault	An error has occurred in the user settings, and a user-side interrupt timeout has occurred. Re-check the settings, and restart.
	Green/ Red	○ Off	No power supply	The power is not supplied, or initialization is in progress. Check the power supply.
NS	Green	● On	Normal	One or more connections are established (running) in online status.
		★ Flashing	Connection wait	The master unit is not starting normally. (A configuration area has occurred in the master unit I/O area.) Check if the master unit has started normally.
	Red	● On	Critical communication error	A communication error has occurred (such as a duplicate node address, busoff detection, mismatched baud rate, etc.) Check the connection, noise, node address settings, baud rate settings, and other parameters, and then restart.
		★ Flashing	Minor communication error	Communication with the master unit has timed out. Check the master unit status, connection, noise, node address settings, baud rate settings, and other parameters, and then restart.
	Green/ Red	○ Off	No power supply	Either there is no power supply, or there is a WDT error, baud rate check in progress, or duplicate node address check in progress. Check the power supply.

The LED turns on for 0.5 second and turns off for 0.5 second.

② DeviceNet connector

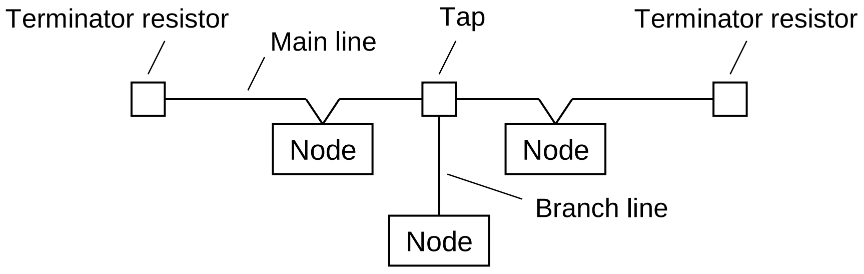
The exclusive DeviceNet cable for data linkage is connected to this connector.

Pin no.	Signal name	Symbol	Wire color
1	V-	V-	Black
2	CANL	CL	Blue
3	Shield	Dr	Shield
4	CANH	CH	White
5	V+	V+	Red



■ 13.1.4 Connection of exclusive DeviceNet cable

The cable connection order is not related to the station number setting (MAC ID).
Be sure to always connect a terminator resistor (121 Ω, 1% metal coating, 1/4 W) at both ends of the main line. Connect the terminator resistor between CANH and CANL.
A terminator resistor is not supplied with this controller.



For details on the cable connections, refer to the master station operating manual or document published by the ODVA.

■ 13.1.5 DeviceNet settings

(1) CA20-M00/M01 settings
The station number (MAC ID) and baud rate are specified by [PARA] M18 in the mode setting.
To enable a modified value, turn the power off and then on again. (Refer to section 14.2.18.)

(2) DeviceNet master station settings
Make the DeviceNet master station settings by following the master station operating manual.

■ 13.2 Connection with External Devices

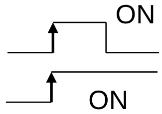
■ 13.2.1 List of master unit I/O signals

Signal direction: DeviceNet master station ← CA20–M00/M01		Signal direction: DeviceNet master station → □CA20–M00/M01 (*1)	
Input Device No. (Offset*2)	Signal name	Output Device No. (Offset*2)	Signal name
+0	Running" output	+0	Return to origin input
+1	Error output	+1	Start input
+2	Positioning finish output	+2	Stop input
+3	Return to origin finish output	+3	Reset input
+4～+7	Use prohibited	+4～+7	Use prohibited
+8～+15	General output port 1–1 ~ 8	+8～+15	General input port 1–1 ~ 8
+16～+23	General output port 2–1 ~ 8	+16～+23	General input port 2–1 ~ 8
+24～+31	General output port 3–1 ~ 8	+24～+31	General input port 3–1 ~ 8
+32～+39	General output port 4–1 ~ 8	+32～+39	General input port 4–1 ~ 8
+40～+47	General output port 5–1 ~ 8	+40～+47	General input port 5–1 ~ 8
+48～+55	General output port 6–1 ~ 8	+48～+55	General input port 6–1 ~ 8
+56～+63	General output port 7–1 ~ 8	+56～+63	General input port 7–1 ~ 8
+64～+71	General output port 8–1 ~ 8	+64～+71	General input port 8–1 ~ 8
+72～+79	Jog output (*3)	+72～+79	Jog input (*3)
+80～+127	Reserved (*4)	+80～+127	Reserved (*4)

- *1: If DeviceNet communication is cut off, the stop input is set to 1, and all others are cleared to 0. However, during T/P operation, the stop input is also cleared to 0.
- *2: Offset amount from the start device (unit: bits)
- *3: Refer to 13.2.2 and 13.2.4.
- *4: Area reserved for future function expansion (Fix at 0.)

■ 13.2.2 System I/O

(1) System input (DeviceNet master station → CA20–M00/M01)

Signal name	Remote device (*1)	Normal mode	External point designation mode	Remarks
Return to origin	+0	ON: Start of return to origin operation.	Return to origin	Detection of leading edge 
Start	+1	ON: Restart from currently stopped step or from feed hold state.	ON: Starts moving based on currently specified table information.	
Stop	+2	ON: Stops after current step has been executed.	Invalid	When this input is ON, return to origin and start input are invalid.
Reset	+3	ON: Cancels an error status. (Valid while program execution is stopped.)	ON: Cancels an error status.	
Jog input	+72 ~ +79	A selected axis is moved by jogging after the motion mode (jog, low-speed or high-speed) and travel direction are specified.		Section 13.2.4

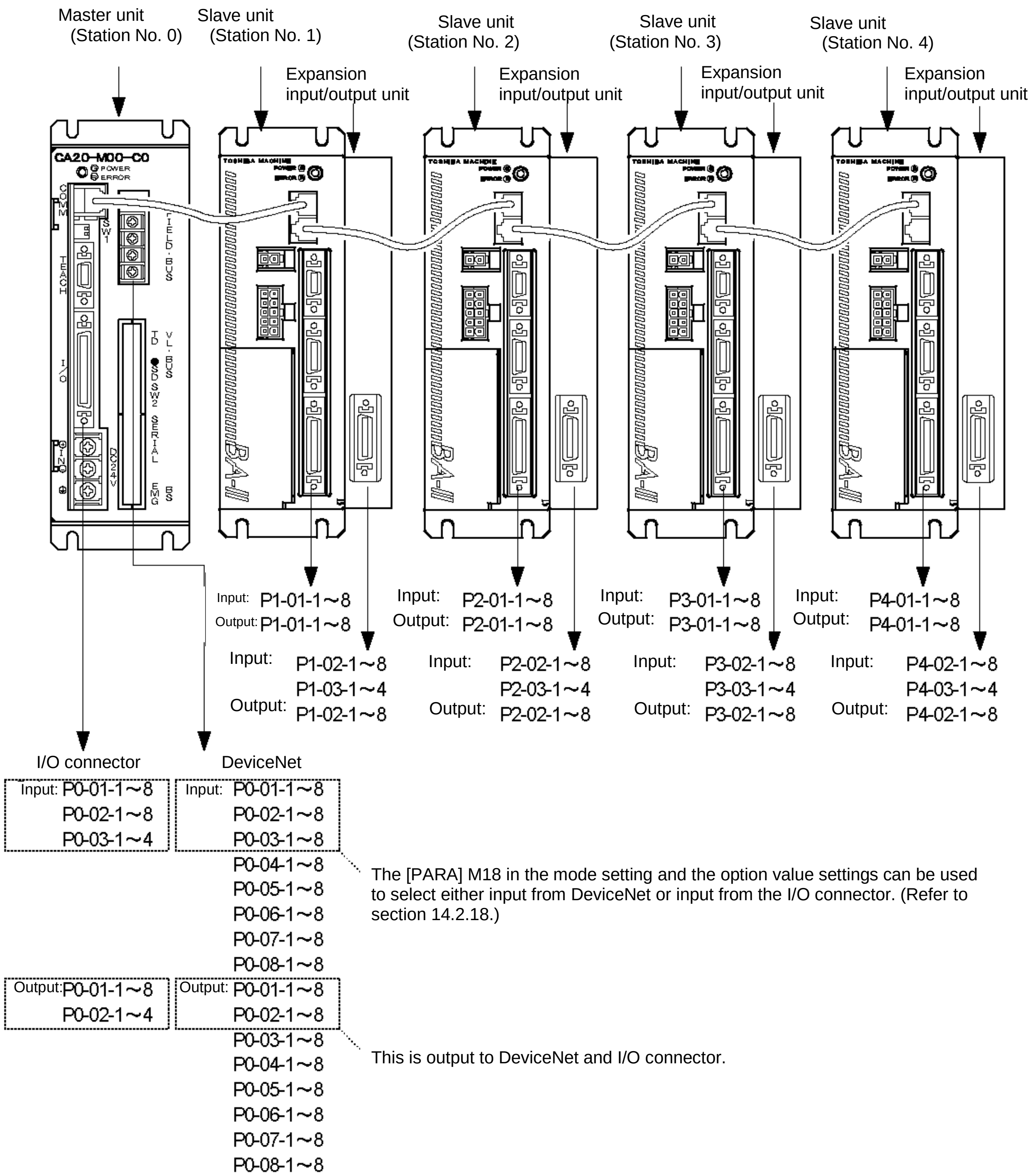
*1) Offset amount from the start device (unit: bits)

(2) System output (CA20–M09/M01 → DeviceNet master station)

Signal name	Remote device (*1)	Normal mode	External point designation mode	Ref.
Running	+0	ON during controller operation and during return to origin.	ON during robot operation.	Section 10.2.11
Error	+1	ON at error generation.	Same as left	Section 10.2.12
Positioning finish	+2	ON when the robot has been located at a predetermined position. OFF while the robot is moving. (Remains OFF when it is paused.)	Same as left	Section 10.2.13
Return to origin finish	+3	ON when return to origin is completed.	Same as left	Section 10.2.14
Jog output	+72 ~ +79	Acceptance or rejection of jog, active status, etc. are displayed.		Section 13.2.4

*1) Offset amount from the start device (unit: bits)

■ 13.2.3 Name of general-purpose I/O port and teach pendant display



- For details on the port numbers and support for input devices and output devices, refer to section 13.2.1.
- The names of the general-purpose input/output ports in CA20-M01 are identical to those in the figure above.

■ 13.2.4 Jog input/output

(1) List of jog input/output signals

Signal direction: DeviceNet master station ← CA20–M00–01		Signal direction: DeviceNet master station → CA20–M00–M01	
Input Device No. (Offset *1)	Signal name	Output Device No. (Offset *1)	Signal name
+72	"Axis 1 jogging" output	+72	"Request axis 1 jog" input
+73	"Axis 2 jogging" output	+73	"Request axis 2 jog" input
+74	"Axis 3 jogging" output	+74	"Request axis 3 jog" input
+75	"Axis 4 jogging" output	+75	"Request axis 4 jog" input
+76	Jog-ready output	+76	"Request inching" input
+77	Unused	+77	"Request low-speed jog" input
+78	Unused	+78	"Request high-speed jog" input
+79	Unused	+79	"Designate jog direction" input OFF: + direction, ON: – direction

*1: Offset amount from the start device (unit: bits)

- When the jog conditions (inching request, low-speed jog request, high-speed jog request) and jog direction are specified, and the jog request is ON, the corresponding axis performs the jog operation. (Refer to Fig. 13.2.4-1.)
- Jogging by I/O signal is not accepted as long as the jog ready output signal is OFF. The jog ready output signal is OFF under the following conditions.
  - While the robot is controlled through the teach pendant (T/P).
    → While the T/P is connected and turned on.
  - While the robot is controlled by the personal computer software.
    → While the execution screen of the personal computer software is opened.
  - While the "running" output is ON.
  - While the error output is ON.
- When the multiple bits for the "request inching" input, "request low-speed jog" input and "request high-speed jog" input are ON, the motions are executed according to the following order.

  Inching > Low-speed jog > High-speed jog
- It is not possible to simultaneously move two (2) or more axes at jogging. Move each axis separately.
- The axis stops if the communication through the DeviceNet has been severed during jogging.

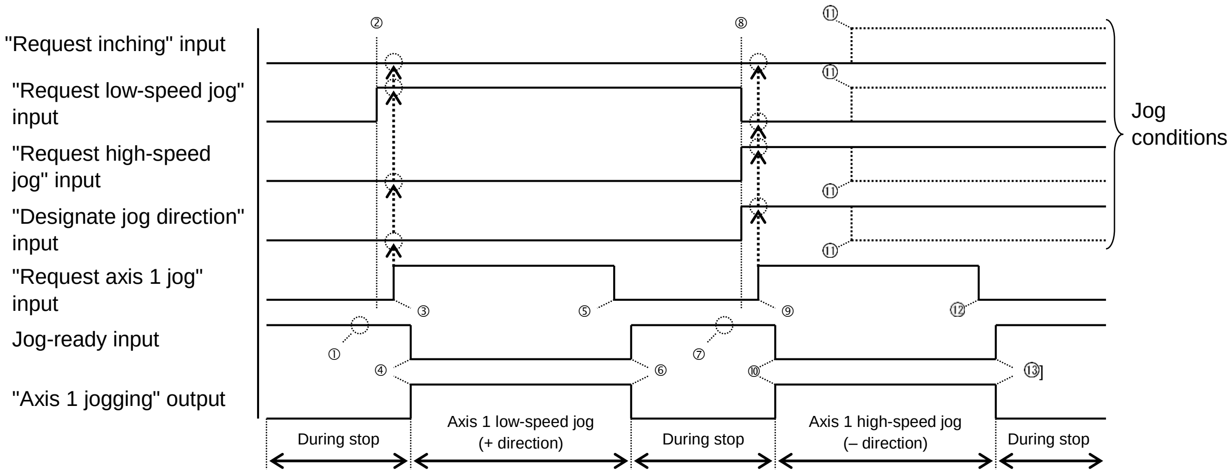


Fig. 13.2.4–1 Example of axis 1 travel

① Make sure that the jog-ready signal is ON.
② Set the jog conditions. (In the above figure, low-speed jog and plus "+" direction are specified.)
③ Turn on the "request axis 1 jog" input. (With this timing, the jog conditions are input.)
④ The jog-ready output turns off and the "axis 1 jogging" output turns on. Then the axis 1 starts jogging at low speed in the plus "+" direction.
⑤ To stop the axis, turn off the "request axis 1 jog" input signal.
⑥ The jog-ready output turns on and the "axis 1 jogging" output turns off. Then the axis 1 jogging at low speed in the plus "+" direction stops.
⑦ Make sure that the jog-ready signal is ON.
⑧ Set the jog conditions. (In the above figure, high-speed jog and "–" direction are specified.)
⑨ Turn on the "request axis 1 jog" input. (With this timing, the jog conditions are input.)
⑩ The jog-ready output turns off and the "axis 1 jogging" output turns on. Then the axis 1 starts jogging at high speed in the minus "–" direction.
⑪ Even if the jog conditions have been changed during travel, they are neglected.
⑫ To stop the axis, turn off the "request axis 1 jog" input signal.
⑬ The jog-ready output turns on and the "axis 1 jogging" output turns off. Then the axis 1 jogging at high speed in the minus "–" direction stops.

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Chapter 14 Parameter Setting

Various parameters can be set in the PRGM modes other than the palletizing mode. The parameters can be divided into the following five kinds.

● Mode setting	Designation of the bits for system input, and setting of the easy mode, external point designation mode and pulse train input mode, etc., can be carried out.
● Parameter 1	Parameters whose settings will be changed frequently
● Parameter 2	Parameters whose change frequencies are smaller than that of Parameter 1.
● Parameter 3	Parameters for setting the BS servo amplifier (user parameters)
● Table	Tables of various points, speed and acceleration

■ 14.1 How to Enter and Leave the PARA Mode

Press HELP in program mode. The following display appears. (Refer to section 4.1.1.)

```
[PRGM] F1:EXTENSION
 HELP  F2:DIRECT OUT
       F3:EDIT
       F4:PARAMETER
```

STEP 1

When this display appears, press F4 to go to PARA mode instruction.
Press ESC to return to the program mode screen.

```
[PARA] F1:SET MODE
       F2:PARAMETER1
       F3:PARAMETER2
1/2    F4:TABLE
```

STEP 2

Press F1 to enable mode setting.
Press F2 to set parameter 1.
Press F3 to set parameter 2.
Press F4 to enable table setting mode.
Press NEXT to move to STEP 3.
Press ESC to return to the program mode screen.

```
[PARA] F1:PARAMETER3
       F2:
       F3:
2/2    F4:
```

STEP 3

Press F1 to set parameter 3.
Press -NEXT to move to STEP 2.
Press ESC to return to the program mode screen.

■ 14.2 Method of Mode Setting

The mode should be set for the following items.

1. Single operation mode input bit designation
2. Continuous start input bit designation
3. Escape input bit designation
4. Pause input bit designation
5. Program selection input bit designation
6. Palletizing input bit designation
7. Pausing output bit designation
8. Input wait output bit designation
9. Teach Pendant display language　Japanese/English
10. OFF/easy/point
11. Clear at general-purpose output reset　Valid/Invalid
12. Direct output designation
13. READY output bit designation
14. Task positioning output designation
15. Task return to origin output designation
16. Designation of BS amplifier send fiber-optic cable length
17. Setting of CC-Link
18. Setting of DeviceNet
19. Battery alarm output bit designation
20. Moving coordinate table number output in external point designation mode
21. Servo on input bit designation
22. Positive logic/negative logic selection (input 1)
23. Positive logic/negative logic selection (input 2)
24. Positive logic/negative logic selection (input 3)
25. Positive logic/negative logic selection (input 4)
26. Positive logic/negative logic selection (output 1)
27. Positive logic/negative logic selection (output 2)
28. Positive logic/negative logic selection (output 3)
29. Positive logic/negative logic selection (output 4)

These are controlled
by CA20-M00/M01 in version 4.36 or later,
by TPH-4C in version 2.37 or later,
by TPX-4A in version 1.20 or later,
by SF-98D in version 3.2.1 or later.

Enter the PARA mode to set the mode. (Refer to section 14.1.)

STEP 1 Press F1 in the state.

```
[PARA] F1:SET MODE
       F2:PARAMETER1
       F3:PARAMETER2
1/2    F4:TABLE
```

STEP 2 Press NEXT or -NEXT to move to the mode setting screens.

Parameter No.

```
[PARA]M01
 ROBOT MOVEMENT MODE

                 0-01-0
```

- Search function

  When SEARCH is pressed and the parameter No. is input, the mode setting screen can be searched.

- Bit designation screen

  When designating a bit, 0-01-0 will display on the lower right of the screen. The meanings of the numbers are as follow.

  0-01-0

  Bit (Input 0 when a bit is not to be designated, or in other words the function is to be invalidated.)
  Port No.
  Station No.

Refer to section 10.1.4 for the names of the ports.

■ 14.2.1 Designation of single operation mode input bit

STEP 1 Use the numeric keypad to designate the input bit and press ENT .

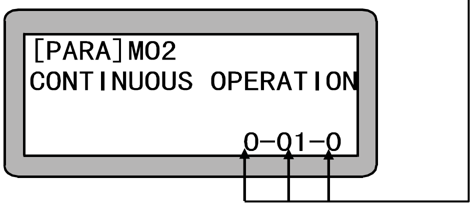
When NEXT is pressed, the next screen will display.

Press ESC to return to the PARA mode screen.

```
[PARA]M01
 ROBOT MOVEMENT MODE

                 0-01-0
```

? When the single operation mode input bit is designated and operation is started with the designated bit turned ON, the robot single operation mode will be entered. (Refer to section 10.2.5.)

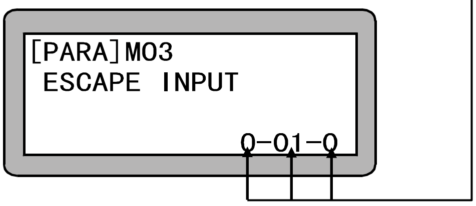
■ 14.2.2 Designation of continuous start input bit



STEP 1 Use the numeric keypad to designate the input bit and press ENT .
It can be used only when the station No. is 0 (master unit).
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to return to the PARA mode screen.

If the reset input or power is turned ON when the continuous start input bit is designated, the memory values (step No., counter value, etc.) will be held or cleared according to the table in section 10.2.6.

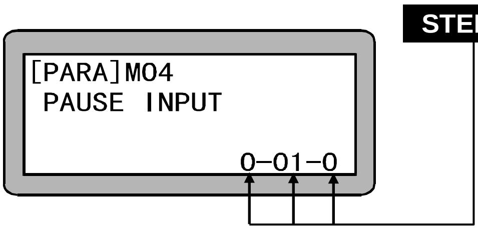
■ 14.2.3 Designation of escape input bit



STEP 1 **Error! Not a valid link.**Use the numeric keypad to designate the input bit and press ENT .
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to return to the PARA mode screen.

If the escape input bit is designated and the MVE command is executed, the axis will decelerate and stop when the designated bit turns ON. It will be interpreted that the step has ended, and the next step will be executed. (Refer to section 10.2.7.)

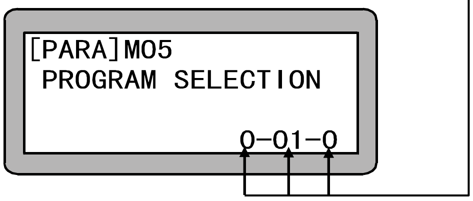
■ 14.2.4 Designation of pause input bit



STEP 1 Use the numeric keypad to designate the input bit and press ENT .
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to return to the PARA mode screen.

If pause input bit is designated, the axis will decelerate and stop when the designated bit turns ON. (Refer to section 10.2.8.)

■ 14.2.5 Designation of program selection input bit



STEP 1 **Error! Not a valid link.**Use the numeric keypad to designate the input bit and press ENT .
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to return to the PARA mode screen.

?

- When the program selection input bit is designated and the PSEL command is executed, the program will be executed from the tag No. designated with the designated bit (continuous 4 bits). (Refer to section 10.2.9.)
  In the easy or palletizing mode, the program No. designated with the designated bit will be executed.
- Continuous 4 bits
  The bit designated with this mode setting is a 20 bit. The 4 bits following the designated bit will be the program selection input.

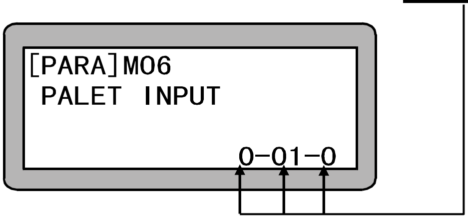
  <Example> When 01-1 is set
  When 01-1 is designated, the setting will be as follows.
  Port 01-1 → Program selection input 2^0
  Port 01-2 → Program selection input 2^1
  Port 01-3 → Program selection input 2^2
  Port 01-4 → Program selection input 2^3
  The program selection number will be 16.

NOTE

- The continuous 4 bits cannot be set to bridge over ports.

  <Example> When 01-7 is set.
  When port 01-7 is set, since port 01 is bit 1 to 8, the setting will be as follows.
  Port 01-7 → Program selection input 2^0
  Port 01-8 → Program selection input 2^1
  The program selection number will be 4.
- This setting is also used as the point table designation input 20 to 23 during the external point designation mode. (Refer to section 8.1.)

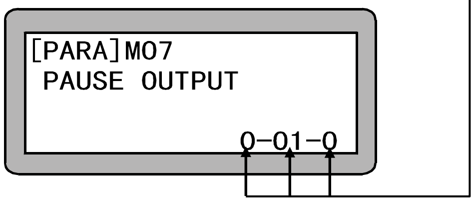
■ 14.2.6 Designation of return to origin input bit



STEP 1 Use the numeric keypad to designate the input bit and press ENT .
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to return to the PARA mode screen.

NOTE This setting is also used to set the input of the relative coordinate/absolute coordinate in the external point designation mode. (Refer to section 8.1.)

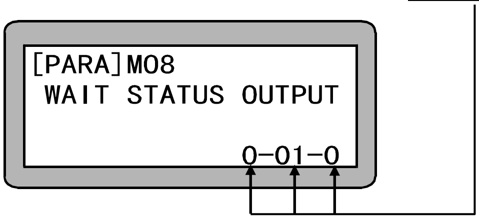
■ 14.2.7 Designation of pausing output bit



STEP 1 Use the numeric keypad to designate the output bit and press [ENT] .
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.
Press [ESC] to return to the PARA mode screen.

- When the pausing output bit is designated, the designated bit will turn ON while operation is paused (temporarily stopped). (Refer to section 10.2.16.)

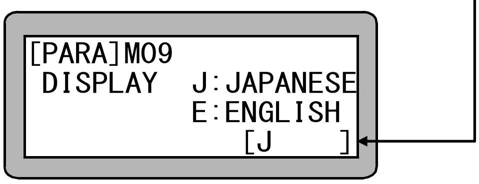
■ 14.2.8 Designation of input wait output bit



STEP 1 Use the numeric keypad to designate the output bit and press [ENT] .
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.
Press [ESC] to return to the PARA mode screen.

- When the input wait output bit is designated, the designated bit will remain ON while the program is waiting for the input of the IN command. (Refer to section 10.2.15.)

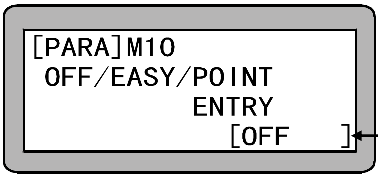
■ 14.2.9 Setting of teach pendant display (Japanese/English) mode



STEP 1 Switch between Japanese/English by pressing [ALT] and press [ENT] .
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.
Press [ESC] to return to the PARA mode screen.

- The display here refers to the display of the Teach Pendant screens.

■ 14.2.10 OFF(Invalid), easy, point



STEP 1 Select the operation mode with the [ALT]. When the required mode is displayed, press [ENT].
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.
Press [ESC] to return to the PARA mode screen.

?

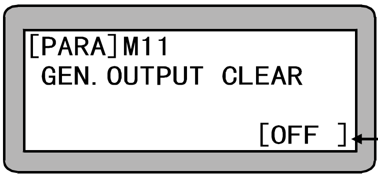
- The Easy option is not available when the total number of task steps is 2,001 or more. (Refer to section 14.4.22.).
- When [ALT] is pressed, the mode will display in order as shown below.

→ OFF → EASY → POINT →

- The relation of the display and mode is as follows.

OFF (Invalid)	Sequential mode or palletizing mode	Refer to Chapters 4 and 7
EASY	Easy mode	Refer to Chapter 6
POINT	External point designation mode	Refer to Chapter 8

■ 14.2.11 Setting of general-purpose output clear mode during emergency stop and reset

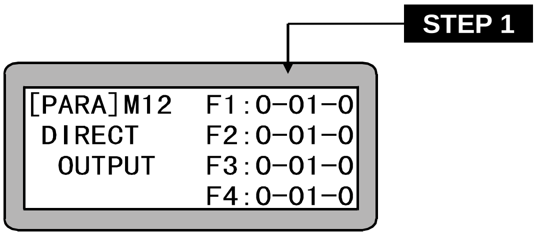


STEP 1 Switch between Invalid/Valid by pressing [ALT].
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.
Press [ESC] to return to the PARA mode screen.

?

- When this mode setting is validated, all general-purpose outputs will be turned OFF during emergency stop or reset.
- When continuous start input is set, the continuous start setting will have a priority.

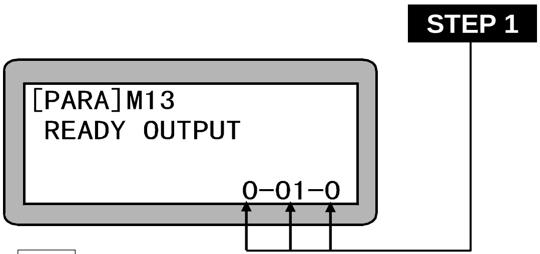
■ 14.2.12 Setting of direct output bit



Use the numeric keypad to designate the output bit and press ENT .
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to return to the PARA mode screen.

? Direct output means to turn the general-purpose output ON or OFF directly by pressing the function keys (F1 to F4) on the Teach Pendant. (Refer to section 17.1.)
The general-purpose output bit assigned to each function key is set here.

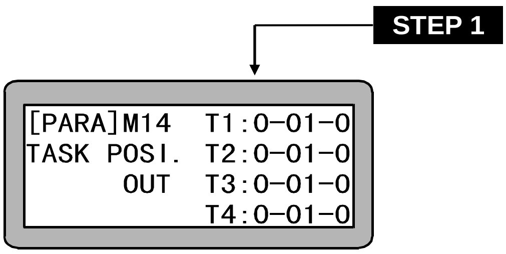
■ 14.2.13 Designation of READY output bit



Use the numeric keypad to designate the output bit and press ENT .
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to return to the PARA mode screen.

? When the READY output bit is designated, the designated output bit will turn OFF until the controller is ready for operation after the power is turned ON. The bit will turn ON when the controller is ready for operation. (Refer to section 10.2.17.)

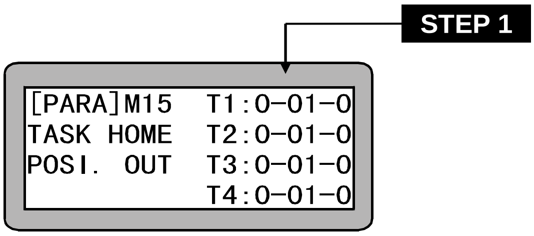
■ 14.2.14 Setting of task positioning output



Use the numeric keypad to designate the output bit and press ENT .
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to return to the PARA mode screen.

? The positioning completion output explained in section 10.2.13 will turn ON when positioning of all axes is completed. The positioning completed output can be set for each task with this setting.

■ 14.2.15 Setting of task return to origin output



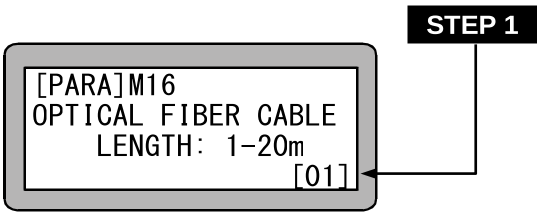
Use the numeric keypad to designate the output bit and then press ENT .

Press NEXT to display the next screen and -NEXT to display the previous screen.

Press ESC to return to the PARA mode screen.

? The return to origin completion output explained in section 10.2.14 will turn ON when all axes have return to the origin. The return to origin completed output can be set for each task with this setting.

■ 14.2.16 Designation of BS amplifier send fiber-optic cable length



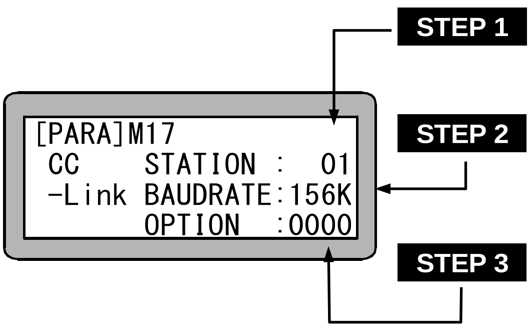
Use the numeric keypad to enter the cable length, and press ENT .

Press NEXT to display the next screen and -NEXT to display the previous screen.

Press ESC to return to the PARA mode screen.

Set the length of the fiber-optic cable (m) connected to the fiber-optic communication send connector (TD). (Initial value: 1, Setting range: 1 to 20)

■ 14.2.17 Setting of CC-Link



STEP 1 Use the numeric keypad to enter the station number, and press ENT .

STEP 2 Use ALT to select BAUD RATE, and press ENT. Use the numeric keypad to enter the option flag value, and press ENT .

STEP 3 Press NEXT to display the next screen and -NEXT to display the previous screen.

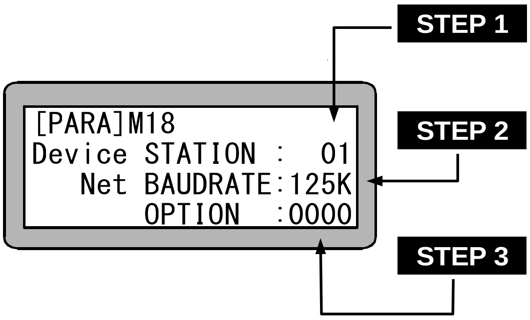
Press ESC to return to the PARA mode screen.

?

- The STATION option sets the CC-Link unit station number. This controller occupies the four consecutive stations from the station number that was set. Therefore, the valid range of setting values is 1 to 61. The setting is invalid if the 0 station or 62 station or higher is set. (Initial value: 1, Setting range: 0 to 99)
- The BAUD RATE option sets the CC-Link transmission speed. The settable transmission speed varies depending on the total cable length, CC-Link version, and cable types. (Initial value: 156K, Selection range: 156K, 625K, 2.5M, 5M, 10M)

- When the thousands place of the option value is set to "0", all system input and general-purpose input from CC-Link is enabled.
  When "1" is set, system input and general-purpose input (ports 1 to 3) of the master unit is enabled from the input/output connectors.
  (Initial value: 0000, Setting range: 0000 to 9999) (Refer to section 12.2.3.)

■ 14.2.18 Setting of DeviceNet



STEP 1 Use the numeric keypad to enter the station number, and press ENT .

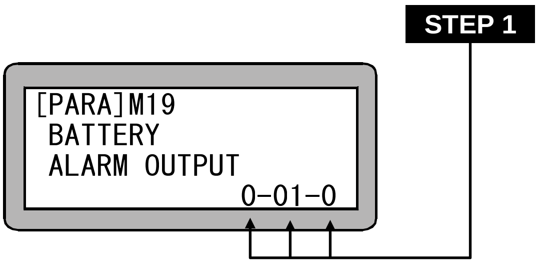
STEP 2 Use ALT to select BAUD RATE, and press ENT.

STEP 3 Use the numeric keypad to enter the option flag value, and press ENT.
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to return to the PARA mode screen.

?

- The STATION option sets the DeviceNet unit station number.
  (Initial value: 1, Setting range: 0 to 99)
- The BAUD RATE option sets the DeviceNet transmission speed. The settable transmission speed varies depending on the total cable length and cable types.
  (Initial value: 125K, Selection range: 125K, 250K, 500K)
- When the thousands place of the option value is set to "0", all system input and general-purpose input from DeviceNet is enabled.
  When "1" is set, system input and general-purpose input (ports 1 to 3) of the master unit is enabled from the input/output connectors.
  (Initial value: 0000, Setting range: 0000 to 9999)

■ 14.2.19 Designation of battery alarm output bit

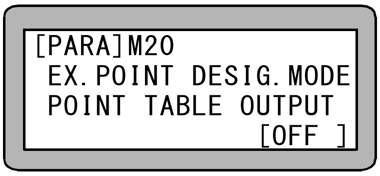


STEP 1 Use the numeric keypad to designate the output bit and press ENT .
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to return to the PARA mode screen.

?

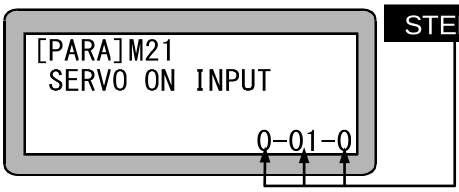
- When the battery voltage drops, the bit designated for battery alarm output is set to ON. (Refer to section 10.2.20.)

■ 14.2.20 Moving coordinate table number output in external point designation mode



STEP 1 This parameter is not available.
Press [-NEXT] to display the previous screen.
Press [ESC] to return to the PARA mode screen.

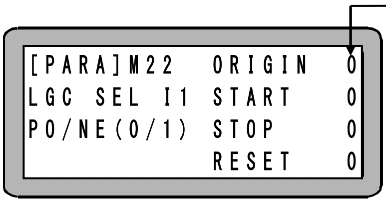
■ 14.2.21 Designation of servo on input bit



STEP 1

Use the numeric keypad to designate input bits, and then press [ENT].
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.
Press [ESC] to return to the PARA mode screen.

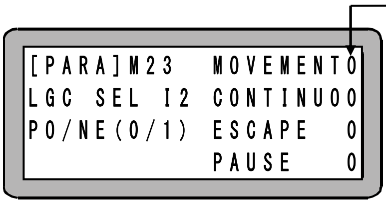
■ 14.2.22 Positive logic/negative logic selection (input 1)



STEP 1 Use the numeric keypad to select the logic and then press [ENT].
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.
Press [ESC] to return to the PARA mode screen.

? Each input logic of return to origin input, start input, stop input and reset input (refer to section 10.2.1 to 10.2.4) is selected. Each input is positive logic (no inverse) the case of selecting 0, negative logic (inverse) the case of selecting 1. (Initial value: 0, Setting range: 0, 1)

■ 14.2.23 Positive logic/negative logic selection (input 2)



STEP 1 Use the numeric keypad to select the logic and then press [ENT].
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.
Press [ESC] to return to the PARA mode screen.

? Each input logic of single operation input, continuous start input, escape input and pause input (refer to section 10.2.5 to 10.2.8) is selected. Each input is positive logic (no inverse) the case of selecting 0, negative logic (inverse) the case of selecting 1. (Initial value: 0, Setting range: 0, 1)

■ 14.2.24 Positive logic/negative logic selection (input 3)

```
[PARA]M24  PRGM SEL0
LGC SEL I3 PALLET  0
PO/NE(0/1) SERVO ON0
           ---     0
```

STEP 1 Use the numeric keypad to select the logic and then press [ENT].
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.
Press [ESC] to return to the PARA mode screen.

? Each input logic of program No. selection input, palletizing input and servo-on input (refer to section 10.2.9, 8.1(2), 10.2.10, 8.1(4) and 10.2.21) is selected. Each input is positive logic (no inverse) the case of selecting 0, negative logic (inverse) the case of selecting 1. (Initial value: 0, Setting range: 0, 1)

■ 14.2.25 Positive logic/negative logic selection (input 4)

```
[PARA]M25  ---     0
LGC SEL I4 ---     0
PO/NE(0/1) ---     0
           ---     0
```

STEP 1 Use the numeric keypad to select the logic and then press [ENT].
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.
Press [ESC] to return to the PARA mode screen.

? The corresponding input is not assigned.

■ 14.2.26 Positive logic/negative logic selection (output 1)

```
[PARA]M26  RUNNING 0
LGC SEL O1 ERROR   0
PO/NE(0/1) POS COMPO
           ORG COMPO
```

STEP 1 Use the numeric keypad to select the logic and then press [ENT].
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.
Press [ESC] to return to the PARA mode screen.

? Each output logic of running output, error output, positioning complete output and return to origin complete output (refer to section 10.2.11 to 10.2.14) is selected. Each output is positive logic (no inverse) the case of selecting 0, negative logic (inverse) the case of selecting 1. (Initial value: 0, Setting range: 0, 1)

■ 14.2.27 Positive logic/negative logic selection (output 2)

```
[PARA]M27  PAUSE    0
LGC SEL 02 WAIT STS0
PO/NE(0/1) READY    0
           TASK POS0
```

STEP 1 Use the numeric keypad to select the logic and then press ENT.

Press NEXT to display the next screen and -NEXT to display the previous screen.

Press ESC to return to the PARA mode screen.

? Each output logic of pausing output, input wait output, ready output and individual task positioning complete output (refer to section 10.2.15 to 10.2.18) is selected. Each output is positive logic (no inverse) the case of selecting 0, negative logic (inverse) the case of selecting 1. (Initial value: 0, Setting range: 0, 1)

■ 14.2.28 Positive logic/negative logic selection (output 3)

```
[PARA]M28  TASK ORG0
LGC SEL 03 BATTERY 0
PO/NE(0/1) ---      0
           ---      0
```

STEP 1 Use the numeric keypad to select the logic and then press ENT.

Press NEXT to display the next screen and -NEXT to display the previous screen.

Press ESC to return to the PARA mode screen.

? Each output logic of individual task return to origin complete output and battery alarm output (refer to section 10.2.19, 10.2.20) is selected. Each output is positive logic (no inverse) the case of selecting 0, negative logic (inverse) the case of selecting 1. (Initial value: 0, Setting range: 0, 1)

■ 14.2.29 Positive logic/negative logic selection (output 4)

```
[PARA]M29  ---      0
LGC SEL 04 ---      0
PO/NE(0/1) ---      0
           ---      0
```

STEP 1 Use the numeric keypad to select the logic and then press ENT.

Press NEXT to display the next screen and -NEXT to display the previous screen.

Press ESC to return to the PARA mode screen.

? The corresponding output is not assigned.

■ 14.3 Parameter 1 Setting

Parameter 1 contains the following items. For the items marked with ◆, the most appropriate parameters are set automatically when the robot type is selected.
Refer to section 2.4.7 for details on selecting the robot type.

1. Software limit value (upper limit)
2. Software limit value (lower limit)
3. Servo gain (position) ◆
4. Servo gain (speed) ◆
5. Pass area data value
6. Origin offset value
7. Sequence of return to origin
8. JOG speed (A1)
9. JOG speed (A2)
10. JOG speed (A3)
11. JOG speed (A4)
12. JOG inching movement
13. Designation of area output (A1)
14. Designation of area output (A2)
15. Designation of area output (A3)
16. Designation of area output (A4)
17. Synchronized offset
18. Synchronized error allowable value

Set PARA mode for setting parameter 1. (Refer to section 14.1.)

```
[PARA] F1:SET MODE
       F2:PARAMETER1
       F3:PARAMETER2
1/2    F4:TABLE
```

STEP 1 Press F2 in this state.

Parameter No.

```
[PARA]P01A1= 0000.00
 UPPER    A2= 0000.00
 LIMIT    A3= 0000.00
          A4= 0000.00
```

STEP 2 Use NEXT and -NEXT to move to the parameter 1 setting screen.

To exit the parameter settings, press ESC.

- Search function
  When SEARCH is pressed and the parameter No. 1 to 16 is input, the parameter 1 setting screen can be searched.

■ 14.3.1 Setting of software limit value (upper limit)

```
[PARA]P01A1= 0000.00
 UPPER    A2= 0000.00
 LIMIT    A3= 0000.00
          A4= 0000.00
```

STEP 1 Use the numeric keypad to enter the coordinates and press ENT .

When NEXT is pressed, the next screen will display.

Press ESC to return to the PARA mode screen.

?

- The software limit value is set for each station. (Refer to section 2.4.4.)
- The "upper limit" of the software limit expresses the maximum value [mm] of the movement range of the robot. (Initial value: 0, Setting range: –8000 to 8000)

NOTE When a subtracted value becomes below zero, the counter value remains zero.

■ 14.3.2 Setting of software limit value (lower limit)

```
[PARA]P02A1= 0000.00
 LOWER    A2= 0000.00
 LIMIT    A3= 0000.00
          A4= 0000.00
```

STEP 1 Use the numeric keypad to enter the coordinates and press ENT .

Press NEXT to display the next screen and -NEXT to display the previous screen.

Press ESC to return to the PARA mode screen.

?

- The software limit value is set for each station. (Refer to section 2.4.4.)
- The "lower limit" of the software limit expresses the minimum value [mm] of the movement range of the robot. (Initial value: 0, Setting range: –8000 to 8000)

■ 14.3.3 Setting of servo gain (position)

```
[PARA]P03
 SERVO GAIN(POSI.)
     A1  A2  A3  A4
    [08][08][08][08]
```

STEP 1 Use the numeric keypad to enter the servo gain and press [ENT] .
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.
Press [ESC] to return to the PARA mode screen.

For the position gain of the servo system, the positioning time becomes long as the setting value is excessively small, and hunting (vibration) occurs as it is excessively large. (Setting range: 0 to 99)

CAUTION When the robot type is input, the optimum values for the servo gain (position) are automatically set. However, these should be changed as required. Refer to the Instruction Manual (Axis Installation Section) for the setting values.

■ 14.3.4 Setting of servo gain (speed)

```
[PARA]P04
 SERVO GAIN(SPEED)
     A1  A2  A3  A4
    [08][08][08][08]
```

STEP 1 Use the numeric keypad to enter the servo gain and press [ENT] .
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.
Press [ESC] to return to the PARA mode screen.

For the position gain of the servo system, the hunting (vibration) becomes high as the setting value is excessively small, and beating sound occurs as it is excessively large. (Setting range: 0 to 99)

CAUTION When the robot type is input, the optimum values for the servo gain (speed) are automatically set. However, these should be changed as required. Refer to the Instruction Manual (Axis Installation Section) for the setting values.

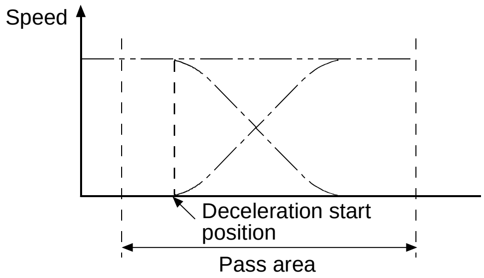
■ 14.3.5 Setting of pass area

```
[PARA]P05 A1=0200
PASS AREA A2=0200
     DATA A3=0200
          A4=0200
```

STEP 1 Use the numeric keypad to enter the pass area value (mm) of each station, and press [ENT] .
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.
Press [ESC] to return to the PARA mode screen.

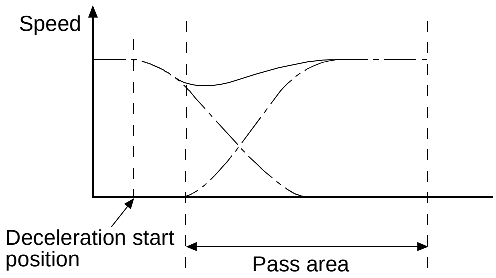
? If PASS is selected with MOV command word or similar, the axis will smoothly pass to the next point when it enters the range specified by the pass area value. The range is herein specified. Unit = mm (Initial values: 200, Setting range: 0 to 9999)

Pass area and speed variation



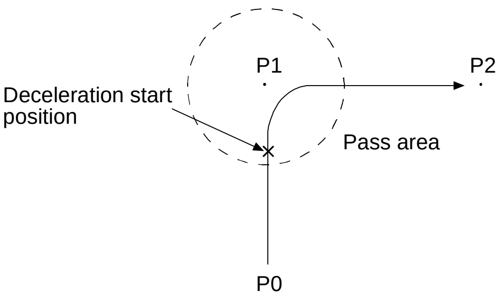
- In this case, the deceleration start position is present inside the pass area.

Movement speed by 1st command word
Movement speed by 2nd command word
Composed speed of axis



- In this case, the deceleration start position is present outside the pass area.

CAUTION If the deceleration start position is present inside the pass area, the speed will vary.



- Locus when the point P1 is instructed with PASS.
(In this case, the deceleration start position is present inside the pass area.)

■ 14.3.6 Setting of origin offset value

```
[PARA]P06A1= 0000.00
 ORIGIN   A2= 0000.00
 OFFSET   A3= 0000.00
          A4= 0000.00
```

STEP 1 Use the numeric keypad to enter coordinates of the origin offset value of each station, and press ENT .

Press NEXT to display the next screen and -NEXT to display the previous screen.

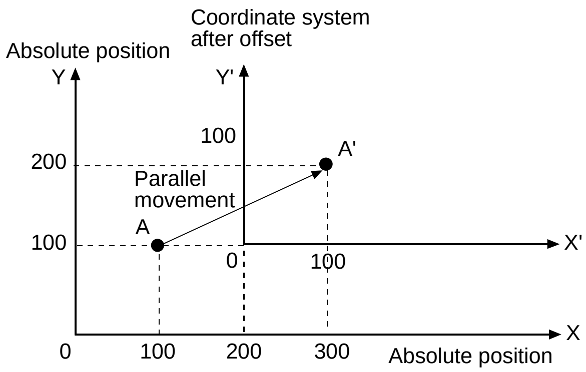
Press ESC to return to the PARA mode screen.

- The station No. is a number assigned to each unit. The origin offset value is set for each unit. (Refer to section 2.4.4.)
- The offset value is the distance [mm] to offset the origin when required. This is used to move all points in the program parallel in respect to the coordinate axis. After changing the origin offset, all points in the program will be moved in parallel by the offset value. The movement coordinates will also be offset when using the sequential, easy, palletizing or external point designation mode. (Initial value: 0, Setting range: -8000 to 8000)
- If the OFS command is used in the sequential mode, this offset value will be added.

[General offset value] = [Offset value set in parameter 1] + [Offset value set with OFS command]

- Always return to the origin after changing the origin offset. If the origin is not returned to, the origin offset will not be set.

[Example] When using a two-axis combination and the origin offset values X axis = 200 and Y axis = 100 are validated, the point A (X = 100, Y = 100) in the program will be moved in parallel 200 in the X axis direction and 100 in the Y axis direction. This will change the point A' position to X = 300, Y = 200.



X axis: station No. 1
Y axis: station No. 2

■ 14.3.7 Setting of sequence of return to origin

```
[PARA]P07
 HOME SEQUENCE
         A1  A2  A3  A4
         [1] [1] [1] [1]
```

STEP 1 Use the numeric keypad to enter the sequence of return to origin (1 to 4) and press ENT .
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to return to the PARA mode screen.

?

- The station No. is a number assigned to each unit. (Refer to section 2.4.4.)
- The sequence of return to origin is the order that each axis of the robot returns to the origin. For example, if the sequence of return to origin for station No. 1 is set to "1" and the sequence of return to origin for station No. 2 is set to "2", the axis controlled by the station No. 1 unit will return to the origin, and then the axis controlled by the station No. 2 unit will return to the origin. If both are set to "1", both axes will simultaneously return to the origin. (Initial value: 1, Setting range 1 to 4)

■ 14.3.8 Setting of JOG speed (A1)

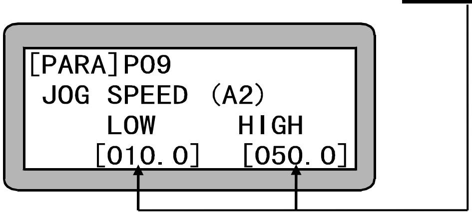
```
[PARA]P08
 JOG SPEED (A1)
      LOW      HIGH
    [010.0]   [050.0]
```

STEP 1 Use the numeric keypad to enter JOG speeds (low speed and high speed) of the axis of the station No. 1, and press ENT.
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to return to the PARA mode screen.

?

JOG speed refers to the speed for manual operation (JOG operation) using the movement keys. The unit is mm/s.
(Initial values Low speed: 10mm/s High speed: 50mm/s)
The initial values are the same for each axis. (Setting range: 1 to 250)
Even if any value below the decimal point is input, it will be ignored during operation.

■ 14.3.9 Setting of JOG speed (A2)



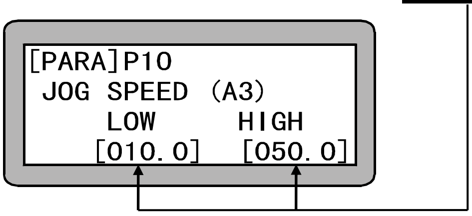
STEP 1

Use the numeric keypad to enter JOG speeds (low speed and high speed) of the axis of the station No. 2, and press ENT.

Press NEXT to display the next screen and -NEXT to display the previous screen.

Press ESC to return to the PARA mode screen.

■ 14.3.10 Setting of JOG speed (A3)



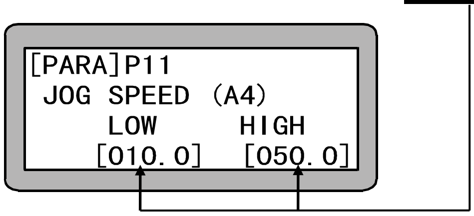
STEP 1

Use the numeric keypad to enter JOG speeds (low speed and high speed) of the axis of the station No. 3, and press ENT.

Press NEXT to display the next screen and -NEXT to display the previous screen.

Press ESC to return to the PARA mode screen.

■ 14.3.11 Setting of JOG speed (A4)



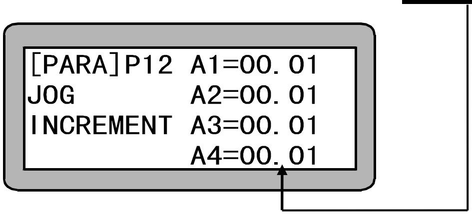
STEP 1

Use the numeric keypad to enter JOG speeds (low speed and high speed) of the axis of the station No. 4, and press ENT.

Press NEXT to display the next screen and -NEXT to display the previous screen.

Press ESC to return to the PARA mode screen.

■ 14.3.12 Setting of JOG inching movement



STEP 1

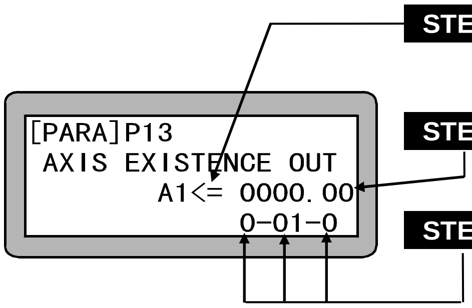
Use the numeric keypad to enter the JOG inching movement rate and press ENT .

Press NEXT to display the next screen and -NEXT to display the previous screen.

Press ESC to return to the PARA mode screen.

- The station No. is a number assigned to each unit. The JOG inching movement is set for each unit. (Refer to section 2.4.4)
- The JOG inching movement is the stroke gained by instantaneously pressing the movement key in the JOG operation mode. (Initial value: 0.01 Setting range: 0 to 65)

■ 14.3.13 Designation of area output bit (A1)



STEP 1 Use ALT to select "<=" or ">=", and press ENT .

STEP 2 Use the numeric keypad to enter the area output coordinates of A1 axis, and press ENT .

STEP 3 Use the numeric keypad, designate the output bit, and press ENT .

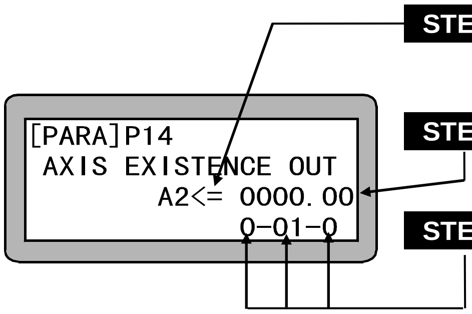
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to return to the PARA mode screen.

?

If the area output bit is designated, the designated bit will be turned ON for the time when the axis slide position is present in the designated area.
To make the function invalid, input 0 into the bit No.

NOTE It will be forcibly turned OFF if return to origin is required, soon after power is turned ON or after an error or similar while using incremental encoder.

■ 14.3.14 Designation of area output bit (A2)



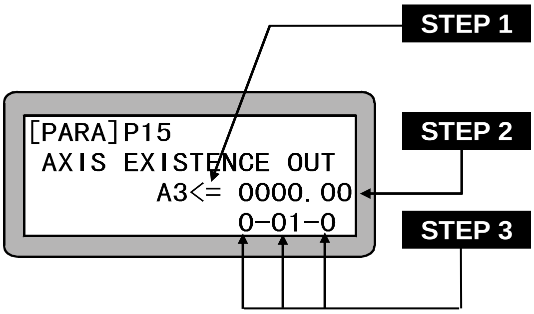
STEP 1 Use ALT to select "<=" or ">=", and press ENT .

STEP 2 Use the numeric keypad to enter coordinates of the area output of A2 axis, and press ENT .

STEP 3 Use the numeric keypad, designate the output bit, and press ENT .

Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to return to the PARA mode screen.

■ 14.3.15 Designation of area output bit (A3)



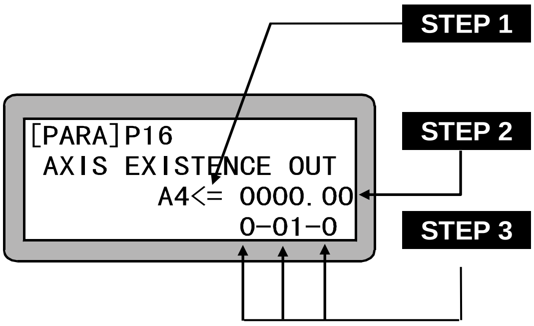
STEP 1: Use ALT to select "<=" or ">=", and press ENT .

STEP 2: Use the numeric keypad to enter coordinates of the area output of A3 axis, and press ENT .

STEP 3: Use the numeric keypad to designate the output bit, and press ENT .

Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to return to the PARA mode screen.

■ 14.3.16 Designation of area output bit (A4)



STEP 1: Use ALT to select "<=" or ">=", and press ENT .

STEP 2: Use the numeric keypad to enter coordinates of the area output of A4 axis, and press ENT .

STEP 3: Use the numeric keypad to designate the output bit and press ENT .

Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to return to the PARA mode screen.

■ 14.3.17 Synchronized offset

STEP 1

```
[PARA]P17 A1= 00.000
 SYNC.    A2= 00.000
 OFFSET   A3= 00.000
          A4= 00.000
```

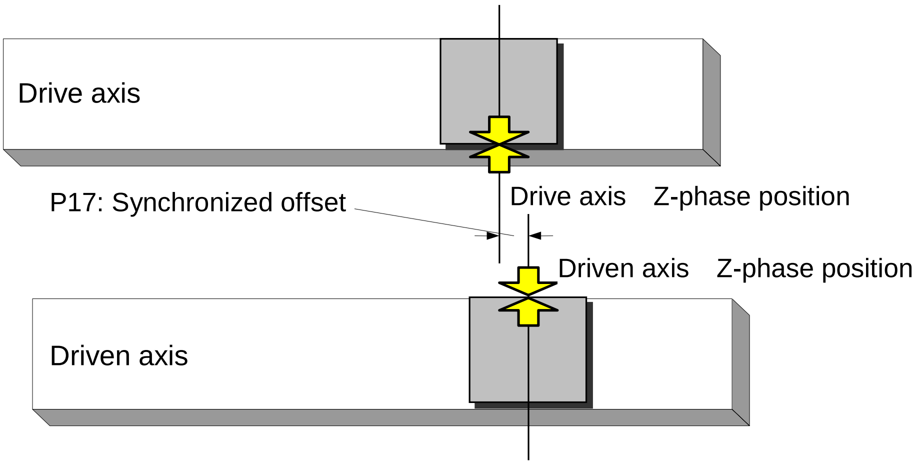
Each time [ENT] is pressed, the cursor moves from A1 to A4 one step at a time. To enter a numerical value, enter a number at the position where the cursor is located, and press [ENT] to register the setting and move to the next line.

Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.

Press [ESC] to return to the PARA mode screen.

?

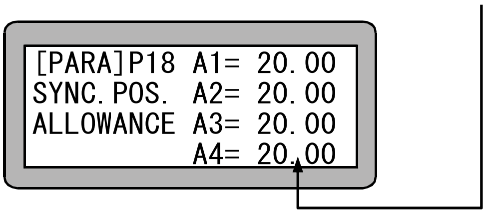
- The "P17: Synchronized Offset" designates the installation error amount (mm) of the drive axis and driven axis. (The installation error amount refers to the position error (mm) to the driven axis Z-phase position as viewed from the drive axis Z-phase position.)
- This parameter is automatically set when the synchronized axes origin search function is executed.
- This parameter is set to the axis number position of the driven axis. (The value set to the drive axis or normal axis (non-synchronized axis) is ignored.)
- (Initial value: 0.000, Setting range: -99.999 to 99.999)



NOTE

- A synchronized offset amount that exceeds one-quarter of a motor rotation cannot be set. When [-NEXT] or [NEXT] is pressed, a beeping alarm occurs, and the value returns to the value before it was modified.
  Example: This occurs when a lead 20 mm ball screw type is set to a value exceeding → ±5 mm.
- If this parameter is modified, be sure to execute the return to origin operation.
  (If program operation is started without performing the return to origin operation, "ER61 Return to Origin Incomplete Error" occurs.)
- The setting values of axes that are not set as the synchronized axes by the "K26: Synchronized Axes Setting" parameter is ignored.

■ 14.3.18 Synchronized error allowable value parameter



STEP 1

Each time ENT is pressed, the cursor moves from A1 to A4 one step at a time. To enter a numerical value, enter a number at the position where the cursor is located, and press ENT to register the setting and move to the next line.

Press -NEXT to display the previous screen.

Press ESC to return to the PARA mode screen.

?

- The upper limit of the position error for the drive axis and driven axis that occurs during synchronized operation is specified in millimeter (mm) units.
- This parameter is set to the **axis number position of the driven axis**. (The value set to the drive axis or normal axis (non-synchronized axis) is ignored.)
- If the position error exceeds this parameter, "ER65 Synchronized Error Exceeded" occurs.
- (Initial value: 20.00, Setting range: 1.00 to 99.99)

NOTE The setting values of axes that are not set as the synchronized axes by the "K26: Synchronized Axes Setting" parameter is ignored.

■ 14.4 Parameter 2 Setting

Parameter 2 contains the following items. For the items marked with a ◆, the optimum values are automatically entered when the robot type is entered. Refer to section 2.4.7 on how to enter the robot type.
After setting parameter 2, turn the controller power OFF and ON. As opposed to parameter 1, parameter 2 will not be validated unless the controller power is turned OFF.

1. Axis display ◆
2. In position data value
3. Overflow data value
4. Feed forward data value ◆
5. Direction of motor revolution ◆
6. Maximum speed ◆
7. Return to origin speed (A1) ◆
8. Return to origin speed (A2) ◆
9. Return to origin speed (A3) ◆
10. Return to origin speed (A4) ◆
11. Return to origin method ◆
12. Origin sensor logic ◆
13. High speed return to origin position
14. Lead ◆
15. Encoder No. of divisions ◆
16. Encoder pulse multiplier ◆
17. Encoder type
18. Setting of acceleration/deceleration time constant
19. Task and axis combination
20. Task order of priority
21. Task point table (Use prohibited with this unit. Will be invalid when set.)
22. No. of task steps
23. BA I/O compatibility mode
24. Setting of return to origin direction
25. Setting of dynamic brake
26. Setting of synchronized axes

NOTE Some settings in parameter 2 have been created for future axis developments. Be careful not to use inappropriate settings. Also do not change initial values set when the robot type is entered. If these initial value are changed, malfunctions may occur.

Set PARA mode to input parameter 2. (Refer to section 14.1.)

```
[PARA] F1:SET MODE
       F2:PARAMETER1
       F3:PARAMETER2
1/2    F4:TABLE
```

STEP 1 Press F3 in this state.

```
[PARA]
 CHANGE PARAMETER2

     YES:ENT   NO:ESC
```

STEP 2 Press ENT to change parameter 2, and press ESC not to change it.
Press ENT to go to STEP 3, press ESC to return to the previous screen.

Parameter No.

```
[PARA]K01
 AXIS DISPLAY
          1  2  3  4
         [X][Y][Z][R]
```

STEP 3 Use NEXT and -NEXT to move to the parameter 2 setting screens in this state. To end the parameter setting, press ESC.
Press ESC to move to STEP 4.

● Search function

When SEARCH is pressed and the parameter number is input, the parameter 2 setting screen can be searched.

```

 PLEASE POWER OFF!!

```

STEP 4 This is the parameter 2 end screen.
Follow the instructions on the screen, and turn the power OFF. The parameter 2 setting will be validated when the power is turned ON again.

■ 14.4.1 Setting of axis display

```
[PARA]K01
 AXIS DISPLAY
          1  2  3  4
         [X][Y][Z][R]
```

STEP 1 Select the axis display (X, Y, Z, R) with ALT and press ENT .
When NEXT is pressed, the next screen will display.
Press ESC to display the parameter 2 end screen.

? ●The axis display refers to the name of the axis connected to each unit when displayed on the Teach Pendant. (Selective display: X, Y, Z, R and ?)

NOTE If two or more same displays are selected in the same task, the axis with the smaller station number has the priority for SVON, SVOF and OUTS commands.

■ 14.4.2 Setting of in-position data value

```
[PARA]K02 A1=00.05
 INPOSI.  A2=00.05
 ZONE     A3=00.05
          A4=00.05
```

STEP 1 Use the numeric keypad to enter the in-position data and press ENT .
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to display the parameter 2 end screen.

? ●The in-position data is an item used as a judgment standard of the completion of positioning. When the logic coordinates reach the target coordinates and the deflection counter (difference of target position and current position) becomes less than this value, it will be judged that positioning has been completed, and the program will move to the next operation (step).
Even if this value is increased, the positioning will not be completed until the two conditions are established. (Initial value: 0.05, Setting range: 0.01 to 65.0, Unit: mm)

■ 14.4.3 Setting of overflow data value

```
[PARA]K03 A1=20000
 OVERFLOW A2=20000
     DATA A3=20000
          A4=20000
```

STEP 1 Use the numeric keypad to enter the overflow data and press ENT .
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to display the parameter 2 end screen.

? ●When the value of the deflection counter (difference of target position and current position) increases above this value, an overflow error will occur. (Do not change the initial value.)
(Initial value: 20000, Setting range: 1 to 65535, Unit: pulse)

■ 14.4.4 Setting of feed forward data value

```
[PARA]K04 A1=20000
 FEED     A2=20000
 FORWARD  A3=20000
          A4=20000
```

STEP 1 Use the numeric keypad to enter the feed forward data and press ENT .
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to display the parameter 2 end screen.

?

- This is the feed forward control constant. (Do not change the initial value.)
  (Initial value: 2000, Setting range: 0 to 65535, Unit: pulse)

■ 14.4.5 Setting of direction of motor revolution

```
[PARA]K05 A1=1
ROTATION  A2=1
DIRECTION A3=1
          A4=1
```

STEP 1 Use the numeric keypad to enter the direction of motor revolution (0: forward, 1: reverse) and press ENT .
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to display the parameter 2 end screen.

?

- Forward (0) : Motor rotates in clockwise direction in respect to the positive movement command when the motor output shaft is looked from the load side.
- Reverse (1) : Motor rotates in counterclockwise direction in respect to the positive movement command when the motor output shaft is looked from the load side.

- Set this value according to the Instruction Manual (Axis Installation Section).
  (This value is set automatically when the robot type is entered. Refer to section 2.4.7.)

■ 14.4.6 Setting of maximum speed

```
[PARA]K06 A1=1000
 MAX.     A2=1000
 SPEED    A3=1000
          A4=1000
```

STEP 1 Use the numeric keypad to enter the maximum speed and press ENT .
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to display the parameter 2 end screen.

?

- This is the movement speed limit value. This setting will have a priority over all other settings.
  (Initial value: 1000, Setting range: 1 to 9999, Unit: mm/s)
- Set this value according to the Instruction Manual (Axis Installation Section).
  (This value is set automatically when the robot type is entered. Refer to section 2.4.7.)

■ 14.4.7 Setting of return to origin speed (A1)

```
[PARA]K07
HOME POSI.L:002.0
SPEED A1  M:020.0
          H:100.0
```

STEP 1 Use the numeric keypad to enter the return to origin speed of A1 axis and press ENT .
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to display the parameter 2 end screen.

?

- Set movement speed L (low speed), M (medium speed) and H (high speed) for returning to the origin.
(Setting range L, M: 1 to 250, H: 1 to 999, Unit: mm/s)
- This value is set automatically when the robot type is entered. (Refer to section 2.4.7.)

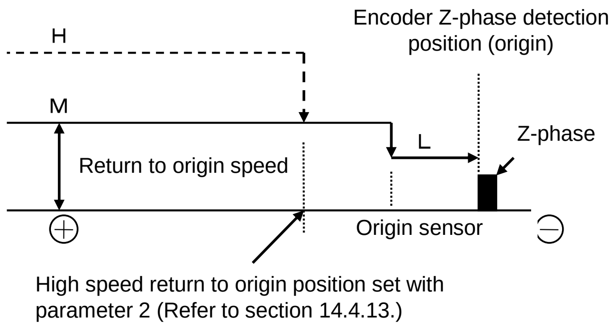
NOTE
- If movement speed L (low speed) and M (medium speed) are set to more than the initial value, normal return to the origin may not be possible. Also encoder error may occur.
- Even if any value below the decimal point is input, it will be ignored during operation.

[Explanation of return to origin speed L, M and H]

This unit has two methods of returning to the origin. (Refer to section 14.4.11.) Furthermore, there is the initial return to origin after the power is turned ON and the second and following return to origin.

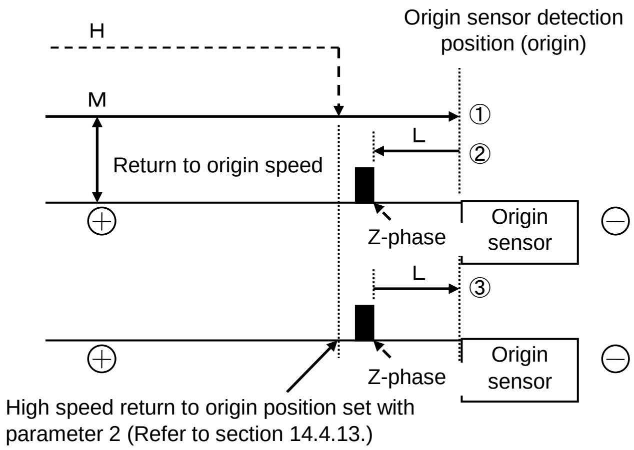
(1) When parameter 2 return to origin method is set to "0"

(Refer to section 14.4.11)



(2) When parameter 2 return to origin method is set to "1"

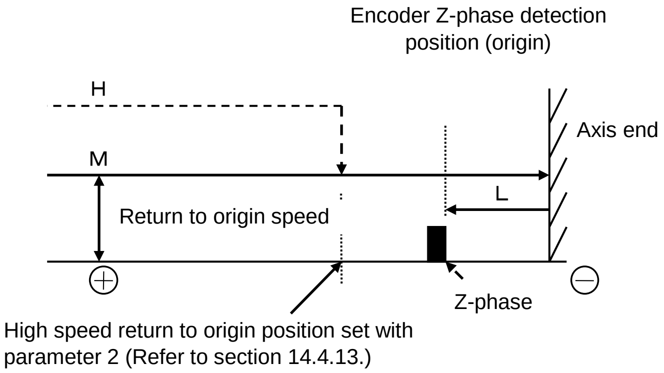
(Refer to section 14.4.11)



NOTE
- If it is present at the origin, move it out of the origin sensor once, and try return to origin again.

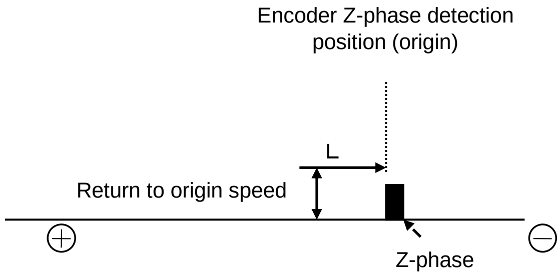
(3) When parameter 2 return to origin method is set to "2"

(Refer to section 14.4.11)

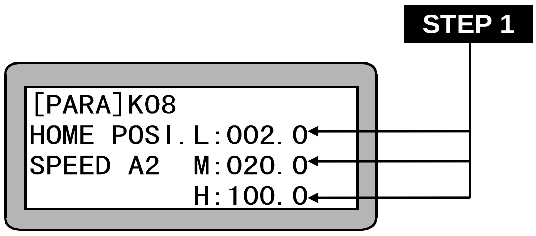


(4) When parameter 3 return to origin method is set to "3"

(Refer to section 14.4.11)

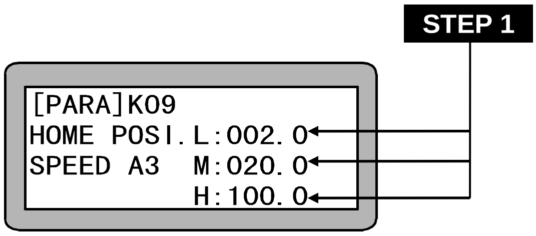


■ 14.4.8 Setting of return to origin speed (A2)



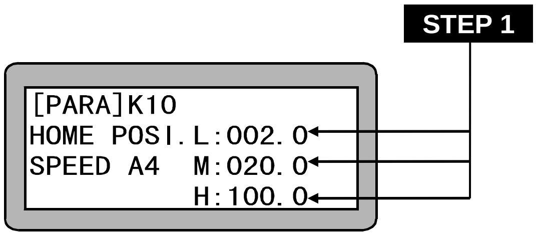
Use the numeric keypad to enter the return to origin speed of A2 axis and press ENT .
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to display the parameter 2 end screen.

■ 14.4.9 Setting of return to origin speed (A3)



Use the numeric keypad to enter the return to origin speed of A3 axis and press ENT .
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to display the parameter 2 end screen.

■ 14.4.10 Setting of return to origin speed (A4)



Use the numeric keypad to enter the return to origin speed of A4 axis and press ENT .
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to display the parameter 2 end screen.

■ 14.4.11 Setting of return to origin method

STEP 1

```
[PARA]K11 A1=0
HOME POSI A2=0
METHOD    A3=0
          A4=0
```

Use the numeric keypad to enter the return to origin method (0 to 4) and press ENT .

Press NEXT to display the next screen and -NEXT to display the previous screen.

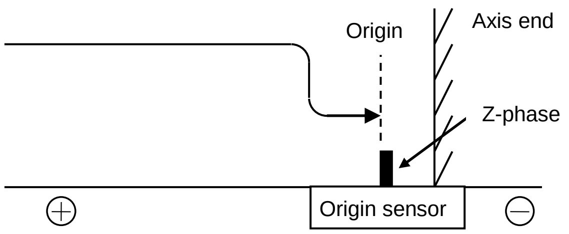
Press ESC to display the parameter 2 end screen.

?

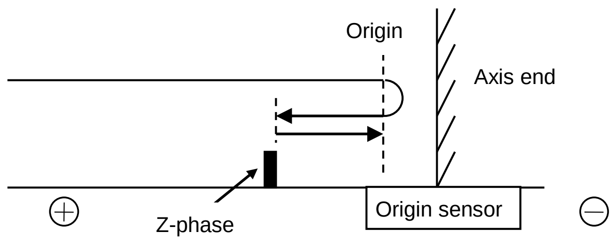
- Set the return to origin method for each slave unit. (Refer to section 2.4.4.)
- Follow the Operating Manual (Axis Setting) to make the settings.
  (Entry of the robot type is set automatically. Refer to section 2.4.7.)

NOTE If a return to origin system is set that does not match the axis model type, the return to origin operation may not be performed normally, and the origin position may change. Therefore, do not change the robot type input from the value that was set.

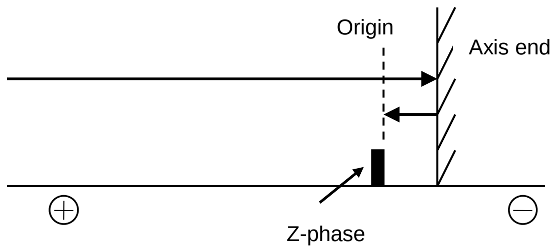
0: After the origin sensor is set to ON, the encoder Z-phase is detected at low speed to set the origin position.
If the value of the return to origin speed M (medium speed) (refer to section 14.4.7) is increased, the operation may pass over the Z-phase.



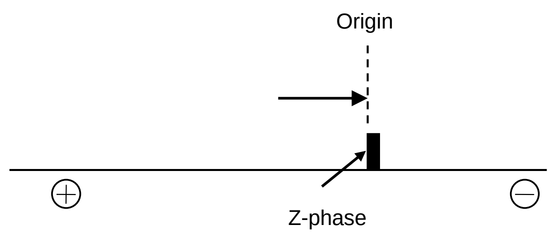
1: After the origin sensor is set to ON, operation advances (+ direction) and stops at the Z-phase, and a search is made for the origin sensor at low-speed again, and the origin position is set where the sensor turns ON.



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



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



■ 14.4.12 Setting of origin sensor logic

```
[PARA]K12 A1=1
HOME LS   A2=1
LOGIC     A3=1
          A4=1
```

STEP 1 Use the numeric keypad to enter the origin sensor logic (0 or 1) and press [ENT].
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.
Press [ESC] to display the parameter 2 end screen.

- Setting of the origin sensor logic means to select whether the output signal of the sensor assembled in the axis turns OFF or ON when detected.
  (Setting range: 0, 1)
  1: OFF when detected 0: ON when detected
- Set this value according to the Instruction Manual (Axis Installation Section)
  (This value is set automatically when the robot type is entered. Refer to section 2.4.7.)

■ 14.4.13 Setting of high speed return to origin position

```
[PARA]K13A1= 0020.00
HOME PO.  A2= 0020.00
TARGET    A3= 0020.00
          A4= 0020.00
```

STEP 1 Use the numeric keypad to enter the high speed return to origin position data and press [ENT].
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.
Press [ESC] to display the parameter 2 end screen.

- The high speed return to origin position refers to the target position when moving at a high speed (return to origin speed H) while executing high speed return to origin. The initial value is 20, and a value less than this must not be set.
  (Initial value: 20.00, Setting range: –8000.00 to 8000.00, Unit: mm)

■ 14.4.14 Setting of lead

```
[PARA]K14 A1=20.000
 LEAD     A2=20.000
          A3=20.000
          A4=20.000
```

STEP 1 Use the numeric keypad to enter the axis lead and press [ENT].
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.
Press [ESC] to display the parameter 2 end screen.

- The lead is the advance direction per motor revolution.
  (Initial value: 20.00, Setting range: 1.000 to 99.999, Unit: mm)
- Set this value according to the Instruction Manual (Axis Installation Section).
  (This value is set automatically when the robot type is entered. Refer to section 2.4.7.)

■ 14.4.15 Setting of encoder No. of divisions

```
[PARA]K15 A1=2000
 DIVISION A2=2000
          A3=2000
          A4=2000
```

STEP 1 Use the numeric keypad to enter the encoder No. of divisions and press ENT .

Press NEXT to display the next screen and -NEXT to display the previous screen.

Press ESC to display the parameter 2 end screen.

- The encoder No. of divisions refers to the No. of pulses per revolution of the encoder installed on the motor.
  (Don't change the initial value.)
  (Initial value: 2000, Setting range; 1 to 9999, Unit: pulse/rev)
- Set this value according to the Instruction Manual (Axis Installation Section).
  (This value is set automatically when the robot type is entered. Refer to section 2.4.7.)

■ 14.4.16 Setting of encoder pulse multiplier

```
[PARA]K16 A1=4
MULTIPLI- A2=4
CATION    A3=4
          A4=4
```

STEP 1 Use the numeric keypad to enter the encoder pulse multiplier and press ENT .

Press NEXT to display the next screen and -NEXT to display the previous screen.

Press ESC to display the parameter 2 end screen.

- The multiplier determines at what fold to generate the pulses of the encoder installed on the motor.
  (If a multiplier of 3 is set, the operation will be 2-fold.)
  (Initial value: 4, Setting range: 1 to 4)

NOTE Don't change the initial value.
(This value is set automatically when the robot type is entered. Refer to section 2.4.7.)

■ 14.4.17 Setting of encoder type

```
[PARA]K17
 ENCODER TYPE

                  [i]
```

STEP 1 Select the encoder type with ALT and press ENT .

Press NEXT to display the next screen and -NEXT to display the previous screen.

Press ESC to display the parameter 2 end screen.

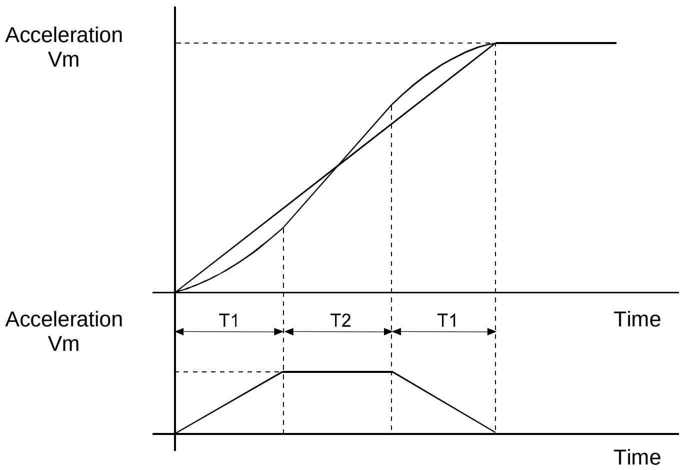
- The encoder type is the type of encoder installed on the motor. The following types are available.
  a : Absolute encoder
  i : Incremental encoder
  (Initial value: a, selective types: a, i)
- The absolute encoder is compatible for the slave unit version 2.00 and above. If an absolute encoder is set for a version 2.00 and below controller, the setting will be invalid.
  (Refer to section 18.4 on how to confirm the version.)

■ 14.4.18 Setting of acceleration/deceleration time constant

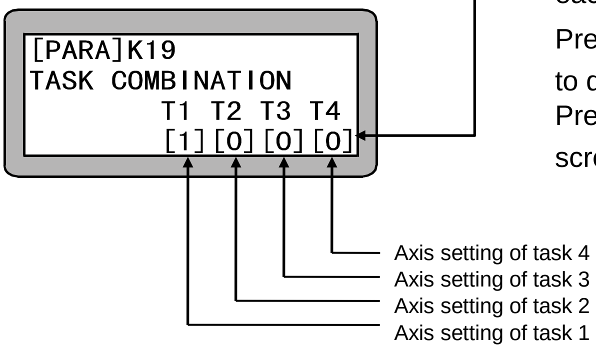
```
[PARA]K18
ACC T2 RATIO: 1-100%

                [060]
```

STEP 1 Use the numeric keypad to enter the acceleration/deceleration rate, and press ENT .
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to display the parameter 2 end screen.

The acceleration/deceleration rate expresses the rate of the relevant speed part (T2) in the trapezoidal speedup/slowdown pattern.
(Initial value: 60(%), Setting range: 1 to 100)
The whole acceleration/deceleration time is set by the acceleration/deceleration command (ACC). (Refer to Chapter 19.)



■ 14.4.19 Setting of task and axis combination



STEP 1 Use the numeric keypad to enter the axis setting of each task, and press ENT .

Press NEXT to display the next screen and -NEXT to display the previous screen.

Press ESC to display the parameter 2 end screen.

?

● The station No. is a number assigned to each unit, and the axis setting is set for each task. (Refer to section 2.4.4.)

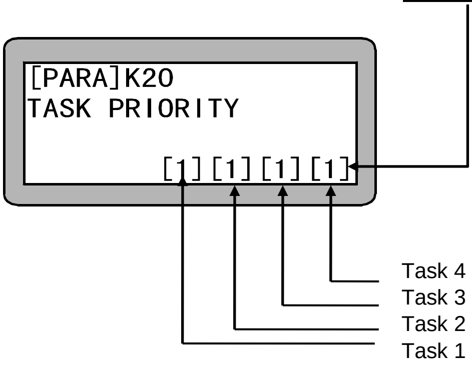
(Initial value: [1] [0] [0][0], Setting range = T1: 1 to 5, T2 to T4: 0)

Set the axis setting as shown below.

Axis setting	Setting	Description
0	0-axis specifications	No control axis
1	1-axis specifications	Axis setting
2	2-axis specifications (2-dimensional circular interpolation)	2-dimensional circular interpolation is possible through 2-axis setting.
3	3-axis specifications (2-dimensional circular interpolation)	2-dimensional circular interpolation of Axes 1 and 2 is possible through 3-axis setting. Simultaneous arrival is applied for Axis 3.
4	3-axis specifications (3-dimensional circular interpolation)	3-dimensional circular interpolation is possible through 3-axis setting.
5	4-axis specifications (3-dimensional circular interpolation)	3-dimensional circular interpolation of Axes 1 , 2 and 3 is possible through 4-axis setting. Simultaneous arrival is applied for Axis 4.

NOTE As "axisless task", the axis setting 0 is applied for execution of the other commands (movement command, etc.) except those concerned with the axes.

■ 14.4.20 Setting of task order of priority



STEP 1 Use the numeric keypad to enter each task priority (0 to 4) and press ENT .

1 has the highest priority and 4 has the lowest priority.

Press NEXT to display the next screen and -NEXT to display the previous screen.

Press ESC to display the parameter 2 end screen.

? With multitasking, the open time of each task is used to execute the other tasks, so it appears that each task is carried out simultaneously.
The priority to execute which task is set to determine which task to execute when an opening is generated in the task.
If the priority is low, the execution of that task will be delayed, so set a higher priority for tasks that have time limits. If the same priority is set for multiple tasks, the task with the smaller task No. will have the higher priority.

NOTE If the priority is set to 0, that task will not be executed.
Task 1 (main task) can only be set to "1". Setting to another value will revert it to "1".

■ 14.4.21 Setting of task point table

```
[PARA]K21 T1=999
TASK      T2=999
POINT-TBL T3=999
          T4=999
```

This value is set to 999 for each task with this equipment.

■ 14.4.22 Setting of No. of task steps

```
[PARA]K22 T1=1000
TASK      T2=0000
STEP NUM. T3=0000
          T4=0000
```

STEP 1 Use the numeric key pad to enter the max. No. of steps in each task and press [ENT] .
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.
Press (ESC) to display the parameter 2 end screen.

```
A PART OF PROGRAM
        DATA CLR?

    YES:ENT  NO:ESC
```

STEP 2 Because programs can be cleared when this setting is changed, a confirmation message is displayed.
Press [ENT] to change the setting value.
Press (ESC) to return to STEP 1.

?

The total number of steps is a maximum of 2,500.
(Initial value: T1: 2000, T2 to T4: 0, Setting range: T1: 1 to 2500, T2 to T4: 0 to 2500)

NOTE

- If the max. No. of steps is set to lower than the current value, the program of that step will be cleared.
- When 2,001 or more steps are set, the easy mode program area will be cleared and used as the sequential program area.
- If a total of 2,001 or more steps is set from the easy mode with this setting, the error "EXECUTION NOT POSSIBLE" will occur.
- If a total of 1,001 or more steps is set with this setting, and the easy mode is entered, the error "EXECUTION NOT POSSIBLE" will occur. (Refer to section 14.2.10.)

■ 14.4.23 BA I/O compatibility mode

```
[PARA]K23
 BA I/O COMPATIBLE
  MODE
               [OFF ]
```

STEP 1 Press [ALT] to switch between Valid and Invalid.
Press [NEXT] to display the next screen and [-NEXT] to display the previous screen.
Press (ESC) to display the parameter 2 end screen.

?

- When this mode is set to Valid the positioning complete signal and return to origin complete signal are based on the BA series controller specifications. (Refer to section 18.8.)

■ 14.4.24 Setting of return to origin direction

STEP 1

```
[PARA]K24 A1=0
HOME POSI.A2=0
DIRECTION A3=0
          A4=0
```

Use the numeric keypad to enter the return to origin direction (0: - direction, 1: +direction), and press ENT.
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to display the parameter 2 end screen

*The return to origin direction is set for each slave unit. (Refer to section 2.4.4.)

■ 14.4.25 Setting of dynamic brake

```
[PARA]K25 A1=0
 DYNAMIC  A2=0
 BRAKE    A3=0
          A4=0
```

Use this parameter at the initial setting.
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to display the parameter 2 end screen

■ 14.4.26 Setting of synchronized axes

STEP 1

```
[PARA]K26
 SYNC.AXIS SETTING
         A1 A2 A3 A4
         [M][S][0][0]
```

Press ALT to switch between the M: Drive Axis and 0: Normal Axis setting. (If M: Drive Axis is set, the next axis automatically becomes S: Driven axis.)
Press ENT to move the cursor from A1 to A3 one step at a time.
Press -NEXT to display the previous screen.
Press ESC to display the parameter 2 end screen

- This sets the axes where synchronized axes control is performed.
  - Set "M" for the axis set as the drive axis.
  - Set "0" for the axis set as the normal axis.
  - When "M" (drive axis) is set, the next axis automatically becomes "S" (driven axis).

NOTE If synchronized axes are set for axes that do not exist, the error message "ER66: Synchronized Axes Parameter Error" occurs when performing a synchronized axes origin search.

■ 14.5 Parameter 3 Setting

Parameter 3 edits the user parameters for the BS servo amplifier.
Parameter 3 contains the following items.

1. Setting of resolver cable length
2. Setting of external reverse-current absorption resistance value
3. Setting of external reverse-current absorption resistor allowable value

After setting parameter 3, turn the controller power OFF and then ON again.
Modified settings are not enabled unless the controller is turned OFF.

The parameter 3 settings must be made in PARA mode. (Refer to section 14.1.)

```
[PARA] F1:PARAMETER3
       F2:
       F3:
2/2    F4:
```

STEP 1 Press F1 in this state.

```
[PARA]
 CHANGE PARAMETER3
 (BS USER PARAMETER)
    YES:ENT  NO:ESC
```

STEP 2 Press ENT to change parameter 3, and press ESC not to change it.
Press ENT to move to STEP 3, press ESC to return to the previous screen.

```
[PARA]U03 A1=005
 RSLV.CBL. A2=005
   LENGTH A3=005
          A4=005
```

STEP 3 Use NEXT and -NEXT in this state to move to the various parameter setting screens.
To end the parameter setting, press ESC .
Press ESC to move to STEP 4.

```
 PLEASE POWER OFF !!
```

STEP 4 This is the parameter 3 end screen.
Follow the instructions on the screen, and turn the power OFF. The parameter 3 setting will be validated when the power is turned ON again.

■ 14.5.1 Setting of resolver cable length

```
[PARA]U03 A1=005
 RSLV.CBL. A2=005
   LENGTH A3=005
          A4=005
```

STEP 1 Use the numeric keypad to enter the cable length, and press [ENT].
Press [NEXT] to display the next screen.
Press [ESC] to move to the parameter 3 end screen.

- This sets the cable length when the motor sensor is a resolver.
  If the motor sensor is not a resolver, this setting is ignored.
  (Initial value: 5, Setting range: 1 to 120, Unit: m)

■ 14.5.2 Setting of external reverse-current absorption resistance value

```
[PARA]U21 A1=000.0
 EX.RESIS. A2=000.0
    VALUE A3=000.0
          A4=000.0
```

STEP 1 Use the numeric keypad to enter the resistance value, and press [ENT].
Press [NEXT] to display the next screen, and press [-NEXT] to display the previous screen.
Press [ESC] to move to the parameter 3 end screen.

- This is set when using an external reverse-current absorption resistor.
  When set to 0, this is set to the internal reverse-current absorption resistor.
  (Initial value: 0, Setting range: 0 to 100, Unit: Ω)

■ 14.5.3 Setting of external reverse-current absorption resistor allowable value

```
[PARA]U22 A1=000.00
 EX.RESIS. A2=000.00
 CAPACITY A3=000.00
          A4=000.00
```

STEP 1 Use the numeric keypad to enter the resistor allowable value, and press [ENT].
Press [-NEXT] to display the previous screen.
Press [ESC] to move to the parameter 3 end screen.

- This sets the capacity of the external reverse-current absorption resistor.
  When set to 0, this is set to the internal reverse-current absorption resistor.
  (Initial value: 0, Setting range: 0 to 327.67, Unit: kW)

■ 14.6 How to Set the Tables

The tables are groups of data for which addresses are assigned to each data item.
To use the table, designate the data indirectly using the address (table No.) in the program.
As an example, the concept of the coordinate table as shown in a table below.

Coordinate table No. (address)	Coordinate data [mm]
001	X = 100, Y = 150
002	X = 700, Y = 500
•	•
999	X = 600, Y = 300

The following types of tables are available.

- Coordinate (point) table·········table Nos. 1 to 999 (Set for each task when using multitasking)
- Speed table ························table Nos. 1 to 10
- Acceleration (ACC) table·······table Nos. 1 to 20
- MVM table··························table Nos. 1 to 32

Refer to section 4.1.7 for details on the MVM command.

NOTE When using multitasking, the coordinate tables are provided for each task, so change the task first. (Refer to section 5.3.2 (1).)

Enter the PARA mode. (Refer to section 14.1.)

STEP 1 Press F4 in this state.

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

STEP 2 Press F1 to F4 to select the table to be set.

```
[PARA] F1:POINT TABL
       F2:SPEED TABL
       F3:ACCEL TABL
       F4:MVM   TABL
```

■ 14.6.1 Setting of coordinate (point) table

Press F1 in the table selection screen shown in section 10.5, and select the coordinate (point) table.

```
[PARA]      X= 0000.00
PNT-TBL     Y= 0000.00
NO.001      Z= 0000.00
            R= 0000.00
```

STEP 1 Use the numeric keypad to enter the coordinates and press ENT . (Input range: –8000 to 8000)
Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to return to the table selection screen.
Pressing SEARCH and entering the table number enables jumping to the specified table.

?

- Unit: mm
- The tables that can be set are Nos. 1 to 999.
- The screen shows an example of 4-axis setting.
- Remote teaching and direct teaching can be used. (Refer to section 3.2.2.)

```
[PARA]      X= *******
PNT-TBL     Y= 0000.00
NO.001      Z= 0000.00
            R= 0000.00
```

STEP 1 If ALT is pressed instead of a value, the display will change to *******, and that coordinate will be handled in the same manner as the current coordinate value.

■ 14.6.2 Setting of speed table

Press F2 in the table selection screen shown in section 14.6, and select the speed table.

```
[PARA]
SPD-TBL  NO 01:0100.0
         NO 02:0200.0
         NO 03:0300.0
```

STEP 1 Input is possible for the speed table at the second line from the top.
Use the numeric keypad to enter the speed and press ENT .
Press NEXT to scroll the screen.

?

- Though the setting range is 1.0 to 9999.9 [mm/s], a value below the decimal point will be ignored during operation even if it is input.
- Even if the speed is specified by this parameter, the speed is limited to the value that was set for "Setting of maximum speed" in parameter 2.
- The initial values are as shown below.

SPD table No.	1	2	3	4	5	6	7	8	9	10
Initial value [mm/s]	100	200	300	400	500	600	700	800	900	1000

STEP 2

```
[PARA]   NO 01:0100.0
SPD-TBL  NO 02:0200.0
         NO 03:0300.0
         NO 04:0400.0
```

Press [-NEXT] or [NEXT] to scroll the screen.

Pressing [SEARCH] and entering the table number enables jumping to the specified table.

Press [ESC] to return to the table selection screen.

?

- The tables that can be set are Nos. 1 to 10.

■ 14.6.3 Setting of acceleration/deceleration table

Press [F3] in the table selection screen shown in section 14.6, and select the acceleration table.

STEP 1

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

Input is possible for the speed table at the second line from the top.

Use the numeric keypad and enter the acceleration speed (time to reach set speed) and press [ENT] .

Press [NEXT] to scroll to the next screen.

?

- The input range is 0.01 to 9.99 [s].
- The initial values are as shown below.

ACC table No.	1	2	3	4	5	6	7	8	9	10
Time [s]	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55

ACC table No.	11	12	13	14	15	16	17	18	19	20
Time [s]	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05

STEP 2

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

Press [-NEXT] or [-NEXT] to scroll the table.

Pressing [SEARCH] and entering the table number enables jumping to the specified table.

Press [ESC] to return to the table selection screen.

?

- The tables that can be set are Nos. 1 to 20.

NOTE The maximum portable weight will differ according to the acceleration speed.

■ 14.6.4 Setting of MVM table

Press F4 in the table selection screen shown in section 14.6, and select the MVM table.

STEP 1

```
[PARA]   ORG:NO=001
MVM-TBL   P1:NO=000
01-1      P2:NO=000
          P3:NO=000
```

MVM table No.

Use the numeric keypad to enter the P0 (ORG), P1, P2 and P3 coordinate table Nos. (Input range: 1 to 999) and press ENT .

Press NEXT to display the next screen and -NEXT to display the previous screen.

Press ESC to return to the table selection screen.

- If a specific MVM table is to be displayed or revised while inputting the MVM table, press SEARCH and then enter the table No. with the numeric keypad (1 to 32).
- Refer to section 4.1.7 for program examples using the MVM table.

STEP 2

```
[PARA]   NUMBER
MVM-TBL   P1:0000
01-2      P2:0000
          P3:0000
```

Use the numeric keypad to enter the No. of pieces to be moved and loaded and then press ENT .

Press NEXT to display the next screen and -NEXT to display the previous screen.

Press ESC to return to the table selection screen.

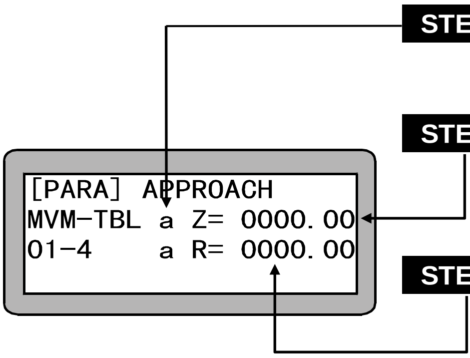
STEP 3

```
[PARA]  CNT NO.
MVM-TBL   P1:NO=00
01-3      P2:NO=00
          P3:NO=00
```

Use the numeric keypad to enter the counter No. used for each axis, and press ENT .

Press NEXT to display the next screen and -NEXT to display the previous screen.

Press ESC to return to the table selection screen.

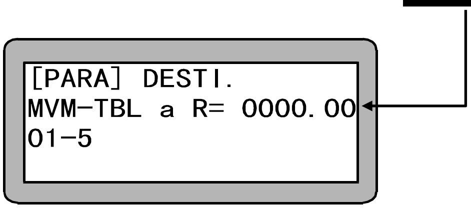


STEP 4 Use ALT to select a (absolute coordinate) or i (relative coordinate), and press ENT .

STEP 5 Next, for Z axis, use the numeric keypad to enter the coordinate of an approach point, and press ENT .

STEP 6 Next, for R axis, use the numeric keypad to enter the coordinate (only for designation of absolute coordinate) of the approach point, and press ENT .

Press NEXT to display the next screen and -NEXT to display the previous screen.
Press ESC to return to the table selection screen.



STEP 5 For R axis, use the numeric keypad to enter the coordinate (only for designation of absolute coordinate) of the destination point, and press ENT .
Press -NEXT to display the previous screen
Press ESC to return to the table selection screen.

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Chapter 15 Monitoring

This unit has a function to monitor the various parameters on a screen during operation. The parameters that can be monitored are as shown below.

1. Step monitor ······················ Monitor of sequential program step number
   Monitor of external point designation coordinate step

2. Input/output monitor ············ Input status of system and general-purpose port
   Output status of system and general-purpose port
   Output status of internal port

3. Counter and timer monitor ···· Status of counter
   Status of timer
   Setting of counter

4. Coordinate monitor·············· Current position coordinate
   Offset coordinate
   Coordinate input with RS-232C

NOTE
- Stop input from Teach Pendant is not effective during monitoring.
- Monitor Use prohibited for external point appointment mode.
- When using multitasking, the status of the task displayed on the Teach Pendant will be monitored.

Method of monitoring

Programming for monitoring.

STEP 1

```
[RUN]  F1:AUTO/STEP
       F2:OVERRIDE
       F3:RESET
       F4:PAGE
```

The prompt is displayed when HELP is pressed during program execution.
Press F4 in this state.
When using multitasking, change to the task to be monitored before starting this operation.

STEP 2

```
[RUN]  F1:MONITOR
       F2:
       F3:T/P ON
       F4:T/P OFF
```

Press F1 in this state to enter the monitor mode.

STEP 3 This is the initial display for monitoring.
Select a key from F1 to F4 and press it for necessary monitoring.
When ESC is pressed, the display returns to STEP 2.

```
[MONI] F1:STEP
       F2:I/O
       F3:CNT/TIM
       F4:POSITION
```

■ 15.1 Step Monitor

This displays the execution progress on the screen together with the content of the program step currently being executed in the sequential program or the content of the coordinate step currently being executed in the external point designation.

- Display the initial monitoring screen.

STEP 1 Press F1 in this state.

```
[MONI] F1:STEP
       F2:I/O
       F3:CNT/TIM
       F4:POSITION
```

- During sequential mode, palletizing mode, and easy mode (Sequential program step monitor)

STEP 2A The program step currently being executed is displayed. The screen display changes based on the program progress.

Press ESC to return to STEP 1.

```
[MONI]
0005 a  S NO=001
     V=00 CNT[00]
     POST
```

- During external point designation mode (External point designation coordinate step monitor)

STEP 2B The coordinate step currently being executed is displayed. The screen display changes based on the program progress.
Press ESC to return to STEP 1.

```
[MONI]     X= 0000.00
PNT-TBL    Y= 0000.00
NO.001     Z= 0000.00
           R= 0000.00
```

■ 15.2 Input/Output Monitoring

Status of input/output port in program execution is monitored according to the progress of the program.

- Display the initial monitoring screen.

STEP 1 Press F2 in this state.

```
[MONI] F1:STEP
       F2:I/O
       F3:CNT/TIM
       F4:POSITION
```

STEP 2 Press F1 to monitor the input port and F2 to monitor the output port and F3 to monitor internal port.
Press ESC to return to STEP 1.

```
[MONI] F1:IN
       F2:OUT
       F3:IPORT
       F4:
```

- When F1 is pressed (Input monitor)

STEP 3A Enter the station No. of the controller to be monitored and press ENT . (Input range: 0 to 4)

```
 STAITION NO.   [0]
```

STEP 4A The status of the current system input port and general-purpose input port will be displayed in bit units.
Press -NEXT or NEXT to scroll the screen.
Press ESC to return to STEP 2.

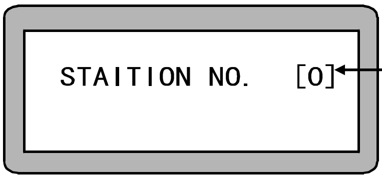
```
System input   No. 8      No. 1
[MONI SYS01:00000000
 -IN] GEN01:00000000
      GEN02:00000000
      GEN03:00000000
General-purpose
input          No. 8      No. 1
```

Display “0”: OFF
Display “1”: ON

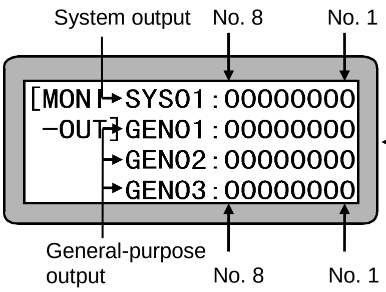
	Signal name	
	System input	General-purpose input 09
No. 1	Return to origin (monitor)	Request axis 1 jog
No. 2	Start	Request axis 2 jog
No. 3	Stop	Request axis 3 jog
No. 4	Reset	Request axis 4 jog
No. 5	Origin point sensor (Station 1)	Request inching
No. 6	Origin point sensor (Station 2)	Request low-speed jog
No. 7	Origin point sensor (Station 3)	Request high-speed jog
No. 8	Origin point sensor (Station 4)	Designate jog direction OFF: + direction, ON: – direction

NOTE
- The system input is not displayed for Stations No. 1 to 4 (slave unit).
- 0 is displayed for an invalid bit.
- The reverse of real signal is displayed in No. 1 to 4 of System input the case 1 is set in mode setting M22 (Positive logic/negative logic selection (input 1)).
- The reverse of real signal is displayed in No. 1 to 4 of General-purpose input 09 the case 1 is set in start input of mode setting M22 (Positive logic/negative logic selection (input 1)).

- When F2 is pressed (output monitor)



STEP 3B Enter the station No. of the controller to be monitored and press ENT . (Input range: 0 to 4)



STEP 4B The status of the current system output port and general-purpose output port will be displayed in bit units.
Press -NEXT or NEXT to scroll the screen.
Press ESC to return to STEP 2.

Display "0":OFF
Display "1": ON

	Signal name	
	System output	General-purpose output 09
No. 1	Running	Axis 1 jogging
No. 2	Error	Axis 2 jogging
No. 3	Positioning complete	Axis 3 jogging
No. 4	Return to origin complete	Axis 4 jogging
No. 5	invalid	Jog-ready
No. 6	invalid	invalid
No. 7	invalid	invalid
No. 8	invalid	invalid

NOTE
- The system output is not displayed for Stations No. 1 to 4 (slave unit). Moreover, all bits are invalid for the general-purpose output GEN03.
- 0 is displayed for the invalid bits.
- The reverse of real signal is displayed in No. 1 to 4 of System output the case 1 is set in mode setting M26 (Positive logic/negative logic selection (output 1)).

- The reverse of real signal is displayed in No. 1 to 4 of General-purpose output 09 the case 1 is set in running output of mode setting M26 (Positive logic/negative logic selection (output 1)).
- The reverse of real signal is displayed in No. 5 of General-purpose output 09 the case 1 is set in ready output of mode setting M27 (Positive logic/negative logic selection (output 2)).

● When [F3] is pressed (internal port monitor)

STEP 3C The status of the current internal port is displayed with a bit unit.
Press (ESC) to return to STEP 2.

```
[MONI SYS01:00000000
 -IP] GEN02:00000000
      GEN03:00000000
      GEN04:00000000
```

Internal port No. 8 No. 1

Display "0":OFF
Display "1": ON

? For details of the internal port, refer to INSP and IOUT commands of Chapter 19 "Commands".

■ 15.3 Counter and Timer Monitoring

Current counter and timer condition are monitored according to the proceedings of program execution.

● Display the initial instruction for monitoring.

STEP 1 Press [F3] in this state.

```
[MONI] F1:STEP
       F2:I/O
       F3:CNT/TIM
       F4:POSITION
```

STEP 2 To monitor the counter, press [F1]. Press [F2] to monitor the timer.
Press (ESC) to return to STEP 1.

```
[MONI] F1:COUNTER
 C/T   F2:TIMER
       F3:
       F4:SET COUNT
```

? For direct setting of counter with [F4], refer to section 18.3.

●When F1 is pressed (counter monitoring)

STEP 3A The current conditions of the counter are monitored.
Press -NEXT or NEXT to scroll the display.
Press SEARCH and enter the counter number to perform a search in the counter monitor screen.
Press ESC to return to STEP 2.

```
[MONI   NO.01=0000
 -CNT]  NO.02=0000
        NO.03=0000
        NO.04=0000
```

●When F2 is pressed (timer monitoring)

STEP 3B The current conditions of the timer are monitored.
Press -NEXT or NEXT to scroll the display.
Press ESC to return to STEP 2.

```
[MONI        NO.1=000.0
 -TIM]       NO.2=000.0
             NO.3=000.0
             NO.4=000.0
```

NOTE Counter No. 1 to 99 can be monitored.
Timer No. 1 to 9 can be monitored.

■ 15.4 Coordinate Monitoring

Current coordinates are monitored according to the progress of the program.

●Display the initial screen for monitoring.

STEP 1 Press F4 in this state.

```
[MONI] F1:STEP
       F2:I/O
       F3:CNT/TIM
       F4:POSITION
```

STEP 2 Press F1 to monitor the current position coordinate (absolute coordinate). Press F2 to monitor the offset coordinates.
Press ESC to return to STEP 1.

```
[MONI] F1:POSITION
 P/O   F2:OFS POSI
       F3:232C SIMU
       F4:
```

? For inputting of RS-232C coordinate with F3 , refer to section 18.7.

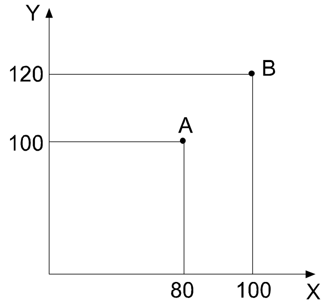
●When F1 is pressed (coordinate monitoring)

STEP 3A Current position coordinate is displayed.
Press ESC to return to STEP 2.

```
[MONI      X= 0100.00
 -POSI]    Y= 0100.00
           Z= 0100.00
           R= 0100.00
```

NOTE ●The value displayed for the current position is the absolute value minus the offset value.

●When the controller does not execute the OFS command, the display shows OFS = 0 in the current position monitor. The absolute position is displayed on the screen.



[Example] When the offset command (X=20, Y=20, Z=0) is executed before the point A movement command (MOVa X=80, Y=100, Z=0) is executed in the program, the robot will move to point B. The current position monitor will be displayed as (X=80, Y=100, Z=0).

●When F2 is pressed (offset coordinate monitor)

STEP 3B Current offset coordinate is displayed.
Press ESC to return to STEP 2.

```
[MONI      X= 0100.00
 -OFS]     Y= 0100.00
           Z= 0100.00
           R= 0100.00
```

? The offset coordinates refer to the coordinate system using the origin that has been offset (moved in parallel) with the command. This is not displayed for the origin offset.

NOTE ● The axis display in the screen becomes as set with "setting of axis display" of parameter 2. (Refer to section 14.4.1.)
"?" is displayed for an axis which is not used.

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Chapter 16 Search Function

When SEARCH is pressed in any mode, the following search operation can be carried out.

■ 16.1 Search of Step No.

When SEARCH is pressed in the sequential PRGM mode, AUTO mode or step mode, the following screen will display.

```
[SRCH]
 STEP NO. SEARCH
                  [0010]
```

STEP 1 Use the numeric keypad to enter the step No. and press ENT . (Input range: 1 to 2500)

Press ESC to return to origin screen.

```
[PRGM]
0010
NOP
```

STEP 2A The designated step will display.

■ 16.2 Search of Tag No.

If SEARCH is pressed twice in the sequential PRGM mode, AUTO mode or step mode, the following screen will display.

```
[SRCH]
 STEP NO. SEARCH
                   [001]
```

STEP 1 Use the numeric keypad to enter the tag No. and press ENT . (Input range: 1 to 999)

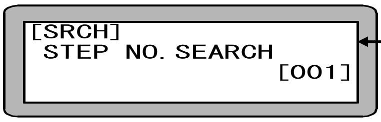
Press ESC to return to origin screen.

```
[PRGM]
0001
TAG  020
```

STEP 2 The designated tag No. step will display.

■ 16.3 Search of Easy Step Number

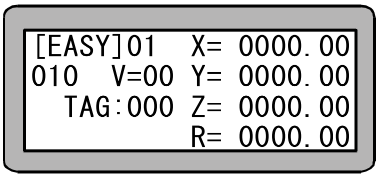
Press [SEARCH] in easy mode of PRGM mode to display the screen below.



STEP 1 Use the numeric keypad to enter the step No., and press [ENT]. (Input range: 1 to 800)

Press [ESC] to return to origin screen.

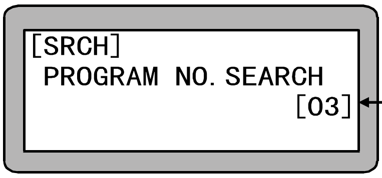
STEP 2 The designated step is displayed.



■ 16.4 Search of Easy Program No.

If [SEARCH] is pressed in the easy mode, the easy program screen can be searched.

If [SEARCH] is pressed twice in the PRGM mode, or once in the AUTO mode or step mode, the following screen will display.

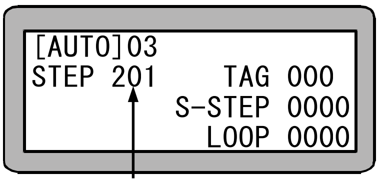


STEP 1 Use the numeric keypad to enter the easy program No. and press [ENT] .(Input range: 1 to 8)

Press [ESC] to return to origin screen.

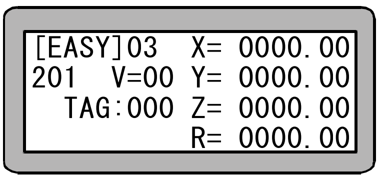
STEP 2 The designated easy program will display.

PRGM mode



Step No.

AUTO. step mode



■ 16.5 Search of Palletizing Program No.

If SEARCH is pressed in the palletizing mode's PRGM mode, AUTO mode or step mode, the following screen will display.

STEP 1 Use the numeric keypad to enter the palletizing program No. and press ENT .(Input range: 1 to 16)
Press ESC to return to origin screen.

```
[SRCH]
 PROGRAM NO. SEARCH
                [03]
```

STEP 2 The designated palletizing program will display.

```
[PRGM]01  START-TAG
03                000
M-1
```

Program No.

■ 16.6 Search of Palletizing Program Screen No.

If SEARCH is pressed twice in the palletizing mode's PRGM mode, the following screen will display.

STEP 1 Use the numeric keypad to enter the screen No. and press ENT . (Input range: 1 to 16)
Press ESC to return to origin screen.

```
[SRCH]
 DISPLAY NO. SEARCH
                [06]
```

STEP 2 The designated screen will display.

```
[PRGM]06 SO NUMBER
01           P1=0000
M-1          P2=0000
             P3=0000
```

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Chapter 17 Manual Operation of General-purpose Outputs

The general-purpose output from the Teach Pendant can be directly turned ON and OFF. There are two methods for this outputting method.

1. Manual output using function keys
2. Manual output of random bit from PRGM (program) mode

■ 17.1 Manual Output Using Function Keys

- The random output port and general-purpose output bits set in the mode setting can be manually output using the function keys. This method is valid only during the JOG mode or remote teaching mode.

NOTE Set the output bit to be directly output with the mode setting before starting this operation. (Refer to section 14.2.12.)

Press DIRECT JOG in the AUTO mode or PRGM mode.

```
[AUTO]     X=0000.00
0001 a   S Y=0000.00
MOV   V=00 Z=0000.00
JG-L POST R=0000.00
```

STEP 1 The JOG screen is displayed, and JOG operation is enabled.
Press ESC to proceed to STEP 2.

```
[OUT] F1:NO.1 ON/OFF
      F2:NO.2 ON/OFF
      F3:NO.3 ON/OFF
      F4:NO.4 ON/OFF
```

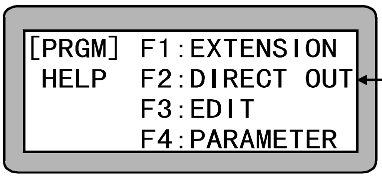
Bit No.

STEP 2 When HELP is pressed, the bit No. set in F1 to F4 will display.
In this state, press F1 to F4 , and the relevant port will be turned ON. Press it again, and it will be turned OFF.
Press ESC to return to STEP 1.

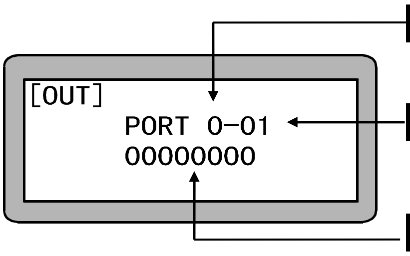
■ 17.2 Manual Output of Random Bit Designation from PRGM Mode

- A random bit can be manually output in the PRGM mode.

Enter the program mode and press [HELP] . The following screen will display. (Refer to section 4.1.1.)



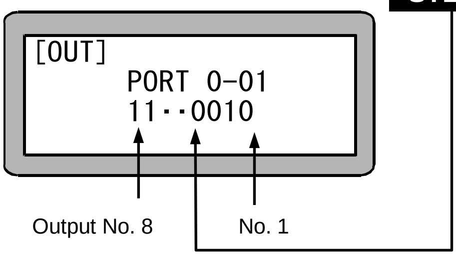
STEP 1 Press [F2] and enter the direct output mode.



STEP 2 Use the numeric keypad to enter the station No. (0 or 4) and press [ENT] .

STEP 3 Use the numeric keypad to enter the port No. and press [ENT] .

STEP 4 The status of the output port designated in STEPS 2 and 3 is displayed.



STEP 5 Press [IN 1] (ON), [RET 0] (OFF) or [TAG •] (no change) to designate the bit. Confirm the data and press [ENT] .

The set general-purpose output bit will turn ON or OFF.

Press [ESC] to return to the initial screen of the PRGM mode.

NOTE ●For the station No., port No. and bit No. which can be used, refer to "Names of general-purpose output ports and Teach Pendant displays" (section 10.1.4).

Chapter 18 Other Handy Operations

■ 18.1 Teach Pendant ON/OFF

When the Teach Pendant is physically connected to the controller, it can be logically disconnected by the following key operation and make system input signals effective.

● Teach pendant OFF operation

```
[RUN]   F1:AUTO/STEP
 HELP   F2:OVERRIDE
        F3:RESET
        F4:PAGE
```

STEP 1

After exiting the initial screen, start RUN mode, and press HELP to display the screen on the left.

Press F 4 to proceed to STEP 2.

Press ESC to return to RUN mode.

```
[RUN] F1:MONITOR
      F2:OPTION
      F3:T/P ON
      F4:T/P OFF
```

STEP 2

The screen on the left is displayed.

For the CA20-M00:

Press F 4 to proceed to STEP 3,.

For the CA20-M01:

Hold down the F 4 key for three seconds to proceed to STEP 3.

Press ESC to return to RUN mode.

```
TEACHING PENDANT OFF
```

STEP 3

The Teach Pendant OFF screen is displayed. This enables simulation with the teach pendant disconnected.

● Teach pendant ON operation

```
[RUN] F1:MONITOR
      F2:OPTION
      F3:T/P ON
      F4:T/P OFF
```

STEP 4

When the teach pendant is OFF, press HELP to display the screen on the left.

Press F 3 to establish the connection and return to RUN mode.

Press ESC to return to STEP 3.

■ 18.2 Reset Operation

The Teach Pendant can perform the same function as the reset signal (Pin No. 24) of the system input.

STEP 1

```
[RUN]   F1:AUTO/STEP
 HELP   F2:OVERRIDE
        F3:RESET
        F4:PAGE
```

In RUN mode, press HELP to display the screen on the left.
Press F 3 to proceed to STEP 2.
Press ESC to return to RUN mode.

STEP 2

```
    RESET OK ?

    YES:ENT   NO:ESC
```

To reset, press ENT. To not reset, press ESC.
After pressing the key, operation returns to RUN mode.

- For operation during reset input, refer to section 10.2.4 "Reset input".

■ 18.3 Counter Direct Set

Teach Pendant can be used to set the counter value directly.

STEP 1

```
[RUN]   F1:AUTO/STEP
 HELP   F2:OVERRIDE
        F3:RESET
        F4:PAGE
```

In RUN mode, press HELP to display the screen on the left.
Press F4 to proceed to STEP 2.
Press ESC to return to RUN mode.

STEP 2

```
[RUN]   F1:MONITOR
        F2:
        F3:T/P ON
        F4:T/P OFF
```

The screen on the left is displayed.
Press F1 to set to Monitor mode.
Press ESC to return to RUN mode.

STEP 3

```
[MONI]  F1:STEP
        F2:I/O
        F3:CNT/TIM
        F4:POSITION
```

The screen on the left is displayed.
Press F3 to proceed to STEP 4.
Press ESC to return to STEP 2.

STEP 4

```
[MONI]  F1:COUNTER
 C/T    F2:TIMER
        F3:
        F4:SET COUNT
```

The screen on the left is displayed.
Press F4 to proceed to STEP 5.
Press ESC to return to STEP 3.

```
[SET-
 CNT]
          NO.01=0000
```

STEP 5

Use the numeric keypad to enter the specified counter No. and then press ENT . (Input range: 1 to 99)

STEP 6

Use the numeric keypad to enter the setting value. (Input range: 1 to 9999)
Press ENT to set the counter value.
Press ESC to return to STEP 4.

■ 18.4 Version Display

The ROM version of the controller and Teach pendant can be displayed.

STEP 1 When you turn ON the power, the initial screen is displayed for two seconds.

```
TEACHING PENDANT
TPH-4C Ver.2.21
```

STEP 2 When this display appears after the initial screen, press F4 to continue to STEP 3.

```
POWER   F1:T/P ON
   -ON  F2:
        F3:CHANG TASK
        F4:EXTENSION
```

STEP 3 The screen on the left is displayed.
Press F3 to proceed to STEP 4.
Press ESC to return to STEP 2.

```
POWER   F1:MONITER
   -ON  F2:ROBOT TYPE
        F3:VERSION
        F4:PAGE
```

STEP 4 The version will display on the screen.
Press ESC to return to STEP 3.

```
VERSION      A1 2.88n
MASTER 4.00  A2 2.88n
 T/P 2.21    A3 2.88n
             A4 2.88n
```

?

The displayed indicators on the screen have the meanings below.

MASTER : Master unit (Station No. 0)
A1 : Slave unit (Station No. 1)
A2 : Slave unit (Station No. 2)
A3 : Slave unit (Station No. 3)
A4 : Slave unit (Station No. 4)
T/P : Teach pendant

■ 18.5 JOG Operation (Manual operation of axis)

JOG operation is the operation in which the axis is moved with remote operations using the Teach Pendant.
This is used to stop the program and move the axis during operations, or to move the axis during a program. editing
If the axis is provided with brakes, the brakes will be applied and the axis will not move in the servo free state. Thus, the JOG operation is used to move the axis.

? Refer to section 3.2.2 on how to input the position data using JOG operation while creating the program.

JOG operation can be used in the PRGM mode or RUN mode when the Teach Pendant is connected and turned ON.

An example of operation in the sequential mode is given below.

STEP 1 In PRGM mode or RUN mode, press [DIRECT JOG] .
When using multitasking in the sequential mode, the task in which the axis to be jogged is assigned must be changed to. (Refer to section 5.3.2 (1).)

```
[PRGM]
0001
SPD   V=05
```

STEP 2 The JOG screen is displayed, and jog operation is enabled.

STEP 3 The jog speed is switched between HIGH and LOW by pressing [ALT].
As an example, the axis 1 will move when [+1] is held down.

```
[AUTO]     X= 0000.00
JOG        Y= 0000.00
OPERATION  Z= 0000.00
SPD:LOW    R= 0000.00
```

NOTE

- For the axis movement during JOG operation, +1 and -1 are used for the axis 1 and +2 and -2 are used for the axis 2. If a plus key is held down, the axis will move in the direction opposite the origin, and if a minus key is held down, the axis will move in the direction of the origin.
- Jog operation can be executed even when the controller has lost track of the current axis position (when return to origin is required). In this case, the soft limit is not applied.
- The JOG operation speed can be set with parameter 1 JOG speed. (Refer to section 14.3.8.)
- Inching during JOG operation is possible by pressing the movement keys (+1 , -1 , +2 , -2 , +3 , -3 , +4 , -4) and release the key immediately. The movement amount per inching movement can be set with parameter 1 inching movement amount. (Refer to section 14.3.12.)

```
[PRGM]
0001
SPD  V=05
```

STEP 4 After moving the axis to the designated position, press DIRECT JOG .

The JOG operation will be canceled, and the display will return to the first screen.

■ 18.6 Clearing (initializing) Coordinate Table

All coordinate tables in the controller memory can be cleared.
When using multitasking, only the coordinate table of the displayed task will be cleared. Thus, change to the task containing the table to be cleared before carrying out the following operation.
(Refer to section 5.3.2 (1).)

Enter the PRGM mode (sequential) and press HELP . (Refer to section 4.1.1.)
The following screen will display.

```
[PRGM] F1:EXTENSION
 HELP  F2:DIRECT OUT
       F3:EDIT
       F4:PARAMETER
```

STEP 1

Press F3 in this state to proceed to STEP 2.
Press ESC to return to PRGM mode.

```
[EDIT] F1:INS STEP
       F2:DEL STEP
       F3:CLEAR
       F4:PAGE
```

STEP 2

The screen on the left is displayed.
Press F3 to proceed to STEP 3.
Press ESC to return to the PRGM mode screen.

```
[CLR]  F1:SEQUN
       F2:PALET
       F3:SEQ/PALET
       F4:PAGE
```

STEP 3

The screen on the left is displayed.
Press F 4 to proceed to STEP 4.
Press ESC to return to STEP 2.

```
[CLR] F1:MEMORY INT
      F2:EASY/POINT
      F3:POINT TABLE
      F4:
```

STEP 4

The screen on the left is displayed.
Press F3 to proceed to STEP 5.
Press ESC to return to STEP 3.

```
ALL POINT(TBL)CLEAR?

    YES:ENT  NO:ESC
```

STEP 5

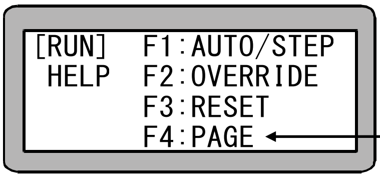
The screen on the left is displayed.

To clear the coordinate table, press ENT . To not clear the table, press ESC .
After pressing the key, operation returns to STEP 4.

NOTE All of the easy program coordinate data will also be cleared (initialized) with this operation.

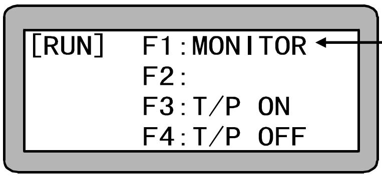
■ 18.7 Coordinate Input with RS-232C

During execution of RSMV command, the coordinate data can be input through RS-232C from Teach Pendant.



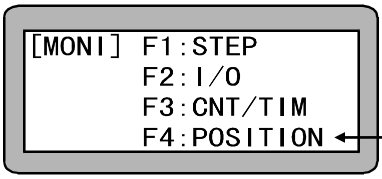
STEP 1

During program execution, press HELP , and the screen on the left will be displayed.
Press F4 to proceed to STEP 2.
Press ESC to return to the RUN mode screen.



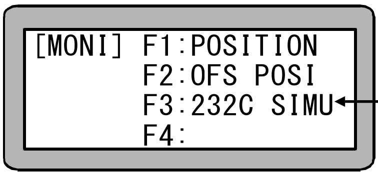
STEP 2

The screen on the left is displayed.
Press F1 to proceed to STEP 3.
Press ESC to return to the RUN mode screen.



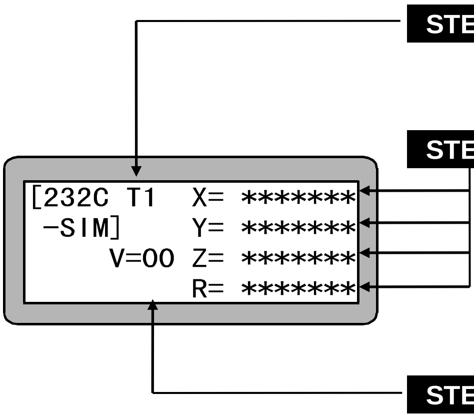
STEP 3

The screen on the left is displayed.
Press F4 to proceed to STEP 4.
Press ESC to return to STEP 2.



STEP 4

The screen on the left is displayed.
Press F3 to select RS-232C coordinate input mode.
Press ESC to return to STEP 3.



STEP 5

Use the numeric keypad to enter the task No. of the program which inputs the coordinate, and press ENT . (Input range: 1 to 4)

STEP 6

Use the numeric keypad to enter the coordinate data, and press ENT . (Input range: –8000 to 8000)
For the axis which displays "*******", the coordinate which is designated with RSMV command is held.

STEP 7

Use the numeric keypad to enter the speed No., and press ENT. (Input range: 0 to 10)
When V=0 is input, the movement speed will become the speed which is specified with the previously set SPD command.

```
[232C
 -SIM]
     SENDING OK!!
```

STEP 8 Press -NEXT or NEXT , and the controller will send the coordinate data, and the screen on the left will be displayed for one second.
Then, it will return to STEP5.
Press ESC to return to STEP 4.

■ 18.8 BA I/O Compatibility Mode

The BA I/O compatibility mode is a function that sets the operation specifications for return to origin complete output and positioning complete output to match the BA series.

■ 18.8.1 Selection method of BA I/O compatibility mode

BA I/O compatibility mode can be selected by the Disable/Enable setting in BA I/O Compatibility Mode of Parameter 2. (Refer to section 14.4.23.)

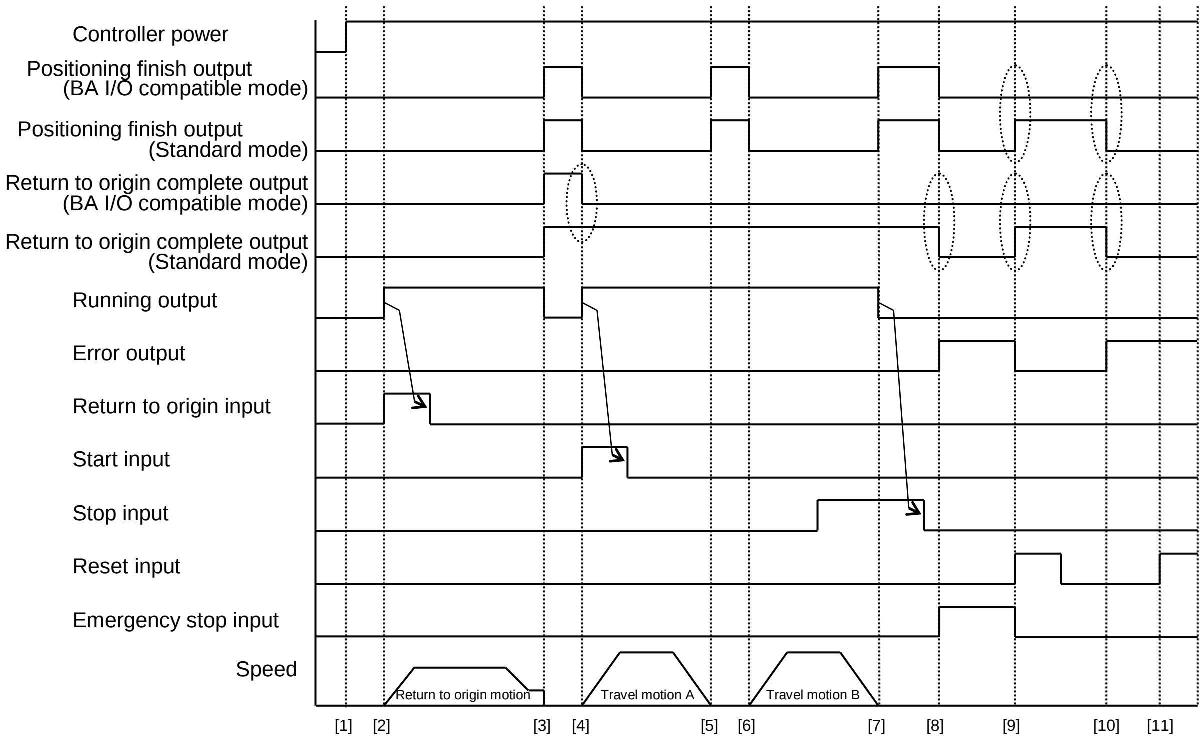
Setting	Mode	Output signal specifications (*1)	Remarks
Disable	Standard mode	BA III and BA II series controller specifications	Default
Enable	BA I/O compatibility mode	BA series controller specifications	

*1: Positioning complete signal/Return to origin complete signal

- The default setting (at factory shipping and after memory initialization) is Disable.
- The BA series controller specifications are referred to as "BA I/O compatibility mode".
- The BA III and BA II series controller specifications are referred to as "Standard mode".

■ 18.8.2 Operation specifications for return to origin complete output and positioning complete output

(1) When incremental encoder type is specified

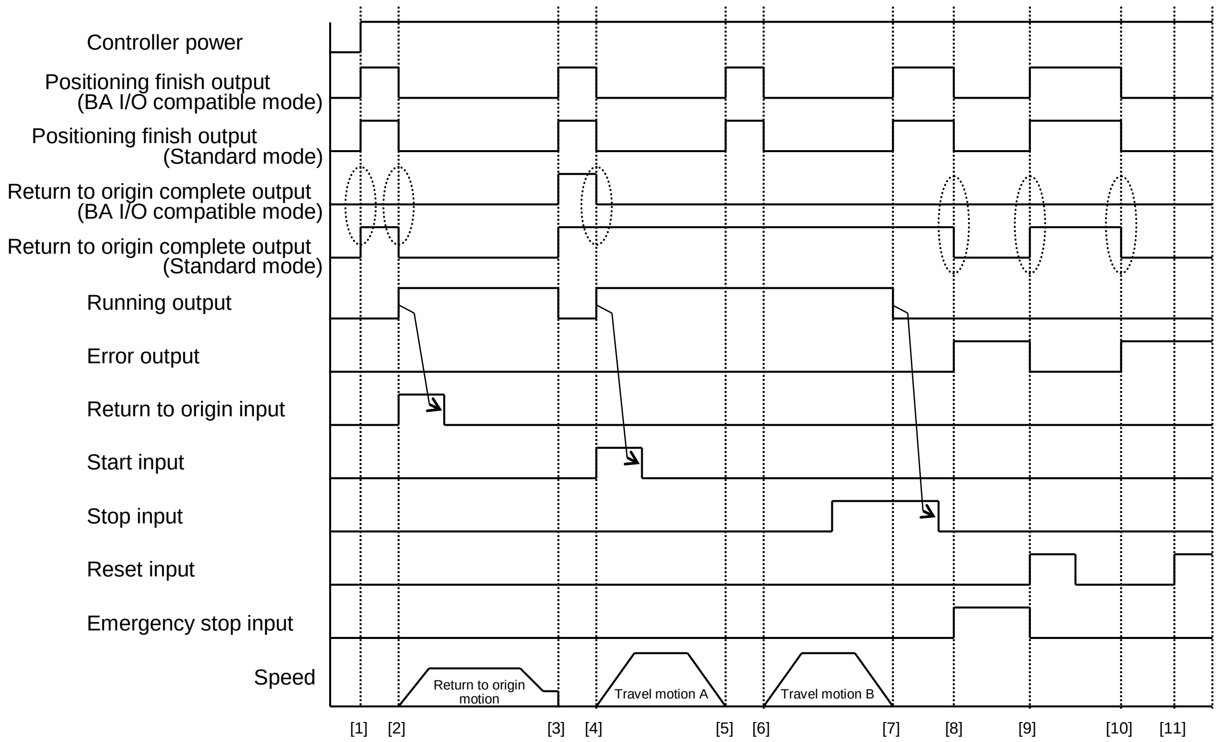


① Power ON
② Return to origin start
③ Return to origin complete
④ Travel motion A start
⑤ Travel motion A finish
⑥ Travel motion B start
⑦ Travel motion B finish
⑧ Emergency stop input ON
⑨ Reset input (Emergency stop cancel)
⑩ Encoder error generation
⑪ Reset input → Error clear is not possible.

Motion program
MOV A
TIM ***
MOV B

Difference

(2) When absolute encoder type is specified



Motion program
MOV A
TIM ***
MOV B

① Power ON
② Return to origin start
③ Return to origin complete
④ Travel motion A start
⑤ Travel motion A finish
⑥ Travel motion B start
⑦ Travel motion B finish
⑧ Emergency stop input ON
⑨ Reset input (Emergency stop cancel)
⑩ Encoder error generation
⑪ Reset input → Error clear is not possible.

NOTE Use version 2.1.0 or later of the personal computer software (SF-98D).

■ 18.9 Movement operation on coordinate table setting screen

This operation is used to move the axis to the coordinate position in the coordinate table currently displayed during setting of the coordinate table.

Call the coordinate table setting screen. (Refer to section エラー**!** 参照元が見つかりません。)

```
[PARA]      X= 0000.00
PNT-TBL     Y= 0000.00
NO.001      Z= 0000.00
            R= 0000.00
```

STEP 1 Use the [NEXT] , [-NEXT] and [SEARCH] keys to display the coordinate table to be moved.

```
[PARA]      X= 0100.00
PNT-TBL     Y= 0200.00
NO.002      Z= 0300.00
            R= 0400.00
```

STEP 2 To change the coordinate, enter the coordinate with the numeric keypad and then press the [ENT] key. (Setting range: -8000.00 to 8000.00, Unit: mm) (Refer to section ■ 13.5.1)
Press the [START] key to move to the STEP 3.

NOTE Pressing the [START] key when the controller has lost the current position of the axis (when return to origin is necessary) or when the servo is free leads to an error beep. In this case, the procedure does not proceed to the STEP 3.

```
[PARA]
    START OK ?

    YES:ENT  NO:ESC
```

STEP 3 The confirmation screen is displayed.
Press the [ENT] key to start movement to the coordinate on the coordinate table screen in the STEP 2 and to proceed to the STEP 4.
Press the [ESC] key to return to the STEP 2.

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

STEP 4 During movement, the screen at the left is shown. When the movement finishes, the procedure returns to the STEP 2.

? The specifications of the operation are as the followings.

Speed:	Speed table No. 1
Acceleration/deceleration time:	Acceleration/deceleration table No. 5
Coordinate system:	Absolute coordinate

NOTE This operation is supported by TPH-4C version 2.27 or later.

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Chapter 19 Commands

■ 19.1 Command List

Program commands and the key operation for this unit are listed below.

- Move

Command	Reading	Function	Key operation	Refer to
MOV	Move	Linear interpolation movement	Press [MOV 9] .	19-35
MOVP	Move P	Linear interpolation movement (Coordinate table designation)	Press [MOV 9] twice.	19-37
MVC	Move C	Circular interpolation movement	Press [MVC 8] .	19-40
MVCP	Move CP	Circular interpolation movement (Coordinate table designation)	Press [MVC 8] twice.	19-43
MVB	Move B	Move (return) to point immediately before the current position	Press [F1] , [IN 1] , [OUT 2] in this sequence.	19-39
MVE	Move E	Escape move	Press [F1] , [IN 1] , [TIM 6] in this sequence.	19-45
RSMV	RS move	Axis movement with RS-232C	Press [F1] , [OUT 2] , [MOV 9] in this sequence.	19-62
HOME	Home	Return to origin	Press [F1] , [IN 1] , [MOV 9] in this sequence.	19-21

- Setting parameters

Command	Reading	Function	Key operation	Refer to
SPD	Speed	Setting speed	Press [PSD 7] .	19-64
ACC	Accel	Setting acceleration/ deceleration	Press [PSD 7] twice.	19-5
OFS	Offset	Offset	Press [F1] , [IN 1] , [IN 1] in this sequence.	19-50

- Servo control

Command	Reading	Function	Key operation	Refer to
SVON	Servo-ON	Servo-on	Press [F1] , [IN 1] , [PSD 7] in this sequence.	19-67
SVOF	Servo-OFF	Servo-off	Press [F1] , [IN 1] , [MVC 8] in this sequence.	19-66

- Input/output port control

Command	Reading	Function	Key operation	Refer to
OUT	Out	General-purpose port output	Press OUT 2 .	19-52
OUTP	Out P	General-purpose port pulse output	Press OUT 2 twice.	19-55
OUTC	Out C	General-purpose port output of counter value	Press OUT 2 three times.	19-54
OUTS	Out S	Designated coordinate general-purpose output	Press F1 , OUT 2 , OUT 2 in this sequence.	19-57
CANS	Cancel	Designated coordinate general-purpose output cancel	Press F1 , OUT 2 , PSD 7 in this sequence.	19-13
IOUT	I out	Inner port output	Press F1 , CNT 3 , IN 1 in this sequence.	19-27
IN	In	Waiting for input	Press IN 1 .	19-22
INPC	In PC	Setting general-purpose port input to counter	Press IN 1 twice.	19-24
INSP	In SP	Inner port input wait	Press F1 , CNT 3 , RET 0 .	19-25

- Timer and counter control

Command	Reading	Function	Key operation	Refer to
TIM	Time	Waiting	Press TIM 6 .	19-70
TIMP	Time P	Timer preset	Press TIM 6 twice.	19-71
CNT	Counter	Preset counter value	Press CNT 3 .	19-14
CNT+	Counter Plus	Count up	Press CNT 3 twice.	19-15
CNT–	Counter Minus	Count down	Press CNT 3 three times.	19-16
CNTC	Counter Clear	Clear all counters	Press F1 , OUT 2 , IN 1 in this sequence.	19-17
CWIT	Counter weight	Counter condition wait	Press F1 , OUT 2 , MVC 8 in this sequence.	19-18

- Program control

Command	Reading	Function	Key operation	Refer to
NOP	Nop	No function	Press NOP/- .	19-49
RET	Return	Return	Press RET/0 .	19-61
STOP	Stop	Stop	Press RET/0 twice.	19-65
END	End	End	Press RET/0 three times.	19-20
TAG	Tag	Tag	Press TAG/• .	19-68
PSEL	P Sel	Program selection	Press F1 , IN/1 , RET/0 in this sequence.	19-60

- Jump

Command	Reading	Function	Key operation	Refer to
JMP	Jump	Unconditional jump	Press JMP/5 .	19-28
JMPI	Jump I	Input conditional jump	Press JMP/5 twice.	19-30
JMPC	Jump C	Counter conditional jump	Press JMP/5 three times.	19-29
JMPT	Jump T	Timer conditional jump	Press JMP/5 four times.	19-32
BRAC	Branch	Counter jump	Press F1 , OUT/2 , RET/0 in this sequence.	19-6

- Subroutine call

Command	Reading	Function	Key operation	Refer to
CAL	Call	Unconditional call	Press CAL/4 .	19-7
CALI	Call I	Input conditional call	Press CAL/4 twice.	19-10
CALC	Call C	Counter conditional call	Press CAL/4 three times.	19-9
CALT	Call T	Timer conditional call	Press CAL/4 four times.	19-12

● MVM commands

Command	Reading	Function	Key operation	Refer to
MVM	Move M	Palletizing movement	Press F1 , IN 1 , CAL 4 in this sequence.	19-47
LOOP	Loop	Loop for MVM	Press F1 , IN 1 , JMP 5 in this sequence.	19-33
MINI	Matrix Initial	Initial counter value for MVM	Press F1 , IN 1 , CNT 3 in this sequence.	19-34

● Task control

Command	Reading	Function	Key operation	Refer to
TSTR	Task Start	Task start	Press F1 , OUT 2 , CNT 3 in this sequence.	19-74
TSTO	Task Stop	Task temporary stop	Press F1 , OUT 2 , CAL 4 in this sequence.	19-73
TRSA	Task Restart	Task restart	Press F1 , OUT 2 , TMP 5 in this sequence.	19-72
TCAN	Task Cancel	Task forced end	Press F1 , OUT 2 , TIM 6 in this sequence.	19-69

ACC Acceleration/deceleration command

[Function] This command is used to set the acceleration/deceleration time required for the axis to reach a specified speed.

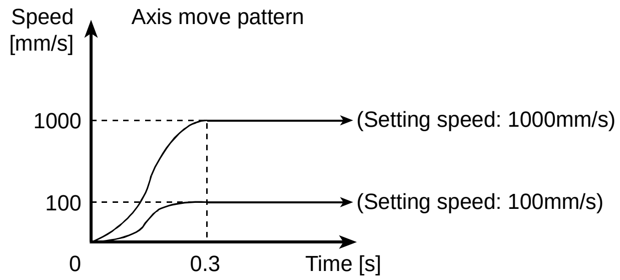
[Explanation]

- Twenty acceleration/deceleration levels can be set from ACC1 to ACC20.
  ACC command must be set before a Move command (MOV, MOVP, MVC, MVCP, MVB, MVE, RSMV, MVM, HOME).
- When using multitasking, a setting must be made for each task.
- The value at each level sets the time required for the axis to reach a specified speed. Times for acceleration and deceleration are equal for each setting. The settings can be changed according to the acceleration/ deceleration table. (Refer to section 14.6.3.)
  The initial values are shown in the table below.

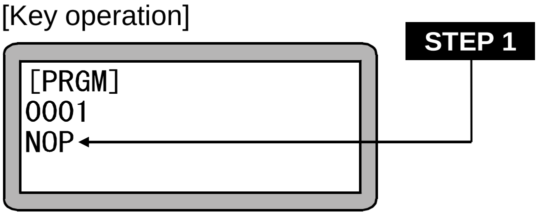
ACC level	1	2	3	4	5	6	7	8	9	10
Time [s]	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55

ACC level	11	12	13	14	15	16	17	18	19	20
Time [s]	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05

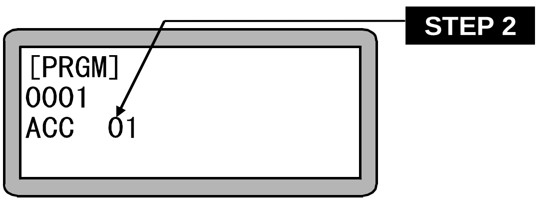
- Once set, the acceleration/deceleration rate remains unchanged until it is reset. If you do not set it the default of ACC5 is used.
- The control system is a curved acceleration type.
  (Example) Axis move pattern at ACC5



[Key operation]



Press SPD 7 twice, and the NOP will change to ACC. Then, press ENT .

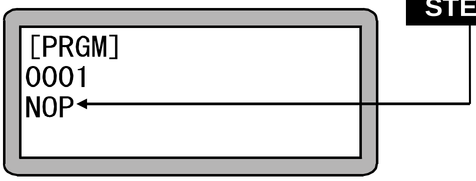


Input an acceleration/deceleration No. with the numeric keypad and press ENT .
(Input range: 1 to 20)

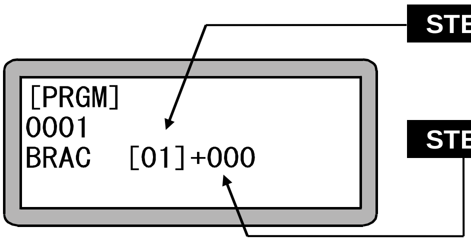
BRAC **Counter jump**

[Function] The command BRAC is used to jump to a program to the tag No. which is the resultant value of a counter No. plus the set counter value.

[Key operation]



STEP 1 Press F1 followed by OUT/2 and RET/0 . NOP changes to BRAC.



STEP 2 Enter the counter No. with the numeric keypad. Press ENT . (Input range: 1 to 99)

STEP 3 Enter the counter setting value with the numeric keypad. Press ENT . (Input range: 0 to 999)

NOTE

- The control jumps to the tag No. which is the resultant value of the counter value + counter Nos. The counter content will remain unchanged after the execution of this command.
- When the counter value details are "0" and the number to be added is "0", if the command is executed, the "TAG NOT FOUND" error will occur.
- If any total of (counter value) + (setting value) exceeds "999", "TAG NO. error" will occur.

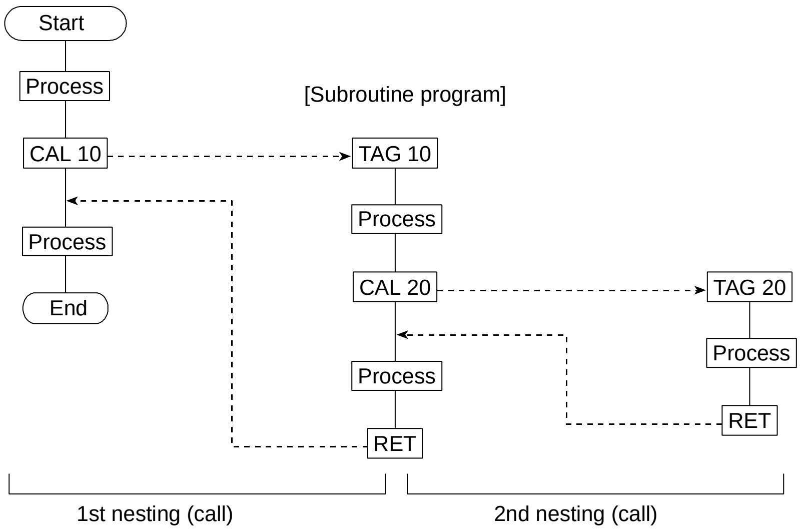
CAL Unconditional Call

[Function] This command is used to call a subroutine program of a designated step identified by tag No.

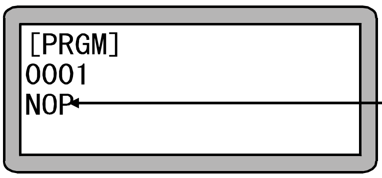
[Explanation]

- This command is used to call a subroutine program of a designated program step identified by tag No.
- This instruction requires a RET (return) command after the last step jumped to. Each subroutine must end with a RET command.
  When the return instruction is executed, the program returns to the step immediately following the CAL (call) step.
- Subroutines can be nested up to 10 levels. Nesting is the system in which another subroutine is called in a subroutine program.
- A diagram of the main routine and subroutine relation is shown below.

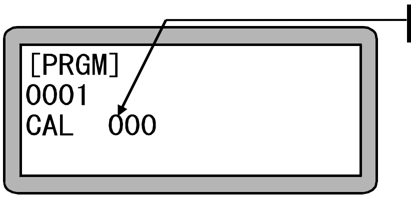
[Main routine program]



[Key operation]



STEP 1 Press CAL 4 , and the NOP will change to CAL. Then, press ENT .



STEP 2 Use the numeric keypad to enter the tag No. to be called. Press ENT . (Input range: 0 to 999)

NOTE The tag No. for STEP 2 can be set to "0" as a temporary value. However, if the command is executed with that value, the "NO TAG FOUND" error will occur.
When using multitasking, a tag No. in another task cannot be called.

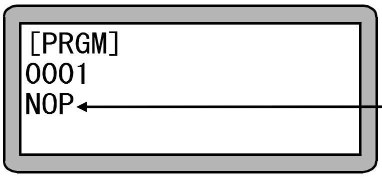
CALC **Counter Conditional Call**

[Function] This command is used to call a subroutine of a specified tag No. when the specified counter contents agree with the setting condition.

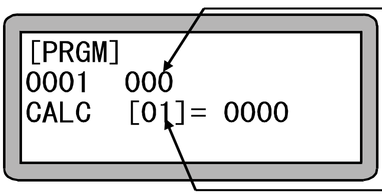
[Explanation]

- The program proceeds to the next step when the contents of the specified counter do not meet the setting conditions.
- This command is used in the program with the command used to set the counter value (CNT) and the command to increment (CNT+) or decrement (CNT–) the counter value.
- Five comparisons are available: (=), (<), (>), (≤), (≥).
- Refer to the CAL command for the relation of the main routine and subroutine.

[Key operation]



STEP 1 Press [CAL 4] key three times, and the NOP will change to CALC. Then, press [ENT] .

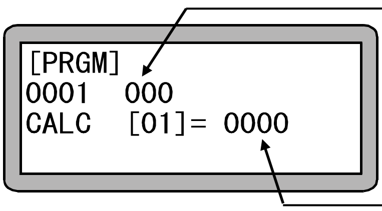


STEP 2 Use the numeric keypad to enter the tag No. to be called. Press [ENT] . (Input range: 0 to 999)

STEP 3 Use the numeric keypad to enter the counter No. and press [ENT] . (Input range: 1 to 99)

NOTE

- The tag No. for STEP 2 can be set to "0" as a temporary value. However, if the command is executed with that value, the "NO TAG FOUND" error will occur.
- In case of multitask, any tag No. in any other task can not be called.



STEP 4 Press [ALT] to display operators (=, <, >, < =, >=). Select one and press [ENT] .

STEP 5 After entering the counter value to be compared, press [ENT] . (Input range: 0 to 9999)

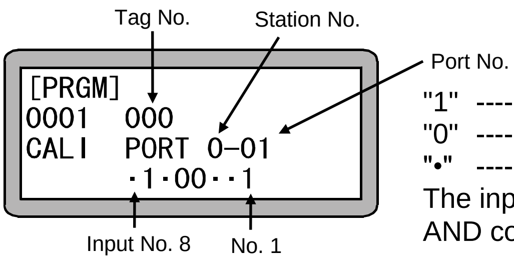
CALI Input Conditional Call

[Function] The subroutine program with the specified tag No. is called when the input state of the specified general-purpose input (general-purpose input port) corresponds to the setting conditions.

[Explanation]

- If all of the details of the designated general-purpose port do not match the set conditions, the subroutine of the designated tag No. will not be called, and the program will move to the next step.
- If the CALI command is set as shown below, when the general-purpose input port 1 No. 1 (general-purpose input port 1-1) and No. 7 (general-purpose input port 1-7) are ON and the general-purpose input port 1 No. 4 (general-purpose input port 1-4) and No. 5 (general-purpose input port 1-5) are OFF for the unit of which the station No. is set to "0", the designated subroutine will be called. The subroutine will not be called unless all of the ON and OFF conditions match.
  The general-purpose input signal at the "•" display section will not judge the conditions.

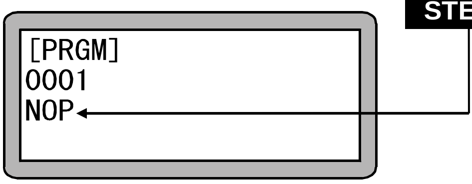
(Example)



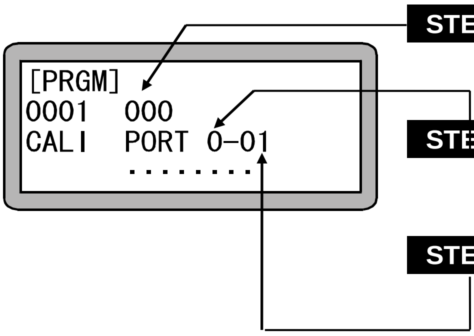
"1" ---------- Input ON
"0" ---------- Input OFF
"•" ---------- Ignore
The input signal is judged with an AND condition.

- Refer to the CAL command for the relation of the main routine and subroutine.

[Key operation]



STEP 1 Press [CAL/4] key twice, and the NOP will change to CALI. Then, press [ENT] .



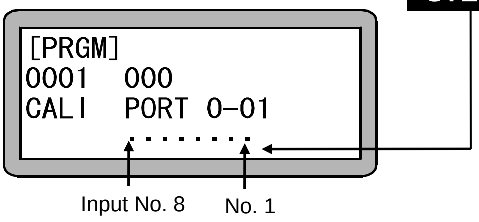
STEP 2 Use the numeric keypad to enter the tag No. to be called. (Input range: 0 to 999.) Press [ENT] .

STEP 3 Use the numeric keypad to enter a station No., and press [ENT] . (Input range: 0 to 4)

STEP 4 Use the numeric keypad to enter a port No., and press [ENT] .

NOTE ● The tag No. for STEP 2 can be set to "0" as a temporary value. However, if the command is executed with that value, the "TAG NOT FOUND" error will occur.
In case of multitask, any tag No. in any other task can not be called.

[Key operation]



STEP 5 Enter the input conditions with [RET 0], [IN 1] and [TAG •], and press [ENT]. The key functions.

[RET 0] Input OFF

[IN 1] Input ON

[TAG •] Ignored

NOTE

- The station No. is a number assigned to each unit. (Refer to section 2.4.4.)
- For the station No., port No. and bit No. which can be used, refer to section 10.1.4 "Names of general-purpose input/output ports and Teach Pendant displays".
- Don’t use any port which is not present.

CALT **Conditional Call**

[Function] This subroutine program with specified tag No. is called when the content of the specified timer meets the setting condition.

[Explanation]

- When the content of the specified timer does not meet the setting condition, the program proceeds to the next step.
- When CALT is used in a program, another command TIMP is necessary in the program to set the timer.
- Nine timers are available: 1 to 9.
- Five comparisons are available: (=), (<), (>), (≤), (≥).
- Refer to the CAL command for the relation of the main routine and subroutine.

[Key operation]

```
[PRGM]
0001
NOP
```

STEP 1 Press CAL/4 key four times, and the NOP will change to CALT. Then, press ENT .

```
[PRGM]
0001   000
CALT   [1]= 000.0s
```

STEP 2 Use the numeric keypad to enter the tag No. to be called. (Input range: 0 to 999.) Press ENT .

STEP 3 Use the numeric keypad to enter the timer No. and press ENT . (Input range: 1 to 9.)

NOTE

- The tag No. for STEP 2 can be set to "0" as a temporary value. However, if the command is executed with that value, the "NO TAG FOUND" error will occur.
- In case of multitask, any tag No. in any other task can not be called.

```
[PRGM]
0001   000
CALT   [1]= 000.0s
```

STEP 4 Press ALT to display operators (=, <, >, <=, >=). Select one and press ENT .

STEP 5 Use the numeric keypad to enter the timer value to be compared, then press ENT . (Input range: 0 to 999.9)

CANS Designated Coordinate General-purpose Output Cancel

[Function] This command is used to cancel the remaining data which are set with OUTS command but not executed since the condition is not satisfied.

[Explanation]
- This command is used together with OUTS command and movement commands.
- This command clears the designated coordinate general-purpose output data which is set in the inner buffer.
  To clear the data of the own task, select T0, and to clear the data of another task, select one of the task Nos. T1 to T4.

[Key operation]

```
[PRGM]
0001
NOP
```

STEP 1 Press [F1] , [OUT 2] , [SPD 7] in this sequence, and the NOP will change to CANS.

```
[PRGM]
0001
CANS T0
```

STEP 2 Use the numeric keypad to enter the task No. which will be cleared, and press [ENT] .
(Input range: 0 to 4)

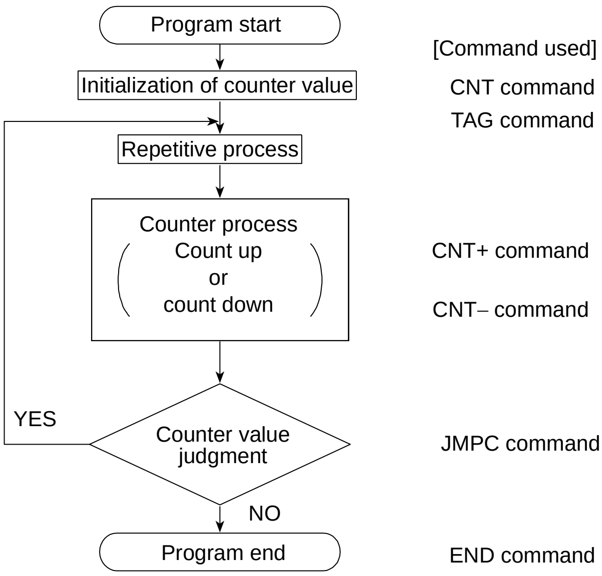
NOTE
- Though the inner buffer is cleared if CANS command is executed, the state output with OUTS command will not change.

CNT **Preset Counter Value**

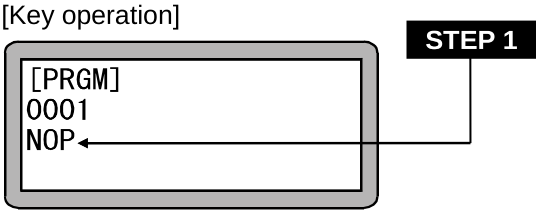
[Function] This command is used to set the value for a specified counter.

[Explanation]

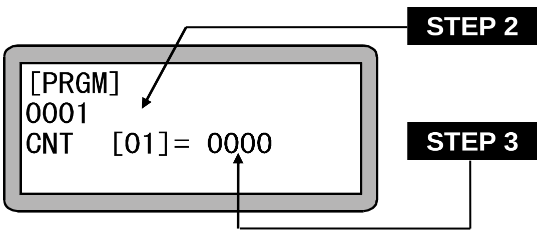
- Ninety-nine counters from No. 1 to No. 99 can be used.
- Any value from 0 through 9999 can be set for each counter.
- A usage example is shown below.
  The counter is used when repetitive movement is to be carried out for a designated number of times, etc.



[Key operation]



Press CNT/3 key, and the NOP will change to CNT. Then, press ENT .



After entering the counter No. with the numeric keypad, press ENT . (Input range: 1 to 99.)

Enter preset values (initial values) with the numeric keypad. (Input range: 0 to 9999.)
Press ENT .

NOTE

- Whether to clear the counter details (set the counter details to "0") or to hold (not change the counter details) when the controller power is turned ON or reset is executed can be selected. (Refer to section 10.2.6.)

CNT+ **Counts up**

[Function]　This command is used to increment the counter value for a specified counter.

[Key operation]

```
[PRGM]
0001
NOP
```

STEP 1 Press [CNT 3] key twice, and the NOP will change to CNT+.
Then, press [ENT] .

```
[PRGM]
0001
CNT+ [01]=[01]+0000
```

STEP 2 After entering the counter No. with the numeric keypad, press [ENT] . (Input range: 1 to 99.)

STEP 3 Enter the increment value with the numeric keypad and press [ENT] . (Input range: 0 to 9999.)

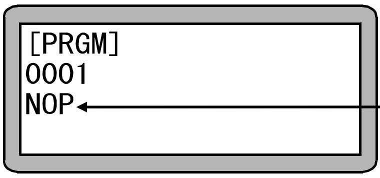
NOTE
- If any value gained with addition becomes more than "9999", the counter value will stay at "9999".

?
- Refer to the CNT command for the usage method.

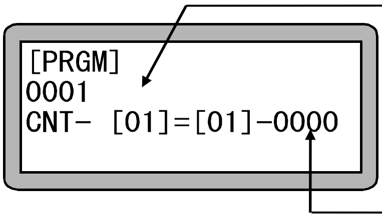
CNT– Counts down

[Function] This command is used to decrement the specified counter value for the specified counter.

[Key operation]



STEP 1 Press CNT 3 key three times, and the NOP will change to CNT–.
Then, press ENT .



STEP 2 Enter the counter No. with the numeric keypad and press ENT . (Input range: 1 through 99.)

STEP 3 Enter the decrement value with the numeric keypad and press ENT . (Input range: 0 through 9999.)

NOTE

- If any value gained with subtraction becomes less than "0", the counter value will stay at "0".

?

- Refer to the CNT command for the usage method.

CNTC Counter All Clear

[Function] This command is used to clear all counters, that is to set all counter values to zero.

[Key operation]

```
[PRGM]
0001
NOP
```

STEP 1 Press F1 , OUT 2 and IN 1 in order.
NOP changes to CNTC.

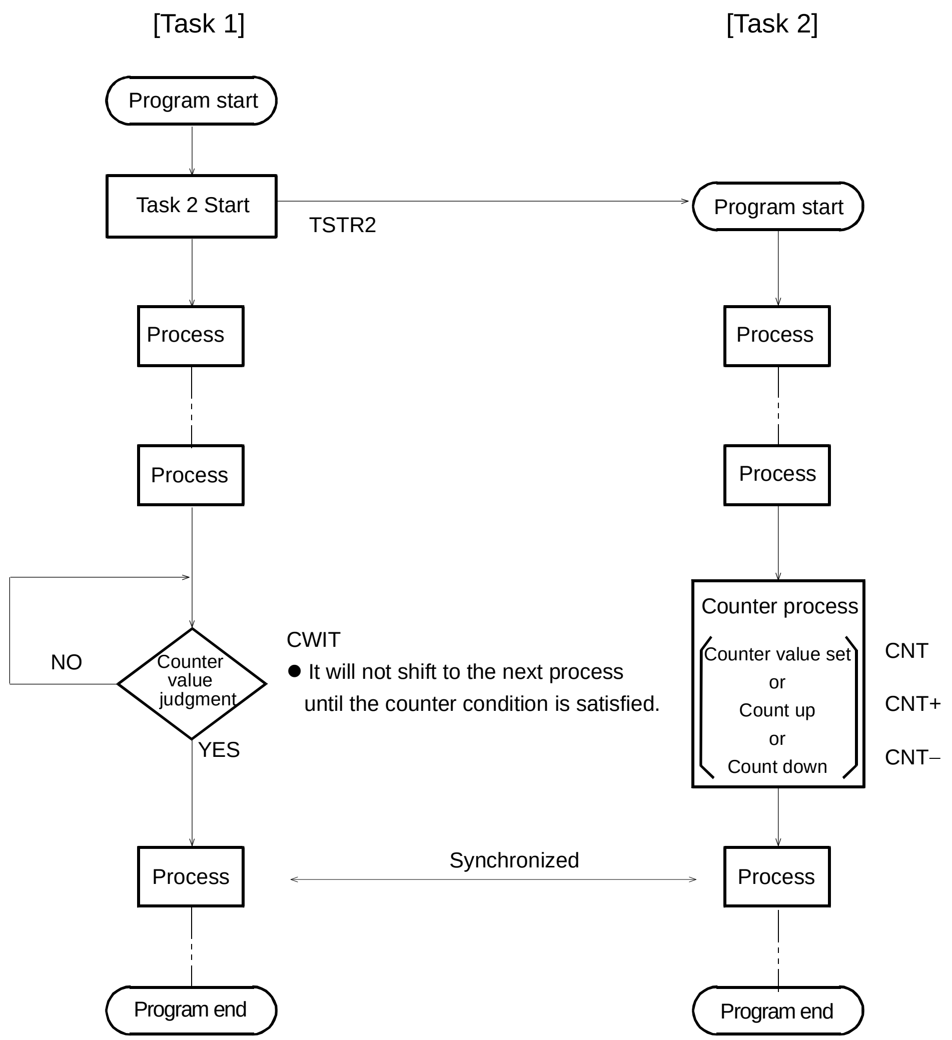
```
[PRGM]
0001
CNTC
```

CWIT **Counter Condition Wait**

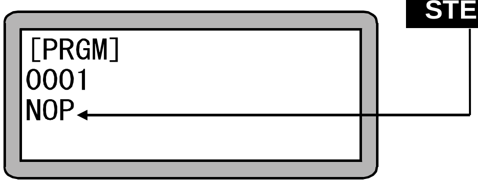
[Function] The waiting state will be kept until the designated counter condition is satisfied.

[Explanation]
- The command is used to gain synchronization between the tasks.
- If it is stopped with stop input or similar in the condition waiting state, it will stop at this step.

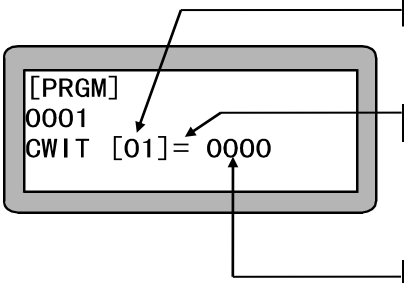
<u>CWIT command flow chart</u>



[Key operation]



STEP 1 Press F1 , OUT 2 and MVC 8 in order.
NOP changes to CWIT.



STEP 2 Enter the counter No. with the numeric keypad, and press ENT . (Input range: 1 to 99)

STEP 3 Press ALT , and the operator (=, <, >, <=, >=) will be displayed. Select one of them, and press ENT .

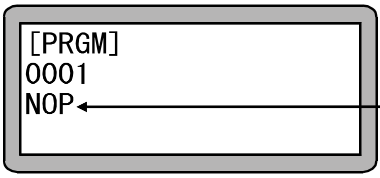
STEP 4 Use the numeric keypad to enter the compared counter value, and press ENT . (Input range: 0 to 9999)

END Program End

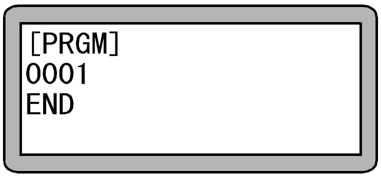
[Function] The program end defined with this command

[Explanation] When executed, the END instruction will return the program step counter to STEP 0001 and the COMPO ARM BA II will wait for another START input.
If the END command is executed in task 2 to 4 of multitasking, that task will return to STEP 0001 and stop. Then, it will wait for starting with TSTR.

[Key operation]



STEP 1 Press RET/0 key three times, and the NOP will change to END. Then, press ENT .



HOME **Return to Origin**

[Function] An Axis returns to origin at high Home positioning speed set with parameters. When using multitasking, only the task that executes this command will return to the origin.

[Explanation] The axes are moved in an order preset with the parameters. (Refer to section 14.3.7.)

[Key operation]

```
[PRGM]
0001
NOP
```

STEP 1 Press [F1], [IN 1] and [MOV 9] in order.
NOP changes to HOME.

```
[PRGM]
0001
HOME
```

?

- Refer to sections 14.4.7 to 14.4.10 "Setting of return to origin speed".

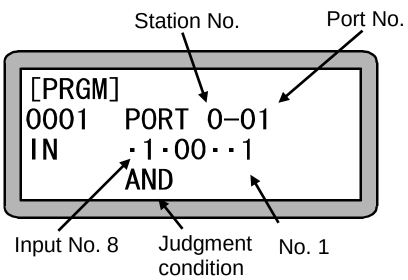
IN Waiting for General-Purpose Port Input

[Function] This command is used to stop a program from proceeding to the next step until conditions set by general-purpose input ports are satisfied.

[Explanation]

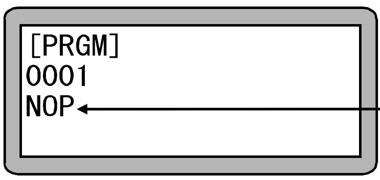
- If it is stopped with the stop input or similar at the condition waiting state, it will stop at this step.
  When restart is applied, it will restart the execution at this step.
- If the IN command is set as shown below, when the general-purpose input port 1 No. 1 (general-purpose input port 1-1) and No. 7 (general-purpose input port 1-7) are ON and the general-purpose input port 1 No. 4 (general-purpose input port 1-4) and No. 5 (general-purpose input port 1-5) are OFF for the unit of which the station No. is set to "0", the program will move to the next step. The general-purpose input signal at the "." display section will not judge the conditions.

(Example)

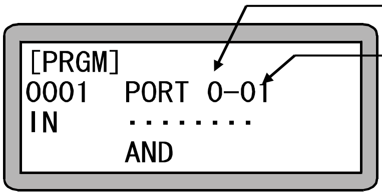


"1" ---------- Input ON
"0" ---------- Input OFF
"•" ---------- Ignore
AND or OR is selected for the judgment condition of the input signal.

[Key operation]

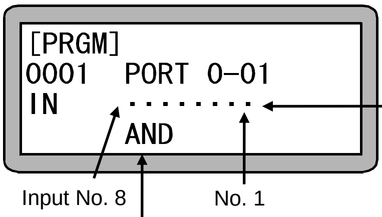


STEP 1 Press IN/1 key, and the NOP will change to IN. Then, press ENT .



STEP 2 Use the numeric keypad to enter the station No., and press ENT . (Input range: 0 to 4)

STEP 3 Use the numeric key to enter the port No., and press ENT .



STEP 4 Enter the input conditions with [RET/0], [IN/1] and [TAG/•], and press [ENT].

The key functions

[RET/0] Input OFF

[IN/1] Input ON

[TAG/•] Ignored

STEP 5 Use [ALT] to select AND or OR.

When the conditions are all satisfied in AND mode or when one or more conditions are satisfied among the designated conditions in OR mode, it will proceed to the next step.

NOTE

- The station No. is a number assigned to each unit. (Refer to section 2.4.4.)
- For the station No., port No. and bit No. which can be used, refer to section 10.1.4 "Names of general-purpose input/output ports and Teach Pendant displays".
- Don’t use any port which is not present.

INPC **Setting General-Purpose Port Input to Counter**

[Function] This command is used to set general-purpose input as the content of a specified counter.

[Explanation]

- In the unit with the designated station No., the designated general-purpose input port signal is interpreted as a binary value, is converted into a decimal value and is set in the designated counter.
- The counter value which can be fetched is "0 to 15" when the general-purpose input port 3 of the master unit and the general-purpose input port 3 of the expansion input/output unit for the slave unit are used, and is "0 to 255" when the other ports are used.

General-purpose input bit pattern (Binary)	Counter value (Decimal)
0000 0000	0
0000 0001	1
0000 0010	2
0000 0011	3
.	.
. .	.
0000 1111	15
. .	.
1111 1111	255

0 ... Input off (OFF)
1 ... Input on (ON)

Input No. 8 No. 1

[Key operation]

```
[PRGM]
0001
NOP
```

STEP 1 Press [IN 1] key twice, and the NOP will change to INPC.
Then, press [ENT] .

```
[PRGM]
0001  PORT 0-01
INPC  CNT [01]
```

STEP 2 Use the numeric keypad to enter the station No., and press [ENT] . (Input range: 0 to 4)

STEP 3 Use the numeric key to enter the port No., and press [ENT] .

STEP 4 Enter a counter No. with the numeric keypad and press [ENT] . (Input range: 1 to 99.)

NOTE

- The station No. is a number assigned to each unit. (Refer to section 2.4.4.)
- For the station No., port No. and bit No. which can be used, refer to section 10.1.4 "Names of general-purpose input/output ports and Teach Pendant displays".

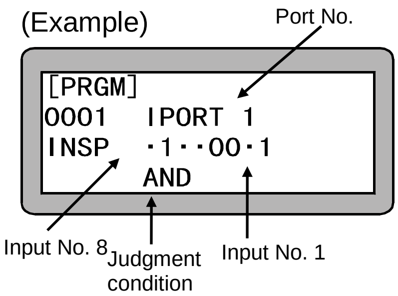
INSP Internal Port Input Wait

[Function] This command is used to stop a program from proceeding to the next step until the designated internal port satisfies the set conditions.

[Explanation]

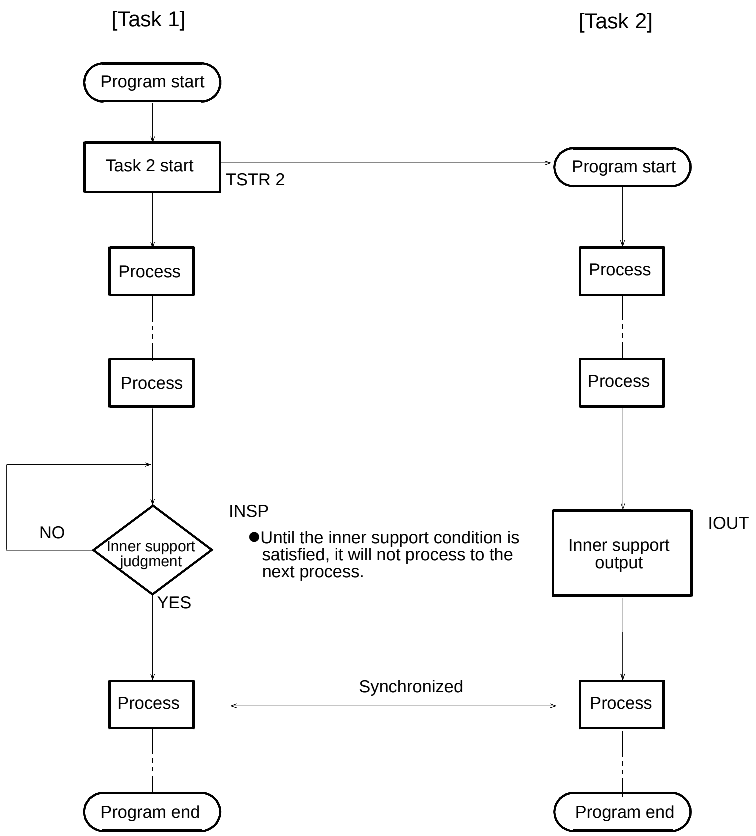
- The command is used together with IOUT command.
- The command is used for synchronization between the tasks, and so on.
- If it is stopped with the stop input or similar in the condition waiting state, it will stop at this step. When restart is applied, it will restart the execution at this step.
- The internal ports are numbered 1 to 4.
- If INSP command is set as shown below, it will proceed to the next step when No. 1 (internal port 1-1) and No. 7 (internal port 1-7) of the internal ports are ON and No. 4 (internal port 1-4) and No. 5 (internal port 1-5) of the internal ports are OFF.
  Here, the internal port signal in the "•" display part is not subject to the condition judgment.

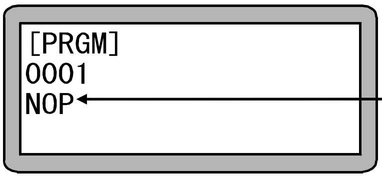
(Example)



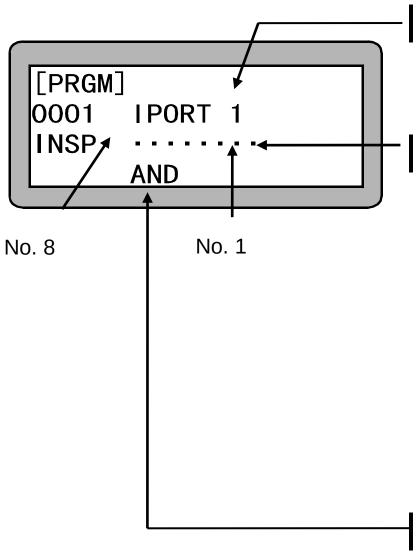
"1" ---------- Input ON
"0" ---------- Input OFF
"•" ---------- Ignore
AND or OR is selected for the judgment condition of the internal port signal.

<u>INSP command flow chart</u>





STEP 1 Press [F1] , [CNT 3] , [RET 0] in this sequence, and the NOP will change to INSP.



STEP 2 Use the numeric keypad to enter the port NO., and press [ENT] . (Input range: 1 to 4)

STEP 3 Enter the input conditions with [RET 0] , [IN 1] and [TAG •] , and then press [ENT] .

The key functions

[RET 0] Input OFF

[IN 1] Input ON

[TAG •] Ignored

STEP 4 Use [ALT] to select AND or OR.

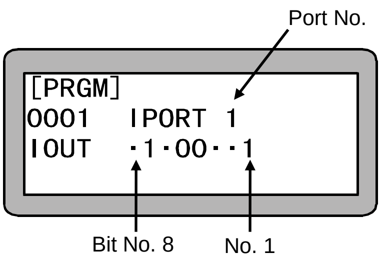
When the conditions are all satisfied in AND mode or when one or more conditions are satisfied among the designated conditions in OR mode, it will proceed to the next step.

IOUT Internal Port Output Command

[Function] This command is used to output the set data to the designated internal port.

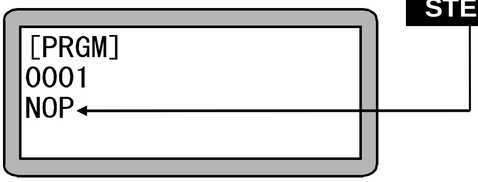
[Explanation]

- The command is used together with INSP command.
- The command is used for synchronization between the tasks, and so on.
- The internal ports are numbered 1 to 4.
- After execution, the executed data will be held till next IOUT command. Even if the program is ended by executing END command, the data will be held.
- To turn OFF the data, set "0" at the port with IOUT command or turn OFF the power supply of the controller.
- If IOUT command is set as shown below, turn ON No. 1 (internal port 1-1) and No. 7 (internal port 1-7) of the internal port and OFF No. 4 (internal port 1-4) and No. 5 (internal port 1-5) of the internal port.
  Here, the internal port data in the "•" display part is held as it is.

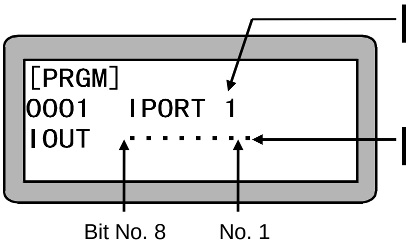


"1" ---------- Output ON
"0" ---------- Output OFF
"•" ---------- Current output state is held.

[Key operation]



STEP 1 Press [F1], [CNT 3], [IN 1] in this sequence, and the NOP will change to IOUT.



STEP 2 Use the numeric keypad to enter the port NO., and press [ENT]. (Input range: 1 to 4)

STEP 3 Input the output data with [RET 0], [IN 1] and [TAG •], and press [ENT].

The key functions

[RET 0] turns OFF the output.

[IN 1] turns ON the output.

[TAG •] does not designate anything. (Held as it is.)

?

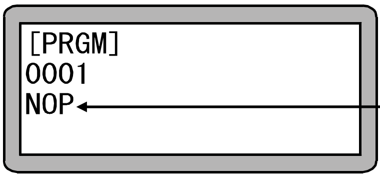
- For the using method, refer to INSP command.

JMP **Unconditional Jump**

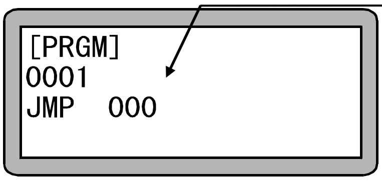
[Function] The control jumps to a specified tag No.

[Explanation]
- This command is used to instruct a program to jump unconditionally to a step specified by a tag No.
- Refer to the TAG command for usage examples.

[Key operation]



STEP 1 Press JMP/5 key, and the NOP will change to JMP. Then, press ENT .



STEP 2 After entering a tag No. with the numeric keypad, press ENT . (Input range: 1 to 999.)

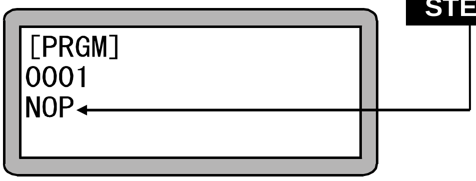
NOTE
- The tag No. for STEP 2 can be set to "0" as a temporary value. However, if the command is executed with that value, the "TAG NOT FOUND" error will occur.
- In case of multitask, any tag No. in any other task can not be called.

JMPC Counter Conditional Jump

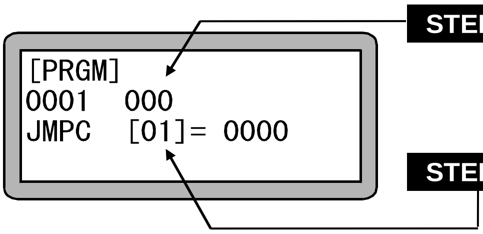
[Function] This command is used to instruct a program to jump to a step with a specified tag No. only when the set counter value meets specified conditions in the program.

[Explanation]
- When the set counter value does not meet the specified conditions, the program proceeds to the next step.
- Programs for which this command is used need another program to execute setting of the counter value, CNT and to increment and decrement the counter value, CNT+, CNT–.
- Five comparisons are available: (=), (<), (>), (≤), (≥).
- Refer to the CNT command for the usage methods.

[Key operation]



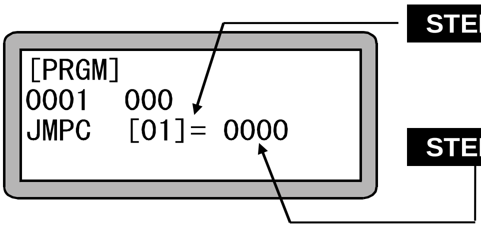
STEP 1 Press [JMP 5] key three times, and the NOP will change to JMPC. Then, press [ENT] .



STEP 2 Use the numeric keypad to enter the tag No. which the program jumps to, then press [ENT] . (Input range: 0 to 999.)

STEP 3 Enter a counter No. with the numeric keypad and press [ENT] . (Input range: 1 to 99.)

NOTE
- The tag No. for STEP 2 can be set to "0" as a temporary value. However, if the command is executed with that value, the "TAG NOT FOUND" error will occur.
- In case of multitask, any tag No. in any other task can not be called.



STEP 4 Press [ALT] to display operators (=, <, >, <=, >=). Select one and press [ENT] .

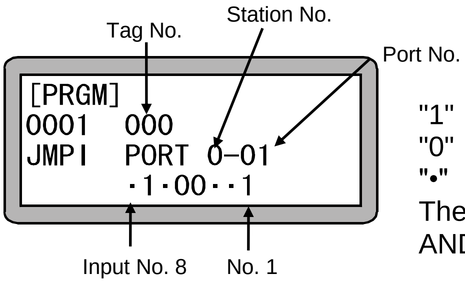
STEP 5 Use the numeric keypad to enter a counter value to be compared and press [ENT] .
(Input range: 0 to 9999.)

JMPI **Input Conditional Jump**

[Function] This command is used to instruct a program to jump to a step with a specified tag number when the input conditions of a general-purpose input signal meet the set conditions in the program.

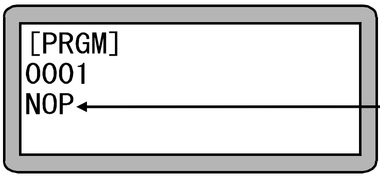
[Explanation]
- The jump is executed only when the input of ports set by this command satisfy the ON/OFF conditions of general input port; if they do not, the program proceeds to the next step.
- If the JMPI command is set as shown below, when the general-purpose input port 1 No. 1 (general-purpose input port 1-1) and No. 7 (general-purpose input port 1-7) are ON and the general-purpose input port 1 No. 4 (general-purpose input port 1-4) and No. 5 (general-purpose input port 1-5) are OFF for the unit of which the station No. is set to "0", the program will jump to the designated step.
  The general-purpose input signal at the "•" display section will not judge the conditions.

(Example)

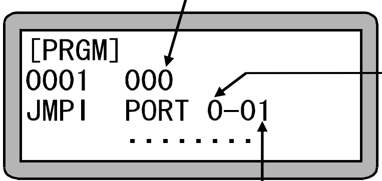


"1" ---------- Input ON
"0" ---------- Input OFF
"•" ---------- Ignore
The input signal is judged with an AND condition.

[Key operation]



STEP 1 Press [JMP 5] key twice, and the NOP will change to JMPI.
Then, press [ENT] .

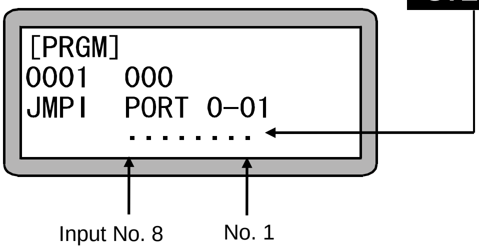


STEP 2 Use the numeric keypad to enter the tag No. the program jumps to, then press [ENT] . (Input range: 0 to 999)

STEP 3 Use the numeric keypad to input the tag No. which will be called, and press [ENT] .

STEP 4 Use the numeric keypad to enter the port No.
Then, press [ENT] .

NOTE The tag No. for STEP 2 can be set to "0" as a temporary value. However, if the command is executed with that value, the "TAG NOT FOUND" error will occur.
In case of multitask, any tag No. in any other task can not be called.



STEP 5 Enter the input conditions with RET/0 , IN/1 and TAG/• , and press ENT .

The key functions.

RET/0 Input ON

IN/1 Input OFF

TAG/• Ignored

NOTE

- The station No. is a number assigned to each unit. (Refer to section 2.4.4.)
- For the station No., port No. and bit No. which can be used, refer to section 10.1.4 "Names of general-purpose input/output ports and Teach Pendant displays".
- Don’t use any port which is not present.

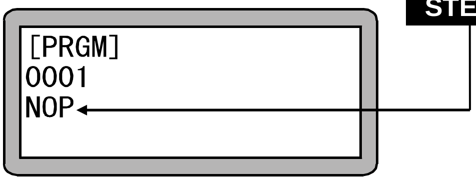
JMPT **Timer Conditional Jump**

[Function] This command is used to instruct a program to jump to a step with a specified tag No. only when the specified timer value meets the set conditions in the program.

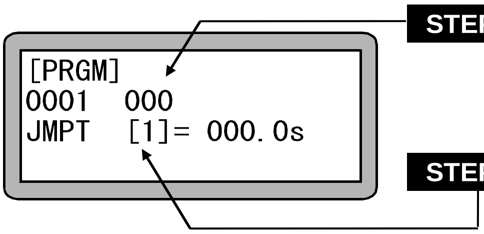
[Explanation]

- When the specified timer value does not meet the set conditions, the program proceeds to the next step.
- Programs for which this command is used need another program to command the timer setting (TIMP).
- Nine timers from No. 1 to No. 9 are used.
- Five comparisons are available: (=), (<), (>), (≤), (≥).
- Refer to the TIMP command for usage examples.

[Key operation]



STEP 1 Press [JMP 5] key four times, and the NOP will change to JMPT.
Then, press [ENT] .

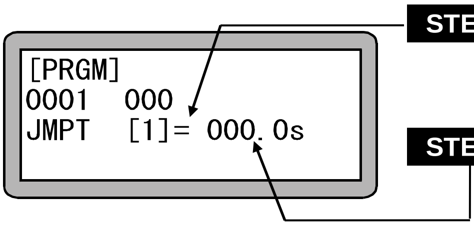


STEP 2 Use the numeric keypad to enter the tag No. which the program jumps to, then press [ENT] .
(Input range: 1 to 999.)

STEP 3 Use the numeric keypad to enter the timer No. and press [ENT] . (Input range: 1 to 9).

NOTE

- The tag No. for STEP 2 can be set to "0" as a temporary value. However, if the command is executed with that value, the "TAG NOT FOUND" error will occur.
- In case of multitask, any tag No. in any other task can not be called.



STEP 4 Press [ALT] to display operators (=, <, >, <=, >=).
Select one and press [ENT] .

STEP 5 Use the numeric keypad to enter a counter value to be compared and press [ENT] .
(Input range: 0 to 999.9)

LOOP **MVM Loop**

[Function] This command is used to control loop operation in the specified MVM table.

[Explanation] When this command is executed, the counter specified in the MVM table of the specified group is controlled. the program jumps to the step with the tag No. specified by the content and conditions of the counter.

[Key operation]

```
[PRGM]
0001
NOP
```

STEP 1 Press [F1] , [IN 1] , [JMP 5] in order. NOP changes to LOOP.

```
[PRGM]
0001      IF LOOP END
LOOP GRP=01 THEN 000
            ELSE 000
```

STEP 2 Use the numeric keypad to enter the group No. (MVM table No.), then press [ENT] . (Input range: 1 to 32.)

STEP 3 Enter a tag No. for THEN with the numeric keypad and press [ENT] . (Input range: 0 to 999.)

```
[PRGM]
0001      IF LOOP END
LOOP GRP=01 THEN 000
            ELSE 000
```

STEP 4 Enter a tag No. for ELSE with the numeric keypad and press [ENT] . (Input range: 0 to 999.)

- Tag for THEN : A program jumps to the THEN tag when an MVM program has completed.
- Tag for ELSE : A program jumps to the ELSE tag when an MVM program has not completed.

NOTE
- The tag Nos. for STEP 3 and STEP 4 can be set to "0" as a temporary value. However, if the command is executed with that value, the "TAG NOT FOUND" error will occur.
- When using multitasking, a tag No. in another task cannot be designated.
- For an application example of the command, refer to "Palletizing work with MVM commands" (section 4.1.7).

MINI **MVM Counter Initial**

[Function] This command is used to set "1" to the counter in a specified group used for matrix movement.

[Explanation]
- This command MINI is a command related to palletizing movement and used together with MVM and LOOP.
- When MINI is executed, the values of all counters in the MVM table of the specified group No. are set to "1."

[Key operation]

```
[PRGM]
0001
NOP
```

STEP 1 Press F1 , IN 1 , CNT 3 in order.
NOP changes to MINI.

```
[PRGM]
0001
MINI GRP=01
```

STEP 2 Enter a group No. (MVM group No.) with the numeric keypad and press ENT .
(Input range: 1 to 32.)

?
- When this command is used, the values of all counters in a specified MVM table are set to "1."

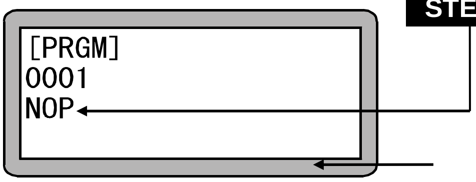
NOTE
- For an application example of the command, refer to "Palletizing work with MVM commands" (section 4.1.7).

MOV Direct Interpolation Move

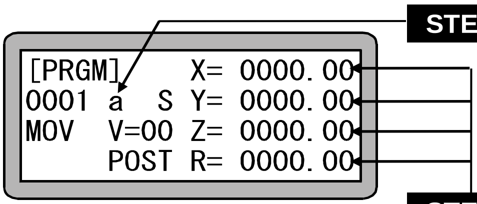
[Function] Direct movement to the designated coordinate position (linear interpolation)

[Explanation]
- There are 3 kinds of the position data input methods: numeric value input (MDI) method, remote teaching method and direct teaching method.
- The speed can be designated in 10 steps of 1 to 10, and there are 2 setting methods of S (axial speed) and T (linear speed).

[Key operation]



STEP 1 Press [MOV 9], and the NOP will change to MOV. Then, press [ENT].



STEP 2 Use [ALT] to select either a (absolute coordinate) or i (relative coordinate), and press [ENT].

STEP 3 Use the numeric keypad to enter the coordinate of each axis, and press [ENT]. (Inputting range: –8000 to 8000)

Press [ALT], and "*******" will be displayed. For the axis, the previous numeric value before the command is executed will be applied.

NOTE
- Press [DIRECT JOG], and the remote teaching and direct teaching will be applicable. (Refer to section 3.2.2.)

```
[PRGM]     X= 0000.00
0001 a   S Y= 0000.00
MOV  V=00  Z= 0000.00
     POST  R= 0000.00
```

STEP 4 Press [ALT] to select either S (axial speed) or T (linear speed), and press [ENT] .

STEP 5 Use the numeric keypad to enter the speed No., and press [ENT] key. (Input range: 0 to 10)
When V=0 is entered, the designated speed of the previously set SPD command will be selected.

```
[PRGM]     X= 0000.00
0001 a   S Y= 0000.00
MOV  V=00  Z= 0000.00
     POST  R= 0000.00
```

STEP 6 Press [ALT] to select either POST (position) or PASS (pass point), and press [ENT] .

NOTE

- The axis displayed in the screen is as set by "Setting of axis display" of Parameter 2. (Refer to section 14.4.1.)
  "?" is displayed for the axis which is not used.
- For details of a (absolute coordinate position), i (relative coordinate position), S (axial speed), T (linear speed), POST and PASS, refer to "MOV System Command Words and Parameters" (section 3.2.5).

MOVP Axis Movement to the Indirectly Designated Point by Coordinate Table

[Function] The COMPO ARM BA II moves a point set indirectly by coordinate table No. (Linear interpolation)

[Explanation]
- This command is used to execute COMPO ARM BA II movement to a point set by the coordinate table in parameter mode.
- There are two ways to designate the coordinate table No. in which counters are used: direct and indirect.
- When using multitasking, a separate coordinate table is used for each task.

[Key operation]

```
[PRGM]
0001
NOP
```

STEP 1 Press MOV 9 key twice, and the NOP will change to MOVP.
Then, press ENT .

```
[PRGM]
0001 a  S NO=000
MOVP V=00 CNT[00]
     POST
```

STEP 2 Press ALT and select either "a" (absolute coordinate) or i (relative coordinate) and press ENT .

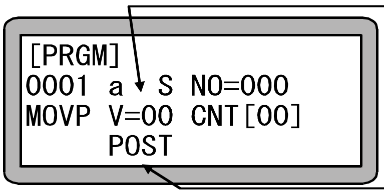
STEP 3 Enter the first coordinate table No. with the numeric keypad and press ENT .
(Input range: 0 to 999, 0: Not specified)

```
[PRGM]
0001 a  S NO=000
MOVP V=00 CNT[00]
     POST
```

STEP 4 Enter the counter No. to designate the coordinate table No. of the destination with the numeric keypad, then press ENT .
(Input range: 0 to 99, 0 : Not specified)
When indirect designation of points is executed by using counters, the specified counter content (value) is the coordinate table No.

STEP 5 Press ALT to select either S (axial speed) or T (linear speed), and then press ENT .

NOTE If neither STEP 3 nor STEP 4 or if both are designated, a "PARAMETER ERROR" will occur when the command is executed. If the counter No. is designated in STEP 4 and the counter details are "0", a "TABLE No. ERROR" will occur when the command is executed.



STEP 6 Enter the speed table No. with the numeric keypad and press [ENT]. (Input range: 1 to 10.)
When V = 0 is entered, the speed is set to the designated speed preset by SPD command.

STEP 7 Press [ALT] to select either POST (position) or PASS (pass point), and press [ENT].

?

- If the cursor is at STEP 2 to 7, press [F1] to change to the coordinate table display and set the coordinate value. Press [ESC] to return to the original display.

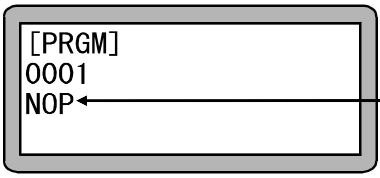
NOTE

- For details of a (absolute coordinate position), i (relative coordinate position), S (axial speed), T (linear speed), POST and PASS, refer to "MOV System Command Words and Parameters" (section 3.2.5).
- When the first axis movement after the axis stops due to an error during the axis movement command is designated as a relative coordinate position, the movement will be relative from that coordinate position and will not be the commanded start position before the error occurred.
- In the same manner, if an absolute encoder axis is connected, and the first axis movement after the axis stops due to the power being turned OFF and ON during execution of an axis movement command is designated as a relative position, the movement will be relative from that coordinate position and will not be the commanded start position before the power was turned OFF.

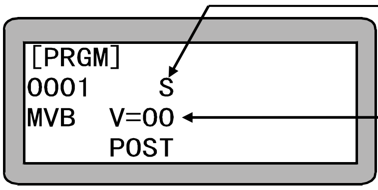
MVB **Return to Previous Point**

[Function] This command is used to return the COMPO ARM BA II to the point prior to the current position, form which the previous move command was is used.

[Key operation]

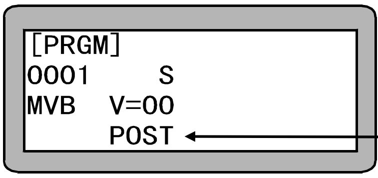


STEP 1 Press F1 , IN 1 and OUT 2 in order. NOP changes to MVB.



STEP 2 Press ALT to select either S (axial speed) or T (linear speed), and press ENT .

STEP 3 Enter the speed No. with the numeric keypad and press ENT . (Input range: 0 to 10.)
When V = 0 is entered, the speed is set to the designated speed preset by SPD command.



STEP 4 Press ALT to select either POST (position) or PASS (pass point), and press ENT .

NOTE

- For details of S (axial speed), T (linear speed), POST and PASS, refer to "MOV System Command Words and Parameters" (section 3.2.5).

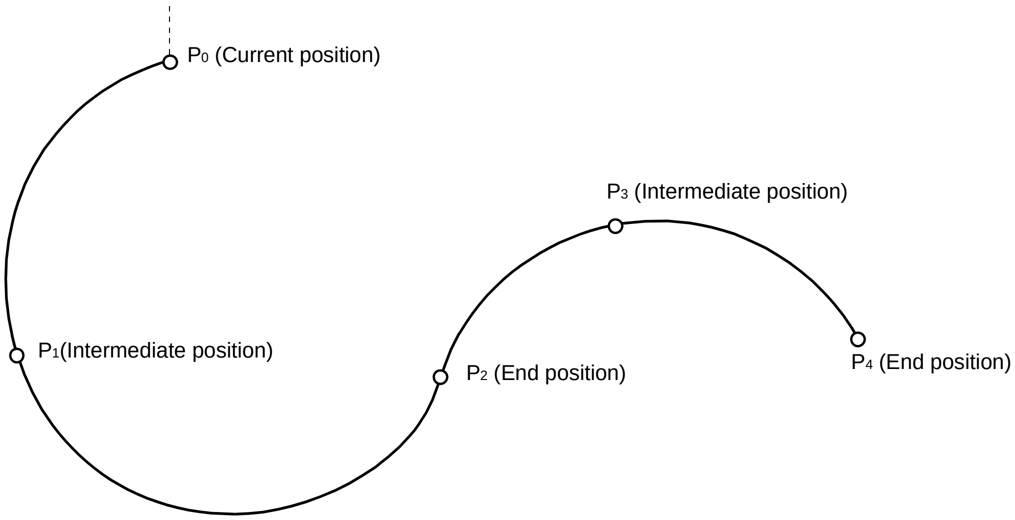
MVC **Circular Interpolation Move**

[Function] This command is used to set circular movement through the designated coordinates (intermediate and target positions). (Circular interpolation)

[Explanation]

- It moves on the circle which is calculated from the position data of three points of the current position, intermediate position and target position. Moreover, it moves on the 3-dimensional circle.
- When MVC command is used, two commands of MVC command which instructs the intermediate point and MVC command which instructs the target position must always make a pair. Here, MVCP can be used to instruct the target position.

(Example)



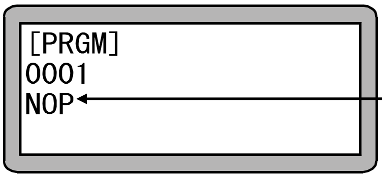
Step	Command word	Data (Coordinate)	
009	MOV	P_0	Circular movement of $P_0 \rightarrow P_1 \rightarrow P_2$ is executed.
010	MVC	P_1	
011	MVC	P_2	
012	MVC	P_3	Circular movement of $P_2 \rightarrow P_3 \rightarrow P_4$ is executed.
013	MVC	P_4	

NOTE

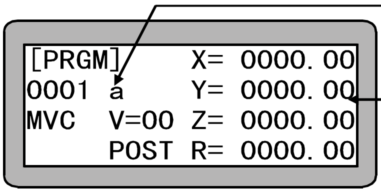
- If any two of the current position, intermediate position and target position have the same coordinate value or if three positions are linearly arranged, it will become an error (excessive circular interpolation radius).
- To draw a true circle, a combination of two arcs is used.
- To prevent slowdown at the joint of two arcs, select the rear step which sets MVC, as PASS (pass point). For example, to prevent slowdown at P_2 in the figure above, designate PASS at STEP 011.

- To designate i (relative coordinate position), the relative coordinates of the intermediate point and end point are determined against the current position.
  Note that the relative coordinate of the end point is not determined against the intermediate point.

[Key operation]



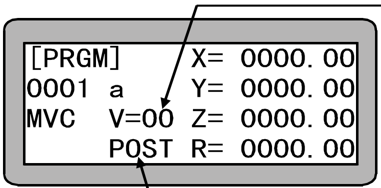
STEP 1 Press MVC 8 , and the NOP will change to MVC. Then, press ENT .
(Here, designate one point of three-point arc.)



STEP 2 Press ALT to select either a (absolute coordinate position) or i (relative coordinate position), and press ENT .

STEP 3 Use the numeric keypad to enter the coordinate of each axis, and press ENT . (Input range: –8000 to 8000)
Press ALT , and "*******" will be displayed. For the axis, the previous numeric value before the command is executed will be applied.

NOTE
- Remote teaching and direct teaching are also possible by pressing DIRECT JOG .
  (Refer to section 3.2.2.)



STEP 4 Use the numeric keypad to enter the speed No., and press ENT . (Input range: 0 to 10)
The movement speed becomes linear.
If V=0 is entered, the movement speed will become the designated speed of SPD command which is previously set.

STEP 5 Press ALT to select either POST (position) or PASS (pass point), and press ENT .

?
- The movement speed is based on the value that was set by the MVC command that instructs the intermediate coordinate.

NOTE

- MVC command must be continuously described two times.
  If any axis movement system command (excluding MVC and MVCP) is executed after the last MVC command when an odd number of MVC commands are set, it will be regarded as an error (circular interpolation data shortage).
- For details of a (absolute coordinate position), i (relative coordinate position), POST and PASS of the parameters, refer to "MOV system command words and parameters" (section 3.2.5).
- If three axes are specified, two kinds of 3-dimensional circular interpolation (spherical interpolation) and 2-dimensional circular interpolation (interpolation in axis 1 and axis 2) with simultaneous arrival of axis 3 can be designated.
  If four axes are specified, 3-dimensional circular interpolation (spherical interpolation) will be applied together with simultaneous arrival of axis 4.
  "Setting of task and axis combination" of Parameter 2 is applied for setting. (Refer to section 14.4.19.)
- The axis is displayed in the screen as set by "Setting of axis display". (Refer to section 14.4.1.)
  "?" is displayed for an axis which is not used.

MVCP **Coordinate Table Indirect Designation Circular Interpolation Move**

[Function] Movement in the circular interpolation mode (Coordinate table No. designation)
Circular movement via the coordinates (intermediate and target coordinates) designated with the coordinate table (Circular interpolation)

[Explanation]

- Three current position, intermediate position and target position are designated from the coordinate table, and MVCP moves the circle calculated from the position data of these three points.
- There are two methods of the method to directly designate the coordinate table No. and the method to indirectly designate the coordinate table No. from the counter.
- Except when the position data is designated with the coordinate table No., the other items are the same as those of MVC command.

[Key operation]

```
[PRGM]
0001
NOP
```

STEP 1 Press [MVC 8] twice, and the NOP will change to MVCP.
Then, press [ENT] .

```
[PRGM]
0001 a    NO=000
MVCP V=00 CNT[00]
     POST
```

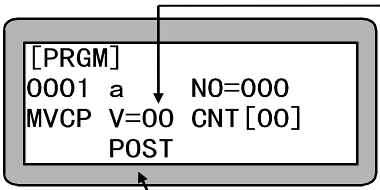
STEP 2 Press [ALT] to select either a (absolute coordinate position) or i (relative coordinate position), and press [ENT] .

STEP 3 Use the numeric keypad to enter the first coordinate table No., and press [ENT] .
(Input range: 0 to 999, 0: Not specified.)

```
[PRGM]
0001 a    NO=000
MVCP V=00 CNT[00]
     POST
```

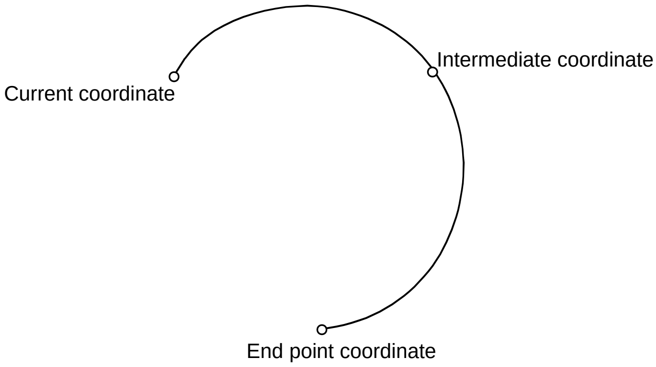
STEP 4 Use the numeric keypad to enter the coordinate table No. designation counter No. of the destination, and press [ENT] . (Input range: 0 to 99, 0: Not specified.)

NOTE
- If either STEP3 or STEP4 is not designated, or if both are designated, it will be regarded as an error during execution of the command.



STEP 5 Use the numeric keypad to enter the speed No., and press [ENT] . (Input range: 0 to 10)
The movement speed becomes linear speed.
If V=0 is entered, the movement speed will become the designated speed of SPD command which is previously set.

STEP 6 Press [ALT] to select either POST (position) or PASS (pass point), and press [ENT] .



?

- The movement speed is based on the value that was set by the MVC command that instructs the intermediate coordinate.
- The POST (position) and PASS (pass point) operations are based on the setting by the MVC command that instructs the target position.
- If the cursor is placed at the position in STEPS 2 to 7, pressing [F1] changes to the edit screen for the coordinate table specified in STEP 3 where the coordinate value can be set.
  Here, to return to the previous display, press [ESC] .

NOTE

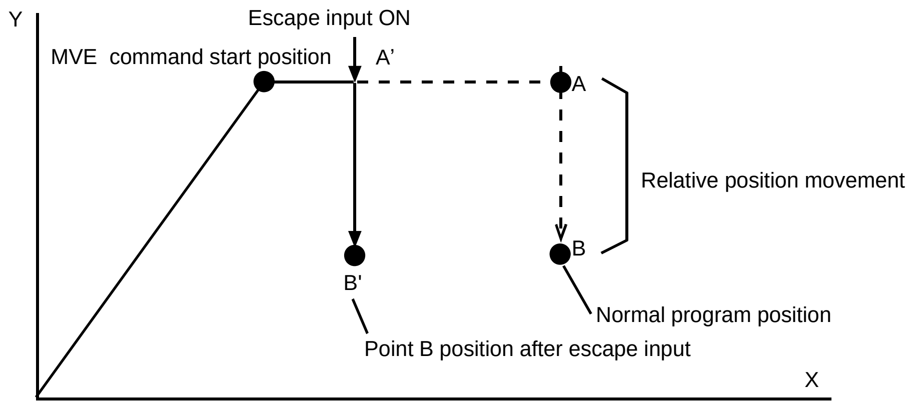
- For details of a (absolute coordinate position), i (relative coordinate position), POST and PASS of the parameters, refer to "MOV system command words and parameters" (section 3.2.5).
- MVCP command must be continuously described two times.

MVE **Escape Move**

[Function] When escape input signal set in the mode setting is ON while an MVE command is executed , the current program step will be recognized completed and the program will proceed to the next step.

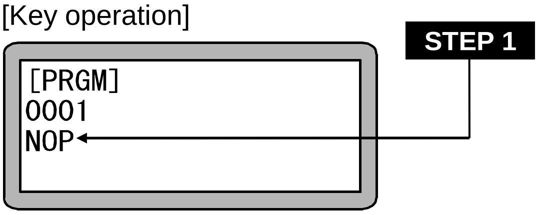
[Explanation]

- If escape input is set in the mode setting, the set general-purpose input signal will function as the escape input during execution of the MVE command. When this input turns ON, the axis will decelerate to a stop, and then the next step will be executed. (Refer to section 14.2.3.)
- The deceleration time will be the time set with the ACC command. If ACC is not set, the speed in ACC5 will be used.
- If the MVE command is executed while the escape input is ON, the MVE command will not be executed, and the next step will be executed.
- The set general-purpose input signal will be the escape input only when the MVE command is executed. It will function as the general-purpose input port during commands other than the MVE command.
- If the axis has been decelerated and stopped with the escape input and the next command is a move command to a relative position, the relative movement will take place using this stop position as a reference.
  (B → B' in the figure shown below.)



- The MVE command includes a method to directly designate the coordinate table No. and a method to designate the coordinate table No. indirectly using a counter.

[Key operation]



Press F1 , IN 1 and TIM 6 in order.
NOP changes to MVE.

```
[PRGM]
0001 a  S NO=000
MVE  V=00 CNT[00]
     POST
```

STEP 2 Press ALT and select either "a" (absolute coordinate) or "i" (relative coordinate), and press ENT .

STEP 3 Enter the coordinate table No. with the numeric keypad and press ENT . (Input range: 0 to 999, 0: Not specified.)

```
[PRGM]
0001 a  S NO=000
MVE  V=00 CNT[00]
     POST
```

STEP 4 Use the numeric keypad to enter the counter No., which designates the coordinate table No. of the destination. Press ENT .
(Input range: 0 to 99, 0: Not specified.)
When counters are used to designate positions indirectly, the content (counter value) is the coordinate table No.

STEP 5 Press ALT to select either S (axial speed) or T (linear speed), and press ENT .

NOTE

- If neither STEP 3 nor STEP 4 or if both are designated, a "PARAMETER ERROR" will occur when the command is executed. If the counter No. is designated in STEP 3 and the counter details are "0", a "TABLE No. ERROR" will occur when the command is executed.

```
[PRGM]
0001 a  S NO=000
MVE  V=00 CNT[00]
     POST
```

STEP 6 Enter the speed No. with the numeric keypad and press ENT . (Input range: 0 to 10.)

When V = 0 is entered, the speed becomes the value preset by the SPD command.

?

- If the cursor is placed at the position in STEPS 2 to 7, pressing F1 changes to the edit screen for the coordinate table specified in STEP 3 where the coordinate value can be set.
  Press ESC to return to the original display.

NOTE

- When the first axis movement after the axis stops due to an error during the axis movement command is designated as a relative coordinate position, the movement will be relative from that coordinate position and will not be the commanded start position before the error occurred.
- In the same manner, if an absolute encoder axis is connected, and the first axis movement after the axis stops due to the power being turned OFF and ON during execution of an axis movement command is designated as a relative position, the movement will be relative from that coordinate position and will not be the commanded start position before the power was turned OFF.

MVM **Palletizing Move**

[Function] This command is used to execute palletizing movement according to the MVM table of a specified group.

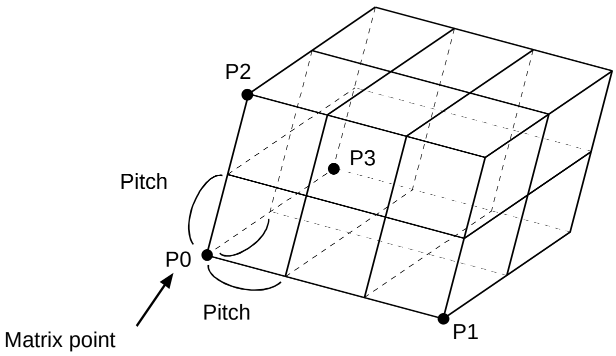
[Explanation]
- Before using the MVM command, you set the parameters listed below relating to the MVM operation in parameter mode.
  - Coordinate table No. of operation origin points P0, P1, P2 and P3.
  - Numbers of objects to be picked up and carried
  - Counter No. used for the palletizing operation

?

- Refer to section 14.6.4 MVM Table Setting for the parameter setting.
- When MVM command is executed, the COMPO ARM BA II moves to the coordinate calculated by the following equations:

Coordinates of each matrix point
P0: (X_0, Y_0, Z_0)
P1: (X_1, Y_1, Z_1)
P2: (X_2, Y_2, Z_2)
P3: (X_3, Y_3, Z_3)

$P_0 \rightarrow P_1$ pieces: n_1
$P_0 \rightarrow P_2$ pieces: n_2
$P_0 \rightarrow P_3$ pieces: n_3



$$\left.\begin{array}{l}\text{Value of counter used in } P_0 \rightarrow P_1 \text{ direction: } C_1\\ \text{Value of counter used in } P_0 \rightarrow P_2 \text{ direction: } C_2\\ \text{Value of counter used in } P_0 \rightarrow P_3 \text{ direction: } C_3\end{array}\right\}$$

C_1 and C_3 are incremented by one with the LOOP command.
These are variables that are the details (value) of the counter.

MVM calculation expression

X coordinate value = $X_0 + x_1 (C_1 - 1) + x_2 (C_2 - 1) + x_3 (C_3 - 1)$
Y coordinate value = $Y_0 + y_1 (C_1 - 1) + y_2 (C_2 - 1) + y_3 (C_3 - 1)$
Z coordinate value = $Z_0 + z_1 (C_1 - 1) + z_2 (C_2 - 1) + z_3 (C_3 - 1)$
Where, x_1, y_1 and z_1 are the X, Y and Z elements of the pitch in the $P_0 \rightarrow P_1$ direction

$$x_1 = \frac{X_1 - X_0}{n_1 - 1}, \quad y_1 = \frac{Y_1 - Y_0}{n_1 - 1}, \quad z_1 = \frac{Z_1 - Z_0}{n_1 - 1}$$

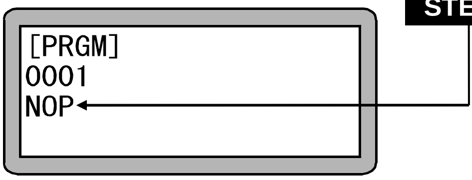
x_2, y_2 and z_2 are the X, Y and Z elements of the pitch in the $P_0 \rightarrow P_2$ direction

$$x_2 = \frac{X_2 - X_0}{n_2 - 1}, \quad y_2 = \frac{Y_2 - Y_0}{n_2 - 1}, \quad z_2 = \frac{Z_2 - Z_0}{n_2 - 1}$$

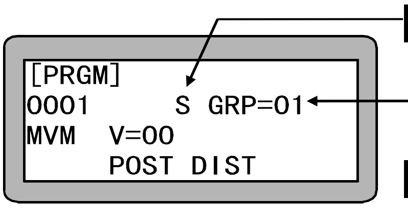
x_3, y_3 and z_3 are the X, Y and Z elements of the pitch in the $P_0 \rightarrow P_3$ direction

$$x_3 = \frac{X_3 - X_0}{n_3 - 1}, \quad y_3 = \frac{Y_3 - Y_0}{n_3 - 1}, \quad z_3 = \frac{Z_3 - Z_0}{n_3 - 1}$$

[Key operation]

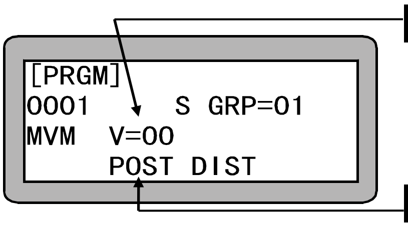


STEP 1 Press F1 , IN/1 and CAL/4 .
NOP changes to MVM.



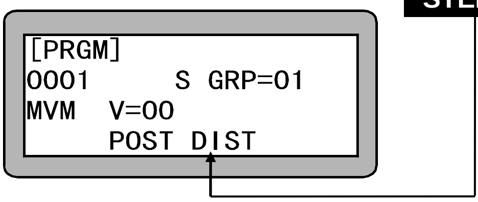
STEP 2 Press ALT to select either S (axial speed) or T (linear speed), and press ENT .

STEP 3 Enter the group No. with the numeric keypad and press ENT . (Input range: 1 to 32.)



STEP 4 Enter the speed No. with the numeric keypad and press ENT . (Input range: 0 to 10.)
When V = 0 is entered, the speed becomes the value preset by the SPD command.

STEP 5 Press ALT to select either POST (position) or PASS (pass point), and then press ENT .



STEP 6 Press ALT to select either DIST (destination) or APPR (approach), and then press ENT .

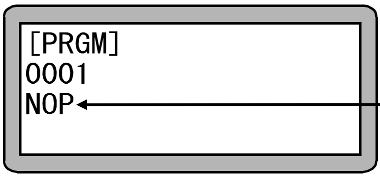
NOTE

- For details of S (axial speed), T (linear speed), POST and PASS of the parameters, refer to "MOV system command words and parameters" (section 3.2.5).
- For an application example of the command, refer to "Palletizing work with MVM commands" (section 4.1.7).

NOP **No Operation**

[Function] There is no execution at this step, and the program proceeds to the next step.

[Key operation]



STEP 1 Press [NOP / -] followed by [ENT], then NOP is entered.

NOTE ● NOP is entered in any program step in which no instruction is written.

OFS **Offset**

[Function] Addition of only the amount (offset value) which designates the coordinate

[Explanation]

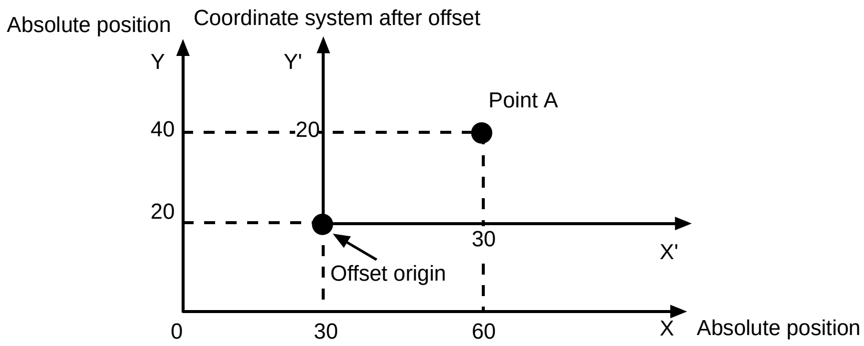
- Valid for MOV system commands (excluding HOME)
- The OFS command, once executed, remains effective until the next OFS command is executed.
- To cancel the offset, set the offset value "0" for each axis , and execute it.
- Note that the current position after the execution of the offset command is displayed as follows.

[Current position monitor display] = [absolute position] − [executed offset value]

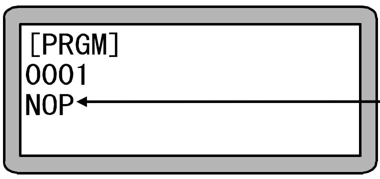
(Example)

When offset value is X = 30, Y = 20

	Point A absolute coordinate:	X = 60, Y = 40
−)	Executed offset value:	X = 30, Y = 20
Current position monitor display:		X = 30, Y = 20



[Key operation]



STEP 1 Press F1 , and then press IN/1 twice, and the NOP will change to OFS.

STEP 2

```
[PRGM]     X= 0000.00
0001       Y= 0000.00
OFS        Z= 0000.00
           R= 0000.00
```

Use the numeric keypad to enter the coordinate of each axis, and press ENT . (Input range: –8000 to 8000)
Press ALT , and "*******" will be displayed. For the axis, the previous numeric value before the command is executed will be applied.

NOTE

- The axis displayed in the screen is as set by "Setting of axis display" of Parameter 2. (Refer to section 14.4.1.)
  "?" is displayed for the axis which is not used.

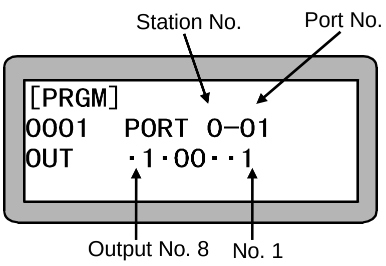
OUT **General-purpose Port Output**

[Function] The general-purpose output of the unit with the designated station No. is turned ON or OFF.

[Explanation]

- After execution, the output state is held until the next OUT command is issued. Even if the END command is executed and the program ended, the output signal will be held.
- To turn OFF the output signal, set "0" at the output bit desired to be turned OFF with OUT command, or turn OFF the power supply of the controller.
- If the OUT command is set as shown below, the general-purpose output port 1 No. 1 (general-purpose output port 1-1) and No. 7 (general-purpose output port 1-7) will turn ON and the general-purpose output port 1 No. 4 (general-purpose output port 1-4) and No. 5 (general-purpose output port 1-5) will turn OFF for the unit of which the station No. is set to "0". The general-purpose output signal at the "•" display section will hold the current signal state.

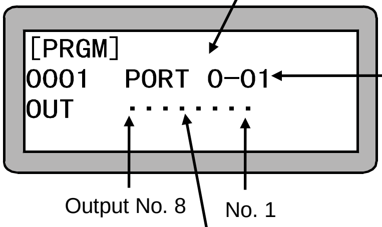
(Example)



"1" ---------- Output ON
"0" ---------- Output OFF
"•" ---------- Hold current output state

[Key operation]

STEP 1 Press [OUT/2] key, and the NOP will change to OUT.
Then, press [ENT] .



STEP 2 Use the numeric keypad to enter the station No., and press ENT . (Input range: 0 to 4)

STEP 3 Use the numeric key to enter the port No., and press ENT .

STEP 4 Enter the output conditions with RET 0 , IN 1 and TAG • , and then press ENT .

The key functions.

RET 0	Output OFF
IN 1	Output ON
TAG •	Ignored (Held as it is)

NOTE

- The station No. is a number assigned to each unit. (Refer to section 2.4.4.)
- For the station No., port No. and bit No. which can be used, refer to "Names of general-purpose input/output ports and Teach Pendant displays" (Section 10.1.4) .

OUTC Counter Value General-purpose Port Output

[Function] The counter details are output to the general-purpose port of the designated station No.

[Explanation]

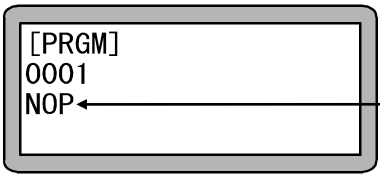
- The content of the designated counter is converted into the binary content, and is output to the designated general-purpose output port.
- The counter values that can be output are 0 to 255.
  If the counter value exceeds this range, a parameter error occurs.
  Ports that have up to four output bits are displayed as the lower four digits of the converted binary number.

Counter value (Decimal)	General-purpose output bit pattern (Binary)
0	0000 0000
1	0000 0001
2	0000 0010
3	0000 0011
•	• •
15	0000 1111
•	• •
255	1111 1111

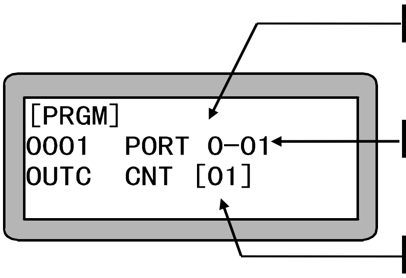
0 ... Output OFF
1 ... Output ON

Output No. 8 No. 1

[Key operation]



STEP 1 Press OUT 2 key three times, and the NOP will change to OUTC.
Then, press ENT .



STEP 2 Use the numeric keypad to enter the station No., and press ENT . (Input range: 0 to 4)

STEP 3 Use the numeric key to enter the port No., and press ENT .

STEP 4 Enter the counter No. with the numeric keypad and press ENT . (Input range: 1 to 99.)

NOTE

- The station No. is a number assigned to each unit. (Refer to section 2.4.4.)
- For the station No., port No. and bit No. which can be used, refer to "Names of general-purpose input/output ports and Teach Pendant displays" (section 10.1.4).

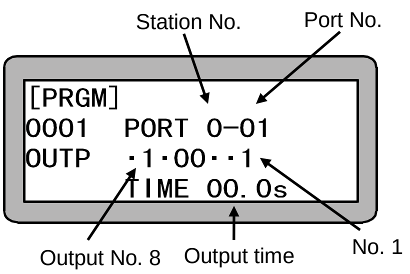
OUTP **General-purpose Port Pulse Output**

[Function] The output of the designated general-purpose output port of the designated station No. is turned ON or OFF for a designated time.

[Explanation]

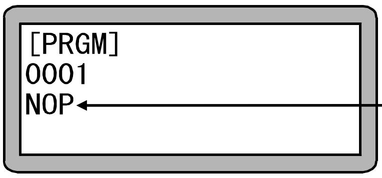
- The next step will not be moved to unless the set time has passed.
- The time can be set between 0 and 99.9 sec. in 0.1 second increments.
- The state of the general-purpose output signal after execution of OUTP command returns to the state before OUTP command is executed.
- If the OUTP command is set as shown below, the general-purpose output port 1 No. 1 (general-purpose output port 1-1) and No. 7 (general-purpose output port 1-7) will turn ON and the general-purpose output port 1 No. 4 (general-purpose output port 1-4) and No. 5 (general-purpose output port 1-5) will turn OFF for the unit of which the station No. is set to "0".
  The general-purpose output signal at the "•" display section will hold the current signal state.

(Example)

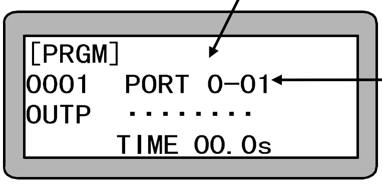


"1" ---------- Output ON
"0" ---------- Output OFF
"•" ---------- Hold current output state

[Key operation]

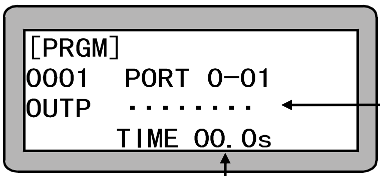


STEP 1 Press [OUT 2] key twice, and the NOP will change to OUTP.
Then, press [ENT] .



STEP 2 Use the numeric keypad to enter the station No., and press [ENT] . (Input range: 0 to 4)

STEP 3 Use the numeric key to enter the port No., and press [ENT] .



STEP 4 Enter the output conditions with [RET/0], [IN/1] and [TAG/•], and then press [ENT].

The key functions.

[RET/0] Output OFF

[IN/1] Output ON

[TAG/•] Ignored (Held as it is)

STEP 5 Use the numeric key to enter the output time, and press [ENT]. (Input range: 0 to 99.9 sec.)

NOTE

- If any output time is set at "0", the signal will not be output.
- The station No. is a number assigned to each unit. (Refer to section 2.4.4.)
- During execution of this command in multitask operation, other tasks are in the ready status and do not proceed to the next step until the preset time has elapsed.
- For the station No., port No. and bit No. which can be used, refer to section 10.1.4 "Names of general-purpose input/output ports and Teach Pendant displays".

OUTS **Designated Coordinate General-purpose Output**

[Function] This command is used in combination with the axis movement command to compare the designated coordinate with the movement axis coordinate during axis movement. If the conditions are satisfied as the comparison result, the designated general-purpose output will be turned ON and OFF.

[Explanation]

- Before the axis movement, the command designates the compared coordinate, comparison conditions and general-purpose output. A maximum of 64 items can be designated once each task, and can be repeatedly within the designated range. Moreover, if they are cleared with CANS command, 64 items can be newly designated.
- When the axis movement command is executed after designation, the designated coordinate will be compared until the conditions are satisfied. At the time of satisfaction, the general-purpose output will be turned ON/OFF. If it is continuously set, it will be started to compare the next set coordinate.
  Since the data for which the conditions are once satisfied are erased, it is necessary to input the conditions again when the same conditions are used.
- The coordinate is compared at the frequency of approx. 1mS.
- The coordinate data and others which have remained since the conditions are not satisfied deleted can be cleared with CANS command.
- The application example is shown below.

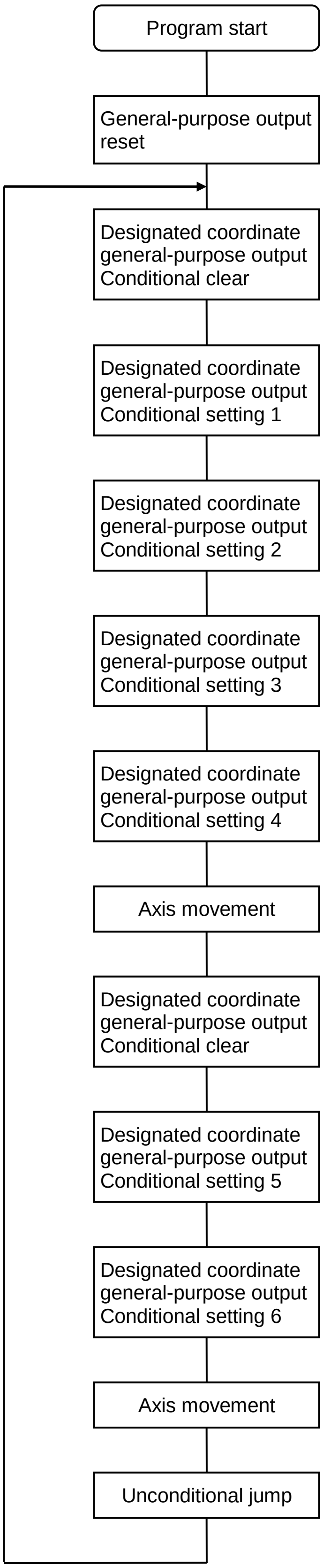
① During the own task, X axis moves from 0mm to 500mm, and the general-purpose output port 1-01 is also turned ON/OFF during the axis movement as shown below.

X axis movement [mm]	State of general-purpose output port 1-01							
	No. 8	No. 7	No. 6	No. 5	No. 4	No. 3	No. 2	No. 1
Start time	0	0	0	0	0	0	0	0
100mm passing time	0	0	0	0	0	0	0	1
200mm passing time	0	0	0	0	0	0	1	0
300mm passing time	0	0	0	0	0	1	0	0
400mm passing time	0	0	0	0	1	0	0	0

② While X axis next moves from 500mm to 000mm, the general-purpose output is turned ON/OFF as shown below.

X axis movement [mm]	State of general-purpose output port 1-01							
	No. 8	No. 7	No. 6	No. 5	No. 4	No. 3	No. 2	No. 1
Start time	1	1	1	1	1	1	1	1
250mm passing time	0	0	0	0	0	0	0	0

③ The cycle of ① → ② above is repeatedly operated.
(①→ ② → ① → ② ………...)



[Commands and data]

```
OUT     PORT   1-01
        00000000
TAG.    010
CANS    T0
OUTS    T0   PORT   1-01
        00000001
        X >= 0100.00
OUTS    T0   PORT   1-01
        00000010
        X >= 0200.00
OUTS    T0   PORT   1-01
        00000100
        X >= 0300.00
OUTS    T0   PORT   1-01
        00001000
        X >= 0400.00
MOV     X= 0500.00
CANS    T0
OUTS    T0   PORT   1-01
        11111111
        X <= 0500.00
OUTS    T0   PORT   1-01
        00000000
        X <= 0250.00
MOV     X= 0000.00
JMP     010
```

[Key operation]

```
[PRGM]
0001
NOP
```

STEP 1 Press [F1] , and then press [OUT 2] and [OUT 2] , and the NOP will change to OUTS.

```
[PRGM]
0001   TO PORT 0-01
OUTS   ........
          X <= 0000.00
```

STEP 2 Use the numeric keypad to enter the task No., and press [ENT] . (Input range: 0*)

STEP 3 Use the numeric key to enter the station No., and press [ENT] .(Input range: 0 to 4)

STEP 4 Use the numeric key to enter the port No., and press [ENT] .

STEP 5 Enter the output conditions with [RET 0] , [IN 1] and [TAG •] , and then press [ENT] .

The key functions.

[RET 0] Output OFF

[IN 1] Output ON

[TAG •] Ignored (Held as it is)

* This command can be used only with the task 1.
Use '0' for this command value as it (preset task) is.

```
[PRGM]
0001   TO PORT 0-01
OUTS   ........
          X <= 0000.00
```

STEP 6 Press [ALT] , and the axis will be displayed. Select a desired axis, and press [ENT] .

STEP 7 Press [ALT] , and the operator (<= and >=) will be displayed. Select a desired one, and press [ENT] .

STEP 8 Use the numeric keypad to enter the designated coordinate, and press [ENT] . (Input range: –8000 to 8000)

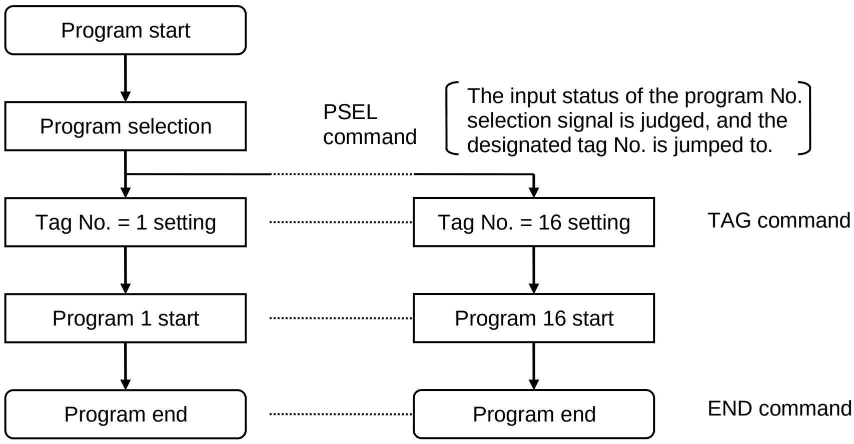
NOTE

- For the applicable station No., port No. and bit No., refer to "Names of general-purpose input/output ports and Teach Pendant display" (section 10.1.4).
- If 65 conditions or more are set for one task, an error will occur.
- If the same axis display is used 2 times or more in one task, the axis which has the smaller station No. will be prior.
- The data which was set and remains in the buffer will be cleared by the reset input.
- It will not be held as the data of continuous start.

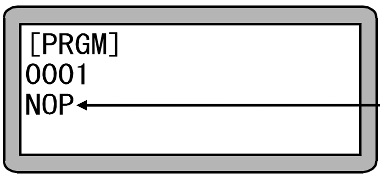
PSEL **Program Selection**

[Function] The status of the program No. selection input signal set with the mode setting is judged, and the tag No. is jumped to according to the input state. (Refer to section 109.2.9.)

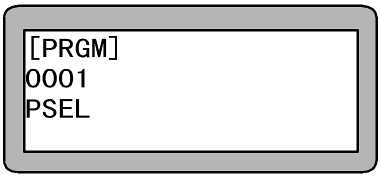
[Explanation]
- The program No. input signal is judged at the point the PSEL command is executed.
- The application example is shown below.



[Key operation]



STEP 1 Press [F1], and then press [IN 1] and [RET 0] in order.
NOP changes to PSEL.



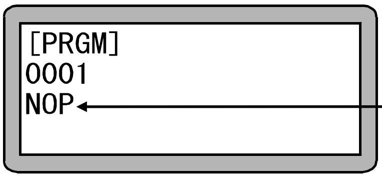
?

- Refer to section 14.2.5 for details on the bit No. selection input bit designation.
  During multitasking, if the PSEL command is input for multiple tasks and is executed, the "NO TAG FOUND" error will occur. Jumping to a tag No. in another task is also not possible.

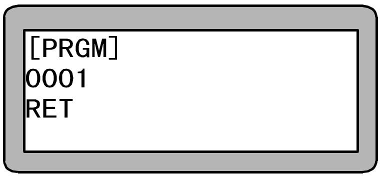
RET **Return Command**

[Function] This command is used with a CAL command (CAL, CALI, CALC and CALT) in pairs to return the program to the next step following the step called by it. The subroutine program ends when this command is executed.

[Key operation]



STEP 1 Press [RET/0] key, and the NOP will change to RET. Then, press [ENT] .



?

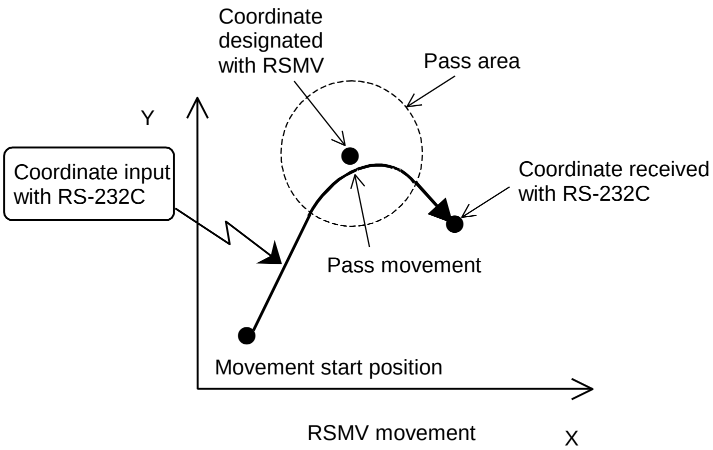
- Refer to the CAL command for the ideology on the main routine and subroutine.

RSMV Axis movement with RS-232-C

[Function] This command changes the target position to the coordinate data which is received with RS-232C communication during designated axis movement.

[Explanation]

- This command is used to compensate the target position with RS-232C communication.
- If any coordinate data is received from RS-232C before arrival at the coordinate designated with RSMV command (before start of deceleration), the deceleration stop will not be applied but it will move to the received coordinate through the pass operation.



- If any coordinate data is not input from RS-232C even though it arrives at the coordinate designated with RSMV command, the coordinate data will be waited for.
- Designation is possible for each task.
- If it is restarted after stop with the stop input or similar, it will start moving from the waiting state of coordinate data from RS-232C.
- "*******" is valid for the coordinate data input from RS-232C.

[RS-232C coordinate data input format]

@MRSSΔTASK = 01ΔX = ± 0000.00ΔY = ±0000.00
ΔZ = ±0000.00ΔR = ±0000.00ΔV = 00CRLF
The designated coordinates are designated by POST at an absolute coordinate position.

?

- For details of RS-232C communication, refer to the communication specifications of RS-232C.
  The communication specifications of RS-232C are available at our branch office or business office.

[Key operation]

```
[PRGM]
0001
NOP
```

STEP 1 Press [F1] , and next press [OUT/2] and [MOV/9] , and the NOP will change to RSMV.

```
[PRGM]      X= 0000.00
0001  a   S Y= 0000.00
RSMV  V=00  Z= 0000.00
      PASS  R= 0000.00
```

STEP 2 Use the numeric keypad to enter the coordinate of each axis, and press [ENT] . (Input range: –8000 to 8000)
Press [ALT] , and "*******" will be displayed.
For the axis, the previous numeric value before the command is executed will be applied.

NOTE

- Remote teaching and direct teaching are possible by pressing [DIRECT/JOG] . (Refer to section 3.2.2.)
- The axis displayed in the screen is as set by "Setting of axis display" of Parameter 2. (Refer to section 14.4.1.)
  "?" is displayed for the axis which is not used.

STEP 3 Press [ALT] to select either S (axial speed) or T (linear speed), and then press [ENT] .

```
[PRGM]      X= 0000.00
0001  a   S Y= 0000.00
RSMV  V=00  Z= 0000.00
      PASS  R= 0000.00
```

STEP 4 Use the numeric keypad to enter the speed No., and press [ENT] . (Input range: 0 to 10)
If V=0 is entered, the movement speed will become the designated speed of SPD command which is previously set.

?

- During execution of the command, it is possible to enter RS-232C coordinate data for the test using Teach Pendant. For details, refer to "Coordinate input with RS-232C" (section 18.7).

NOTE

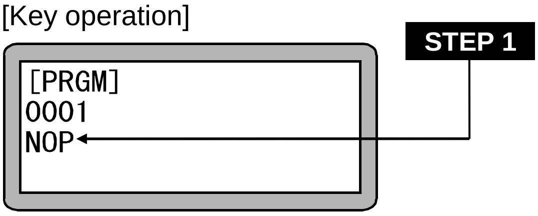
- If any coordinate data receiving with RS-232C is not in time for the pass operation process, the ordinary positting operation will be applied, and it will move to the received coordinate after stopping at the designated coordinate.
- Though the coordinate data received from RS-232C is memorized in the memory in the controller, it will be cleared at the end of RSMV command or with reset input.
- RS-232C coordinate data can be received even before RSMV command is executed.
- If any plural coordinate data are received from RS-232C, the coordinate data which is last received will be memorized in the memory.

SPD **Speed Command**

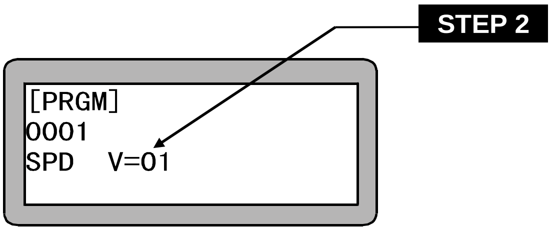
[Function] This command is used to set the speed for the actuator movement.

[Explanation]
- Ten levels of speed from SPD1 to SPD10 can be set.
- This command must be set before a Move command (MOV, MOVP, MVC, MVCP, MVB, MVE, MVM, RSMV.)
- When using multitasking, a setting must be made for each task.
- The speed at each level can be changed with the speed table. (Refer to section 14.6.2.)
- Once the speed is set, this value remains unchanged until the next setting. If no speed value is set, the speed defaults to the SPD1.
- Do not set the speed higher than the maximum allowed. If the speed value exceeds the maximum, the speed defaults to the speed set in parameter 2. (Refer to section 14.4.6.)
- The allowable maximum speed depends on the length of the axis stroke and ball screw lead. (Refer to the COMPO ARM BA II instruction manual for details.)

[Key operation]



Press [SPD/7] key, and the NOP will change to SPD.
Then, press [ENT] .



Enter speed No. with the numeric keypad and press [ENT] . (Input range: 1 to 10.)

STOP **Stop Command**

[Function] This command is used to stop the program and display the next program step. When using multitasking, the task that executed this command will stop.

[Explanation] If the program is to be continued after stopping it with a command, input the start signal. If the program is to be returned to step No. 1 and then executed, input the reset signal, and then input the start signal. Note that the setting of the continuous start bit and the status of the continuous start input signal are related. (Refer to section 10.2.6.)

[Key operation]

```
[PRGM]
0001
NOP
```

STEP 1 Press [RET/0] key twice, and the NOP will change to STOP.
Then, press [ENT] .

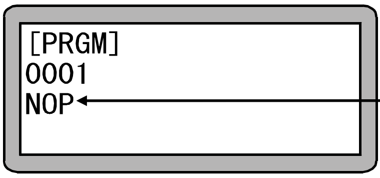
```
[PRGM]
0001
STOP
```

SVOF **Servo-off Command**

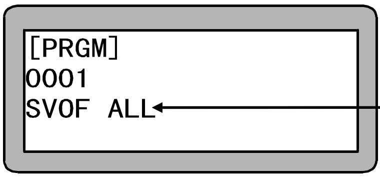
[Function] All axes or designated axis is brought into the servo free state.
If all axes are generally designated for execution with the command in the multitask mode, the axis in the task will be brought into the servo free state.

[Explanation] When the SVOF command is executed, any axis equipped with a brake is braked.

[Key operation]



STEP 1 Press F1 , IN 1 and MVC 8 in order. NOP changes to SVOF.



STEP 2 Press ALT , and (ALL, X, Y, Z, R) will be displayed. Select the servo-free desired axis.
"ALL" ······· All axes

NOTE ● If any same axis display is used two times or more in one task, the axis of the smaller station No. will be prior.

SVON Servo-on Command

[Function] All axes or designated axis is brought into the servo lock state.
If all axes are generally designated for execution with this command in the multitask mode, the axis in the task will be brought into the servo lock state.

[Explanation] When SVON command is executed, any axis brake is released.

[Key operation]

```
[PRGM]
0001
NOP
```

STEP 1 Press F1 , IN 1 and SPD 7 in order. NOP changes to SVON.

```
[PRGM]
0001
SVON ALL
```

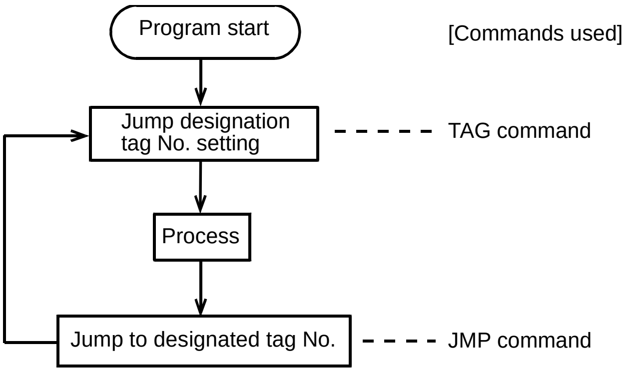
STEP 2 Press ALT , and (ALL, X, Y, Z, R) will be displayed. Select the servo-lock desired axis.
"ALL" ······· All axes

NOTE
- If any same axis display is used two times or more in one task, the axis of the smaller station No. will be prior.

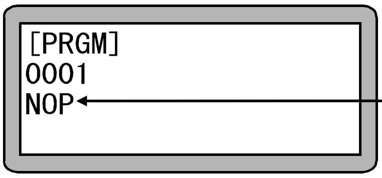
TAG **Tag Command**

[Function] This command is used to enter the tag No. in the program.

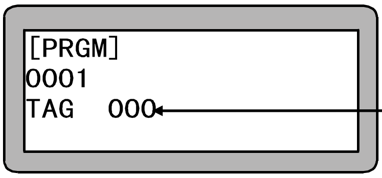
[Explanation]
- The tag No. is an address that designates the jump designation.
- The tag No. can be entered from No. 1 to 999.
- When this command is executed, the program proceeds to the next step with no program execution similarly to NOP command.
- A usage example is shown below.
  This is a program that repeats a certain process.



[Key operation]



STEP 1 Press TAG • key, and the NOP will change to TAG.
Then, press ENT .



STEP 2 Enter the tag No. with the numeric keypad and press ENT . (Input range: 1 to 999)

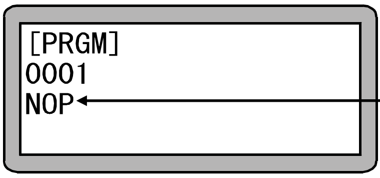
NOTE
- If the same tag No. is input, the "DOUBLE TAG ERR." will occur.
  When using multitasking, if the same tag No. is input even in another task, the "DOUBLE TAG ERR." will occur.

TCAN **Task Forced End**

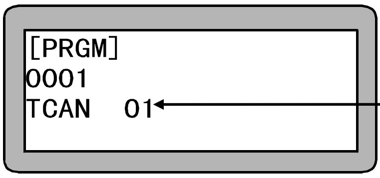
[Function] The designated task is ended.

[Explanation] The designated task will be set in the same state as when that task executes the END command.

[Key operation]



STEP 1 Press F1, then OUT 2 and TIM 6, and NOP changes to TCAN.



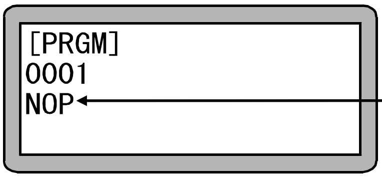
STEP 2 Enter the task No. with the numeric keypad and press ENT . (Input range: 1 to 4)

TIM **Wait Command**

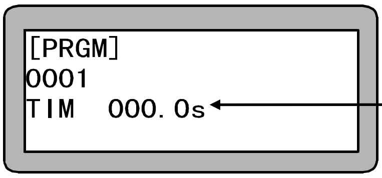
[Function] This command is used to stop the program execution for a specified period of time.

[Explanation] The amount of time to wait can be set from 0.0 to 999.9 seconds in increments of 0.1 seconds.

[Key operation]



STEP 1 Press [TIM 6] key, and the NOP will change to TIM. Then, press [ENT] .



STEP 2 Enter the wait period (in seconds) with the numeric keypad and press [ENT] . (Input range: 0 to 999.9)

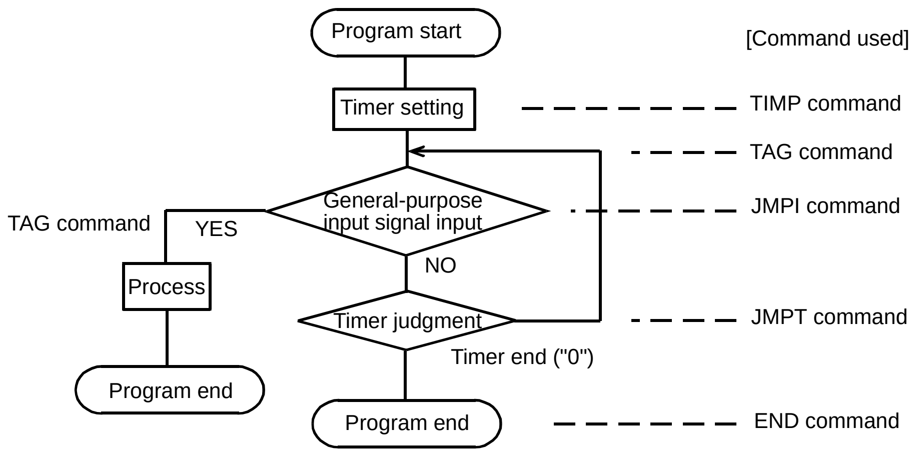
NOTE
- During execution of this command in multitask operation, other tasks are in the ready status and do not proceed to the next step until the preset time has elapsed.

TIMP **Timer Preset Command**

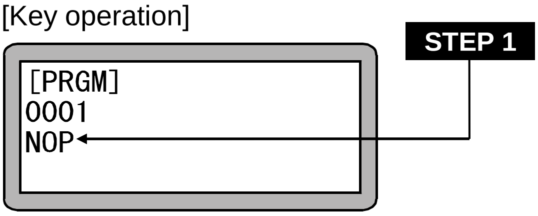
[Function] This command is used to set the initial time value to a specified timer.

[Explanation]

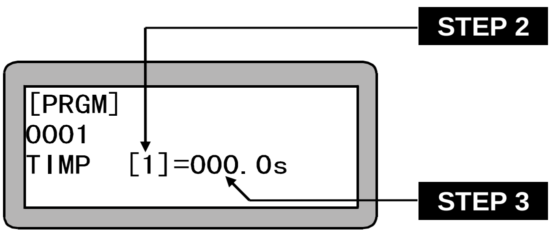
- There are nine timers from No. 1 to No. 9 Initial time value can be set in each timer from 0.0 to 999.9 seconds in increments of 0.1 second.
- After the time is set, the timer begins counting to 0. Program execution, however, proceeds to the following steps independently of the count down.
- This command is used together with JMPT and CALT.
- A usage example is shown below.
  The program waits the specified time for the general-purpose input signal input from an external source. If there is an input signal, it is processed. If there is no signal input within the designated time, the program is ended.



[Key operation]



Press TIM/6 key twice, and the NOP will change to TIMP.
Then, press ENT .



Enter the timer No. with the numeric keypad and press ENT . (Input range: 1 to 9.)

Enter the preset value (initial value) with the numeric keypad and press ENT .
(Input range: 0.0 to 999.9.)

TRSA Task Restart

[Function] The designated task is restarted.

[Explanation]
- The task that was started and then stopped with the STOP command or TSTO command will enter the ready state again.
- If this command is executed to a task that has not been started once, an error will occur.

[Key operation]

STEP 1 Press [F1] and then [OUT 2] and [JMP 5] in order. NOP changes to TRSA.

```
[PRGM]
0001
NOP
```

STEP 2 Enter the task No. with the numeric keypad and press. (Input range: 2 to 4)

```
[PRGM]
0001
TRSA   02
```

TSTO Task Temporary Stop

[Function] The designated task is stopped temporarily.

[Explanation] The designated task will be set in the same state as when that task executes the STOP command.

[Key operation]

```
[PRGM]
0001
NOP
```

STEP 1 Press [F1] and then [OUT/2] and [CAL/4] in order. NOP changes to TSTO.

```
[PRGM]
0001
TSTO   01
```

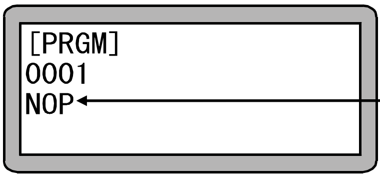
STEP 2 Enter the task No. with the numeric keypad and press [ENT]. (Input range: 1 to 4)

TSTR **Task Start**

[Function] The designated task is started.

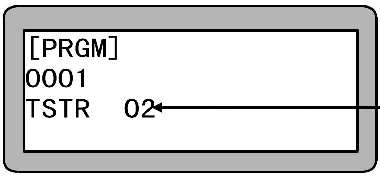
[Explanation] When this command is executed, the designated task will enter the ready state.
Task 1 will start from the Teach Pendant or system input start, so it will not start with this command.

[Key operation]



STEP 1

Press F1 and then OUT 2 and CNT 3 in order.
NOP changes to TSTR.



STEP 2

Enter the task No. with the numeric keypad and press ENT. (Input range: 2 to 4)

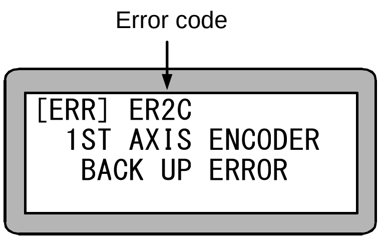
Chapter 20 Error Messages

- When an error is generated, the ERROR LED (red) on the front panel of the controller will light and flicker the Teach Pendant will display error messages.
- If an error occurs during multitasking, the Teach Pendant display will automatically change to the task in which an error occurred, and an error message will display.
- There are two ways to clear an error.
  When an error cannot be cleared, the power must be turned off and then on again.

1. Teach Pendant clear	Press CLEAR on the Teach Pendant.
2. System input clear	Perform a reset input. (Set pin number 24 to ON.)
3. CC-Link clear	Perform a reset input. (Set RYn3 to ON.)(*1)
4. DeviceNet clear	Perform a reset input. (Set the start device+3 to ON.)(*2)

*1: n: Address assigned to the master unit by the station number setting
*2: +3: Offset amount from the start device (unit: bits)

■ 20.1 Error Display



When an error occurs, the error code and error message are displayed on the teach pendant. Check the meaning and cause of the error from the error list, and perform the remedy.

- When multiple errors occur, the error that was detected first is displayed.
  Although all errors are cleared by the error clear procedure, if these errors include an error that cannot be cleared, that error will be displayed, and the power must be turned off and then on again.

■ 20.2 Error history display

The latest 99 errors (including power ON records) can be displayed.

```
[RUN]   F1:AUTO/STEP
 HELP   F2:OVERRIDE
        F3:RESET
        F4:PAGE
```

STEP 1 In the RUN mode, press the HELP key to display the screen shown at the left. Then press the F4 key.

? In the external point designation mode, "AUTO/STEP" display does not appear.

```
[RUN]   F1:MONITOR
        F2:OPTION
        F3:T/P ON
        F4:T/P OFF
```

STEP 2 Then press the F2 key.
To return to the RUN mode, press the ESC key.

```
[OPT]  F1:SYNC.UTL.
       F2:FIELD BUS
       F3:ERR.HISTORY
       F4:
```

STEP 3 Then press the F3 key.
To return to the STEP 2, press the ESC key.

```
[ERR]HISTORY    H M S
01 ER62AL***  0000605
02 ER13AL***  0000236
03 *********  *******
```

STEP 4 The error history screen appears. Error codes and elapsed time from turning ON of the power are displayed. ("********* *******" represents turning ON of the power.)
Press the F1 key to proceed to the STEP 5A.
Press the F2 key to proceed to the STEP 5B.
To scroll the error history, press the NEXT key or the -NEXT key.
Press the SEARCH key and enter an error history No. to jump to the error history.
To return to the STEP 3, press the ESC key.

```
[ERR] ER62
EXECUTION IMPOSSIBLE
```

STEP 5A The name of the error code displayed in the second line of the error history screen of the STEP 4 appears.
To return to the STEP 4, press the [ESC] key.

```
[CLR]
  ERROR HISTORY
            CLEAR ?
    YES:ENT   NO:ESC
```

STEP 5B The confirmation screen of clearing the error history appears.
To clear all the error history, press the [ENT] key.
To return to the STEP 4, press the [ESC] key.

? The error codes ER02, ER14, ER80, and ERB8 are not recorded in the error history.

■ 20.3 Error Table

No.	Error name	Meaning/Cause	Remedy	State
ER02	Incompatible controller	An incompatible type of T/P was connected to the controller.	Check the T/P and controller model, and use the correct type.	L-*G-N
ER12	Watchdog timer error	The CPU is being overloaded.	Turn the power off and then on again. The CPU may be overloaded due to noise. Refer to section 2.4.3 for measures for reducing and preventing noise. * The error cannot be cleared by CLEAR or a reset. The power must be turned off and on again.	F-R-1
ER13	Emergency stop	The emergency stop switch or emergency stop input was activated.	Clear the emergency stop switch or emergency stop input.	F-R-1
ER20	Axis 1 communication error	An error occurred in communication with the slave unit.	Check if the link cable is disconnected, has a bad contact, or a broken wire. Also, check that the power supply is operating normally. * The error cannot be cleared by CLEAR or a reset. The power must be turned off and on again.	F-R-1
ER30	Axis 2 communication error			
ER40	Axis 3 communication error			
ER50	Axis 4 communication error			
ER21	Axis 1 overspeed error	The motor speed is abnormally high	Check if the maximum speed setting is within the specification range.	F-R-1
ER31	Axis 2 overspeed error			
ER41	Axis 3 overspeed error			
ER51	Axis 4 overspeed error			
ER22	Axis 1 overcurrent error	A driver error occurred due to a low voltage, excessive current, or driver overheating.	Check if the input current has fallen below -10% of the voltage setting, the transportable weight has been exceeded, the robot has contacted the mechanical stopper, the robot has contacted a foreign object, or the controller cable has a short-circuit or ground fault.	F-R-1
ER32	Axis 2 overcurrent error			
ER42	Axis 3 overcurrent error			
ER52	Axis 4 overcurrent error			
ER23	Axis 1 overload error	The motor load is large, or a current exceeding the rated current has flowed continuously. The power line or the brake line is breaking (unconnected).	Check if the transportable weight has been exceeded, the robot has contacted the mechanical stopper, the robot has contacted a foreign object, or the power line or the brake line has a broken wire.	F-R-1
ER33	Axis 2 overload error			
ER43	Axis 3 overload error			
ER53	Axis 4 overload error			
ER24	Axis 1 overflow	The motor could not perform tracking for the command. The power line or the brake line is breaking (unconnected).	Check if the overflow data value is set correctly, the acceleration/deceleration time is normal, the transportable weight has been exceeded, the robot has contacted the mechanical stopper, the robot has contacted a foreign object, or the power line or the brake line has a broken wire.	F-R-1
ER34	Axis 2 overflow			
ER44	Axis 3 overflow			
ER54	Axis 4 overflow			

No.	Error name	Meaning/Cause	Remedy	State
ER25	Axis 1 BS servo amplifier alarm	An alarm occurred in the BS servo amplifier.	Implement the proper remedy based on the BS Alarm Table (refer to section 20.4).	-
ER35	Axis 2 BS servo amplifier alarm			
ER45	Axis 3 BS servo amplifier alarm			
ER55	Axis 4 BS servo amplifier alarm			
ER26	Axis 1 encoder error	The encoder signal line has a disconnected connector, broken wire, bad contact, or faulty encoder. The setting of return to origin speed or the adjustment of return to origin position are incorrect.	Check if the encoder signal line connector is connected securely and if there is a bad contact or broken wire in the cable. Set return to origin speed or adjust return to origin position. * The error cannot be cleared by CLEAR or a reset. The power must be turned off and on again.	F-R-1
ER36	Axis 2 encoder error			
ER46	Axis 3 encoder error			
ER56	Axis 4 encoder error			
ER27	Axis 1 home positioning error	Origin sensor signal status has not changed after moving 20mm from the sensor detection condition.	Check if the origin sensor signal line connector is connected securely and if there is a bad contact or broken wire in the cable. Check if the origin sensor working ON/OFF correctly	F-R-1
ER37	Axis 2 home positioning error			
ER47	Axis 3 home positioning error			
ER57	Axis 4 home positioning error			
ER28	Axis 1 + soft limit exceeded (during execution)	The designated coordinate value has exceeded the soft limit positive value. This was detected during program execution.	Check the soft limit positive value and the program.	F-R-1
ER38	Axis 2 + soft limit exceeded (during execution)			
ER48	Axis 3 + soft limit exceeded (during execution)			
ER58	Axis 4 + soft limit exceeded (during execution)			
ER29	Axis 1 - soft limit exceeded (during execution)	The designated coordinate value has exceeded the soft limit negative value. This was detected during program execution.	Check the soft limit negative value and the program.	F-R-1
ER39	Axis 2 - soft limit exceeded (during execution)			
ER49	Axis 3 - soft limit exceeded (during execution)			
ER59	Axis 4 - soft limit exceeded (during execution)			
ER2A	Axis 1 overvoltage error	The main power has risen to an abnormally high level (rise in power supply voltage or regenerative voltage).	Check if the input voltage is within +10% of the voltage setting, or the transportable weight has been exceeded.	F-R-1
ER3A	Axis 2 overvoltage error			
ER4A	Axis 3 overvoltage error			
ER5A	Axis 4 overvoltage error			

No.	Error name	Meaning/Cause	Remedy	State
ER2B	Axis 1 motor overheat error	The temperature in the encoder exceeds 90°C	Check if the acceleration/deceleration time is normal, the transportable weight has been exceeded, the robot has contacted the mechanical stopper, or the robot has contacted a foreign object.	F-R-1
ER3B	Axis 2 motor overheat error			
ER4B	Axis 3 motor overheat error			
ER5B	Axis 4 motor overheat error			
ER2C	Axis 1 encoder backup error	The absolute counter value of the encoder could not be backed up normally. This error also occurs if the encoder connector is temporarily disconnected during backup.	Check if the voltage of the backup power supply (such as the battery) is less than 3.6 V. After this error occurs, the return to origin operation must be performed before executing any axis operations.	F-R-1
ER3C	Axis 2 encoder backup error			
ER4C	Axis 3 encoder backup error			
ER5C	Axis 4 encoder backup error			
ER2D	Axis 1 encoder switching error	During backup, the robot was subjected to a sudden acceleration, and the encoder motion could not be tracked.	Check if the axis unit was stopped during high-speed movement, collided with the axis end or other component, and has rebounded. Also, check if the axis unit has been subjected to a sudden acceleration by an external force when the power was turned off. If an error has occurred because of rebound acceleration due to a collision, cushioning materials can be installed at the collision location to reduce the rebound acceleration. * The error cannot be cleared by CLEAR or a reset. The power must be turned off and on again.	F-R-1
ER3D	Axis 2 encoder switching error			
ER4D	Axis 3 encoder switching error			
ER5D	Axis 4 encoder switching error			
ER2F	Axis 1 driver error	The interlock function related to the brake operated.	Please contact a detailed usage condition to out sales department. * The error cannot be cleared by CLEAR or a reset. The power must be turned off and on again.	F-R-1
ER3F	Axis 2 driver error			
ER4F	Axis 3 driver error			
ER5F	Axis 4 driver error			
ER60	Continuous execution failure	This equipment is in a state where continuous execution cannot be performed. (The power was during off during program execution (during operation).)	Set the continuous start input to OFF, and then turn the power off and then on again. After the power is turned off, continuous restart is enabled only when program execution is stopped or the power was turned off. * The error cannot be cleared by CLEAR or a reset. The power must be turned off and on again.	F-R-1
ER61	Return to origin incomplete	An axis-related command was executed (sequential) or started while return to origin operation had not been performed after an encoder-related error occurred or after a synchronized axes search.	Perform return to origin operation.	F-R-1

No.	Error name	Meaning/Cause	Remedy	State
ER62	Unexecutable	• The stop input is ON, or a start or return to origin was performed in a servo free state. • A palletizing command (MVM, LOOP, MINI), circular interpolation command (MVC, MVCP), or palletizing mode operation was executed when using the synchronized axes function	• After clearing the error, check that the stop input of system input is not set to ON. Also, if the servo is turned off, turn on the servo. • Do not use the commands on the left when using the synchronized axes function (or do not perform the operation on the left).	F-R-1
ER64	Synchronized axes origin search incomplete	This error occurs if one of the operations below is performed without performing the synchronized axes origin search operation or after an origin search was aborted (such as by an error). • When an axis operation command was executed • When an external point designation mode operation was used • When an easy mode operation was used • When the return to origin operation was performed	Be sure to always execute an origin search after the following operations. • After modifying "K26: Synchronized Axes Setting" parameter • After modifying the "K14: Lead" parameter of an axis set as a synchronized axis • After modifying the "K05: Motor Rotation Direction" parameter of an axis set as a synchronized axis • After modifying the robot type	L-R-1
ER65	Excessive synchronization error	• The position error of the drive axis and driven axis that occurs during synchronization operation has exceeded "Parameter 1 P18: Synchronized error allowable value". (This error does not occur until the return to origin is completed.) • The origin sensor for one axis was turned off when return to origin was completed.	Perform positioning manually from the drive axis to the driven axis, and then clear this error.	F-R-1
ER66	Synchronized axes parameter error	The synchronized axes search or return to origin was performed when the "K26: Synchronized Axes Setting" parameter was set for a nonexistent axis.	Set this parameter only for axes that actually exist.	L-R-1
ER67	Synchronized axes origin search error	• The origin sensor for one axis is turned off after the synchronized axes origin search is completed. • The synchronized axes offset that was measured by the synchronized axes origin search exceeds one-quarter rotation of the motor.	• Perform positioning manually from the drive axis to the driven axis, and then perform the origin search again. • Review the axis installation state (installation error).	L-R-1

No.	Error name	Meaning/Cause	Remedy	State
EP80	TP communication error	Communication cannot be established using the teach pendant or RS-232C cable.	Check if the connector is connected securely, there is a bad contact, or the cable has a broken wire. *The error cannot be cleared by CLEAR or a reset. The power must be turned off and on again.	F-R-1
ER90	ID error	The contents of the backup memory were corrupted by noise, fluctuations in the supply voltage, or other cause.	Clear the error. All the programs and parameters are initialized, and so re-enter the programs and parameters.	F-R-1
ER91	Sequential program memory error	The contents of the sequential program were corrupted by noise, fluctuations in the supply voltage, or other cause.	The error step number is displayed on the screen, and so check the program. If errors occurred in multiple locations, another error step number is displayed when an error is cleared.	F-R-1
ER92	Palletizing program memory error	The contents of the palletizing program were corrupted by noise, fluctuations in the supply voltage, or other cause.	The program number and screen number where the error occurred are displayed on the screen. (Program number – Screen number) If errors occurred in multiple locations, the program number and screen number for another error are displayed when an error is cleared.	F-R-1
ER93	Parameter memory error	The contents of the parameters were corrupted by noise, fluctuations in the supply voltage, or other cause.	Check the parameters.	F-R-1
ER94	Coordinate table memory error	The contents of the coordinate table were corrupted by noise, fluctuations in the supply voltage, or other cause.	The error table number is displayed on the screen, and so check the coordinate table. If errors occurred in multiple locations, another error table number is displayed when an error is cleared.	F-R-1
ER95	Speed table memory error	The contents of the speed table were corrupted by noise, fluctuations in the supply voltage, or other cause.	The error table number is displayed on the screen, and so check the speed table. If errors occurred in multiple locations, another error table number is displayed when an error is cleared.	F-R-1
ER96	Acceleration/deceleration table memory error	The contents of the acceleration/deceleration table were corrupted by noise, fluctuations in the supply voltage, or other cause.	The error table number is displayed on the screen, and so check the acceleration/deceleration table. If errors occurred in multiple locations, another error table number is displayed when an error is cleared.	F-R-1
ER97	MVM table memory error	The contents of the MVM table were corrupted by noise, fluctuations in the supply voltage, or other cause.	The error table number is displayed on the screen, and so check the MVM table. If errors occurred in multiple locations, another error table number is displayed when an error is cleared.	F-R-1
ER98	Easy program memory error	The contents of the easy program were corrupted by noise, fluctuations in the supply voltage, or other cause.	The error step number is displayed on the screen, and so check the program. If errors occurred in multiple locations, another error step number is displayed when an error is cleared.	F-R-1

No.	Error name	Meaning/Cause	Remedy	State
ERA0	Command error (impossible command)	The program tried to execute an impossible command.	Check the program.	F-R-1
ERA1	Tag undefined	An undefined tag number was found in a jump, call, BRAC, PSEL, or tag number search.	Check the program.	F-R-1
ERA2	Tag duplicate definition	A tag number was double-defined.	Correct the tag number.	F-R-1
ERA3	Stack overflow	Nesting was performed more than 10 times in the CAL system command.	Check the program.	F-R-1
ERA4	Stack underflow	An extra RET command was executed in the relationship between the CAL system commands and RET commands.	Check the program.	F-R-1
ERA5	Not enough circular interpolation data	The circular interpolation commands (MVC and MVCP commands) are not paired.	Check the program.	F-R-1
ERA6	Circular interpolation radius oversize	The radius based on the circular interpolation commands (MVC and MVCP commands) exceeds 8388.607 mm (maximum value).	Check the program.	F-R-1
ERA7	Calculation error	Calculation cannot be performed based on the movement commands.	Check the program.	F-R-1
ERA8	Parameter error	Command and other parameters are invalid. The OUTS command is set to 65 or higher.	Check the program.	F-R-1
ERB0	Step number error	A program was executed that exceeded the number of task steps (refer to section 14.4.22) setting. In easy mode, a program was executed that went past the final step. In external point designation mode, the program selection input bit was not designated for the mode designation.	Check the program. In external point designation mode, designate the program selection input bit.	F-R-1
ERB1	Tag number error	The tag number is outside the range.	Check the program.	F-R-1
ERB8	Robot number error	The robot type is outside the range.	Set the correct robot type.	L-G-0

No.	Error name	Meaning/Cause	Remedy	State
ERC0	Axis 1 + soft limit exceeded	The designated coordinate value has exceeded the soft limit positive value.	Check the axis 1 soft limit positive value and the program.	F-R-1
ERC1	Axis 1 - soft limit exceeded	The designated coordinate value has exceeded the soft limit negative value.	Check the axis 1 soft limit negative value and the program.	F-R-1
ERC2	Axis 2 + soft limit exceeded	The designated coordinate value has exceeded the soft limit positive value.	Check the axis 2 soft limit positive value and the program.	F-R-1
ERC3	Axis 2 + soft limit exceeded	The designated coordinate value has exceeded the soft limit negative value.	Check the axis 2 soft limit negative value and the program.	F-R-1
ERC4	Axis 3 + soft limit exceeded	The designated coordinate value has exceeded the soft limit positive value.	Check the axis 3 soft limit positive value and the program.	F-R-1
ERC5	Axis 3 - soft limit exceeded	The designated coordinate value has exceeded the soft limit negative value.	Check the axis 3 soft limit negative value and the program.	F-R-1
ERC6	Axis 4 + soft limit exceeded	The designated coordinate value has exceeded the soft limit positive value.	Check the axis 4 soft limit positive value and the program.	F-R-1
ERC7	Axis 4 - soft limit exceeded	The designated coordinate value has exceeded the soft limit negative value.	Check the axis 1 soft limit negative value and the program.	F-R-1
ERE0	Other errors	This indicates other errors		F-R-1

- The state column refers to the state of the controller when an error occurs (servo LED error output).
  - Servo state L: Lock, F: Free
  - LED state R: Lit red, *R: Flashing red, G: Lit green
  - Error output 0: OFF, 1: ON

■ 20.4 BS Alarm Table

No.	Alarm	Detection method	Cause/Remedy	State
AL01	Overcurrent	One of the errors below was detected in the IPM of the power supply unit. (1) Overcurrent (2) Overheating (3) Low gate power supply	Possible causes include: (1) A short-circuit or ground fault occurred in the armature line (U, V, W). (2) The ambient temperature exceeds 55°C.	F-R-1
AL02	Overvoltage	The main circuit DC power supply (PN voltage) exceeds 400 V DC.	(1) The motor is running at higher than the maximum rotation speed. (2) An overshoot exceeding the maximum rotation speed occurred during acceleration. (3) JP1 or JP2 are disconnected, or absorption resistor is either disconnected or has a broken wire. (4) The input power supply exceeds the stipulated values.	F-R-1
AL03	PN voltage drop	The main circuit DC power supply (PN voltage) is less than 170 V DC	(1) A voltage drop occurred in the input power supply. (2) The T-phase of the input power supply is missing (for 070 to 200P). (3) If this occurs during motor acceleration, the input power supply may not have sufficient capacity.	F-R-1
AL04	Main power supply input error	Main power supply (AC) input voltage drop	(1) When the main power supply was turned on, the electrolytic capacity is not charged properly. (2) The main power supply was cut off during operation.	F-R-1
AL05	Charging resistor overheat	Overheating of charging resistor for inrush current prevention	BS servo amplifier fault	F-R-1
AL06	Disconnected resolver wire	The voltage of the resolver signal (between R1 and R2) is less than 0.35 V (AC).	Check if the resolver cable has a broken wire. Measure the voltage between R1 and R2. (A value of 0.35 V or higher is normal in the AC range.) * The error cannot be cleared by CLEAR or a reset. The power must be turned off and on again.	F-R-1
AL07	Power status error	This occurs when the CPU cannot identify the amplifier model.	Possible causes include: (1) The CPU software version and unit configuration do not match. (2) The amplifier is faulty.	F-R-1
AL08	Servo amplifier overheat	The heat-dissipating fin temperature exceeds the 90 to 100°C range.	(1) The temperature in the control panel has risen. (2) The cooling fans in the amplifier are faulty.	F-R-1

No.	Alarm	Detection method	Cause/Remedy	State
AL09	Reverse-current absorption resistor overheat	Overheating of the reverse-current resistor inside the amplifier was detected by software calculation.	The frequency of acceleration/deceleration may be too high, or there may be a continuous absorption operation (negative load). Calculate the reverse-current energy, and install an external reverse-current absorption resistor, or increase the capacity.	F-R-1
AL10	Reverse-current absorption error	The transistor for reverse-current absorption was ON for more than 100 ms.	(1) If an external resistor is not being used, check if there is a short circuit between JP1 and JP2 on the terminal block. (2) If an external resistor is being used, turn off the power, and check the resistance between PA and JP2 on the terminal block. It is normal if it is between 6 and 30Ω. If it exceeds this range, there may be a broken wire in the resistor, and the resistor must be replaced.	F-R-1
AL11	Undefined function			F-R-1
AL12	DSP error	The DSP was stopped.	Amplifier fault	F-R-1
AL13	ABS battery voltage drop	The battery voltage is less than 3.4 V	Replace the battery. If AL24 did not occur, the origin remains stored in the memory.	F-R-1
AL14	Brake error	(1) Dynamic brake: The brake confirmation signal was not input even though brake output was ON. (2) Holding brake: The brake confirmation signal remained input even though brake output was ON.	Refer to the dynamic brake and holding brake connections, and check the wiring and the parts used.	F-R-1
AL15	Overcurrent detection	The motor current exceeds 120% of the current limit value.	(1) A lock was applied by the mechanical system during motor rotation. (2) A short-circuit or ground fault occurred in the U, V, or W phases of the motor. (3) The parameter UP-02 (applicable motor) setting is incorrect.	F-R-1
AL16	Speed amplifier saturation	The speed amplifier is saturated, and the motor maximum current flowed for three seconds or longer.	(1) The motor was locked by the mechanical system. (2) The load inertia is too large for the acceleration/deceleration. (3) The parameter UP-02 (applicable motor) setting is incorrect.	F-R-1

No.	Alarm	Detection method	Cause/Remedy	State
AL17	Motor overload	The motor temperature rise calculated by the actual load exceeded 110%.	(1) The load is too heavy for the motor output. (2) The operation cycle is too short for the motor capacity. (3) The parameter UP-02 (applicable motor) setting is incorrect.	F-R-1
		After removing the cause of the alarm, wait until the motor temperature has fully cooled before restarting operation.		F-R-1
AL18	Instant thermal	Operation was performed at a current of 120% or higher of the motor rated current.	(1) The motor was locked by the mechanical system. (2) The load is too heavy for the motor output. (3) The parameter UP-02 (applicable motor) setting is incorrect.	F-R-1
AL19	Resolver phase error	A counting error occurred in the resolver feedback counter.	(1) There is a bad contact in the resolver cable. (2) The resolver cable is near a power cable and is affected by the noise. Check the resolver cable. (3) The ground wire between the motor and amplifier is disconnected. * The error cannot be cleared by CLEAR or a reset. The power must be turned off and on again.	F-R-1
AL20	Overspeed	The speed exceeds 120% of the maximum speed setting.	(1) The servo adjustment is not suitable, and overshooting occurs. Perform auto-tuning. (2) The program contains an out-of-range command. (3) There is a bad contact in the resolver cable. (4) The resolver cable is near a power cable and is affected by the noise. (5) The ground wire between the motor and amplifier is disconnected.	F-R-1
AL21	Deviation counter exceeded	The residual pulse of the deviation counter has exceeded the detection levels below. Detection level $\frac{\text{Motor maximum rotation speedi}}{60} \times \frac{\text{Number of divisons for sensor}}{\text{TP2}} \times 10$ Example: Maximum rotation speed of 2000 min^{-1}, Motor sensor: Resolver Target loop gain TP-02=60 Detection level $\frac{2000}{60} \times \frac{24000}{60} \times 10 = 133000$(pulse)	(1) The load is too heavy for the motor output. (2) The load inertia is too large for the acceleration/deceleration. (3) TP02 (target loop gain) is too high. (4) The current limit is too low.	F-R-1

No.	Alarm	Detection method	Cause/Remedy	State
AL22	Resolver ABS phase error	A phase misalignment occurred in the ABS sensor.	Phase adjustment or replacement of the ABS sensor is necessary. * The error cannot be cleared by CLEAR or a reset. The power must be turned off and on again.	F-R-1
AL23	Resolver ABS disconnected wire	The ABS cable is disconnected, or the +10 or CTD signal wires are broken.	The alarm occurs when the ABS cable is disconnected when the power is off. If a cable is disconnected, such as when moving this equipment, the absolute setting must be made again. * The error cannot be cleared by CLEAR or a reset. The power must be turned off and on again.	F-R-1
AL24	ABS battery system	The ABS battery voltage is less than 3.2 V.	Replace the ABS battery as soon as possible. The origin is no longer saved in memory. After this error occurs, perform the return to origin operation before executing axis operation.	F-R-1
AL25	Option alarm	Option board alarm	Fault in option board	F-R-1
AL26	Parameter setting error	The parameters UP-01 (control mode) or UP-02 (applicable motor) is not set, or the settings are incorrect.	This occurs when power is turned on the first time. Set UP-01 and UP-02, turn off the power, check that the display unit is off, and then turn on the power again.	F-R-1
AL27	Resolver ABS error	When the power was on, the CHA or CHB signal was forced to ON, but it remained OFF due to a broken wire or other cause.	(1) There is a broken wire in the ABS cable. (2) There is a bad contact in the connector. Check the conductivity of the CTD, CHA, and CHB signals. * The error cannot be cleared by CLEAR or a reset. The power must be turned off and on again.	F-R-1
AL28	Link error	Communication error with amplifier axes	Check the communication state.	F-R-1
AL29	Command value exceeded	The command value has exceeded $\pm 2^{31}$ pulses.	Check the settings for the minimum setting unit, pulses per minimum setting unit, and other parameters.	F-R-1
AL30	Current value exceeded	The current value has exceeded $\pm 2^{31}$ pulses.	Check the settings for the minimum setting unit, pulses per minimum setting unit, and other parameters.	F-R-1
AL31	Undefined function			F-R-1

No.	Alarm	Detection method	Cause/Remedy	State
AL32	Origin not stored error	(1) When using resolver ABS: The ABS was not set in the ABS motor. This occurs at the same time with AL06, AL19, AL22, AL23, and AL27. (2) When using encoder: This occurs at the same time with AL42, AL43, and AL45.	For ABS motor, AL32 always occurs in the default settings. Clear the error, and perform the return to origin operation.	F-R-1
AL33	ABS origin invalid	This occurs if ABS is not set by following the procedure in the figure at right when AL06, AL19, AL22, AL23, or AL27 has occurred.		F-R-1
AL34	+ soft limit exceeded	This occurs when there is a movement command that exceeds the positive-side soft limit that was set by the parameter. (This is valid only when the origin is stored in memory.)	After resetting the alarm, use jog feeding to move away from the soft limit.	F-R-1
AL35	- soft limit exceeded	This occurs when there is a movement command that exceeds the negative-side soft limit that was set by the parameter. (This is valid only when the origin is stored in memory.)		F-R-1
AL36	ABS battery cable disconnected wire	The ABS battery is disconnected when the power is off.	Check if a battery cable connector is disconnected or if the cable has a broken wire.	F-R-1
AL37	Undefined function			F-R-1
AL38	Overrun	The stroke end limit in the movement direction was exceeded.	Reset the alarm, and use jog feeding to move away from the limit.	F-R-1
AL39	Undefined function			
AL40	Encoder disconnected wire	The differential signal from the encoder is disconnected.	(1) There is a broken wire in the encoder cable. (2) There is a bad contact in the connector. * The error cannot be cleared by CLEAR or a reset. The power must be turned off and on again.	F-R-1
AL41	Encoder communication error	Communication with the encoder could not be established.	(1) There is a broken wire in the encoder cable. (2) There is a bad contact in the connector. * The error cannot be cleared by CLEAR or a reset. The power must be turned off and on again.	F-R-1

No.	Alarm	Detection method	Cause/Remedy	State
AL42	Encoder backup error	The encoder battery voltage dropped, and the ABS coordinates were lost.	(1) The encoder battery voltage dropped below 2.5 V. (2) A battery cable is disconnected. (3) There is a bad contact in the connector of the encoder cable. * The error cannot be cleared by CLEAR or a reset. The power must be turned off and on again.	F-R-1
AL43	Encoder checksum error	Checksum error	This is not detected in the 17-bit serial ABS encoder. * The error cannot be cleared by CLEAR or a reset. The power must be turned off and on again.	F-R-1
AL44	Encoder battery alarm	The encoder battery voltage has dropped.	The battery voltage is less than 3.1 V. Replace the battery.	F-R-1
AL45	Encoder ABS phase error	An encoder position data error was detected.	If this alarm occurs frequently, the encoder may be faulty. * The error cannot be cleared by CLEAR or a reset. The power must be turned off and on again.	F-R-1
AL46	Encoder overspeed	The encoder was detected with a rotational speed of 6000 min^{-1}. This is also detected when the power is cut off.	(1) An out-of-range command was input. (2) Check the mechanical system. * The error cannot be cleared by CLEAR or a reset. The power must be turned off and on again.	F-R-1
AL47	Encoder communication error	An error occurred in communication with the encoder.	This is not detected in the 17-bit serial ABS encoder. * The error cannot be cleared by CLEAR or a reset. The power must be turned off and on again.	F-R-1
AL48	Encoder initialization error	The encoder detected an initialization error.	This is not detected in the 17-bit serial ABS encoder. * The error cannot be cleared by CLEAR or a reset. The power must be turned off and on again.	F-R-1
AL49	Encoder sensor phase error	A phase error was detected within one rotation of the sensor.	This is not detected in the 17-bit serial ABS encoder. * The error cannot be cleared by CLEAR or a reset. The power must be turned off and on again.	F-R-1
AL50	Undefined function			F-R-1
AL51	Undefined function			F-R-1
AL52	Undefined function			F-R-1
AL53	Undefined function			F-R-1

No.	Alarm	Detection method	Cause/Remedy	State
AL54	Magnetic pole detection error	This occurs when the initial electrical angle could not be determined in the DC excitation magnetic pole detection or automatic magnetic pole detection. When the OT retract function is used, this also occurs when the OT cannot be retracted.	* The error cannot be cleared by CLEAR or a reset. The power must be turned off and on again.	F-R-1
AL55	Undefined function			F-R-1
AL56	Undefined function			F-R-1
AL57	Undefined function			F-R-1
AL251	PON error	The PON signal is not being input.	The PON signal (BS EMG) is not being input to CN2-2P(IN0).	F-R-1
AL252	Control power supply input trouble	The control power supply voltage drop was detected.	(1) The control power supply was shut off. (2) The control power supply instantly shut down. * The error cannot be cleared by CLEAR or a reset. The power must be turned on and off again.	F-R-1

■ 20.5 Other phenomena

This section describes conditions where Other phenomena occur.

(1) Waiting for establishment of slave communication

Screen display: No error display (Normal screen)

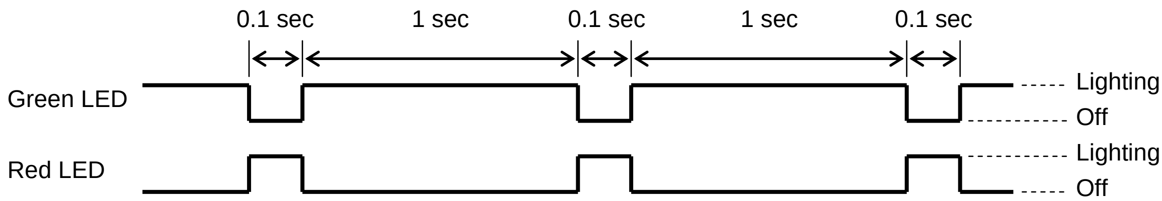
Servo condition: Servo free
Status display LED: Flashing (*1)
System output: ———

Meaning/cause: In the case of a two or more axes specification, power is not supplied to the slave unit.
The link cable is not connected.
The station No. of the slave unit is out of the designated range, or overlapping.
The setting of terminal resistor is wrong.
An incorrect robot type is set.

Remedy: Supply power to the slave unit.
Connect the link cable correctly. (Refer to section ■ 2.4.4 (1))
Set the slave unit station No. setting switch correctly. (Refer to section ■ 2.4.4 (2), ■ 11.4.2 (2))
Set the terminal resistor correctly. (Refer to section ■ 2.4.4 (4))
Set the correct robot type. (Refer to section ■ 2.4.7)

Note: The slave unit to witch communication is not established can be confirmed on the version display (refer to section ■ 18.4).

*1: When waiting for establishment of slave communication, the status display LED is flashing repeatedly at intervals shown below.



(2) Request for power OFF

Screen display: PLEASE POWER OFF !!

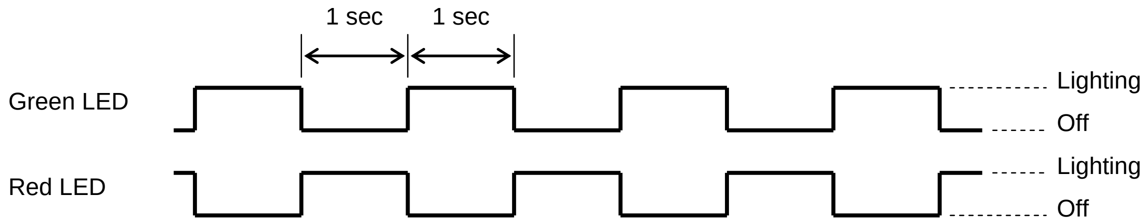
Servo condition: Servo free
Status display LED: Flashing (*2)
System output: ———

Meaning/cause: Request for power OFF when the robot type, the parameter 2 or the parameter 3 is changed.
Request for power OFF when the memory is initialized.
The number of axes is changed.
The slave unit is replaced, or a new slave unit is connected.

Remedy: Turn OFF the power, and then turn ON the power.

Note: When the number of axes is changed or the slave unit is replaced or added, request for power OFF may occur twice.

*2: When request for power OFF, the status display LED is flashing repeatedly at intervals shown below.



Chapter 21 BA-C Series

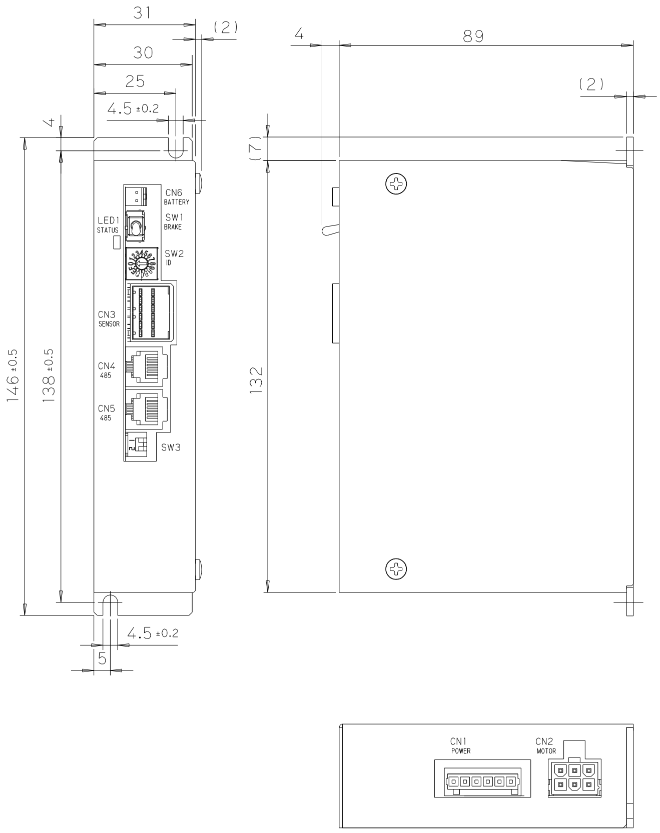
The master unit can be connected with CA01-S05 slave unit of BA-C series. This chapter describes CA01-S05. For the robot type (6-digit number), refer to the instruction manual of the axis unit.

■ 21.1 Specifications

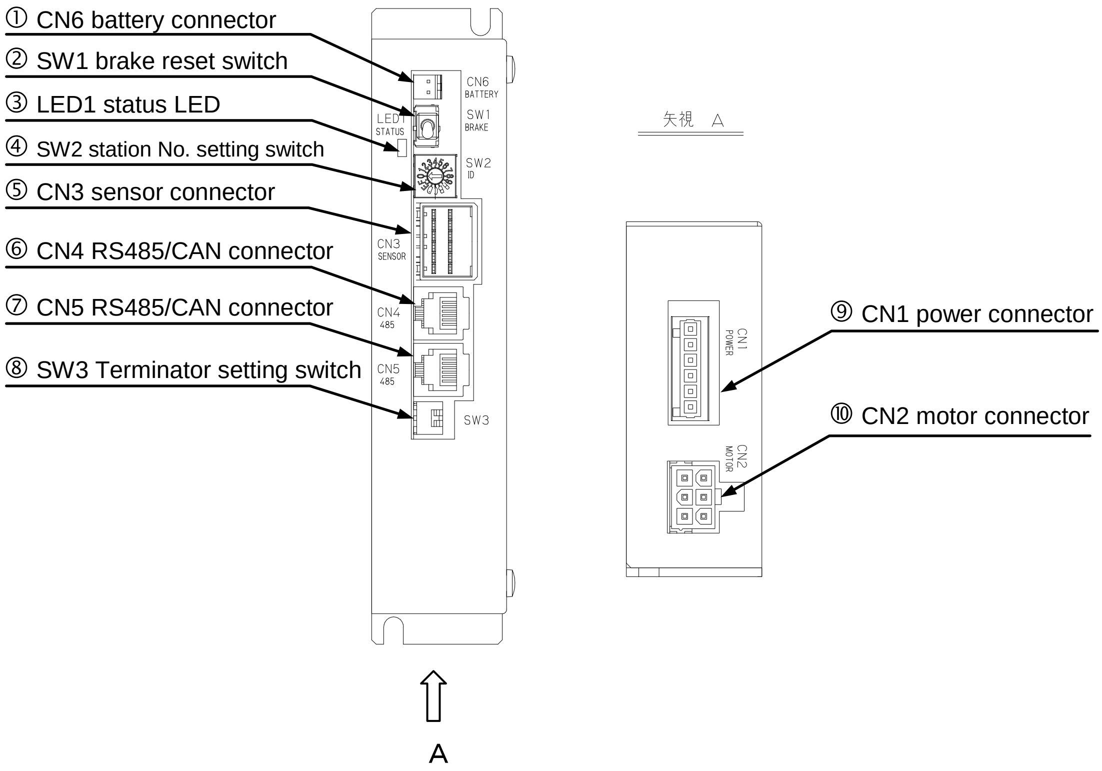
Item	Description		
Applicable robot	Compo Arm BA-C series		
Controller type	CA01-S05		
Number of controllable axes	One axis (with master unit connection)		
Motor capacity	50 W		
Error signal	Error display lamp lights (front panel) Teach pendant (connected to master unit)		
Origin sensor input	Equipped		
Regeneration function	Equipped (with external regenerative resistor mounted)		
Dynamic brake function	Not equipped		
Mechanical brake operation power	24 VDC 0.4 A or less (for non-excitation operation holding brake) The brake can be released forcibly with brake release switch (SW1)		
Protection function	Hardware error	Sensor error, Drive power error, Flash memory error, etc.	
	Software error	Overspeed, Overload, Positional overdeviation, etc.	
	Warning	Battery low voltage	
Status indication	The green LED lights when the power is ON and the red LED lights when an error has occurred.		
Power supply	Control power voltage	24 VDC ±10%	
	Drive power voltage	24 VDC ±10%	
Power capacity (per axis)	Control power capacity	0.25 A	
	Drive power capacity	Depending on axis type. Rated 3 A (Max. 9 A)	
Operation conditions	Working ambient temperature	0 to 40°C	
	Working ambient humidity	90% max. (no condensation)	
	Storage ambient temperature	-10 to 85°C	
	Storage ambient humidity	90% max. (no condensation)	
	Environment	Indoor (not exposed to direct sunlight) 1000 m or less above sea-level No dust, corrosive gas, or flammable gas exists.	
	Vibration / shock	4.9 m/s^2 or less / 19.6 m/s^2 or less	
Dimensions	31(W) × 146(H) × 89(D) (not including screws)		
Weight	Approximately 0.25 kg		

■ 21.2 Explanation of each part

(1) External dimensions



(2) Names and functions of each part



① CN6　Battery connector

This connector is used to connect a backup battery for resolver ABS.
For details on the battery connector, refer to section 21.9.

② SW1　Brake release switch

This momentary switch is used to release the brake forcibly.
While the lever is being lifted, the brake is released forcibly. When the lever is released, the brake control returns to the normal state.

CAUTION When the brake is released forcibly, the workpiece or the hand may drop suddenly and then be damaged or a worker’s hand may be caught. Pay enough attention to safety.

③ LED1　Status LED

This LED displays the status of the controller.

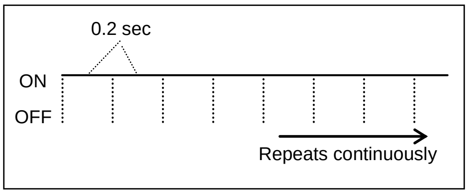
I. Normal mode (SW2 is set to 1 to 4)

Refer to “① Status display LED” in section 2.3.2.

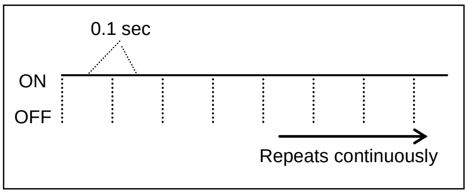
II. Boot mode (SW2 is set to F)

Color	Status	Flashing pattern
Flashing red + green	Boot standby	①
	Boot in progress	②
Solid green	Normal end	–
Solid red	Abnormal end	–

● Flashing pattern ①



● Flashing pattern ②



④ SW2　Station No. setting switch

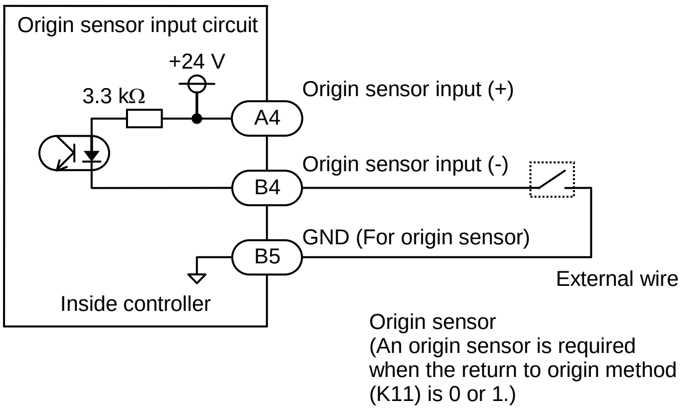
This switch is used to set the station No. of each slave unit when a slave unit is connected and multiple axes are controlled. For updating the firmware, set this switch to "F".

⑤ CN3 Sensor connector

This connector is used to connect the resolver cable.

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

N. C: No Connection

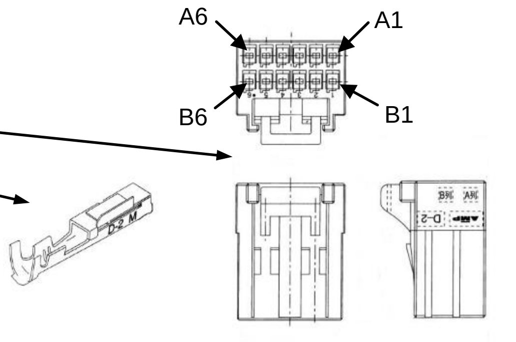


● Cable-side connector model

Receptacle housing 1-1318118-6

Terminal 1318108-1

Manufacturer Tyco Electronics AMP



● Controller-side connector model

Tab header 1376020-1

Manufacturer Tyco Electronics AMP

⑥ CN4 RS485/CAN connector

This connector is used to connect a link cable from an upper controller. For the connecting method, refer to section ■ 21.8.

⑦ CN5 RS485/CAN connector

This connector is used to connect a link cable to a lower controller. For the connecting method, refer to section ■ 21.8.

⑧ SW3 Terminator setting switch

This switch is used to set a terminator for communication. For the setting method, refer to section ■ 21.8.

Bit	Signal name	Remarks
1	Terminator setting	This bit is set to ON for connection of a terminator.
2	N.C	

N. C: No Connection

⑨ CN1 Power connector

This connector is used to input control power and drive power.

Pin No.	Signal name	Remarks	Reference section
1	GND (drive power)	This pin is connected with the pin 3 internally.	Section ■ 21.6
2	24 VDC (drive power)		
3	GND (control power)	This pin is connected with the pin 1 internally.	
4	24 VDC (control power)		
5	PA	This pin is used to connect an external regenerative resistor.	Section ■ 21.10
6	JP1	This pin is used to connect an external regenerative resistor.	

Note For selection of power, refer to section ■ 21.4.

- Part number of cable side connector

  Plug 734-106/037-000

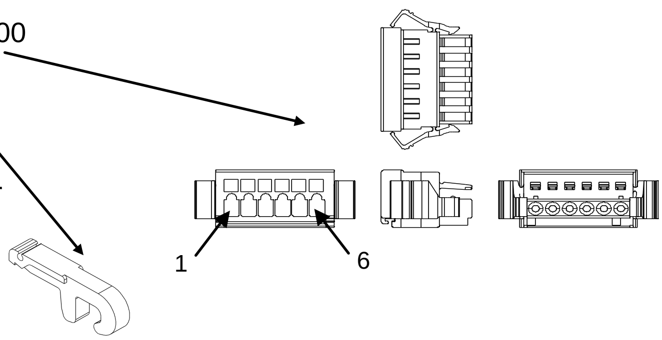
  Connection lever 734-230

  Manufacturer WAGO

- Part number of controller side connector

  Header 734-166

  Manufacturer WAGO



⑩ CN2 Motor connector

This connector is used to connect the motor cable.

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

- Part number of cable side connector

  Receptacle housing 5557-06R

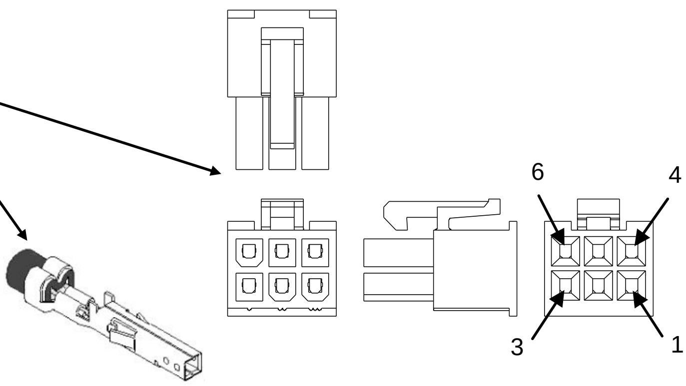
  Terminal 5556TL

  Manufacturer MOLEX

- Part number of controller side connector

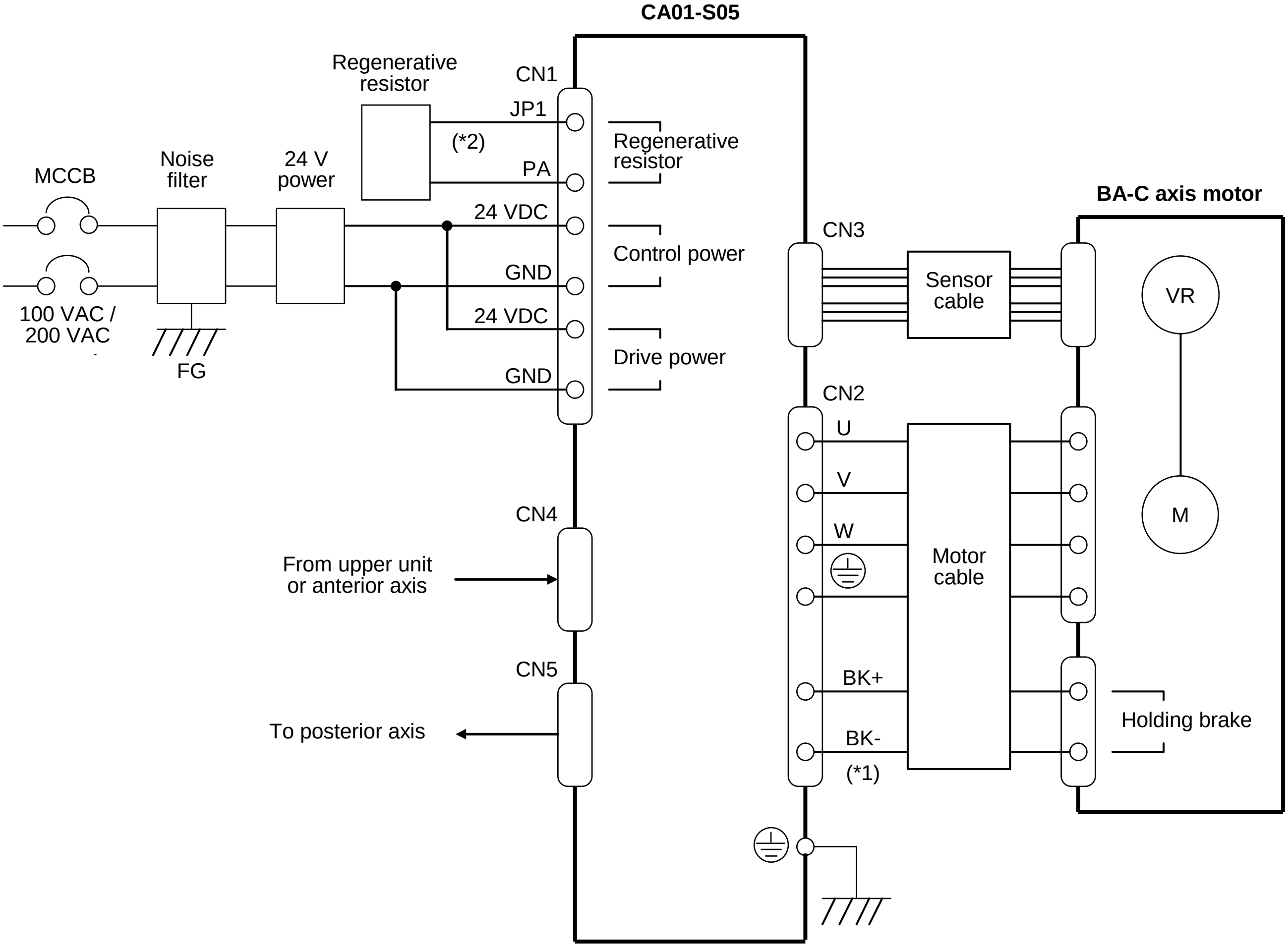
  Header 5569-06A1

  Manufacturer MOLEX



■ 21.3 Wiring

Connect wires to CA01-S05 as shown in the figure below.



*1: Not required to be connected for use of BA-C axis without holding brake

*2: Required to be connected when regenerative energy is large. Refer to section ■ 21.10.

■ 21.4 Selection of power source

Each power capacity of CA01-S05 is shown in the following table.
Note that insufficient drive power may cause troubles including decrease of power output and torque and then the original performance may not be attained.

Power capacity

Power	Voltage	Power capacity	Remarks
Control power	24 VDC ±10%	0.25 A	
Drive power	24 VDC ±10%	3 A	Rated value (max. 9 A)

- When connecting multiple controllers
  When multiple controllers are connected to one power supply, the power supply is required to have power capacity corresponding to the sum of individual controller power capacities.
  When axes do not move simultaneously, however, the power capacity can be reduced depending on their moving patterns.
  Example) Two robots are connected to one power source.
  •Control power: 0.25 A × 2 = 0.50 A or higher
  •Drive power: 9 A × 2 = 18 A or higher (when two robots accelerate or decelerate simultaneously).

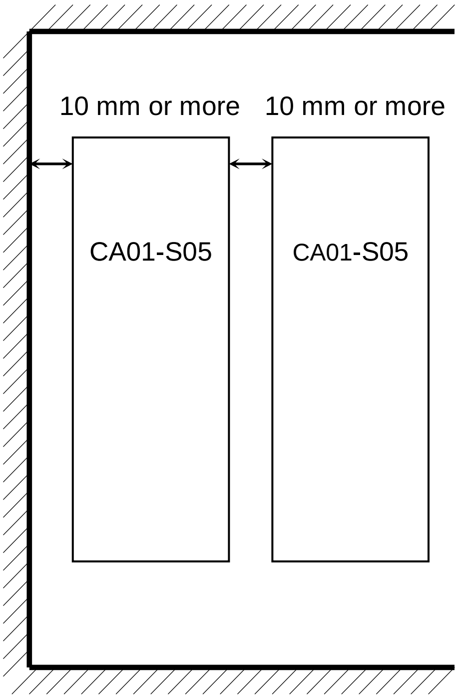
- Regenerative action
  The motor may generate back electromotive force resulting in increase of drive voltage when decelerating suddenly or being rotated by external torque.

■ 21.5 Installation

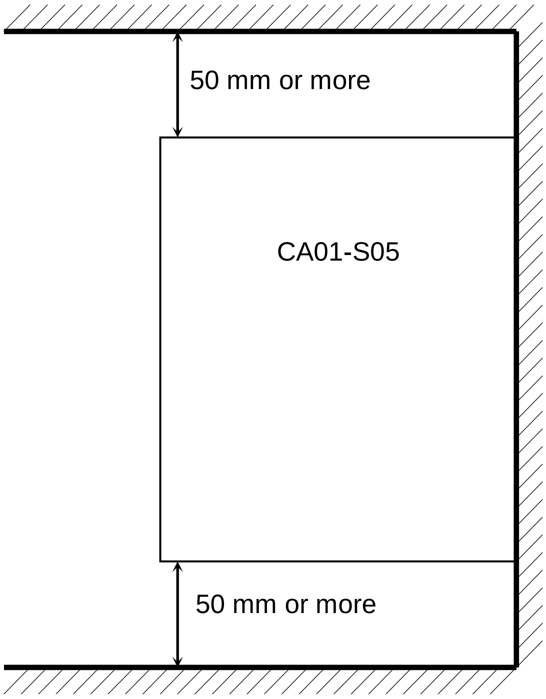
The controller uses a natural cooling method through convection. When installing the controller, place it vertically as shown below, and leave a space of 10 mm or more on the left and right sides and 50 mm or more on the top and bottom sides.
If the ventilation is insufficient, the sufficient performance will not be achieved, and faults could occur.

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

If ambient temperature exceeds +40°C, add a cooling method such as a cooling fan.



Front side



Side surface

■ 21.6 Power supply and ground

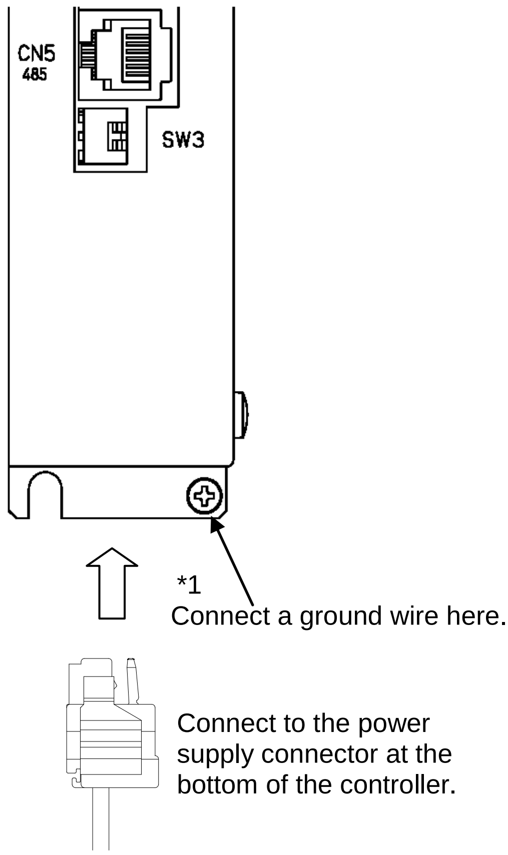
Connect power supply to CA01-S05 as shown below.

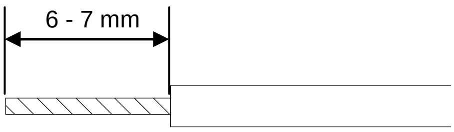
Power supply connector wiring procedure

① Strip the wire.
Wire stripping length: 6 to 7 mm

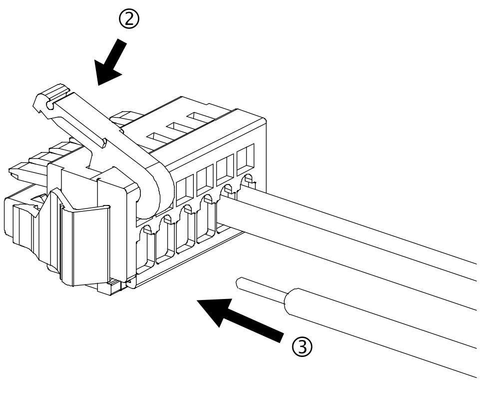
② Open the wire terminal pockets of the power supply connector.
Attach the wire connection lever supplied with the controller onto the cable side connector and push it in the direction shown by the arrow below to open the connecting hole.

③ Insert the stripped conductor of the wire into the hole.
After insertion, release the wire connection lever.
* Insert the wire fully.
* Take care not to allow neighboring wires to contact each other resulting in a short circuit.



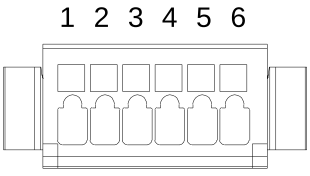


①
Peel off 6 to 7 mm of the wire covering.



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

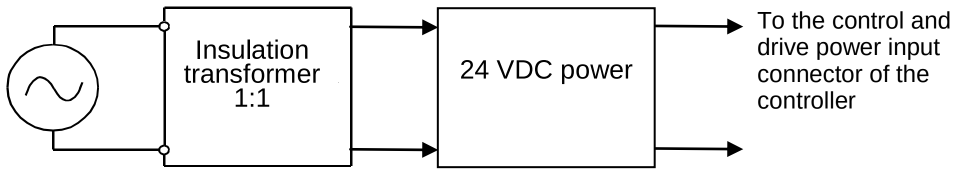
Pin No.	Signal name	Notes
1	GND (Drive power supply)	Connected with pin No. 3 inside the controller
2	24 V DC (Drive power supply)	
3	GND (Control power supply)	Connected with pin No. 1 inside the controller
4	24 V DC (Control power supply)	
5	PA	Connected to external regenerative resistor
6	JP1	Connected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

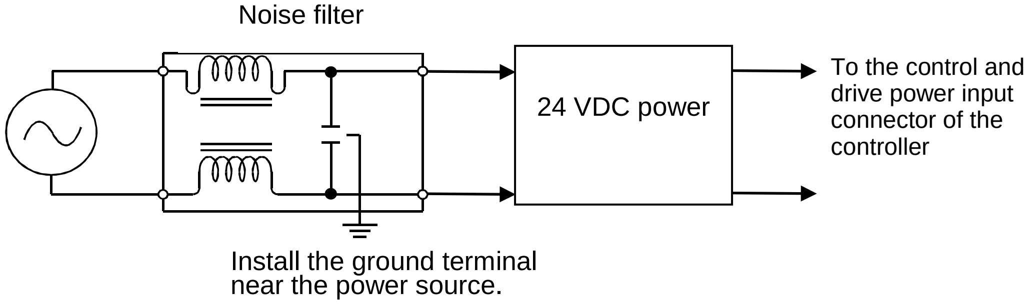


The pin number indicators are not shown on the wire connectors. As shown in the figure, they are numbered 1, 2, … 6 from the left.

■ 21.7 Improvement of noise resistance

For improvement of noise resistance, refer to section ■ 2.4.3. When a power line insulation transformer (1:1) or noise filter is inserted, however, refer to the following figures.



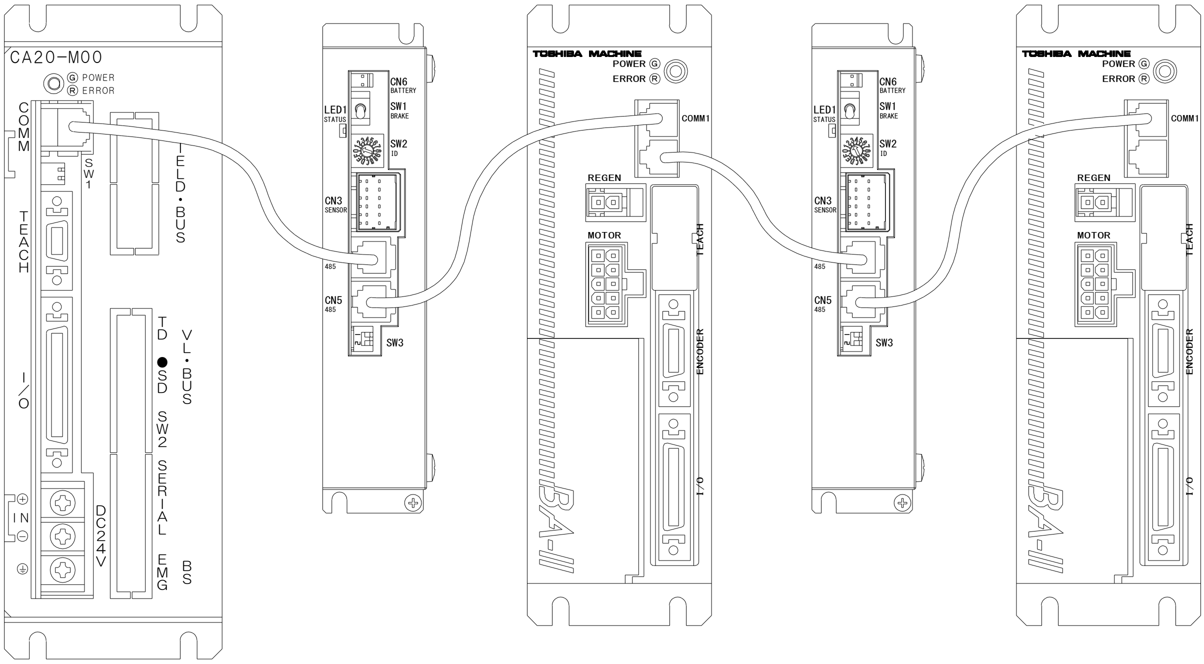


■ 21.8 Connecting the controllers

By connecting multiple CA01-S05 with link cables, the master unit CA20-M00 can control up to four axes. Also a slave unit CA20-S10 and CA01-S05 can be controlled together. For connecting method, refer to section ■ 2.4.4. However, use COMM1 and COMM2 of the communication connector as CN4 and CN5 respectively. The station No. setting and the terminator setting of the CA01-S05 are set using SW2 and SW3 (bit 1) respectively.

The following figure shows example connection where CA01-S05 is used for the axis 1 and 3, and CA20-S10 is used for the axes 2 and 4.

Master unit CA20-M00 | Slave unit 1 CA01-S05 | Slave unit 2 CA20-S10 | Slave unit 3 CA01-S05 | Slave unit 4 CA20-S10



* When the master unit is CA20-M01, the connecting method is same.

■ 21.9 Resolver ABS backup

All AC servomotors of the BA-C axis are equipped with the resolver ABS. By using power from the battery, the motor action is always monitored even when the controller power supply is shut off. This enables smooth start without origin return when starting up of the system or recovery from an emergency stop.

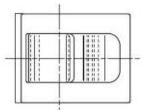
Note When the encoder type setting parameter is set to "incremental encoder" (refer to section ■ 14.4.17), the absolute function does not work even if the backup power is connected.

- Signal name and pin number of CN6 battery connector

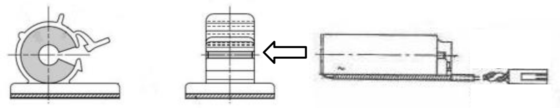
Pin No.	Signal name
1	GND (-)
2	VB (+)

Note If the pins are connected with incorrect polarity, the backup function cannot work and even a failure may be caused.

- Part number of controller side connector
  Header IL-2P-S3FP2-1
  Manufacturer JAE

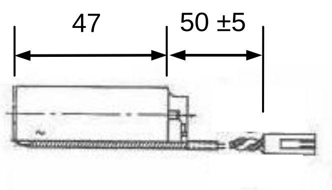


- Battery holder
  Wire clamp SSP-518
  Manufacturer Shinagawa Shoko



  * Insert the battery into the battery holder as shown in the figure. Then attach the holder on the upper face of the controller etc.

- Specifications of lithium battery

<table>
<tr><th colspan="3">Item</th><th>Description</th><th>Remarks</th></tr>
<tr><td colspan="3">Part name</td><td>Lithium battery</td><td>Thionyl chloride lithium battery</td></tr>
<tr><td colspan="3">Type</td><td>ER17500V C</td><td>Manufactured by Toshiba</td></tr>
<tr><td rowspan="4">Specifications</td><td colspan="2">Nominal voltage and capacity</td><td>3.6 V 2700 mAh</td><td rowspan="4"></td></tr>
<tr><td rowspan="2">Dimensions</td><td>Battery</td><td>ϕ17 × 47 mm
(not including protrusions)</td></tr>
<tr><td>Harness length</td><td>50 ±5 mm
(not including connector)</td></tr>
<tr><td colspan="2">Weight</td><td>Approximately 20 g</td></tr>
<tr><td colspan="3">Backup duration (*1)</td><td>Approximately one year (*2)</td><td>25°C, Backup current 260 μA</td></tr>
</table>

*1: This is accumulation time in which the controller unit is turned OFF.

*2: Battery duration varies depending on the temperature etc. The value shown should be used as reference only.

- Backup specifications

<table>
<tr><th colspan="2">Item</th><th>Specification</th><th>Remarks</th></tr>
<tr><td colspan="2">Backup voltage</td><td>3.6 VDC
(nominal)</td><td>If the voltage drops to 3.1 VDC or lower, the status LED blinks in green (warning of voltage drop). (*1)
When the voltage drops to 2.5 VDC or lower during backup, the battery error is occurred.</td></tr>
<tr><td rowspan="2">Consumption current</td><td>When controller is not energized</td><td>260 μA (Max)</td><td rowspan="2">25°C
Instantaneous maximum current 2 mA</td></tr>
<tr><td>When controller is energized</td><td>1 μA (nominal)</td></tr>
</table>

*1: Once the status LED blinks in green due to backup voltage drop, the LED continues to blink until shutting off of the power even if the voltage returns to the normal value. In some cases, the status LED does not blink in green even at a voltage drop due to the impedance.

- Encoder error

For encoder errors, refer to section ■ 2.4.10.

■ 21.10 Regenerative resistor

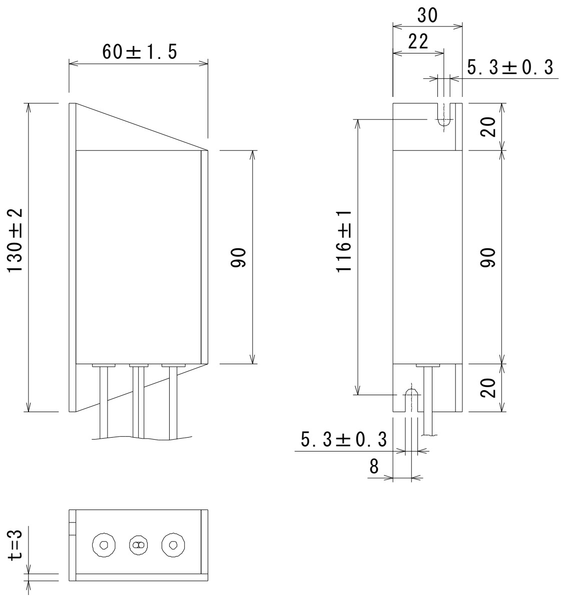
The regenerative resistor absorbs electrical power energy generated during deceleration of the axis motor.
The regenerative resistor is used to prevent overvoltage of the controller when a load inertia exceeds the permissible value or a large load on the Z axis is lowered down over a long stroke (too much electrical power is generated).
(The regenerative resistor is used to prevent overvoltage of the controller.)

* Resistor type CAR-0500 and unit type CAR-UN50 are available.
* All discharged energy will be converted into heat.
* If the resistor generates abnormal heat, a contact output is outputted (N.C).
* The one unit can be used for one axis.

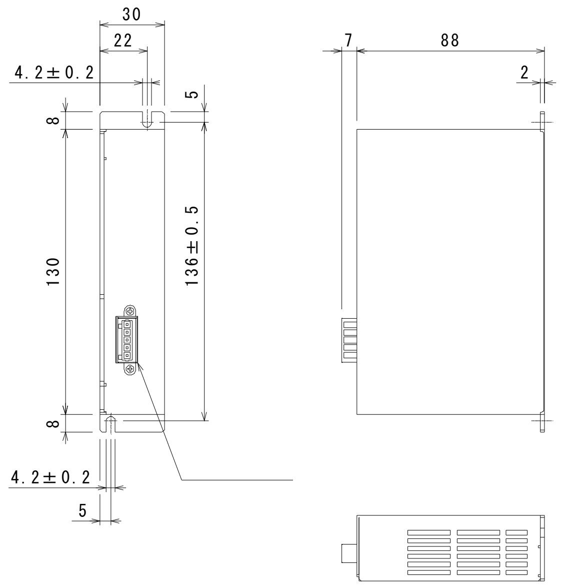
■ 21.10.1 Specifications

Item	Description	
Model number	CAR-0500	CAR-UN50
Type	Resistor	Unit
Regeneration activating voltage	48 VDC (controlled by the controller)	
Cooling	Natural air cooling	
Protection	Thermal relay activated at resistor internal temperature of 135°C Output contact : 1b Maximum switching voltage: 250 VAC/42 VDC Maximum switching current:0.2 A AC/DC (Minimum switching current:1 mA AC/DC)	Thermal relay activated at unit surface temperature of 120°C Output contact : 1b Maximum switching voltage:110 V AC/DC Maximum switching current:0.3 A AC/DC Maximum switching power:6 W AC/DC (Minimum switching current:0.1 mA/1 VDC)
Operation conditions	Working ambient temperature	0 to 40°C
	Working ambient humidity	90% max. (no condensation)
	Storage ambient temperature	-10 to 85°C
	Storage ambient humidity	90% max. (no condensation)
	Environment	Indoor (not exposed to direct sunlight) 1000 m or less above sea-level No dust, corrosive gas, or flammable gas exists.
	Vibration	4.9 m/s^2 or less
External dimensions	30 (W) × 130 (H) × 60 (D)	30 (W) × 146 (H) × 88 (D)
Mass	Approximately 0.39 kg	Approximately 0.22 kg

■ 21.10.2 Dimensions



CAR-0500



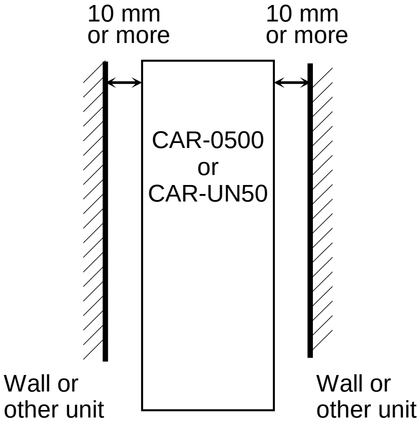
CAR-UN50

■ 21.10.3 Installation

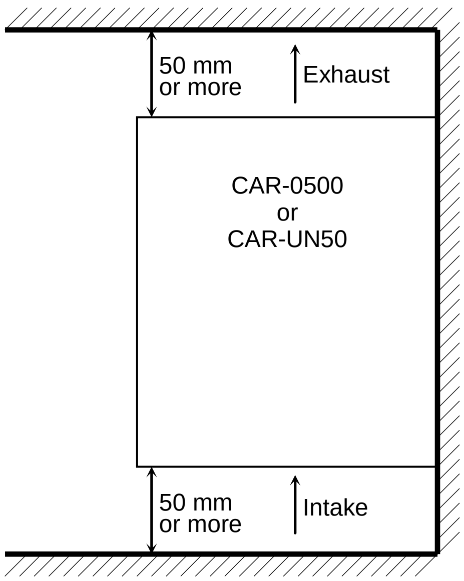
The regenerative resistor uses a natural cooling method through convection. When installing the regenerative resistor, place it vertically as shown below, and leave a space of 10 mm or more on the left and right sides and 50 mm or more on the top and bottom sides.
If the ventilation is insufficient, the sufficient performance will not be achieved, and faults could occur.

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

If ambient temperature exceeds +40°C, add a cooling method such as a cooling fan.



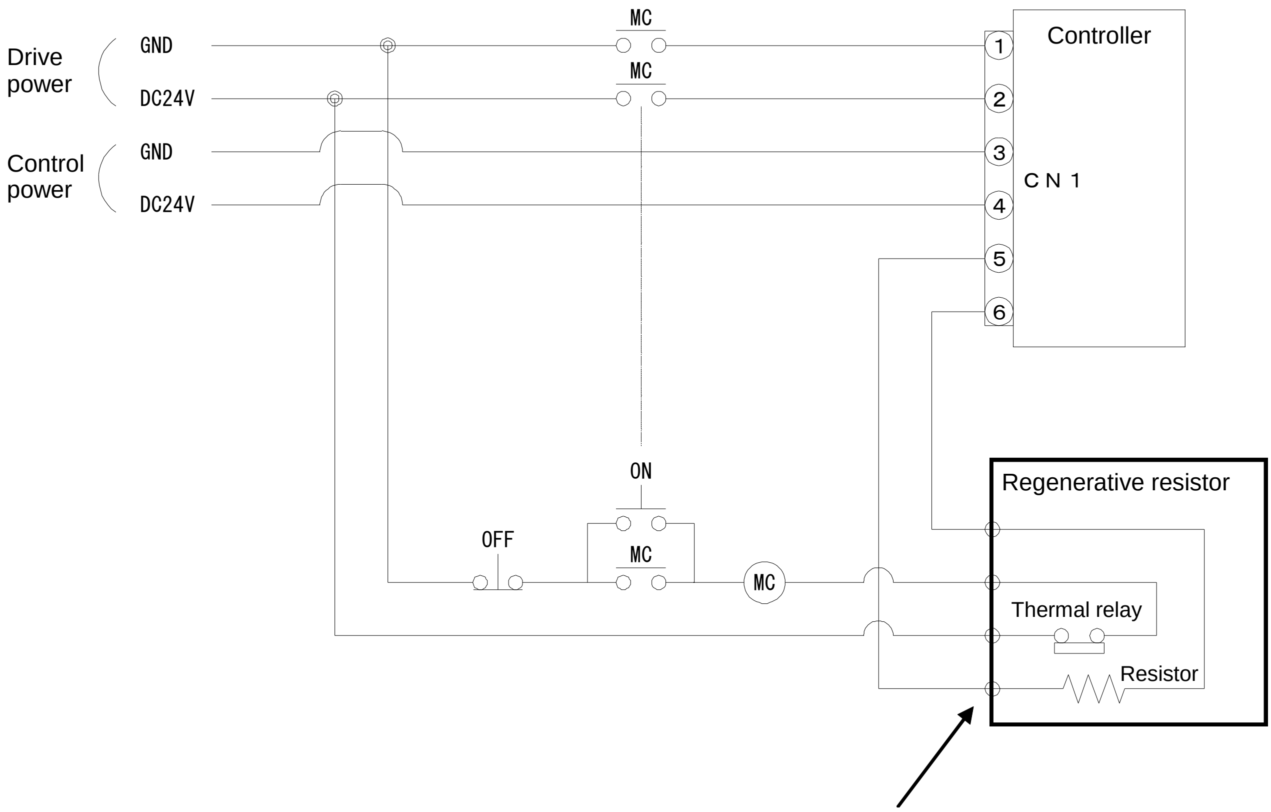
Front face



Side face

■ 21.10.4 Example connection

Connect the controller and the power source to the regenerative resistor as the following figure.



* The unit type is connected using the connector.

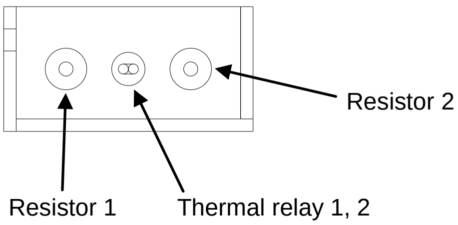
- Precautions for use
  - CAR-0500 and CAR-UN50 have the built-in thermal relay that is activated at temperature of 135°C (CAR-0500) and 120°C (CAR-UN50).
  - When this relay is activated, the circuit between outputs of the thermal relay opens.
  - Make a sequence program so that the controller power is always turned OFF when the thermal relay is activated.
  - When the thermal relay is activated once, it requires approximately three minutes to reset (return to the normal state).

⚠ CAUTION The regenerative resistor may reach a very high temperature during use. Do not touch the regenerative resistor, or burn injury may be caused. When inspecting the regenerative resistor, wait enough time to allow the regenerative resistor to cool down before starting work.

- Connection terminal

CAR-0500

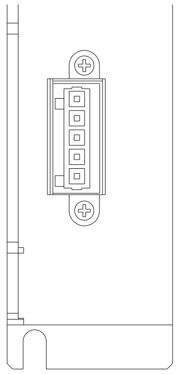
Bottom view



* When the output wire length of the thermal relay is insufficient, use the supplied junction connector.
* Prepare the wires by yourself.

CAR-UN50

Frontal view



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

* Prepare the wires by yourself.

- Use of accessory

CAR-0500

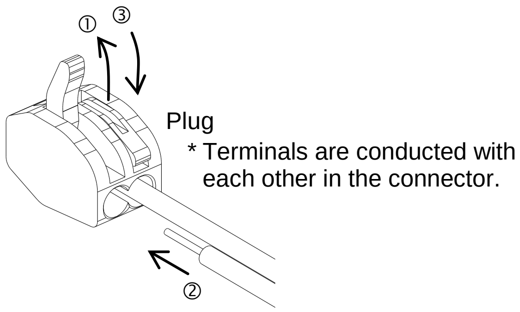
Accessory: Two junction connectors

- Connector part number

Plug	222-412
Manufacturer	WAGO

- Connecting method

① Lift the upper lever to 90° to the connector.
② Insert the wire fully.
③ Return the upper lever.
④ Pull the wire lightly to make sure that it is firmly connected.
* Wire strip length: approximately 9 mm



CAR-UN50

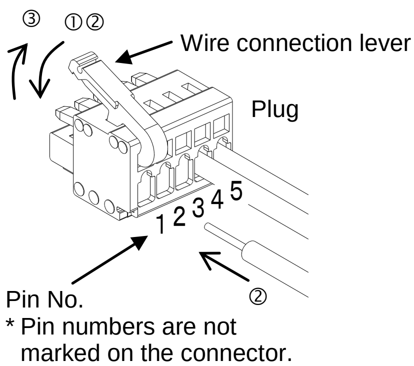
Accessory: Connector, connection lever

- Connector part number

Plug	734-105
Connection lever	734-230
Manufacturer	WAGO

- Connecting method

① Attach the supplied wire connection lever as the following figure.
② While pushing the wire connection lever in the direction shown in the figure, insert the wire fully.
③ Release the wire connection lever.
④ Pull the wire lightly to make sure that it is firmly connected.
* Wire strip length: approximately 7 mm



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Chapter 22 Maintenance and Inspection

■ 22.1 Procedures Before and After Inspection and Maintenance

(1) Before inspection and maintenance

1) Be sure maintenance and inspection personnel are adequately trained. If none of your personnel has adequate training, ask your manufacturer's representative to carry out inspection and maintenance or to train your personnel.
2) Make sure the operating area is adequately illuminated.
3) Put a nice on the start switch and other devices at the operator's stationary panel informing that inspection or maintenance is underway.
   Before personnel enter the operating area, the power switch must be locked open to prevent power being supplied to this unit. Also, if the entrance to the fence around the operating area is equipped with a safety plug, personnel should carry it when entering the fenced area.
4) Before personnel enter fenced areas of cabinets for inspection or maintenance of control circuits, cut off power to all drive units.
5) If inspection or maintenance must be done within the operating area while the robot is moving, take the following precautions:
   - Do not enter the area alone. Work in pairs. One person might act as a watchman while the other performs the inspection.
   - Operate the robot at the slowest speed practical to accomplish its job to give personnel time to avoid being struck by any unexpected movement by the robot.
   - Have an operator closely monitor the robot, so he can immediately activate emergency stop if the robot makes any unexpected movement or if inspection personnel appear endangered.
6) Discharge residual pneumatic pressure in the cylinder before disassembling or changing parts in the pneumatic gauge.
7) When disassembling or changing parts in hydraulic and pneumatic lines, be very careful to prevent dust or other foreign matter from contaminating them.

(2) Procedures after inspection or maintenance

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

■ 22.2 Inspection Before Operation

(1) Check the following before operation:
1. Braking device performance
2. Emergency stop device performance
3. Interlock device between bumpers and robot
4. Interlock devices between auxiliary devices and robot
5. External cables and piping for damage
6. Power source voltage, hydraulic oil pressure and pneumatic pressure
7. Robot movement
8. Presence of abnormal sound or vibration
9. Bumpers

(2) Determine the positions from which personnel will perform the inspection or maintenance. They should remain as far out of the operating area as possible.

■ 22.3 Periodic Inspection

Make an inspection standard including inspection items, method, criteria and timing considering the installation location, operating frequency, parts durability and other conditions and factors of the robot, and conduct periodic inspections.
Check the following during inspection work:
1. Loose parts on the main components
2. Lubrication and other conditions of moving parts
3. Power transmission components
4. Hydraulic and pneumatic systems
5. Electric systems
6. Fault detection systems
7. Encoder section
8. Servo system

[Controller inspection places]

9. Check that the voltage supplied to the controller is in the usage range (±10% of rated voltage).
10. Inspect the ventilation holes to the controller, and remove any dirt or dust, etc., that is adhered.
11. Inspect the controller cable (controller to axis), and confirm that none of the screws, etc., are loose.
12. Confirm that the controller installation screws, etc., are not loose.
13. Inspect each connector (motor output connector, encoder input connector, Teach Pendant connector), and confirm that there is no looseness or play, etc.

Inspection of timing belt

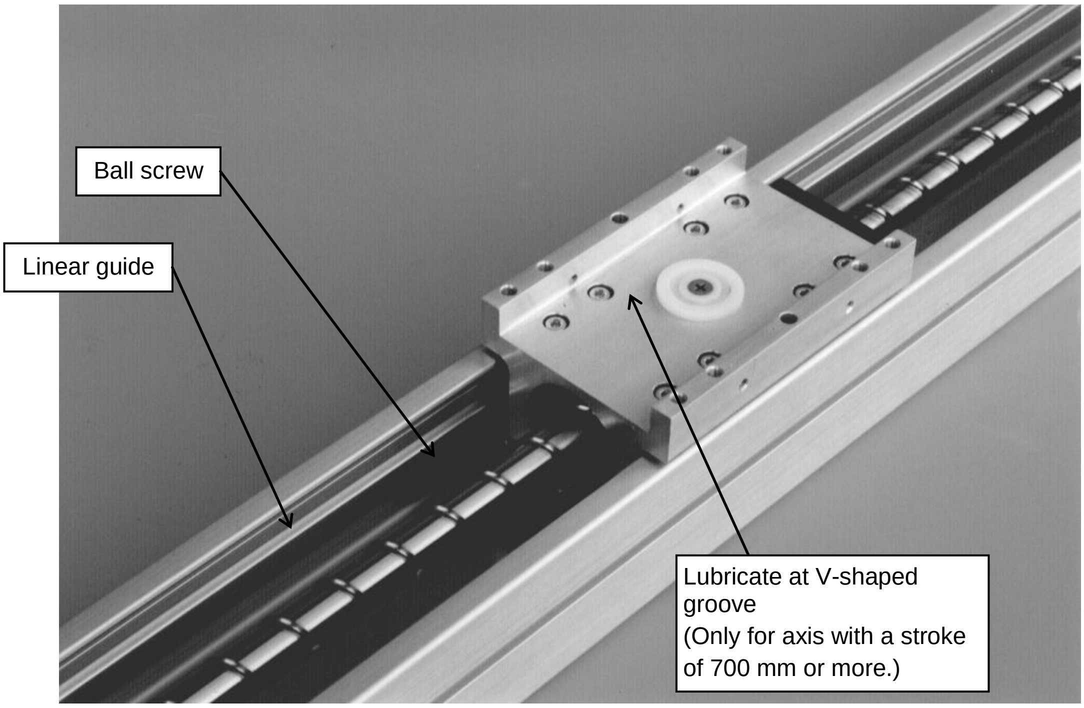
The timing belt should be inspected approximately every 500 hours.

- Check the belt for deterioration, fatigue and scratches, etc., and replace it immediately if any abnormality is found. Refer to the Axis Instruction Manual section 4.4 for the replacement procedures.
- When using the motor folding axis with brakes for vertical use (as the Z axis) observe the following items.
  1. The belt must be replaced periodically within 3,000 hours of operation.
  2. The belt's life will be greatly affected by the working environment and conditions. If any abnormality is found during inspection, replace the belt immediately.

CAUTION Snapping of the belt used for vertical use will be extremely dangerous. Make sure to replace the belt at an early stage.

■ 22.4 Lubrication

(1) Parts to be lubricated



Parts to be lubricated	Lubricant (Maker)	Interval	Quantity of lubricant
Ball screw	Alvania No. 2 (Showa Shell)	Every three months	Apply light coat on ball screw shaft
Linear guide			Supply approx. 1 cc of grease to each part with a grease nipple.

(The first lubrication must be performed on the 30th day after the starting operation.)

(2) Lubrication procedure
1) Turn OFF the power switch and unplug the power cable to disconnect this unit from the power source.
2) Remove the axis frame cover.
3) Lubricate the parts listed in the table above.
4) Wipe off excess lubricant.
5) Reassemble the frame cover.

■ 22.5 Cleaning

Clean the robot body.

Cleaning procedure

1. Turn OFF the power switch and disconnect this unit from the power source.
2. Use a rag to wipe dust and foreign matter off the frame and covers.
3. Remove the frame cover and wipe away dust and foreign matter from the in side. Lubricate according to the lubrication procedure given in section 21-4.
4. Resecure the frame cover.

■ 22.6 Spare Parts

■ 22.6.1 Controller spare parts

- Although a fault or error may be found at an early stage, repairs cannot be made without the required parts. It is recommended that spare parts for consumable components be kept on hand.

Applicable controller	Master unit (CA20-M00, CA20-M01)	Slave unit (CA20-S10, CA20-S40)
Part name	Fuse	
Qty per unit	1	2
Part and type	Cylindrical glass tube fuse 51NM030H	Cylindrical glass tube fuse 232008MA250
Maker	PICO	Littelfuse, Inc.
Specifications	250V-3A Rapid melt-off type 135%/6 minutes or less 200%/0.5 seconds or less	250V-8A Electricity Control Law Class B specified. Rush-resistant type
Size	ø5.2 × 20mm	ø5.2 × 20mm

■ 22.6.2 Axis spare parts

Refer to Chapter 5 of the Axis Instruction Manual for the axis spare parts.

Chapter 23 Appendix

■ 23.1 Replacement of conventional models

In the case of replacing conventional models of CA10-M00B or CA10-M01B-CC, the target model is CA20-M00. CA20-M01 is not the target model normally because conventional models of CA10-M00B or CA10-M01B-CC do not support safety category 3, but CA20-M01 do.
This section describes notes for replacement of CA10-M00B or CA10-M01B-CC with CA20-M00 and difference between their specifications.

■ 23.1.1 Notes for replacement of conventional models

(1) Replacement of CA10-M00B with CA20-M00

① External dimensions
CA20-M00 is bigger than CA10-M00B. For external dimensions of each unit, refer to Table 23.1 in section ■ 23.1.2. For mounting hole dimension, refer to Figure 23.4 in section ■ 23.1.2.

② Power supply voltage
This is 24 VDC and unchanged. (refer to Table 23.1 in section ■ 23.1.2)

③ Compatible slave unit
This is unchanged. CA20-S10/S40 can be used.

④ Emergency stop input/output
The same type of connector is used and therefore the conventional wiring can be used without change. (Refer to Table 23.2 in section ■ 23.1.2)

⑤ I/O wiring of master unit
The same type of connector is used and therefore the conventional wiring can be used without change. (Refer to Table 23.2 in section ■ 23.1.2)

⑥ Expansion input/output unit
If the expansion input/output unit (CA10-EX-B40, the number of general-purpose input/output is 24/16) was used with CA10-M00B, the corresponding expansion input/output unit is not available with CA20-M00. Use slave units I/O (the number of general-purpose input/output is 8/8 per unit. Refer to section ■ 10.1.2). In this case, wiring needs to be changed and port designation of input/output commands needs to be corrected.
In the case of insufficient number of general-purpose input/output because of slave units are few, mount the expansion input/output unit (CA20-EX-A20, the number of general-purpose input/output is 12/8. Refer to section ■ 10.1.3) on slave units.

⑦ Memory card unit
If the memory card unit (CA10-MC-B20) was used with CA10-M00B, the corresponding memory card unit is not available with CA20-M00. Perform backup of programs and parameters with PC software (SF-98D).

⑧ Robot type, program and parameter
Robot type, program and parameter of CA10-M00B can be used without change. However, If the expansion input/output unit I/O with CA10-M00B was changed to slave units I/O, port designation of input/output commands needs to be corrected. (Refer to ⑥)

⑨ Teach pendant
TPH-4C can be used for both CA20-M00 and CA10-M00B. If TPH-4B was used with CA10-M00B, use TPH-4C because TPH-4B do not correspond to CA20-M00.

⑩ PC software
SF-98D can be used for both CA20-M00 and CA10-M00B.

(2) <u>Replacement of CA10-M01B-CC with CA20-M00</u>

① External dimensions
CA20-M00 is bigger than CA10-M01B-CC. For external dimensions of each unit, refer to Table 23.1 in section ■ 23.1.2. For mounting hole dimension, refer to Figure 23.4 in section ■ 23.1.2.

② Power supply voltage
This is 24 VDC and unchanged. (refer to Table 23.1 in section ■ 23.1.2)

③ Compatible slave unit
This is unchanged. CA20-S10/S40 can be used.

④ Emergency stop input/output
A different type of connector is used and therefore wiring needs to be changed. (Refer to Figure 23.1 in section ■ 23.1.2)

⑤ Wiring of CC-Link cable
CA10-M01B-CC uses connector connection, but CA20-M00 uses terminal block connection. Therefore wiring needs to be changed. (Refer to Figure 23.2 in section ■ 23.1.2)

⑥ CC-Link setting of station No. and baud rate
CA10-M01B-CC :
Set with the switch on front of controller. (Refer to Figure 23.3 in section ■ 23.1.2)
CA20-M00 : Set in parameter. (Refer to section ■ 14.2.17)

⑦ Robot type, program and parameter
Robot type, program and parameter of CA10-M01B-CC can be used without change.

⑧ Teach pendant
TPH-4C can be used for both CA20-M00 and CA10-M01B-CC. If TPH-4B was used with CA10-M01B-CC, use TPH-4C because TPH-4B do not correspond to CA20-M00.

⑨ PC software
SF-98D can be used for both CA20-M00 and CA10-M01B-CC.

■ 23.1.2 Specifications comparison table and drawings

Table 23.1 Master unit specifications comparison table

Item		CA20-M00	CA10-M00B	CA10-M01B-CC
Applicable robot		BA III, BA II and BA-C series	←	←
Corresponding slave unit		CA25-S10/S40/S80 CA20-S10/S40 CA01-S05	CA20-S10/S40	←
Maximum number of task		4 (*1)	←	←
Maximum number of controllable axis		4	←	←
Maximum number of controllable axis per one task		4	←	←
Three dimension linear/circular interpolation		○	○	○
Position command distribution cycle		24 mSEC	←	←
Slave communication cycle		10 mSEC	←	←
Two axes synchronization control		○	×	×
Number of speed and acceleration/deceleration tables		10/20 (variable)	←	←
Operation mode		Step / continuous / single	←	←
Sequential mode (number of program)		○ (16)	○ (16)	○ (16)
Maximum number of program step		2500	←	←
Palletizing mode (number of program)		○ (16)	○ (16)	○ (16)
External point designation mode		○	○	○
Easy mode (number of program)		○ (8)	○ (8)	○ (8)
Number of counter / timer		99/9	←	←
Number of coordinate tables		999	←	←
Communication function (RS-232C)		1CH (OP: 1CH)	1CH	2CH
Communication cable type		PCBL-31	←	←
Number of system input/output		4/4	←	None (*2)
Number of general-purpose input/output		20/12	←	None (*2)
I/O type		NPN	←	None (*2)
Option	Number of expansion input/output	None	24/16	None
	CC-Link	○	×	○
	DeviceNet	○	×	×
	Memory card unit	×	○	×
	Teach pendant	TPH-4C	TPH-4C TPH-4B	←
	PC software	SF-98D	←	←
Power source		24 VDC – 0.5A	←	24 VDC – 1.0A
External dimensions (W × H × D) (mm)		65×170×150	25×160×130	47×160×130
Mounting hole dimension		Refer to figure 23.4 in section ■ 23.1.2.	←	←
Weight (kg)		1.2	0.4	0.8

NOTE

*1: Axis movement can be used with task 1

*2: No I/O connector because of controller exclusive for CC-Link

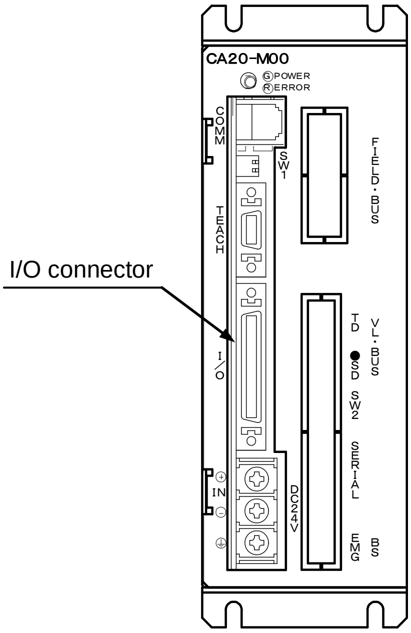
Table 23.2 Master unit I/O connector comparison table

Pin No.	CA20-M00	CA10-M00B
1	+COM1 (*1)	←
2	General-purpose output port 1-1	←
3	General-purpose output port 1-2	←
4	General-purpose output port 1-3	←
5	General-purpose output port 1-4	←
6	General-purpose output port 1-5	←
7	General-purpose output port 1-6	←
8	General-purpose output port 1-7	←
9	General-purpose output port 1-8	←
10	General-purpose output port 2-1	←
11	General-purpose output port 2-2	←
12	General-purpose output port 2-3	←
13	General-purpose output port 2-4	←
14	-COM1 (*2)	←
15	-COM1 (*2)	←
16	+COM2 (*1)	←
17	Running output	←
18	Error output	←
19	Positioning complete output	←
20	Return to origin complete output	←
21	Return to origin input	←
22	Start input	←
23	Stop input	←
24	Reset input	←
25	-COM2 (*2)	←
26	General-purpose input port 1-1	←
27	General-purpose input port 1-2	←
28	General-purpose input port 1-3	←
29	General-purpose input port 1-4	←
30	General-purpose input port 1-5	←
31	General-purpose input port 1-6	←
32	General-purpose input port 1-7	←
33	General-purpose input port 1-8	←
34	General-purpose input port 2-1	←
35	General-purpose input port 2-2	←
36	General-purpose input port 2-3	←
37	General-purpose input port 2-4	←
38	General-purpose input port 2-5	←
39	General-purpose input port 2-6	←
40	General-purpose input port 2-7	←
41	General-purpose input port 2-8	←
42	General-purpose input port 3-1	←
43	General-purpose input port 3-2	←
44	General-purpose input port 3-3	←
45	General-purpose input port 3-4	←
46	Emergency stop input	←
47	Emergency stop input	←
48	Emergency stop output (NO)	←
49	Emergency stop output (COM)	←
50	Emergency stop output (NC)	←

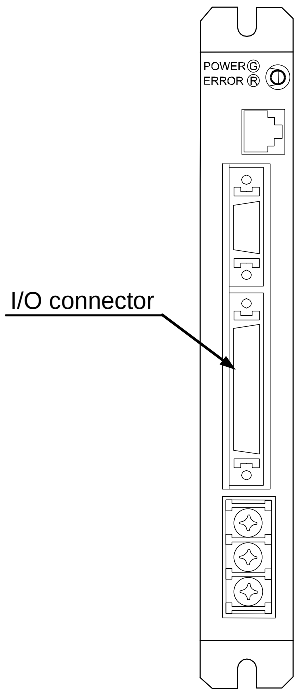
Emergency stop input/output

Note *1: +COM1 and +COM2 are not connected to each other internally.

*2: -COM1 and -COM2 are not connected to each other internally.



CA20-M00



CA10-M00B

Table 23.3 Operation command comparison table

Command		CA20-M00	CA10-M00B	CA10-M01B-CC
Movement	MOV	○	○	○
	MOVP	○	○	○
	MVC	○	○	○
	MVCP	○	○	○
	MVB	○	○	○
	MVE	○	○	○
	RSMV	○	○	○
	HOME	○	○	○
Parameter	SPD	○	○	○
	ACC	○	○	○
	OFS	○	○	○
MVM	MINI	○	○	○
	MVM	○	○	○
	LOOP	○	○	○
Servo control	SVON	○	○	○
	SVOF	○	○	○
Input/output port control	OUT	○	○	○
	OUTP	○	○	○
	OUTC	○	○	○
	OUTS	○	○	○
	CANS	○	○	○
	IOUT	○	○	○
	IN	○	○	○
	INPC	○	○	○
	INSP	○	○	○
Timer/counter control	TIM	○	○	○
	TIMP	○	○	○
	CNT	○	○	○
	CNT+	○	○	○
	CNT-	○	○	○
	CNTC	○	○	○
	CWIT	○	○	○
Jump	JMP	○	○	○
	JMPI	○	○	○
	JMPC	○	○	○
	JMPT	○	○	○
	BRAC	○	○	○
Sub routine call	CAL	○	○	○
	CALI	○	○	○
	CALC	○	○	○
	CALT	○	○	○
Program control	NOP	○	○	○
	RET	○	○	○
	STOP	○	○	○
	END	○	○	○
	TAG	○	○	○
	PSEL	○	○	○
Task control	TSTR	○	○	○
	TSTO	○	○	○
	TRSA	○	○	○
	TCAN	○	○	○

Table 23.4 Mode setting parameter comparison table

No.	Parameter	CA20-M00	CA10-M00B	CA10-M01B-CC
M01	Single operation mode input bit designation	○	○	○
M02	Continuous start input bit designation	○	○	○
M03	Escape input bit designation	○	○	○
M04	Pause input bit designation	○	○	○
M05	Program selection input bit designation	○	○	○
M06	Palletizing input bit designation	○	○	○
M07	Pausing output bit designation	○	○	○
M08	Input wait output bit designation	○	○	○
M09	Teach Pendant display language Japanese/English	○	○	○
M10	OFF/easy/point	○	○	○
M11	Clear at general-purpose output reset Valid/Invalid	○	○	○
M12	Direct output designation	○	○	○
M13	READY output bit designation	○	○	○
M14	Task positioning output designation	○	○	○
M15	Task return to origin output designation	○	○	○
M16	Designation of BS amplifier send fiber-optic cable length	○	×	×
M17	Setting of CC-Link	○	×	×
M18	Setting of DeviceNet	○	×	×
M19	Battery alarm output bit designation	○	×	×
M20	Moving coordinate table number output in external point designation mode	○	×	×
M21	Servo on input bit	○	×	×

Table 23.5 Parameter 1 comparison table

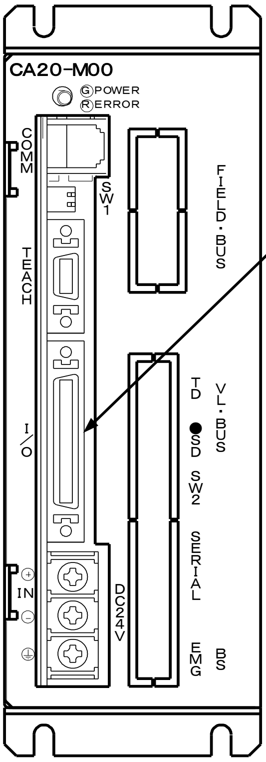
No.	Parameter	CA20-M00	CA10-M00B	CA10-M01B-CC
P01	Software limit value (upper limit)	○	○	○
P02	Software limit value (lower limit)	○	○	○
P03	Servo gain (position)	○	○	○
P04	Servo gain (speed)	○	○	○
P05	Pass area data value	○	○	○
P06	Origin offset value	○	○	○
P07	Sequence of return to origin	○	○	○
P08	JOG speed (A1)	○	○	○
P09	JOG speed (A2)	○	○	○
P10	JOG speed (A3)	○	○	○
P11	JOG speed (A4)	○	○	○
P12	JOG inching movement	○	○	○
P13	Designation of area output (A1)	○	○	○
P14	Designation of area output (A2)	○	○	○
P15	Designation of area output (A3)	○	○	○
P16	Designation of area output (A4)	○	○	○
P17	Synchronized offset	○	×	×
P18	Synchronized error allowable value	○	×	×

Table 23.6 Parameter 2 comparison table

No.	Parameter	CA20-M00	CA10-M00B	CA10-M01B-CC
K01	Axis display	○	○	○
K02	In position data value	○	○	○
K03	Overflow data value	○	○	○
K04	Feed forward data value	○	○	○
K05	Direction of motor revolution	○	○	○
K06	Maximum speed	○	○	○
K07	Return to origin speed (A1)	○	○	○
K08	Return to origin speed (A2)	○	○	○
K09	Return to origin speed (A3)	○	○	○
K10	Return to origin speed (A4)	○	○	○
K11	Return to origin method	○	○	○
K12	Origin sensor logic	○	○	○
K13	High speed return to origin position	○	○	○
K14	Lead	○	○	○
K15	Encoder No. of divisions	○	○	○
K16	Encoder pulse multiplier	○	○	○
K17	Encoder type	○	○	○
K18	acceleration/deceleration time constant	○	○	○
K19	Task and axis combination	○	○	○
K20	Task order of priority	○	○	○
K21	Task point table	○	○	○
K22	No. of task steps	○	○	○
K23	BA I/O compatibility mode	○	○	○
K24	Setting of return to origin direction	○	×	×
K25	Setting of dynamic brake	○	×	×
K26	Setting of synchronized axes	○	×	×

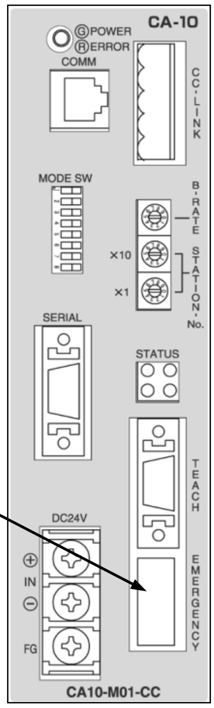
Table 23.7 PC software (SF-98D) extension list

File type	CA20-M00	CA10-M00B	CA10-M01B-CC
Group file	DCN	←	←
Sequential program	DSN	←	←
Palletizing program	DPN	←	←
Easy program	DEN	←	←
Coordinate table	DTN	←	←
MVM table	DMN	←	←
Speed and acceleration/deceleration table	DAN	←	←
Robot type	DRN	←	←
Parameter 1	D1N	←	←
Parameter 2	D2N	←	←



Pin No.	Signal
46	Emergency stop input
47	Emergency stop input
48	Emergency stop output (NO)
49	Emergency stop output (COM)
50	Emergency stop output (NC)

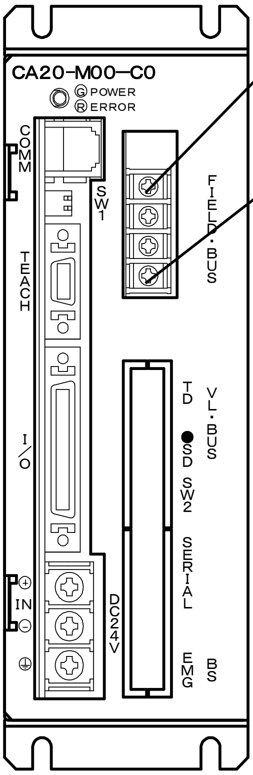
Pin No.	Signal
1	Emergency stop output (NC)
2	Emergency stop output (COM)
3	Emergency stop output (NO)
4	Emergency stop input
5	Emergency stop input



CA20-M00

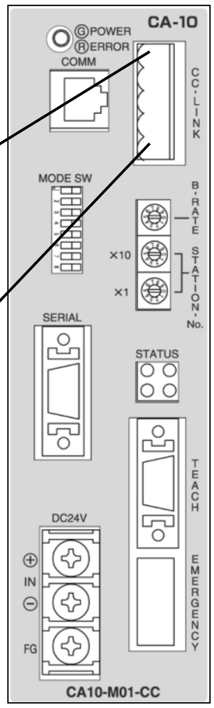
CA10-M01B-CC

Figure 23.1 The difference in emergency stop input/output
between CA20-M00 and CA10-M01B-CC



Shield (SLD)
Digital GND (DG) - Yellow
Communication line (DB) - White
Communication line (DA) - Blue

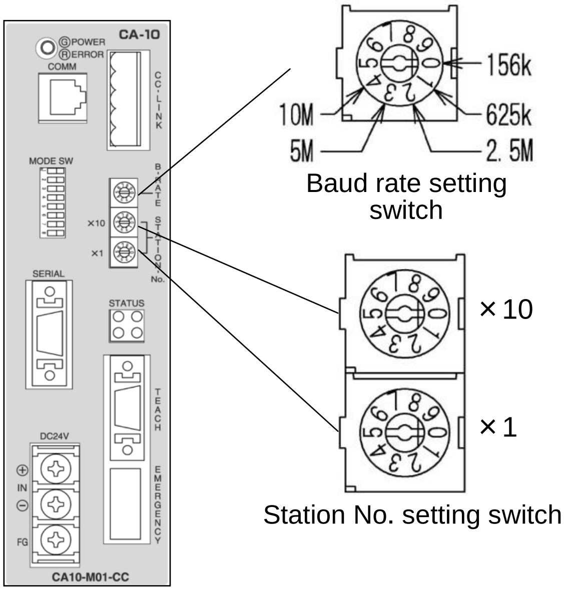
Communication line (DA) - Blue
Communication line (DB) - White
Digital GND (DG) - Yellow
Shield (SLD)
Frame ground (FG)



CA20-M00

CA10-M01B-CC

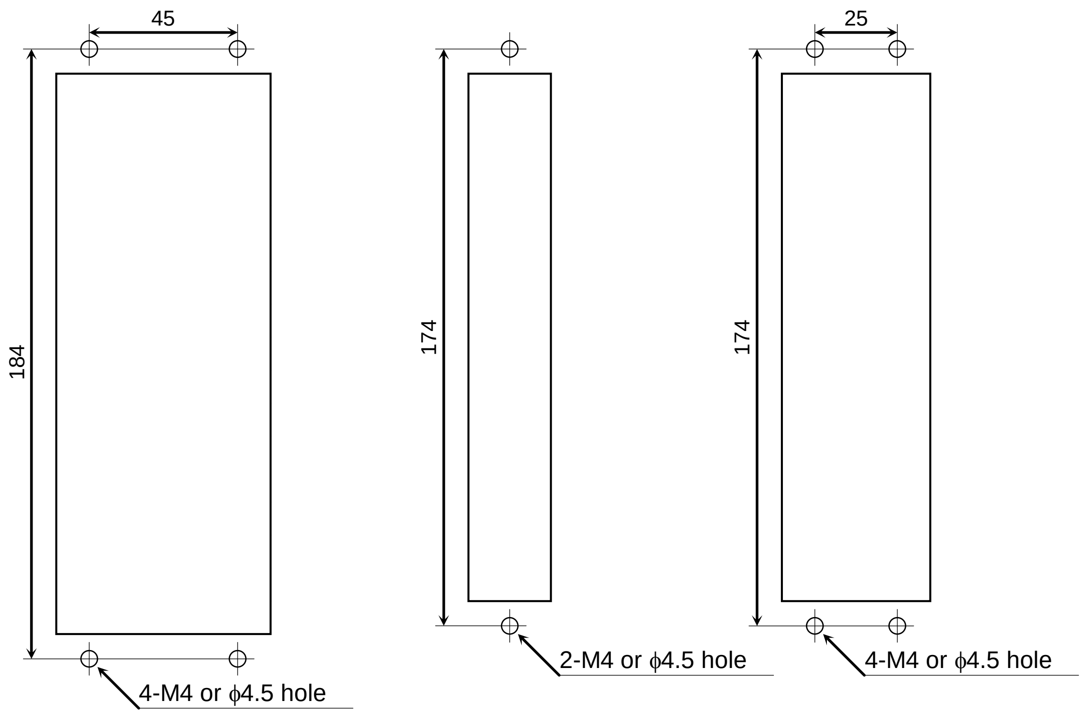
Figure 23.2 The difference in CC-Link wiring between CA20-M00 and CA10-M01B-CC



No.	Baud rate [bps]
0	156k
1	625k
2	2.5M
3	5M
4	10M
Other than that above	Setting error

CA10-M01B-CC

Figure 23.3　CC-link setting of station No. and baud rate of CA10-M01B-CC



CA20-M00　　CA10-M00B　　CA10-M01B-CC

Figure 23.4　Mounting hole dimension

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