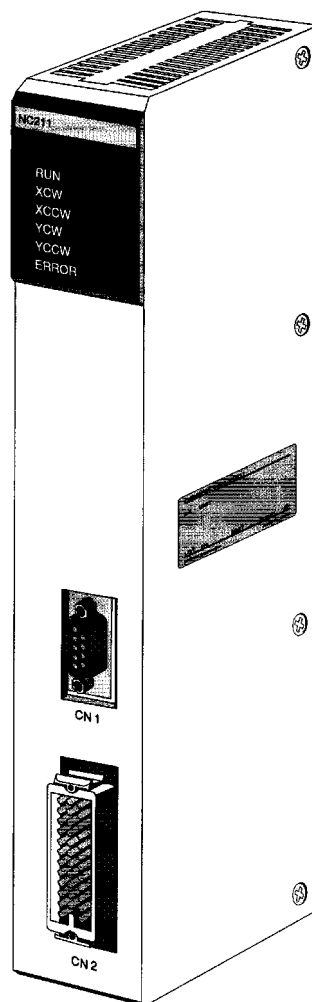


# C500-NC113 (One-axis Control) C500-NC211 (Two-axis Control) Position Control Units

## Operation Manual

Cat. No. W323-E3-1







## Notice:

OMRON products are manufactured for use according to proper procedures by a qualified operator and only for the purposes described in this manual.

The following conventions are used to indicate and classify precautions in this manual. Always heed the information provided with them. Failure to heed precautions can result in injury to people or damage to the product.

 **DANGER** Indicates information that, if not heeded, is likely to result in loss of life or serious injury.

 **WARNING** Indicates information that, if not heeded, could possibly result in loss of life or serious injury.

 **Caution** Indicates information that, if not heeded, could result in relatively serious or minor injury, damage to the product, or faulty operation.

## OMRON Product References

All OMRON products are capitalized in this manual. The word “Unit” is also capitalized when it refers to an OMRON product, regardless of whether or not it appears in the proper name of the product.

The abbreviation “Ch,” which appears in some displays and on some OMRON products, often means “word” and is abbreviated “Wd” in documentation in this sense.

The abbreviation “PC” means Programmable Controller and is not used as an abbreviation for anything else.

## Visual Aids

The following headings appear in the left column of the manual to help you locate different types of information.

**Note** Indicates information of particular interest for efficient and convenient operation of the product.

**1, 2, 3...** 1. Indicates lists of one sort or another, such as procedures, checklists, etc.

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## About this Manual:

This manual describes the installation and operation of the C500-NC113 (one-axis control) and C500-NC221 (two-axis control) Position Control Units for C-series and CV-series PC. It includes the sections described below.

Please read this manual carefully and be sure you understand the information provided before attempting to install and operate the C500-NC113/221 Position Control Unit.

**Section 1** describes the basic features and operations of the Position Control Unit, as well as the basic configuration and operating principles of positioning control systems. Be sure to read and study these sections carefully; an understanding of the control system is essential for successful operation.

**Section 2** provides the specifications and illustrates the components of the Position Control Unit.

**Section 3** explains the Position Control Unit's connector pin arrangement and wiring.

**Section 4** outlines the procedures that need to be performed before operating the Position Control Unit.

**Section 5** explains the Position Control Unit data configuration and the types of data involved in position control. There are two methods for creating position control data. The first is to create it using NC Support Software and then transfer it to the Position Control Unit, and the second is to create it in the CPU Unit's DM area according to PCU data addresses and then use the Intelligent I/O Write (WRIT) instruction to transfer it to the Position Control Unit. Both of these methods are explained in this section, along with the five types of position control data: positioning actions, speeds, acceleration/deceleration patterns, dwell times, and parameters.

**Section 6** explains the commands used by the Position Control Unit. There are two ways to execute commands. One way is to set the Programmable Controller's operating mode to either RUN or Monitor, and to use the Intelligent I/O Write instruction (WRIT) to transfer nine words of command data to the Position Control Unit. The other way is to set the Programmable Controller's operating mode to Program, and to give commands to the Position Control Unit by turning ON and OFF bits in the output area allocated for Special I/O.

**Section 7** explains the two ways in which the Position Control Unit's current status is transmitted to the CPU Unit. The term "status" here refers to the operations that the Position Control Unit is currently performing, and to the operating conditions. The first way in which the PCU status is transmitted to the CPU Unit is the regular transfer of one word of data with the I/O refresh. The other way is the transfer, as required, of 15 words of data by means of the Intelligent I/O Read instruction (READ).

**Section 8** provides some simple example of Position Control Unit operations, including explanations of basic procedures, trial operation, and ladder program examples.


**Section 9** explains how to make the settings required for Position Control Unit operations.

**Section 10** provides examples of programs for some practical applications.

**Section 11** explains the internal processing of the Position Control Unit.

**Section 12** explains the error processing procedures for the Position Control Unit, including error codes, alarm codes, displays, and troubleshooting.

The **Appendix** provides data memory coding sheets and command and status charts.

 <b>WARNING</b> Failure to read and understand the information provided in this manual may result in personal injury or death, damage to the product, or product failure. Please read each section in its entirety and be sure you understand the information provided in the section and related sections before attempting any of the procedures or operations given.
--

# PRECAUTIONS

This section provides general precautions for using the Programmable Controller(PC), Position Control Unit, and related devices.

**The information contained in this section is important for the safe and reliable application of the PC and the Position Control Unit. You must read this section and understand the information contained before attempting to set up or operate a PC system.**

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## 1 Intended Audience

This manual is intended for the following personnel, who must also have knowledge of electrical systems (an electrical engineer or the equivalent).

- Personnel in charge of installing FA systems.
- Personnel in charge of designing FA systems.
- Personnel in charge of managing FA systems and facilities.


## 2 General Precautions

The user must operate the product according to the performance specifications described in the operation manuals.







Before using the product under conditions which are not described in the manual or applying the product to nuclear control systems, railroad systems, aviation systems, vehicles, combustion systems, medical equipment, amusement machines, safety equipment, and other systems, machines, and equipment that may have a serious influence on lives and property if used improperly, consult your OMRON representative.

Make sure that the ratings and performance characteristics of the product are sufficient for the systems, machines, and equipment, and be sure to provide the systems, machines, and equipment with double safety mechanisms.

This manual provides information for programming and operating Position Control Unit. Be sure to read this manual before attempting to use the software and keep this manual close at hand for reference during operation.

-  **WARNING** It is extremely important that a PC and all PC Units be used for the specified purpose and under the specified conditions, especially in applications that can directly or indirectly affect human life. You must consult with your OMRON representative before applying a PC System to the abovementioned applications.


## 3 Safety Precautions

-  **WARNING** Never attempt to disassemble any Units while power is being supplied. Doing so may result in serious electrical shock or electrocution.
-  **WARNING** Never touch any of the terminals while power is being supplied. Doing so may result in serious electrical shock or electrocution.
-  **Caution** Confirm safety at the destination node before transferring a program to another node or editing the I/O area. Doing either of these without confirming safety may result in injury.
-  **Caution** Tighten the screws on the terminal block on the AC Power Supply Unit to the torque specified in the reference manuals. Loose screws may result in short-circuits, malfunction, or burning.
-  **Caution** Wire correctly as specified in this manual. Incorrect wiring may result in burning.
-  **Caution** Double-check pin numbers before wiring connectors. Incorrect wiring may result in burning in the Unit.

## 4 Operating Environment Precautions


Do not operate the control system in the following places.

- Locations subject to direct sunlight.
- Locations subject to temperatures or humidity outside the range specified in the specifications.
- Locations subject to condensation as the result of severe changes in temperature.
- Locations subject to corrosive or flammable gases.
- Locations subject to dust (especially iron dust) or salts.
- Locations subject to shock or vibration.
- Locations subject to exposure to water, oil, or chemicals.
- Take appropriate and sufficient countermeasures when installing systems in the following locations.
  - Locations subject to static electricity or other forms of noise.
  - Locations subject to strong electric fields or magnetic fields.
  - Locations subject to possible exposure to radioactivity.
  - Locations close to power supplies.


 **Caution** The operating environment of the PC System can have a large effect on the longevity and reliability of the system. Improper operating environments can lead to malfunction, failure, and other unforeseeable problems with the PC System. Be sure that the operating environment is within the specified conditions at installation and remains within the specified conditions during the life of the system.

## 5 Application Precautions

Observe the following precautions when using the PC.

 **WARNING** Failure to abide by the following precautions could lead to serious or possibly fatal injury. Always heed these precautions.

- Always ground the system to 100  $\Omega$  or less when installing the system to protect against electrical shock.
- Always turn off the power supply to the PC before attempting any of the following:
  - Mounting or dismounting the NC Unit.
  - Assembling the devices.
  - Setting DIP switches or rotary switches.
  - Connecting or disconnecting the driver connectors.

 **Caution** Failure to abide by the following precautions could lead to faulty operation of the PC or the system or could damage the PC or PC Units. Always heed these precautions.

- Fail-safe measures must be taken by the customer to ensure safety in the event of incorrect, missing, or abnormal signals caused by broken signal lines, momentary power interruptions, or other causes.
- Interlock circuits, limit circuits, and similar safety measures must be provided by the customer as external circuits.
- Always use the power supply voltage specified in this manual.
- Take appropriate measures to ensure that the specified power with the rated voltage and frequency is supplied. Be particularly careful in places where the power supply is unstable.

- Install external breakers and take other safety measures against short-circuiting in external wiring.
- Do not apply voltages to the Input Units in excess of the rated input voltage.
- Do not apply voltages or connect loads to the Output Units in excess of the maximum switching capacity.
- Disconnect the functional ground terminal when performing withstand voltage tests.
- Do not attempt to disassemble, repair, or modify any Units.
- Be sure that all mounting screws and cable connector screws are tightened to the specified torque.
  - M2.6: 0.3 N • m (personal computer connecting cable screws)
  - M4: 1.2 N • m (Unit mounting screws)
- Use crimp terminals for wiring. Do not connect bare stranded wires directly to terminals.
- Double-check all the wiring before turning on the power supply.
- Be sure that the connecting cables and other items with locking devices are properly locked.
- Check the user program for proper execution before actually running it in the Unit.
- Be sure that the set parameters and data operate properly.
- Confirm that no adverse effect will occur in the system before performing the following operations:
  - Changing the operating mode of the PC.
  - Force-resetting the relay contacts.
  - Changing the present values or set values.
  - Changing positioning data or parameters.
- Do not pull on the cables or cords, do not bend them beyond their natural limit, and do not place any object on top of them.
- Resume operation only after saving in the NC Unit the parameters and position data required for resuming operation.

# SECTION 1

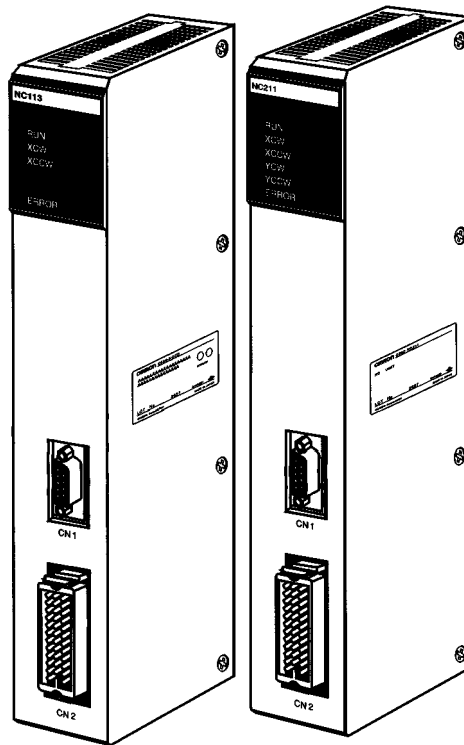
## Introduction

This section describes the basic features and operations of the Position Control Unit, as well as the basic configuration and operating principles of positioning control systems. Be sure to read and study these sections carefully; an understanding of the control system is essential for successful operation.

1-1	Features .....	2
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# 1-1 Features

C500-NC113  
Position Control Unit  
(1-axis control)  
C500-NC211  
Position Control Unit  
(2-axis control)



## Section Overview

The C500-NC113/211 Position Control Unit is a C-series and CV-series Special I/O Unit that receives positioning commands either externally or via Intelligent Write instructions, and uses that data to output control pulses to a stepping motor driver or a servomotor driver. Positioning data can be prepared in advance by NC Support Tool and then transferred to the Position Control Unit.

## Applicable Motor Drivers

The pulse train output can be easily connected to either of the following devices:

1, 2, 3...

1. Stepping motor driver
2. Servomotor driver designed for pulse train input

## Number of Control Axes and Controlling Capacity

Available are the one-axis Unit and the two-axis Unit. The two-axis Unit is capable of either controlling both axes simultaneously (linear interpolation) or controlling each axis independently.

## NC Support Tool

NC Support Tool can be used for reading and writing positioning data between a personal computer and the C500-NC113/211. This data can be saved as files and/or printed out. NC Support Tool can also be used for monitoring positioning actions and I/O during execution. For details on NC Support Tool, refer to the *NC Support Tool Operation Manual*.

## Compact Size

The two-axis Unit provides better space efficiency.

## Flexible Control

Override changes of 10% to 200% can be made even during positioning.

## Large Data Capacity with Backup

The C500-NC113/211 provides ample data capacity, with 500 positioning actions per axis, 30 parameters per axis, 100 acceleration/deceleration times per axis, 50 speeds per axis, and 30 dwell times for both axes combined. All of this data is stored in the Unit's built-in EEPROM, thus eliminating the need for battery maintenance.

## Applicable CPU Units

The C500-NC113/211 Position Control Unit can be used with C-series (C500, C1000H, or C2000H) or CV-series PCs.

**Data Communications  
Between PCU and PC**

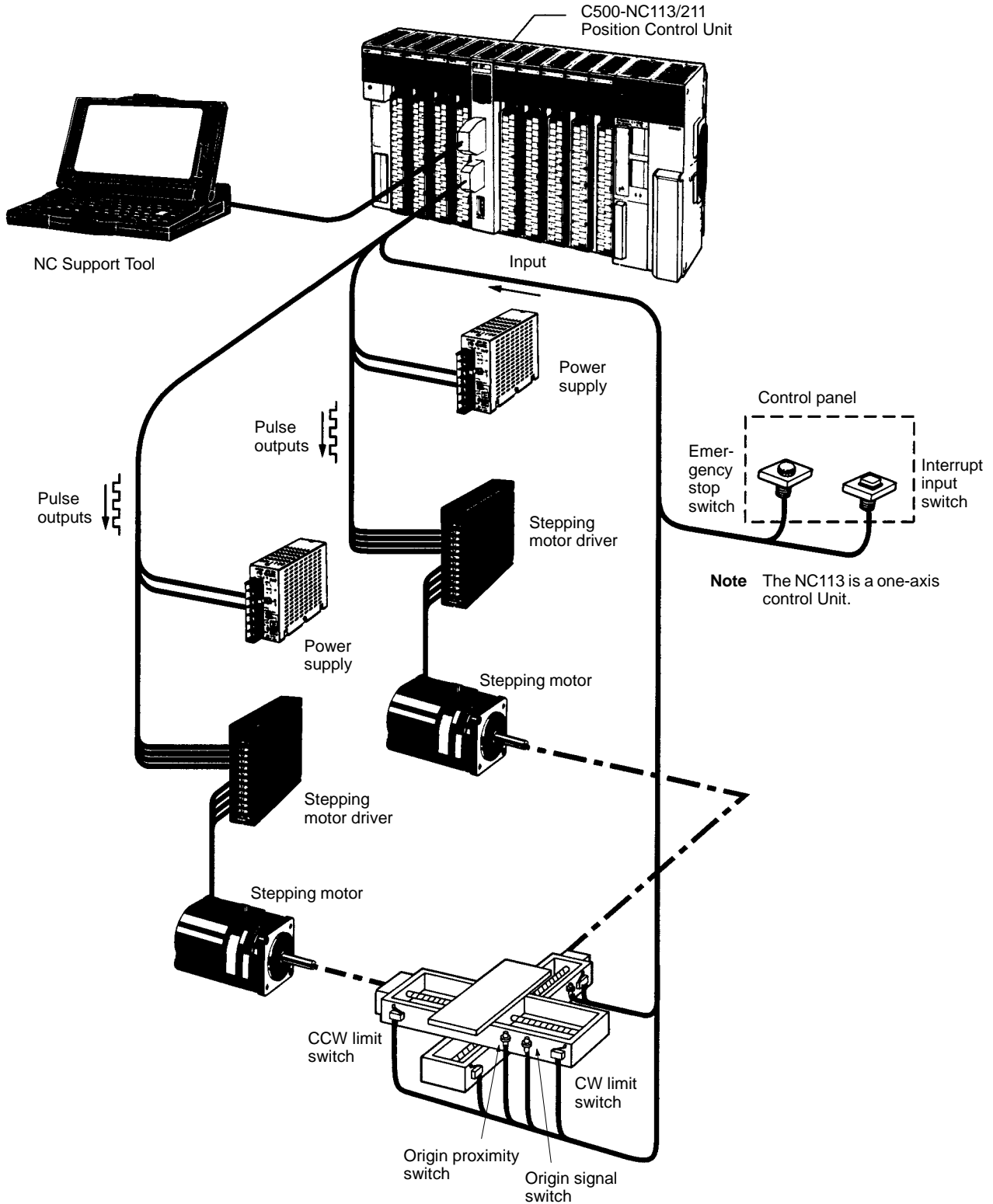
All data and command communications between the Programmable Controller and Position Control Unit use the Intelligent I/O Read and Write instructions.

Because the C500-NC113/211 utilizes Intelligent I/O Read and Write instructions, it cannot be operated in situations where these instructions cannot be used. For example, it cannot be operated with a Remote I/O Slave Unit or with a CPU Unit that does not support these instructions.

# 1-2 System Configuration

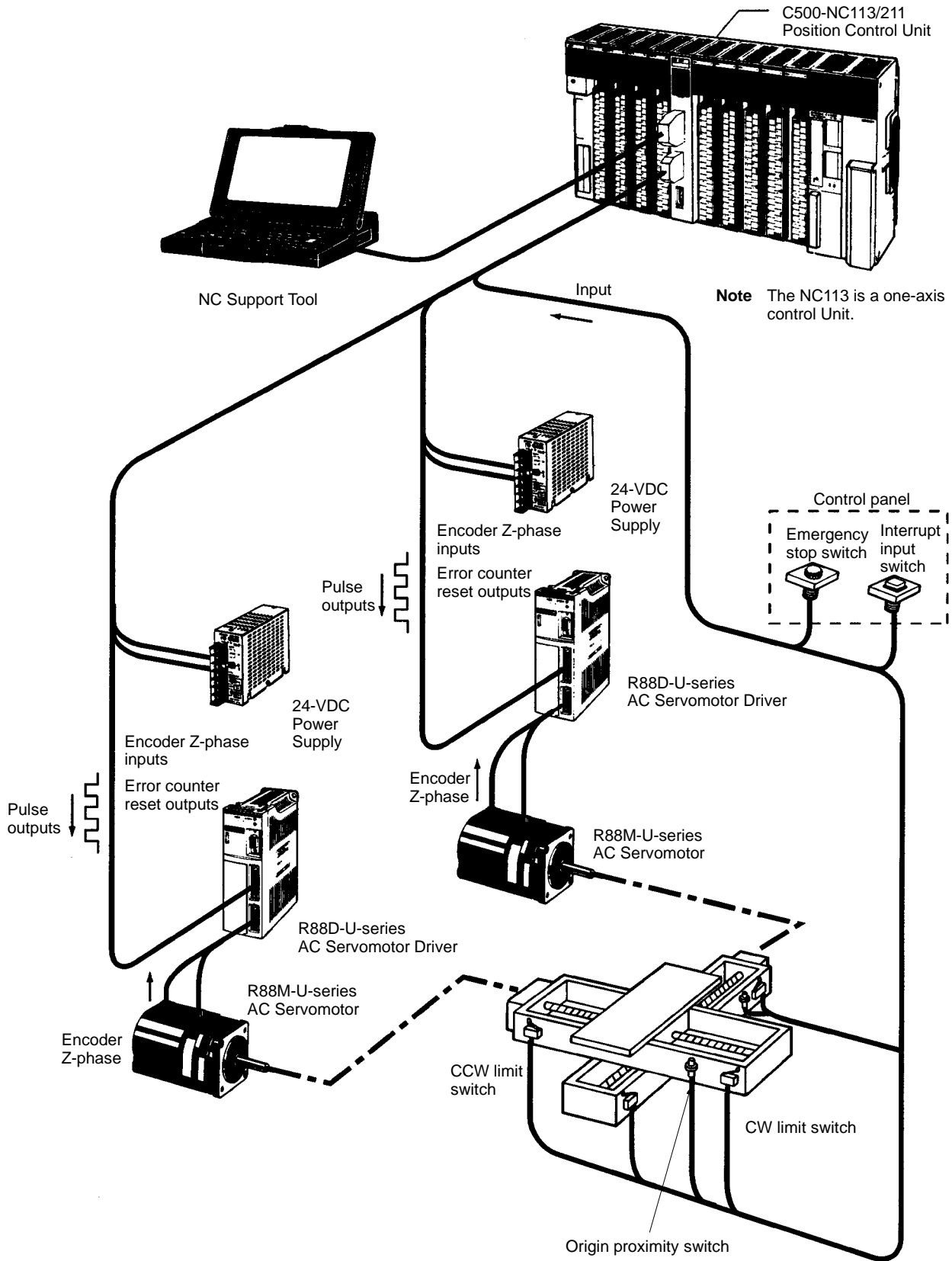
## Stepping Motor Driver Connection

The Position Control Unit receives control signals (CW limit, CCW limit, origin, origin proximity, emergency stop, interrupt) from devices and/or a control panel, and outputs pulse signals to a stepping motor driver.



### Servomotor Driver Connection

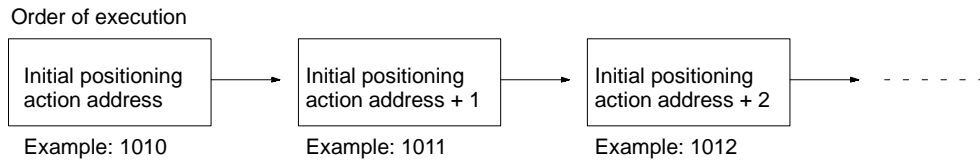
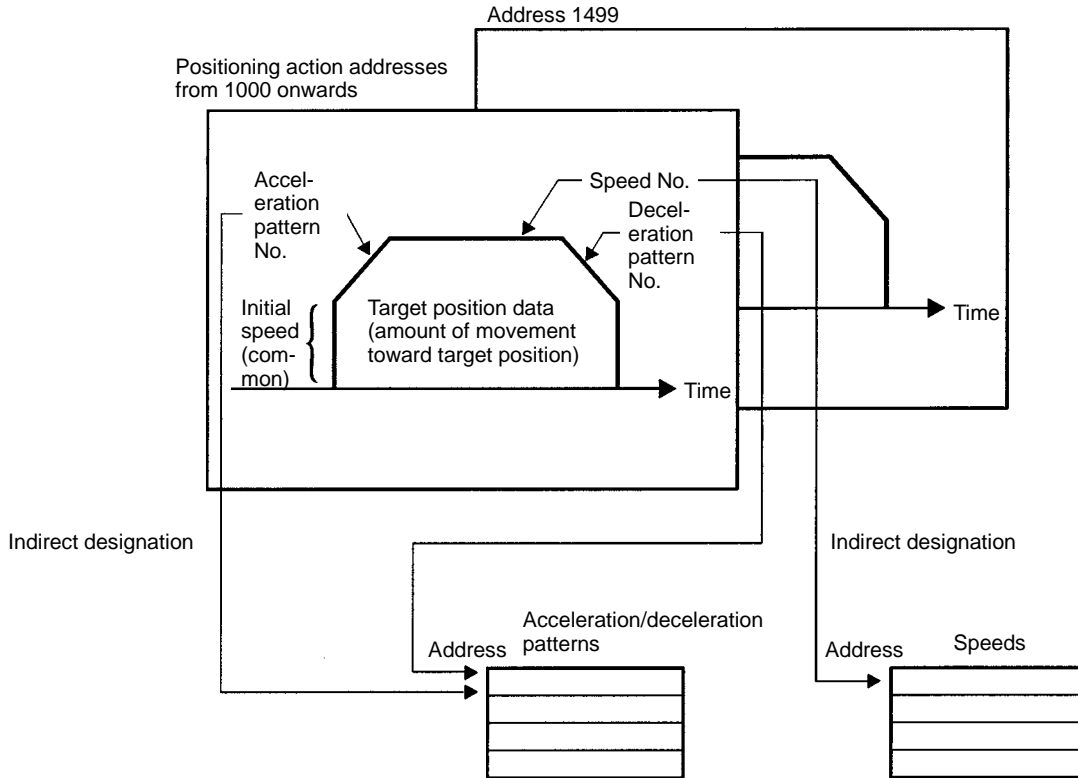
The Position Control Unit receives control signals (CW limit, CCW limit, origin proximity) from the devices and/or a control panel, and encoder Z-phase signals from a servomotor driver, and outputs pulse signals and error counter reset signals to the servomotor driver.





### 1-3 Basic Operations

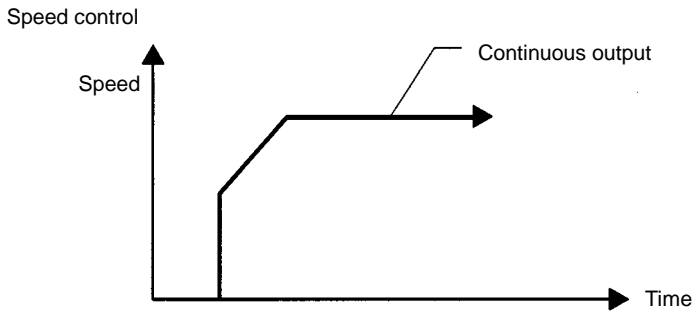
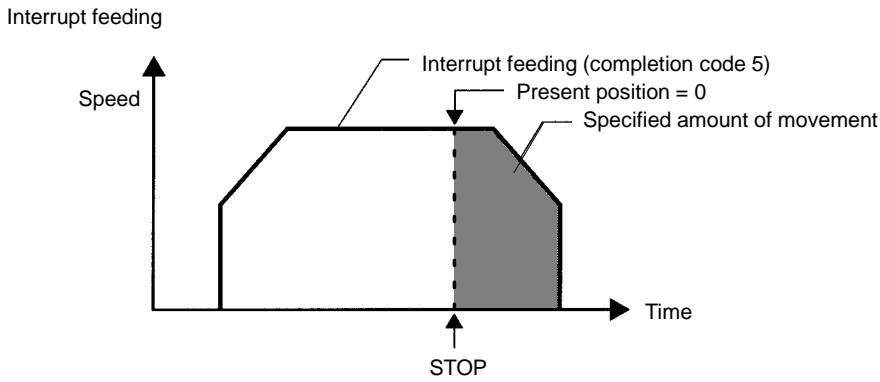
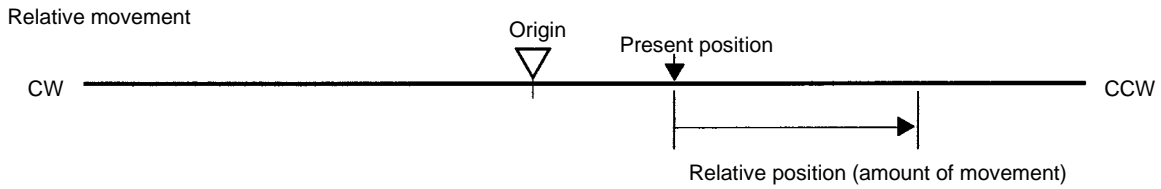
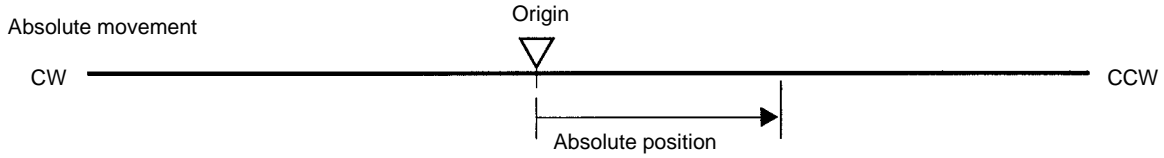
The C500-NC113 (one-axis) and C500-NC211 (two-axis) Position Control Units control positions and speeds by pulse outputs. For both position and speed control, positioning actions are executed in the acceleration/deceleration trapezoidal pattern shown in the following diagram. Up to 500 positioning actions can be stored for each axis. Positioning actions are executed in order, beginning with the initial positioning action.



**Positioning**

Positioning can be executed with either an absolute value (i.e., to an absolute position from the origin), or with an incremental value (i.e., to a relative position from the present position).

In addition, depending on instructions from the PC and interrupt inputs, positioning can be executed using either “speed control,” in which axes are operated at a fixed speed for that operation, or “interrupt feeding,” in which axes are moved for the specified amount during speed control and then stopped.



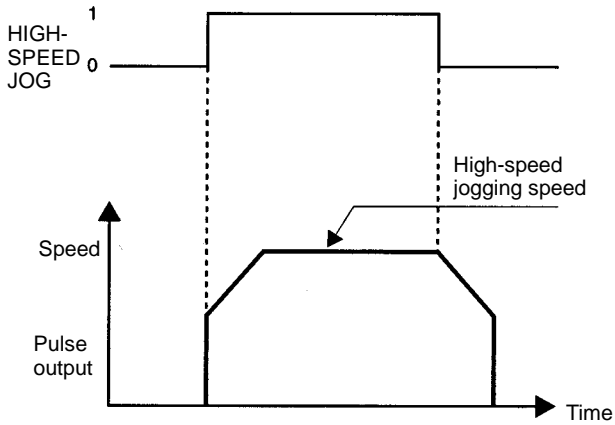
**Manual Operation**

There are two kinds of manual operation: jogging and inching.

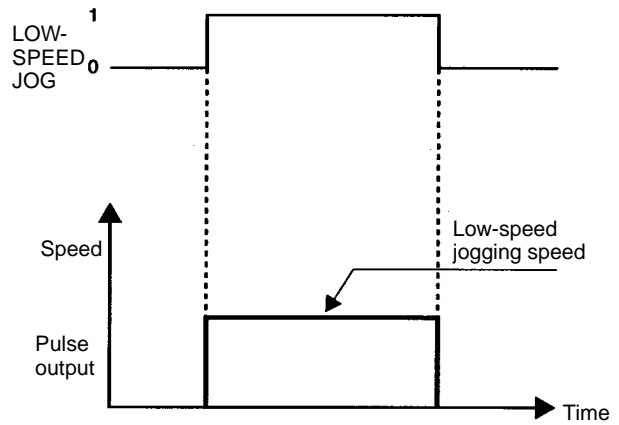
**Jogging**

The jogging operation moves the axis at a designated speed and then stops it.

High-speed Jogging

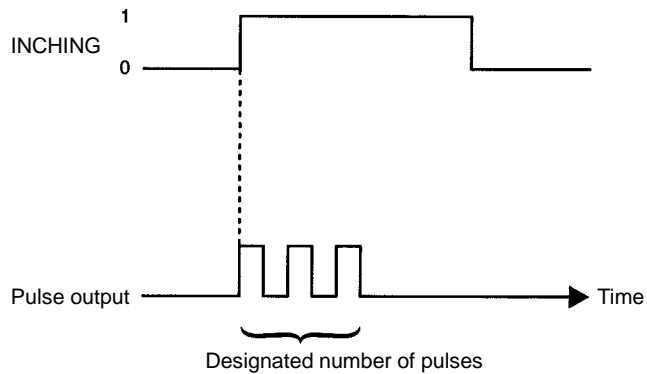


Low-speed Jogging



**Inching**

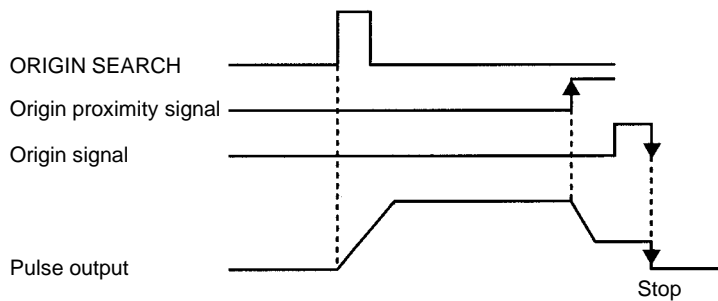
The inching operation moves the axis for a designated number of pulses.



**Other Operations**

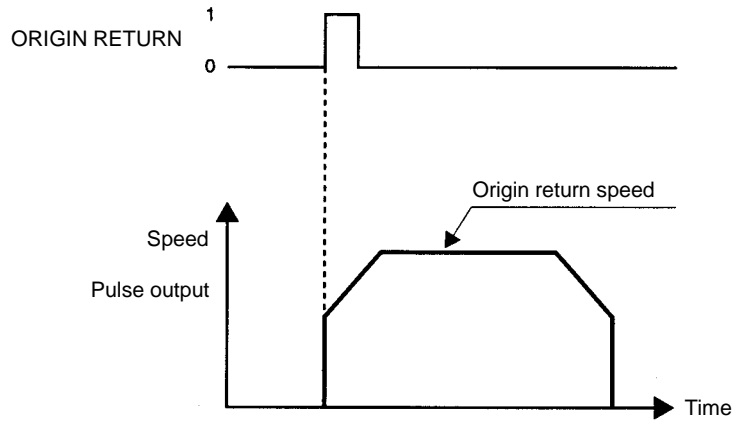
**Origin Search**

The origin search operation finds the origin for the designated axis.



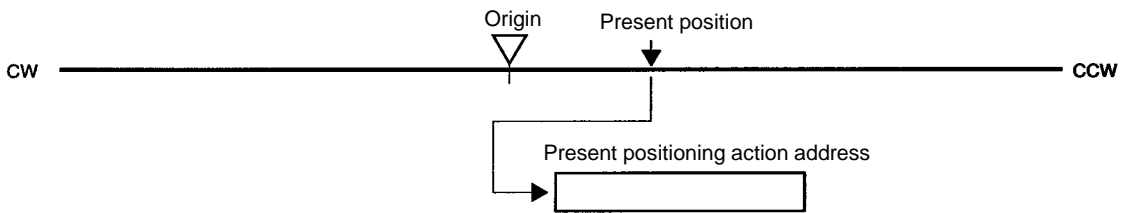
**Origin Return**

With a command from the PC, the origin return operation returns the axis to the origin.



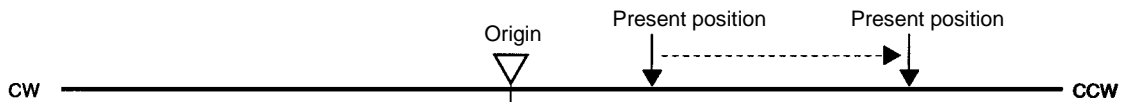
**Teaching**

With a command from the PC, the teaching operation writes the present position to a designated address.



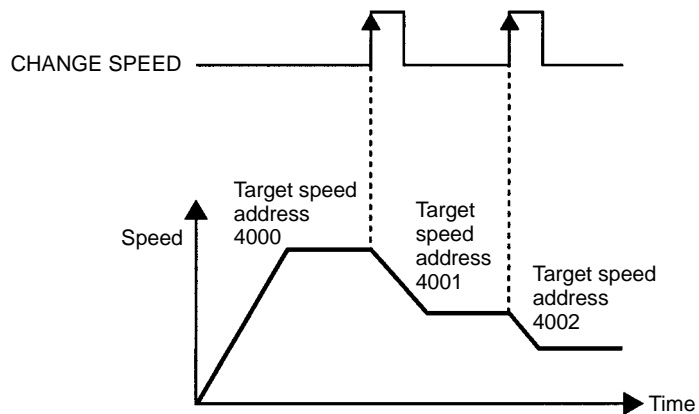
**Changing the Present Position**

With a command from the PC, this operation changes the present position to the specified data.



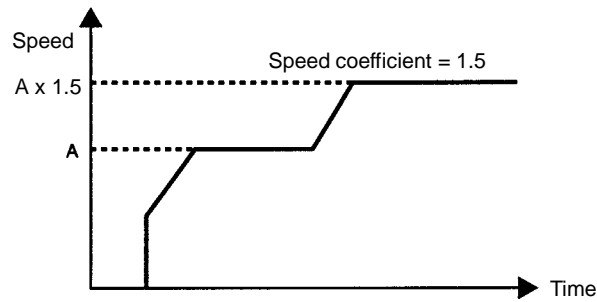
**Changing Speeds**

With an interrupt signal or a command from the PC, this operation changes the speed.



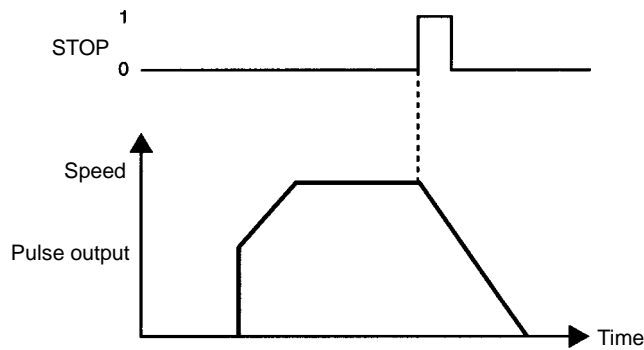
**Override**

The OVERRIDE command can be used to change the target speed during positioning by applying a speed coefficient.



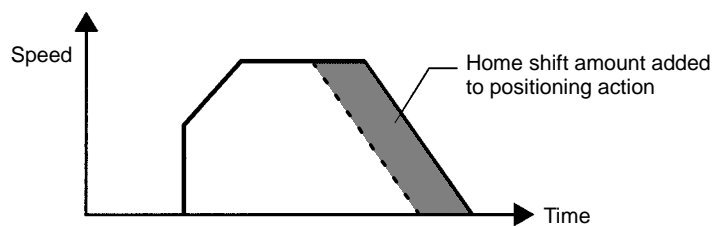
**Deceleration Stop**

Operation can be decelerated to a stop by means of an interrupt input or a command from the PC.



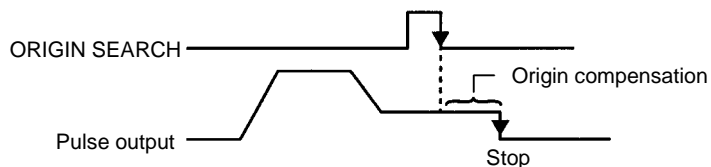
**Home Shift**

Home shift adds a specified amount to the position data that has been set for a positioning action.



**Origin Compensation**

Origin compensation adds a specified value to the origin when positioning is executed by an origin search.

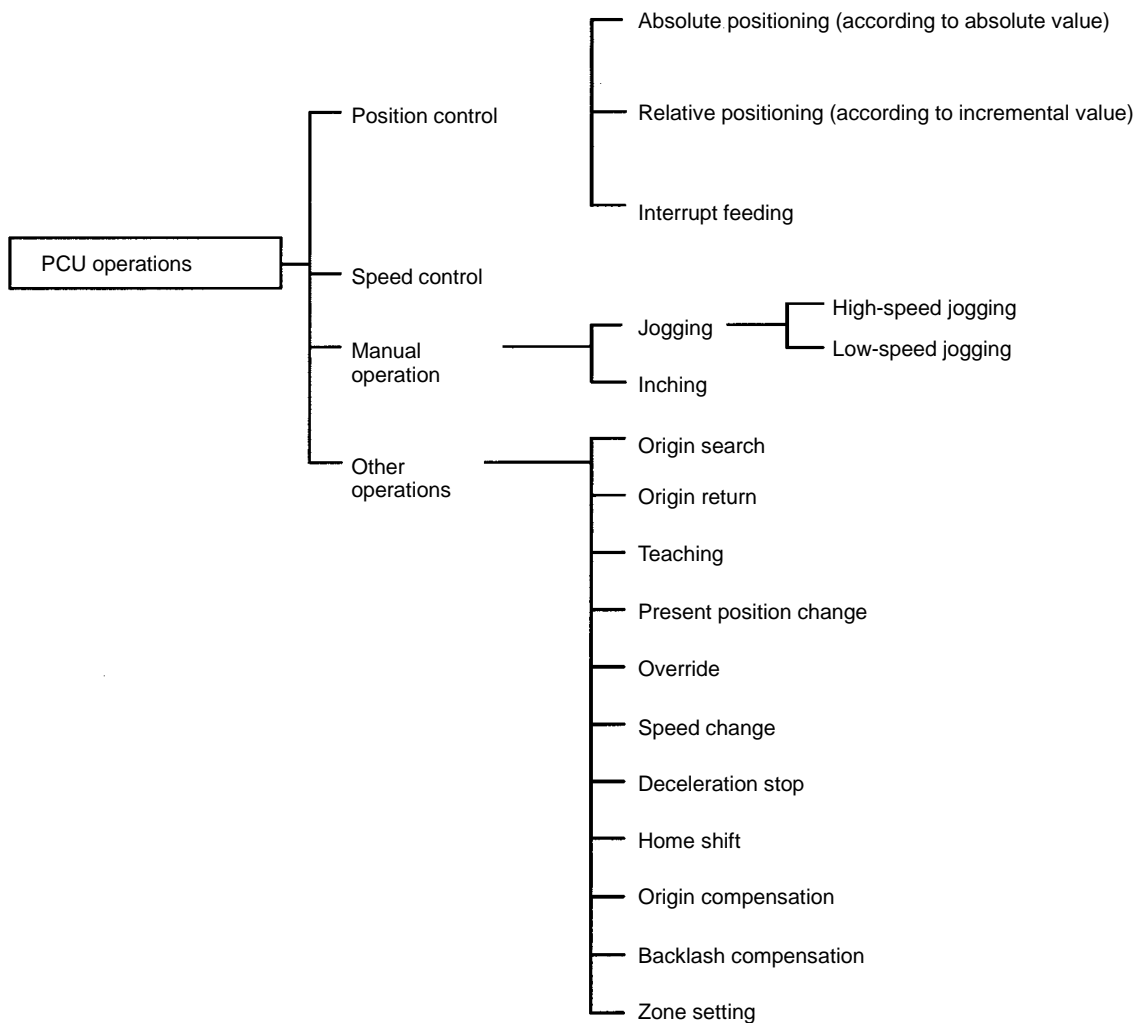
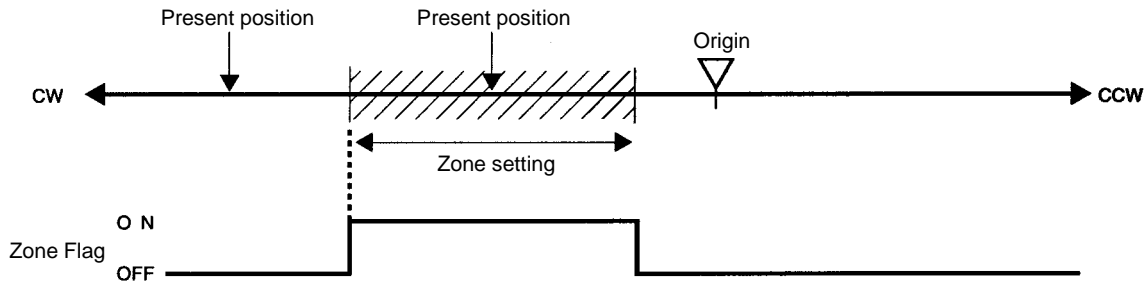


**Backlash Compensation**

This operation compensates for the amount of mechanical play, or "looseness," present in gears.

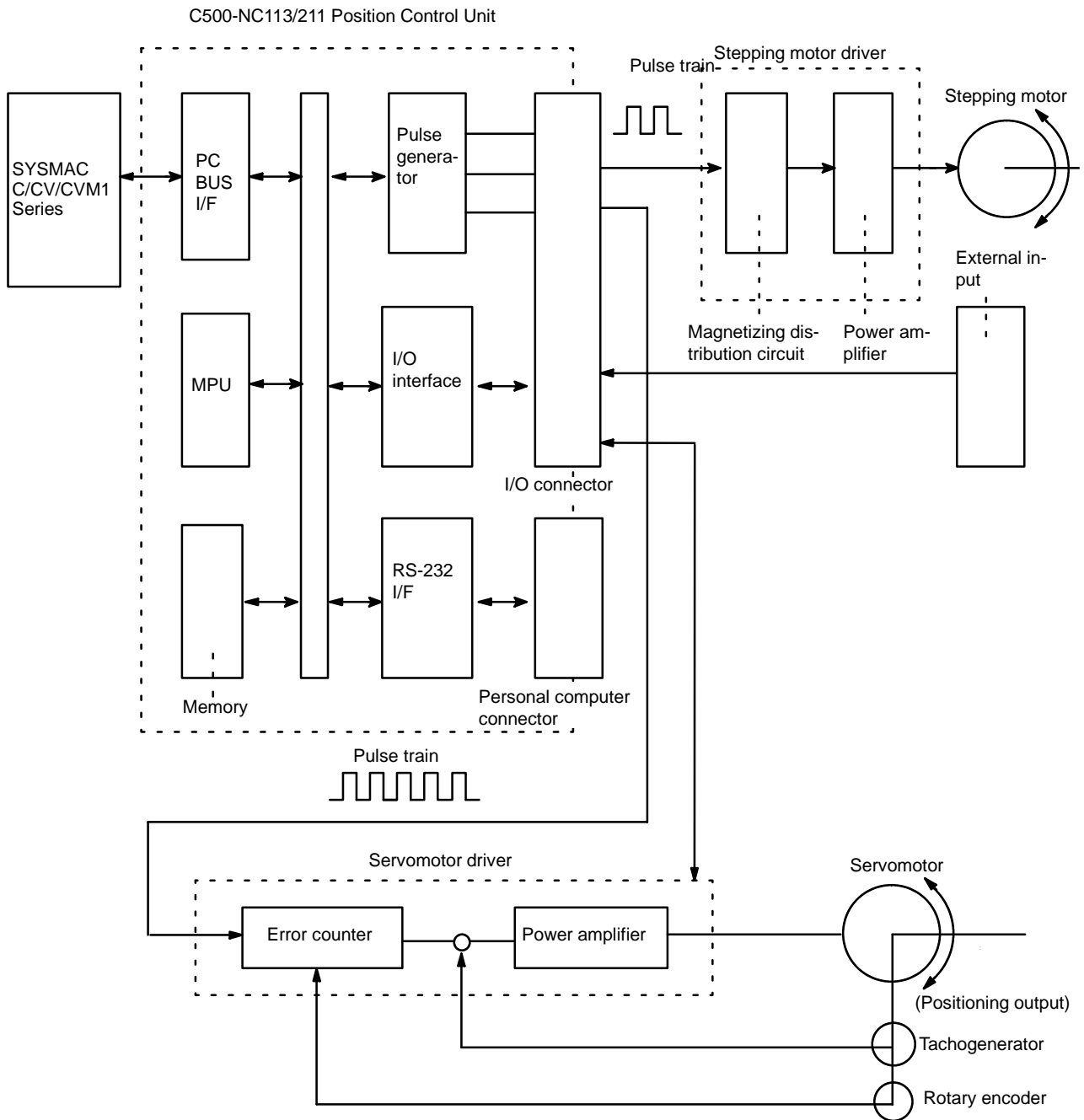
**Zones**

A zone is a range of positions which can be defined so that flags are turned ON whenever the present position is within the range.



# 1-4 Control System Principles

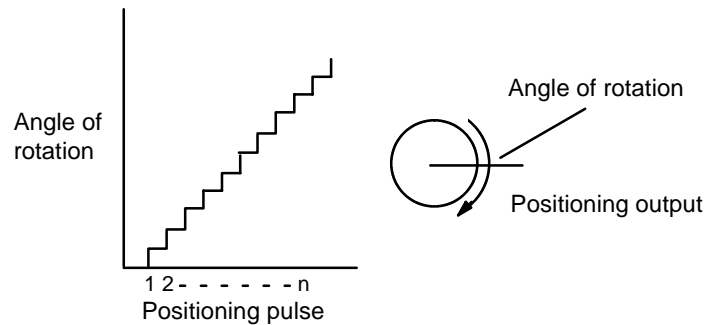
## Data Flow



## Control System Principles

**Open-Loop System**

In an open-loop system, the Position Control Unit outputs pulse trains as specified by the PC program to control the angle of rotation of the motor. Because the Unit outputs pulse trains, it is generally used with a stepping motor. The angle of rotation of a stepping motor can be controlled through the number of pulse signals supplied to the motor driver. The number of rotations of the stepping motor is proportional to the number of pulses supplied by the Unit, and the rotational speed of the stepping motor is proportional to the frequency of the pulse train.

**Basic Positioning System Design**

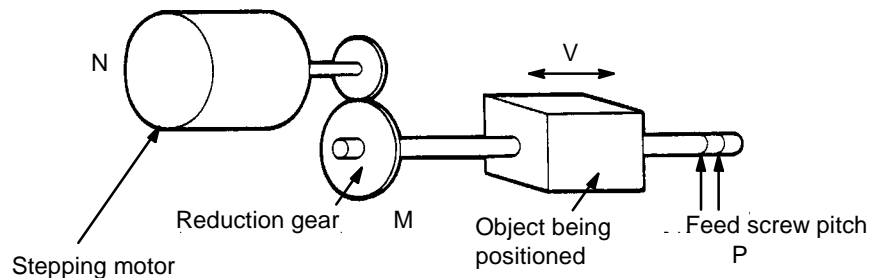
The following diagram and parameters illustrate a simplified positioning system.

$M$  : Reduction ratio

$P$  : Feed screw pitch (mm/revolution)

$V$  : Feed velocity of object being positioned (mm/s)

$\theta_s$  : Stepping angle per pulse (degree/pulse)



The positioning accuracy in mm/pulse is computed as follows:

$$\begin{aligned} \text{Positioning accuracy} &= P / (\text{pulses per revolution} \times M) \\ &= P / ((360 / \theta_s) \times M) \\ &= (P \times \theta_s) / (360 \times M) \end{aligned}$$

The required pulse frequency from the Unit (pulses/second) is computed as follows:

$$\begin{aligned} \text{Pulse frequency} &= V / \text{Positioning accuracy} \\ &= (360 \times M \times V) / (P \times \theta_s) \end{aligned}$$

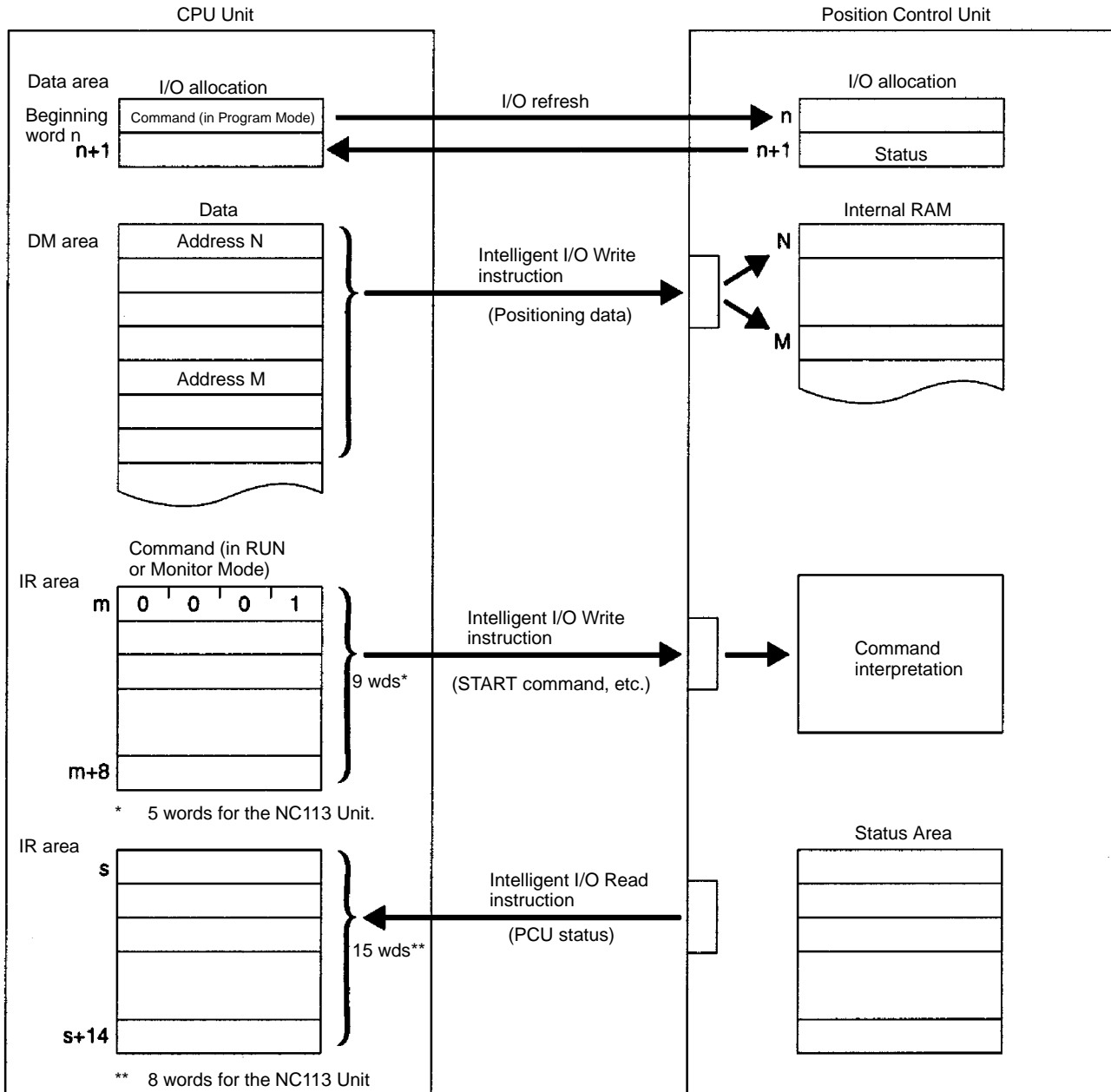
And the required number of pulses to feed an object by a distance  $L$  in mm is computed as follows:

$$\begin{aligned} \text{Number of pulses} &= L / \text{Positioning accuracy} \\ &= (360 \times M \times L) / (P \times \theta_s) \end{aligned}$$



# 1-5 Exchanging Data

The Position Control Unit exchanges data with the CPU Unit as shown in the following diagram.



**Explanation**

1, 2, 3...

**1. I/O Allocation**

The Position Control Unit occupies two CPU Unit output words (32 bits). During an I/O refresh (when the CPU Unit is in Program Mode), one of those words is used for transferring commands from the CPU Unit to the PCU, and the other is used for transferring PCU status to the CPU Unit.

**2. Data**

The positioning data to be stored at the PCU is transferred from the CPU Unit to the PCU, along with the addresses for the individual items of data, by means of the PCU's Intelligent I/O Write instruction. The data is then stored in the PCU's internal RAM according to the header addresses.

**3. Commands**

Commands such as START, ORIGIN SEARCH, and so on, are transferred to the PCU by means of Intelligent I/O Write instructions. The PCU then interprets and executes the commands.

**4. Status Area**

Status information such as the positioning action currently being executed is written to the CPU Unit from the PCU by means of the CPU Unit's Intelligent I/O Read instruction.

**Note** Instructions and data cannot be simultaneously transferred by the Intelligent I/O Write instruction.

# SECTION 2

## Specifications and Components

This section provides the specifications and illustrates the components of the Position Control Unit.

2-1	Specifications .....	18
2-1-1	General Specifications .....	18
2-1-2	Performance Specifications .....	18
2-1-3	I/O Electrical Specifications .....	20
2-2	Components .....	22

## 2-1 Specifications

### 2-1-1 General Specifications

Item	Specification
Power supply voltage	5 VDC (from Backplane) 24 VDC (from external power supply)
Voltage fluctuation tolerance	4.75 to 5.25 VDC (from Backplane) 21.6 to 26.4 VDC (from external power supply)
Internal current consumption	5 VDC at 750 mA max. 24 VDC at 50 mA max.
Voltage resistance	800 VAC at 50/60 Hz for 1 minute between external DC terminals and FG
Noise resistance	Power supply (100 VAC) (a) Normal mode: 1.0 kV (b) Common mode: 1.0 kV Conditions with noise simulator: Pulse width: 1 $\mu$ s, 100 ns Rise time: 1 ns I/O (24 VDC) (a) Normal mode: $\pm$ 600 V (b) Common mode: $\pm$ 1.2 kV I/O (5 VDC): $\pm$ 110 V Origin input (a) Normal mode: $\pm$ 300 V (b) Common mode: $\pm$ 300 V
Vibration resistance	10 to 54.8 Hz for 10 minutes each in X, Y, and Z directions with 0.5-mm double amplitude
Ambient operating temperature	0° to 55°C
Ambient operating humidity	35% to 85% (no condensation)
Ambient operating atmosphere	No corrosive gases
Ambient storage temperature	-20° to 65°C
Ground	Terminal-type ground (via Programmable Controller)
Weight	700 grams or less (not including external connectors)
Dimensions (mm)	250.0 x 34.5 x 93.0 mm (H x W x D) (Occupies one slot.)

### 2-1-2 Performance Specifications

Item	Specification	
Applicable PC models	C500(F), C1000H(F), C2000H CV-series, and CVM1-series	
I/O requirements	Words	2 words (32 bits)
	Slots	1 slot
Control	Control system	Automatic trapezoidal acceleration/deceleration (Pulse output open-loop type)
	Number of control axes	Total number of axes: NC113: 1 max./NC221: 2 max.
		Number of simultaneously controlled axes: NC113: 1 max./NC221: 2 max.
Number of independently controlled axes: NC113: 1 max./NC221: 2 max.		
Interpolation operations	Linear interpolation (NC211 only)	
Positioning operations	Interpolation	Linear interpolation (NC211 only)
	Interrupt feeding	Possible for the first STOP command when the positioning action's completion code is set for "interrupt feeding."
Speed control	Possible when the positioning action's completion code is set for "4."	
Positions	Data	-9999999 to 9999999 pulses -9999.999 to 9999.999 mm -999.9999 to 999.9999 inches
	Data items	500/axis
Speeds	Range	1 to 250,000 pps (pulse/sec)
	Data items	50/axis

Item		Specification
Acceleration/ Deceleration pattern	Data	2 to 2,000 pps/1 ms
	Data items	100/axis for acceleration and deceleration together.
Parameters	Backlash compensation	0 to 99,999 pulses
	Home shift	Position compensation -999999 to 999999 pulses -9999.99 to 9999.99 mm -999.999 to 999.999 inch
	Zone settings	Zone Flags turn ON when present position is within specified range. Up to eight zones can be set.
	Present position change setting	The present position is changed to the value set here. -9999999 to 9999999 pulses -9999.999 to 9999.999 mm -999.9999 to 999.9999 inch
	Number of inching pulses	1 to 100 pulses. The specified number of pulses is output when the INCHING command turns ON.
Functions	Origin search	Origin proximity: selectable (absent, N.O. input, or N.C. input). Origin signal: selectable (N.O. input or N.C. input) Origin compensation: -9999 to 9999 pulses -999.9 to 999.9 mm -99.99 to 99.99 inch  Origin search speed: May be set to high speed or proximity speed. Origin search method: May be set to stop upon origin signal after proximity signal has turned ON, or to stop upon receiving the Z-phase signal or positioning completed signal after the proximity signal has turned OFF. N.O. = Normally open N.C. = Normally closed
	Manual operation	Jogging (high-speed or low-speed) or inching
	Dwell time	30 dwell times can be set for both axes together. 0 to 9,990 ms (Unit: 10 ms)
	Deceleration stop	Operation is decelerated to a stop according to the designated deceleration pattern when the command or interrupt input is received. (During low-speed jogging, operation is stopped immediately without first decelerating.)
	Speed change	The speed is changed to the designated speed when the command or interrupt input is received.
	Teaching	With a command from the PC, the present position is written to the positioning action corresponding to the teaching data address.
	Present position change	With CHANGE PRESENT POSITION command, the present position is forcibly changed to the value set for the parameter.
	Override coefficient	The target speed can be changed during positioning by applying a speed coefficient of 10% to 200%.
Data saving	1) EEPROM data (positioning actions, parameters, acceleration/deceleration patterns, speeds, dwell times) can be read to and written from internal RAM by means of EEPROM READ and EEPROM WRITE commands. 2) Data from internal RAM can be read to a floppy disk or the hard disk by means of NC Support Tool.	
External I/O	Inputs	Origin proximity, origin, origin line driver (encoder Z-phase), positioning completed, CW limit, CCW limit, interrupt, emergency stop
	Outputs	Pulse, error counter reset, origin-adjustment command outputs
Internal current	5 VDC (Provided from Backplane)	
External device	Personal computer (RS-232C port, baud rate: 4,800 bps)	
Self-diagnostic function	Internal hardware errors	
Error detection function	CW limit, emergency stop execution, etc.	
EEPROM life expectancy	100,000 writing operations	

**Differences between the NC113 and NC211**

Item	NC211	NC113	Reference
Number of controlled axes	2	1	2-1
Interpolation function	Available (linear interpolation)	Not available	2-1
LED indicators	RUN, XCW, XCCW, YCW, YCCW, ERROR	RUN, XCW, XCCW, ERROR	2-2
I/O signals (connector: 2-pin allocation)	X-axis signal and Y-axis signal	X-axis signal only	3-1
Positions	X Axis: 500, Y Axis: 500	X Axis: 500 When Y-axis data is transmitted from the CPU Unit side, an error occurs.	5-1, 5-2
Parameters	X Axis: 29, Y Axis: 29	X Axis: 29 When Y-axis data is transmitted from the CPU Unit side, an error occurs.	5-1, 5-2
Speeds	X Axis: 50, Y Axis: 50	X Axis: 50 When Y-axis data is transmitted from the CPU Unit side, an error occurs.	5-1, 5-2
Acceleration/Deceleration patterns	X Axis: 100, Y Axis: 100	X Axis: 100 When Y-axis data is transmitted from the CPU Unit side, an error occurs.	5-1, 5-2
Commands (RUN, MONITOR modes)	9 words	5 words (4 words for the Y axis are not available) Y-axis commands will be neglected.	6-1, 6-2
Commands (PROGRAM mode)	Allocated I/O area X Axis: Bits 4 to 8 Y Axis: Bits 10 to 14	Allocated I/O area X axis: Bits 4 to 8 Y-axis bits will be neglected.	6-3
Status (RUN, MONITOR modes)	15 words	8 words (7 words for the Y axis are not available) The Y-axis status always remains OFF.	7-1, 7-4
Status (PROGRAM mode)	Allocated I/O area X Axis: Bits 4 to 9 Y Axis: Bits 10 to 15	Allocated I/O area X Axis: Bits 4 to 9 The Y-axis bits always remains OFF.	7-2, 7-3

**2-1-3 I/O Electrical Specifications**

**Input Specifications**

Item	Specification
Voltage	12 to 24 VDC $\pm 10\%$
Current	5 mA (at 12 V) to 15 mA (at 24V )
ON voltage	10.5 VDC min.
OFF voltage	3.0 VDC max.
ON response time	1 ms max.
OFF response time	1 ms max.

**Origin-signal Input Specifications**

Item	Connection terminal	Specification	Response time
External signal is open-collector signal	X Axis	Input current is 6 mA (at 12 V) to 17 mA (at 24 V); other specifications remain the same	Mode 0: < 1 ms  Mode 1, 2: < 0.1 ms
	Y Axis		
External signal is line-driver signal	X Axis	Signal is a line-driver signal corresponding to Am26LS31	Mode 3: Not used
	Y Axis		

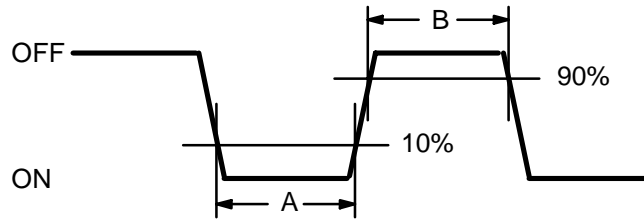
**Note** The Y-axis connection terminal is not provided for the NC113.

Output Specifications

Item	Specification
Maximum switching capacity	30 mA at 5 to 24 VDC $\pm 10\%$ (NPN open collector)
Minimum switching capacity	7 mA at 5 to 24 VDC $\pm 10\%$ (NPN open collector)
Leakage current	0.1 mA max.
Residual voltage	0.6 V max.
External power supply	24 VDC $+10\%$ (maximum 50 mA)

CW/CCW Pulse Output Specifications

Minimum Pulse Width



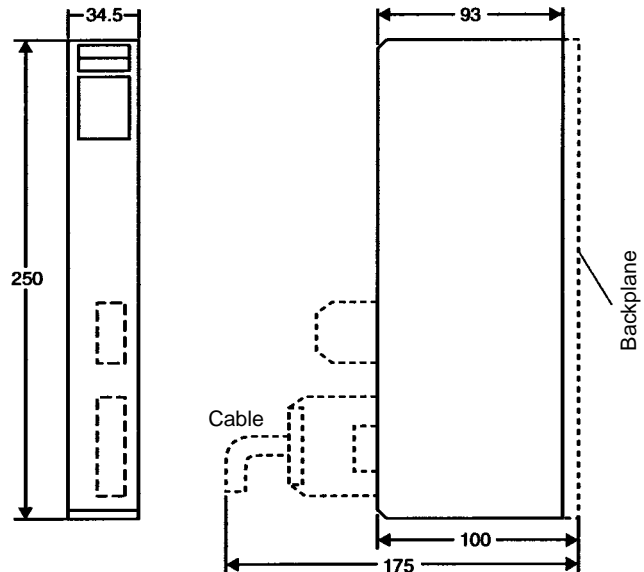
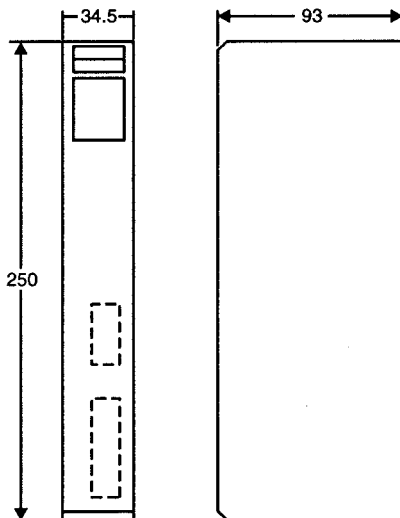
**Note** The OFF and ON refer to the output transistor.  
The output transistor is ON at level "L."

Pulse frequency	Open or close current/loaded power-source voltage					
	7 to 30 mA/5 VDC $\pm 10\%$		7 to 30 mA/12 VDC $\pm 10\%$		7 to 30 mA/24 VDC $\pm 10\%$	
	A	B	A	B	A	B
50 kpps max.	9.9 $\mu$ s min.	9.5 $\mu$ s min.	9.9 $\mu$ s min.	9.5 $\mu$ s min.	9.9 $\mu$ s min.	9.3 $\mu$ s min.
100 kpps max.	4.9 $\mu$ s min.	4.6 $\mu$ s min.	4.9 $\mu$ s min.	4.5 $\mu$ s min.	4.9 $\mu$ s min.	4.3 $\mu$ s min.
200 kpps max.	2.4 $\mu$ s min.	2.1 $\mu$ s min.	2.4 $\mu$ s min.	2.0 $\mu$ s min.	2.4 $\mu$ s min.	1.7 $\mu$ s min.
250 kpps max.	1.8 $\mu$ s min.	1.5 $\mu$ s min.	1.8 $\mu$ s min.	1.4 $\mu$ s min.	1.8 $\mu$ s min.	1.2 $\mu$ s min.

**Note** Specifications other than those above conform to the output specifications of the preceding page.

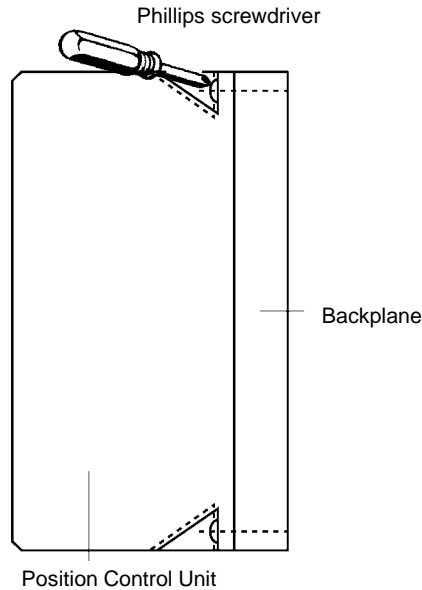
C500-NC113/211 Dimensions (Unit: mm)

Mounted Dimensions



**Mounting the Position Control Unit**

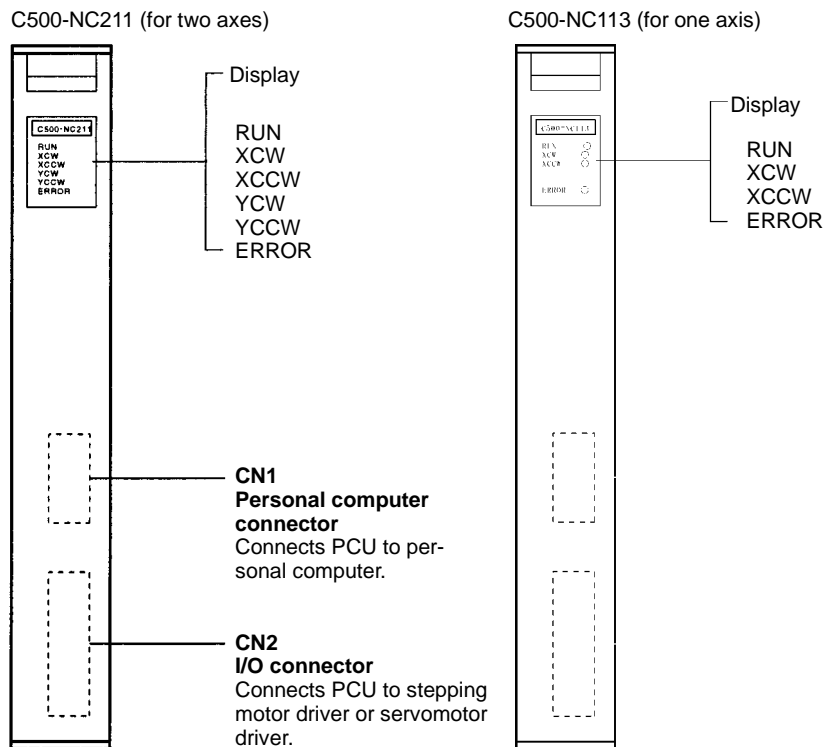
Insert the Position Control Unit into the connector of the Backplane and tighten the two screws (one at the top and one at the bottom) using the Phillips screwdriver to the torque of 1.2 N • m.



**2-2 Components**

**Front Panel**

The following illustration shows the components and nomenclature for the C500-NC211 Position Control Unit (for two axes) and C500-NC113 Position Control Unit (for one axis).





Indicators

Indicator	Color	Function
RUN	Green	Lit during normal operation. Goes out for errors.
XCW	Green	Lit during output of CW (clockwise) pulses for X axis.
XCCW	Green	Lit during output of CCW (counterclockwise) pulses for X axis.
YCW	Green	Lit during output of CW (clockwise) pulses for Y axis.
YCCW	Green	Lit during output of CCW (counterclockwise) pulses for Y axis.
ALARM (flashing)	Red	Flashes if an alarm exists for the set data when the power is turned on or when writing to EEPROM.
ERROR	Red	Lit when an error has occurred causing operation to stop.

- When the power is turned on, or when writing to EEPROM, the ALARM LED flashes if data for X and Y within the assigned range is not entered in the respective DM areas for the X and Y axes.
- When only one axis is used with the NC211 (two-axis control), short-circuit the CW limit and CCW limit of the unused axis to 0 V in the input power supply. The ERROR LED will light if these are not short-circuited, but the axis in use will operate normally.

# SECTION 3

## Wiring

This section explains the Position Control Unit's connector pin arrangement and wiring, using the NC211 as an example. Note that the NC113 is not provided with the Y axis.

3-1	Basic Connections .....	26
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3-1-2	Wiring Configurations According to Origin Search Mode .....	27
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3-3	Connecting External I/O .....	37
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## 3-1 Basic Connections

### 3-1-1 Connector Pin Arrangement

The following shows the I/O connector arrangement as viewed from the front of the Position Control Unit.

Pin No.	Designation	Pin No.	Designation	Pin No.	Designation
12	FG (frame ground)			34	X/Y axis for input common (12-24 VDC)
11	X-axis Origin (0 V/-Z)			33	Y-axis Origin (0 V/-Z)
10	X-axis Origin input (12-24 VDC)	22	X/Y axis for input common (12-24 VDC)	32	Y-axis Origin input (12-24 VDC)
9	X-axis Origin driver input (+Z)	21	Y-axis CW limit input (0 V)	31	Y-axis Origin driver input (+Z)
8	X-axis Positioning completion input (0 V)	20	Y-axis CCW limit input (0 V)	30	Y-axis Positioning completion input (0 V)
7	X-axis Origin proximity input (0 V)	19	X/Y axis Emergency stop input (0 V)	29	Y-axis Origin proximity input (0 V)
6	X-axis External interrupt input (0 V)	18	X-axis CW limit input (0 V)	28	Y-axis Interrupt input (0 V)
5	X-axis (open collector) Origin-adjustment command output	17	X-axis CCW limit input	27	Y-axis (open collector) Origin-adjustment command output
4	X-axis (open collector) Error counter reset output	16	Y-axis CCW pulse/direction output	26	Y-axis (open collector) Error counter reset output
3	X-axis CW pulse/pulse output	15	Y-axis (with 1.6K $\Omega$ resistance) CCW pulse/direction output	25	Y-axis CW pulse/pulse output
2	X-axis (with 1.6K $\Omega$ resistance) CW pulse/pulse output	14	X-axis CCW pulse/direction output	24	Y-axis (with 1.6K $\Omega$ resistance) CW pulse/pulse output
1	Output power supply 24 VDC	13	X-axis (with 1.6K $\Omega$ resistance) CCW pulse/direction output	23	Output power supply 0 V

- Note**
1. Pin numbers in the shaded boxes are those required for the NC113.
  2. The common sides of each output (2-5, 13-16, 24-27) are all short-circuited to No. 23 pin output power supplies (0 V).
  3. The common sides of all inputs apart from the origin inputs and origin line driver inputs (6-8, 17-21, 28-30) are all short-circuited through diodes to the common for No. 22/34 pin input (12-24 V DC).
  4. Origin common 11 is paired with 9 or 10, and 33 is paired with 31 or 32.
  5. The NC113 is not provided with the Y axis.

#### External Wiring Connectors

The external wiring connectors are item MR-34LF, made by Honda Telecommunications Industries (soldered type). These connectors must be prepared by the user.



**Caution** Be sure to adhere to the following specifications.

- Use 24  $\pm$ 10% VDC as the pulse output power supply.
- Use either the origin inputs (10, 11/32, 33) or the origin line driver inputs (9, 11/31, 33), but **not both**. Connecting both of them can damage the internal circuitry.
- For switches that are used for inputs, be sure to use switches with a switching capacity of at least 16 mA.

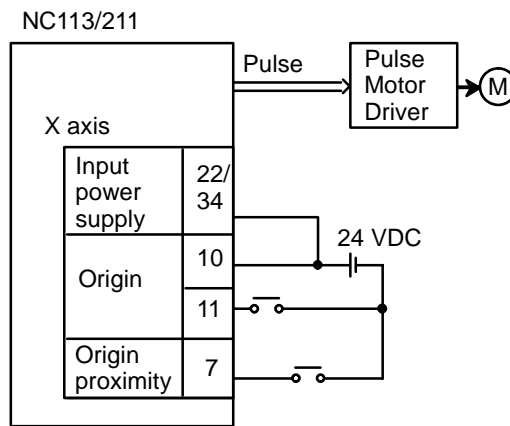
- The leakage current must be less than 1.3 mA when two-wire type sensors are used.
- Since a short-circuit in the load or reversely connected power supply polarity may damage internal circuitry, be careful when wiring them.

### 3-1-2 Wiring Configurations According to Origin Search Mode

Select the appropriate origin search mode (0 to 3) in accordance with the motor driver or signal lines to be used.

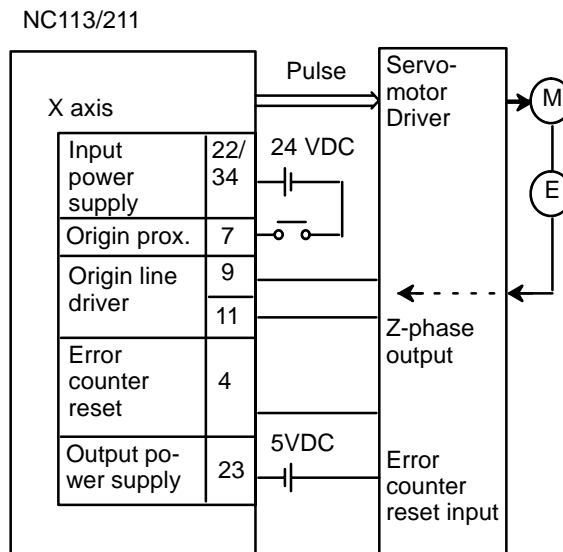
#### Origin Search Mode 0

This mode is used to control a stepping motor driver. In this mode, connect a sensor to the origin signal lines (Connectors No. 10, 11, 32, 33). The response time of the origin signal is 1 ms.



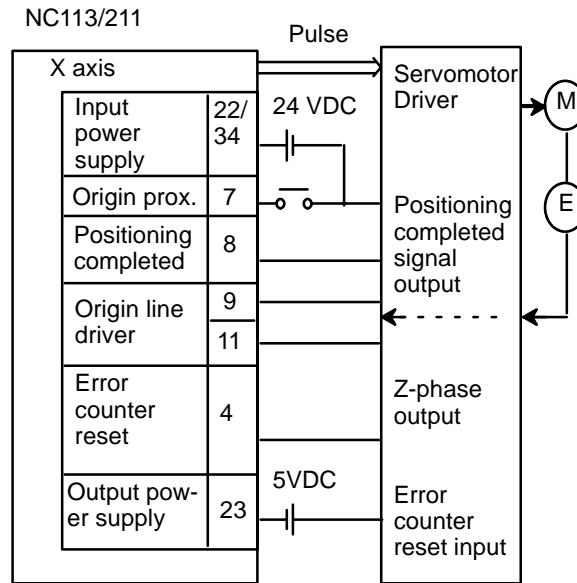
#### Origin Search Mode 1

This mode is used to control a servomotor driver. The origin line driver input signals lines and error counter reset output signal lines are connected, but the positioning completed signal lines are not used. The response time of the origin line driver input is 0.1 ms.



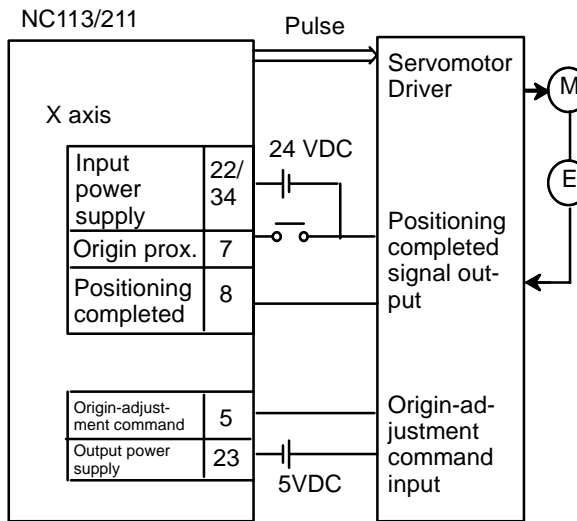
**Origin Search Mode 2**

This mode is used with a servomotor driver. It is the same as mode 1, but uses the positioning completed signal lines.



**Origin Search Mode 3**

This mode is used with a servomotor driver when using an origin adjustment command.



**Note** The above wiring diagrams for modes 1, 2, and 3 are applicable when an OM-RON R88D Servomotor Driver is used.

Adjust the servomotor driver so that its positioning completed signal turns OFF while the motor is operating and ON when the motor stops.

**Relation Between Origin Search Modes and I/O**

Origin search mode	Motor driver	I/O used						
		Input				Output		
		Origin proximity	Origin	Origin line driver (Z phase)	Positioning completed	CW/CCW pulse	Error counter reset	Origin adjustment
0	Stepping motor driver	Yes	Yes	---	---	Yes	---	---
1	Servomotor driver	Yes	---	Yes	---	Yes	Yes	---
2		Yes	---	Yes	Yes	Yes	Yes	---
3		Yes	---	---	Yes	Yes	---	Yes

### 3-2 Origin Search Mode Connection Examples

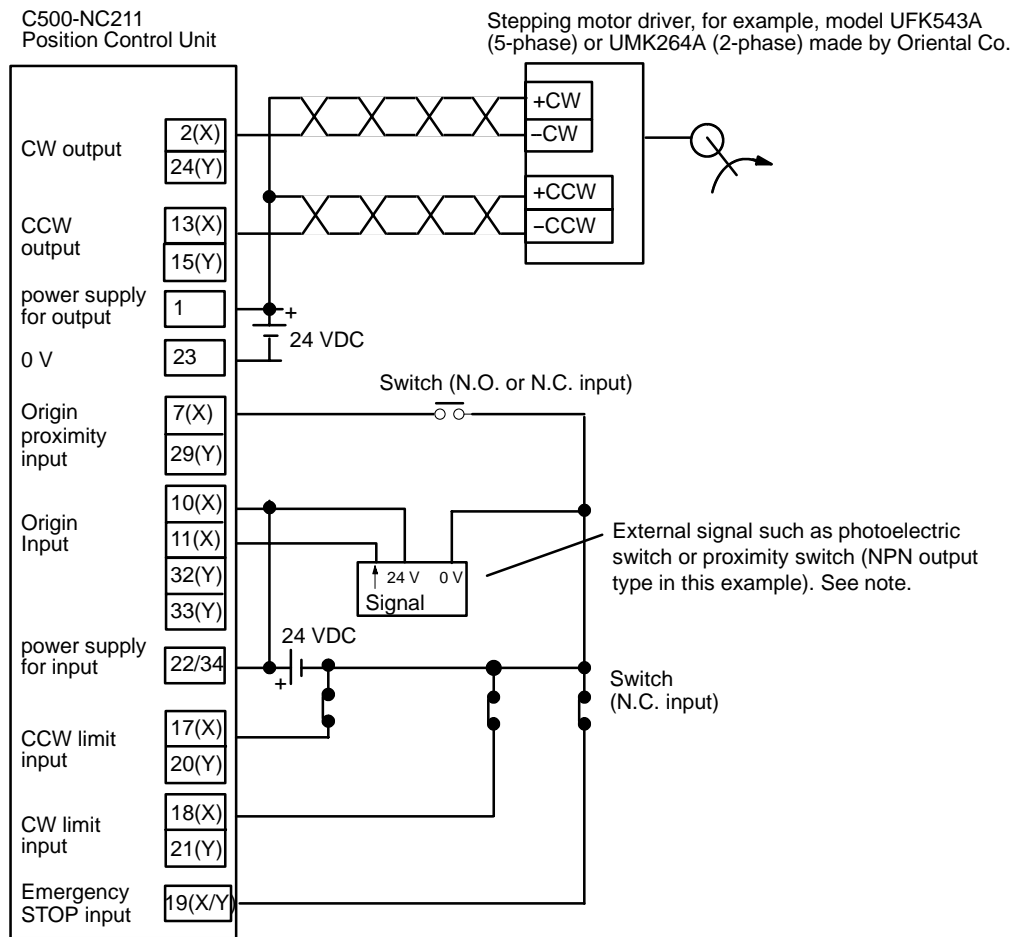
#### Example 1: Origin Search Mode 0 Connection

This example shows the use of a stepping motor with an external sensor signal connected to the origin signal.

Do not make any connection to the Z-phase input (9 (X)/ 31 (Y)).

#### When Stepping Motor Driver is Used

The following diagram illustrates connection in which only the X axis is used. The same wiring can be used for the Y axis of the NC211. The NC113 is not provided with the Y axis.

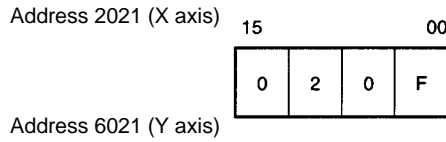


**Note** Be sure there is no chattering in the origin input. If chattering occurs during an origin search, an emergency stop error (error code 6000) will be generated.

**Caution** When only one axis is used, short-circuit the CW limit input and CCW limit input of unused axis to 0 V in 24 VDC. If these are not short-circuited, the ERROR LED will light, although the axis in use will operate normally.

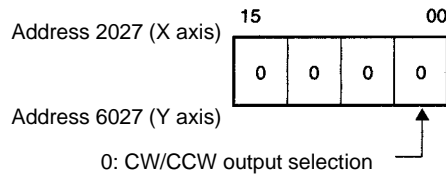
Data Settings Related to Connections (X Axis Only for the NC113)

- 1, 2, 3... 1. Set the origin search mode.



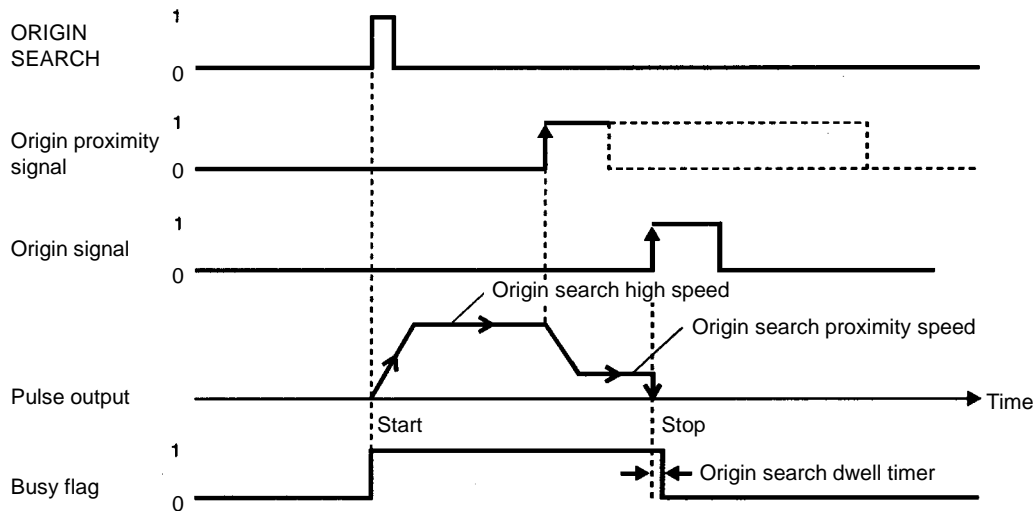
Bit	Setting	Contents	
00	1	Origin type	Origin search direction: CCW
01	1		Origin proximity signal: Yes
02	1		Origin proximity signal contact: N.O. (↑)
03	1		Origin signal contact: N.O. (↑)
04	0		Origin search method: No proximity reversal
08 to 11	2	Origin search pattern: 2	
12 to 15	0	Origin search mode: 0	

2. Set the output pulses.



**ORIGIN SEARCH**

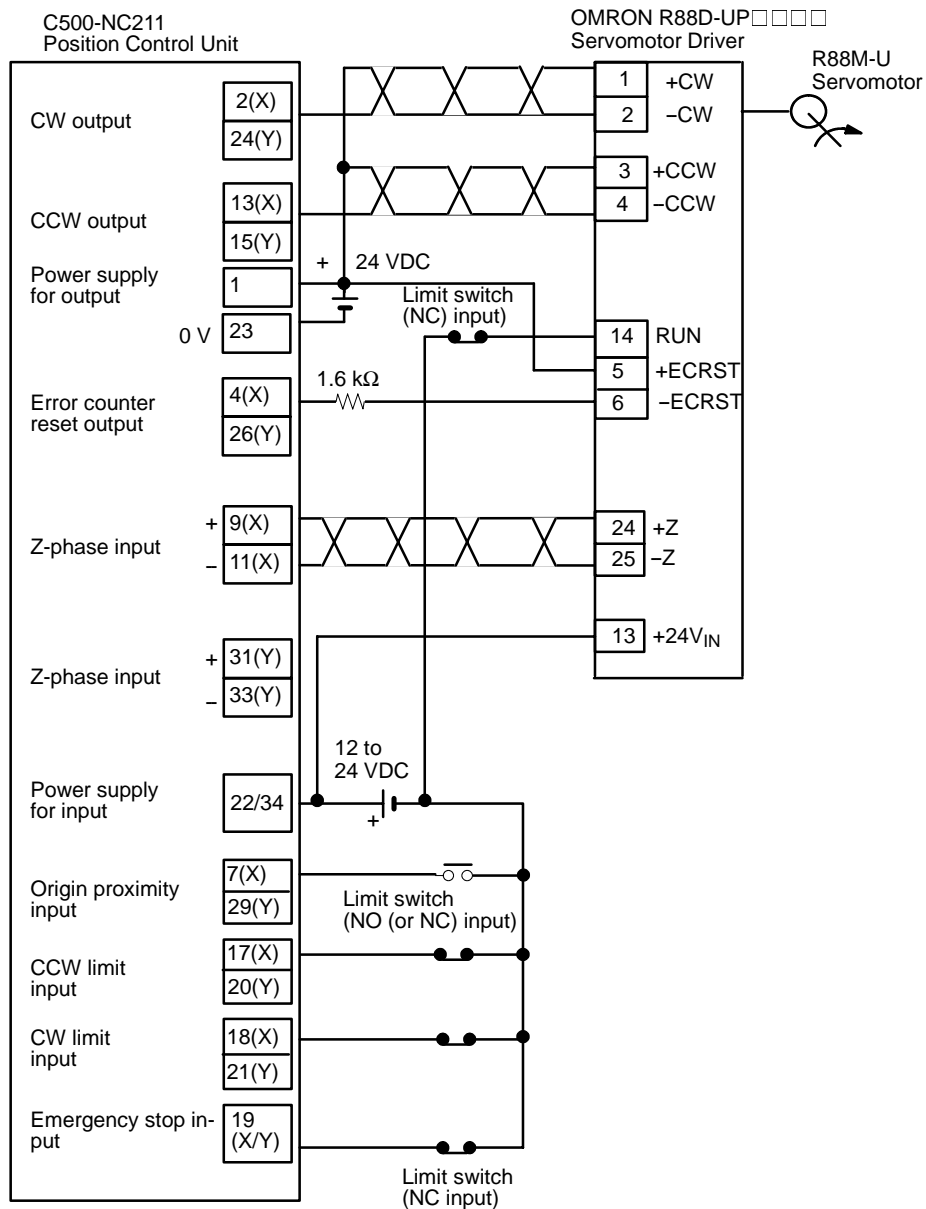
The origin search operation is started after the rising edge of the origin proximity signal and ends with the rising edge of the origin signal (origin search pattern 2).



**Example 2: Origin Search Mode 1 Connection**

In this example, a servomotor driver is employed and the Z-phase of the encoder is connected to the origin line driver input terminal and used as the origin signal. (X axis only for the NC113.)

**Note** Do not connect anything to the origin signal (10 (X) /32 (Y)). In this example an OMRON Servomotor Driver is used.

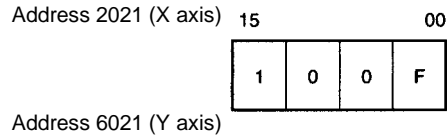


**Caution** When only one axis is used, short-circuit the CW limit input and CCW limit input of unused axis to 0 V in 12 to 24 VDC. If these are not short-circuited, the ER-ROR LED will light, but the axis in use will operate normally.



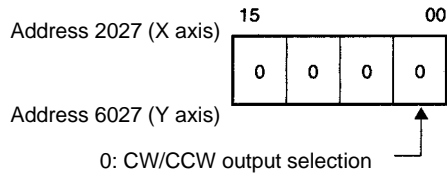
Data Settings Related to Connections (X Axis Only for the NC113)

- 1, 2, 3... 1. Set the origin search mode.



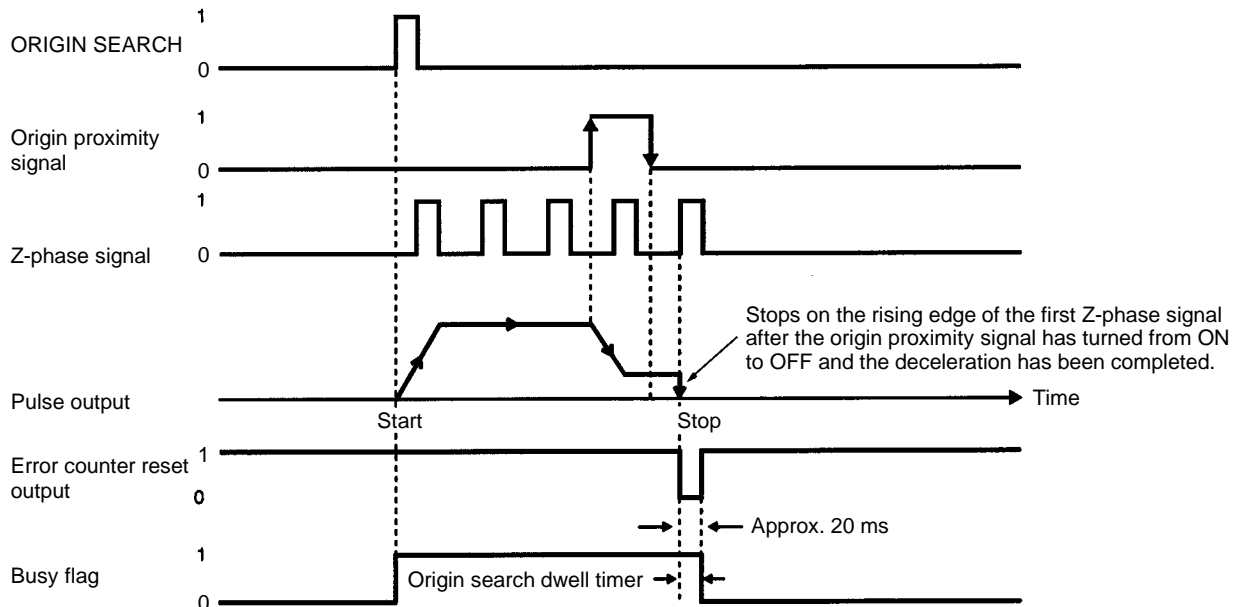
Bit	Setting	Contents	
00	1	Origin type	Origin search direction: CCW
01	1		Origin proximity signal: Yes
02	1		Origin proximity signal contact: N.O. (↑)
03	1		Origin signal contact: N.O. (↑)
04	0		Origin search method: No proximity reversal
08 to 11	0	Not used.	
12 to 15	1	Origin search mode: 1	

2. Set the output pulses.



**ORIGIN SEARCH**

The origin search operation stops on the rising edge of the first Z-phase signal after the origin proximity signal has turned from ON to OFF, and after deceleration has ended.



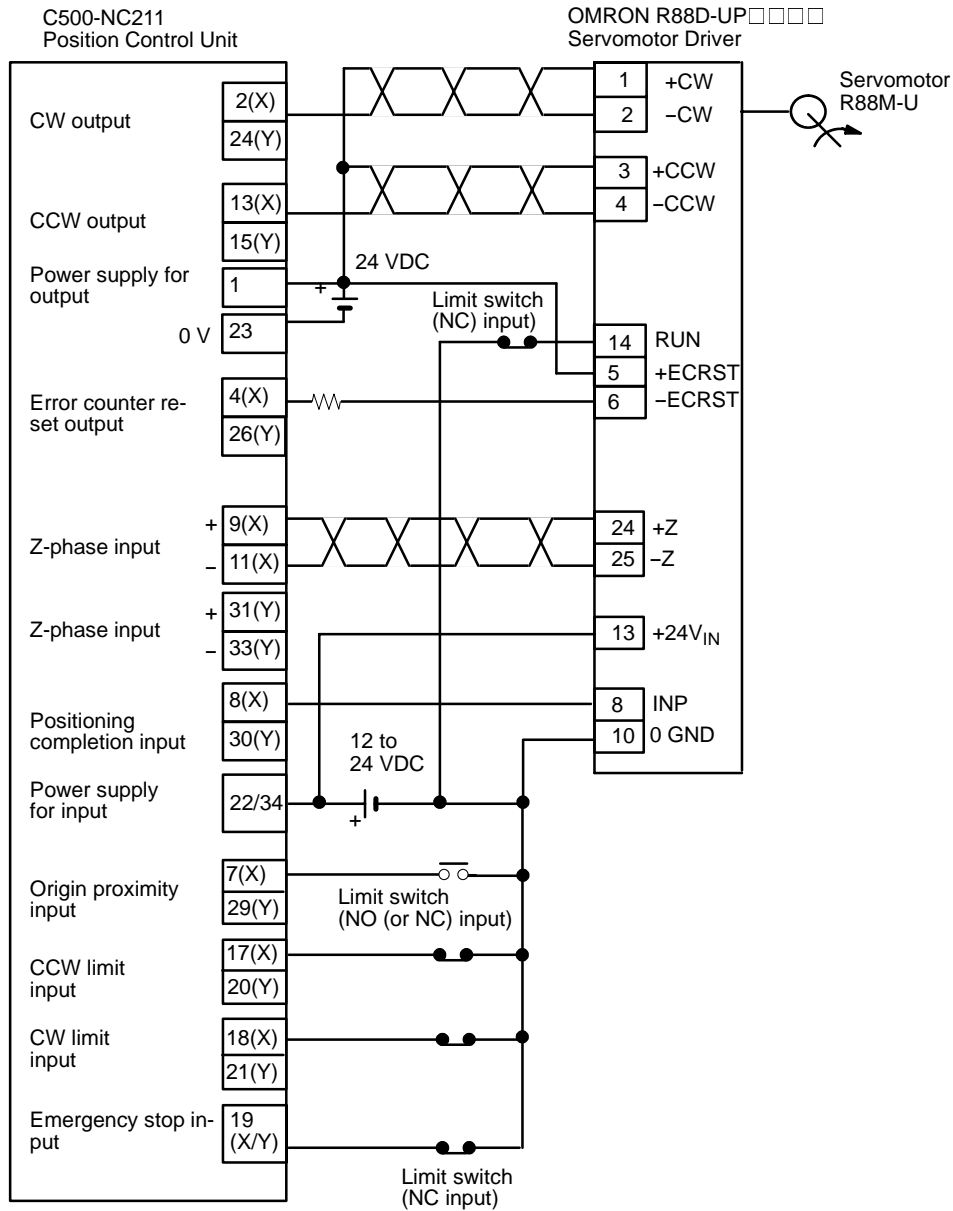
**Example 3: Origin Search Mode 2 Connection**

In this example, as in example 2, a servomotor driver is employed and the Z-phase of the encoder is connected to the origin line driver input terminal and used as the origin signal. (X axis only for the NC113)

**Note** Do not connect anything to the origin signal (10 (X) /32 (Y)).

Here the positioning completed signal of the servomotor driver serves as both the origin search completion and the positioning completed signals. Only the X axis is shown; the same wiring would be used for using the Y axis.

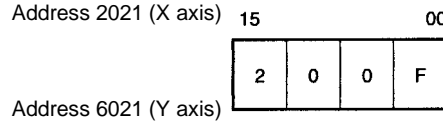
Be sure to adjust the settings of the servomotor driver so that the positioning completed signal is OFF when the motor is operating and ON when it is stopped.



**Caution** When only one axis is used, short-circuit the CW limit input and CCW limit input of unused axis to 0 V in 12 to 24 VDC. If these are not short-circuited, the ER-ROR LED will light, but the axis in use will operate normally.

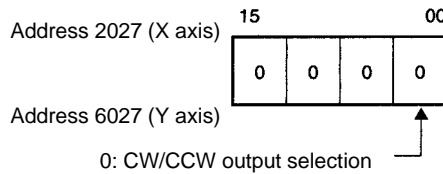
Data Settings Related to Connections (X Axis Only for the NC113)

- 1, 2, 3... 1. Set the origin search mode.



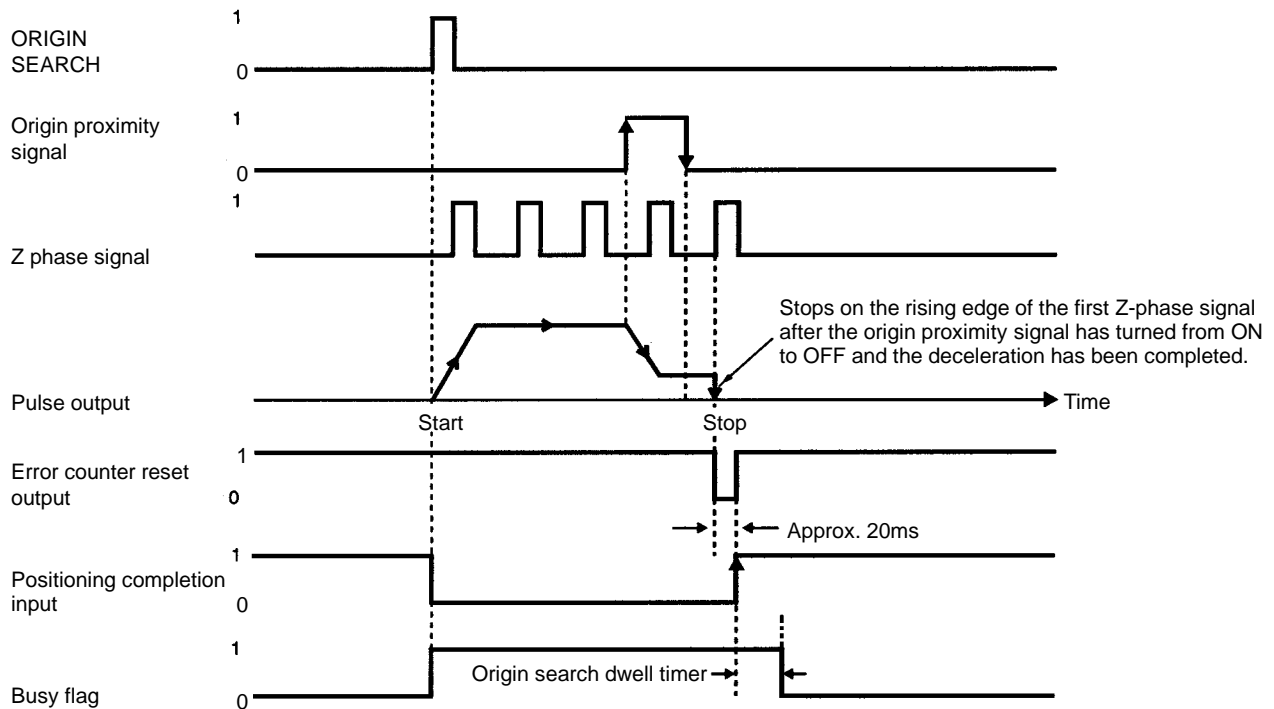
Bit	Setting	Contents	
00	1	Origin type	Origin search direction: CCW
01	1		Origin proximity signal: Yes
02	1		Origin proximity signal contact: N.O. (↑)
03	1		Origin signal contact: N.O. (↑)
04	0		Origin search method: No proximity reversal
08 to 11	0	Not used.	
12 to 15	2	Origin search mode: 2	

2. Set the output pulses.



**ORIGIN SEARCH**

The origin search operation stops on the rising edge of the first Z-phase signal after the origin proximity signal has turned from ON to OFF, and after deceleration has ended. The Busy flag turns OFF with the positioning completed signal.

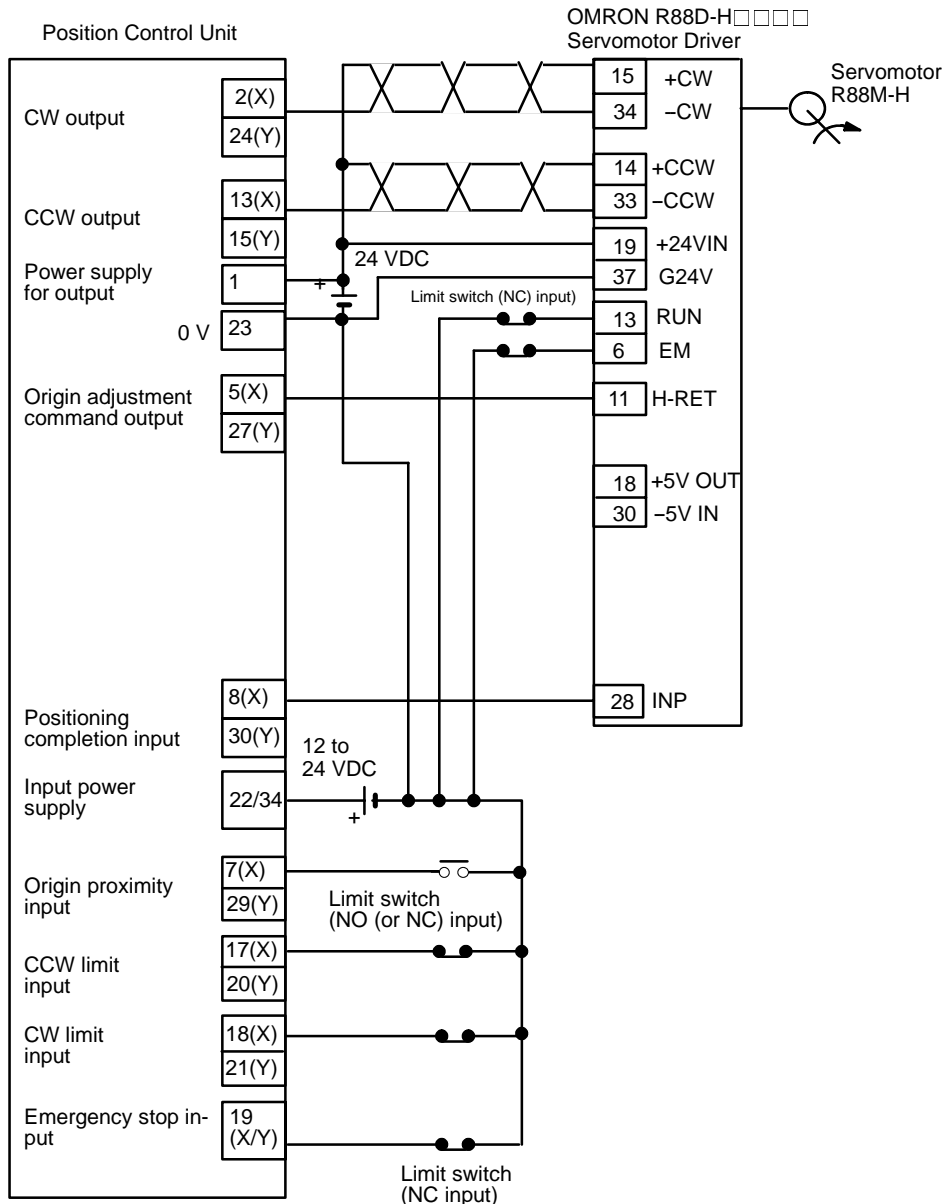


**Example 4: Origin Search Mode 3 Connection**

This is an example using the origin adjustment function of OMRON's Servomotor Driver. The positioning completed signal (INP) is used as both the origin search completion and the positioning completed signal.

Be sure to adjust the settings of the servomotor driver so that the positioning completed signal is OFF when the motor is operating and ON when it is stopped.

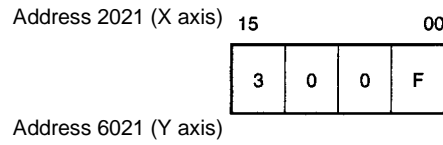
The following diagram illustrates a connection example in which only the X axis is used. The same wiring can be used for the Y axis of the NC211. The NC113 is not provided with the Y axis.



**Caution** When only one axis is used, short-circuit the CW limit input and CCW limit input of unused axis to 0 V in 12 to 24 VDC. If these are not short-circuited, the ER-ROR LED will light, but the axis in use will operate normally.

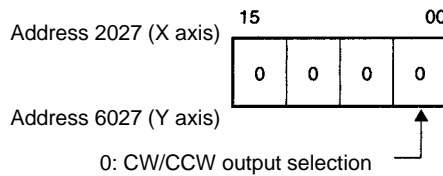
Data Settings Related to Connections

- 1, 2, 3... 1. Set the origin search mode. (X axis only for the NC113.)



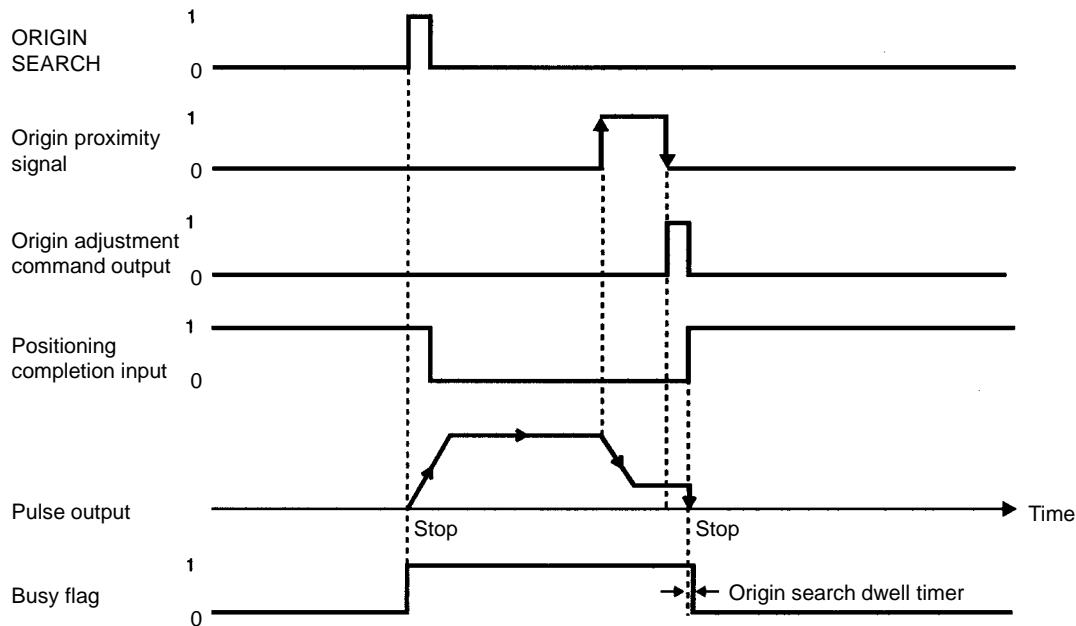
Bit	Setting	Contents	
00	1	Origin type	Origin search direction: CCW
01	1		Origin proximity signal: Yes
02	1		Origin proximity signal contact: N.O. (↑)
03	1		Origin signal contact: N.O. (↑)
04	0		Origin search method: No proximity reversal
08 to 11	0	Not used.	
12 to 15	3	Origin search mode: 3	

2. Set the output pulses.



ORIGIN SEARCH

The origin search operation begins after the origin proximity signal has risen and fallen, and the origin adjustment command is output to the servomotor driver after deceleration has ended. The positioning completed signal is then input from the servomotor driver and origin search ends. The driver internally executes the error counter reset and stops automatically with the first Z-phase input after it has received the origin adjustment signal.

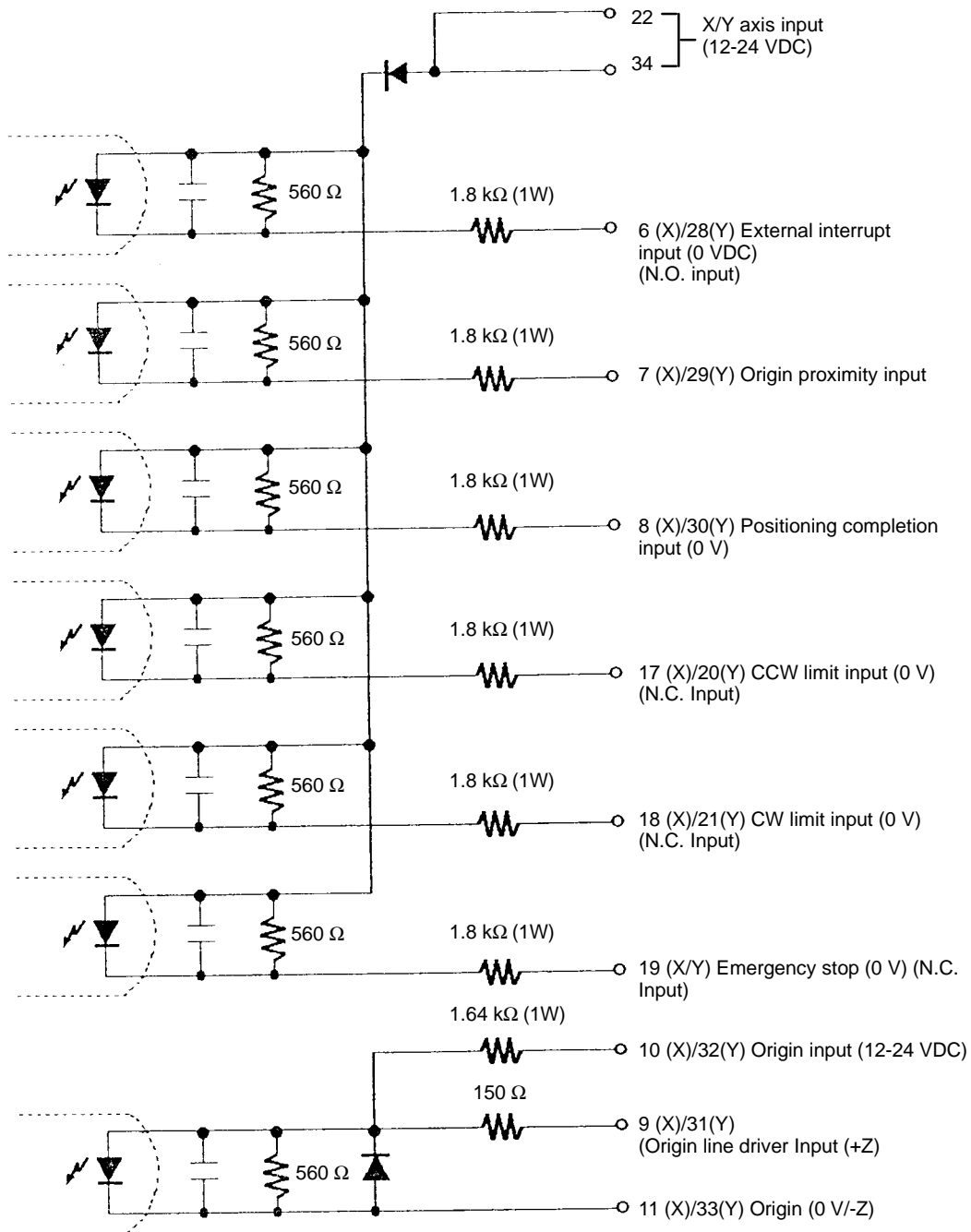


**Note** The servomotor driver stops when both the origin input and the origin adjustment command are ON.

### 3-3 Connecting External I/O

#### 3-3-1 Input Connection Examples

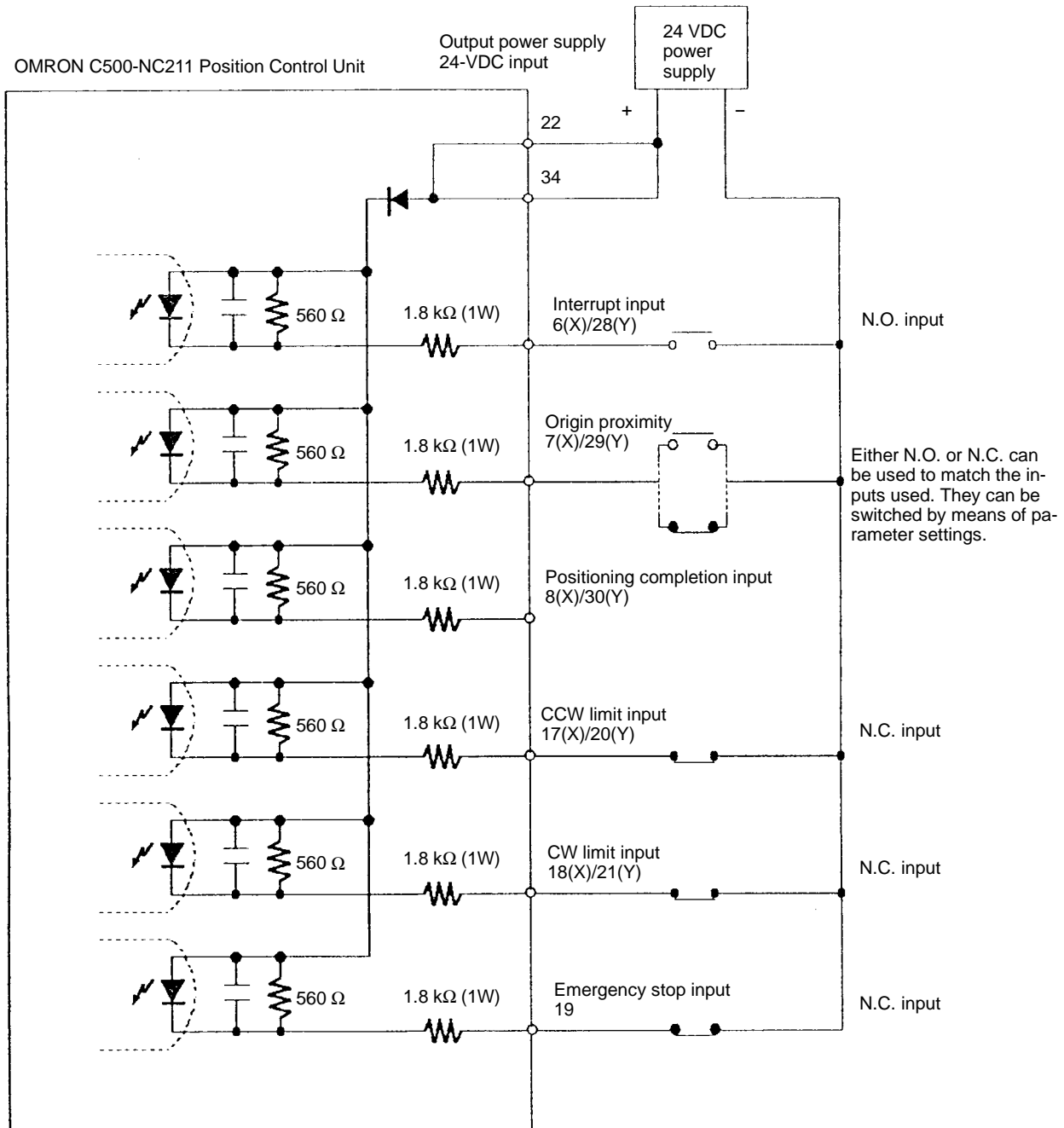
Inputs (X Axis Only for the NC113)



**Caution** Use either (10,11) and (9,11) or (32,33) and (31,33), but not both. Connecting both may damage the internal circuitry.

**Input Connection Example**

The respective inputs are N.O. (normally open) and N.C. (normally closed). When not used, leave the N.O. input pins open, and the N.C. input pins connected to the power supply. (The NC113 is not provided with the Y axis.)

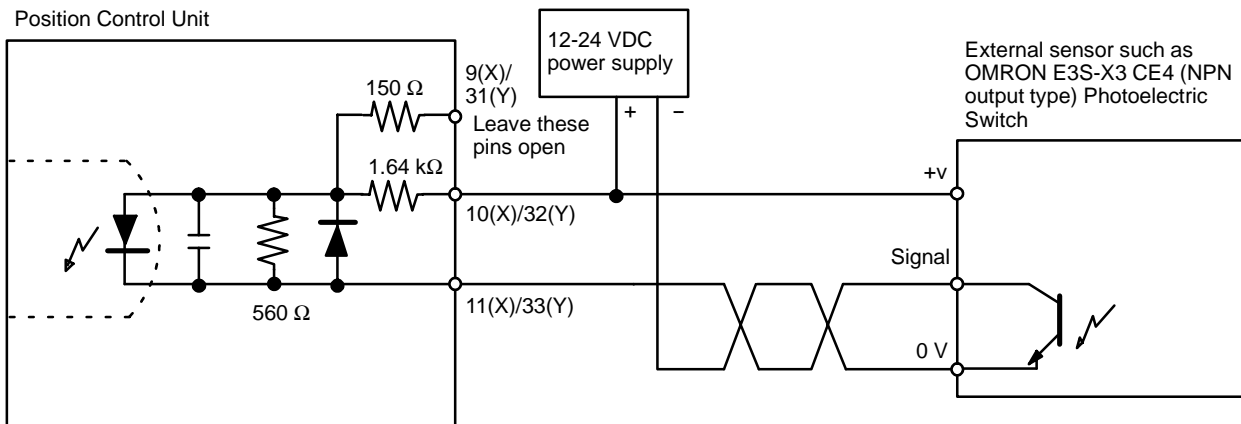


**Note** Connect a switch with an open/close switching capacity of at least 16 mA for each input.

### Origin Input Connection Examples

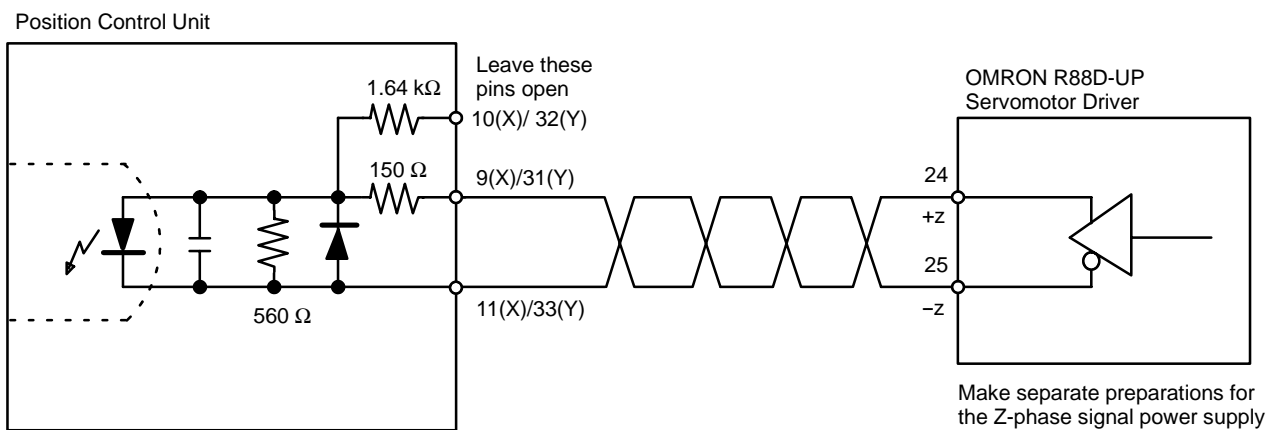
The examples below show input connections when open collector sensor output and the encoder's Z-phase line driver output are used. (The NC113 is not provided with the Y axis.)

#### Origin Input (10-11 (X axis)/32-33 (Y axis))



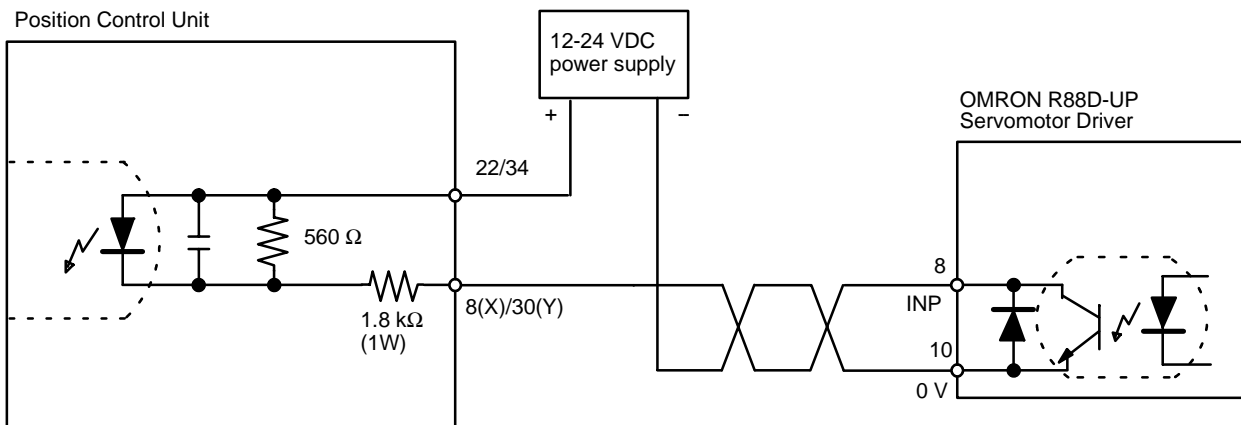
**Note** Be sure there is no chattering. If chattering occurs during an origin search, an emergency stop error (error code 6000) will be generated.

#### Origin Line Driver Input (9-11 (X axis) /31-33 (Y axis))



Make separate preparations for the Z-phase signal power supply

#### Positioning Completion Connection Example



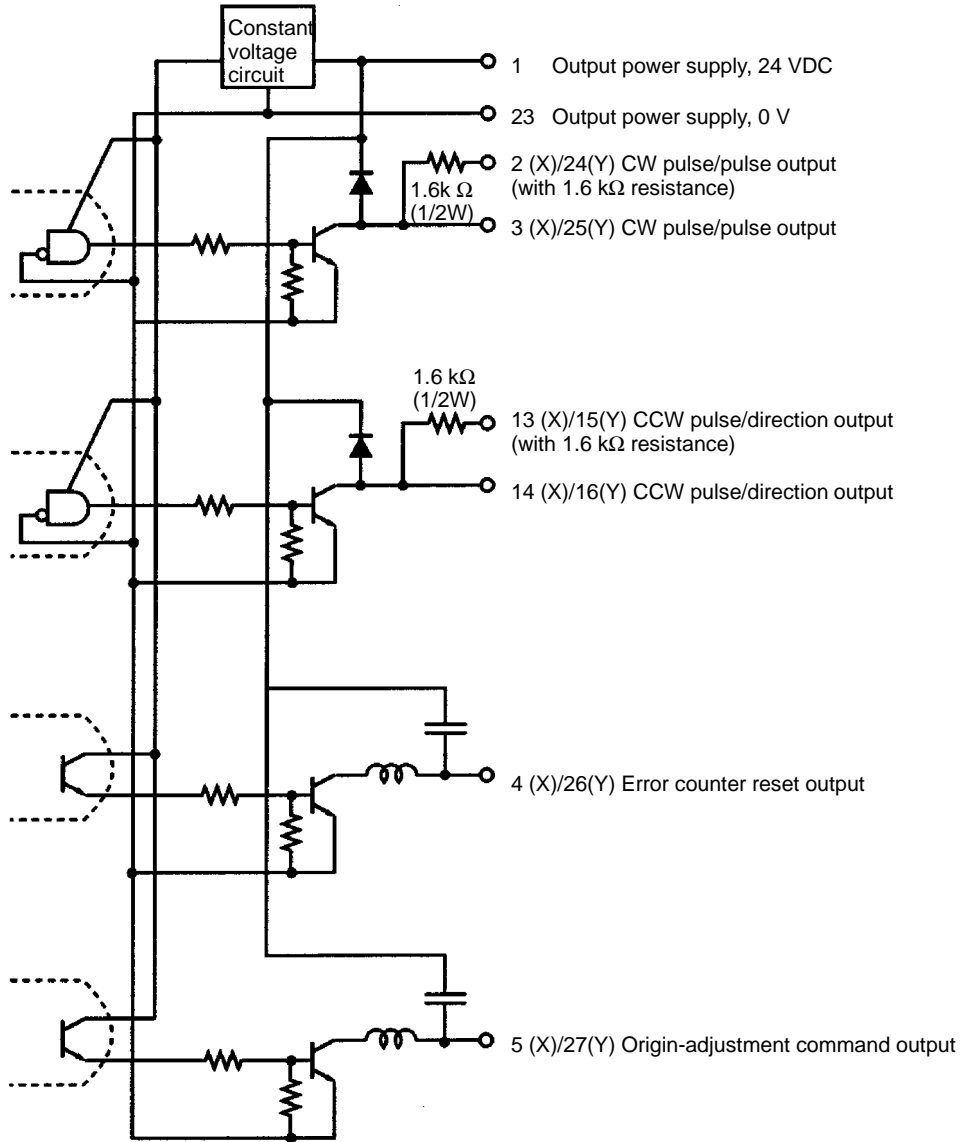
The positioning completed input signal is also used as an origin search completed signal in modes 2 and 3. Adjust the setting of the servomotor driver so that



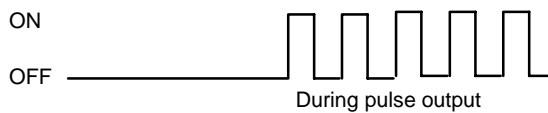
this signal always turns off while the servomotor is operating, and on when the motor is stopped.

### 3-3-2 Output Circuitry

#### Outputs (X Axis Only for the NC113)

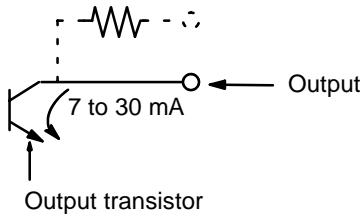


Pulses are not output when the output transistor in the pulse output section is OFF. (For direction output, OFF indicates CCW.)

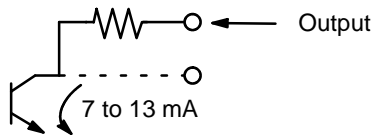


The pulse output circuitry of the Position Control Unit is provided with two types of terminals: terminals with 1.6 kΩ (1/2 W) resistance and terminals with no resistance. Select the terminals in accordance with the power requirements and the specifications of the motor driver to be used.

Open collector output



Open collector output with 1.6 kΩ series resistance

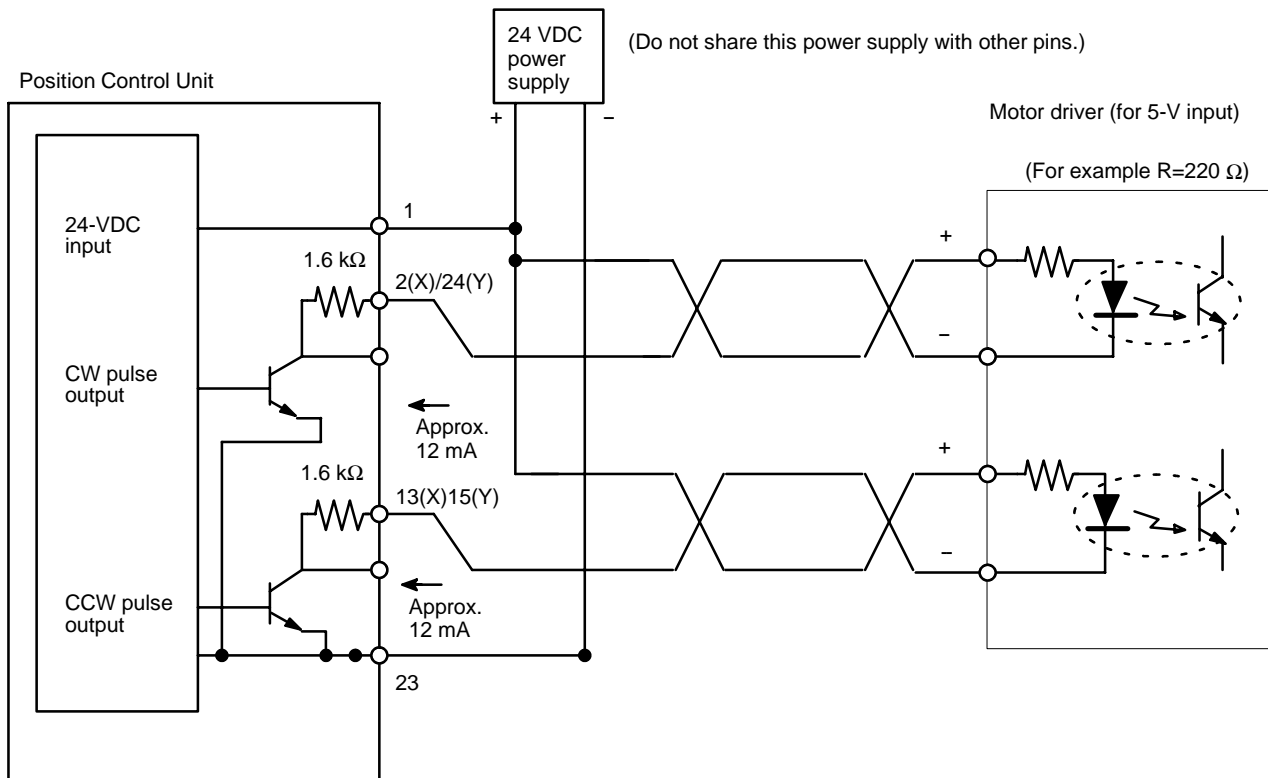


**Note** Connect between 7 mA and 30 mA loads to the outputs of the Position Control Unit, or add bypass resistance for loads less than 7 mA.

The diagrams on the following pages illustrate examples of connections to motor drivers. Always confirm motor driver specifications before making connections.

**Example 1: Outputting CW and CCW Pulses**

In this example, a 5-V photocoupler input motor driver is used for outputting CW and CCW pulses.

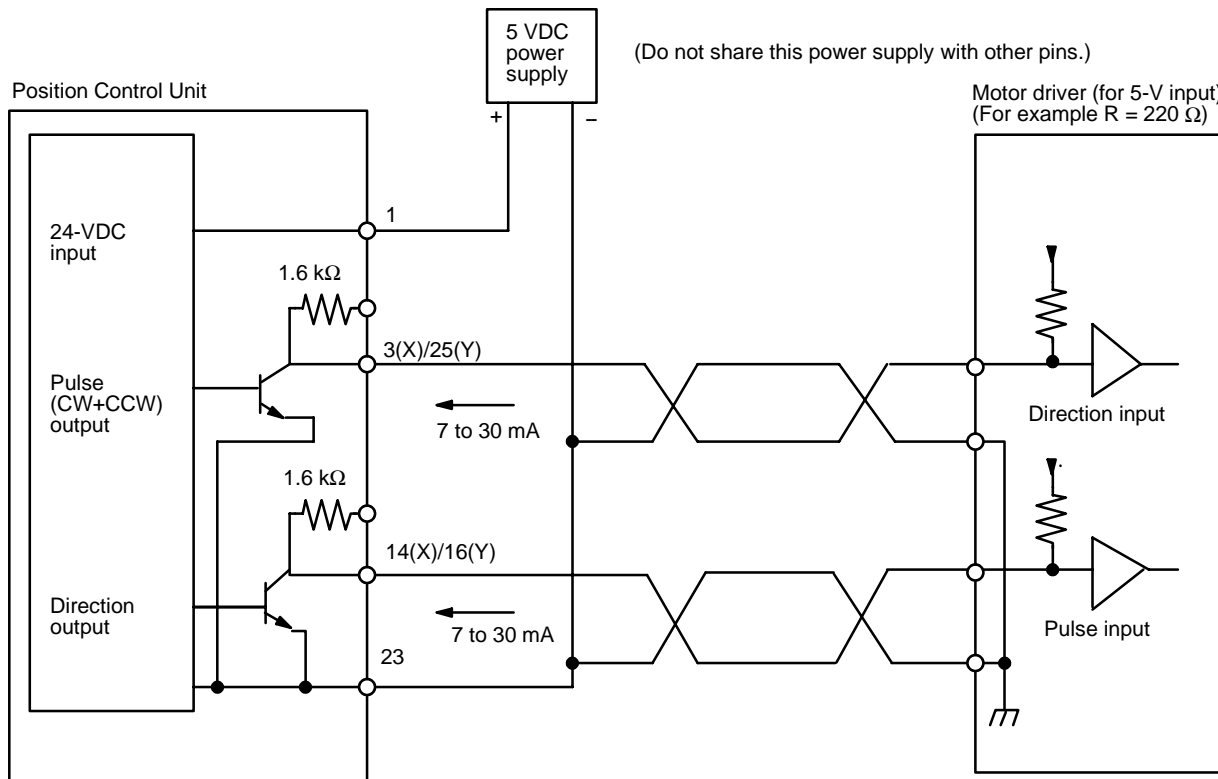


**Note** In this example, the 1.6 kΩ resistors of the Position Control Unit are used to allow a 24-VDC power supply to be used with a motor driver rated at 5 VDC. When wiring your system, carefully note the current required by the motor driver.

**Caution** Beware of the danger of electric shock from the motor driver.

**Example 2: Outputting Pulse and Direction Signals**

In this example, a 5-V input motor is used for outputting pulse and direction signals.

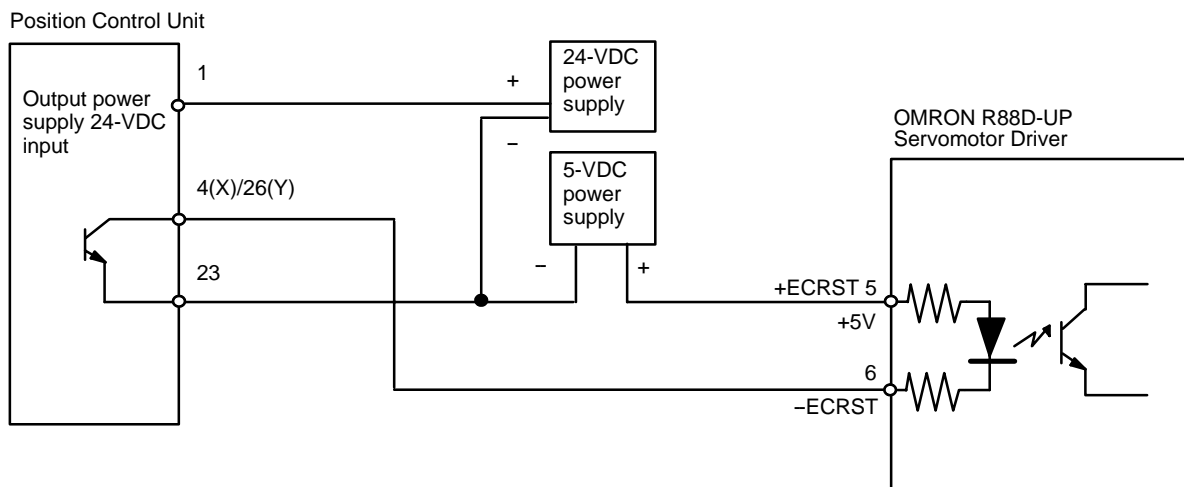


When voltage-level output is used, the level is L for output ON, and H for output OFF.

**Other Output Connection Examples**

**Example 3: Error Counter Reset Output**

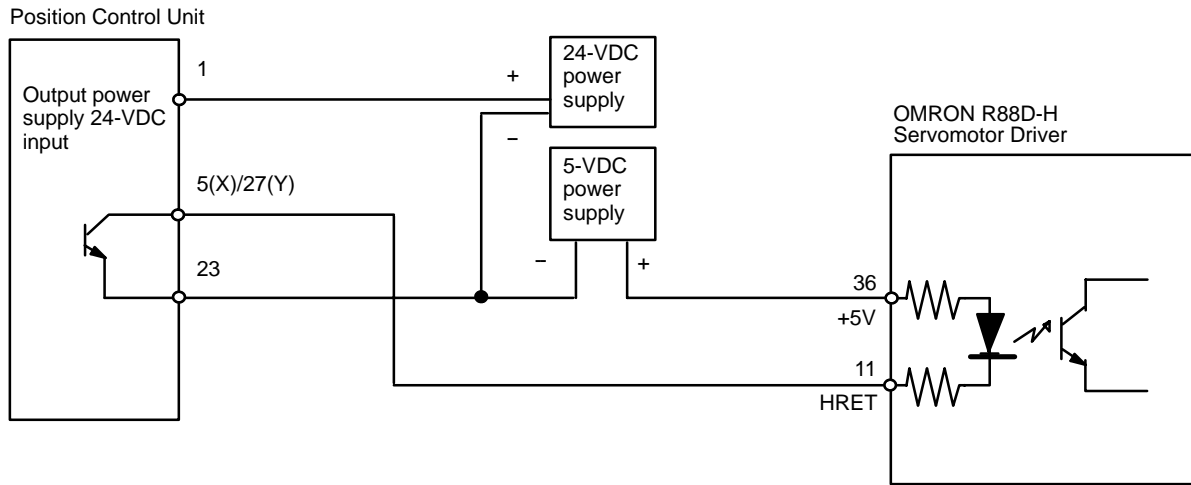
There is approximately 20 ms of output when origin search is completed in modes 1 or 2.



**Note** The error counter reset output will be given for approximately 1 ms when the origin search is completed in Mode 0.

**Example 4: Origin Adjustment Command Output**

This example shows output in mode 3.

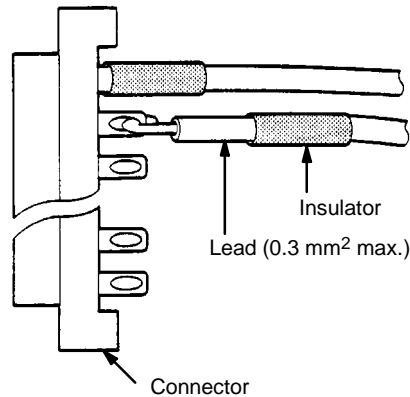


**3-3-3 Wiring to Connectors**

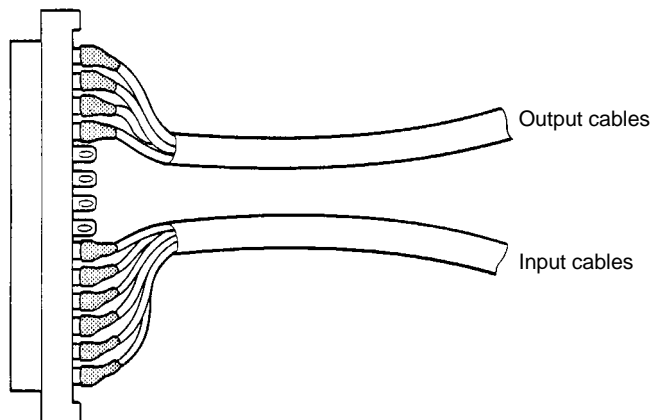
- Use wires with cross-sectional areas of 0.3 mm<sup>2</sup> or less. Take care not to short-circuit neighboring terminals when soldering. Cover the soldered part of the wire with insulation tubing.
- When using a multi-core cable, wire output and input separately.

**Pulse Output Connection Examples**

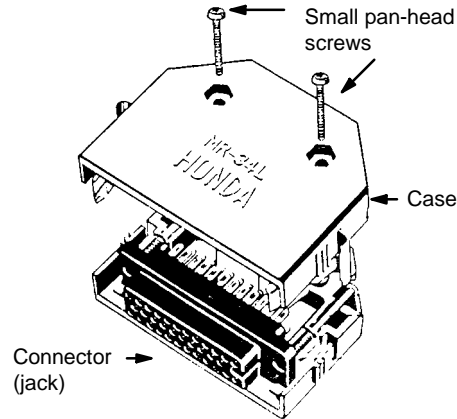
**Wiring Power Lines**



**Differentiating Cables**



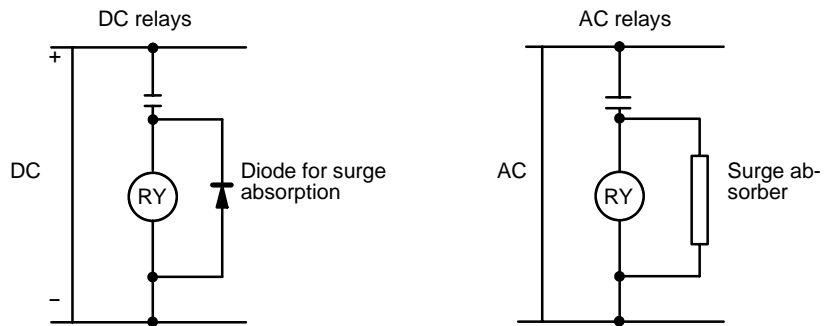
Assembling Connectors



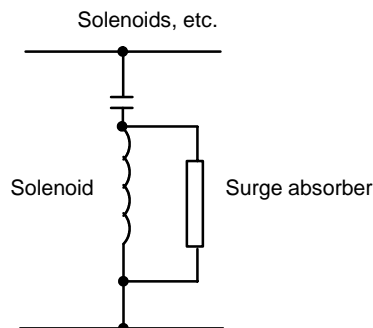
3-3-4 Wiring Precautions

Operational errors can occur in most electronic control devices if they are subjected to electronic noise from nearby power lines or loads. Recovery from such errors is usually very difficult and time consuming. To avoid such noise-generated operational errors and improve system reliability, always observe the following precautions in wiring the system.

- Cables must be of the required diameter.
- Power lines (e.g., AC power supply, motor power line) and control lines (e.g., pulse output lines, external I/O signal lines) must be wired separately. Never put these lines into the same duct or make them into a single bundle.
- Use shielded cable for control lines.
- Attach a surge absorber to all inductive loads, such as relays, solenoids, and solenoid valves.



**Note** Connect the diode and surge absorber as close as possible to the relay. Use a diode capable of withstanding a voltage five times higher than the circuit voltage.



- Insert a noise filter into the power supply inlet if noise enters the power line (e.g., when it is connected to the same power supply as an electric welder or an electric spark machine or when there is any supply generating high frequency noise).
- Twisted pair cable is recommended for power lines.
- Use No. 3 or greater grounding contacts, and the thickest possible wire, greater than 1.25 mm<sup>2</sup>.

# SECTION 4

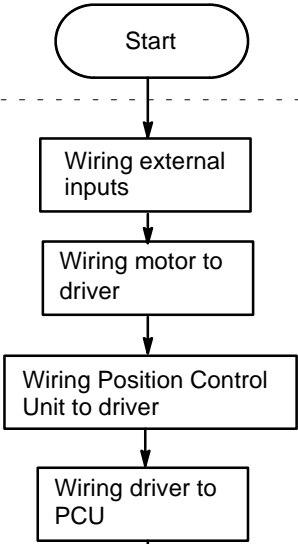
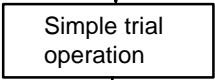
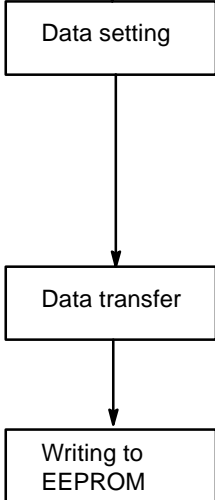
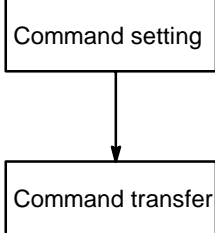
## Before Operation

This section outlines the procedures that need to be performed before operating the Position Control Unit.

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-----	------------------------	----

### 4-1 Operational Flow

The basic procedure used to initially operate the Unit is outlined below. Refer to applicable sections of the manual for details on each of these steps.

Item	Procedure	Refer to:
Wiring	 <pre> graph TD     Start([Start]) --&gt; W1[Wiring external inputs]     W1 --&gt; W2[Wiring motor to driver]     W2 --&gt; W3[Wiring Position Control Unit to driver]     W3 --&gt; W4[Wiring driver to PCU]                     </pre>	<p>Origin, origin proximity, CW/CCW limits, emergency stop, external interrupt</p> <p>Follow motor and driver and instruction manuals for wiring details</p>
Simple trial operation	 <pre> graph TD     STO[Simple trial operation]                     </pre>	<p>Check the wiring by performing basic operations such as jogging, origin search, and so on, at low speed.</p>
Setting data and creating a transfer program	 <pre> graph TD     DS[Data setting] --&gt; DT[Data transfer]     DT --&gt; WE[Writing to EEPROM]                     </pre>	<p>Create the following data in the CPU Unit's DM area or use NC Support Tool to create it in personal computer memory.</p> <ul style="list-style-type: none"> <li>• Positioning actions</li> <li>• Parameters</li> <li>• Acceleration/deceleration patterns</li> <li>• Speeds</li> <li>• Dwell timer data</li> </ul> <p>Use the Intelligent I/O Write instruction in the CPU Unit's program to transfer the above DM area data to the PCU, or use NC Support Tool to transfer the data from the personal computer.</p> <p>Writes the above data to the EEPROM of the Position Control Unit using the EEPROM command or NC Support Tool.</p>
Setting commands and creating a transfer program	 <pre> graph TD     CS[Command setting] --&gt; CT[Command transfer]                     </pre>	<ul style="list-style-type: none"> <li>• ORIGIN SEARCH</li> <li>• START, etc.</li> </ul> <p>Set the commands in the CPU Unit's IR area.</p> <p>Use the Intelligent I/O Write instruction in the CPU Unit's program to transfer the above DM area data to the PCU</p>



Item	Procedure	Refer to:
Trial run	<pre> graph TD     A[Restart by resetting power] --&gt; B[ORIGIN SEARCH, manual operation, start, etc.]     B --&gt; C{Alarm/error LED lit?}     C -- No --&gt; Exit1[ ]     C -- Yes --&gt; D[Error exists]     </pre>	Section 8 Simple Trial Operation
Troubleshooting	<pre> graph TD     E[Read error] --&gt; F[Correct error]     F --&gt; G{Alarm/error LED flashes?}     G -- No --&gt; Exit2[ ]     G -- Yes --&gt; H[Read error]     H --&gt; I[Correct data causing alarm]     </pre>	<p>Section 7 PCU Status</p> <p>Section 12 Error Processing</p>

# SECTION 5

## Data Configuration

This section explains the Position Control Unit data configuration and the types of data involved in position control. There are two methods for creating position control data. The first is to create it using NC Support Tool and then transfer it to the Position Control Unit, and the second is to create it in the CPU Unit's DM area according to PCU data addresses and then use the Intelligent I/O Write (WRIT) instruction to transfer it to the Position Control Unit. Both of these methods are explained in this section, along with the five types of position control data: positioning actions, speeds, acceleration/deceleration patterns, dwell times, and parameters.

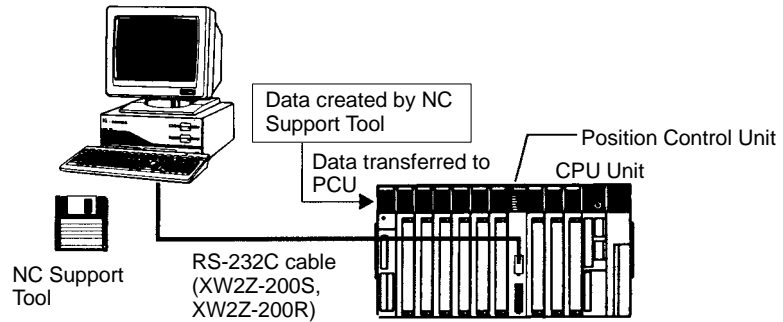
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## 5-1 Creating and Transferring Data

There are two ways to create position control data and transfer it to the Position Control Unit:

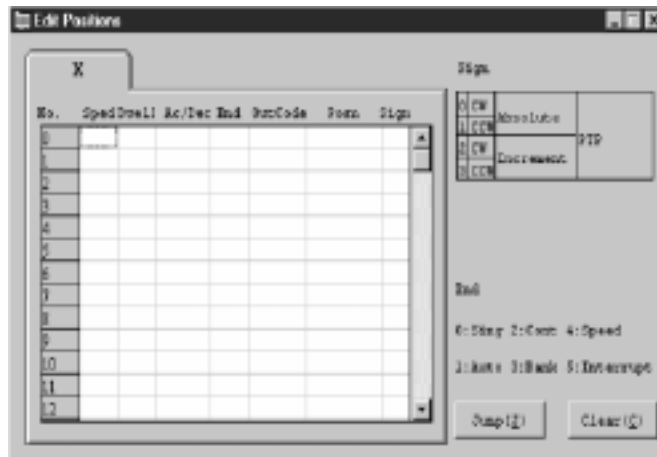
- 1, 2, 3... 1. Create the data using NC Support Tool and then transfer it to the PCU.
2. Create the data in the CPU Unit's DM area and use a ladder program to transfer it to the PCU.

### 1) Transferring Data From NC Support Tool

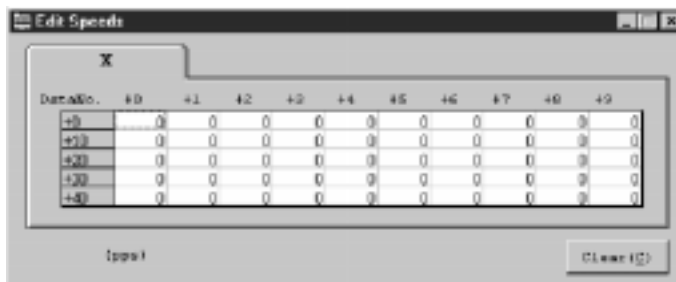


- 1, 2, 3... 1. Create the following position control data using the NC Support Tool's edit screens:
  - Positioning actions
  - Speeds
  - Acceleration/deceleration patterns
  - Dwell times
  - Parameters
2. Transfer the created data to the Position Control Unit.

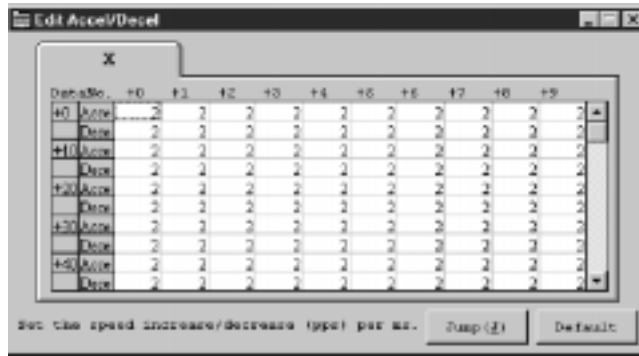
#### Positioning Action Edit Screen



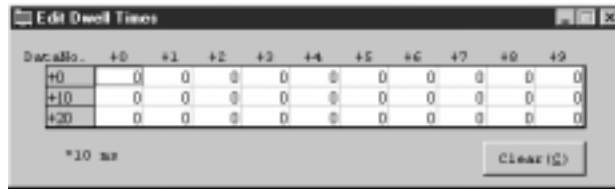
#### Speed Data Edit Screen



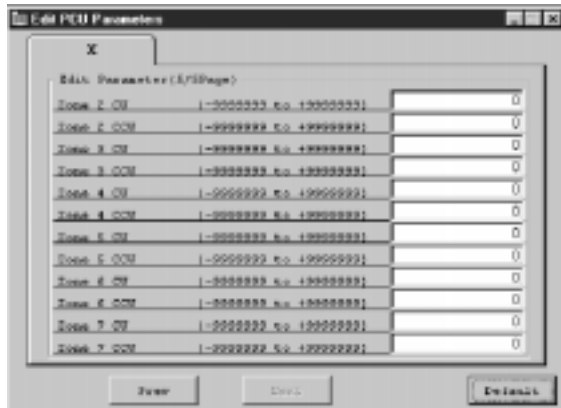
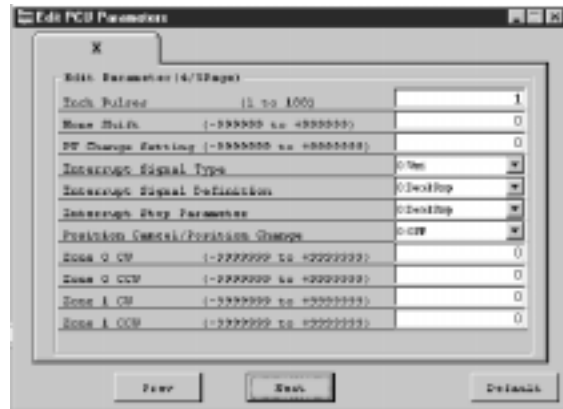
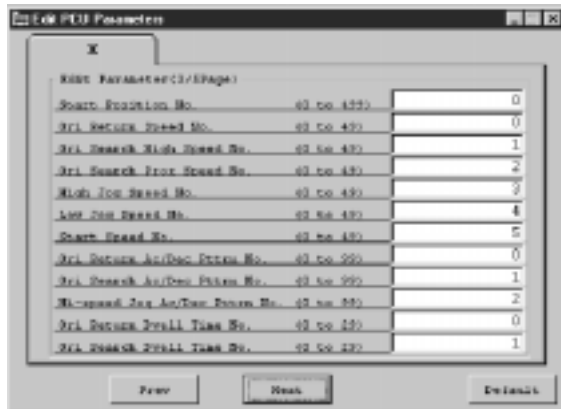
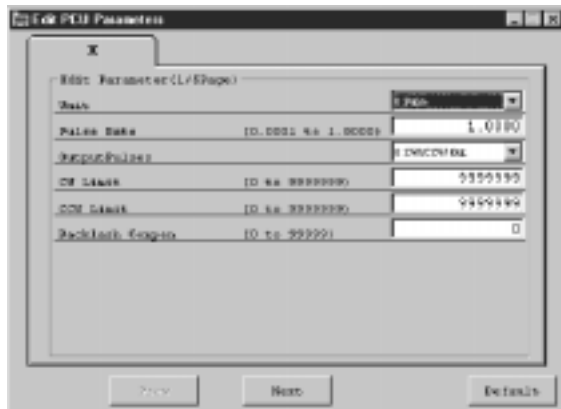
Acceleration/Deceleration Pattern Edit Screen



Dwell Time Data Edit Screen



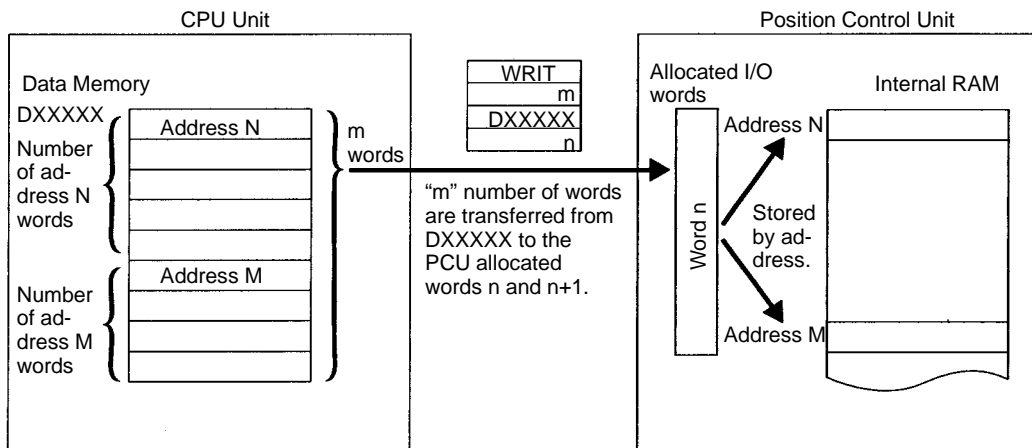
Parameter Data Edit Screen



**Transferring Data From the CPU Unit**

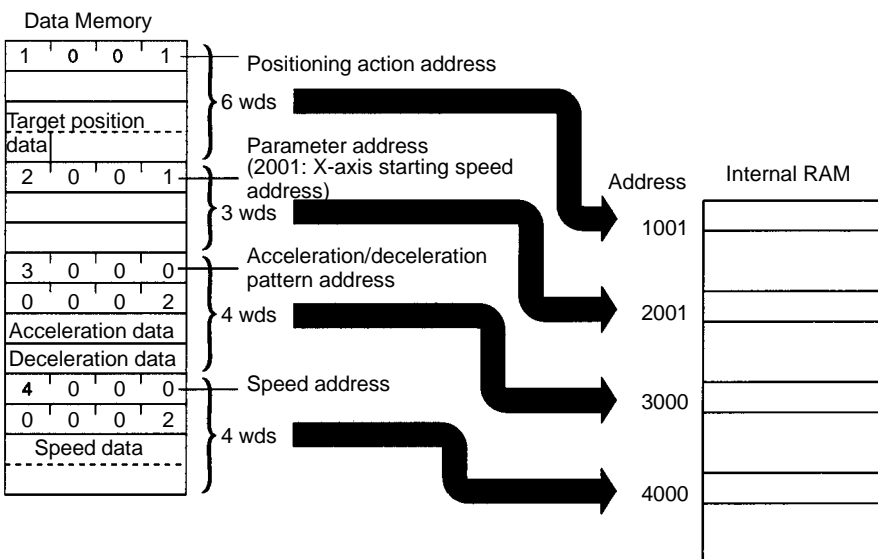
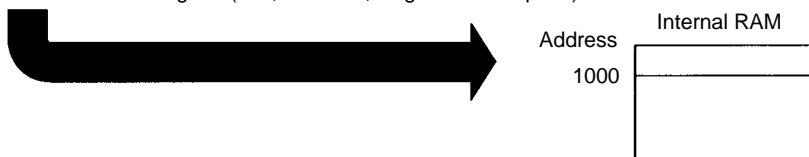
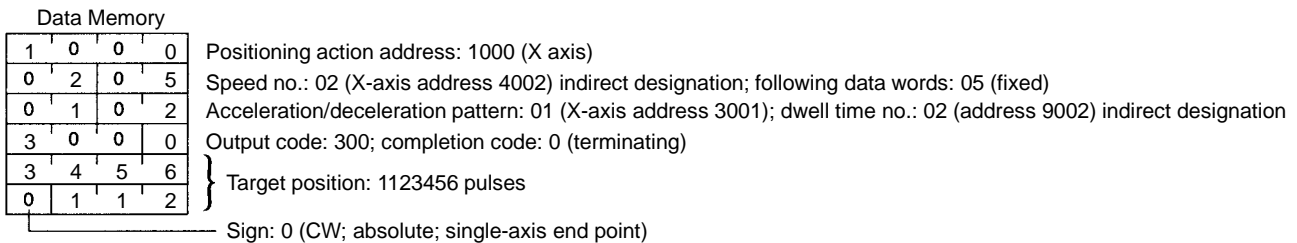
- 1, 2, 3...
1. Create the position control data (positioning actions, parameters, etc.) in advance in the CPU Unit's DM area, using the Position Control Unit's internal RAM addresses as the leading addresses.
  2. Use the Intelligent I/O Write instruction (WRIT) to transfer that data to the Position Control Unit

3. Store the data, according to the leading addresses, in the Position Control Unit's internal RAM.

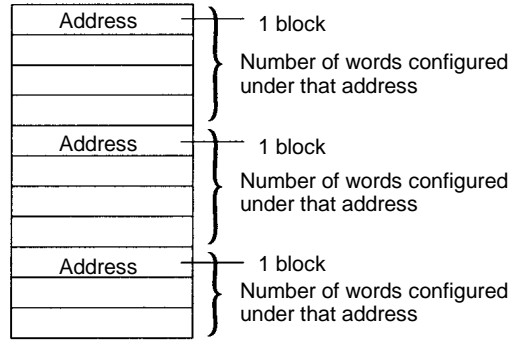


**Creating Data**

Data is created at the Position Control Unit as a block beginning with the designated address for the number of words occupied by one data item of that address. For details on individual data addresses, refer to the subsequent sections beginning with 5-2 Data Handled By the Position Control Unit.

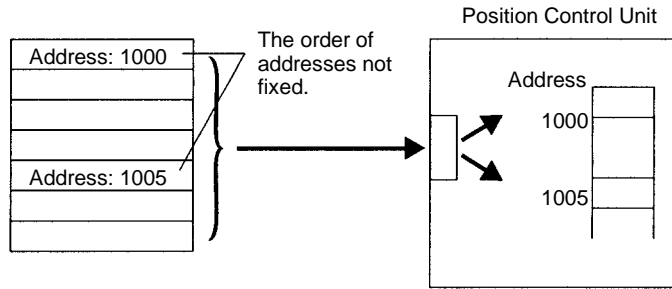


Be sure to put the address at the beginning and set the words as a block.



**Note** Set the data consecutively, with no gaps. If there are any gaps the data cannot be properly transferred to the Position Control Unit.

There is no need to be concerned with the order of data addresses when transferring the data. The Position Control Unit will check the addresses and store them in the internal RAM accordingly.

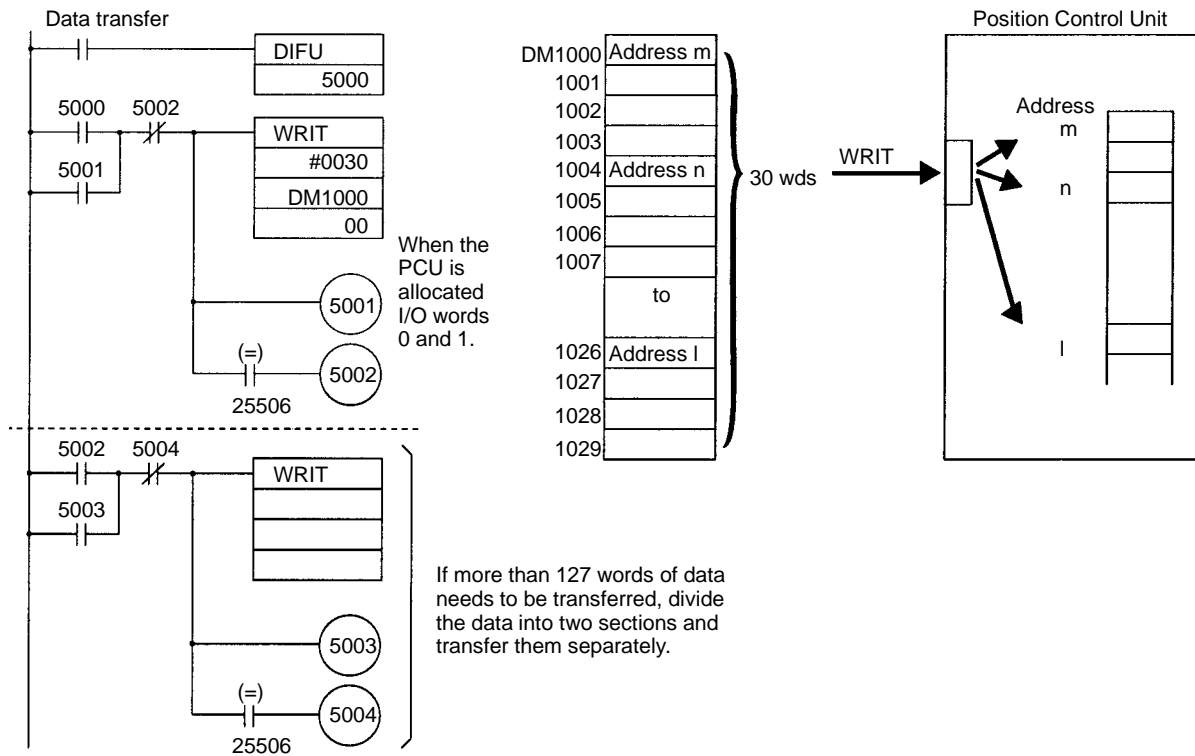


- Note**
1. The number of words for the created data that is to be transferred must match the number of words specified by the Intelligent I/O Write instruction. If they do not match, the data cannot be properly transferred (e.g., if some other data is included or if there is not enough data for the number of designated words, the data may either be treated as an error and not written or may be written as an error data).
  2. Since the NC113 is not provided with the Y axis, do not transfer data to the data area address for the Y axis (refer to 5-2 Data Handled By the Position Control Unit). If data is transferred to this address, a format error (8309) will occur.

**Transfer Method**

Once the data has been created, use the Intelligent I/O Write instruction to transfer it to the Position Control Unit.

In the following program example, 30 words beginning with DM1000 are transferred to the Position Control Unit which is allocated I/O words 0 and 1.

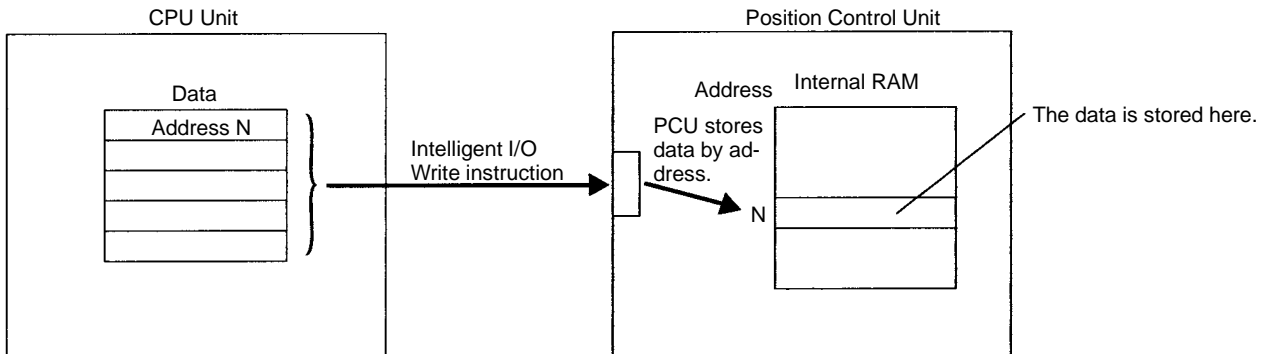


**Note** Up to 127 words of data can be transferred with one Intelligent I/O Write instruction. If it is necessary to divide the data into several sections to be transferred one by one, execute each subsequent Intelligent I/O Write instruction with the Equals Flag of the previous instruction.

## 5-2 Data Handled By the Position Control Unit

**Data Configuration**

Configure the data with the address (i.e., the location where the transferred data is to be stored at the Position Control Unit) at the beginning. Then be sure to configure the rest of the data in exactly the number of words (including the address) indicated under *Data Size* below. When the data is transferred by the Intelligent I/O Write instruction, the Position Control Unit will store it in its internal RAM according to the addresses that have been specified.





Data Size

Data	Address	Number*	Number of words
Positioning actions (500 per axis)	X axis: 1000 to 1499 Y axis: 5000 to 5499	X axis: 0 to 499 Y axis: 0 to 499	6
Accel/decel patterns (100 per axis)	X axis: 3000 to 3099 Y axis: 7000 to 7099	X axis: 0 to 99 Y axis: 0 to 99	4
Speeds (50 per axis)	X axis: 4000 to 4049 Y axis: 8000 to 8049	X axis: 0 to 49 Y axis: 0 to 49	4
Dwell times (30, shared by X and Y axes)	Shared: 9000 to 9029	Shared: 0 to 29	3
Parameters (29 per axis)	X axis: 2000 to 2028 Y axis: 6000 to 6028	---	3 to 6

**Note** The “address” is the actual address in the Position Control Unit’s internal RAM, whereas the “number” is the number from the leading address for each data item. For example, the “numbers” for X-axis positioning action addresses 1000 to 1499 would be 0 to 499. There are no corresponding numbers for parameter addresses.

### 5-3 Positioning Actions

The data stored for positioning actions is the data used when positioning is executed. Up to 500 positioning actions can be set for each axis, and each positioning action is configured of six words. (The NC113 is not provided with the Y axis.)

When the START command is received, the Position Control Unit begins executing positioning actions in order, from the initial positioning action address. For example, if the initial positioning action address is 1010, the first address executed will be 1010, followed in order by 1011, 1012, 1013, etc.

**Note** The initial positioning action number depends on the parameters (X axis: address 2002; Y axis: address 6002) and commands (X axis: m+2; Y axis: m+6).

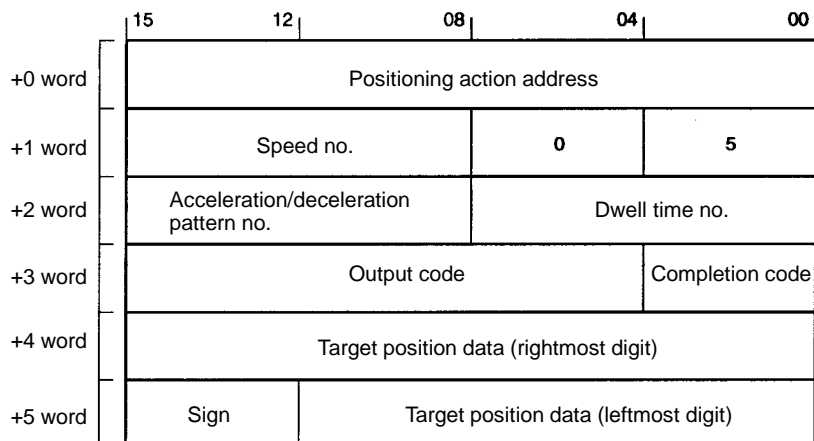
#### 5-3-1 Positioning Action Settings (6-word Configuration)

Data Address

Data	Address	Number of words	Contents	Setting range
Positioning action	1000 to 1499	6	X-axis positioning action	-9999999 to +9999999 (pulses)
	5000 to 5499		X-axis positioning action	

**Note** The Y axis is only for the NC211.

Format

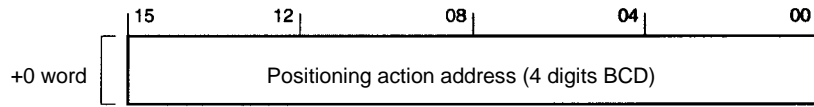


**Setting Positioning Action Addresses**

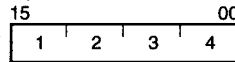
Specify the addresses in the Position Control Unit for which the positioning actions are assigned. The addresses are set in four digits, as follows:

- X axis: 1000 to 1499
- Y axis: 5000 to 5499

**Format**



Example: 1234



**Setting Speeds**

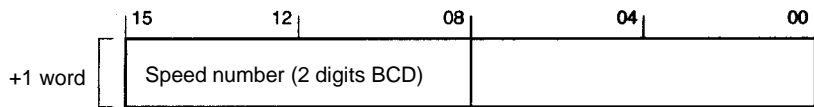
Speed data addresses for the X and Y axes are indirectly designated. The speeds are set in two digits, from 00 to 49. The addresses for both axes are as follows:

- X axis: 4000 to 4049
- Y axis: 8000 to 8049

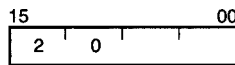
For example, if speed number 20 is set for a Y-axis positioning action, positioning for that positioning action will be executed at the speed registered at speed data address 8020.

For details regarding speed data, refer to 5-4 Speeds.

**Format**



Example: 20



**Setting Acceleration/Deceleration Patterns**

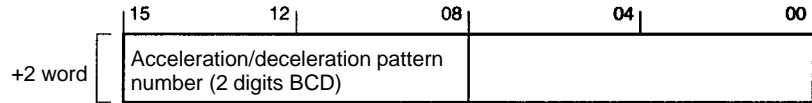
Acceleration/deceleration pattern addresses for the X and Y axes are indirectly designated. The patterns are set in two digits, from 00 to 99. The addresses for both axes are as follows:

- X axis: 3000 to 3099
- Y axis: 7000 to 7099

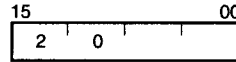
For example, if acceleration/deceleration pattern number 20 is set for a Y-axis positioning action, positioning for that positioning action will be executed according to the pattern registered at acceleration/deceleration pattern data address 7020.

For details on how to set acceleration/deceleration patterns, refer to 5-5 Acceleration/Deceleration Patterns.

Format



Example: 20



**Setting Dwell Times**

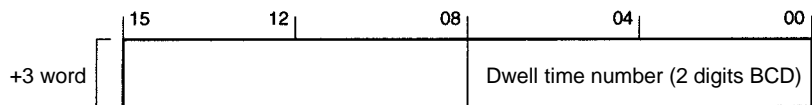
Dwell time addresses for common use by the X and Y axes are indirectly designated. The patterns are set in two digits, from 00 to 29. The addresses for both axes are as follows:

X and Y axes together: 9000 to 9029

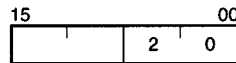
For example, if dwell time number 20 is set the dwell time registered at dwell time data address 9020 will be executed

For details on how to set dwell times, refer to *5-6 Dwell Times*.

Format



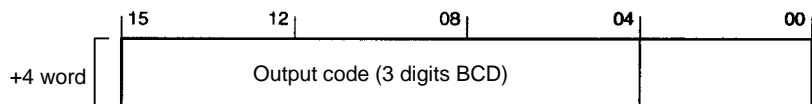
Example: 20



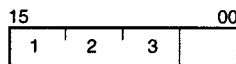
**Setting Output Codes**

Output codes are used to notify the Programmable Controller whenever a positioning action is executed. They are set in three digits, from 0 to 499.

Format



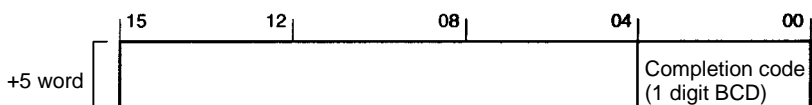
Example: 123



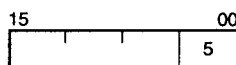
**Setting Completion Codes**

Completion codes are set in one digit, from 0 to 5.

Format



Example: 5

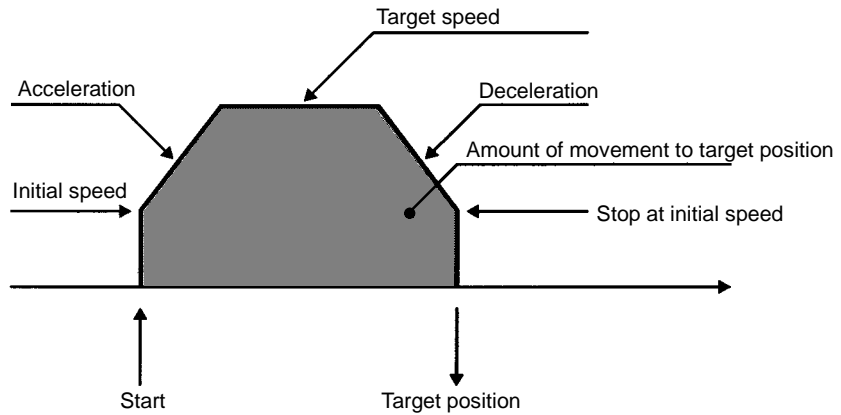


0	Terminating
1	Automatic
2	Continuous
3	Bank end
4	Speed control
5	Interrupt feeding

**Note** Completion codes 4 and 5 are not used for interpolation. When employing interpolation, set the completion code from 0 to 3.

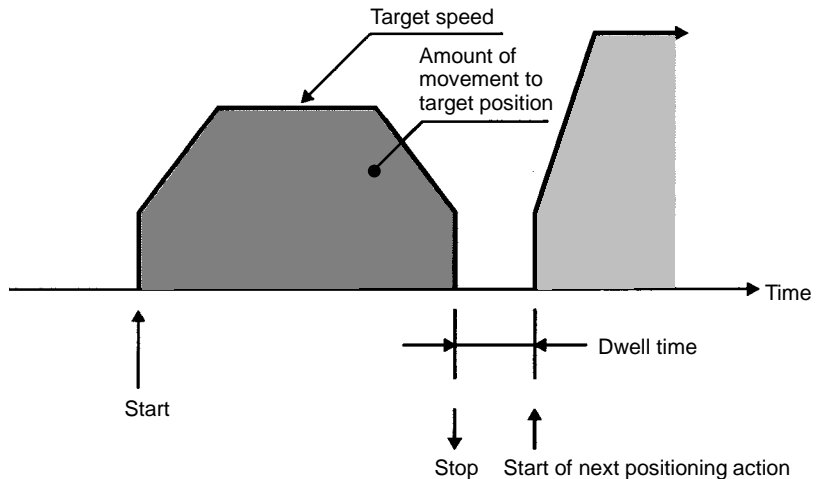
**Terminating (0)**

After the current positioning action has been executed according to the target speed and target position that have been set, positioning is stopped and the next positioning action is awaited.



**Automatic (1)**

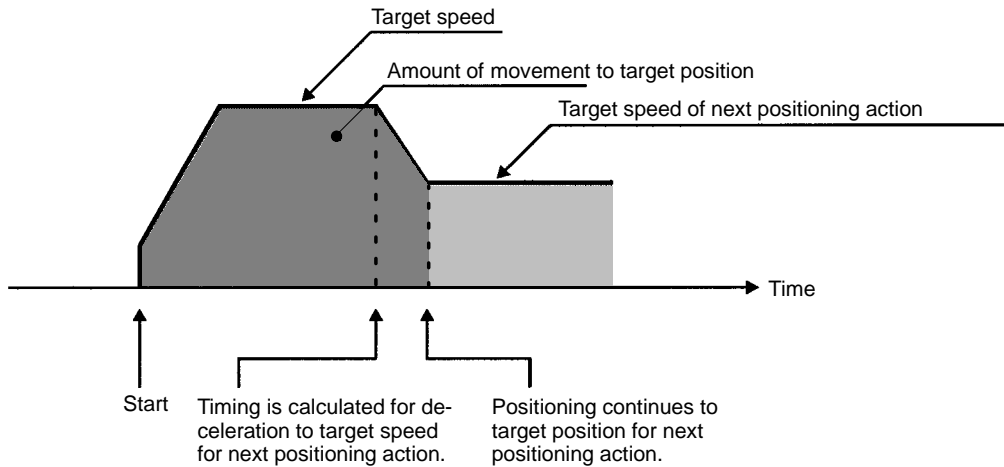
After the current positioning action has been executed according to the target speed and target position that have been set, positioning is paused for the length of time that has been set for the dwell time, and then the next positioning action (i.e., the positioning action at the next address) is automatically started.



**Continuous (2)**

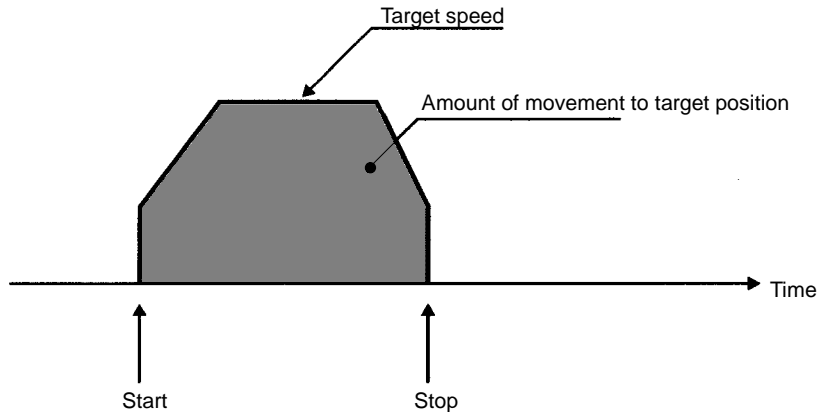
The current positioning action is executed according to the target speed and target position that have been set, and then, once the target position has been reached, the speed is changed to the target speed for the next positioning action (i.e., the positioning action at the next address) and that positioning action is immediately executed without a pause. (The Position Control Unit automatically

calculates the deceleration timing so that the target position for the current positioning action is reached at the target speed for the next positioning action.)



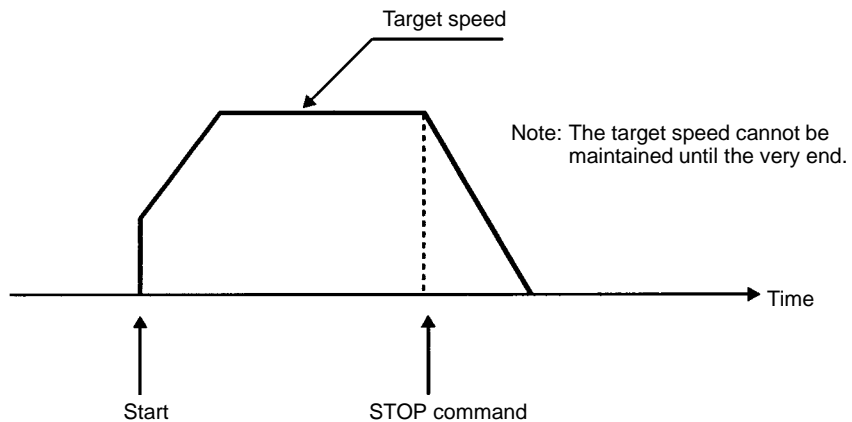
**Bank End (3)**

The current positioning action is executed according to the target speed and target position that have been set, and then positioning stops. The next positioning action to be started will be the positioning action set in the parameters (X axis: address 2002; Y axis: address 6002). For details regarding the order of execution of positioning actions in this case, refer to 9-2-3 Executing START.



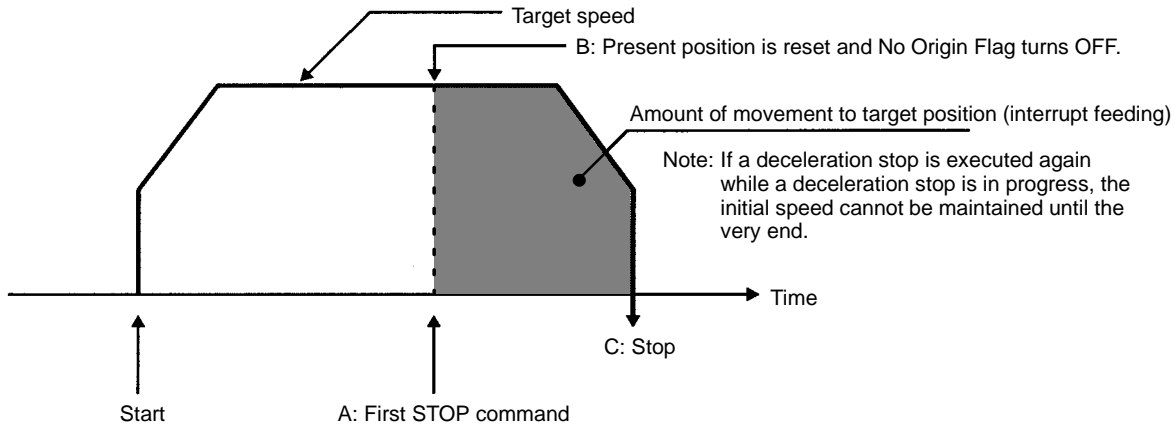
**Speed Control (4)**

Pulse output is maintained at the target speed set for the positioning action, and the present position is not calculated. The No Origin Flag turns ON during operation at the target speed. The direction of the pulse output is determined by the sign that has been set for the positioning action, and the pulse output is stopped by using the STOP command. Interpolation cannot be used with a speed control completion code.



**Interrupt Feeding (5)**

Pulse output is maintained at the target speed set for the positioning action. The No Origin Flag turns ON during operation at the target speed. The direction of the pulse output is determined by the sign that has been set for the positioning action. When the STOP command is executed, the present position is reset and positioning is carried out according to the data set for the positioning action. Interpolation cannot be used with an interrupt feeding completion code.



**Note** There are delays at various points when using an interrupt feeding completion code. The delays indicated below occur with the Position Control Unit's internal processing, and outputs to the memory area add delays with the scan.

- A: STOP command  
There is a delay of approximately 2 ms with STOP. For details regarding deceleration stops, refer to *9-11 STOP and CHANGE SPEED*. (There are two methods, using interrupt input signals and commands.)
- B: Present position reset; No Origin Flag OFF  
A maximum delay of 2 ms is added to the positioning action.
- C: Stop

Note that the processing delay between A and B is not indicated for the present position status. Between B and C, the present position status display is refreshed after going to "0." The stop delay between B and C is shown for the present position status as a number, just as it is.

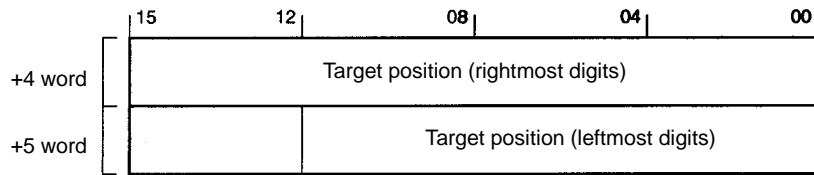
**Setting Target Positions**

Set the target position set as the number of pulses, or as millimeters or inches. The setting is made in seven digits BCD, as follows:

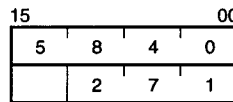
Pulses:	0000000 to 9999999
Millimeters:	0000.000 to 9999.999
Inches:	000.0000 to 999.9999

**Note** The data unit (pulses, millimeters, inches) and pulse rate are set in parameter addresses 2026 (X axis) and 6026 (Y axis).

Format (Unit: Pulses)



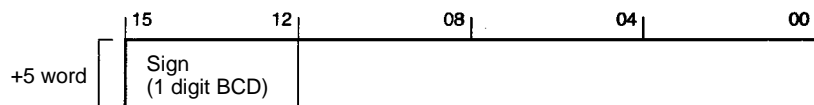
Example: 2,715,840 pulses



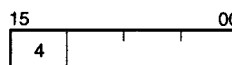
**Setting Target Position Attributes**

Set the target position's sign, direction, data type (absolute/incremental), and single-axis/interpolation designation with one digit from 0 to 7. For example, if the setting is "4," the settings will be CW and absolute, with interpolation.

Format



Example: 4



**Sign Data Contents**

0	CW	Absolute movement	Single-axis end point
1	CCW		
2	CW	Incremental movement	
3	CCW		
4	CW	Absolute movement	Interpolation end point
5	CCW		
6	CW	Incremental movement	
7	CCW		

**Note** 4 to 7 are available only for the NC211. If set to 4 to 7 and data is transferred from the CPU Unit to the NC113, an undefined error (8308) will occur.

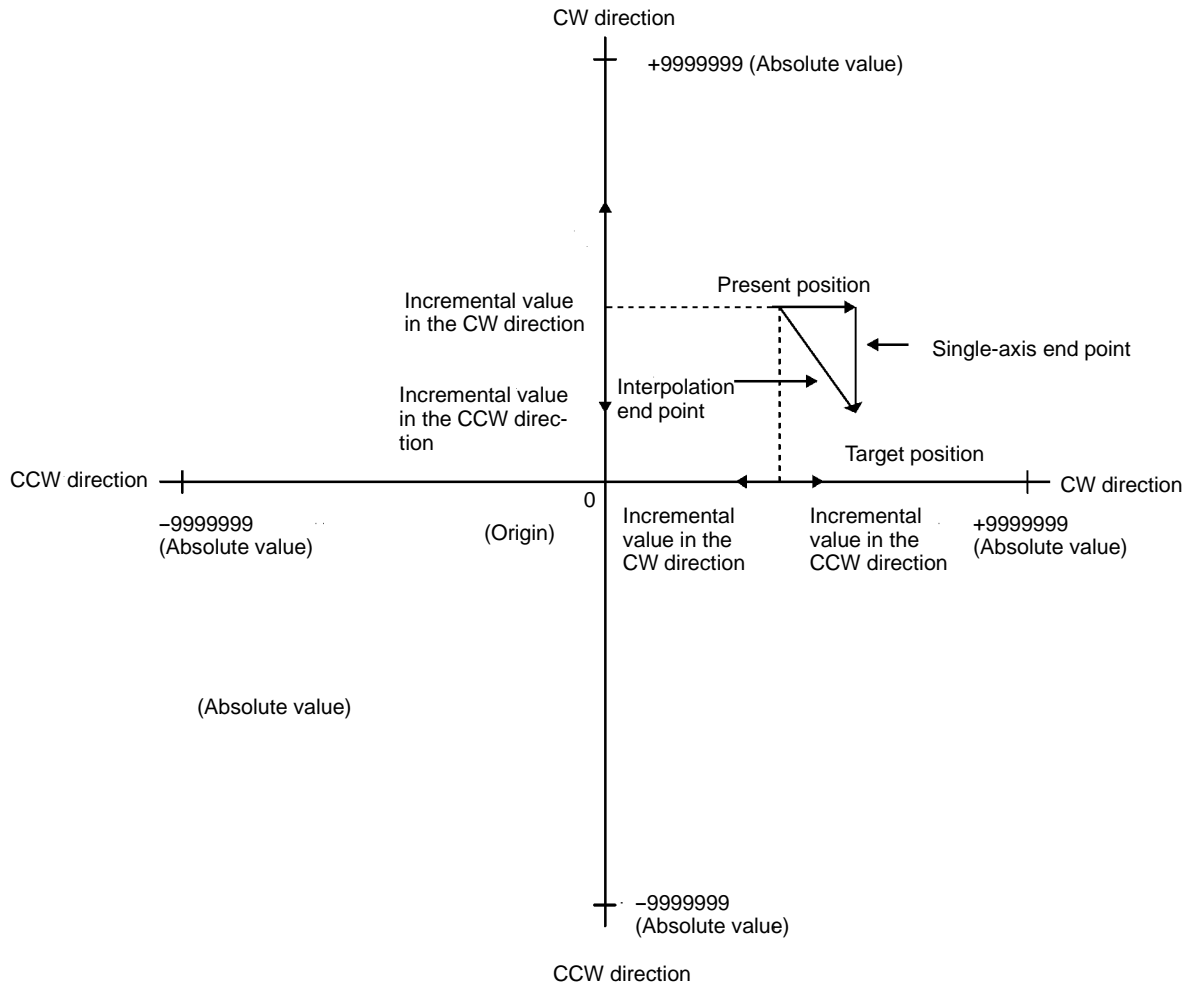
**Additional Information on Setting Target Positions**

The target position is set in seven digits BCD (-9999999 to 9999999).

**Target Position Sign**

0	CW	Absolute value	Single-axis end point
1	CCW		
2	CW	Incremental value	
3	CCW		
4	CW	Absolute value	Interpolation end point
5	CCW		
6	CW	Incremental value	
7	CCW		

**Note** Either 0 to 3 or 4 to 7 can be used as the Y axis sign during interpolation. This applies only to the NC211.



- The absolute value indicates a distance from the 0 point (origin).
- The incremental value indicates a distance from the present value.
- In the case of the single-axis end point, the X axis and Y axis operate independently. (This applies only to the NC211.)
- In the case of the interpolation end point, it operates along the linear line connecting the present value and the target value. (This applies only to the NC211.)
- When setting the incremental value, the sum of the present position and the incremental value should fall in a range from -9999999 to 9999999 assuming that the CW direction is “+” and CCW direction is “-.”

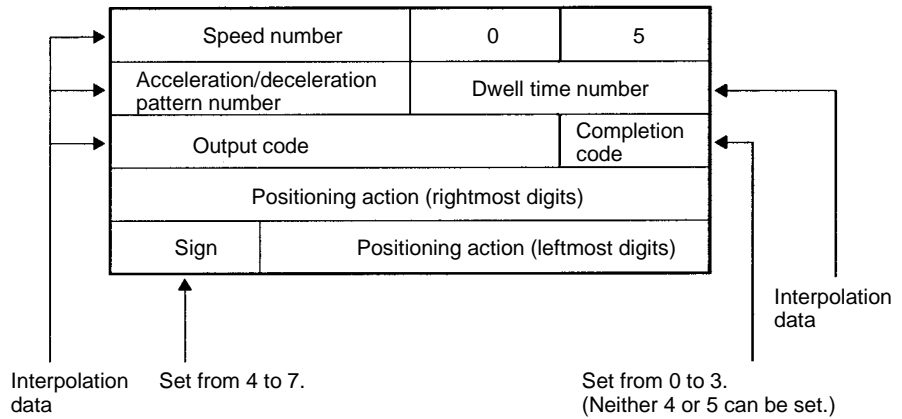
### 5-3-2 Settings for Linear Interpolation (Only for the NC211)

- Interpolation end-point data is set by specifying 4 to 7 for the X-axis target position sign. The corresponding Y-axis address is found by adding 4000 to the X-axis positioning action address.
- Interpolation is started by turning ON the X-axis START command. Only independent Y-axis operation is started by the Y-axis START command.
- The initial position address, initial speed, acceleration/deceleration pattern, positioning action target speed, output code, and dwell time are all determined by the values set for the X axis.
- When interpolation is being used, operation will not be possible with a continuous completion code (2) for just one axis or with a bank end completion code

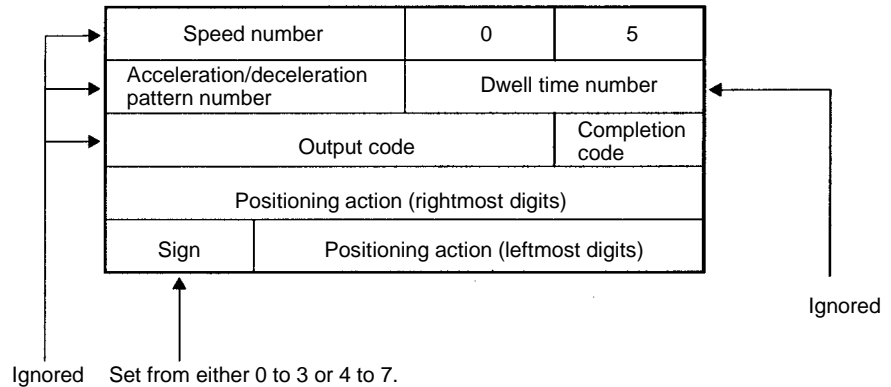


(3) for just the X axis. If either of these is set, the Y axis will be regarded as being set the same way and the Y-axis completion code will be ignored. Interpolation is also not possible with either speed control (4) or interrupt feeding (5) set as the completion code.

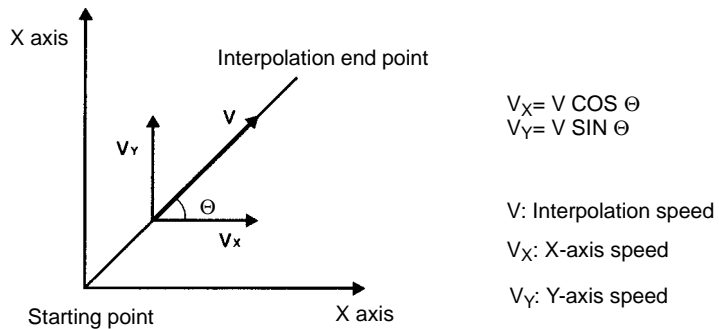
**X-axis Positioning Action Address 1000**



**Y-axis Positioning Action Address 5000 (X-axis Positioning Action Address + 4000)**



The target speed set for the X axis becomes the combined speed (i.e., the interpolation speed) for both the X and Y axis. The individual speeds for each axis can be expressed as shown in the following diagram.



### 5-3-3 Default Values for Positioning Actions

Address	Item	Setting range	Default value (factory setting)
1000	Speed address	00 to 49	6
	Acceleration/deceleration address	00 to 99	3
	Dwell time address	00 to 29	2
	Output code	00 to 499	0
	Completion code	0 to 5	0
	Positioning action	00 to 9999999	0
	Sign	0 to 7	0
5000	Speed address	00 to 49	6
	Acceleration/deceleration address	00 to 99	3
	Dwell time address	00 to 29	2
	Output code	00 to 499	0
	Completion code	0 to 5	0
	Positioning action	00 to 9999999	0
	Sign	0 to 7	0

- No default values are set for positioning actions for addresses other than those shown above.
- The address 5000 is not available for the NC113.

## 5-4 Speeds

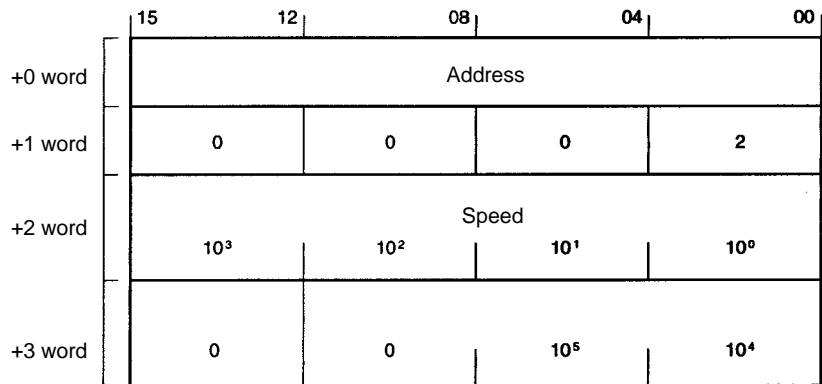
### 5-4-1 Setting Target Speeds (4 Words)

Addresses

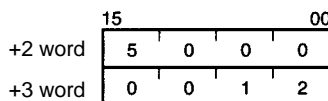
Axis	Address
X	4000 to 4049
Y	8000 to 8049 (NC211 only)

The target speed is set in six digits, from 0 to 250,000, in units of pulses per second (pps).

Format



Example: 125,000 pps



### 5-4-2 Default Values for Speeds

Address	Setting range (pps)	Default value (factory setting)	Default value application (indirect designation)
4000	0 to 250000	5000	Origin return speed, position data speed
4001	0 to 250000	5000	Origin search high speed, position data speed
4002	0 to 250000	500	Origin search proximity speed
4003	0 to 250000	5000	Jogging high speed
4004	0 to 250000	3000	Jogging low speed
4005	0 to 250000	1000	Starting speed
4006	0 to 250000	5000	
8000	0 to 250000	5000	Origin return speed, position data speed
8001	0 to 250000	5000	Origin search high speed, position data speed
8002	0 to 250000	500	Origin search proximity speed
8003	0 to 250000	5000	Jogging high speed
8004	0 to 250000	3000	Jogging low speed
8005	0 to 250000	1000	Starting speed
8006	0 to 250000	5000	

- Note**
1. All addresses other than those shown above are set to "0."
  2. The addresses 8000 to 8006 are only for the NC211.

## 5-5 Acceleration/Deceleration Patterns

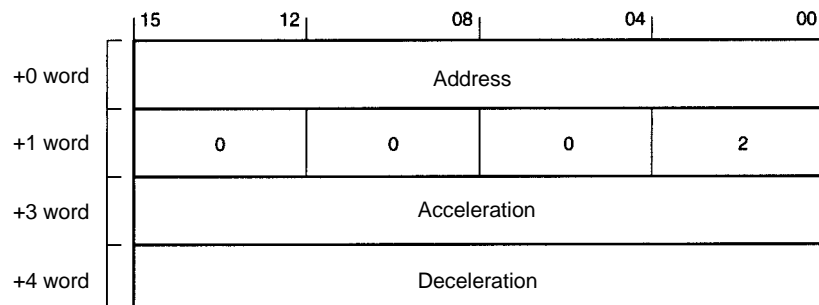
### 5-5-1 Setting Acceleration/Deceleration Patterns (4 Words)

Addresses

Axis	Address
X	3000 to 3099
Y	7000 to 7099 (NC211 only)

This setting indicates the amount of acceleration or deceleration in units of pps/ms. Set a value from 2 to 2,000.

Format



### 5-5-2 Default Values for Acceleration/Deceleration Patterns

Address	Setting range (pps/ms)	Default value (factory setting)		Default value application (indirect designation)
		Acceleration (pps/ms)	Deceleration (pps/ms)	
3000	2 to 2000	100	100	Origin return acceleration/ deceleration pattern
3001	2 to 2000	100	100	Origin search acceleration/ deceleration pattern
3002	2 to 2000	100	100	High-speed jogging acceleration/ deceleration pattern
3003	2 to 2000	100	100	Position action acceleration/ deceleration pattern
7000	2 to 2000	100	100	Origin return acceleration/ deceleration pattern
7001	2 to 2000	100	100	Origin search acceleration/ deceleration pattern
7002	2 to 2000	100	100	High-speed jogging acceleration/ deceleration pattern
7003	2 to 2000	100	100	Positioning action acceleration/ deceleration pattern

- Note**
1. All addresses other than those shown above are set to "2."
  2. The addresses 7000 to 7003 are only for the NC211.

## 5-6 Dwell Times

### 5-6-1 Setting Dwell Times (3 Words)

Addresses

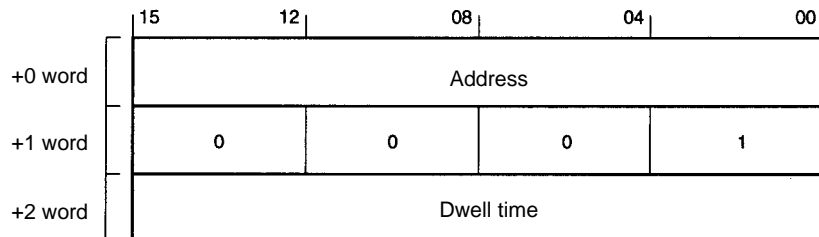
Axis	Address
X	9000 to 9029 (Common to X and Y axes)
Y	

When the origin search mode is set to either 0 or 1, pulse output is stopped for the length of time it takes for the dwell time to elapse, and then the Busy Flag turns OFF and the next operation can be executed. When the origin search mode is set to either 2 or 3, positioning completion input turns ON, and after the elapse of dwell time, the Busy Flag turns OFF and the next operation can be executed.

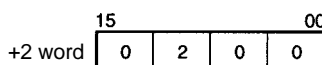
The dwell time is set in four digits from 0 to 9,990 (in units of ms).

**Note** The dwell time is processed in units of 10 ms. (Digit 1 of the set value is ignored.)

Format



Example: 200 ms



- When positioning is performed by the servomotor, some position hunting may occur when the target position is approached, depending on the gain. This tendency becomes more pronounced at times of sudden deceleration, or when high speeds are used over short distances, and so on. The effects of such hunting can be minimized by leaving a specified time interval between when the target position is reached and the Busy Flag turns OFF. That interval, during which operation is not possible, is called the dwell time.
- When the positioning action's completion code is set to "automatic," positioning is stopped for the length of this dwell time after the positioning action has been executed according to the specified target speed and target position. After the dwell time has elapsed, the next positioning action is started automatically.

### 5-6-2 Default Values for Dwell Times

Address	Setting range (ms)	Default value (factory setting)	Default value application (indirect designation)
9000	0 to 9990	0	Origin return dwell time
9001	0 to 9990	0	Origin search dwell time
9002	0 to 9990	0	Positioning action dwell time

**Note** All addresses other than those shown above are also set to "0."

## 5-7 Parameters

The various parameters for the X and Y axis are specified and set by means of their addresses. The X addresses range from 2000 to 2029, and the Y address range from 6000 to 6028 (NC211 only). The parameter data is set in the addresses shown in the following table.

Address	No. of words	Contents	Setting range	Default	Reference page
2000	3	X-axis origin return speed number	0 to 49	0	73
6000		Y-axis origin return speed number		0	
2001	3	X-axis start speed number	0 to 49	5	74
6001		Y-axis start speed number		5	
2002	3	X-axis start positioning number	0 to 499	0	74
6002		Y-axis start positioning number		0	
2003	3	X-axis high jog speed number	0 to 49	3	75
6003		Y-axis high jog speed number		3	
2004	3	X-axis low jog speed number	0 to 49	4	75
6004		Y-axis low jog speed number		4	
2005	3	X-axis origin search high-speed number	0 to 49	1	76
6005		Y-axis origin search high-speed number		1	
2006	3	X-axis origin compensation sign	0, 1	0	76
		X-axis origin search proximity speed number		0 to 49	
6006		Y-axis origin compensation sign	0, 1	0	
		Y-axis origin search proximity speed number	0 to 49	2	
2007	3	X-axis origin compensation	0 to 9999	0	77
6007		Y-axis origin compensation		0	
2008	3	X-axis origin return dwell time number	0 to 29	0	77
		X-axis origin search dwell time number		0 to 29	
6008		Y-axis origin return dwell time number	0 to 29	0	
		Y-axis origin search dwell time number	0 to 29	1	
2009	4	X-axis backlash compensation	0 to 99999	0	78
6009		Y-axis backlash compensation		0	

Address	No. of words	Contents	Setting range	Default	Reference page
2010	4	X-axis home shift	-999999 to 999999	0	78
6010		Y-axis home shift		0	
2011	4	X-axis CW limit	0 to 9999999	9999999	79
6011		Y-axis CW limit		9999999	
2012	4	X-axis CCW limit	0 to 9999999	9999999	80
6012		Y-axis CCW limit		9999999	
2013	6	X-axis zone 0, CW side	-9999999 to 9999999	0	80
		X-axis zone 0, CCW side	-9999999 to 9999999	0	
6013		Y-axis zone 0, CW side	-9999999 to 9999999	0	
		Y-axis zone 0, CCW side	-9999999 to 9999999	0	
2014	6	X-axis zone 1, CW side	-9999999 to 9999999	0	
		X-axis zone 1, CCW side	-9999999 to 9999999	0	
6014		Y-axis zone 1, CW side	-9999999 to 9999999	0	
		Y-axis zone 1, CCW side	-9999999 to 9999999	0	
2015	6	X-axis zone 2, CW side	-9999999 to 9999999	0	
		X-axis zone 2, CCW side	-9999999 to 9999999	0	
6015		Y-axis zone 2, CW side	-9999999 to 9999999	0	
		Y-axis zone 2, CCW side	-9999999 to 9999999	0	
2016	6	X-axis zone 3, CW side	-9999999 to 9999999	0	
		X-axis zone 3, CCW side	-9999999 to 9999999	0	
6016		Y-axis zone 3, CW side	-9999999 to 9999999	0	
		Y-axis zone 3, CCW side	-9999999 to 9999999	0	
2017	6	X-axis zone 4, CW side	-9999999 to 9999999	0	
		X-axis zone 4, CCW side	-9999999 to 9999999	0	
6017		Y-axis zone 4, CW side	-9999999 to 9999999	0	
		Y-axis zone 4, CCW side	-9999999 to 9999999	0	
2018	6	X-axis zone 5, CW side	-9999999 to 9999999	0	
		X-axis zone 5, CCW side	-9999999 to 9999999	0	
6018		Y-axis zone 5, CW side	-9999999 to 9999999	0	
		Y-axis zone 5, CCW side	-9999999 to 9999999	0	

Address	No. of words	Contents	Setting range	Default	Reference page
2019	6	X-axis zone 6, CW side	-9999999 to 9999999	0	
		X-axis zone 6, CCW side	-9999999 to 9999999	0	
6019		Y-axis zone 6, CW side	-9999999 to 9999999	0	
		Y-axis zone 6, CCW side	-9999999 to 9999999	0	
2020	6	X-axis zone 7, CW side	-9999999 to 9999999	0	
		X-axis zone 7, CCW side	-9999999 to 9999999	0	
6020		Y-axis zone 7, CW side	-9999999 to 9999999	0	
		Y-axis zone 7, CCW side	-9999999 to 9999999	0	
2021	3	X-axis origin search mode	0 to 3	0	81
		X-axis origin search pattern	0 to 5	0	
		X-axis origin search classification	0 to 1F	1E	
6021		Y-axis origin search mode	0 to 3	0	
		Y-axis origin search pattern	0 to 5	0	
		Y-axis origin search classification	0 to 1F	1E	
2022	4	X-axis PV change setting	-9999999 to 9999999	0	82
6022		Y-axis PV change setting	-9999999 to 9999999	0	
2023	3	X-axis origin return acceleration/deceleration pattern number	0 to 99	0	83
		X-axis origin search acceleration/deceleration pattern number	0 to 99	1	
6023		Y-axis origin return acceleration/deceleration pattern number	0 to 99	0	
		Y-axis origin search acceleration/deceleration pattern number	0 to 99	1	
2024	3	X-axis high-speed jogging acceleration/deceleration pattern number	0 to 99	2	83
6024		Y-axis high-speed jogging acceleration/deceleration pattern number		2	
2025	3	X-axis, number of pulses for inching	1 to 100	1	84
6025		Y-axis, number of pulses for inching		1	
2026	4	X-axis unit setting	0 to 2	0	85
		X-axis pulse rate	0.0001 to 1	1	
6026		Y-axis unit setting	0 to 2	0	
		Y-axis pulse rate	0.0001 to 1	1	
2027	3	X-axis pulse output selection	0, 1	0	86
6027		Y-axis pulse output selection	0, 1	0	

Address	No. of words	Contents	Setting range	Default	Reference page
2028	3	X-axis interrupt input signal definition	0, 1	0	86
		X-axis interrupt input signal type	0, 1	0	
		X-axis interrupt input emergency stop parameter	0, 1	0	
6028		Y-axis interrupt input signal definition	0, 1	0	
		Y-axis interrupt input signal classification	0, 1	0	
		Y-axis interrupt input emergency stop parameter	0, 1	0	

**Note** The addresses 6000 to 6028 are only for the NC211.

### Data Unit Setting (Pulse, Millimeter, Inch)

The following parameters can be set in pulses, millimeters, or inches.

- Origin compensation (X address: 2007; Y address 6007)
- Home shift (X address: 2010; Y address 6010)
- CW limit (X address: 2011; Y address 6011)
- CCW limit (X address: 2012; Y address 6012)
- Zone 0 to zone 7 (X addresses: 2013 to 2020; Y addresses 6013 to 6020)
- Reset present position setting (X address: 2022; Y address 6022)

The setting ranges for each of these parameters are shown in the following table.

Item	Setting range
Origin compensation (X address: 2007; Y address 6007)	0 to 999.9 mm 0 to 99.99 inch
Home shift (X address: 2010; Y address 6010)	-9999.99 to 9999.99 mm -999.999 to 999.999 inch
CW limit (X address: 2011; Y address 6011)	0 to 9999.999 mm 0 to 999.9999 inch
CCW limit (X address: 2012; Y address 6012)	0 to 9999.999 mm 0 to 999.9999 inch
Zone 0 to zone 7 (X addresses: 2013 to 2020; Y addresses 6013 to 6020)	-9999.999 to 9999.999 mm -999.9999 to 999.9999 inch
Reset present position setting (X address: 2022; Y address 6022)	-9999.999 to 9999.999 mm -999.9999 to 999.9999 inch

- Note**
1. The data unit (pulses, millimeters, inches) and pulse rate are set in parameter addresses 2026 (X axis) and 6026 (Y axis).
  2. The addresses 6007 to 6022 are only for the NC211.

## 5-7-1 Origin Return Speed Number (3 Words)

### Addresses

Axis	Address
X	2000
Y	6000 (NC211 only)

This parameter indirectly designates the speed address for when an origin return is executed on the X or Y axis. The setting is made in two digits, from 00 to 49. The indirectly designated addresses for both axes are as follows:

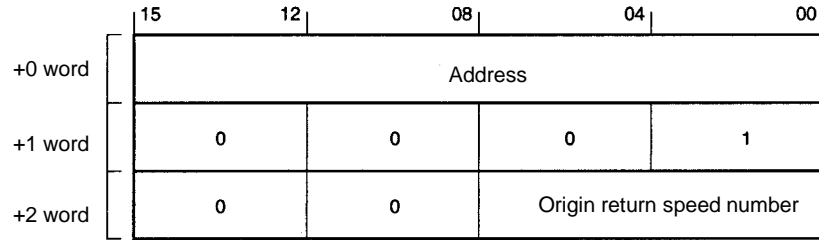
X axis: 4000 to 4049

Y axis: 8000 to 8049 (NC211 only)

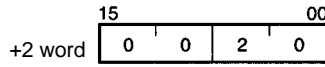
For example, if "20" is set for the Y-axis origin return speed number, the origin return will be executed at the speed registered at speed address 8020. For details on how to set speeds, refer to *5-4 Speeds*.



Format



Example: 20



### 5-7-2 Initial Speed Number (3 Words)

Addresses

Axis	Address
X	2001
Y	6001 (NC211 only)

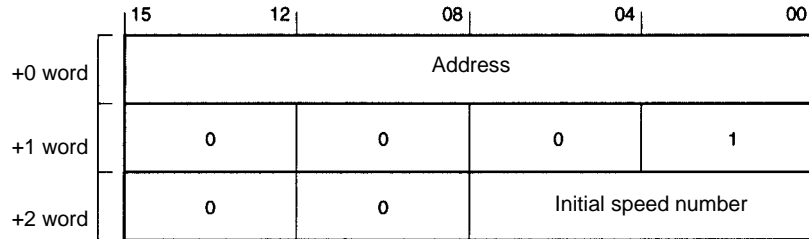
This parameter indirectly designates the initial speed addresses for the X and Y axes. The setting is made in two digits, from 00 to 49. The indirectly designated addresses for both axes are as follows:

X axis: 4000 to 4049

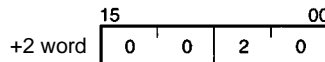
Y axis: 8000 to 8049 (NC211 only)

For example, if “20” is set for the Y-axis initial speed address, the speed registered at speed address 8020 will become the initial speed. For details on how to set speeds, refer to *5-4 Speeds*.

Format



Example: 20



### 5-7-3 Initial Positioning Action Number (3 Words)

Addresses

Axis	Address
X	2002
Y	6002 (NC211 only)

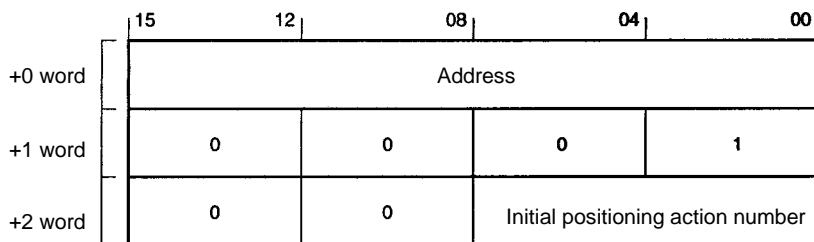
This parameter indirectly designates the initial positioning action addresses for the X and Y axes. The setting is made in three digits, from 000 to 499. The indirectly designated addresses for both axes are as follows:

X axis: 1000 to 1499

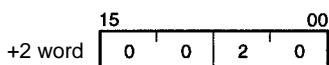
Y axis: 5000 to 5499 (NC211 only)

For example, if “20” is set for the Y-axis initial positioning action address, the speed registered at speed address 5020 will become the initial positioning action. For details on how to set positioning action data, refer to *5-3 Positioning Actions*.

## Format



Example: 20



## 5-7-4 High-speed Jogging Speed Number (3 Words)

## Addresses

Axis	Address
X	2003
Y	6003 (NC211 only)

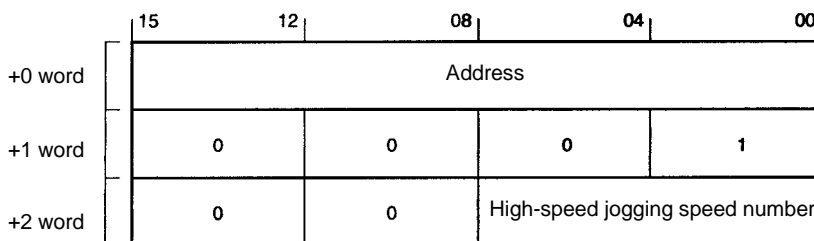
This parameter indirectly designates the high-speed jogging speed addresses for the X and Y axes. The setting is made in two digits, from 00 to 49. The indirectly designated addresses for both axes are as follows:

X axis: 4000 to 4049

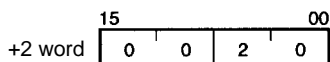
Y axis: 8000 to 8049 (NC211 only)

For example, if "20" is set for the Y-axis speed address for high-speed jogging, the speed registered at speed address 8020 will become the high-speed jogging speed. For details on how to set speeds, refer to *5-4 Speeds*.

## Format



Example: 20



## 5-7-5 Low-speed Jogging Speed Number (3 Words)

## Addresses

Axis	Address
X	2004
Y	6004 (NC211 only)

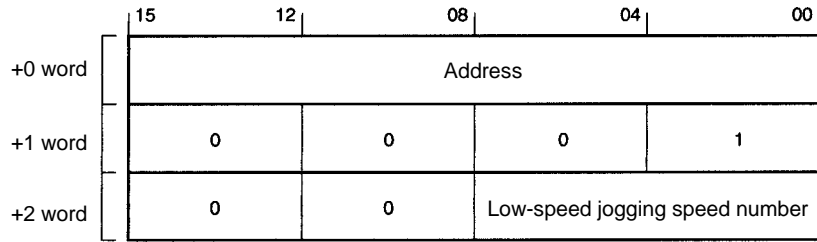
This parameter indirectly designates the low-speed jogging speed addresses for the X and Y axes. The setting is made in two digits, from 00 to 49. The indirectly designated addresses for both axes are as follows:

X axis: 4000 to 4049

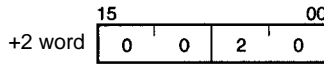
Y axis: 8000 to 8049 (NC211 only)

For example, if "20" is set for the Y-axis speed address for low-speed jogging, the speed registered at speed address 8020 will become the low-speed jogging speed. For details on how to set speeds, refer to *5-4 Speeds*.

Format



Example: 20



### 5-7-6 Origin Search High-speed Number

Addresses

Axis	Address
X	2005
Y	6005 (NC211 only)

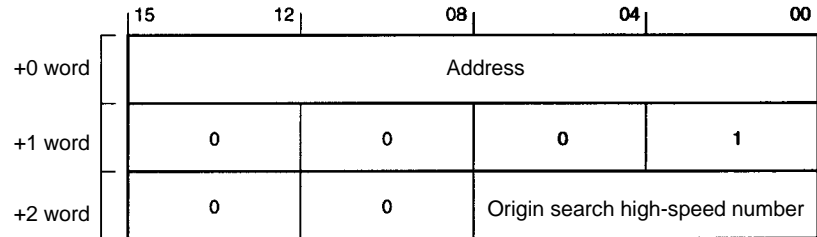
This parameter indirectly designates the origin search high-speed addresses for the X and Y axes. The setting is made in two digits, from 00 to 49. The indirectly designated addresses for both axes are as follows:

X axis: 4000 to 4049

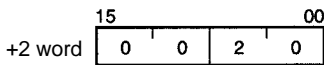
Y axis: 8000 to 8049 (NC211 only)

For example, if “20” is set for the Y-axis high-speed address for origin search, the speed registered at speed address 8020 will become the origin search high speed. For details on how to set speeds, refer to *5-4 Speeds*.

Format



Example: 20



### 5-7-7 Origin Search Proximity Speed Number and Origin Compensation Sign (3 Words)

Address

Axis	Address
X	2006
Y	6006 (NC211 only)

This parameter indirectly designates the origin search proximity speed addresses for the X and Y axes. The setting is made in two digits, from 00 to 49. The indirectly designated addresses for both axes are as follows:

X axis: 4000 to 4049

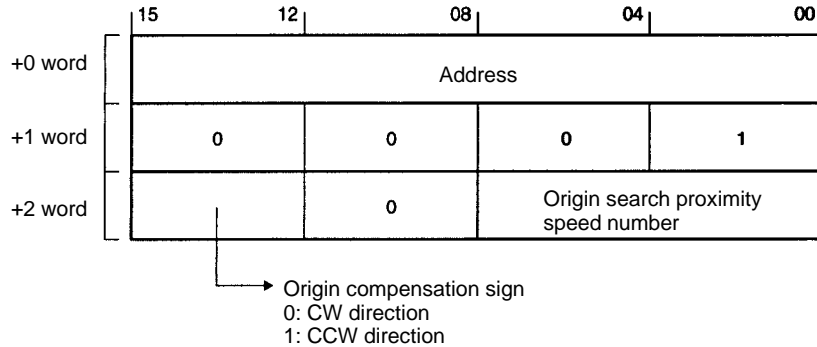
Y axis: 8000 to 8049 (NC211 only)

For example, if “20” is set for the Y-axis proximity speed address for origin search, the speed registered at speed address 8020 will become the origin search proximity speed. For details on how to set speeds, refer to *5-4 Speeds*.

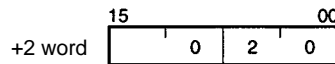
This is also the place for setting the origin compensation sign.

- 0: CW direction
- 1: CCW direction

**Format**



Example: 20



**5-7-8 Origin Search Compensation (3 Words)**

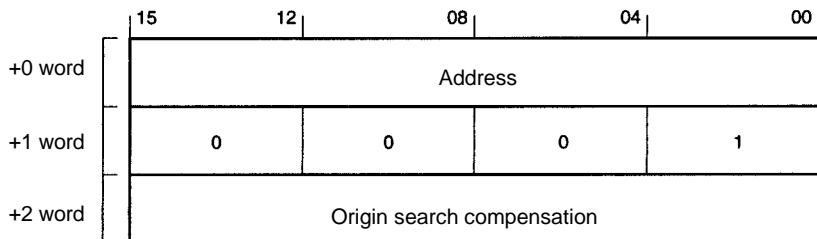
**Addresses**

Axis	Address
X	2007
Y	6007 (NC211 only)

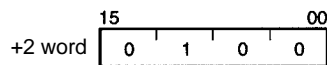
This parameter sets the origin compensation value in pulses, millimeters, or inches. The setting is made in four digits, as follows:

- Pulses: 0000 to 9999
- Millimeters: 000.0 to 999.9
- Inches: 00.00 to 99.99

**Format**



Example: 20



**5-7-9 Origin Return and Origin Search Dwell Time Numbers (3 Words)**

**Addresses**

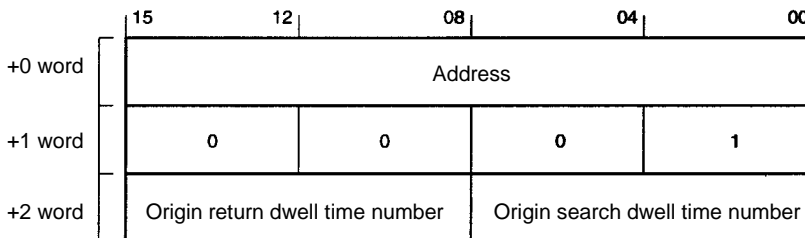
Axis	Address
X	2008
Y	6008 (NC211 only)

This parameter indirectly designates the origin return dwell time address. The setting is made in two digits, from 00 to 29.

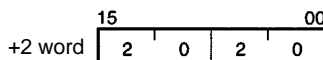
It also indirectly designates the origin search dwell time address. This setting is also made in two digits, from 00 to 29.

For example, if “20” is set for the dwell time number, the dwell time registered at dwell time address 9020 will be executed. For details on how to set dwell times, refer to *5-6 Dwell Times*.

**Format**



Example: 20 for both origin return and origin search dwell time numbers



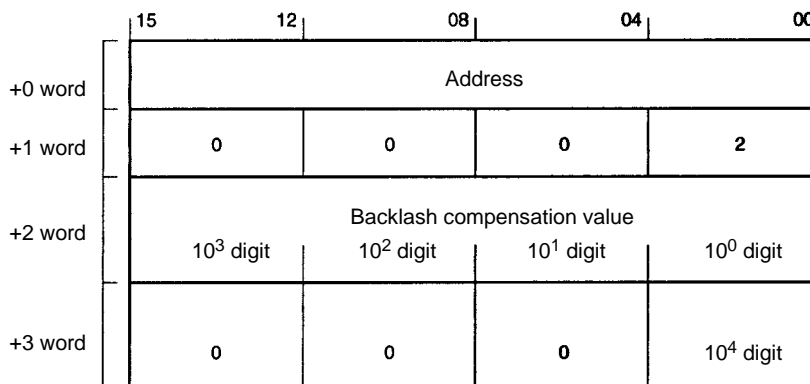
**5-7-10 Backlash Compensation (4 Words)**

**Addresses**

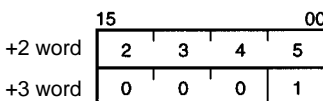
Axis	Address
X	2009
Y	6009 (NC211 only)

This parameter sets the backlash compensation value in five digits, from 0 to 99999.

**Format**



Example: 12345



**5-7-11 Home Shift (4 Words)**

**Addresses**

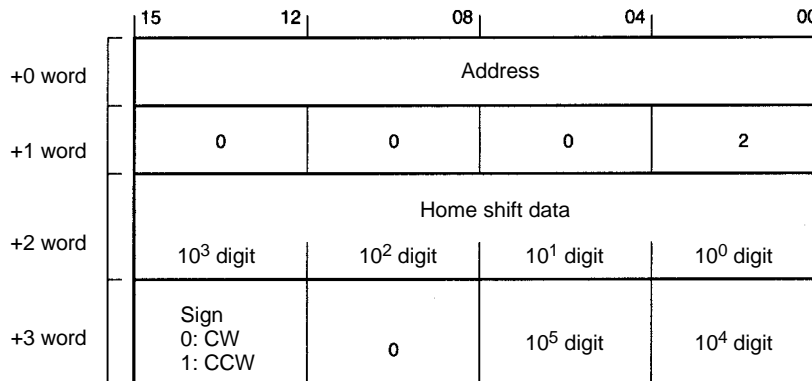
Axis	Address
X	2010
Y	6010 (NC211 only)

This parameter sets the home shift data in six digits, as follows:

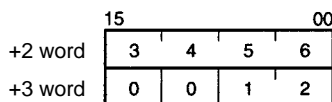
- Pulses: -999999 to 999999
- Millimeters: -9999.99 to 9999.99
- Inches: -999.999 to 999.999

**Note** The data unit (pulses, millimeters, inches) and pulse rate are set in parameter addresses 2026 (X axis) and 6026 (Y axis).

**Format (for Pulses)**



Example: 12345



**Note** For digits 10<sup>0</sup> to 10<sup>5</sup>, the data unit is pulses. If the data unit was millimeters, then the digits would be 10<sup>-2</sup> to 10<sup>3</sup>. If the data unit was inches, then the digits would be 10<sup>-3</sup> to 10<sup>2</sup>.

**5-7-12 CW Limit (4 Words)**

**Addresses**

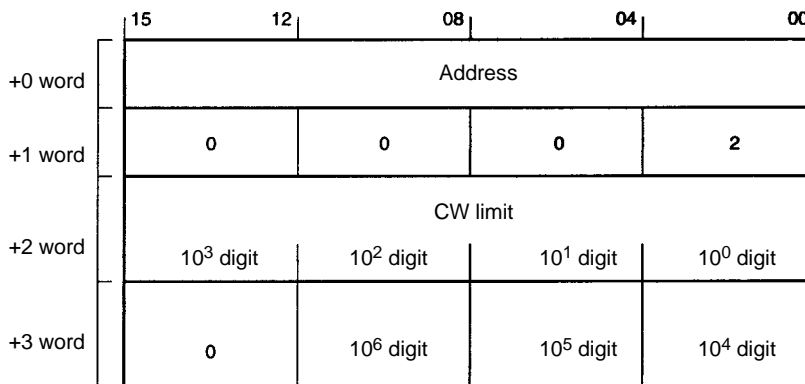
Axis	Address
X	2011
Y	6011 (NC211 only)

This parameter sets the CW limit in seven digits, as follows:

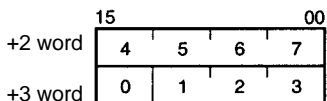
- Pulses: 0000000 to 9999999
- Millimeters: 0000.000 to 9999.999
- Inches: 000.0000 to 999.9999

**Note** The data unit (pulses, millimeters, inches) and pulse rate are set in parameter addresses 2026 (X axis) and 6026 (Y axis).

**Format (for Pulses)**



Example: 1234567 (pulses)



- Note**
1. For digits  $10^0$  to  $10^6$ , the data unit is pulses. If the data unit was millimeters, then the digits would be  $10^{-3}$  to  $10^3$ . If the data unit was inches, then the digits would be  $10^{-4}$  to  $10^2$ .
  2. If the CW limit and the CCW limit are both set to “0,” they will be treated as if the maximum value of 9999999 pulses was set regardless of whether the unit is in pulses, mm, or inches.

### 5-7-13 CCW Limit (4 Words)

Addresses

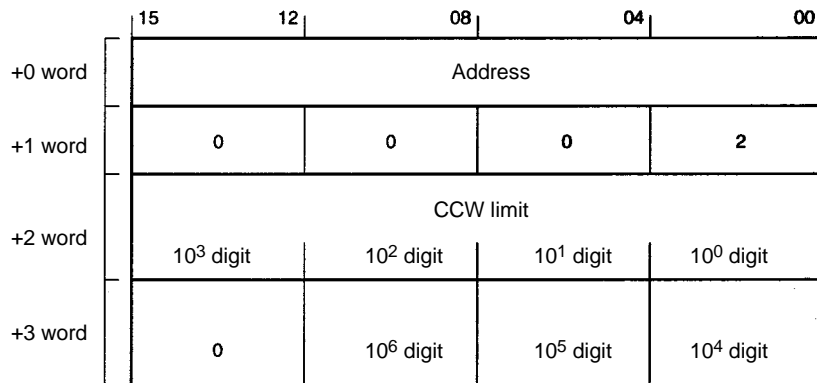
Axis	Address
X	2012
Y	6012 (NC211 only)

This parameter sets the CCW limit in seven digits, as follows:

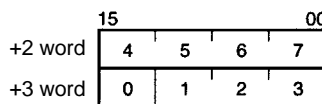
Pulses: 0000000 to 9999999  
 Millimeters: 0000.000 to 9999.999  
 Inches: 000.0000 to 999.9999

- Note** The data unit (pulses, millimeters, inches) and pulse rate are set in parameter addresses 2026 (X axis) and 6026 (Y axis).

Format (for Pulses)



Example: 1234567 (pulses)



- Note**
1. For digits  $10^0$  to  $10^6$ , the data unit is pulses. If the data unit was millimeters, then the digits would be  $10^{-3}$  to  $10^3$ . If the data unit was inches, then the digits would be  $10^{-4}$  to  $10^2$ .
  2. If the CW limit and the CCW limit are both set to “0,” they will be treated as if the maximum value of 9999999 pulses was set regardless of whether the unit is in pulses, mm, or inches.

### 5-7-14 Zones (6 Words)

Addresses

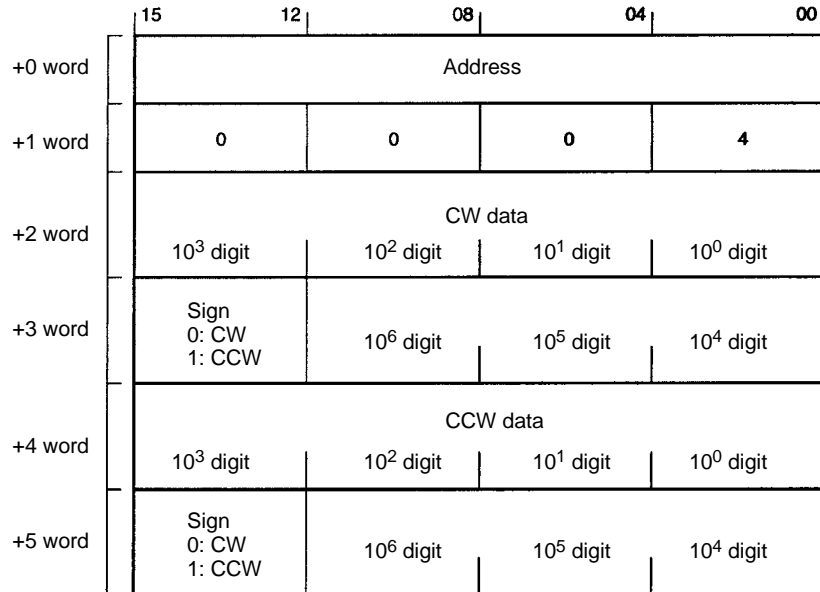
Axis	Address
X	2013 to 2020
Y	6013 to 6020 (NC211 only)

This parameter sets the CW and CCW zones in seven digits, as follows:

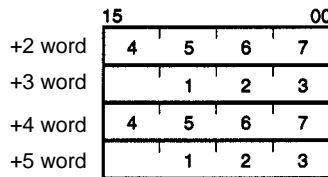
Pulses: -9999999 to 9999999  
 Millimeters: -9999.999 to 9999.999  
 Inches: -999.9999 to 999.9999

**Note** The data unit (pulses, millimeters, inches) and pulse rate are set in parameter addresses 2026 (X axis) and 6026 (Y axis).

**Format (for Pulses)**



Example: 1234567 (pulses) for both CW and CCW



**Note** For digits 10<sup>0</sup> to 10<sup>6</sup>, the data unit is pulses. If the data unit was millimeters, then the digits would be 10<sup>-3</sup> to 10<sup>3</sup>. If the data unit was inches, then the digits would be 10<sup>-4</sup> to 10<sup>2</sup>.

**5-7-15 Origin Search Mode, Pattern, and Type (3 Words)**

**Addresses**

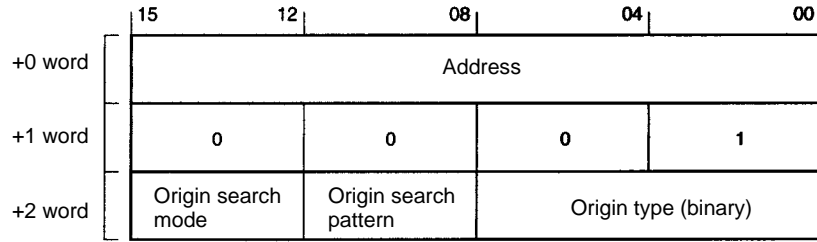
Axis	Address
X	2021
Y	6021 (NC211 only)

- The origin search mode is set in one digit, from 0 to 3. For information regarding the contents of the origin search mode setting, refer to 9-3 *ORIGIN SEARCH*.
- The origin search pattern is set in one digit, from 0 to 5. For information regarding the contents of the origin search pattern setting, refer to 9-3 *ORIGIN SEARCH*.
- The origin search type is set in two digits, from 0 to 1F.

Bit	Function	1	0
0	Origin search direction	CCW	CW
1	Origin proximity signal	Yes	No
2	Origin proximity signal type	N.O. contact	N.C. contact
3	Origin signal type	N.O. contact	N.C. contact
4	Origin search method	With proximity reversal	Without proximity reversal

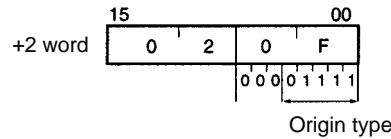


Format



Example

In this example, the following settings are in effect:  
 Origin search mode: 0; origin search pattern: 2; origin type: 01111 binary (origin search method: no proximity reversal; origin signal: N.O. contact; origin proximity signal: N.O. contact; origin proximity signal: yes; origin search direction: CCW).



5-7-16 Reset Present Position Setting (4 Digits)

Addresses

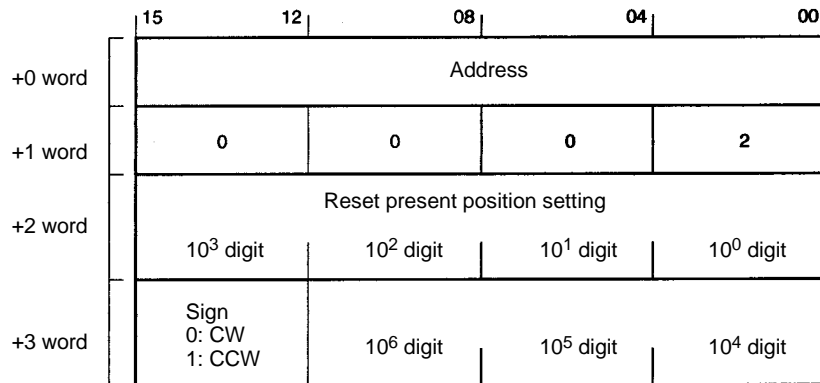
Axis	Address
X	2022
Y	6022 (NC211 only)

When the RESET PRESENT POSITION command is executed, the coordinates of the position where operation is currently stopped are regarded as the data set for the reset present position setting.

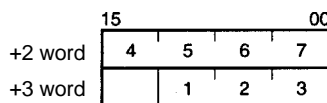
- Pulses: -9999999 to 9999999
- Millimeters: -9999.999 to 9999.999
- Inches: -999.9999 to 999.9999

**Note** The data unit (pulses, millimeters, inches) and pulse rate are set in parameter addresses 2026 (X axis) and 6026 (Y axis).

Format (for Pulses)



Example: 1234567 (pulses)



**Note** For digits 10<sup>0</sup> to 10<sup>6</sup>, the data unit is pulses. If the data unit was millimeters, then the digits would be 10<sup>-3</sup> to 10<sup>3</sup>. If the data unit was inches, then the digits would be 10<sup>-4</sup> to 10<sup>2</sup>.

### 5-7-17 Origin Return and Origin Search Acceleration/Deceleration Pattern Numbers (3 Words)

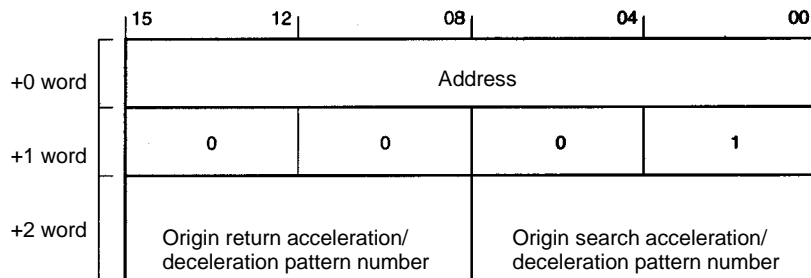
Addresses

Axis	Address
X	2023
Y	6023 (NC211 only)

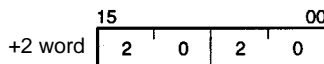
- This parameter indirectly designates the acceleration/deceleration pattern address for origin return operations. The setting is made in two digits, from 00 to 99. When ORIGIN RETURN is executed, acceleration and deceleration are performed according to the data set here.
- This parameter also indirectly designates the acceleration/deceleration pattern address for origin search operations. The setting is made in two digits, from 00 to 99. When ORIGIN SEARCH is executed, acceleration and deceleration are performed according to the data set here.

For example, if “20” is set for the Y-axis acceleration/deceleration pattern number, the acceleration/deceleration pattern registered at address 7020 will be used. For details on how to set acceleration/deceleration patterns, refer to 5-5 *Acceleration/Deceleration Patterns*.

Format



Example: 20 (for both origin return and origin search)



### 5-7-18 High-speed Jogging Acceleration/Deceleration Pattern Number (3 Words)

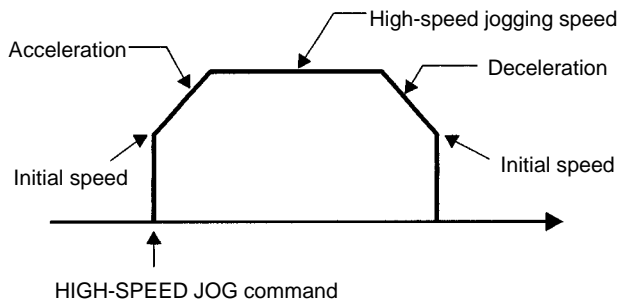
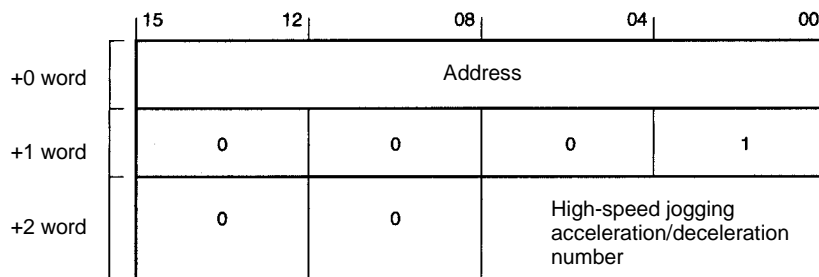
Addresses

Axis	Address
X	2024
Y	6024 (NC211 only)

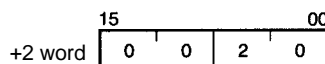
This parameter indirectly designates the acceleration/deceleration pattern address for high-speed jogging. The setting is made in two digits, from 00 to 99. When high-speed jogging is started or completed, acceleration and deceleration are performed according to the data set here.

For example, if “20” is set for the Y-axis acceleration/deceleration pattern number, the acceleration/deceleration pattern registered at address 7020 will be used. For details on how to set acceleration/deceleration patterns, refer to 5-5 *Acceleration/Deceleration Patterns*.

Format



Example: 20



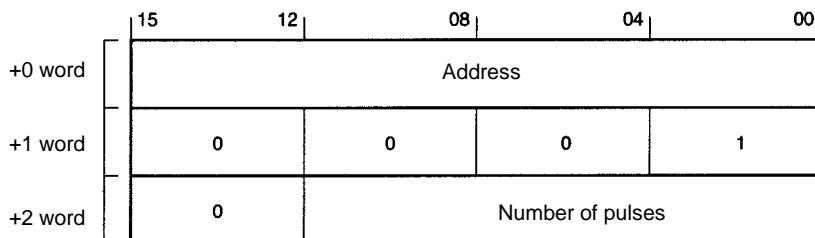
### 5-7-19 Number of Inching Pulses (3 Words)

Addresses

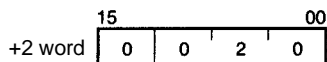
Axis	Address
X	2025
Y	6025 (NC211 only)

This parameter sets the amount of movement along the designated axis when the INCH command is executed. The number of pulses is set in three digits, from 1 to 100.

Format



Example: 20 (pulses)



### 5-7-20 Unit and Pulse Rate (3 Words)

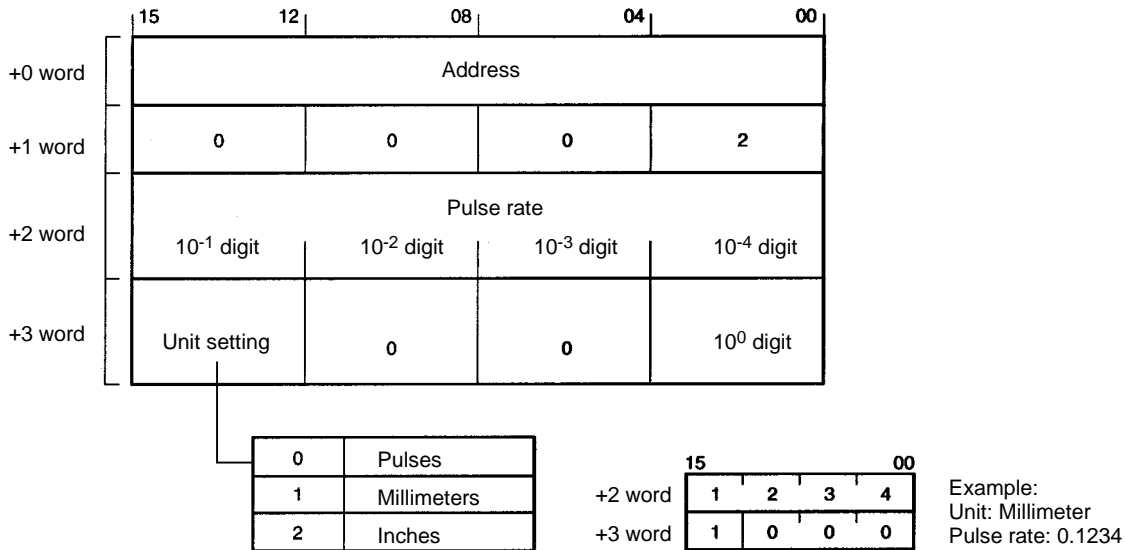
Addresses

Axis	Address
X	2026
Y	6026 (NC211 only)

- This parameter is used to select the unit in which the data is to be expressed (pulses, millimeters, or inches). The setting is made in one digit, as follows:
  - 0: Pulses
  - 1: Millimeters
  - 2: Inches
- This parameter also sets the pulse rate (unit/pulse) in five digits, from 0.0001 to 1.0000.

**Note** If the unit is set to “0: Pulses,” the pulse rate will be fixed at 1.0000.

Format



**Note** 1. Within the Position Control Unit, operations are performed using pulse data as the standard. Therefore, when millimeters or inches are set as the data unit, the data is converted to pulses according to the pulse rate. When the data is converted, all digits to the right of the decimal point are discarded. For example, if the unit is set to millimeters, the pulse rate is 0.4567, and the data setting is 99999.999, the conversion will be calculated as follows:

$$99999.999 \text{ (mm)} / 0.4567 = 218962.1174 \text{ (pulses)}$$

The digits to the right of the decimal point will be discarded, so the internal data will be treated as 218,962 pulses. Thus the data that the Position Control Unit processes internally will be slightly different from the origin 99999.999 mm that was set. (218962 x 0.4567 = 99999.9454 mm)

2. When a change has been made to this parameter, be sure to transfer the new (i.e., changed) parameter data to the Position Control Unit before transferring the rest of the data. The Position Control Unit will use this parameter data to convert the set data to pulse units. (But simply sending the changed parameter data by itself will not cause any data that is already in the Position Control Unit to be changed.)

### 5-7-21 Output Pulses (3 Words)

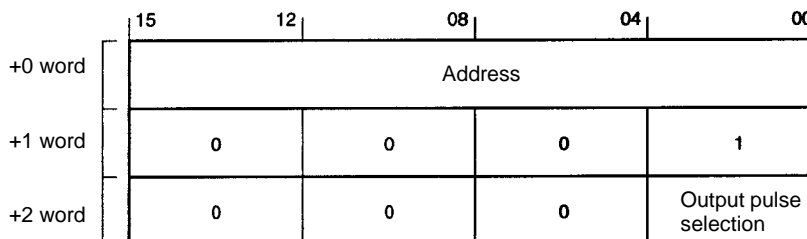
#### Addresses

Axis	Address
X	2027
Y	6027 (NC211 only)

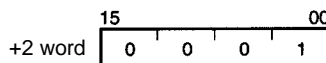
This parameter sets the output pulse selection in one digit, to either 0 or 1, as follows:

- 0: CW/CCW output
- 1: Pulse/direction output

#### Format



Example: Pulse/direction output



**Note** This parameter goes into effect when the power is turned on. When changing the setting, execute the EEPROM WRITE command and then power up the Unit again.

### 5-7-22 Interrupt Input Signal Type, Definition, and Emergency Stop (3 Words)

#### Addresses

Axis	Address
X	2028
Y	6028 (NC211 only)

• This parameter sets the interrupt input signal type in one digit, to either 0 or 1, as follows:

- 0: Interrupt input signal variable (See note 1.)
- 1: Interrupt input signal fixed (See note 2.)

**Note** 1. When the interrupt input signal is variable, the command bit (X axis: bit 06 of word m+1; Y axis: bit 06 of word m+5) is referenced.  
2. When the interrupt input signal is fixed, the interrupt input signal definition is referenced.

• This parameter sets the interrupt input signal definition in one digit, to either 0 or 1, as follows:

- 0: Interrupt input signal regarded as either deceleration stop or emergency stop (depending on the setting of the interrupt input emergency stop parameter).
- 1: Interrupt input signal regarded as speed change.

• This parameter sets the interrupt input emergency stop in one digit, to either 0 or 1, as follows:

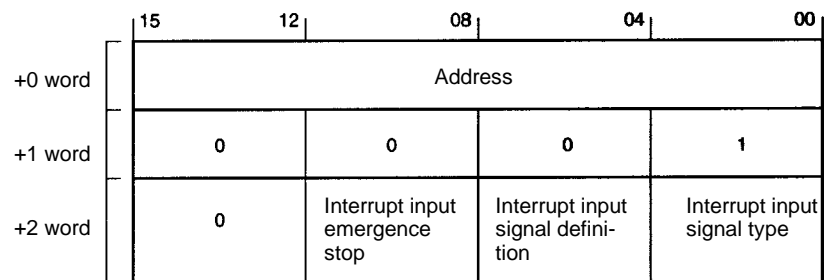
- 0: Deceleration stop
- 1: Emergency stop

The following table shows the three parameter settings combined.

Interrupt input signal type	Interrupt input signal definition	Command (X: bit 06 of word m+1; Y: bit 06 of word m+6)	Interrupt input emergency stop	Operation when interrupt input signal turns ON
Variable (0)	---	0	0	Deceleration stop
			1	Emergency stop
		1	---	Speed change
Fixed (1)	0	--- (See note 1.)	0	Deceleration stop
			1	Emergency stop
	1		---	Speed change (See note 1.)

- Note**
1. The speed change is possible even when the command bit (X: bit 06 of word m+1; Y: bit 06 of word m+6) turns ON.
  2. When interpolation is being used, a deceleration stop or an emergency stop for either axis will cause both axes to be stopped.

### Format



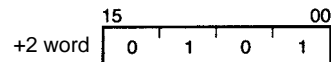
### Example

In this example, the following settings are assumed:

Interrupt input signal type: Fixed (1)

Interrupt input signal definition: 0

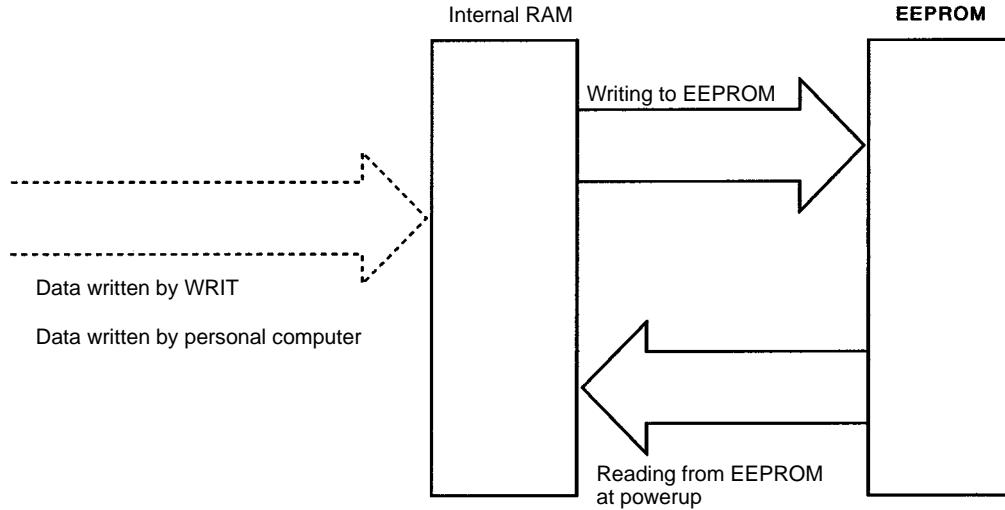
Interrupt input emergency stop: 1



## 5-8 Saving Data

The Position Control Unit uses EEPROM for saving data. All data written to the internal RAM is erased when the power is turned off. If any of that data needs to be saved, it must be written to EEPROM before the power is turned off.

The data saved to EEPROM is automatically read to internal addresses when the Position Control Unit is powered up.



- **Writing to EEPROM**

To write data from internal RAM to EEPROM, execute the EEPROM WRITE command.

- **Reading from EEPROM**

The data saved in EEPROM is automatically read to internal RAM when the power is turned on. To read data to internal RAM from EEPROM at other times, execute the EEPROM READ command.

**Note** If the pulse rate has been changed:

- When reading data from EEPROM, an error will be generated (error code 9200) if values changed to pulses fall outside of the setting range.
- An error will not be generated when writing to EEPROM.

## SECTION 6

### Commands

This section explains the commands used by the Position Control Unit. There are two ways to execute commands. One way is to set the Programmable Controller's operating mode to either RUN or Monitor, and to use the Intelligent I/O Write instruction (WRIT) to transfer nine words (five words for the NC113) of command data to the Position Control Unit. The other way is to set the Programmable Controller's operating mode to Program, and to give commands to the Position Control Unit by turning ON and OFF bits in the output area allocated for Special I/O.

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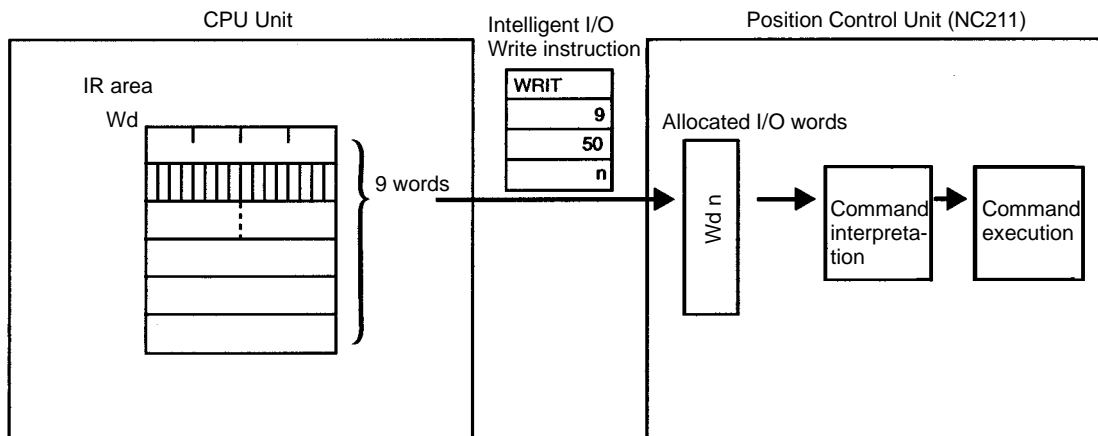


## 6-1 Creating and Transferring Commands

This section explains how to give commands such as START, ORIGIN SEARCH, and so on, to the Position Control Unit.

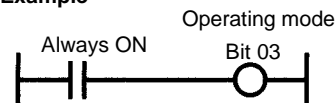
### When the CPU Unit is in RUN or Monitor Mode

- 1, 2, 3... 1. Create nine words (five words for the NC113) of command data, beginning with 0001, in the CPU Unit's DM and IR areas.
2. Use the Intelligent I/O Write instruction to transfer the command data to the Position Control Unit.
3. The Position Control Unit interprets the command and executes it.



**Note** When the CPU Unit is in either Run or Monitor Mode, bit 03 of the allocated I/O word must be turned ON by the program. When bit 03 is OFF, commands cannot be received by means of WRIT (the Intelligent I/O Write instruction).

### Ladder Program Example

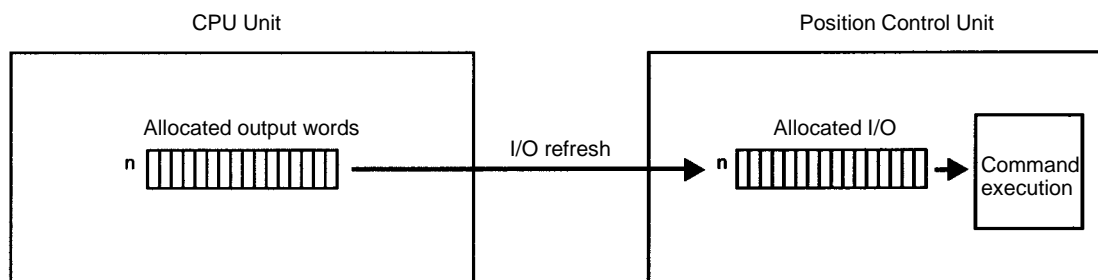


If bit 03 is turned ON by a forced set when the CPU Unit is in Program Mode, the Position Control Unit will stop all operations in Program Mode.

Bits 00 to 02, 09, and 15 are used by the system program, therefore do not use these bits.

### When the CPU Unit is in Program Mode

- 1, 2, 3... 1. Operate (i.e., turn ON and OFF) the bits in the CPU Unit's allocated output words.
2. The command will be automatically transferred to the Position Control Unit during the next I/O refresh.



**Note** Operation will be decelerated to a stop if the PC's operating mode is changed (i.e., RUN/Monitor to Program, or Program to RUN/Monitor) while axes are being operated.

## 6-2 When the PC is in RUN or Monitor Mode

### 6-2-1 Command Configuration (RUN, Monitor Mode)

Commands are configured in nine words of data.

#### X-axis Command Format (Words m+1 to m+4)

Bit	Word				
	m+0	m+1	m+2	m+3	m+4
00	1	START	Initial positioning action number (000 to 499)	Teaching positioning action number (000 to 499)	Override: 00 to 20 (Unit x 0.1) (00: Override 1.0) Speed number for target speed change (00 to 49) (00: Present speed number + 1)
01		Initial positioning action number enable			
02		ORIGIN SEARCH			
03		ORIGIN RETURN			
04	0	RELEASE PROHIBIT			
05		READ ERROR			
06		CHANGE SPEED/DEFINE INTERRUPT INPUT SIGNAL			
07		Override enable			
08	0	RESET PRESENT POSITION			Forced ON/OFF bit for error counter reset. Enabled only while operation is stopped.
09		TEACH			Forced ON/OFF bit for origin adjustment command outputs (See note 1.)
10		Not used.			0
11		HIGH-SPEED JOG			0
12	0	Jogging/inching direction	CHANGE OVERRIDE	0	EEPROM command
13		LOW-SPEED JOG	Home shift enable/disable setting (0: Disable; 1: Enable)	0	EEPROM read/write designation
14		INCH	0	0	PC protect
15		STOP	0	0	External input protect

- Note**
1. Enabled only when stopped or during manual operation.
  2. Commands shown in the shaded boxes for word m+1 are executed when their allocated bit turns ON.

## Y-axis Command Format (Words m+5 to m+8)

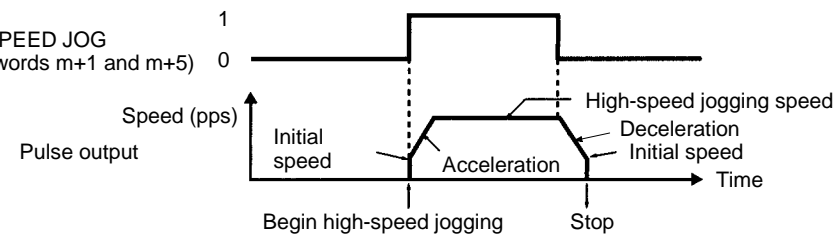
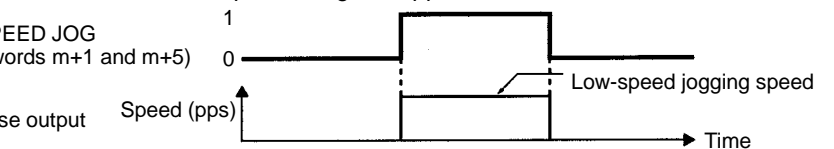
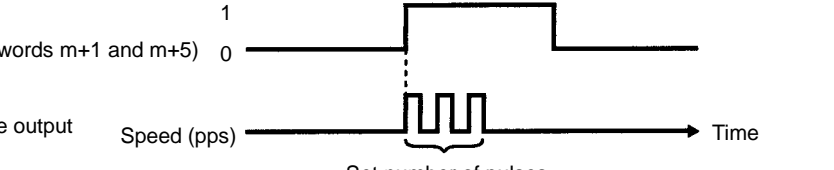
Bit	Word				
	m+5	m+6	m+7	m+8	
00	START	Initial positioning action number (000 to 499)	Teaching positioning action number (000 to 499)	Override: 00 to 20 (Unit x 0.1) (00: Override 1.0) Speed data address for target speed change (00 to 49) (00: Present speed number + 1)	
01	Initial positioning action number enable				
02	ORIGIN SEARCH				
03	ORIGIN RETURN				
04	RELEASE PROHIBIT				
05	READ ERROR				
06	CHANGE SPEED/ DEFINE INTERRUPT INPUT SIGNAL				
07	Override enable				
08	RESET PRESENT POSITION				Forced ON/OFF bit for error counter reset. Enabled only while operation is stopped.
09	TEACH				Forced ON/OFF bit for origin adjustment command outputs (See note 1.)
10	Not used.		0		
11	HIGH-SPEED JOG		0		
12	Jogging/inching direction	CHANGE OVERRIDE	0	0	
13	LOW-SPEED JOG	Home shift enable/disable setting (0: Disable; 1: Enable)	0	0	
14	INCH	0	0	0	
15	STOP	0	0	0	

- Note**
1. Enabled only when stopped or during manual operation.
  2. Commands shown in the shaded boxes for word m+1 are executed when their allocated bit turns ON.
  3. The Y-axis command area does not have the EEPROM command, EEPROM read/write designation, PC protect, or external input protect.
  4. In the case of the NC113, Y-axis commands (words m+5 to m+8) will be ignored when transmitted. Transmit only five words (words m+0 to m+4).

## 6-2-2 Command Details (RUN, Monitor Mode)

Word	Bit	Function
m+1 m+5	00	START / INTERPOLATION START When this bit is turned ON (↑), bit 01 of words m+1 (X axis) and m+5 (Y axis) are referenced and positioning is started. For interpolation positioning, use only word m+1 (NC211 only). Word m+5 is used only for independent Y-axis operation.

Word	Bit	Function
m+1 m+5	01	<p>Initial Positioning Action Number Enable</p> <p>Selects either the data stored in words m+2 (X axis) and m+6 (Y axis) or the data stored in parameter addresses 2002 (X axis) and 6002 (Y axis) for the initial positioning action.</p> <ul style="list-style-type: none"> <li>When set to "0": <ol style="list-style-type: none"> <li>The positioning action stored in parameter addresses 2002 and 6002 will be executed under the following conditions: <ol style="list-style-type: none"> <li>When operation is first started after powerup.</li> <li>When starting after a bank end.</li> <li>When starting after a positioning action at address 1499 (X axis) or 5499 (Y axis) has been executed.</li> </ol> </li> <li>Except for the above circumstances, the positioning action with the next number (i.e., the number of the previously executed positioning action + 1) will be executed.</li> </ol> </li> <li>When set to "1": <p>The positioning action stored in words m+2 and m+6 will be executed.</p> </li> </ul>
	02	<p>ORIGIN SEARCH</p> <p>When this bit is turned ON (↑), the origin search operation begins and the proximity signal and origin signal are used to find the origin.</p>
	03	<p>ORIGIN RETURN</p> <p>When this bit is turned ON (↑), the origin return operation begins and positioning returns to the origin. This command can only be used when the position of the origin is already clearly established.</p>
	04	<p>RELEASE PROHIBIT</p> <p>When this bit is turned ON (↑), it clears the pulse output prohibition that goes into effect after the trailing edge (↓) of an input for an emergency stop, CW limit, or CCW limit.</p> <p><b>Note</b> When pulse output is stopped after an emergency stop, it is also necessary to clear the emergency stop switch.</p>
	05	<p>READ ERROR</p> <p>When there are two or more errors, turning ON (↑) this bit causes the status area (X axis: s+1; Y axis: s+9) to be read.</p>
	06	<p>CHANGE SPEED / DEFINE INTERRUPT INPUT SIGNAL</p> <ul style="list-style-type: none"> <li>When the interrupt input signal type (X: 2028; Y: 6028) is set to "0": <ol style="list-style-type: none"> <li>When this bit is set to "1": <p>When the interrupt input turns ON (↑), the speed is changed to the speed number in bits 07 to 00 of words m+4 (X axis) and m+8 (Y axis).</p> </li> <li>When this bit is set to "0": <ol style="list-style-type: none"> <li>If the interrupt input signal emergency stop parameter is set to "0," a deceleration stop is executed when the interrupt input turns ON (↑).</li> <li>If the interrupt input signal emergency stop parameter is set to "1," an emergency stop is executed when the interrupt input turns ON (↑).</li> </ol> <p>*Speed changes are only enabled for the START command.</p> </li> </ol> </li> <li>When the interrupt input signal type (X: 2028; Y: 6028) is set to "1": <p>When this bit is turned ON (↑), the speed is changed to the speed number in bits 07 to 00 of words m+4 (X axis) and m+8 (Y axis).</p> </li> </ul>
	07	<p>Override enable</p> <ul style="list-style-type: none"> <li>If this bit is set to "1" when the START command is executed, the override for bits 07 to 00 of words m+4 (X axis) and m+8 (Y axis) will be enabled. The override will remain enabled even if bit 12 of word m+2 (X axis) or m+6 (Y axis) turns ON.</li> <li>If this bit is set to "0" when the START command is executed, the override will be fixed at 1.0.</li> </ul>
	08	<p>RESET PRESENT POSITION</p> <p>When this bit is turned ON (↑), the present position is forcibly changed to the value set in parameter addresses 2022 (X axis) and 6022 (Y axis).</p>

Word	Bit	Function
m+1 m+5	09	<p><b>TEACH</b></p> <ul style="list-style-type: none"> <li>When this bit is turned ON (↑), the present position is written to the positioning action corresponding to the teaching positioning action address in bits 11 to 00 of words m+3 (X axis) and m+7 (Y axis).</li> <li>Teaching is only enabled when the No Origin Flag (bit 06) in words s+0 (X axis) and s+7 (Y axis) of the status area is OFF.</li> </ul>
	10	Not used. Always set to "0."
	11	<p><b>HIGH-SPEED JOG</b></p> <ul style="list-style-type: none"> <li>High-speed jogging is one of the manual operations. While the HIGH-SPEED JOG command is being executed, operation continues in a constant direction. Acceleration or deceleration are possible when stopping and starting.</li> <li>When this bit is turned ON (↑), high-speed jogging is started according to the speed number set in parameter addresses 2003 (X axis) and 6003 (Y axis), and the high-speed jogging acceleration/deceleration pattern number set in parameter addresses 2024 (X axis) and 6024 (Y axis).</li> <li>When this bit is turned OFF, positioning is decelerated to a stop according to the high-speed jogging acceleration/deceleration pattern number set in parameter addresses 2024 (X axis) and 6024 (Y axis).</li> </ul>  <ul style="list-style-type: none"> <li>The jogging direction is set by bit 12 of words m+1 (X axis) and m+5 (Y axis).</li> </ul>
	12	<p><b>Jogging/inching direction</b> This bit sets the direction for high-speed jogging, low-speed jogging, and inching. 0: CW 1: CCW</p>
	13	<p><b>LOW-SPEED JOG</b></p> <ul style="list-style-type: none"> <li>Low-speed jogging is one of the manual operations. While the LOW-SPEED JOG command is being executed, operation continues in a constant direction. (There is no acceleration or deceleration.)</li> <li>When this bit is turned ON (↑), low-speed jogging is started according to the speed number set in parameter addresses 2004 (X axis) and 6004 (Y axis).</li> <li>When this bit is turned OFF, positioning is stopped.</li> </ul>  <ul style="list-style-type: none"> <li>The jogging direction is set by bit 12 of words m+1 (X axis) and m+5 (Y axis).</li> </ul>
	14	<p><b>INCH</b></p> <ul style="list-style-type: none"> <li>Inching is one of the manual operations. From 1 to 100 pulses can be output for positioning.</li> <li>When this bit is turned ON (↑), positioning is executed for exactly the number of pulses set in parameter address 2025 (X axis) and 6025 (Y axis).</li> </ul>  <ul style="list-style-type: none"> <li>The jogging direction is set by bit 12 of words m+1 (X axis) and m+5 (Y axis).</li> </ul>

Word	Bit	Function
m+1 m+5	15	<p><b>STOP</b></p> <p>When this bit is turned ON (↑), positioning is decelerated to a stop according to the following acceleration/deceleration patterns:</p> <p>During execution of a positioning action: The pattern set for that positioning action.</p> <p>During origin return: Origin return acceleration/deceleration pattern (X: 2023; Y: 6023)</p> <p>During origin search: Origin search acceleration/deceleration pattern (X: 2023; Y: 6023)</p> <p>During high-speed jogging: Jogging acceleration/deceleration pattern (X: 2024; Y: 6024)</p> <p>During low-speed jogging: No deceleration</p> <p>While this bit is ON, operations involving pulse output are not possible.</p>
m+2 m+6	11 to 00	<p><b>Initial Positioning Action Number</b></p> <p>Used only when bit 01 of words m+1 (X axis) and m+5 (Y axis) is set to "1."</p>
	12	<p><b>CHANGE OVERRIDE</b></p> <p>Used for changing the override during positioning operation initiated by the START command. When this bit is turned ON (↑) during a positioning operation initiated by START, the override value set in bits 07 to 00 of words m+4 (X axis) and m+8 (Y axis) is changed. However, if the "override enable" in bit 07 of words m+1 (X axis) and m+5 (Y axis) is ON when START is executed, that override will remain enabled.</p>
	13	<p><b>Home Shift Enable/Disable Setting</b></p> <p>This bit determines whether home shift will be enabled or disabled.</p> <p>0: Disabled 1: Enabled</p> <p>When started for interpolation, only the X-axis settings are enabled. (This applies only to the NC211.)</p>
	14	Not used. Always set to "0."
	15	Not used. Always set to "0."
m+3 m+7	11 to 00	<p><b>Teaching Positioning Action Number</b></p> <p>Designates the positioning action address for when teaching is initiated by bit 09 of words m+1 (X axis) and m+5 (Y axis).</p>
	15 to 12	Not used. Always set to "0."
m+4 m+8	07 to 00	<p><b>Override Target Speed Number</b></p> <ul style="list-style-type: none"> <li>This sets the override value to be used when the override enable bit (bit 07 of words m+1 and m+5) and the CHANGE OVERRIDE command (bit 12 of words m+2 and m+6) are turned ON.</li> <li>It is also used as the target speed number when the CHANGE SPEED command is executed by means of an interrupt input or bit 06 of words m+1 (X axis) and m+5 (Y axis).</li> </ul>
	08	<p><b>Forced ON/OFF Bit for Error Counter Reset</b></p> <p>Turning this bit ON and OFF forcibly turns the error counter reset output on and off. It is only enabled while operation is stopped.</p>
	09	<p><b>Forced ON/OFF Bit for Origin Adjustment Command Output</b></p> <p>Turning this bit ON and OFF forcibly turns the origin adjustment command output on and off. It is only enabled while operation is stopped or during manual operation (jogging or inching).</p>
	11 to 10	Not used. Always set to "0."
	12	<p><b>EEPROM (Word m+4 only)</b></p> <ul style="list-style-type: none"> <li>When word m+4, bit 13 is "0": When this bit is turned ON (↑), the data stored in EEPROM (positioning actions, parameters, acceleration/deceleration patterns, speeds, dwell times) are read to the internal RAM.</li> <li>When word m+4, bit 13 is "1": When this bit is turned ON (↑), the data stored in the internal RAM (positioning actions, parameters, acceleration/deceleration patterns, speeds, dwell times) are written to EEPROM.</li> </ul>
	13	<p><b>EEPROM Read/Write Designation (Word m+4 only)</b></p> <p>This bit designates whether data is to be read from or written to EEPROM when bit 12 of word m+4 is turned ON.</p> <p>0: Read from EEPROM 1: Write to EEPROM</p>
14	<p><b>PC Protect (Word m+4 only)</b></p> <p>When this bit is ON, commands from the Programmable Controller are not allowed. PC protect is cleared when the power is turned on.</p>	

Word	Bit	Function
m+4 m+8	15	External input protect (Word m+4 only) ON: External inputs are disabled. OFF: External inputs are enabled.  Even if the external input protect is turned ON, the CW and CCW limit inputs will remain enabled. The following external inputs are protected. <ul style="list-style-type: none"> <li>• Interrupt input</li> <li>• Origin proximity input</li> <li>• Immediate stop input</li> <li>• Origin input</li> <li>• Positioning completion input</li> </ul>

**Note** The NC113 is not provided with the Y axis.

## 6-3 When the PC is in Program Mode

### 6-3-1 Command Configuration (Program Mode)

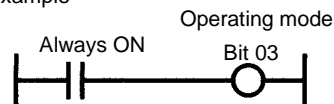
The following table shows the commands that are can be used when the Programmable Controller (i.e., the CPU Unit) is in Program Mode. Word “n” represents the first of the two I/O words allocated for the Special I/O Unit.

Bit	Word n (output)	Remarks
00	Reserved for system.	---
01	Reserved for system.	---
02	Reserved for system.	---
03	Operating mode	---
04	X-AXIS ORIGIN SEARCH	X-axis commands in Program Mode
05	X-AXIS ERROR RESET	
06	X-AXIS CW JOG	
07	X-axis high-speed jogging / low-speed jogging designation	
08	X-AXIS CCW JOG	
09	Reserved for system	---
10	Y-AXIS ORIGIN SEARCH	Y-axis commands in Program Mode
11	Y-AXIS ERROR RESET	
12	Y-AXIS CW JOG	
13	Y-axis high-speed / low-speed jogging designation	
14	Y-AXIS CCW JOG	
15	Reserved for system.	---

When bit 03 is OFF (i.e., Program Mode), bits 04 to 15 are enabled for the Position Control Unit. The NC113 is provided with the X axis only. Bits 10 to 14 will be ignored by the NC113.

**Note** When the CPU Unit is in either Run or Monitor Mode, bit 03 must be turned ON by the program. When bit 03 is OFF, commands cannot be received by means of WRIT (the Intelligent I/O Write instruction).

Ladder Program Example



If bit 03 is turned ON by a forced set when the CPU Unit is in Program Mode, the Position Control Unit will stop all operations in Program Mode.

Bits 00 to 02, 09, and 15 are used by the system program, therefore do not use these bits.

### 6-3-2 Command Details (Program Mode)

Bit	Function
00 to 02	Reserved for system.
03	Operating Mode Informs the Position Control Unit of the Programmable Controller's operating mode. OFF: Program Mode ON: RUN or Monitor Mode
X: 04 Y: 10	ORIGIN SEARCH When this bit is turned ON (↑), the origin search operation begins and the proximity signal and origin signal are used to find the origin.
X: 05 Y: 11	ERROR RESET Clears the pulse output prohibition, the error LED indicator, and the error code after an error has occurred. The pulse output prohibition will remain in effect, however, if the cause of the following error codes is not cleared: 5060, 5061, 6000, 6100, 6101, 6200, 6201, 6400, 6401, 9000, 9100. ERROR RESET also does not clear the pulse output prohibition after an emergency stop input has turned ON.
X: 06 Y: 12	CW JOG Executes jogging in the CW direction. Whether the jogging operation is high-speed or low-speed depends on the setting of bit 07. If the CW JOG and CCW JOG command bits are turned ON at the same time, CCW JOG will be executed and CW JOG will be ignored.
X: 07 Y: 13	High-speed / Low-speed Jogging Designation Designates whether high-speed or low-speed jogging is to be executed when bits 06 and 08 are turned ON. ON: Low-speed jogging OFF: High-speed jogging If the setting of this bit is changed during jogging, operation will be decelerated to a stop.
X: 08 Y: 14	CCW JOG Executes jogging in the CCW direction. Whether the jogging operation is high-speed or low-speed depends on the setting of bit 07 (X axis) and bit 13 (Y axis). If the CW JOG and CCW JOG command bits are turned ON at the same time, CCW JOG will be executed and CW JOG will be ignored.
X: 09 Y: 15	Not used.

**Note** The NC113 is not provided with the Y axis.



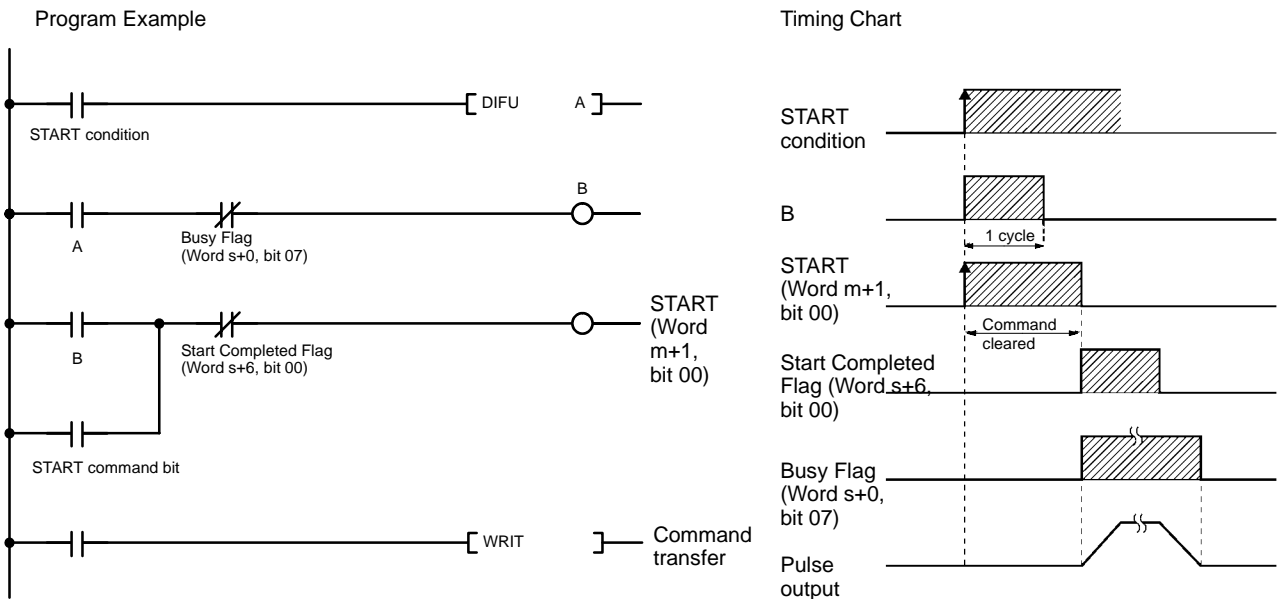
## 6-4 Examples of Command Execution Conditions

Examples of execution conditions for the various commands are shown below. After all of the command data for a particular command has been set, the Intelligent I/O Write command (WRIT) is used to transfer all the data together to the Position Control Unit.

**Note** In the example ladder program diagrams shown here, WRIT is executed after the command data for each individual command has been set, but in an actual program WRIT would be executed after the data for all of the commands has been set.

### 6-4-1 START

First confirm that the Busy Flag has been turned OFF, and then turn ON the START command bit. Leave the START command bit ON until the Start Completed Flag turns ON.



**Note** When positioning with just a small amount of movement is executed, the Busy Flag may turn OFF before the Start Completed Flag turns OFF.

### 6-4-2 ORIGIN SEARCH

First confirm that the Busy Flag has been turned OFF, and then turn ON the ORIGIN SEARCH command bit. Leave the ORIGIN SEARCH command bit ON until the Origin Search Completed Flag turns ON.

**Note** The ladder program example is similar to that for START.

### 6-4-3 ORIGIN RETURN

First confirm that the Busy Flag has been turned OFF, and then turn ON the ORIGIN RETURN command bit. Leave the ORIGIN RETURN command bit ON until the Origin Reset Flag turns ON.

**Note** The ladder program example is similar to that for START.

### 6-4-4 RELEASE PROHIBIT

First confirm that the Busy Flag has been turned OFF, and then turn ON the RELEASE PROHIBIT command bit. Leave the START command bit ON until the Pulse Output Enabled Flag turns ON.

**Note** The ladder program example is similar to that for START.

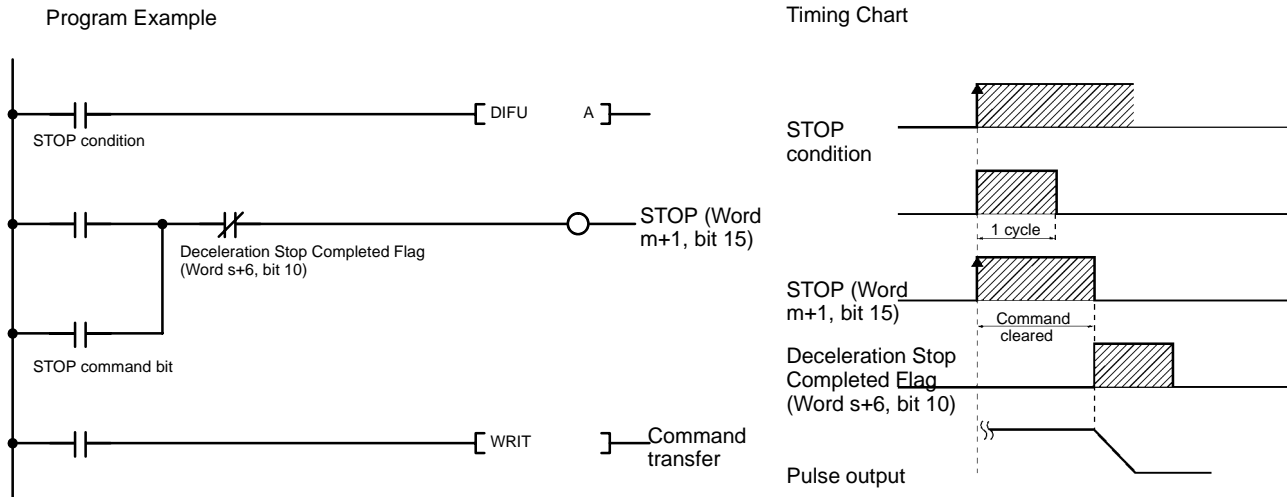
### 6-4-5 CHANGE PRESENT POSITION

First confirm that the Busy Flag has been turned OFF, and then turn ON the CHANGE PRESENT POSITION command bit. Leave the CHANGE PRESENT POSITION command bit ON until the Change Present Position Flag turns ON.

**Note** The ladder program example is similar to that for START.

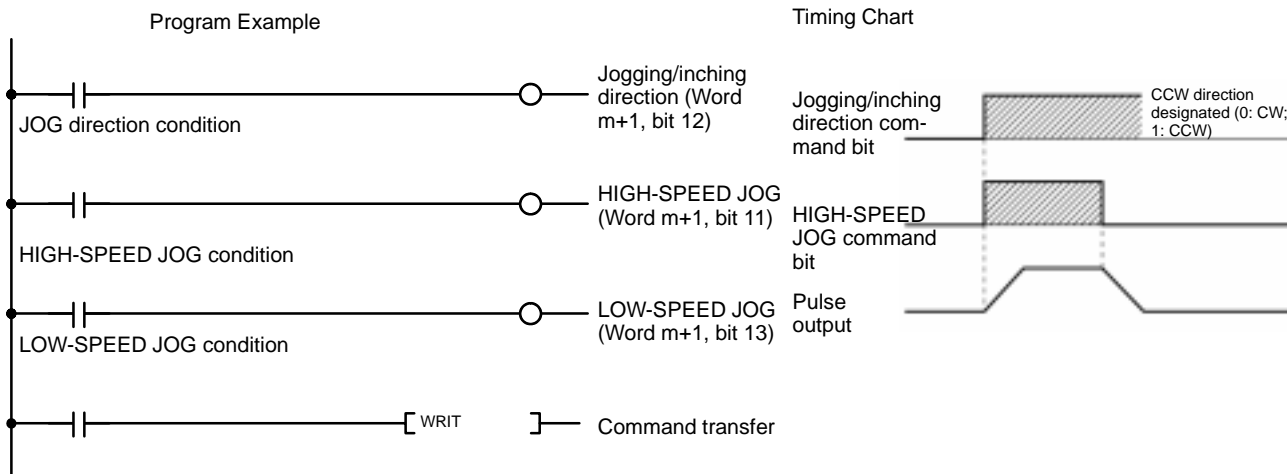
### 6-4-6 STOP

Leave the STOP command bit ON until the Deceleration Stop Completed Flag turns ON. STOP can be executed even when the Busy Flag is ON.



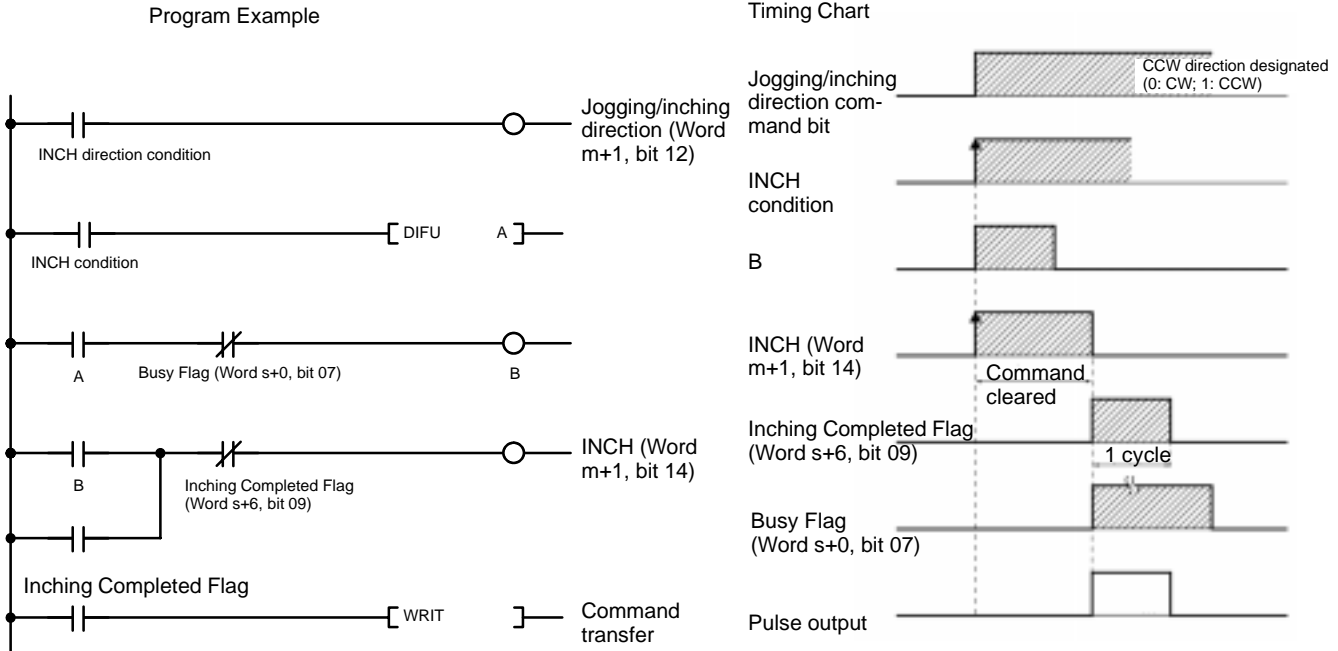
### 6-4-7 HIGH-SPEED JOG and LOW-SPEED JOG

First set the jogging/inching direction, and then turn ON the HIGH-SPEED JOG or LOW-SPEED JOG command bit. JOG commands cannot be received when the Busy Flag is ON.



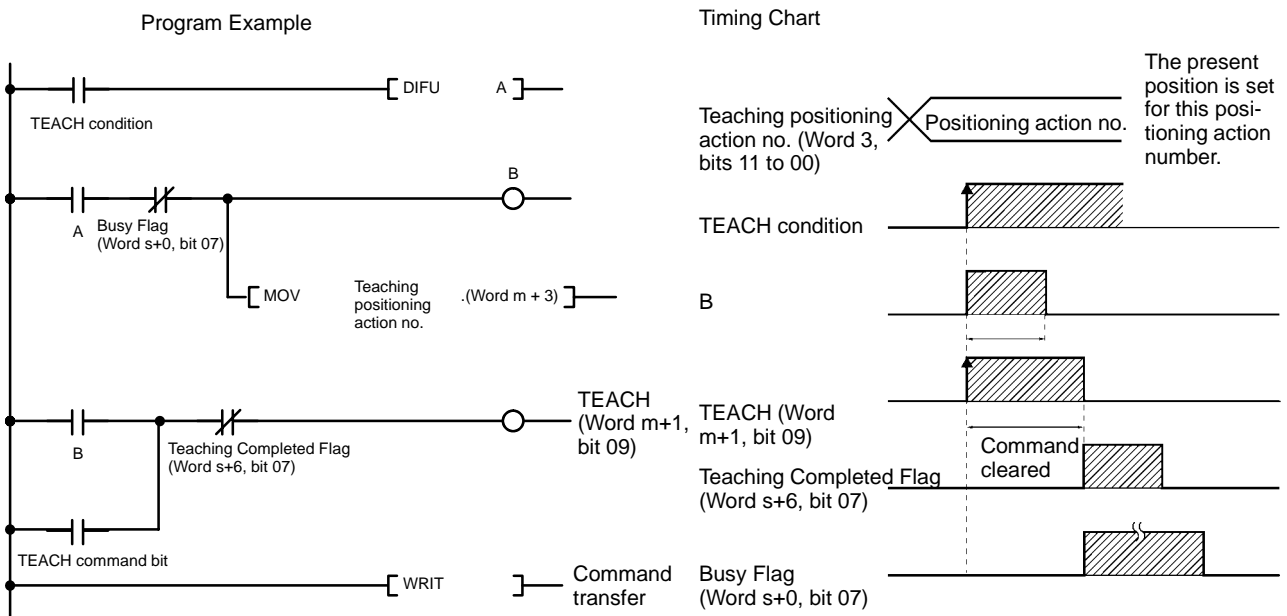
### 6-4-8 INCH

First confirm that the Busy Flag has been turned OFF, and then turn ON the INCH command bit. Leave the INCH command bit ON until the Inching Completed Flag turns ON.



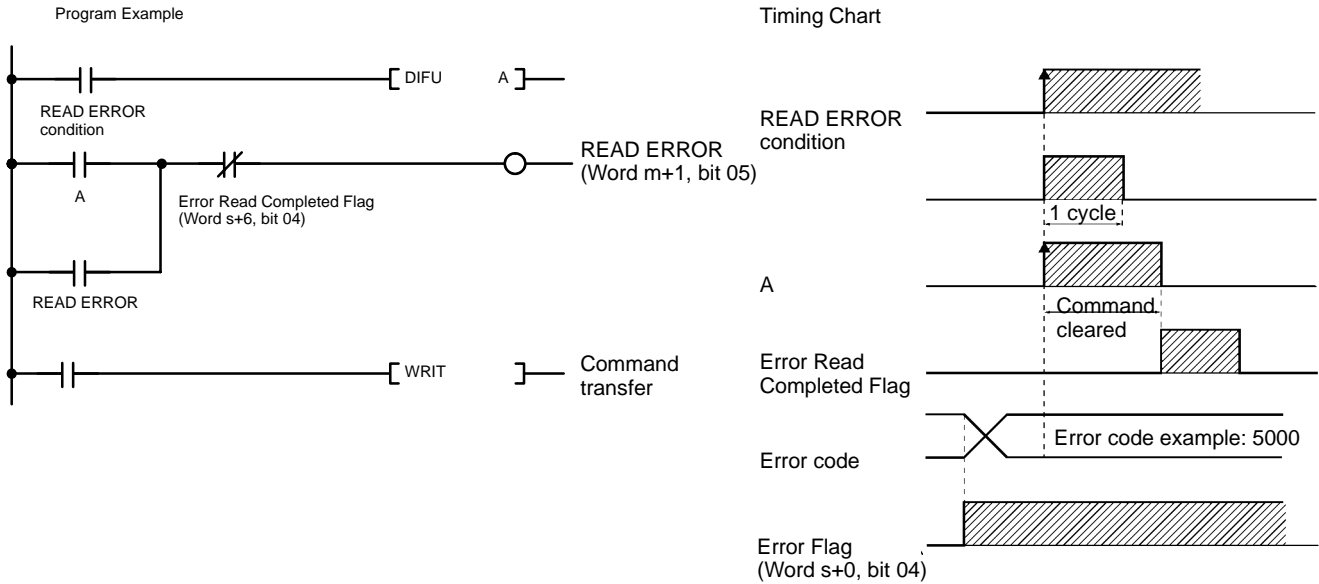
### 6-4-9 TEACH

First confirm that the Busy Flag has been turned OFF, and then turn ON the TEACH command bit. Leave the INCH command bit ON until the Teaching Completed Flag turns ON.



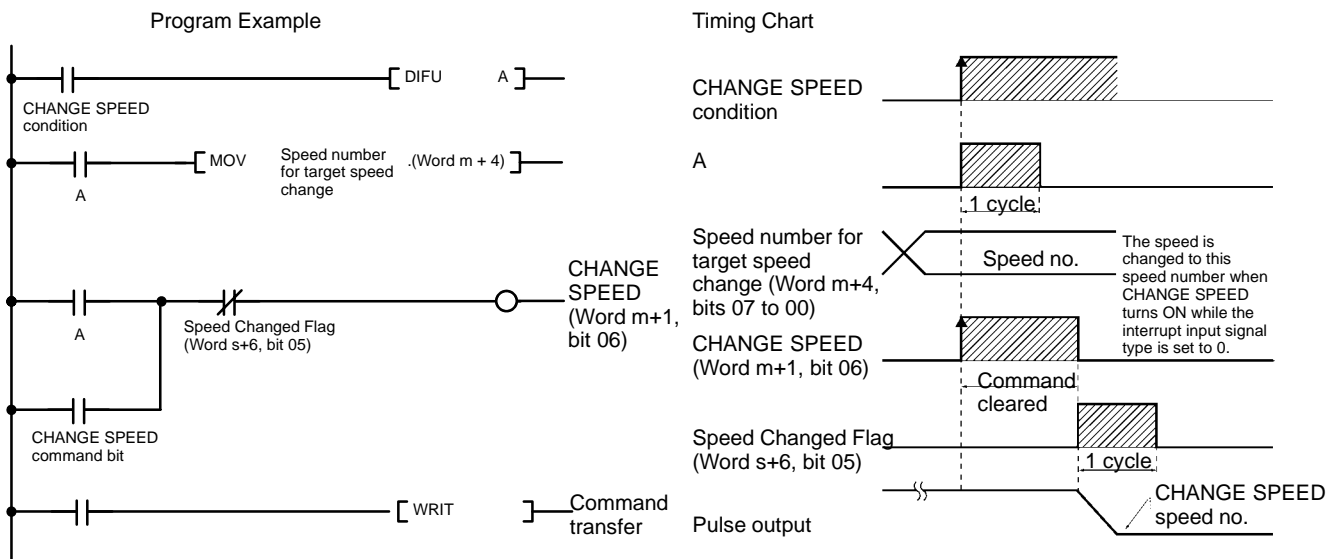
### 6-4-10 READ ERROR

When two or more errors occur, READ ERROR is used for reading the second and subsequent errors to word s+1 of the Status Area. Leave the READ ERROR command bit ON until the Error Read Completed Flag turns ON. READ ERROR can be executed even when the Busy Flag is ON.



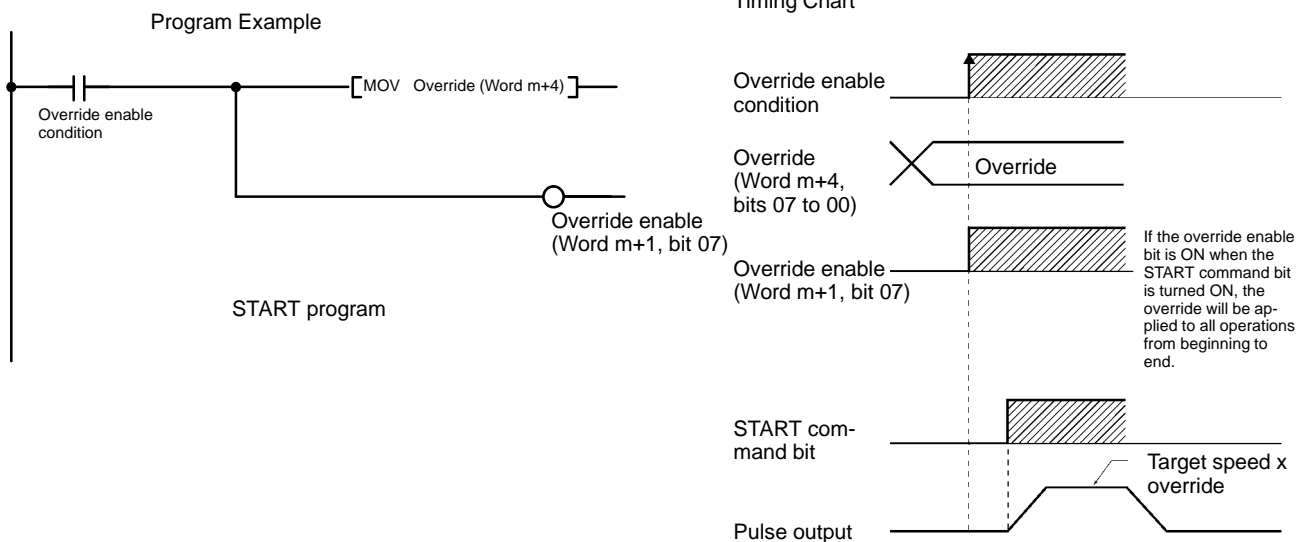
### 6-4-11 CHANGE SPEED

Leave the CHANGE SPEED command bit ON until the Speed Changed Flag turns ON. CHANGE SPEED can be executed even when the Busy Flag is ON.



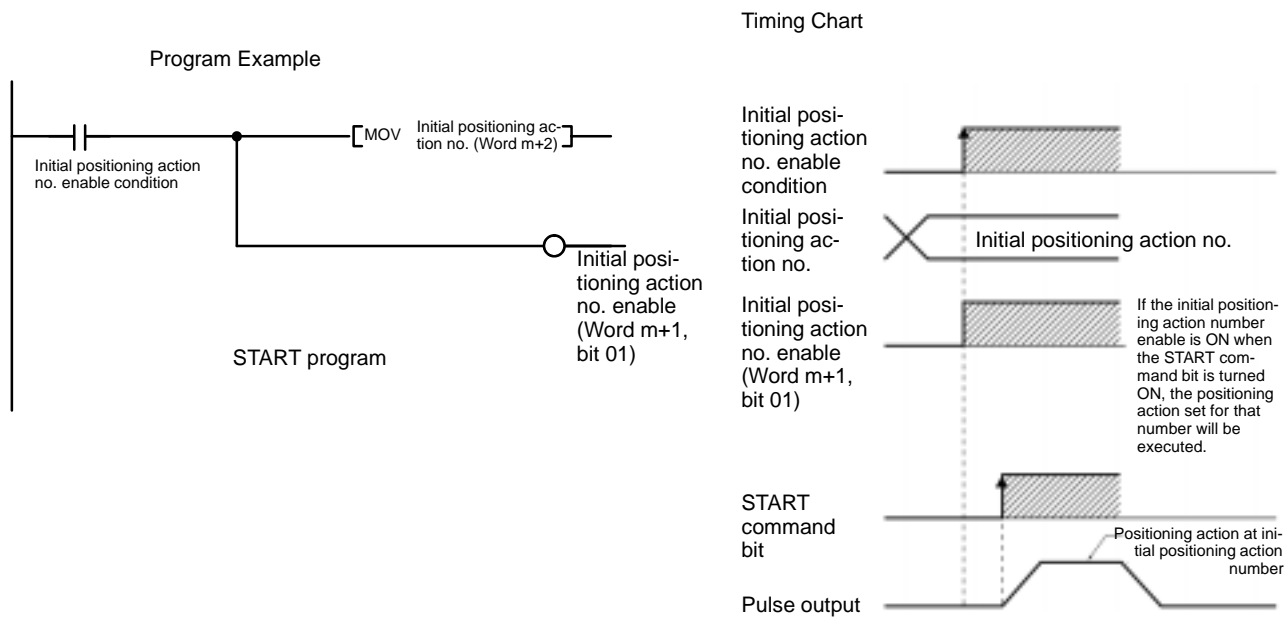
### 6-4-12 Override Enable

To apply an override to all operations from beginning to end, execute START with the override enable bit turned ON.



### 6-4-13 Initial Positioning Action Number Enable

To execute the positioning action at the designated positioning action number, execute START with the initial positioning action number enable bit turned ON.



## SECTION 7

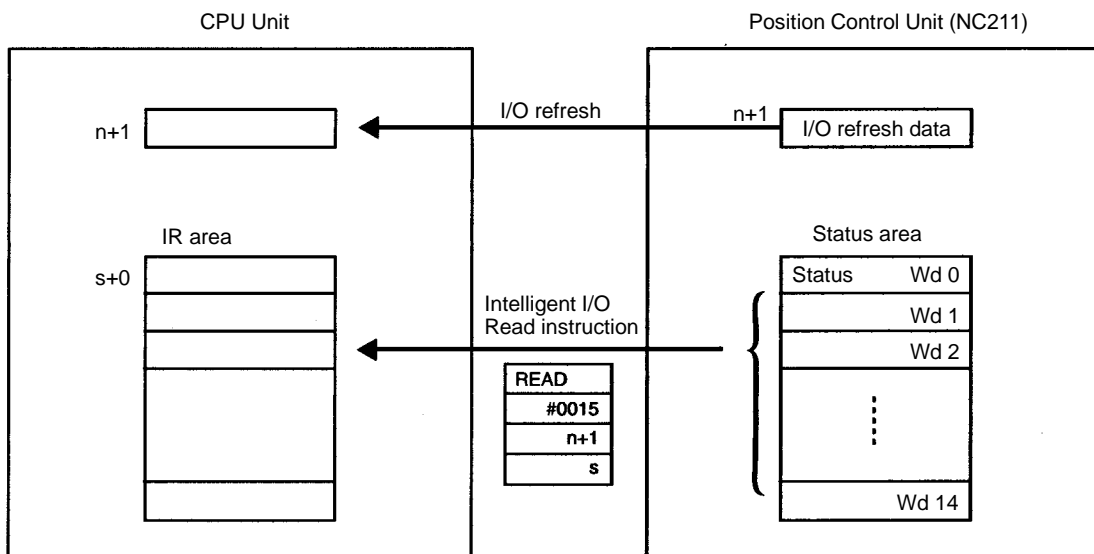
### PCU Status

This section explains the two ways in which the Position Control Unit's current status is transmitted to the CPU Unit. The term "status" here refers to the operations that the Position Control Unit is currently performing, and to the operating conditions. The first way in which the PCU status is transmitted to the CPU Unit is the regular transfer of one word of data with the I/O refresh. The other way is the transfer, as required, of 15 words (eight words for the NC113) of data by means of the Intelligent I/O Read instruction (READ).

7-1	Status Types .....	104
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7-4	Status Area .....	105
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## 7-1 Status Types

The CPU Unit receives two types of status from the Position Control Unit: 1) the information that is transmitted with the I/O refresh, and 2) the detailed PCU information in 15 words (eight words for the NC113) that can be read by the CPU Unit by means of the Intelligent I/O Read instruction. These two types are illustrated in the following diagram.



## 7-2 I/O Refresh Data

The single word of status data shown in the following table is regularly sent from the Position Control Unit to the CPU Unit with each I/O refresh.

Bit	n+1 (input)	Remarks
00	Reserved for system.	---
01	Reserved for system.	---
02	Reserved for system.	---
03	Operating mode status	---
04	X-axis origin search completion	Status signals in Program Mode
05	X-axis error reset completion	
06	X-axis origin input signal	
07	X-axis origin proximity input signal	
08	X-axis origin CW limit input signal	
09	X-axis origin CCW limit input signal	
10	Y-axis origin search completion	
11	Y-axis error reset completion	
12	Y-axis origin input signal	
13	Y-axis origin proximity input signal	
14	Y-axis origin CW limit input signal	
15	Y-axis origin CCW limit input signal	

**Note** The NC113 is not provided with the Y axis. Bits 10 to 15 are always OFF with the NC113.

### 7-3 Detailed Contents of I/O Refresh Data

Bit	Function
00 to 02	Reserved for system.
03	Operating mode Indicates the Programmable Controller's operating mode. OFF: Program Mode ON: RUN or Monitor Mode
X: 04 Y: 10	Origin search completion Indicates whether the origin has been established. OFF: Origin not established. ON: Origin established.
X: 05 Y: 11	Error reset completion Indicates whether error reset processing has been completed. OFF: When the RESET ERROR command is turned OFF. ON: When the RESET ERROR command has been received and all processing for clearing the error has been completed.
X: 06 Y: 12	Origin input signal Indicates the origin input signal status. OFF: Origin input signal OFF ON: Origin input signal ON
X: 07 Y: 13	Origin proximity input signal Indicates the origin proximity input signal status. OFF: Origin proximity input signal OFF ON: Origin proximity input signal ON
X: 08 Y: 14	CW limit input signal Indicates the CW limit input signal status. OFF: CW limit input signal OFF ON: CW limit input signal ON
X: 09 Y: 15	CCW limit input signal Indicates the CCW limit input signal status. OFF: CCW limit input signal OFF ON: CCW limit input signal ON

**Note** The NC113 is not provided with the Y axis.

### 7-4 Status Area

The Position Control Unit's internal status area is configured of 15 words (eight words for the NC113) of data. This data is read to the CPU Unit's IR area by means of the CPU Unit's Intelligent I/O Read instruction (READ).

The following tables show the configuration of the X-axis and Y-axis status areas. Words 0 to 7 are for the X axis, and words 8 to 14 are for the Y axis. In the word addresses, "s" represents a free address that can be designated as the location into which the data is to be read by means of the Intelligent I/O Read instruction.



X-axis Status Area

Bit	Word								
	s+0	s+1	s+2	s+3	s+4	s+5	s+6		
00	Positioning Completed Flag	Error code	Output code	Current positioning action number	Present position (x 10 <sup>0</sup> )	Present position (x 10 <sup>4</sup> )	Start Completed Flag		
01	Bank End Flag						Origin Search Completed Flag		
02	Origin Stop Flag						Origin Reset Flag		
03	Alarm Flag						Pulse Output Enabled Flag		
04	Error Flag				Present position (x 10 <sup>1</sup> )	Present position (x 10 <sup>5</sup> )	Error Read Completed Flag		
05	Teaching Completed Flag						Speed Changed Flag		
06	No Origin Flag						Change Present Position Flag		
07	Busy Flag						Teaching Completed Flag		
08	Zone 0				Present position (x 10 <sup>2</sup> )	Present position (x 10 <sup>6</sup> )	EEPROM Completed Flag		
09	Zone 1						Inching Completed Flag		
10	Zone 2						Deceleration Stop Completed Flag		
11	Zone 3						Positioning completed input signal	Speed Override Changed Flag	
12	Zone 4				Origin input signal	Emergency stop input signal	Present position (x 10 <sup>3</sup> )	Sign 0: CW 1: CCW	Data Transfer Request Completed Flag
13	Zone 5				Origin proximity input signal	Interrupt input signal			---
14	Zone 6				CW limit input signal	Emergency stop execution			---
15	Zone 7	CCW limit input signal	Deceleration stop execution	---					

- Note**
1. During interpolation, the X-axis status area is used for transmitting the status.
  2. The Completed Flags for word s+6 (x axis) and word s+14 (Y axis) turn ON only when commands are received. For example, an ORIGIN SEARCH command issued during the START operation will be disabled and the Origin Search Completed Flag will not turn ON.

Common Area

Bit	Word
	s+7
00	EEPROM Write Completed
01	EEPROM Writing
02	EEPROM Reading
03	---
04	---
05	---
06	---
07	---
08	---
09	---
10	---
11	---
12	---
13	---
14	---
15	---

Y-axis STATUS Area

Bit	Word							
	s+8	s+9	s+10	s+11	s+12	s+13	s+14	
00	Positioning Completed Flag	Error code	Output code	Current positioning action number	Present position (x 10 <sup>0</sup> )	Present position (x 10 <sup>4</sup> )	Start Completed Flag	
01	Bank End Flag						Origin Search Completed Flag	
02	Origin Stop Flag						Origin Reset Flag	
03	Alarm Flag						Pulse Output Enabled Flag	
04	Error Flag						Error Read Completed Flag	
05	Teaching Completed Flag				Speed Changed Flag			
06	No Origin Flag				Change Present Position Flag			
07	Busy Flag				Teaching Completed Flag			
08	Zone 0				Positioning completed input signal	Present position (x 10 <sup>2</sup> )	Present position (x 10 <sup>6</sup> )	---
09	Zone 1							Inching Completed Flag
10	Zone 2							Deceleration Stop Completed Flag
11	Zone 3			Speed Override Changed Flag				
12	Zone 4			Origin input signal				Emergency stop input signal
13	Zone 5			Origin proximity input signal	Interrupt input signal	---		
14	Zone 6			CW limit input signal	Emergency stop execution	---		
15	Zone 7	CCW limit input signal	Deceleration stop execution	---				

**Note** The NC113 is not provided with a Y axis. When reading the Y-axis status area with the NC113, the contents will be all 0.

## 7-5 Detailed Contents of Status Area

Words 0 to 7 contain X-axis status, and words 8 to 14 contain Y-axis status.

Word	Bit	Function
X: S+0 Y: S+8	00	Positioning Completed Flag
		<b>ON</b> When positioning (terminating or bank end) is completed.
		<b>OFF</b> When positioning, origin search, or origin return operation is being executed.
		<b>Remarks</b> <ul style="list-style-type: none"> <li>• When this bit turns ON, the Busy Flag (bit 07 of words s+0 and s+8) turns OFF after a delay of approximately 10 ms.</li> <li>• This bit will not turn ON when a deceleration stop is executed during operation.</li> <li>• During interpolation, only bit 00 of word s+0 (X axis) is enabled. Bit 00 of word s+8 (Y axis) retains its pre-interpolation status (NC211 only).</li> </ul>
	01	Bank End Flag
		<b>ON</b> When bank end positioning is completed.
		<b>OFF</b> When positioning, origin search, or origin return operation is being executed.
		<b>Remarks</b> <ul style="list-style-type: none"> <li>• The Positioning Completed flag (bit 00, words s+0 and s+8) turns ON simultaneously.</li> <li>• During interpolation, only bit 01 of word s+0 (X axis) is enabled. Bit 01 of word s+8 (Y axis) retains its pre-interpolation status (NC211 only).</li> </ul>
	02	Origin Stop Flag
		<b>ON</b> When positioning is stopped at the origin.
		<b>OFF</b> While an operation is in progress, or when positioning is stopped somewhere other than the origin.
		<b>Remarks</b> <ul style="list-style-type: none"> <li>• This bit does not turn ON when the origin is merely passed.</li> <li>• After an operation such as origin search has been completed, there is a delay of approximately 10 ms from the time that the Busy Flag (bit 07 of word s+0 for the X axis and word s+8 for the Y axis) turns OFF until the Origin Stop flag turns ON (NC211 only).</li> </ul>
	03	Alarm Flag
		<b>ON</b> When an alarm code is generated.
		<b>OFF</b> When no alarm code is generated.
	04	Error Flag
		<b>ON</b> When an error is generated.
		<b>OFF</b> When no error is generated.
		<b>Remarks</b> During interpolation, only bit 04 of word s+0 (X axis) is enabled. Bit 04 of word s+8 (Y axis) retains its pre-interpolation status (NC211 only).

Word	Bit	Function
X: S+0 Y: S+8	05	Teaching Completed Flag
		<b>ON</b> When teaching is completed.
		<b>OFF</b> When teaching begins.
		<b>Remarks</b> The Busy Flag (bit 07 of word s+0 for the X axis and word s+8 for the Y axis) turns OFF when this bit turns ON.
	06	No Origin Flag
		<b>ON</b> <ul style="list-style-type: none"> <li>• When the power is turned on.</li> <li>• When operation is stopped by an emergency stop or a CW/CCW limit signal.</li> <li>• When the speed control (end pattern 4) is executed.</li> <li>• When a hardware error (error code: 9100, 9200) causes operation to stop.</li> <li>• When an origin search is started.</li> </ul>
		<b>OFF</b> <ul style="list-style-type: none"> <li>• When the origin is established.</li> <li>• When an origin signal is input during an origin search.</li> <li>• When a present position change is completed.</li> </ul>
		<b>Remarks</b> There is a delay of approximately 10 ms from the time that this bit turns OFF until the Busy Flag (bit 07 of word s+0 for the X axis and word s+8 for the Y axis) turns OFF.
	07	Busy Flag
		<b>ON</b> <ul style="list-style-type: none"> <li>• When processing begins for any operation.</li> <li>• When initial data is transferred (i.e., read from EEPROM).</li> </ul>
		<b>OFF</b> <ul style="list-style-type: none"> <li>• When processing ends for an operation and whatever dwell time that has been set elapses.</li> <li>• When data setting such as the Positioning Completed flag or Teaching Completed flag are completed.</li> <li>• In case of an error, when the error code and flag settings are completed.</li> </ul>
		<b>Remarks</b> During axial operation, the Busy Flag may turn ON approximately 10 ms (max.) after the pulse output. When interpolation is used, the Busy Flag is turned ON or OFF simultaneously for the X and Y axes (NC211 only).
	08 to 15	Zones 0 to 7
		<b>ON</b> The bit for a given zone turns ON when the present position is within the range set for that zone in parameter addresses 2013 to 2020 (X axis) and 6013 to 6020 (Y addresses).
		<b>OFF</b> The bit for a given zone turns OFF when the present position is outside of the range set for that zone in parameter addresses 2013 to 2020 (X axis) and 6013 to 6020 (Y addresses).
X: S+1 Y: S+9	00 to 15	Error Code
		<ul style="list-style-type: none"> <li>• The most recent error code (alarm code) is output.</li> <li>• When there are multiple error codes (alarm codes), they are output in order to this word by means of the READ ERROR command (bit 05, words m+1 and m+5).</li> <li>• Error codes (alarm codes) cannot be deleted by READ ERROR.</li> </ul>

Word	Bit	Function	
X: S+2 Y: S+10	00 to 11	Output Code	
		Outputs the output code for positioning actions that have been executed.	
	12, 13	Origin Input Signal, Origin Proximity Input Signal	
		<b>ON</b> With the rising edge of the signal	
		<b>OFF</b> With the falling edge of the signal	
		<b>Remarks</b> These bits are used to debug the system. To check the wiring, check these bits while manually operating the switches, while using jogging over the switches, etc.	
	14, 15	CW Limit Input Signal, CCW Limit Input Signal	
		<b>ON</b> With the falling edge of the signal.	
		<b>OFF</b> With the rising edge of the signal.	
	X: S+3 Y: S+11	00 to 10	Current Positioning Action Number
<ul style="list-style-type: none"> <li>• During positioning, the number of the positioning action being executed is output. When execution has been completed, the number of the next positioning action to be executed is output.</li> <li>• Positioning action numbers are auto-incremented for execution, but when a deceleration stop is performed the number of the positioning action currently being executed becomes the next positioning action to be executed.</li> <li>• After a bank end, or after execution of the final positioning action addresses 1499 (X axis) and 5499 (Y axis), the initial positioning action number in parameter addresses 2002 (X axis) and 6002 (Y axis) becomes the current positioning action number.</li> </ul>			
11			Positioning Completed Input Signal
<b>ON</b> When the servodriver's positioning completed input signal is ON.			
<b>OFF</b> When the servodriver's positioning completed input signal is OFF.			
<b>Remarks</b> This flag is used for checking external wiring.			
12		Emergency Stop Input Signal	
		<b>ON</b> With rising edge of emergency stop input signal.	
		<b>OFF</b> With falling edge of emergency stop input signal.	
13		Interrupt Input Signal	
		<b>ON</b> With rising edge of interrupt input signal.	
		<b>OFF</b> With falling edge of interrupt input signal.	
		<b>Remarks</b> This bit is used to debug the system. To check the wiring, check this bit while manually operating the switch.	

Word	Bit	Function
X: S+3 Y: S+11	14	Emergency Stop Execution
		<p><b>ON</b></p> <p>When an emergency stop signal is received from an external input, regardless of whether or not an operation is in progress. At that time, pulse outputs are prohibited.</p> <p><b>OFF</b></p> <p>When the emergency stop signal turns OFF and the pulse output prohibition is cleared (i.e., when bit 04 of words m and m+5 turns ON).</p> <p><b>Remarks</b></p> <p>When the emergency stop is executed on either axis during interpolation, the emergency stop execution bit turns ON for both axes (NC211 only).</p>
	15	Deceleration Stop Execution
		<p><b>ON</b></p> <p>When operation (positioning, origin search, origin return, or jogging) is stopped by a STOP command initiated by either an interrupt input signal or by bit 15 of words m (X axis) and m+5 (Y axis).</p> <p><b>OFF</b></p> <p>When an operation (positioning, origin search, origin return, or jogging) is started.</p> <p><b>Remarks</b></p> <ul style="list-style-type: none"> <li>• There is a delay of approximately 10 ms max. from the time that the Busy Flag (bit 07, words s+0 and s+8) turns OFF until this flag turns ON.</li> <li>• When interpolation is used, this bit turns ON for both axes when a deceleration stop is executed for either axis (NC211 only).</li> </ul>
X: S+4, S+5 Y: S+12, S+13		Present Position
		<p>The present position is always output as an absolute position.</p> <p><b>Note</b> In the case of mm or inches, proper values will not be output if the present position value exceeds the maximum value. For example, if the unit is mm and the pulse rate is 1.0000, proper values will not be output because of an overflow when the present position value exceeds 9999.000.</p>
X: S+6 Y: S+14	00	Start Completed Flag
		<p><b>ON</b></p> <p>When the interpretation processing is completed after reception of a START command.</p> <p><b>OFF</b></p> <p>When the START bit turns OFF.</p> <p><b>Remarks</b></p> <p>Retain the START command until this flag turns ON.</p>
	01	Origin Search Completed Flag
		<p><b>ON</b></p> <p>When the interpretation processing is completed after reception of an ORIGIN START command.</p> <p><b>OFF</b></p> <p>When the ORIGIN SEARCH bit turns OFF.</p> <p><b>Remarks</b></p> <p>Retain the ORIGIN SEARCH command until this flag turns ON.</p>

Word	Bit	Function
X: S+6 Y: S+14	02	Origin Reset Flag
		<b>ON</b> When the interpretation processing is completed after reception of an ORIGIN RETURN command.
		<b>OFF</b> When the ORIGIN RETURN bit turns OFF.
		<b>Remarks</b> Retain the ORIGIN SEARCH command until this flag turns ON.
	03	Pulse Output Enabled Flag
		<b>ON</b> When the interpretation processing is completed after reception of a RELEASE PROHIBIT command.
		<b>OFF</b> When the RELEASE PROHIBIT bit turns OFF.
		<b>Remarks</b> Retain the RELEASE PROHIBIT command until this flag turns ON.
	04	Error Read Completed Flag
		<b>ON</b> When the interpretation processing is completed after reception of a READ ERROR command.
		<b>OFF</b> When the READ ERROR bit turns OFF.
		<b>Remarks</b> Retain the READ ERROR command until this flag turns ON.
X: S+6 Y: S+14	05	Speed Changed Flag
		<b>ON</b> When the interpretation processing is completed after reception of a CHANGE SPEED command.
		<b>OFF</b> When the CHANGE SPEED bit turns OFF.
		<b>Remarks</b> Retain the CHANGE SPEED command until this flag turns ON.
	06	Change Present Position Flag
		<b>ON</b> When the interpretation processing is completed after reception of a RESET PRESENT POSITION command.
		<b>OFF</b> When the RESET PRESENT POSITION bit turns OFF.
		<b>Remarks</b> Retain the RESET PRESENT POSITION command until this flag turns ON.
	07	Teaching Completed Flag
		<b>ON</b> When the interpretation processing is completed after reception of a TEACH command.
		<b>OFF</b> When the TEACH bit turns OFF.
		<b>Remarks</b> Retain the TEACH command until this flag turns ON.

Word	Bit	Function
X: S+6 Y: S+14	08	EEPROM Completed Flag
		<b>ON</b> When the interpretation processing is completed after reception of an EEPROM command.
		<b>OFF</b> When the EEPROM bit turns OFF.
		<b>Remarks</b> Enabled only for the X axis (word s+6). Retain the EEPROM command until this flag turns ON.
	09	Inching Completed Flag
		<b>ON</b> When the interpretation processing is completed after reception of an INCH command.
		<b>OFF</b> When the INCH bit turns OFF.
		<b>Remarks</b> Retain the INCH command until this flag turns ON.
	10	Deceleration Stop Completed Flag
		<b>ON</b> When the interpretation processing is completed after reception of a STOP command.
		<b>OFF</b> When the STOP bit turns OFF.
		<b>Remarks</b> Retain the STOP command until this flag turns ON.
	11	Speed Override Changed Flag
		<b>ON</b> When the interpretation processing is completed after reception of a CHANGE OVERRIDE command.
		<b>OFF</b> When the CHANGE OVERRIDE bit turns OFF.
		<b>Remarks</b> Retain the CHANGE OVERRIDE command until this flag turns ON.
	12	Data Transfer Request Completed Flag
		<b>ON</b> When the data transfer processing is completed after a data transfer request.
		<b>OFF</b> When the data has been transferred.
		<b>Remarks</b> If data is transferred during axis operation, this flag will turn ON after the data transfer timing error (error code 8307) has been generated.
	13 to 15	Not used



Word	Bit	Function
X: S+7	00	EEPROM Writing Completed Flag
		<b>ON</b> When EEPROM writing has been completed.
		<b>OFF</b> When EEPROM writing is started.
	01	Writing EEPROM Flag
		<b>ON</b> When EEPROM writing is started.
		<b>OFF</b> When EEPROM writing has been completed.
	02	Reading EEPROM Flag
		<b>ON</b> When EEPROM reading is started.
		<b>OFF</b> When EEPROM reading has been completed.
	03 to 15	Not used.

# SECTION 8

## Simple Operation Examples

This section provides some simple example of Position Control Unit operations, including explanations of basic procedures, trial operation, and ladder program examples.

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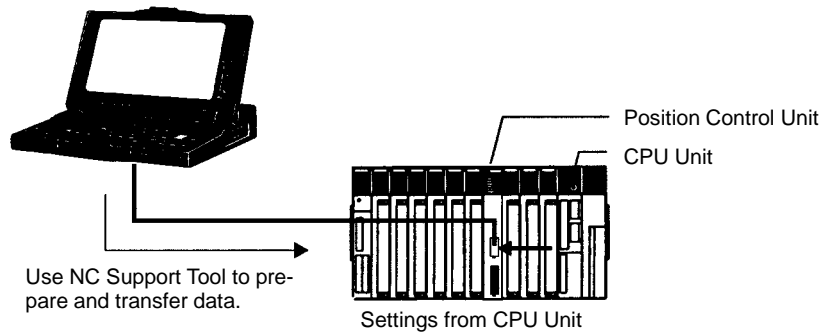
# 8-1 Basic Procedures

**Note** The explanations in this section use the X axis of the NC211 as an example. Use the same settings and procedures for the Y axis.

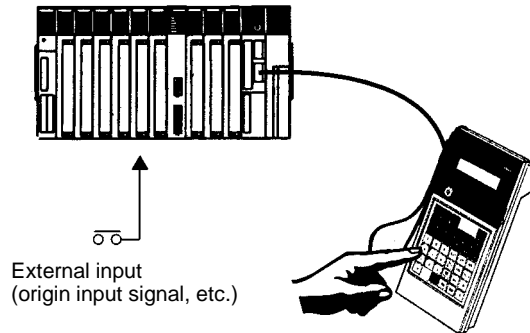
## Trial Operation

Use the trial operation outlined here to check the origin search and jogging operations, as well as the external input wiring.

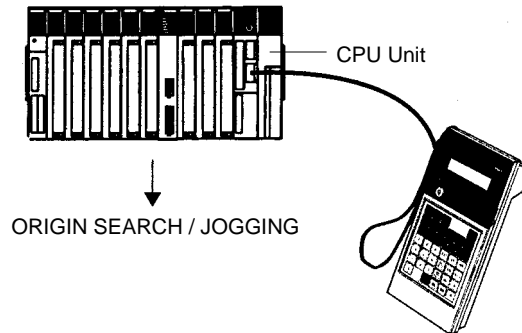
- 1, 2, 3... 1. Set the data for the origin search and jogging operations. Use NC Support Tool to prepare the data, and then transfer it to the Position Control Unit.



2. Check the external input wiring by putting the Programmable Controller in Program Mode and monitoring the allocated input bits while the external input switch is operated.



3. Execute the ORIGIN SEARCH and JOGGING commands by putting the Programmable Controller in Program Mode and operating the allocated output bit from the Programming Console.

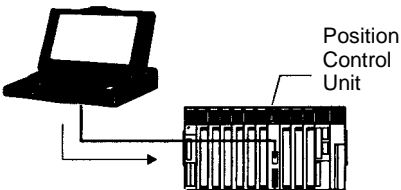
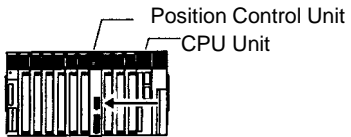


**Note** While performing the above operations, check to be sure that there are no problems with the initial data for settings such as pulse output selection, CW/CCW limits, and so on. If it becomes necessary to change any of the initial data, use the NC Support Tool to make the changes and transfer the new data to the Position Control Unit.

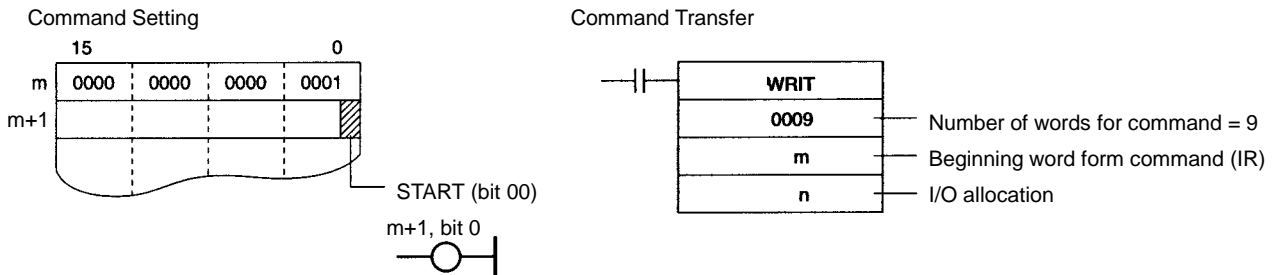
**Actual Operation**

In this operation, with the Programmable Controller in RUN or Monitor Mode, positioning is executed with settings and commands transferred to the Position Control Unit from the CPU Unit.

- 1, 2, 3... 1. Transfer the following data settings to the Position Control Unit, by means of NC Support Tool or the CPU Unit.

Item	When transferring from NC Support Tool	When transferring from CPU Unit
		
Initial positioning action address	Set the initial positioning action number in the parameter editing screen.	Set initial positioning action number to address 2002.
Initial speed address	Set the initial speed number in the parameter editing screen.	Set initial speed number to address 2001.
Positioning actions	Set the positioning actions in the positioning action editing screen.	Set positioning actions to addresses 1000 onwards.
Target speeds	Set the speeds in the speed editing screen.	Set speeds to addresses 4000 onwards.
Acceleration/deceleration patterns	Set the acceleration/deceleration patterns in the acceleration/deceleration pattern editing screen.	Set acceleration/deceleration patterns to addresses 3000 onwards.

2. Execute commands for the Position Control Unit by means of the CPU Unit. First set the commands in the IR area, and then us the Intelligent I/O Write instruction to transfer them to the Position Control Unit.



**8-2 Trial Operation Example**

In this example, origin search and jogging operations are executed with the Programmable Controller in Program Mode.

- 1, 2, 3... 1. Set the data for origin search and jogging. It may be possible to use the default settings, but if they need to be changed then use the NC Support Tool to change them and transfer the new settings to the Position Control Unit. The following parameter settings are required for origin search and jogging.

**Origin Search Mode**

Origin search direction, origin return signal, origin proximity signal, origin search method, origin search pattern, origin search mode

**Speeds**

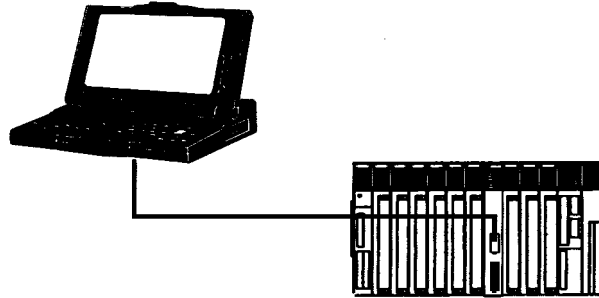
Origin search proximity speed number, origin search high speed number, low-speed jogging speed number, high-speed jogging speed number, pulse output selection, speed data set for speed numbers

**Acceleration/deceleration Pattern**

Origin search acceleration/deceleration pattern number, high-speed jogging acceleration/deceleration pattern number, acceleration/deceleration pattern data set for acceleration/deceleration pattern numbers

Output Pulses

Output pulse selection



**Note** If not using NC Support Tool, create the data as in the trial operation and then use a ladder program to transfer the data from the CPU Unit to the Position Control Unit. Examples of data configuration are shown below.

Parameter Data Configuration

In this example, number “03” is used as the origin search high-speed number. For details regarding other parameters, refer to *5-7 Parameters*.

2	0	0	5
0	0	0	1
0	0	0	3

Speed Data Configuration

In this example, “1,000” is set for speed number 03.

4	0	0	3
0	0	0	2
1	0	0	0
0	0	0	0

Acceleration/Deceleration Pattern Configuration

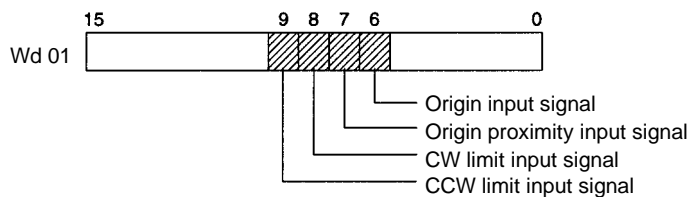
In this example, “50 pps/ms” is set for pattern number 02.

3	0	0	2
0	0	0	2
0	0	5	0
0	0	5	0

For instructions on how to transfer data, refer to *5-1 Creating and Transferring Data*.

2. Check the external input wiring. With the Programmable Controller in Program Mode, turn the external input switch ON and OFF and use the Programming Console (or SYSMAC Support Software) to monitor changes in the bits in the input words allocated in the CPU Unit.

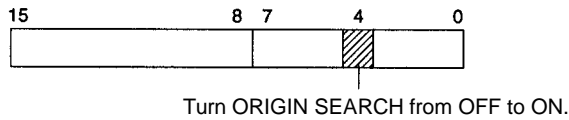
In the following example diagram, the Position Control Unit is allocated words 00 and 01 in the CPU Unit.



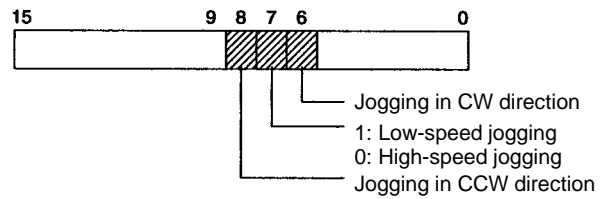
3. Execute ORIGIN SEARCH and JOGGING. With the Programmable Controller in Program Mode, use the Programming Console (or SYSMAC Support Software) to manipulate the bits in the input words allocated in the CPU Unit.

In the following example diagram, the Position Control Unit is allocated words 00 and 01 in the CPU Unit.

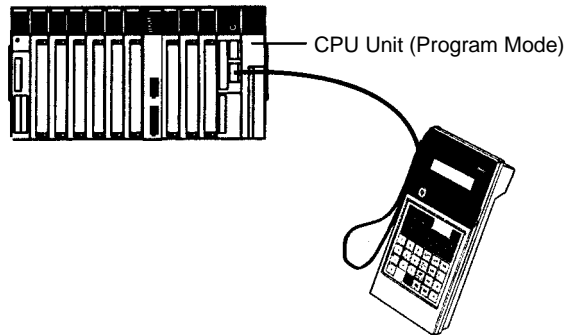
To execute ORIGIN SEARCH:



To execute JOGGING:

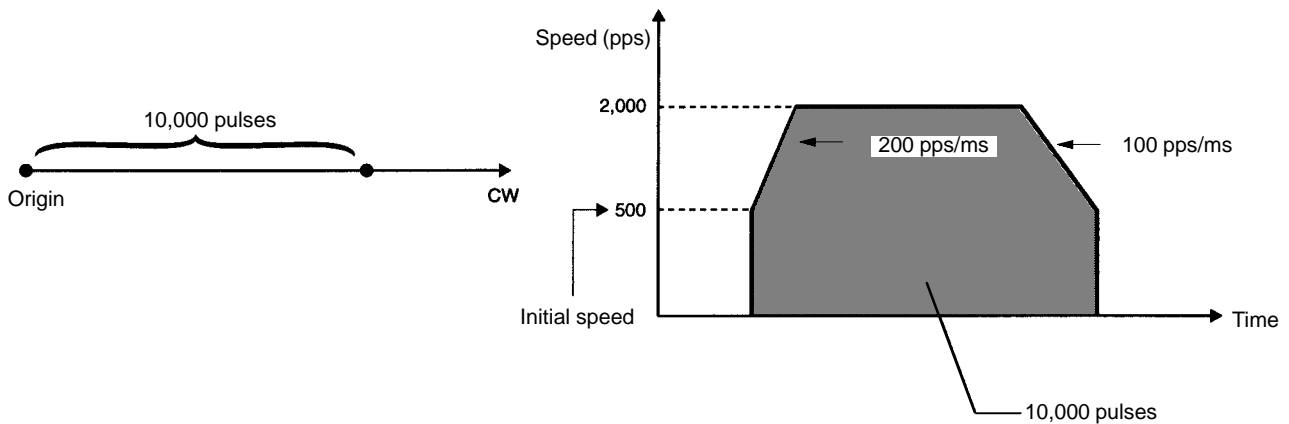


For example, to execute high-speed jogging in the CW direction, leave 0007 OFF and turn 0006 from OFF to ON.



### 8-3 Actual Operation Example

In this example, positioning is executed at a target speed of 2,000 pps from the origin to a position 10,000 pulses along the X axis. Acceleration is 200 pps/ms and deceleration is 100 pps/ms. The initial speed is 500 pps.



### 8-3-1 Settings

#### Making Settings From the CPU Unit (Without Using NC Support Tool)

##### Parameters

Item	Address	Setting	Meaning
X axis, initial positioning action number	2002	10	1010
X axis, initial speed number	2001	01	4001

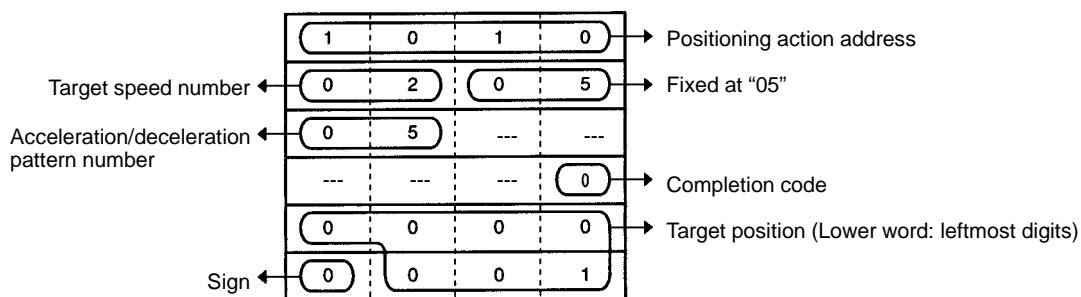
**Note** Set all related data for other parameters as well.

##### Positioning Actions, Speeds, Acceleration/Deceleration Patterns, Dwell Times

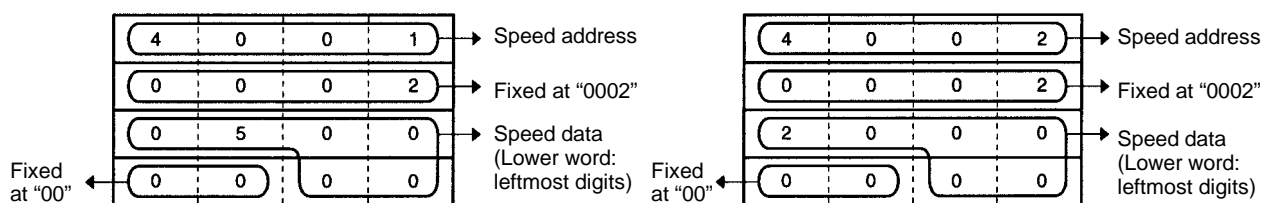
Item	Address	Setting	Meaning
X axis, initial positioning action (See note.)	1010		
Speed number		02	4002
Acceleration/deceleration number		05	3005
Dwell time number		0	
Output code		0	
Completion code		0	Terminating
Target position		10,000	10,000 pulses
Sign		0	CW, absolute value, independent end point
X axis, speed (See note.)	4001	500	500 pps
	4002	2,000	2,000 pps
X axis, acceleration/deceleration pattern	3005		
Acceleration		200	200 pps/1 ms
Deceleration		100	100 pps/1 ms
Dwell time (See note.)	9000	0	0 ms

**Note** The data configurations are shown in the following diagrams.

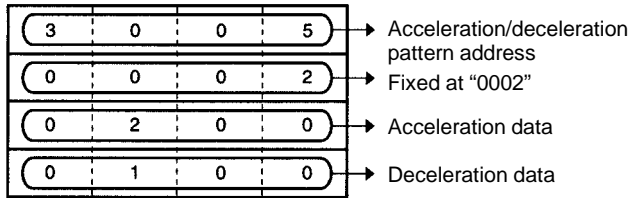
##### Positioning Action Data Configuration



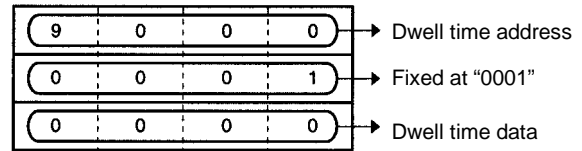
##### Speed Data Configuration



**Acceleration/Deceleration Pattern Configuration**

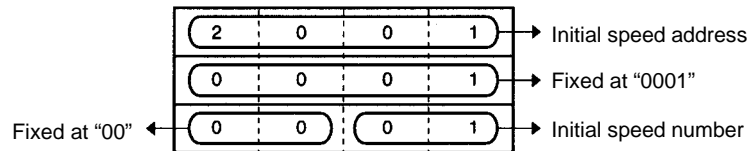


**Dwell Time Configuration**

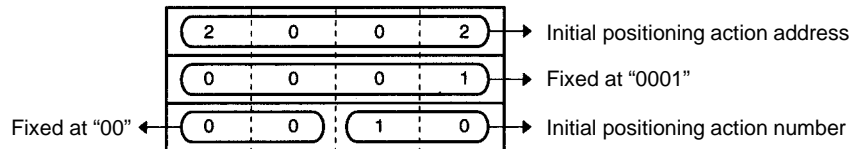


**Parameter Data Configuration**

**Example: Initial speed number**



**Example: Initial positioning action number**



**Making Settings Using NC Support Tool**

**Parameter Editing Screen**

Initial positioning action number: 10  
 Initial speed number: 01

**Positioning Action Editing Screen**

No. 10; speed: 02; dwell time: 0; acceleration/deceleration pattern: 05; completion code: 0; output code: 0; position: 10,000; sign: 0

**Speed Editing Screen**

No. 01 500  
 No. 02 2,000

**Acceleration/Deceleration Pattern Editing Screen**

No. 5; acceleration: 200; deceleration: 100

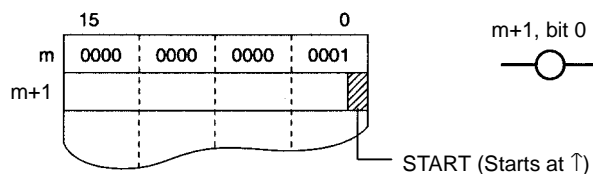
**Dwell Time Editing Screen**

No. 0 0

**8-3-2 Setting and Issuing Commands**

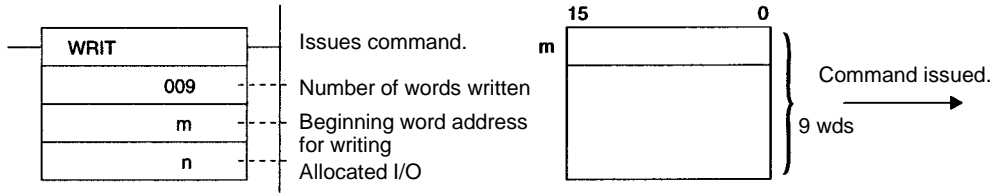
**Setting Commands**

**IR Area**





**Issuing Commands**

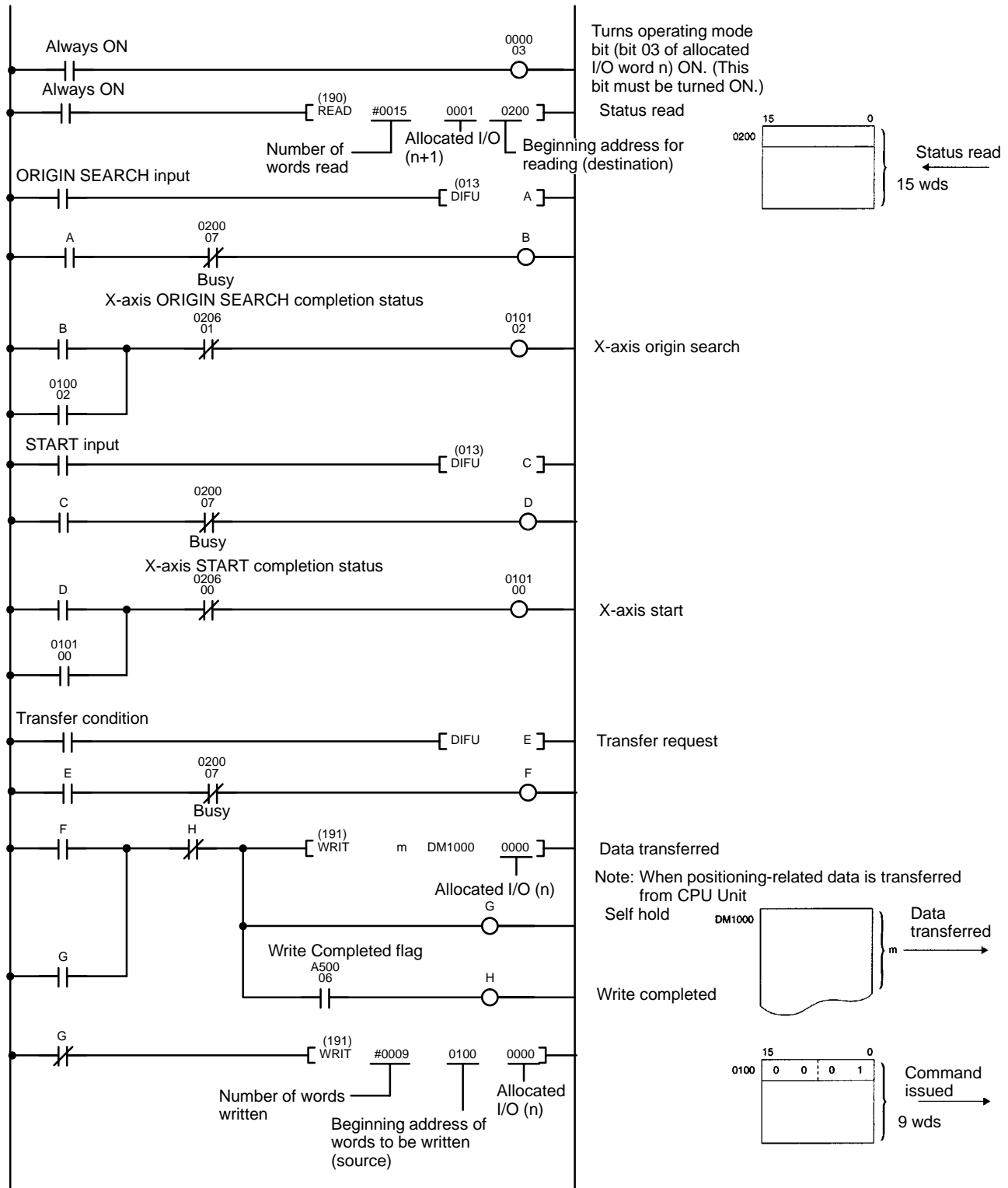


**Note** When axial operations are performed on the Position Control Unit while data is being transferred from the NC Support Tool, axial operation commands may be either accepted or ignored depending on the timing. When the command is accepted, the system may stop due to a transfer error, in which case the partially transferred data will change the contents of the stored data. Therefore, transfer the whole data again.

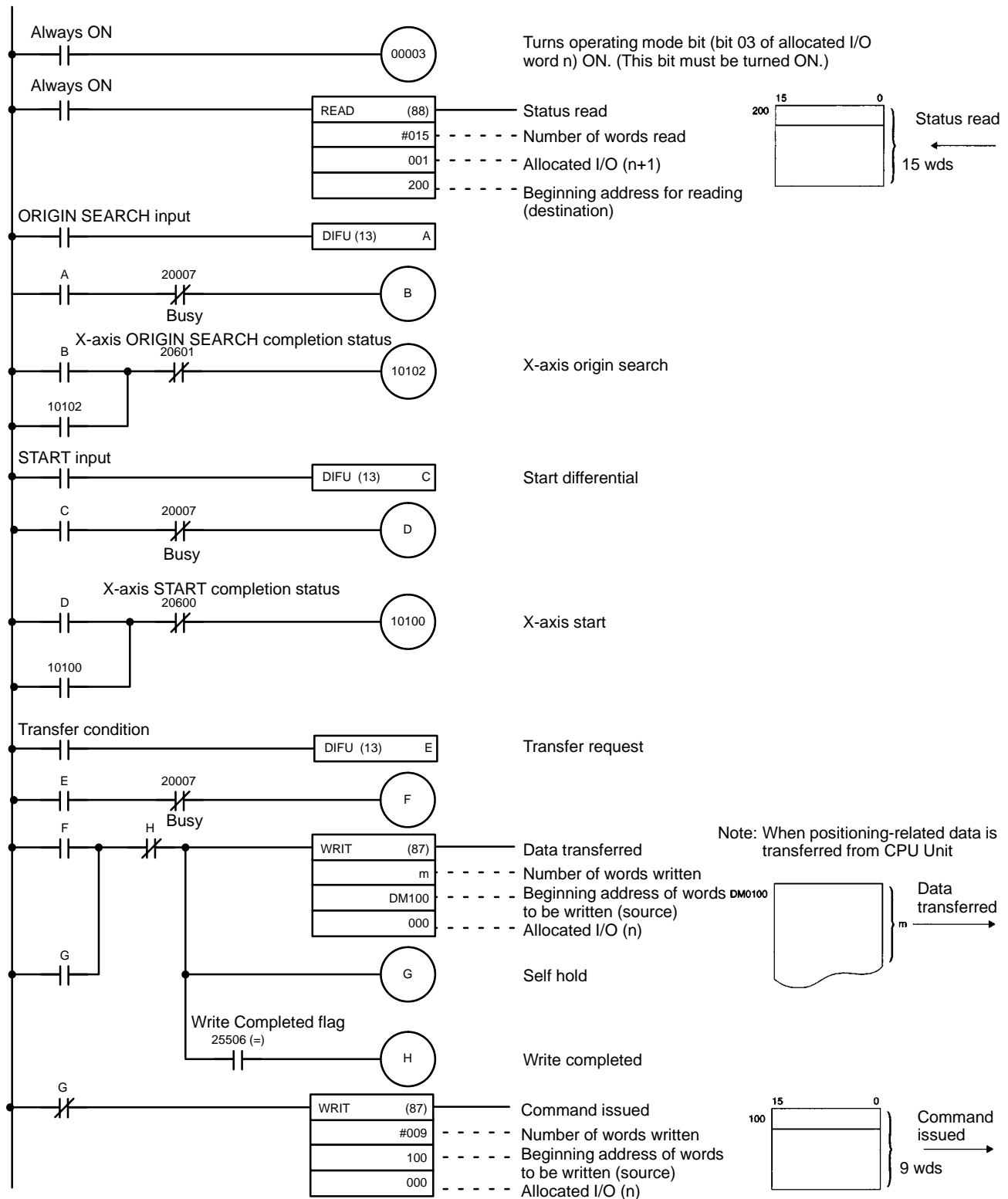
### 8-3-3 Ladder Program Examples

In these examples, START and ORIGIN SEARCH are executed and data is transferred.

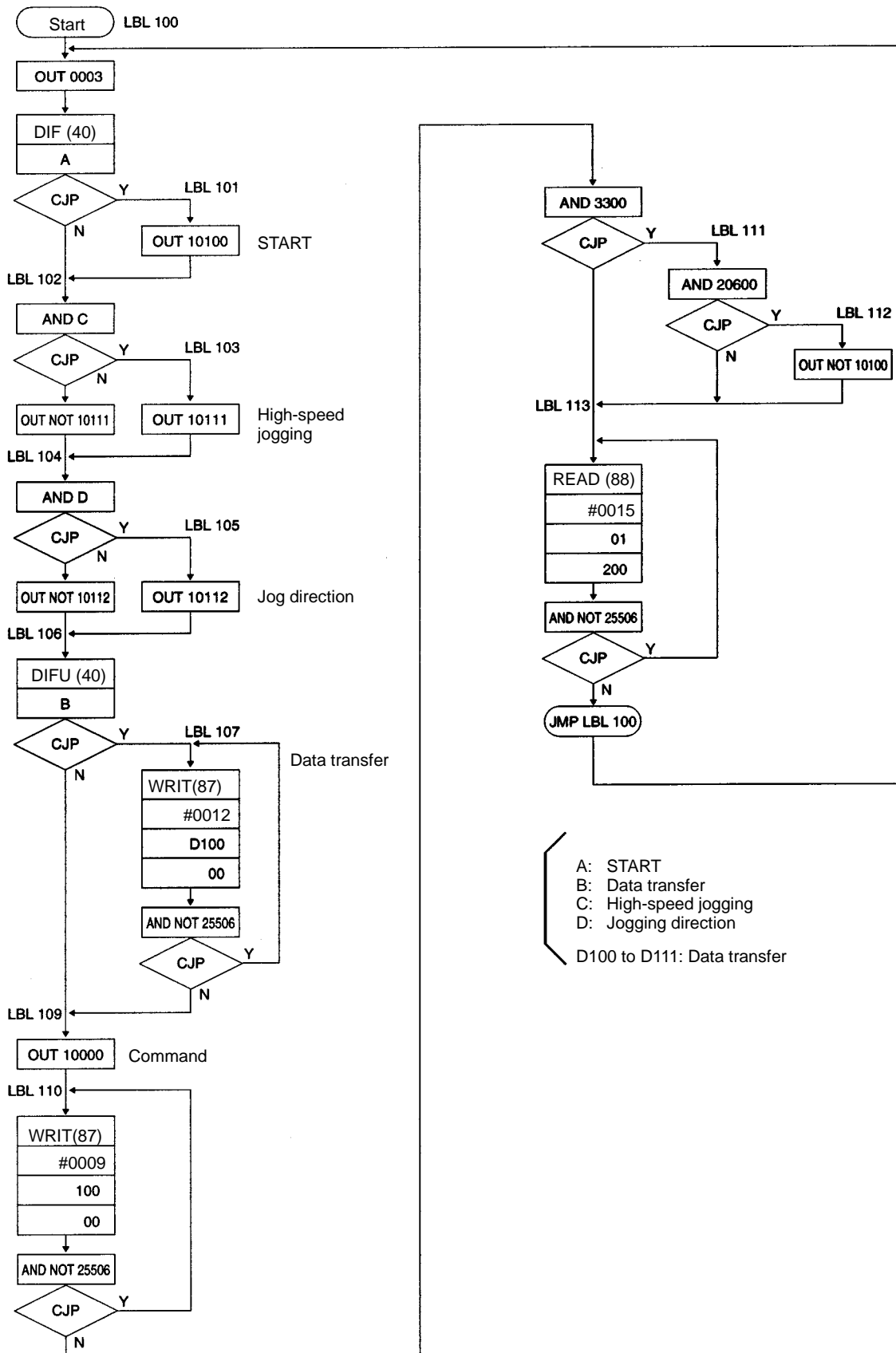
#### CV Series



C500/C1000H/C2000H



C500F/C1000HF



A: START  
 B: Data transfer  
 C: High-speed jogging  
 D: Jogging direction  
 D100 to D111: Data transfer

# SECTION 9

## Settings and Operations

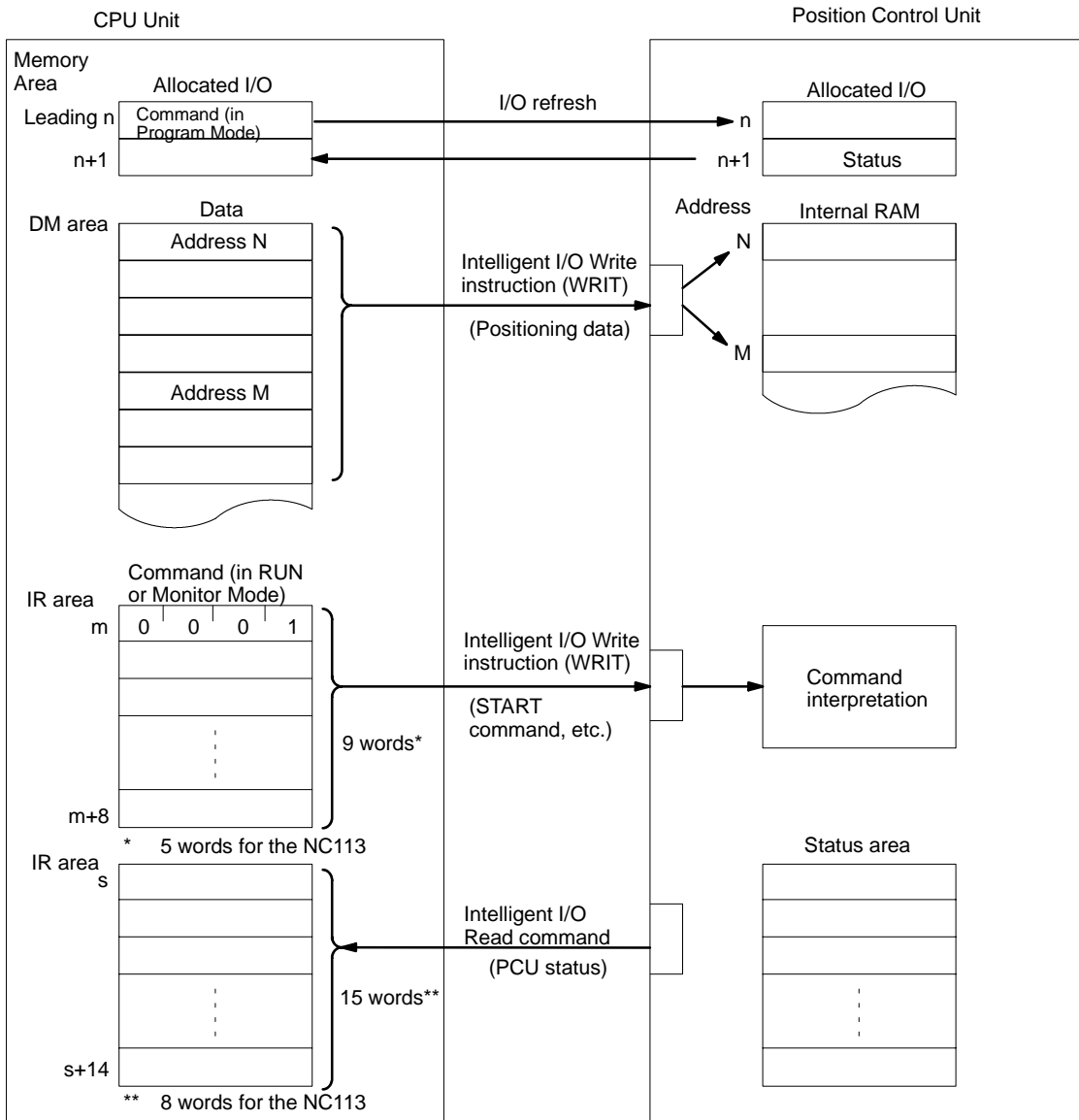
This section explains how to make the settings required for Position Control Unit operations.

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# 9-1 Programming Background

## 9-1-1 Overall Configuration for Exchanging Data

The Position Control Unit exchanges data with the CPU Unit as shown in the following illustration.



### Allocated I/O

The Position Control Unit occupies two of the CPU Unit's output words (32 bits). One of those words is used for transferring commands from the CPU Unit to the Position Control Unit during I/O refreshing (when the CPU Unit is in Program Mode). The other word is used for transferring the PCU status from the Position Control Unit to the CPU Unit during I/O refreshing.

### Data

Positioning data to be stored at the Position Control Unit is transferred from the CPU Unit to the Position Control Unit, along with the addresses in the Position Control Unit, by the CPU Unit's Intelligent I/O Write command. The Position Control Unit stores the data in its internal RAM by address, based on the headers.

### Commands

Commands such as START and ORIGIN SEARCH are transferred to the Position Control Unit by the Intelligent I/O Write instruction. The Position Control Unit interprets the commands and executes them.

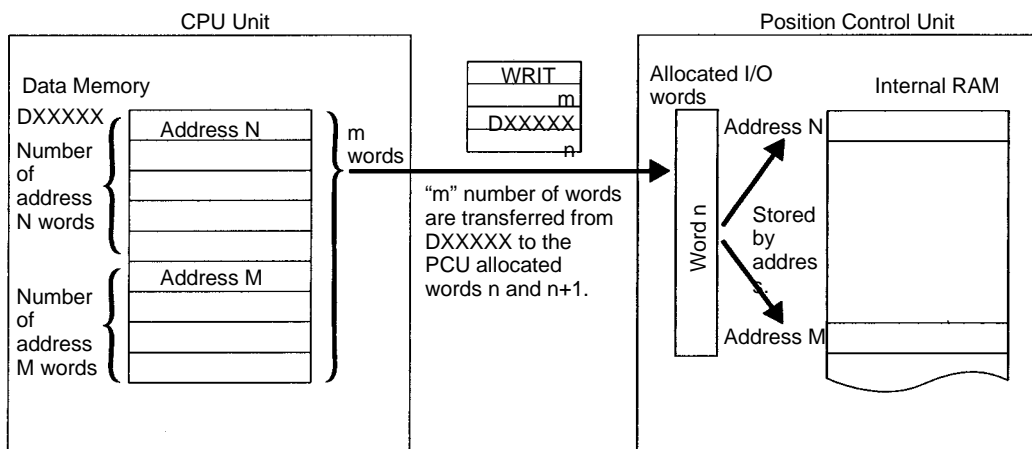
**Status Area**

Status information such as the address of the positioning action currently being executed is read from the Position Control Unit to the CPU Unit by the CPU Unit's Intelligent I/O Read instruction.

**Note** Commands and data cannot be transferred simultaneously by the Intelligent I/O Write instruction.

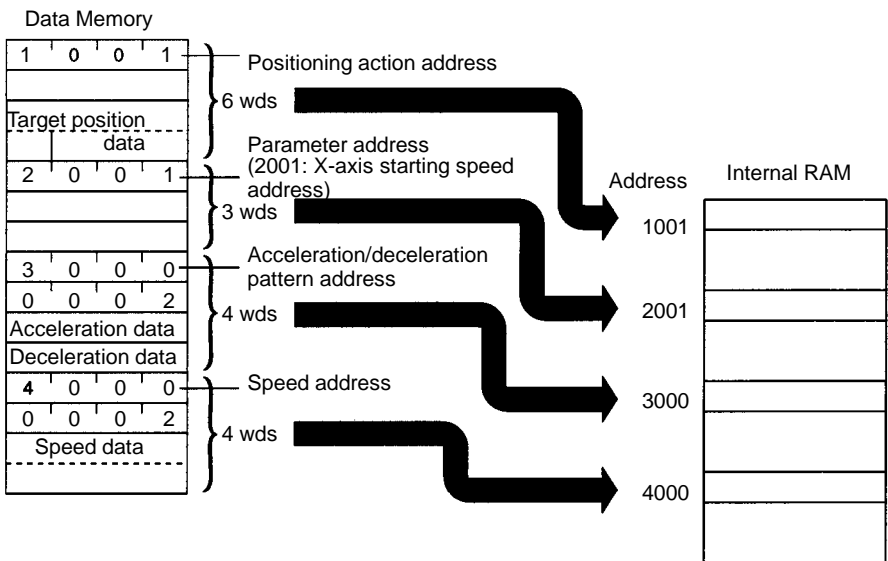
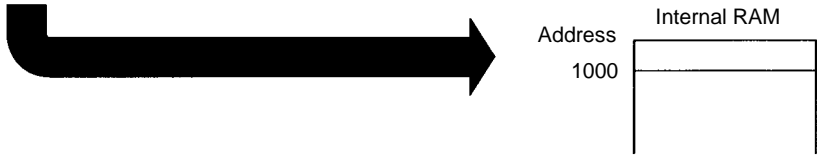
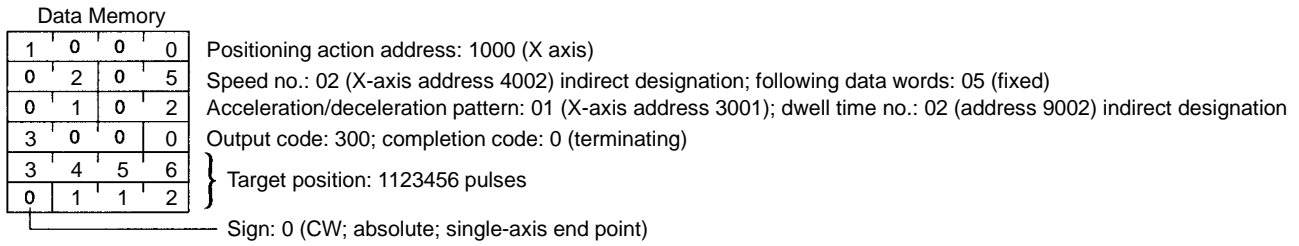
**9-1-2 Creating and Transferring Data**

- 1, 2, 3...
1. First create the data (positioning actions, parameters, etc.) in the CPU Unit's DM area, beginning with the leading address (i.e., the PCU's internal RAM address).
  2. Then use the Intelligent I/O Write instruction (WRIT) to transfer that data to the Position Control Unit.
  3. The Position Control Unit will store the data by address, beginning with the leading header address, in its internal RAM.

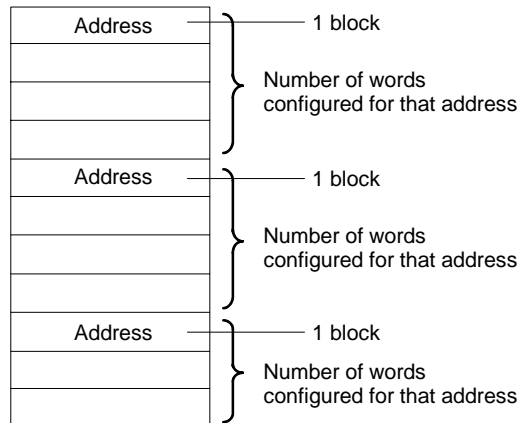


Creating Data

At the CPU Unit, the data is created in blocks, with a number of words configured under a single leading address. For details regarding address allocations for data, refer to *Section 5 Data Configuration*.



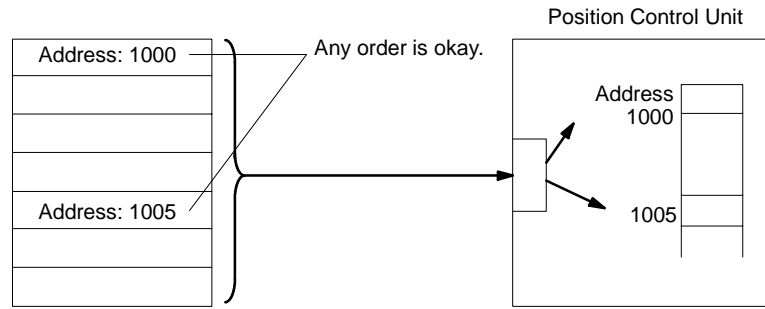
Be sure to put the address at the beginning and set the data according to the number of words configured.



**Note** Set the various data items consecutively, with no gaps. If there are any gaps in the data, it cannot be properly transferred to the Position Control Unit.



When transferring the data, there is no need to be concerned with the order of the addresses. The Position Control Unit will check the addresses and store the data in its internal RAM by address.



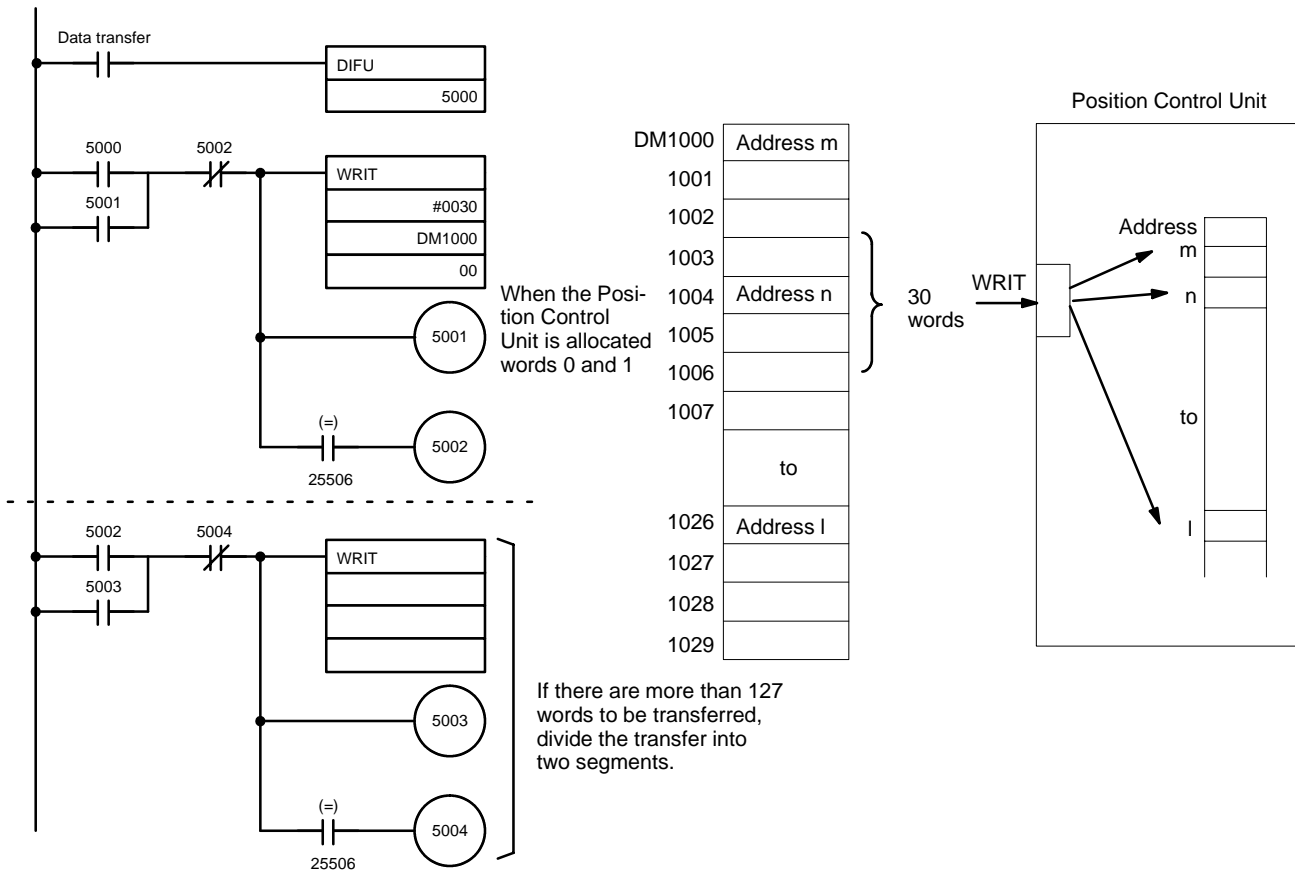
**Transferring Data**

The Intelligent I/O Write instruction is used to transfer the created data to the Position Control Unit.

- Note**
1. The number of words for the created data that is to be transferred must match the number of words specified by the Intelligent I/O Write instruction. If they do not match, the data cannot be properly transferred (e.g., if some other data is included or if there is not enough data for the number of designated words, the data may either be treated as an error and not written or may be written as an error data).
  2. Since the NC113 is not provided with the Y axis, do not transfer data to the data area address for the Y axis (refer to 5-2 Data Handled By the Position Control Unit). If data is transferred to this address, a format error (8309) will occur.

**Program Example**

In this example, 30 words of data beginning with DM 1000 are transferred to the Position Control Unit allocated I/O words 0 and 1.

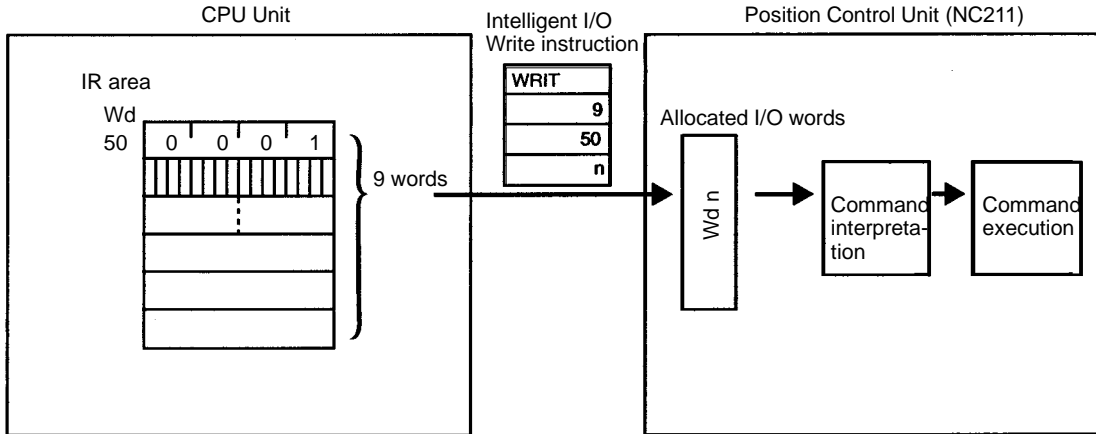


### 9-1-3 Creating and Transferring Commands

Use the method explained below to transfer commands such as START and ORIGIN SEARCH to the Position Control Unit.

**When CPU Unit is in RUN or Monitor Mode**

- 1, 2, 3... 1. Create nine words (five words for the NC113) of command data in the CPU Unit's DM or IR areas, beginning with 0001.
2. Use the Intelligent I/O Write instruction (WRIT) to transfer the data to the Position Control Unit.
3. The Position Control Unit will determine that it is a command, based on the beginning data 0001, and execute it.

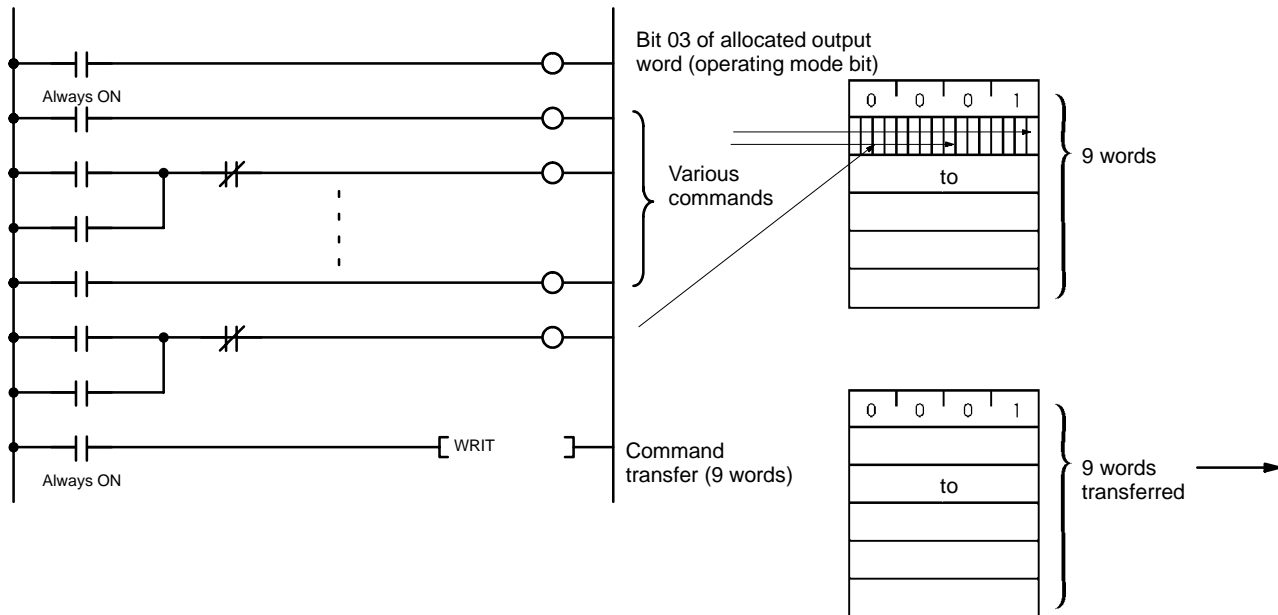


If the data for the leading address is 1000 or higher with the Intelligent I/O Write instruction, it is recognized as a data transfer. If a command other than 0001 (Hex) is issued, with the data below 1000, a format error (error code 8309) is generated and the Position Control Unit cannot recognize the command. (The error can be cleared by re-issuing the command data with 0001 (Hex) at the beginning.)

Basically, as shown below, first use OUT or MOV to set all of the command data, and then use WRIT to write the data as a block.

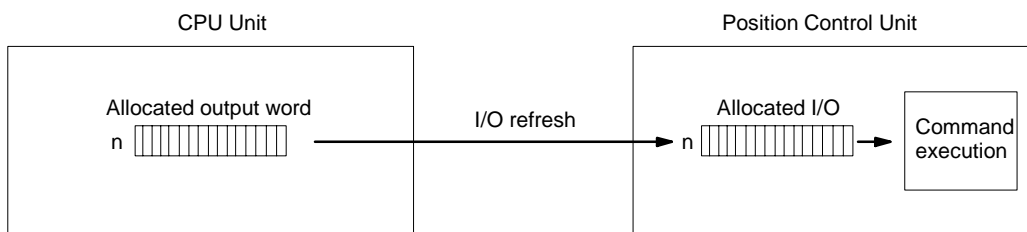
Write the program so that commands that have been set are continually transferred to the Position Control Unit at the end of the program with every scan.

Be sure to turn ON bit 03 of the allocated output word (the operating mode bit).



**When CPU Unit is in Program Mode**

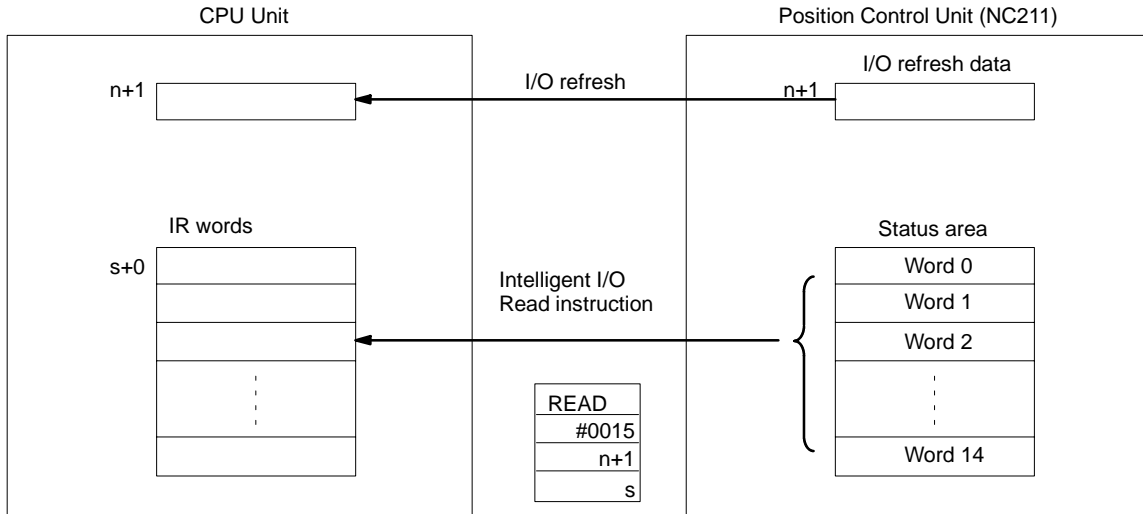
- 1, 2, 3... 1. Turn bits ON and OFF in the CPU Unit's allocated output word.
2. The commands will be automatically transferred to the Position Control Unit during the I/O refresh.



**Note** If the operating mode is changed during axis operation (i.e., from RUN or Monitor Mode to Program Mode or from Program Mode to RUN or Monitor Mode), operation will decelerate to a stop.

### 9-1-4 Reading PCU Status

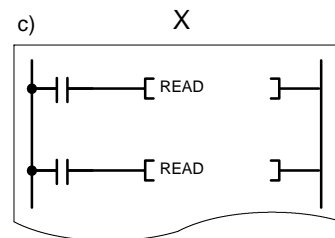
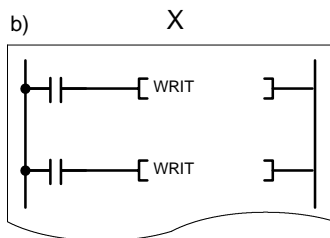
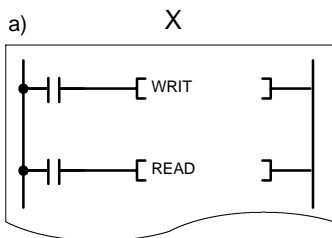
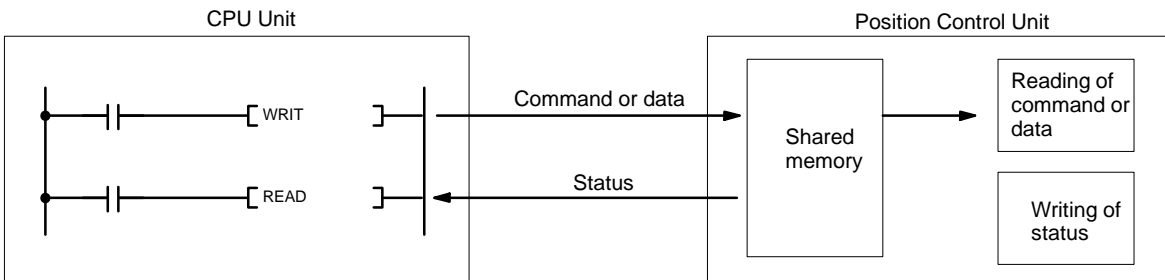
There are two ways to send PCU status to the CPU Unit. The first way is the “I/O refresh data” method, in which the status is transferred from the Position Control Unit to the CPU Unit with each I/O refresh. The other way is the “Status Area” method, in which the Intelligent I/O Read instruction is used to read the detailed information in the Position Control Unit’s Status Area (15 words for the NC211 or 8 words for the NC113) to the CPU Unit.



### 9-1-5 Programming Precautions

To write commands or data to the Position Control Unit, use the Intelligent I/O Write instruction (WRIT). To read the status from the Position Control Unit, use the Intelligent I/O Read instruction (READ). When using these instructions, be careful about the following points.

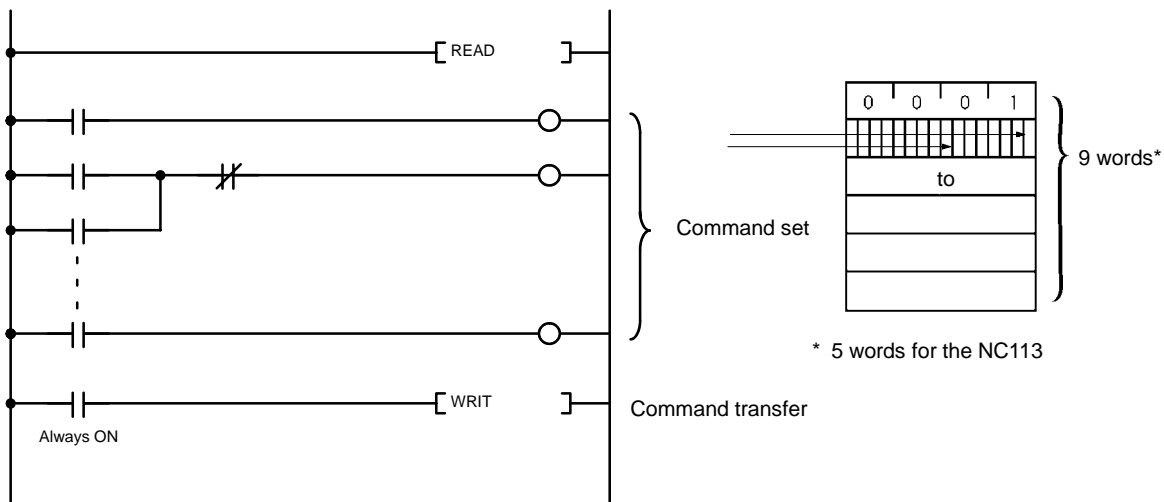
- 1, 2, 3... 1. The Position Control Unit’s shared memory is not completely freed immediately following execution of WRIT or READ, so the Position Control Unit will ignore either of these instructions if they are again executed at that time. Therefore, do not execute either of these instructions consecutively.



In particular, if a WRIT instruction is immediately followed in the program by a READ instruction for reading the status, as shown in example (a) in the above diagram, the READ instruction will not be executed after the WRIT instruction is executed (i.e., the Equals Flag will not turn ON). In examples (b) and (c), after the WRIT and READ instructions in the upper part of the diagram have been executed, the WRIT and READ instructions in the lower part of the diagram will be executed in subsequent cycles if the WRIT and READ in the upper part are not executed.

2. Approximately every 10 ms, asynchronous with the CPU Unit, the Position Control Unit carries out execution processing for commands from the shared memory and data reading, as well as status writing to the shared memory. While this processing is being carried out, the Position Control Unit ignores any WRIT or READ instructions from the CPU Unit. Therefore, be sure to insert WRIT and READ instructions into the program in such a way that they fit within 10-ms intervals.

Create the program as shown in the following example:



For details on transferring data and commands consecutively, refer to *10-3 Using Continuous Operation*.

## 9-2 START

Although the settings are explained here in terms of the X axis of the NC211, the procedures are the same for the Y axis.

### 9-2-1 Data Settings

1, 2, 3...

1. **Initial positioning action number:**

X-axis address 2002

Y-axis address 6002

Set the positioning action number to be used for START in address 2002.

• This positioning action number is used in the following circumstances:

- Initial START after powering up.
- START after a bank end.
- START after execution of positioning action in address 1499.

• When executing the above operations, set the initial positioning action enable bit to OFF (0).

2. **Initial speed number:**

X-axis address 2001

Y-axis address 6001

Set the starting speed number in address 2001.

3. **Speed data:**

X-axis addresses 4000 to 4049

Y-axis addresses 8000 to 8049

Set the speed data to be used for the beginning speed and positioning actions.

4. **Acceleration/deceleration patterns:**

X-axis addresses 3000 to 3099

Y-axis addresses 7000 to 7099

Set the acceleration/deceleration patterns to be used for positioning actions.

5. **Dwell times:**

X and Y axes: Addresses 9000 to 9029

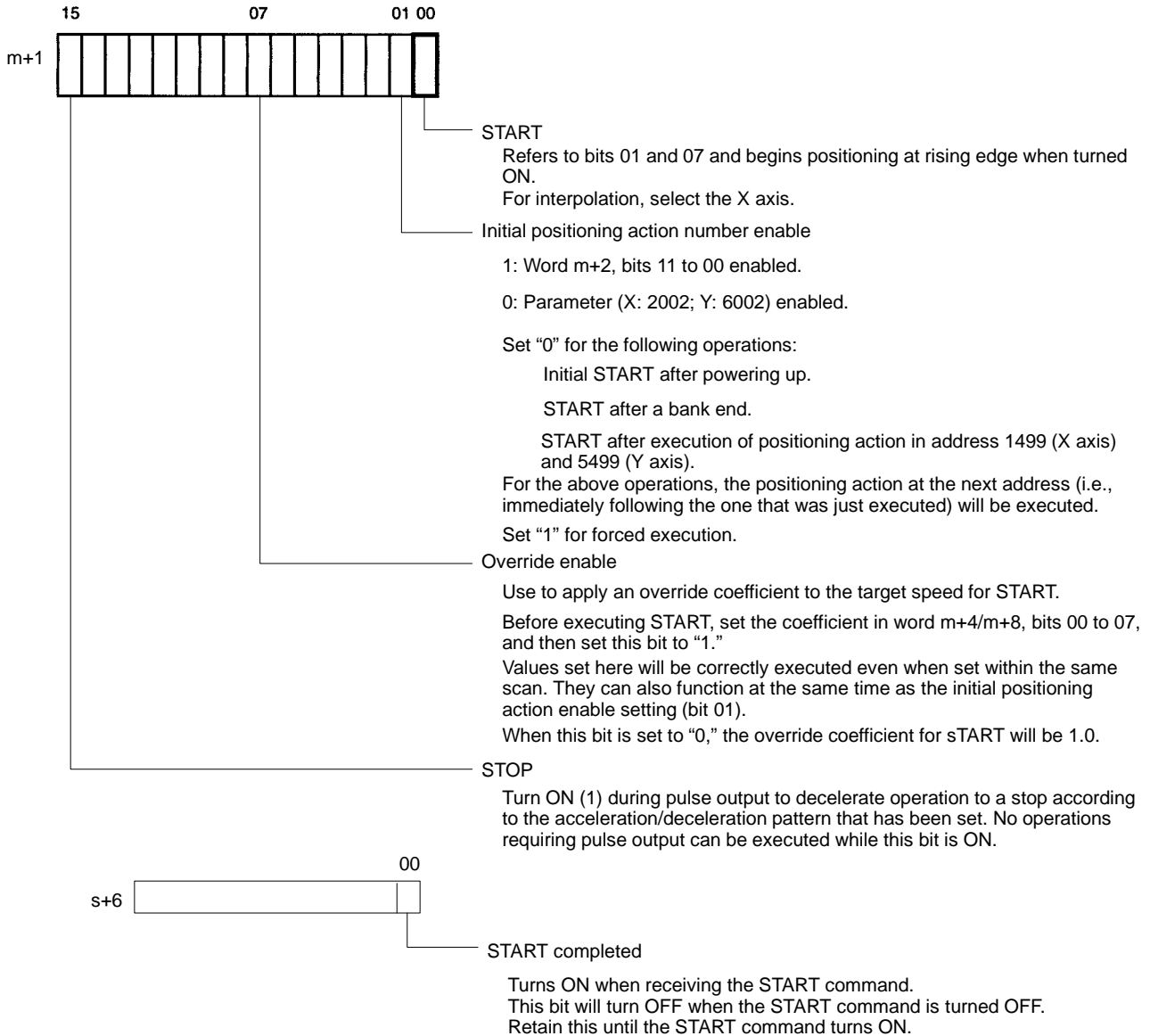
Set the dwell times to be used for positioning actions.

For more details on data settings, refer to *Section 5 Data Configuration*.

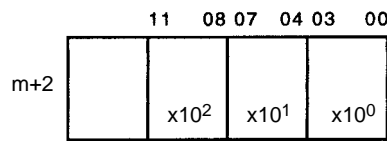
### 9-2-2 Command Settings

#### START (Word m+1, bit 00)

Initial positioning action number enable (word m+1/m+5, bit 01) (X/Y axis)  
 Override enable (word m+1/m+5, bit 07) (X/Y axis)  
 STOP (word m+1/m+5, bit 15) (X/Y axis)



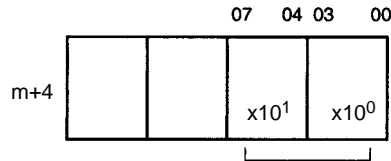
#### Initial Positioning Action Number (Word m+2/m+6, bits 11 to 00) (X/Y axis)



Set the initial positioning action number (0 to 499 BCD) here.

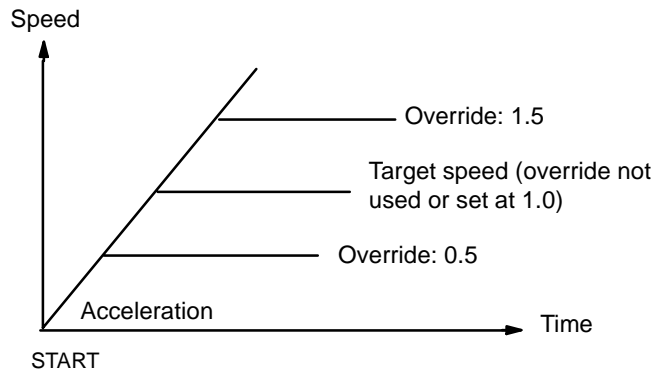
**Note** When the START command bit (bit 00 of word m+1) turns ON, START is executed with the positioning action number specified here if bit 01 of word m+1 is "1."

**Override (Word m+4/m+8, bits 07 to 00) (X/Y axis)**



Set the override as an integer from 00 to 20 (BCD), in units of 0.1.

- This setting represents units of (0.1). A setting of 15, for example, represents a value of (1.5).
- The override represents a coefficient of the target speed. If its value is set at 00, the speed will be taken at face value (100%) and a coefficient of 1.0 will be applied. If the value is set between 01 and 20, the set value will be multiplied by 0.1 to determine the coefficient. The override can thus be set in increments from 0.1 to 2.0.
- If the speed resulting from the override exceeds 250 kpps or falls below 1 kpps, the speed will be set at 250 kpps or 1 kpps, respectively.
- The override takes the value at the time START is executed.
- To change the override, execute CHANGE OVERRIDE by turning ON bit 12 of word m+2.
- The override affects accelerations and decelerations as shown in the following diagram.



**CHANGE OVERRIDE (Word m+2/m+6, bit 12) (X/Y axis)**



Use to change the override during positioning.

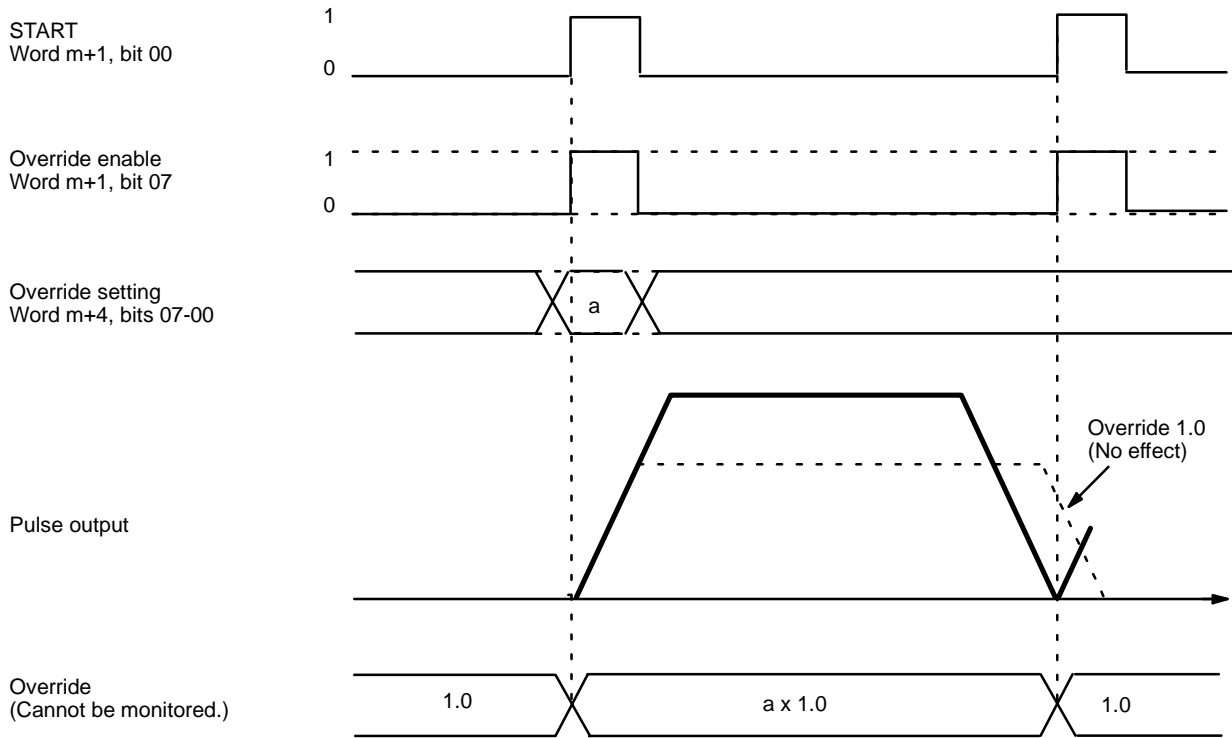
- Use CHANGE OVERRIDE to change the override during positioning.
- After the override has been set in bits 07 to 00 of word m+4, the change is made when CHANGE OVERRIDE (bit 12 of word m+2) turns ON.
- When START is executed with the override enable/disable (bit 07 of word m+1) ON, the override set at that time is used without change.
- The CHANGE OVERRIDE command cannot be executed within the same scan as START. If you want to use CHANGE OVERRIDE with START, be sure to turn this bit ON before executing START.

**Operation of Override Enable (Word m+1/m+5, bit 07) and CHANGE OVERRIDE (Word m+2/m+6, bit 12) (X/Y Axis)**

The override enable and the CHANGE OVERRIDE command both use bits 07-00 of word m+4, but they operate independently. The override enable applies an override coefficient to the whole series of operations, while CHANGE OVERRIDE is used to make changes during operation. Only the X-axis flag turns ON during interpolation; the Y-axis flag is ignored. The override is applied to the interpolation target speed (NC211 only).

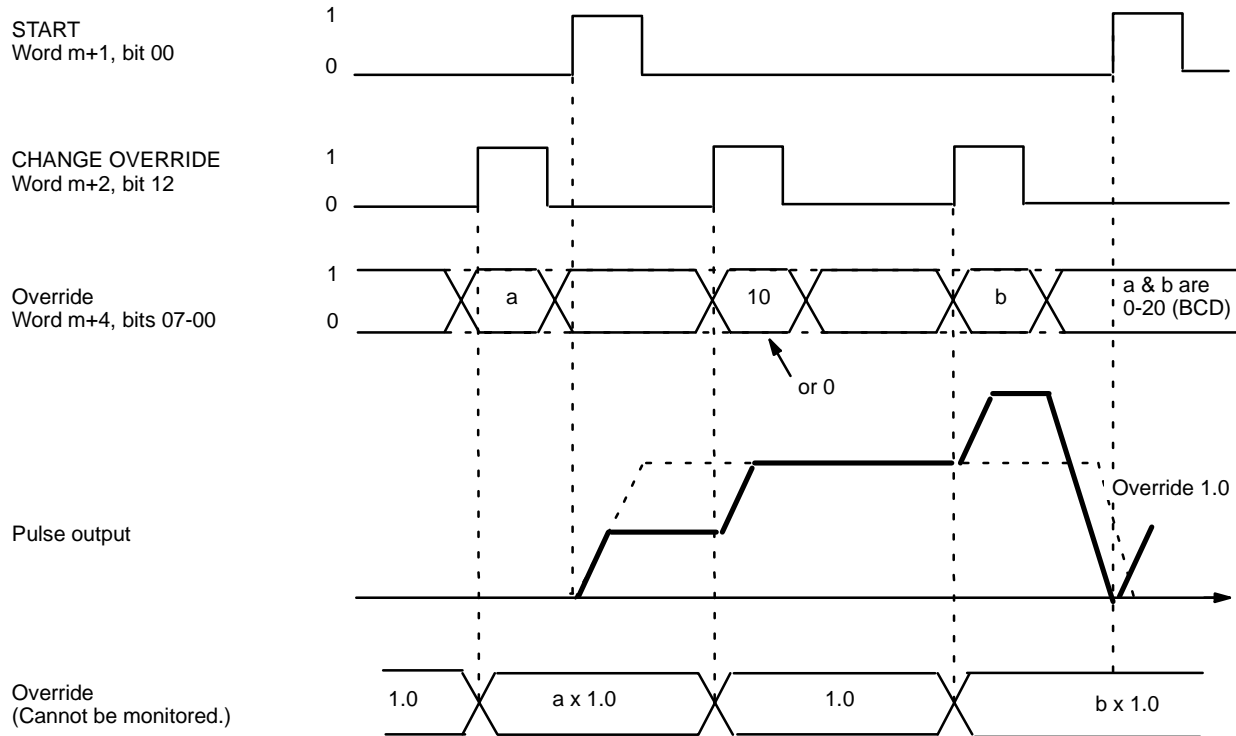


The override enable bit is either ON (1) or OFF (0) throughout operation. If this bit is ON, the override is applied. The bit remains set until the next START command is executed.

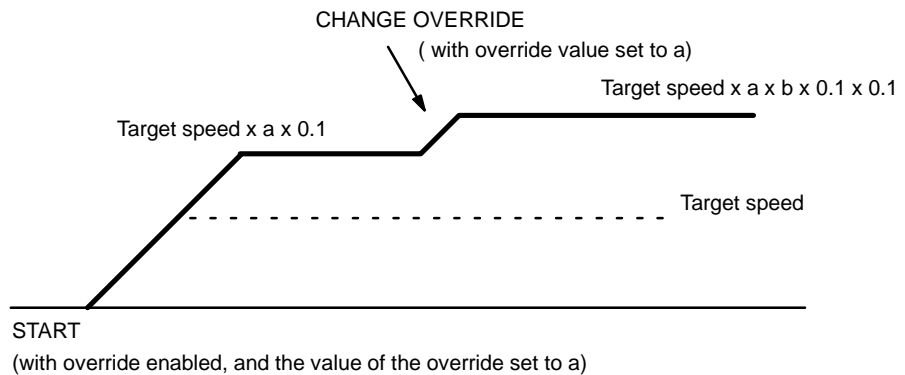


**Operation of CHANGE OVERRIDE**

When the CHANGE OVERRIDE command bit turns ON, all operations use the new override. To disable the override during operation (i.e., to set the override to 1.0), set the value of the override to 0 or 10 and turn ON the CHANGE OVERRIDE command bit.




**CHANGE OVERRIDE Operation When Combined with Override Enable**



This example illustrates how the CHANGE OVERRIDE command works with override enabled. In this case, even if the override setting is 0 or 10 when CHANGE OVERRIDE is executed the override is not disabled (i.e., the override does not become 1.0). To set the override to 1.0, set bits 07-00 of word m+4 to 1/a (1/a will be an integer between 0 and 20), and then execute the CHANGE OVERRIDE command.

### 9-2-3 Executing START

#### Initial Positioning Action

START	Initial positioning action number enable (word m+1, bit 01)	Conditions	Initial positioning action
m+1 CH, 00 bit 1  0	0	When powering up.	(Parameter settings) Positioning action number set for initial positioning action number (X-axis: 2002)
		After a bank end (completion code 3)	
		After positioning action address 1499 (X-axis no. 499) is executed.	
	Other than the above.	Previously executed positioning action number +1	
	1	---	(Command settings) Positioning action number set for initial positioning action number (command word m+2, bits 11 to 00)

#### Subsequent Positioning Actions

Preceding completion code	Condition	Positioning action to be executed
Terminating (0)	START command	Next (+1) positioning action number (when bit 01 of word m+1 is set to "0")
Automatic (1)	After dwell time	Next (+1) positioning action number
Continuous (2)	No stop after positioning	Next (+1) positioning action number
Bank end (3)	START command	
Speed control (4)	START after deceleration stop	Next (+1) positioning action number
Interrupt feeding (5)	START after deceleration stop	Next (+1) positioning action number

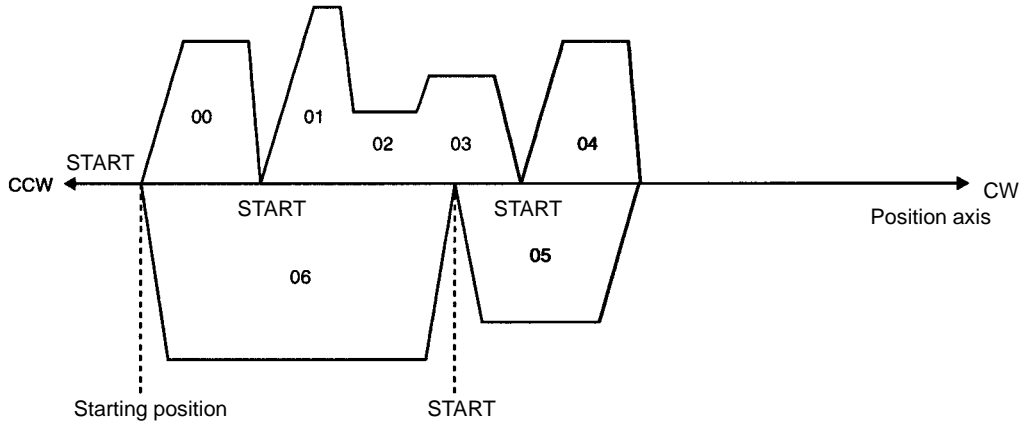
#### START Order (Example)

In this example, the initial positioning action number is 10 (X axis positioning action address 1010).

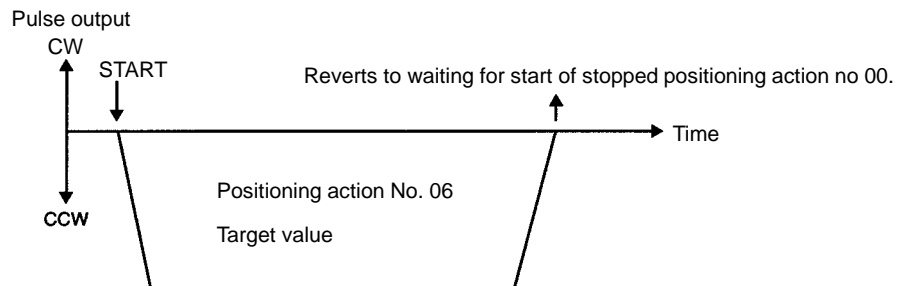
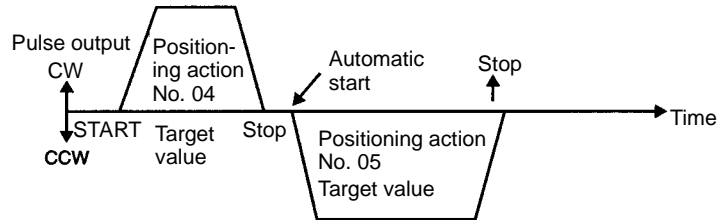
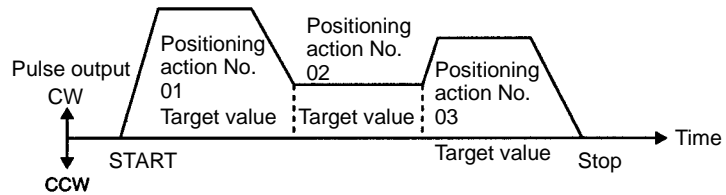
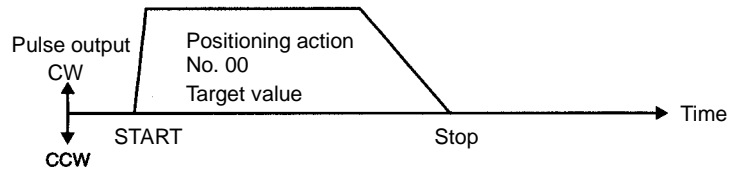
START command (word m+1, bit 00)	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1
Initial positioning action number enable (word m+1, bit 01)	0				0	0	1	0
Initial positioning action number (word m+2, bits 11 to 00)	---	---	---	---	050 (X axis: positioning action No. 50)			
Positioning action number to be executed (positioning action address)	10 (1010)	11 (1011)	12 (1012)	10 (1010)	11 (1011)	12 (1012)	50 (1050)	51 (1051)
Completion code	0	0	3	0	0	3	0	0
Time lapse ---->								

**Using Completion Codes  
(Example)**

In this example the starting position and bank end target position are the same.



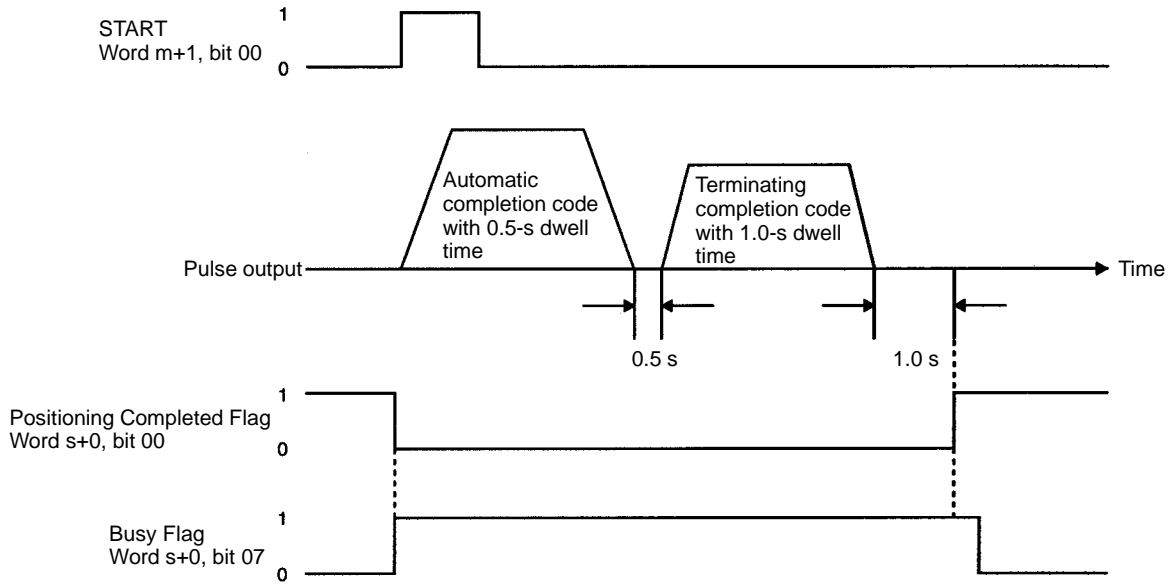
Positioning action	Completion code
Positioning action No. 00	0 Terminating
Positioning action No. 01	2 Continuous
Positioning action No. 02	2 Continuous
Positioning action No. 03	0 Terminating
Positioning action No. 04	1 Automatic
Positioning action No. 05	0 Terminating
Positioning action No. 06	3 Bank end



**Stop Judgement and Using Dwell Times (Example)**

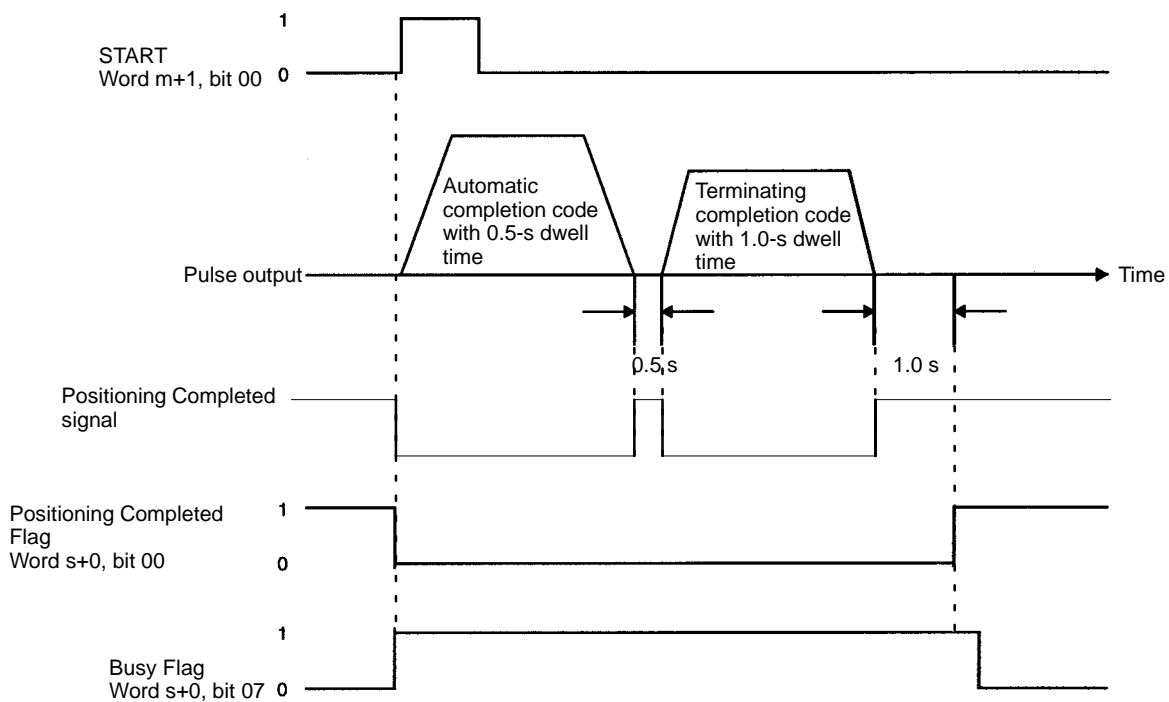
**When the Origin Search Mode is 0 or 1**

When the pulse output is completed, the Positioning Completed Flag turns ON after the dwell time elapses.



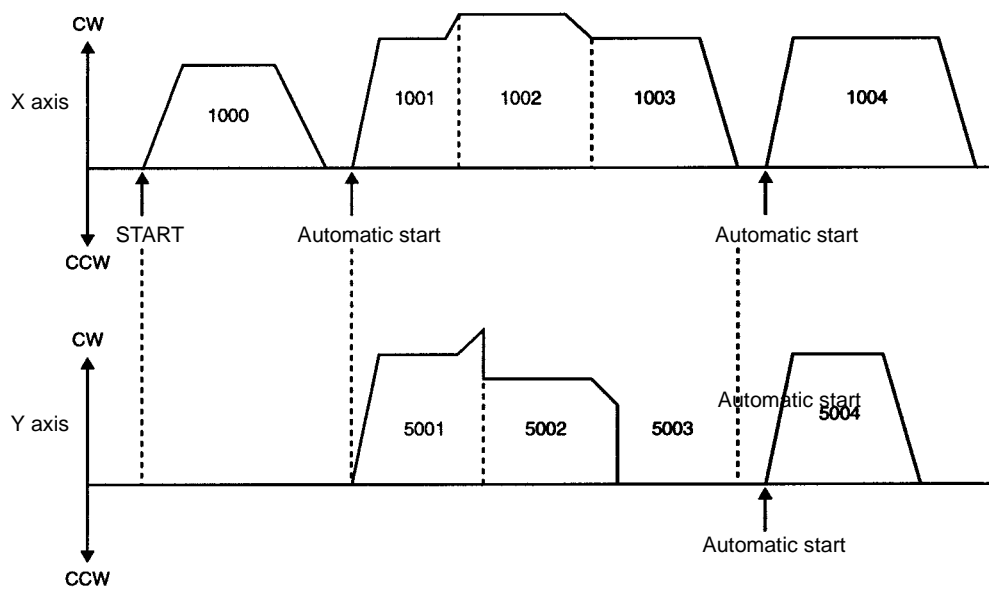
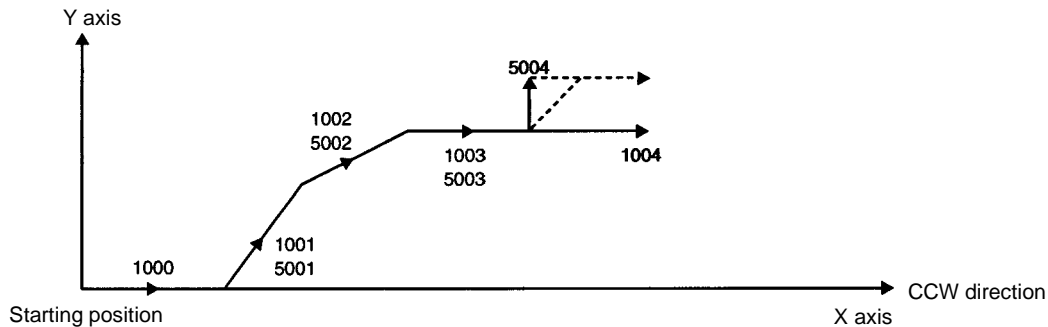
**When the Origin Search Mode is 2 or 3**

When the Positioning Completed signal turns ON, the Positioning Completed Flag turns ON after the dwell time elapses.



**Using Interpolation  
(Example) (NC211 only)**

In this example, the X-axis completion code is 1, so interpolation is executed automatically. For positioning action 1004, the X and Y axes are operated independently based on the completion code (1: automatic) for the last interpolation data (positioning action 1003).



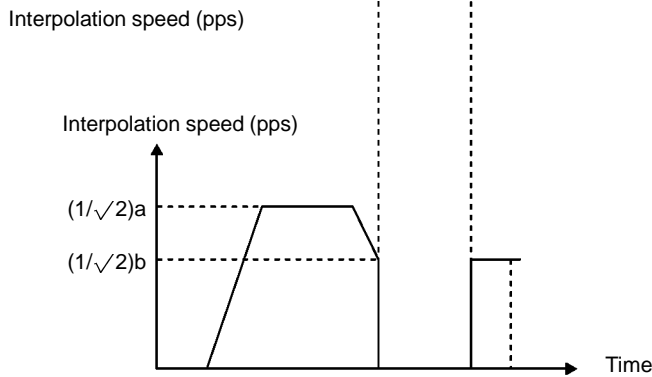
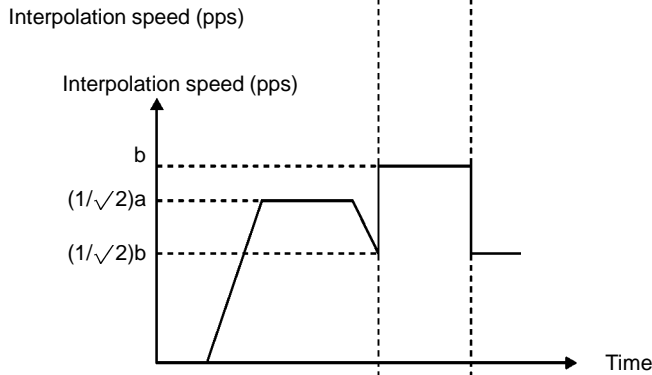
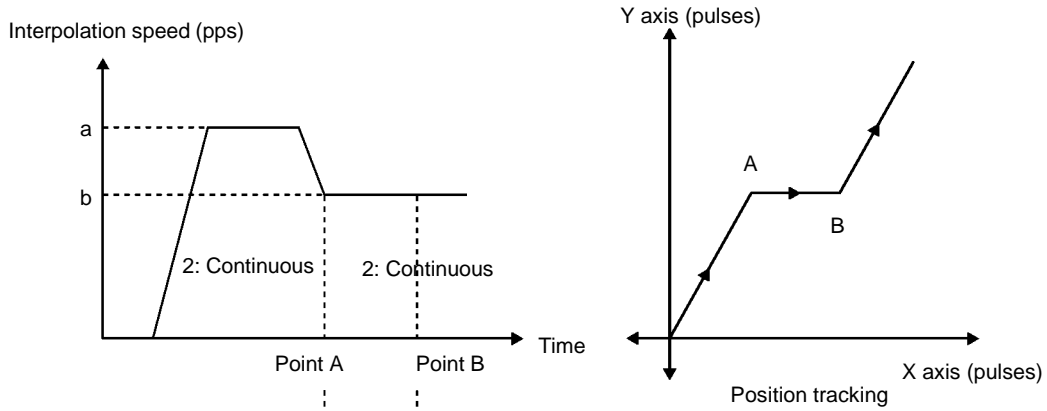
(X axis)	Sign	Completion code		(Y axis)	Sign	Completion code	
Positioning action 1000	2	1	Independent Automatic	Positioning action 5000			
Positioning action 1001	6	2	Interpolation Continuous	Positioning action 5001	2	1	← The X-axis completion code is "continuous" (2), so these completion patterns are ignored.
Positioning action 1002	6	2	Interpolation Continuous	Positioning action 5002	2	2	
Positioning action 1003	6	1	Interpolation Automatic	Positioning action 5003	2	1	
Positioning action 1004	2	3	Independent Bank end	Positioning action 5004	2	3	Independent Bank end

**Precautions When Using Completion Code 2 (Continuous)**

- 1, 2, 3...** 1. When using a stepping motor (NC211 only).  
Do not use completion code 2 (continuous) when using a stepping motor. The pulse output for interpolation follows the programmed positioning, using the acceleration/deceleration pattern for the interpolation data that is set. Therefore, executing interpolation continuous completion may cause the acceleration/deceleration pattern for the X and Y axes to suddenly out-

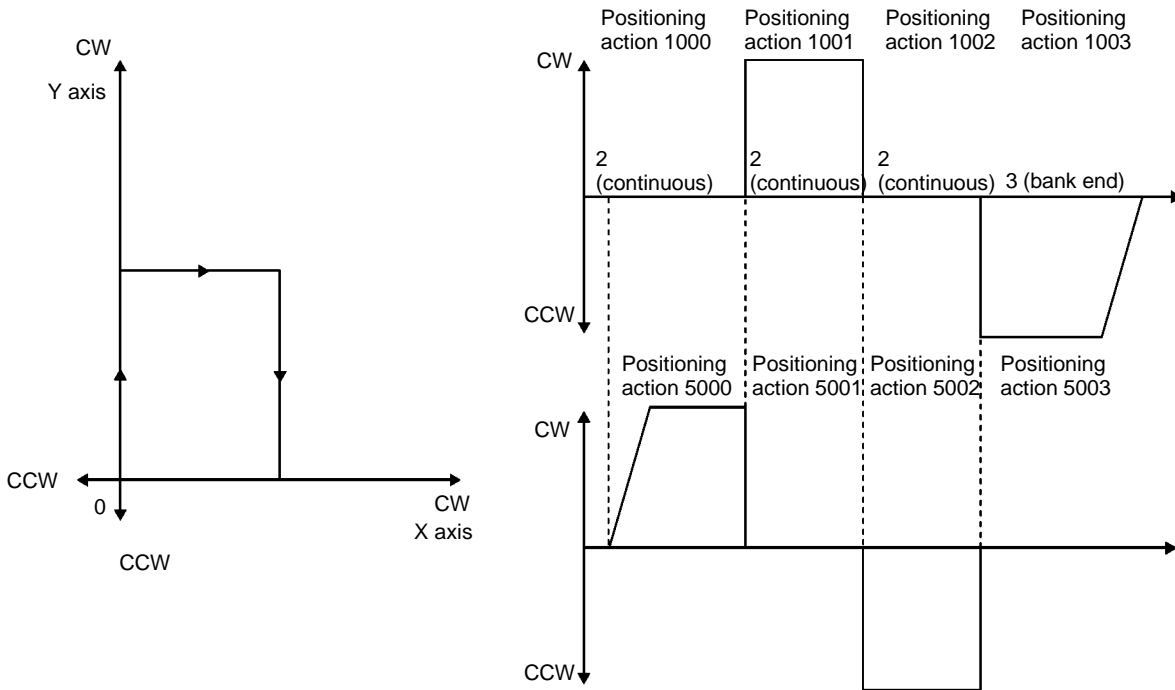
put a high pulse rate and to suddenly stop pulse output, as shown in the following diagrams. When a stepping motor is used, there is a risk that the motor may not follow these changes and thus may not operate properly, so as much as possible use completion code 1 (automatic) instead of 2 (continuous) when using a stepping motor.

Interpolation Operating Pattern



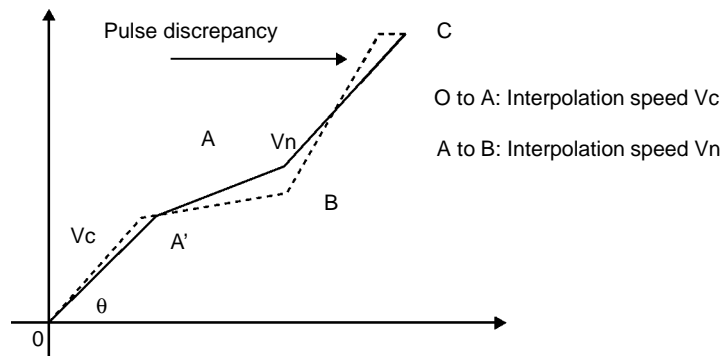
2. When creating the program.

When positioning with a continuous completion code, the speed cannot be reversed until the positioning is completed. For example, when positioning is executed as shown in the following diagram, position actions 1001 and 1003 on the X axis, and 5000 and 5002 on the Y axis, cannot be executed because they are reversed. In this case, either use completion code 1 (automatic) for positioning action 1000 and stop it upon completion, or else use automatic for all the completion codes.



3. Pulse discrepancies at transit points for continuous positioning (NC211 only).

As shown in the following diagram, pulse discrepancies may occur at transit points when positioning is executed using a continuous completion code.



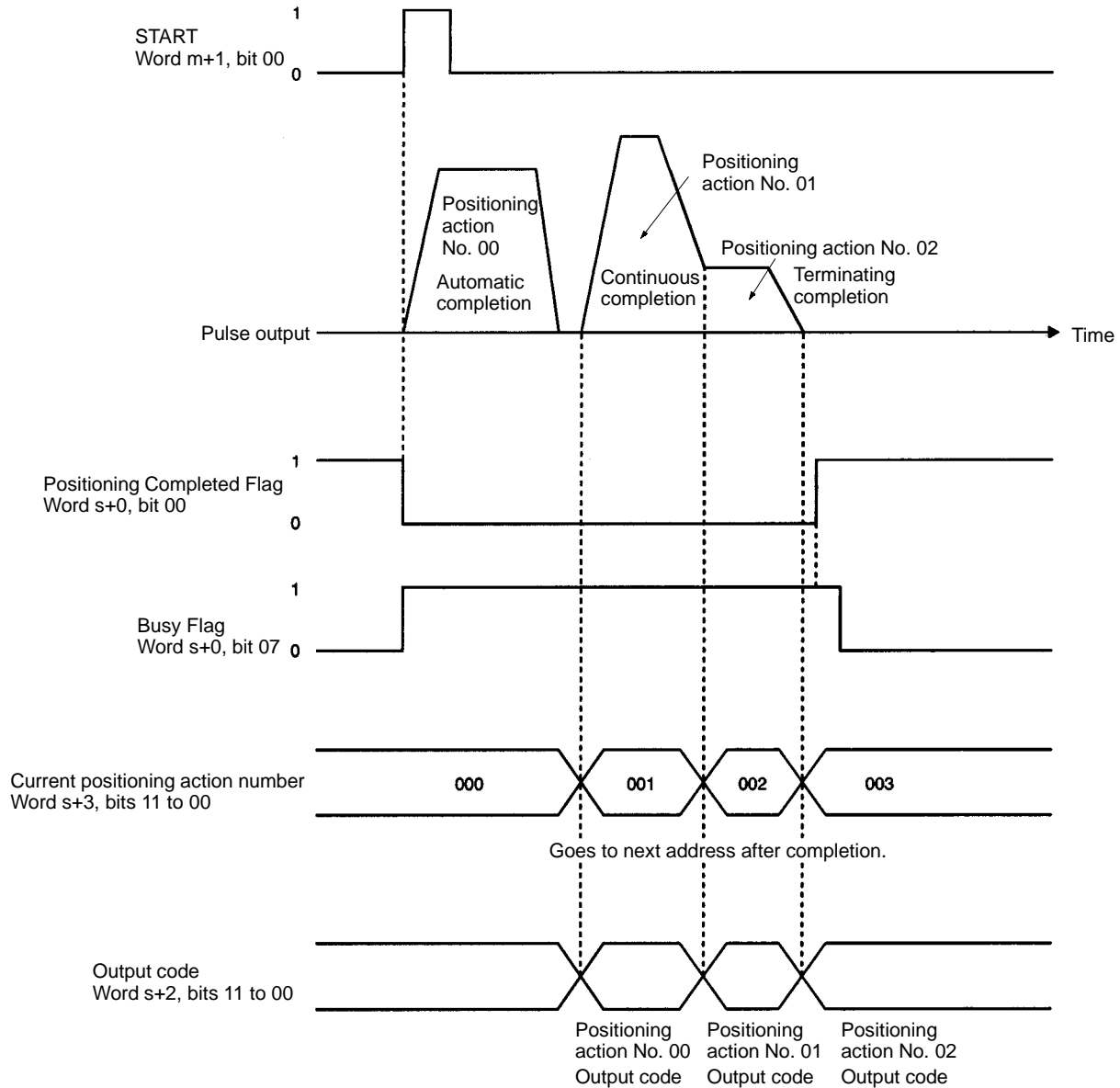
The number of pulses in the discrepancy will vary depending on the set values for the program, but there will certainly be insufficient pulses. This pulse discrepancy is caused by giving priority to the acceleration/deceleration pattern in interpolated positioning. There is no pulse discrepancy at the end point for continuous positioning (point C in the above diagram), so positioning to the end point will still be accurate. In order to obtain accurate positioning through transit points, however, use 1 (automatic) for the completion code.



### 9-2-4 Ending Operations

#### Terminating and Bank End Completion Codes

When positioning operations with multiple automatic and continuous completion codes are ended by terminating or bank end completion codes, the Completion flag turns ON and the Busy Flag turns OFF.

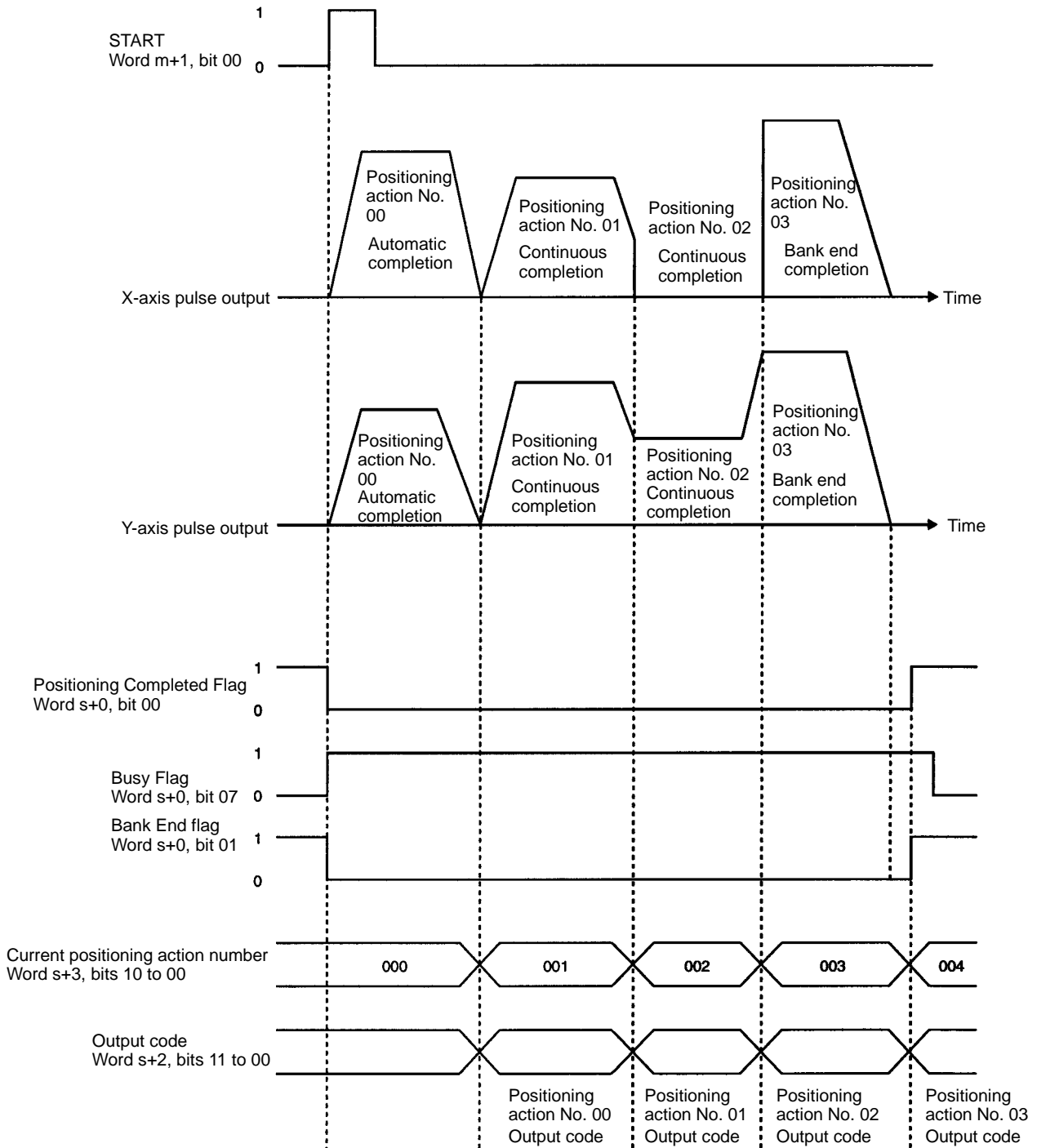


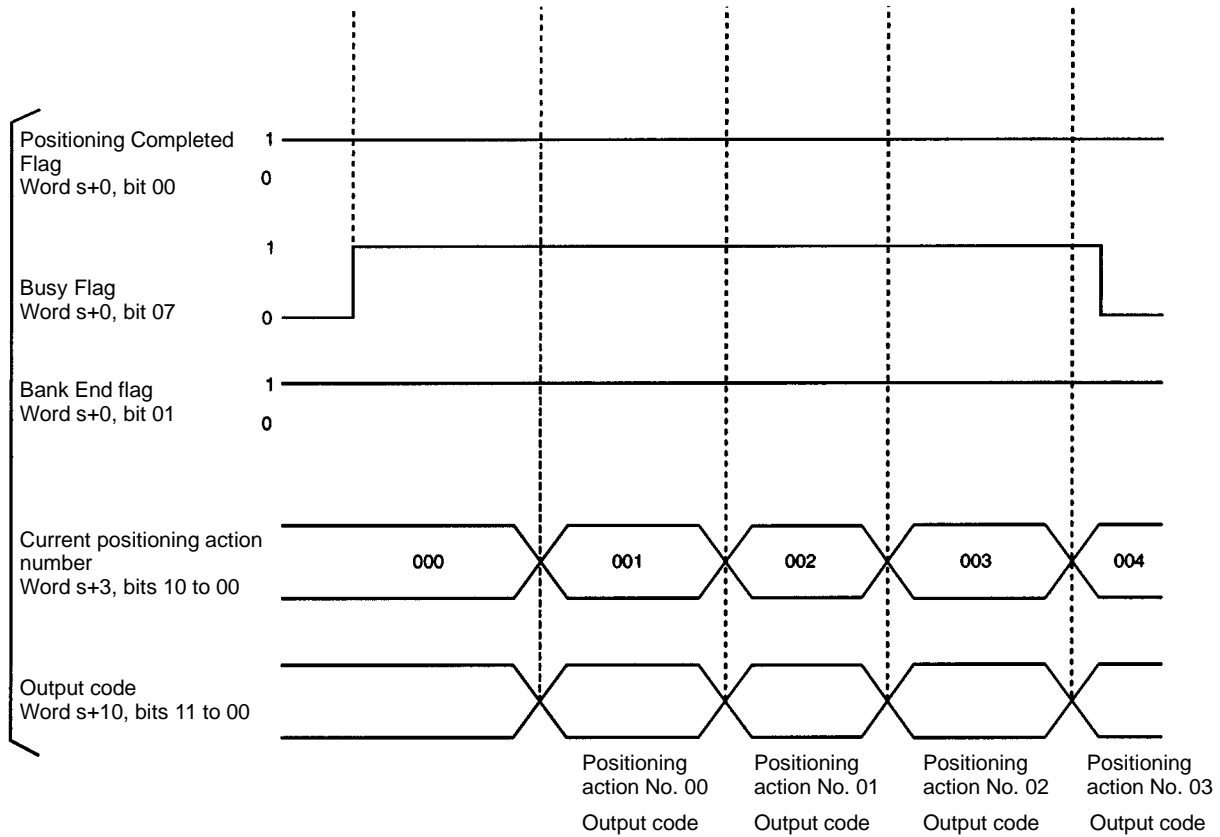
**Note** With completion code 5 (interrupt feeding), just as with the completion codes shown here, the positioning action number and output code are refreshed and the Positioning Completed Flag turns ON. The above example shows the operation when the Origin Search mode is set to 0 or 1. When the mode is set to 2 or 3, after the Positioning Completed input from the servomotor driver turns ON, the Positioning Completed Flag turns ON and the Busy Flag turns OFF after the dwell time elapses.

**Interpolation Operations  
(NC211 only)**

The Positioning Completed and Bank End flags are valid only for the X axis when interpolation is used. The Y axis retains its status from before the interpolation.

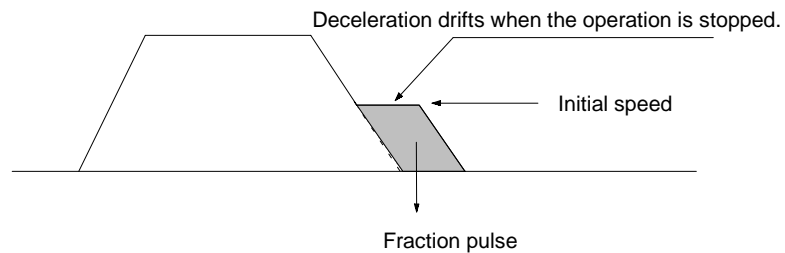
The Y-axis Busy Flag may turn OFF one scan later than the X-axis Busy Flag.





The above example shows the operation when the Origin Search mode is set to 0 or 1. When the mode is set to 2 or 3, after the Positioning Completed input from the servomotor driver turns ON for both the X axis and Y axis, the Positioning Completed Flag turns ON and the Busy Flag turns OFF after the dwell time elapses.

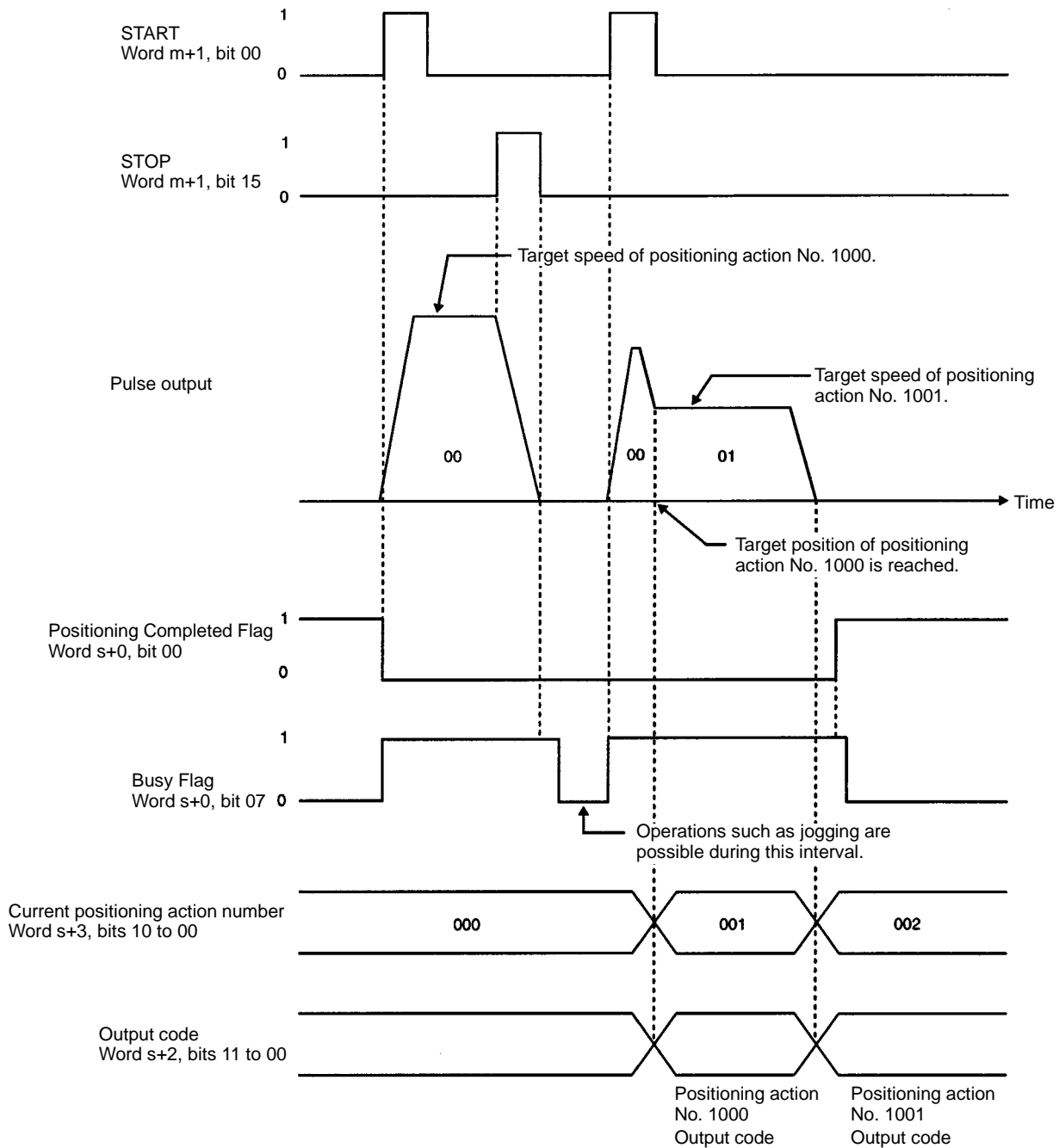
**Note** Due to a fraction pulse that occurs in the internal computation, deceleration may be drawn out longer than desirable when the operation is stopped during interpolation (NC211 only) or independent-axis operation depending on the acceleration/deceleration and speed.



If this occurs, either change the acceleration/deceleration or speed data, or increase the initial speed to so that the system will not be affected.

**Deceleration Stop**

When a deceleration stop is executed during positioning, the Positioning Completed Flag does not turn ON. The positioning action number remains the same as the one that was being executed at the time of the deceleration stop, and that positioning action will be the first to be executed when operation is restarted.



- Note**
1. During interpolation, both axes will be decelerated to a stop if the STOP command is executed for either one of them (NC211 only).
  2. When STOP is executed for a positioning action with completion code 5 (interrupt feeding), just as with the terminating and bank end completion codes, the positioning action number and output code are refreshed and the Positioning Completed Flag turns ON.
  3. While STOP is ON, the next operation cannot be started.

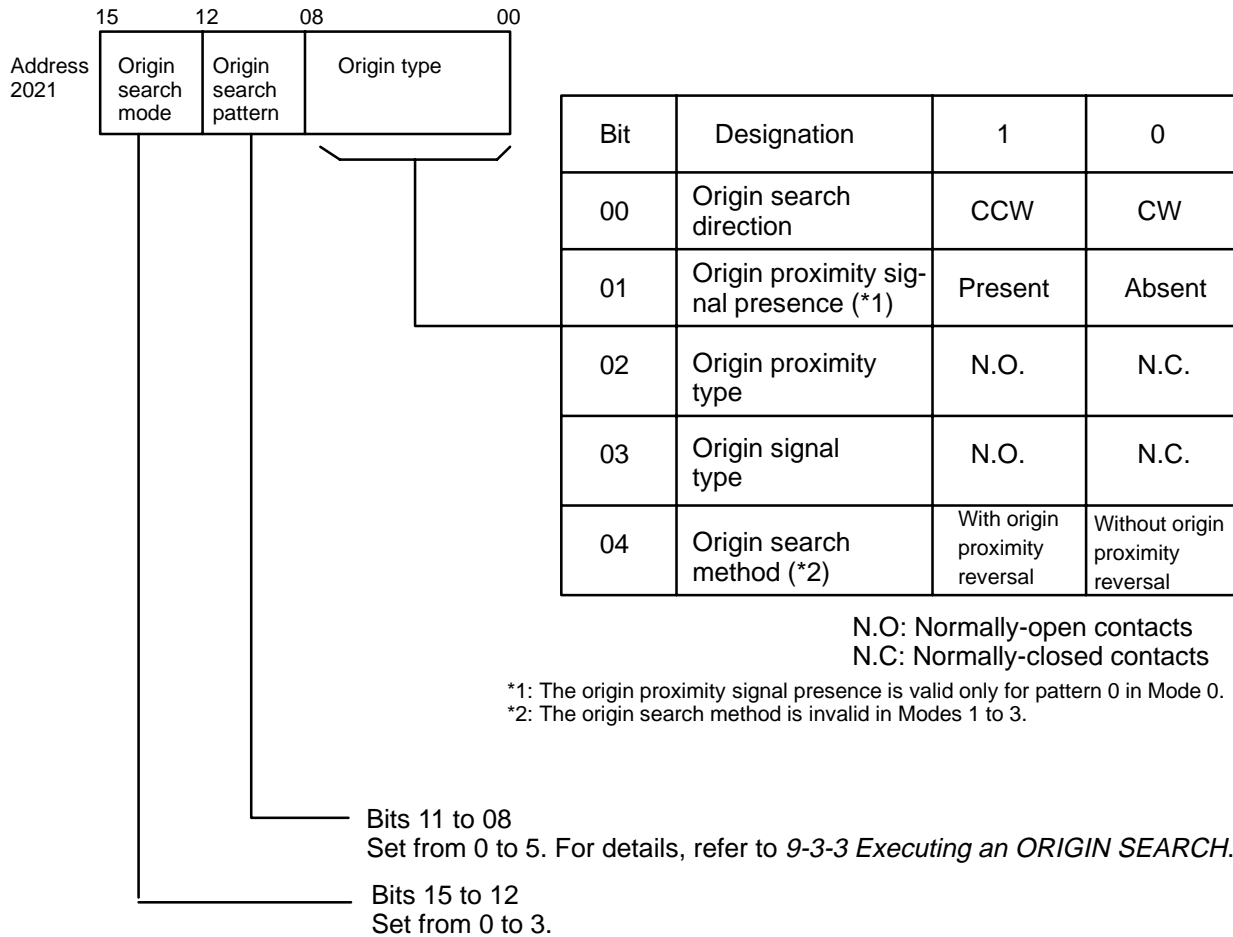
- The above example shows the operation when the Origin Search mode is set to 0 or 1. When the mode is set to 2 or 3, after the Positioning Completed input from the servomotor driver turns ON, the Busy Flag turns OFF.

## 9-3 ORIGIN SEARCH

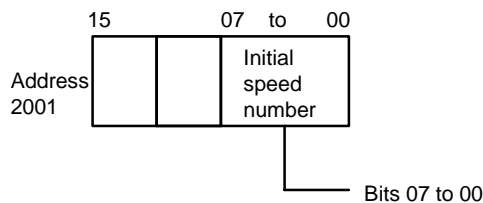
The ORIGIN SEARCH command is used to establish the origin. Although the settings are explained here in terms of the X axis, the procedures are the same for the Y axis of the NC211.

### 9-3-1 Data Settings

Origin Search Mode, Origin Search Pattern, Origin Type (X Axis: 2021; Y Axis: 6021)

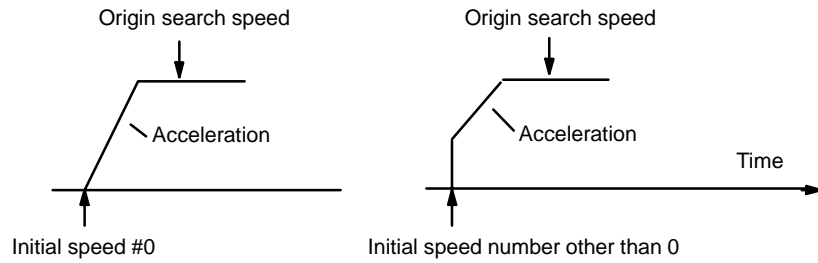


Initial Speed Number (X Axis: 2001; Y Axis: 6001)

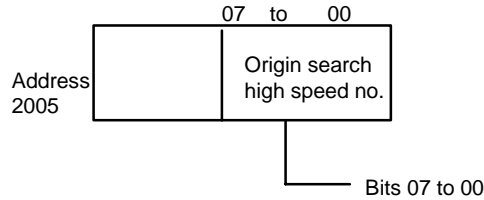


- Set the initial speed number (bits 07 to 00) from 0 to 49.

- Speed addresses 4000 to 4049 (for the X axis) are referenced according to this setting.

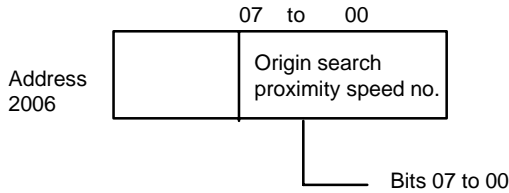


**Origin Search High Speed Number (X Axis: 2005; Y Axis: 6005)**



- Set the origin search high speed number (bits 07 to 00) from 0 to 49.
- Speed addresses 4000 to 4049 (for the X axis) are referenced according to this setting.
- This setting is not used when there is no origin proximity signal.

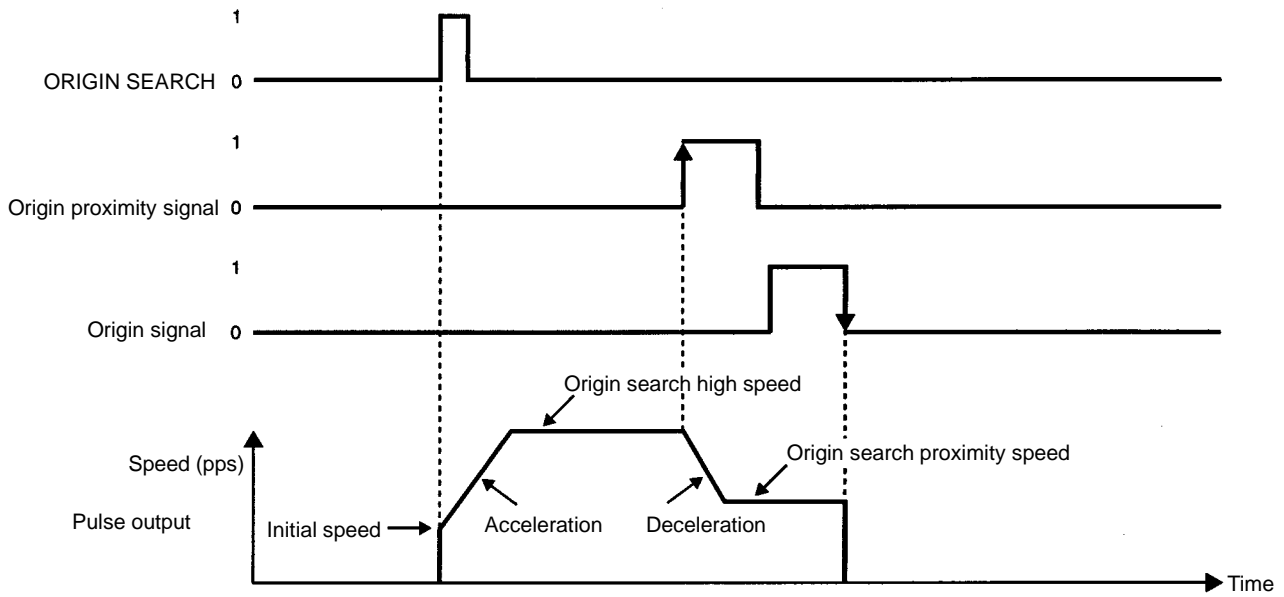
**Origin Search Proximity Speed Number (X Axis: 2006; Y Axis: 6006)**



- Set the origin search proximity speed number (bits 07 to 00) from 0 to 49.
- Speed addresses 4000 to 4049 (for the X axis) are referenced according to this setting.
- This number cannot be set higher than the origin search high speed number.
- Set the origin search proximity speed to a maximum value of 10,000 pps.

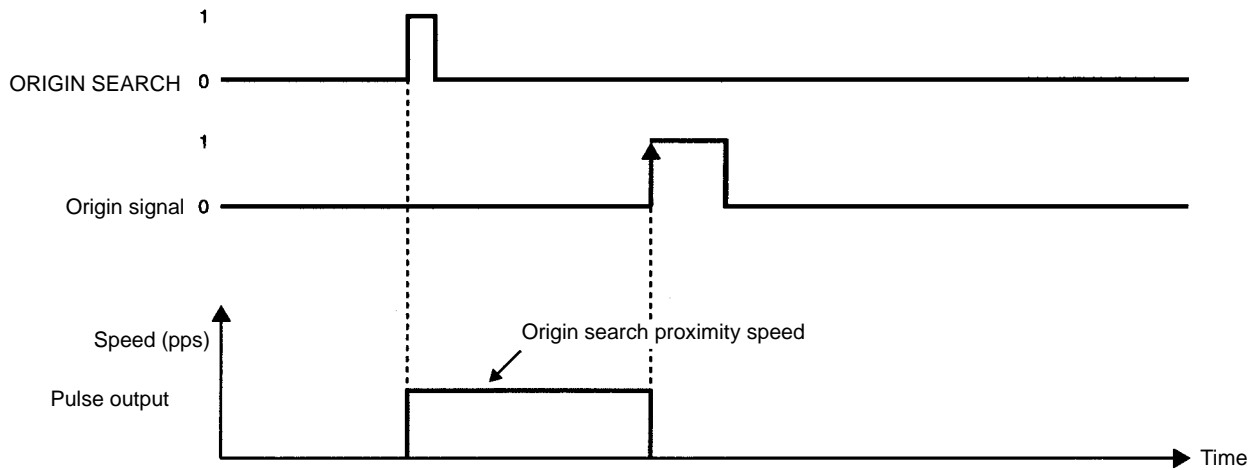
**When There is an Origin Proximity Signal**

In this example the mode and pattern are both 0.



**When There is No Origin Proximity Signal**

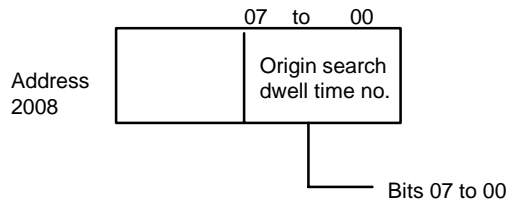
In this example the mode and pattern are both 0.



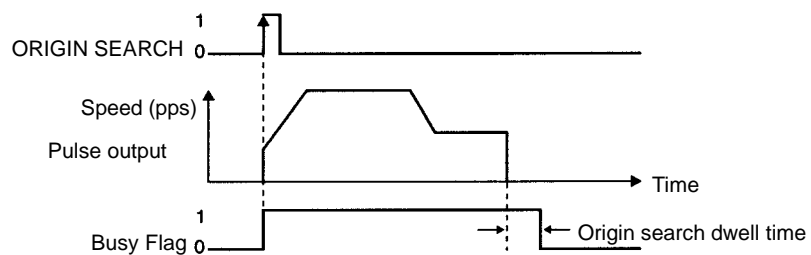
**Speeds (X Axis: 4000 to 4049; Y Axis: 8000 to 8049)**

	15			00	
	$\times 10^3$	$\times 10^2$	$\times 10^1$	$\times 10^0$	
Address 4000	0	0	$\times 10^5$	$\times 10^4$	} Set from 000000 to 250000 (BCD).
	↓				
Address 4049	$\times 10^3$	$\times 10^2$	$\times 10^1$	$\times 10^0$	
	0	0	$\times 10^5$	$\times 10^4$	

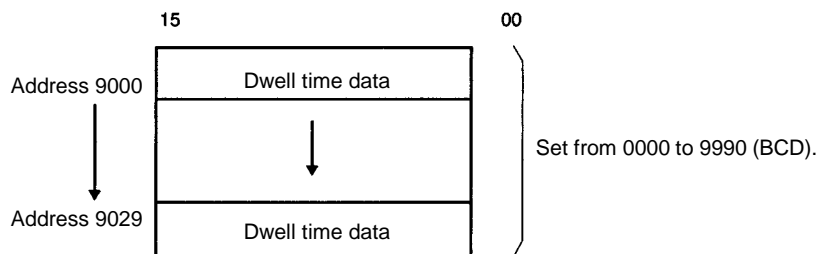
Origin Search Dwell Time Number (X Axis: 2008; Y Axis: 6008)



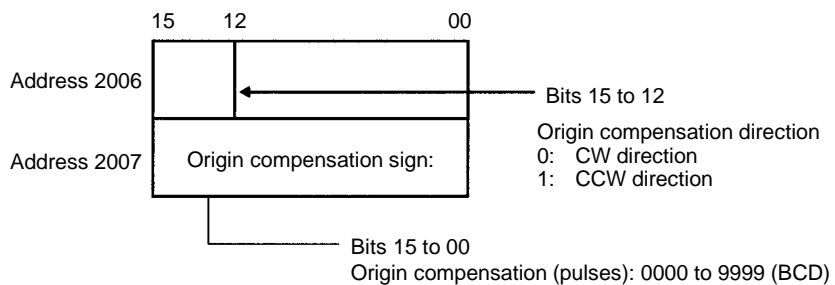
- Set the dwell time number (bits 07 to 00) from 0 to 29 (BCD).
- Dwell time addresses 9000 to 9029 are referenced according to this setting.
- When the dwell time elapses after an origin search operation is completed, the Busy Flag turns OFF and the next operation can be executed.



Dwell Times (X/Y Axes Together: 9000 to 9029)



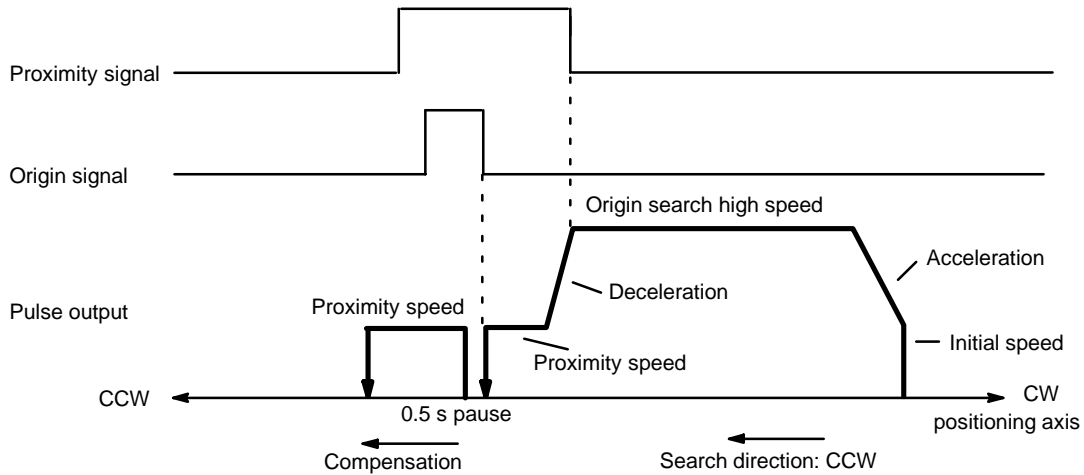
Origin Compensation (X Axis: 2006, 2007; Y Axis: 6006, 6007)



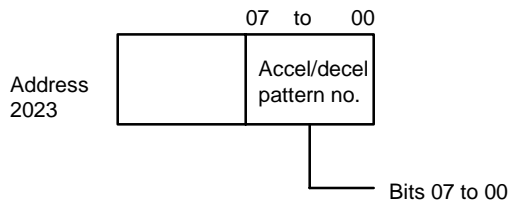
- If the position where operation is stopped by origin signal input is to be treated as the origin, set the origin compensation to 0.



- When an origin compensation value is set, after operation is stopped by an origin signal input the axis will be moved at proximity speed in the direction indicated by the origin compensation sign. In the following example, the sign is CCW so the movement is in the counterclockwise direction.

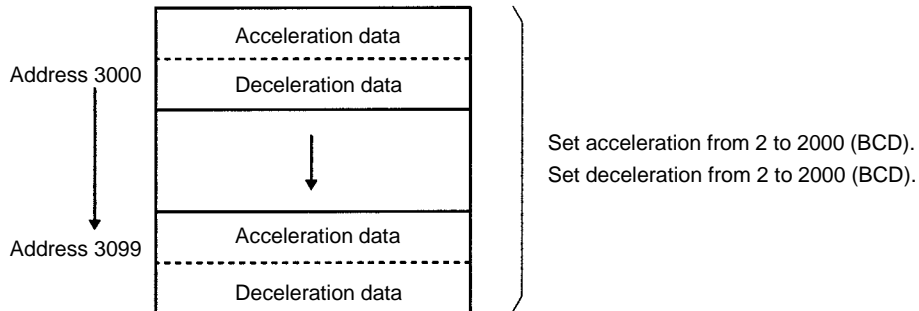


**Origin Search Acceleration/Deceleration Pattern Number (X Axis: 2023; Y Axis: 6023)**

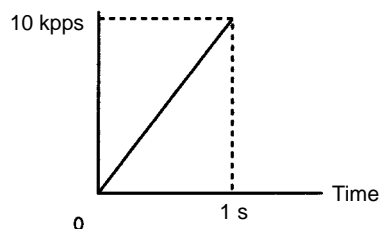


- Set the origin search acceleration/deceleration pattern number from 0 to 99.
- Origin search acceleration/deceleration pattern addresses 3000 to 3099 (X axis) are referenced according to this setting.

**Acceleration/Deceleration Settings (X Axis: 3000 to 3099; Y Axis: 7000 to 7099)**

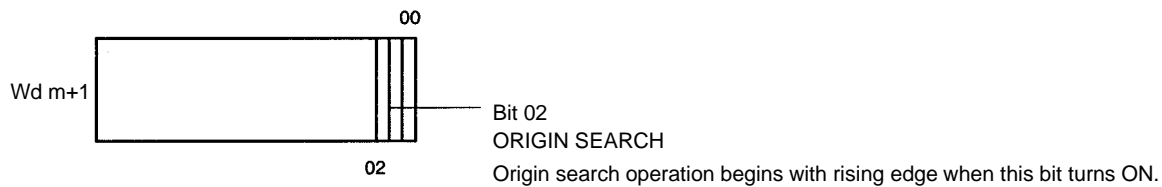


The acceleration and deceleration indicate the increase or decrease per ms of speed (pps: pulses/second). For example, an acceleration of “10” would be 10 kpps at a speed of 1 second.



### 9-3-2 Command Settings

ORIGIN SEARCH (Word m+1/m+5, bit 02) (X/Y axis)



### 9-3-3 Executing an Origin Search

The origin search operation establishes the absolute mechanical origin. The relationships between mode numbers and operations are explained below.

Both the origin signal and the proximity signal are set as N.O. contacts (X axis: 2021; Y axis: 6021). N.C. contacts are not explained here.

#### Mode 0

The origin's response time is 1 ms. Open collector signals such as sensors are connected to terminals 10 and 11 (for the X axis) and 32 and 33 (for the Y axis). Refer to *Section 3 Wiring*. There are six different search patterns in Mode 0, as shown in the following table, according to how the origin input and origin proximity input are received.

#### Search Patterns

Pattern	Conditions for receiving input		Search operation from origin	Remarks
	Origin proximity	Origin		
0	Rising edge or level	Falling edge	Completed only at origin.	Possible even without proximity signal.
1	Rising edge or level	Falling edge	Completed by receiving origin input after confirmation of proximity input.	Executes search from proximity in opposite direction from set search direction.
2	Rising edge or level	Rising edge	Completed by receiving origin input after confirmation of proximity input.	
3	Rising edge or level	Rising edge	Completed by receiving origin input after confirmation of proximity input.	Executes search from proximity in opposite direction from set search direction.
4	Rising edge and falling edge	Falling edge	Completed by receiving origin input after confirmation of proximity input.	
5	Rising edge and falling edge	Rising edge	Completed by receiving origin input after confirmation of proximity input.	

**Note** When using only an origin signal, the origin cannot be established except with search pattern 0.

#### Search Pattern 0

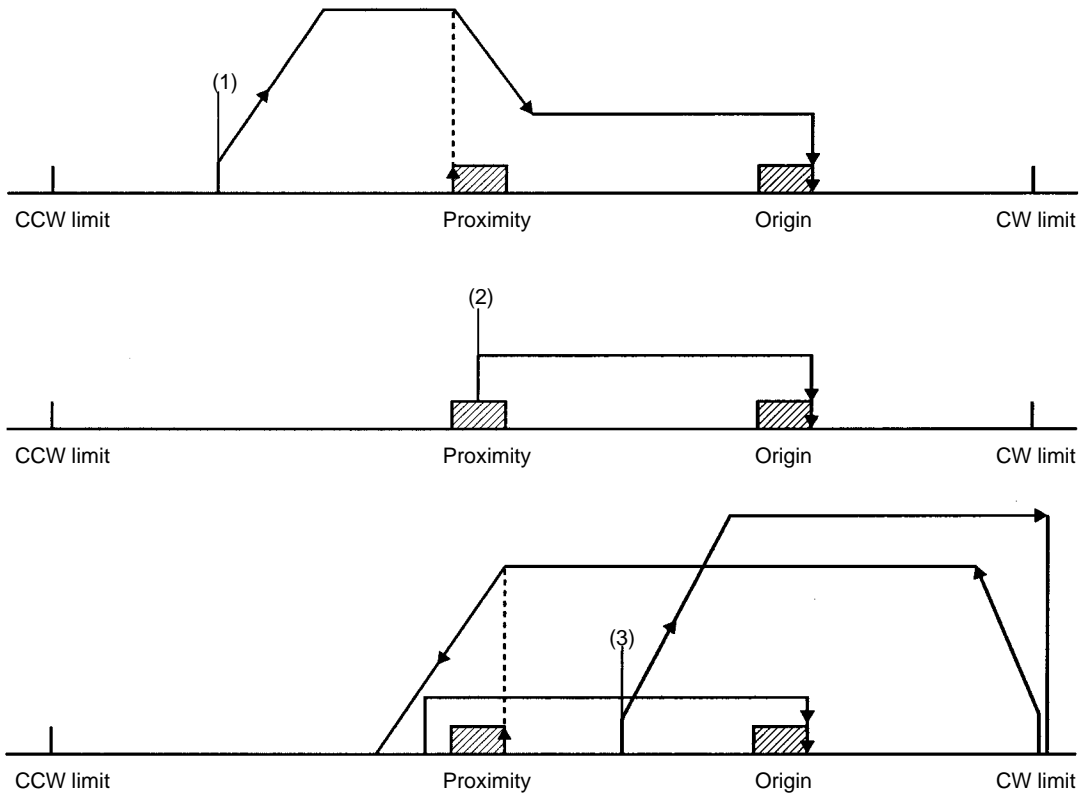
- 1, 2, 3... 1. Origin proximity input: Rising edge (↑) or level
2. Origin input: Normally falling edge (↓), but rising edge (↑) when there is no proximity signal.
3. Search procedure: Ends on falling edge of origin input after rising edge of proximity input has been received.

If the search is started at the origin, then the search operation will be completed with only the origin signal.

When there is no origin proximity signal set, the proximity speed will be used as the origin search speed and the search operation will be completed with only the origin signal.

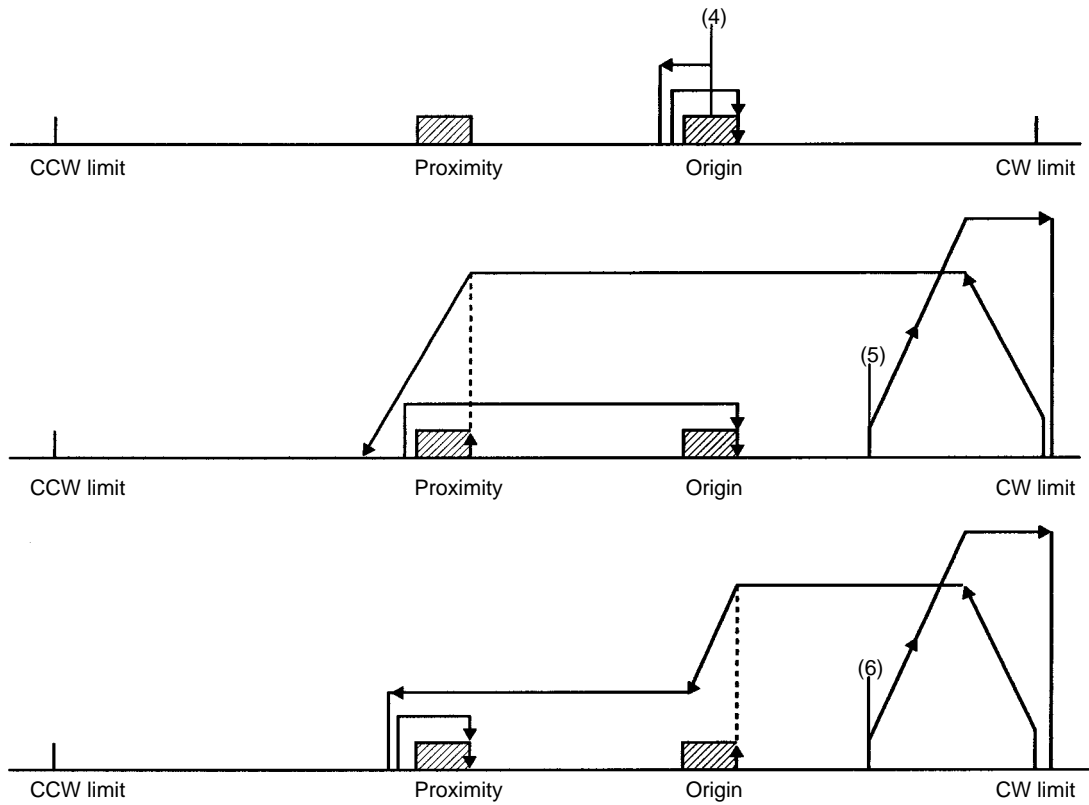
**With an Origin Proximity Signal**

The presence or absence of an origin proximity signal is determined by the setting of the origin type in parameter addresses 2021 (X axis) and 6021 (Y axis).



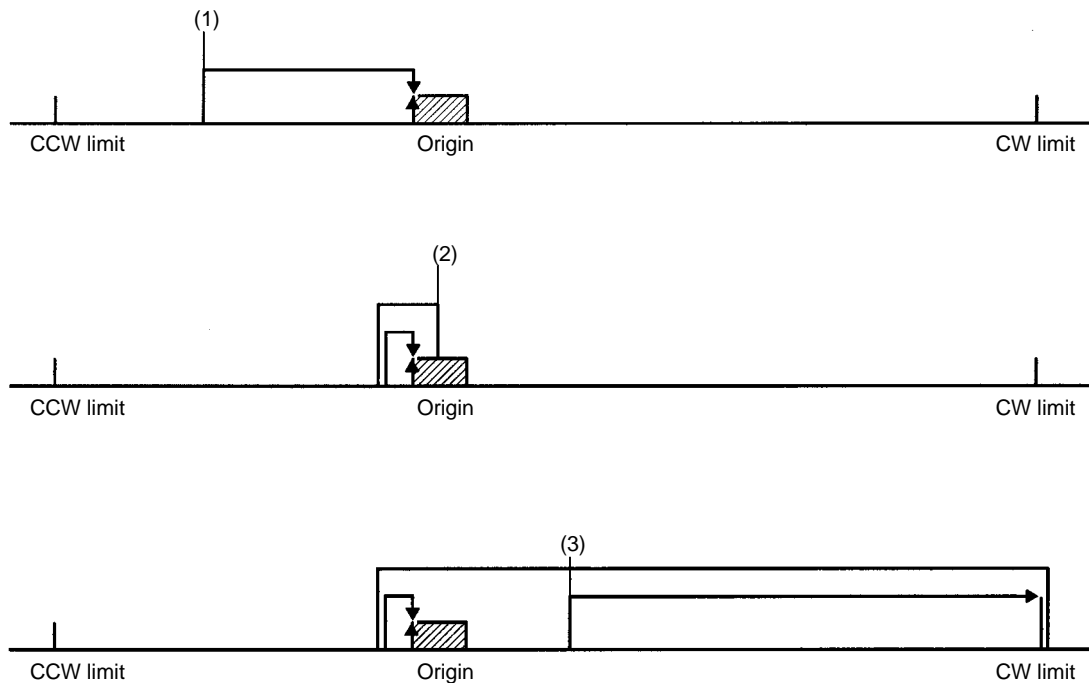
When the limits or proximity input are inverted for each pattern, the stop time is approximately 10 ms. The numbers (1, 2, and 3) in the origin search diagrams indicate operation start positions.

For example, the shaded areas indicate the rising edge of the origin proximity input.



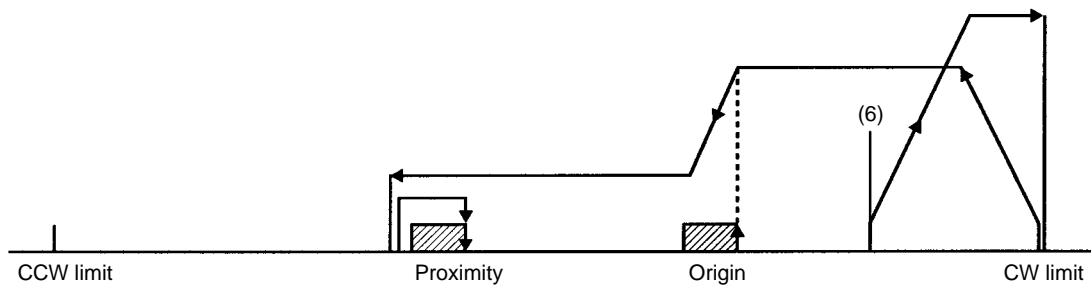
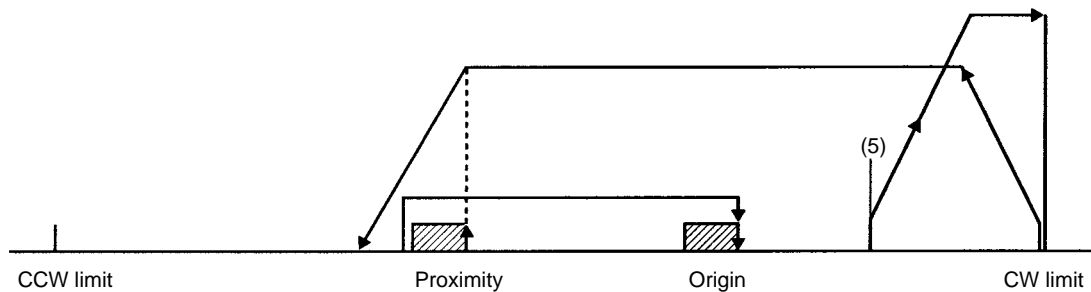
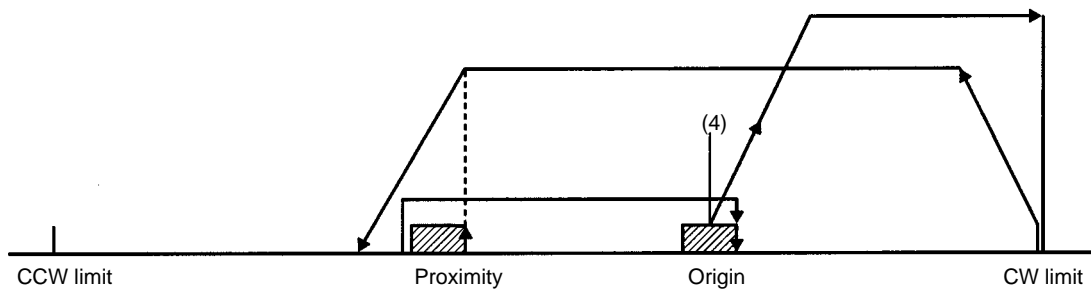
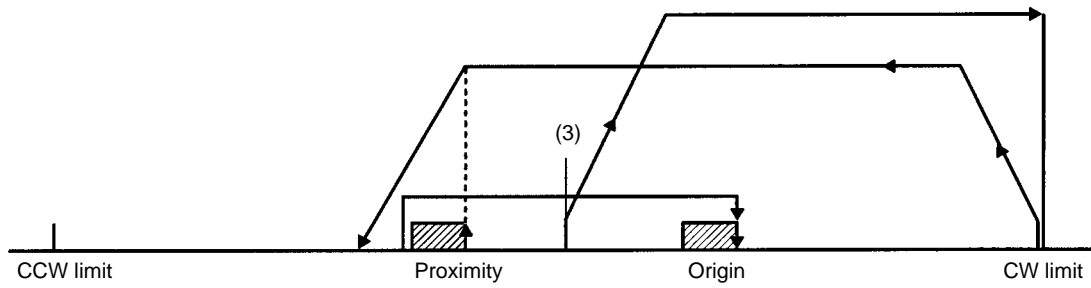
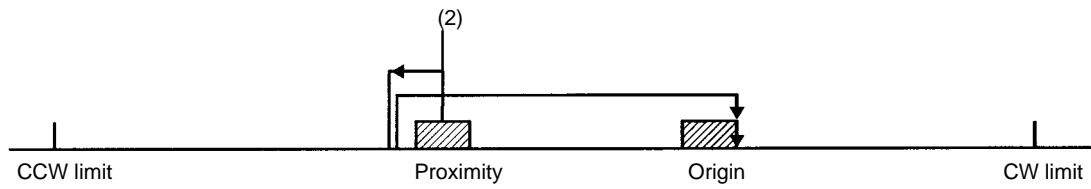
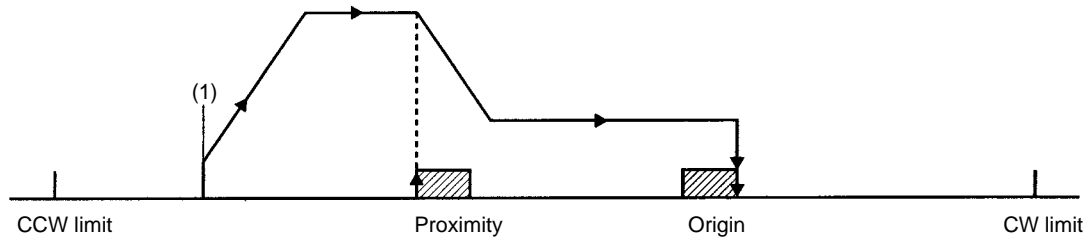
**Without an Origin Proximity Signal**

The presence or absence of an origin proximity signal is determined by the setting of the origin type in parameter addresses 2021 (X axis) and 6021 (Y axis). When the setting for no origin proximity is selected, the origin search is executed at the proximity speed.



**Search Pattern 1**

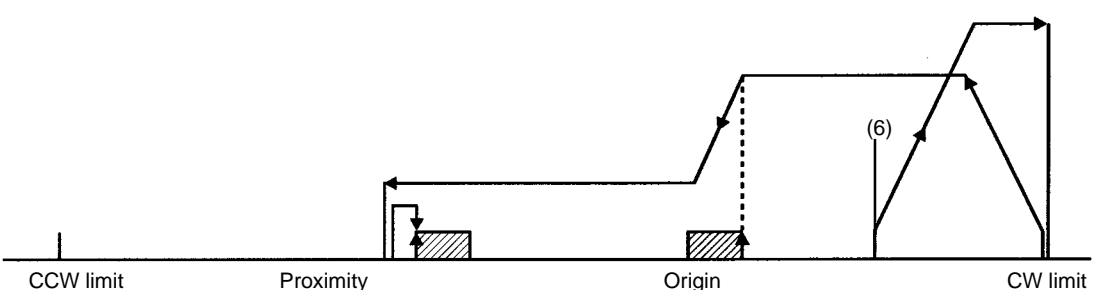
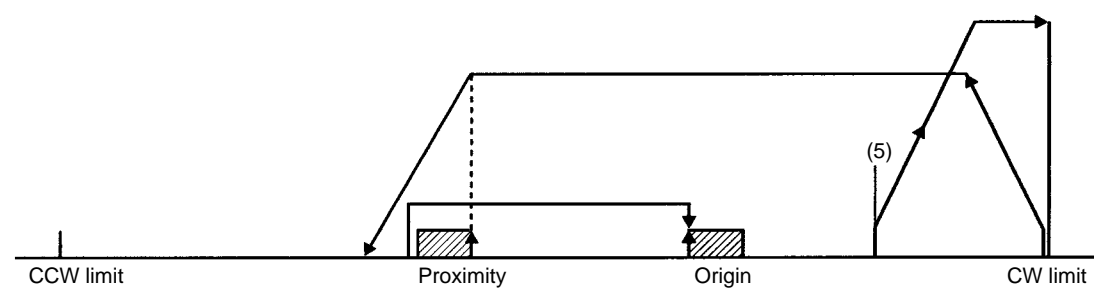
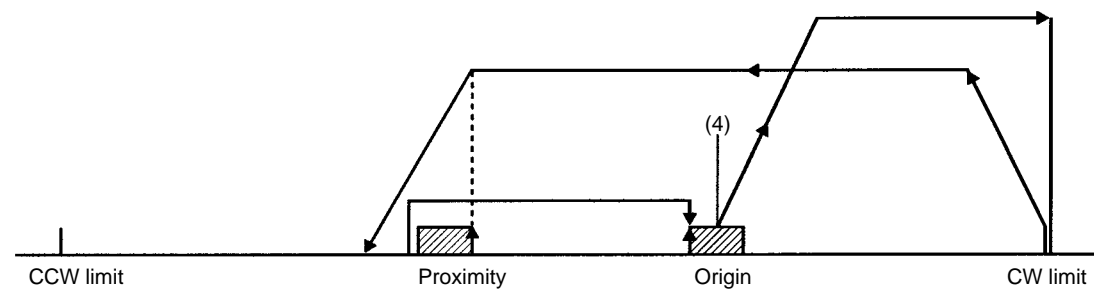
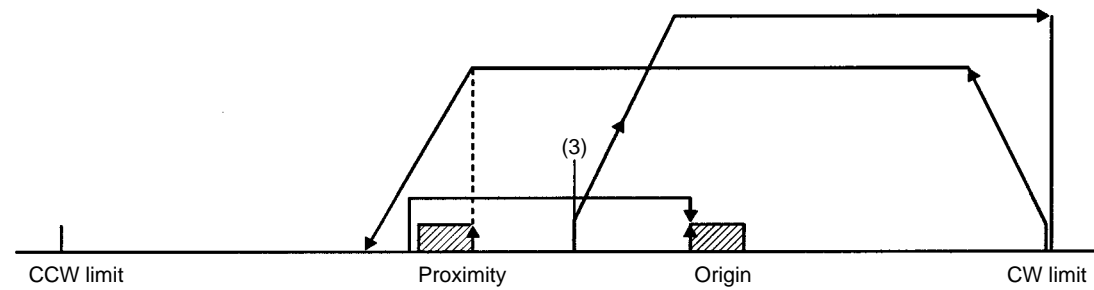
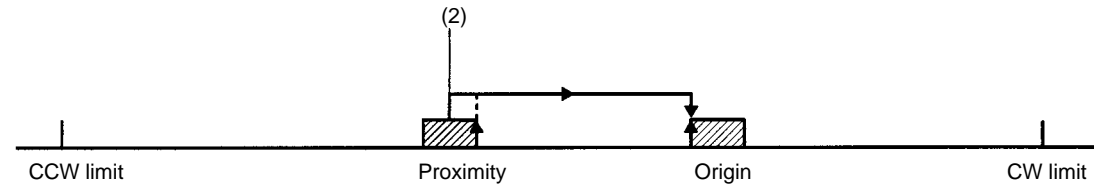
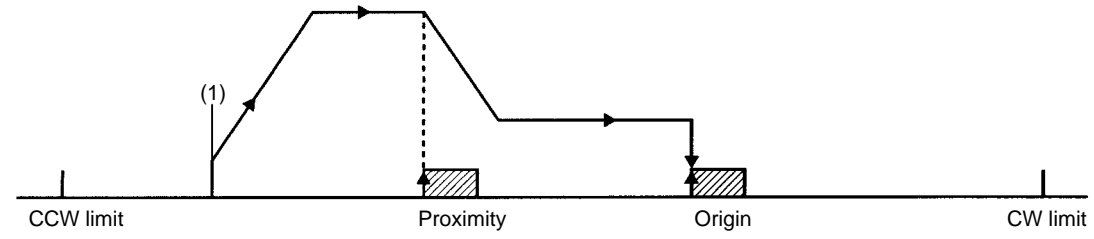
- 1, 2, 3...**
1. Origin proximity input: Rising edge ( $\uparrow$ ) or level
  2. Origin input: Falling edge ( $\downarrow$ )
  3. Search procedure: Ends on falling edge of origin input after rising edge of proximity input has been received. If the search is started at the origin proximity, then the direction of movement will be the reverse of the search direction.



**Note** With search pattern 1, just as with search pattern 0, the search will be completed with only the origin signal if the search is started at the origin.

### **Search Pattern 2**

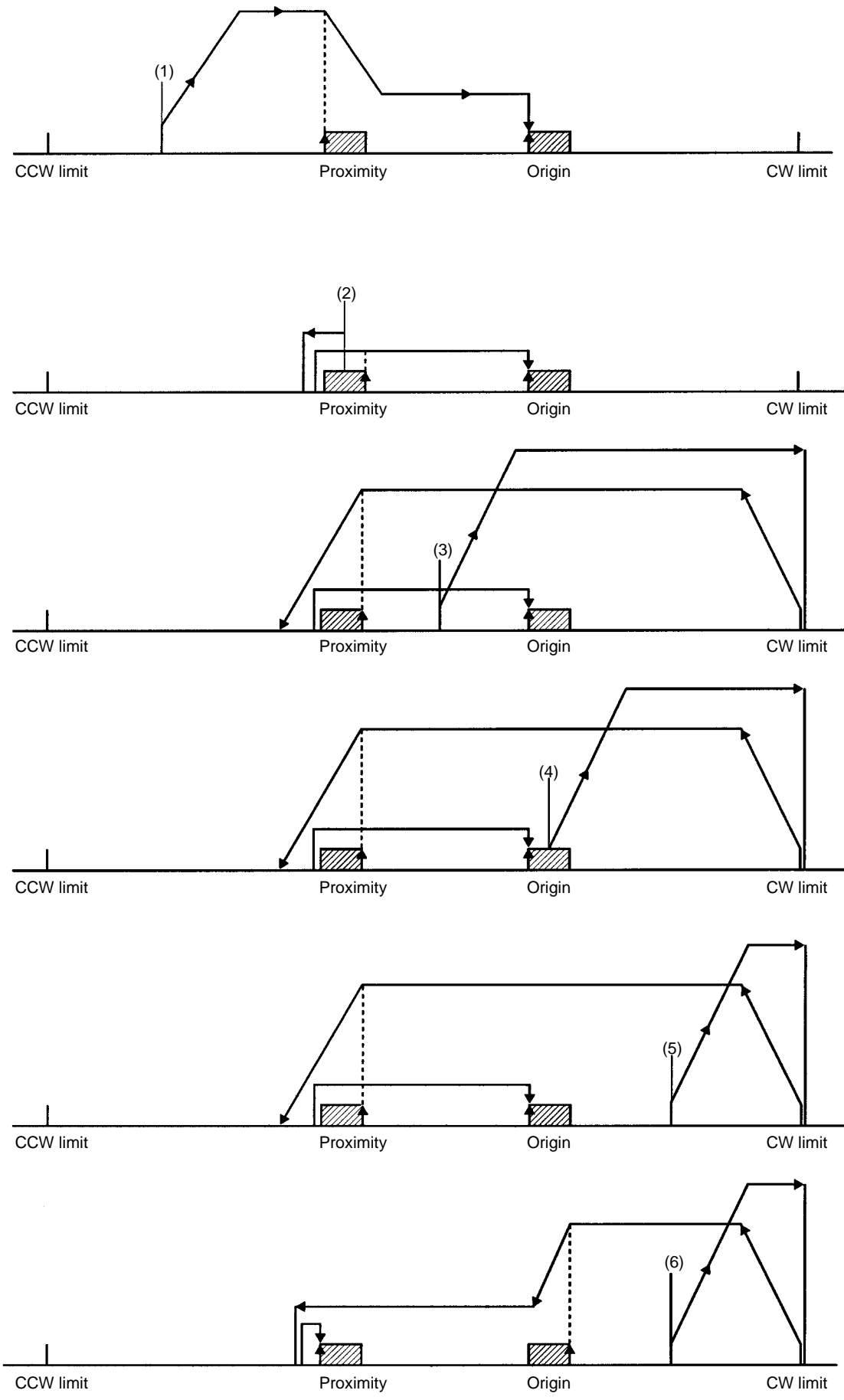
- 1, 2, 3...**
1. Origin proximity input: Rising edge ( $\uparrow$ ) or level
  2. Origin input: Rising edge ( $\uparrow$ )
  3. Search procedure: Ends on rising edge of origin input after rising edge of proximity input has been received.





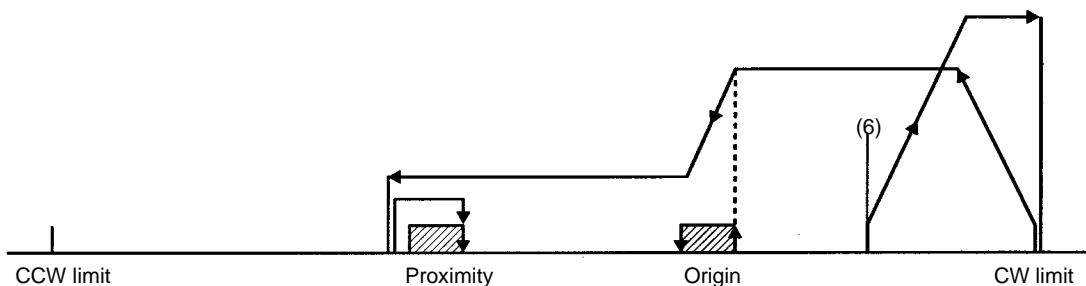
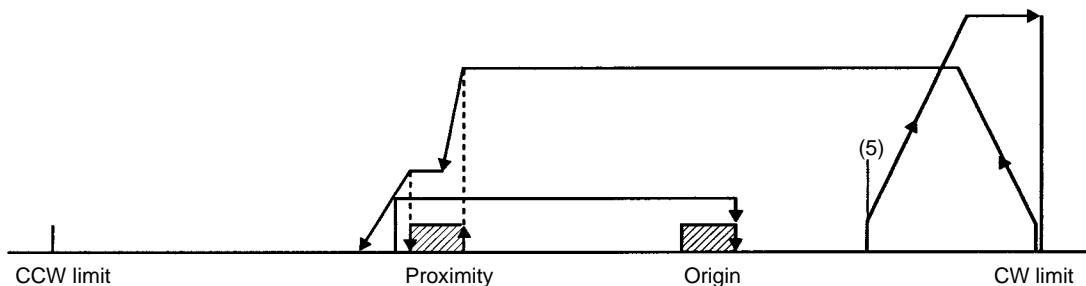
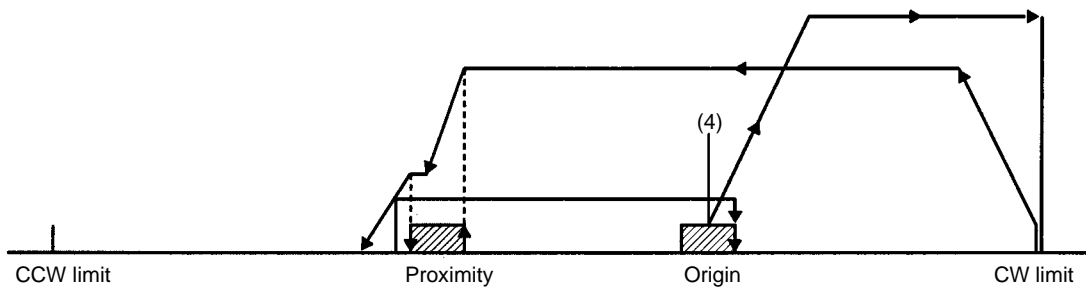
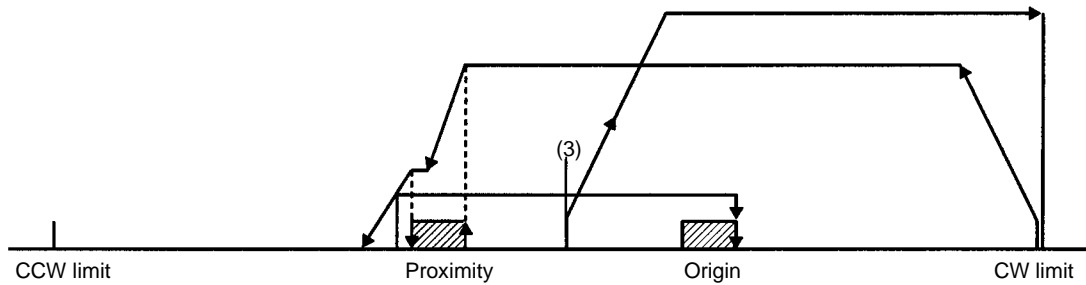
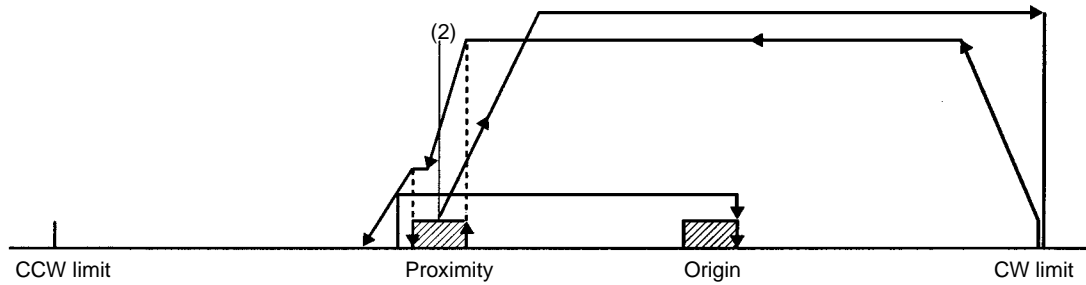
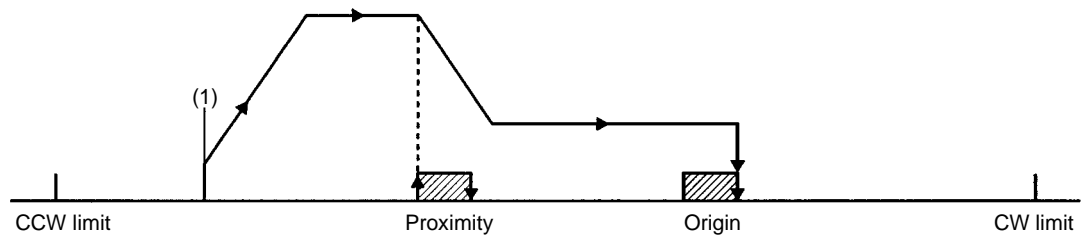
**Search Pattern 3**

- 1, 2, 3...**
1. Origin proximity input: Rising edge ( $\uparrow$ ) or level
  2. Origin input: Rising edge ( $\uparrow$ )
  3. Search procedure: Ends on rising edge of origin input after rising edge of proximity input has been received. If the search is started at the origin proximity, then the direction of movement will be the reverse of the search direction.



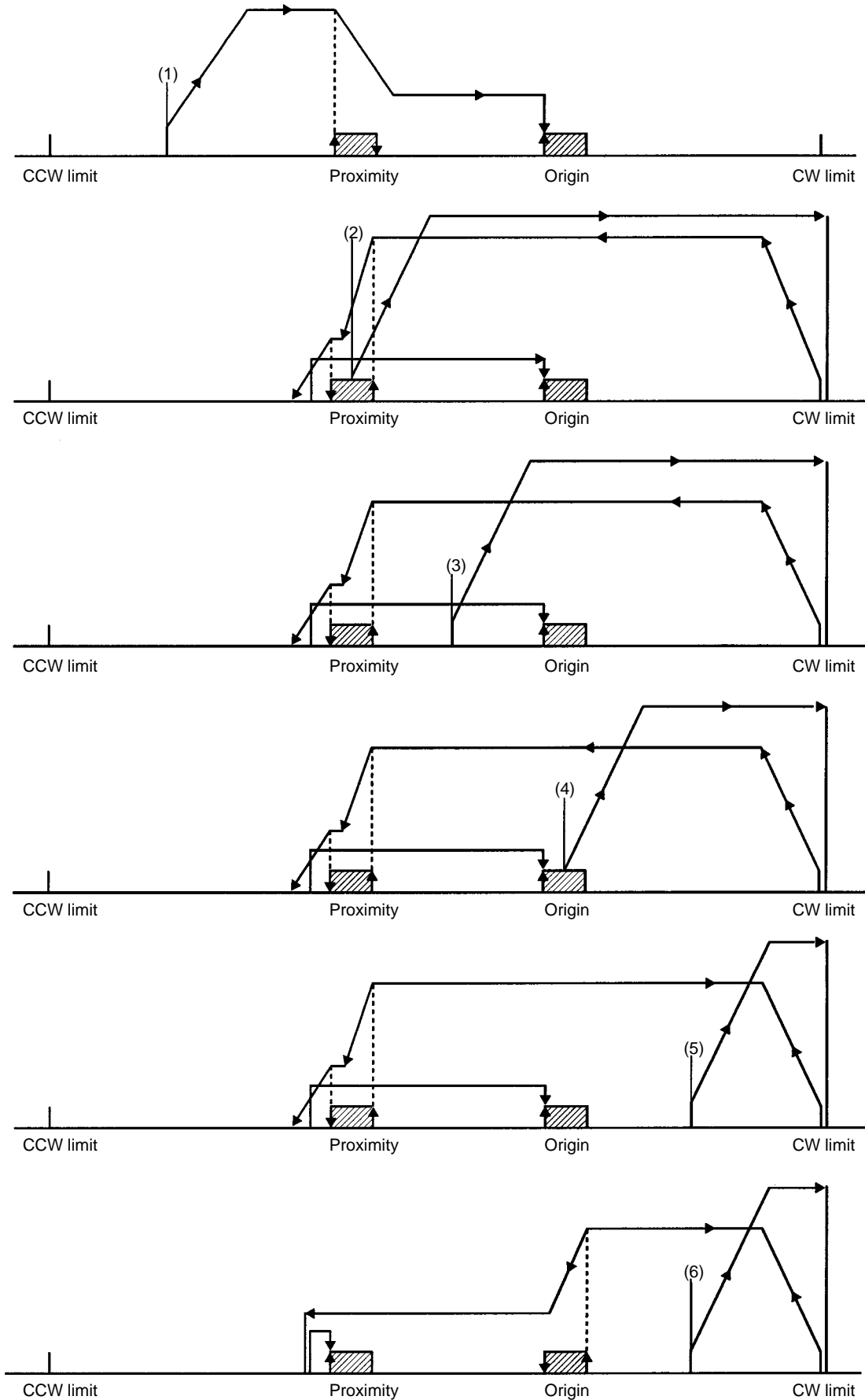
**Search Pattern 4**

- 1, 2, 3...**
1. ON  $\leftrightarrow$  OFF ( $\uparrow$ ,  $\downarrow$ )
  2. Falling edge, ( $\downarrow$ )
  3. Ends on falling edge of first origin input after proximity input ON/OFF.



**Search Pattern 5**

- 1, 2, 3...**
1. ON ← OFF (↑, ↓)
  2. Rising edge (↑)
  3. Ends on rising edge of first origin input after proximity input ON/OFF.

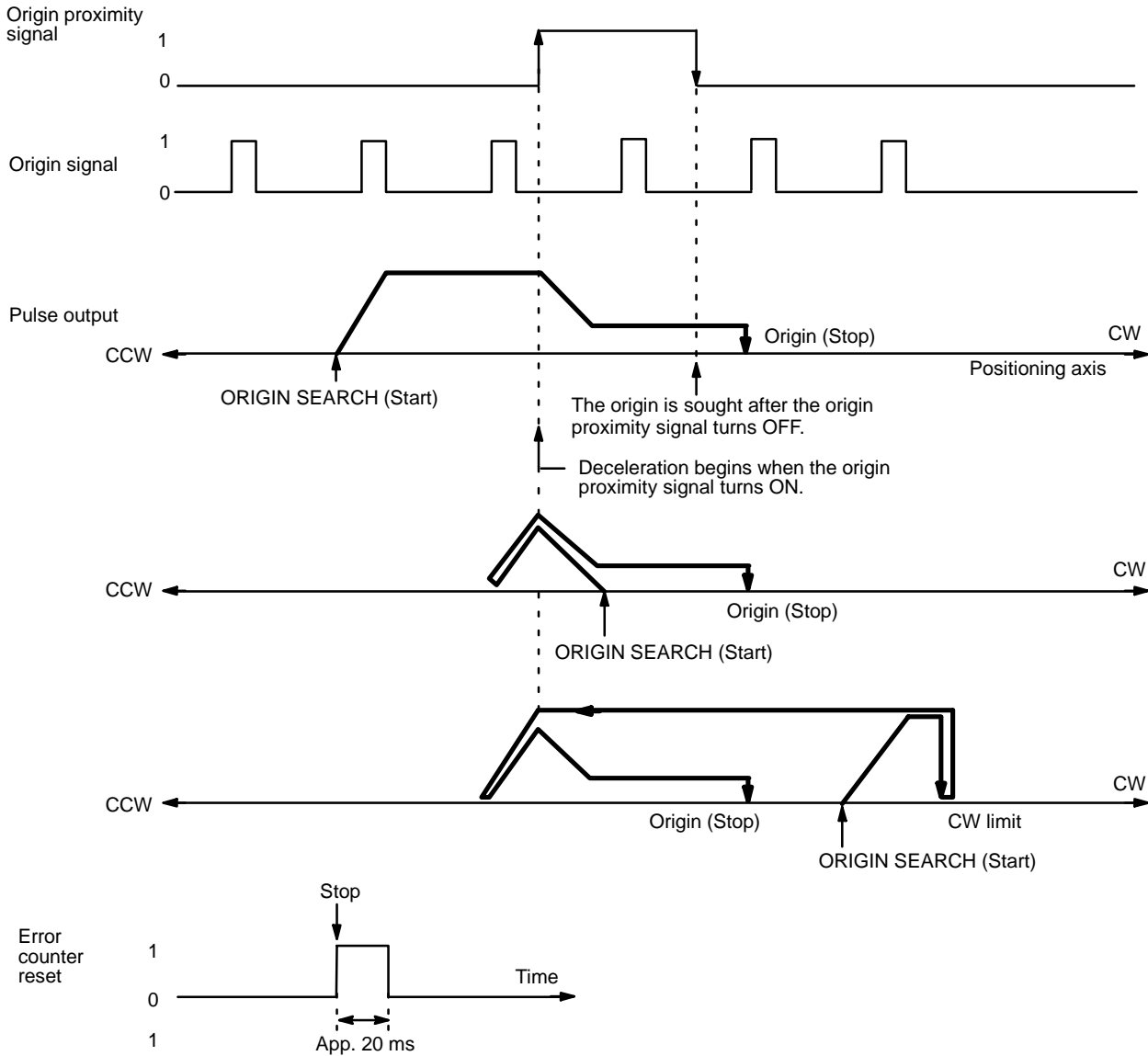


**Mode 1**

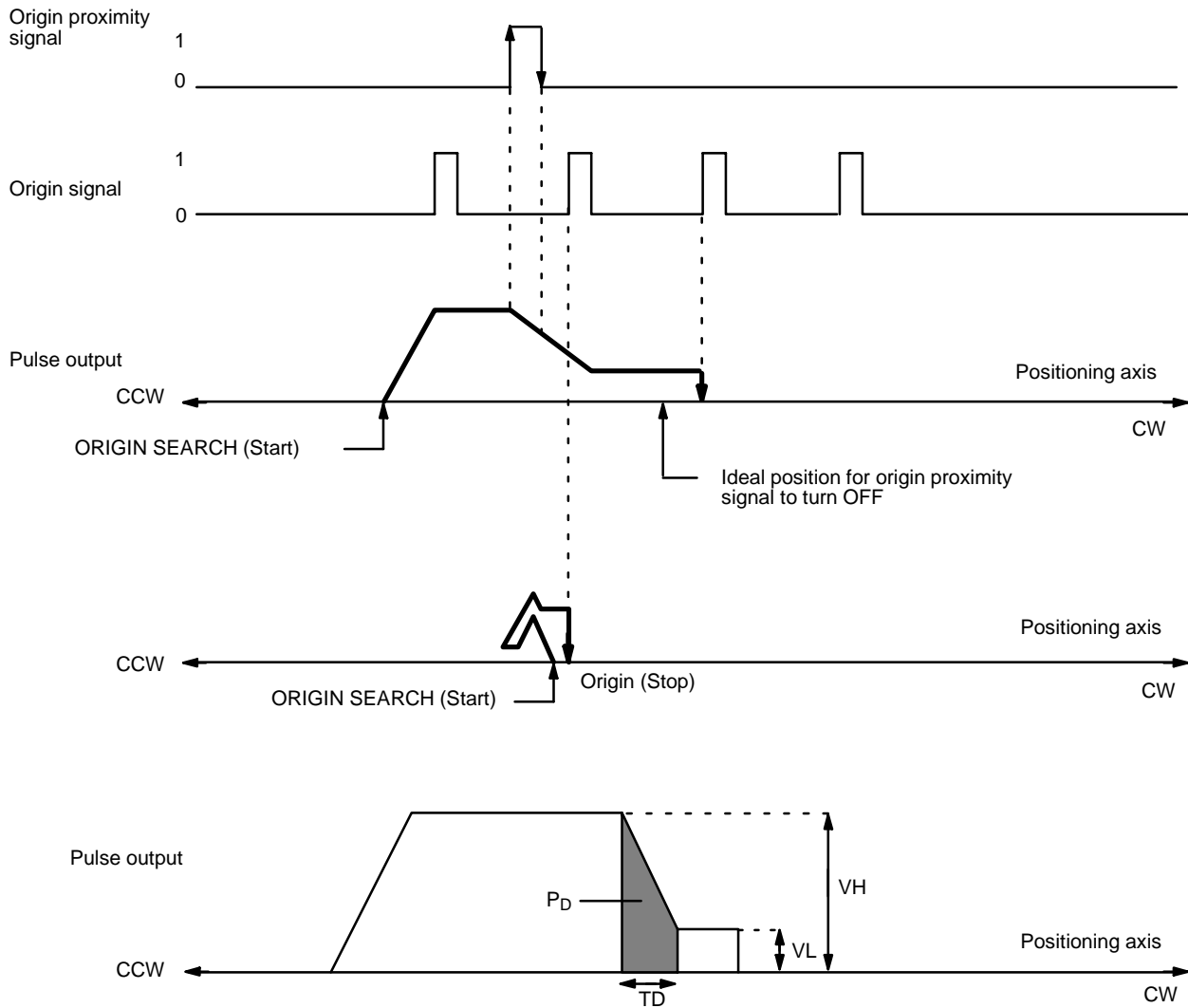
The origin response time is 0.1 ms. Connect the encoder's Z-phase signal to inputs 9 and 11 for the X axis, and to inputs 31 and 33 for Y axis. Be sure to use the proximity signal. Also refer to the wiring information in *Section 3 Wiring*.

**When Origin Proximity Reverse is Enabled**

Use the origin proximity signal to ensure sufficient deceleration time when origin proximity reverse is needed. Bit 01 (proximity signal) and 04 (proximity reverse) of addresses 2021 (X axis) and 6021 (Y axis) are ON.



In this mode, if deceleration has not ended when the origin proximity signal has turned OFF, positioning is stopped by the origin signal input after deceleration has ended. If the deceleration period is short for some reason (such as starting inside the origin proximity area), the Position Control Unit will detect another origin signal. Therefore, be sure that the origin proximity signal period is long enough, i.e., at least as long as the deceleration period.



A general method for calculating the number of pulses within the deceleration interval is presented below.

Deceleration time  $T_D = (V_H - V_L) / 1000 \times R$ ,  
 where R: deceleration data (pps/1 ms);

Number of pulses  $P_D$  for deceleration period =  $(V_H + V_L) \times T_D / 2$   
 =  $(V_H^2 - V_L^2) / 2000 \times R$ .

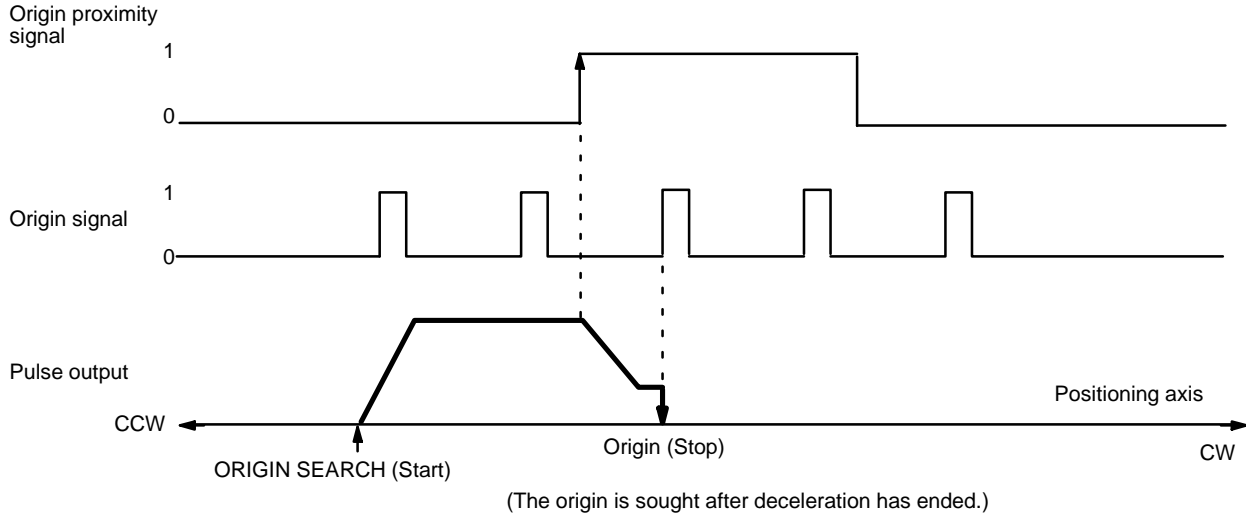
If  $V_H = 20000$  pps,  $V_L = 1000$  pps, and  $R = 1000$  pps/ms,  
 then  $P_D = (20000^2 - 1000^2) / 2000 \times 100 = 1995$ .

Therefore, approximately 2,000 pulses are required for deceleration.

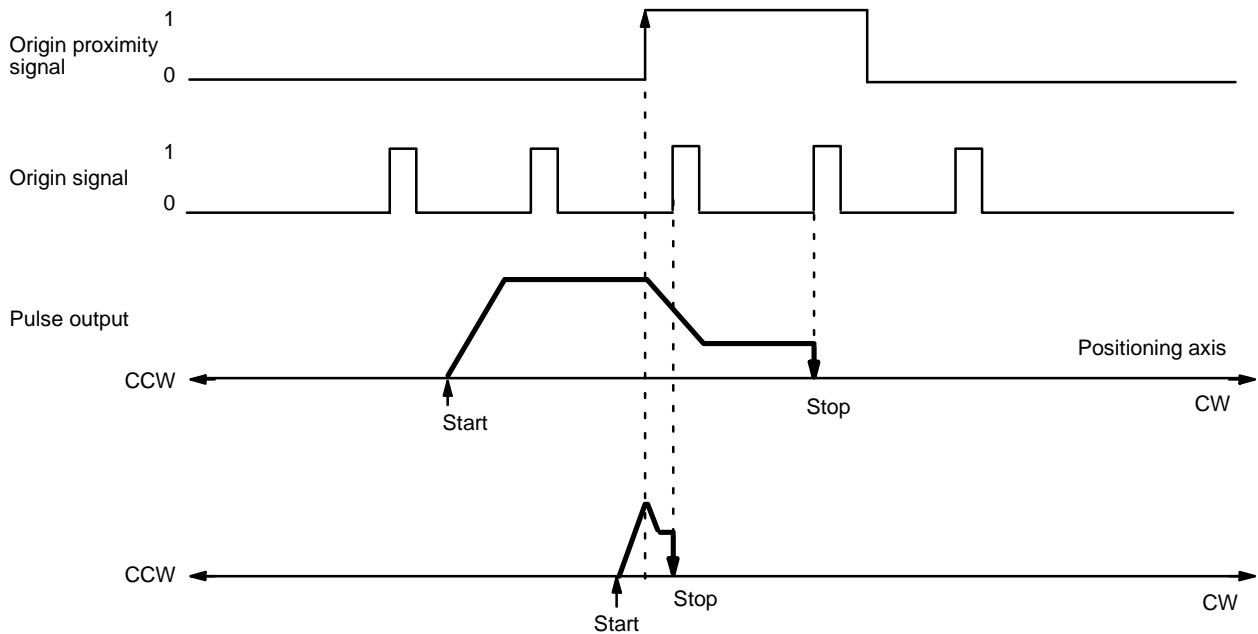


**When Origin Proximity Reverse is Disabled**

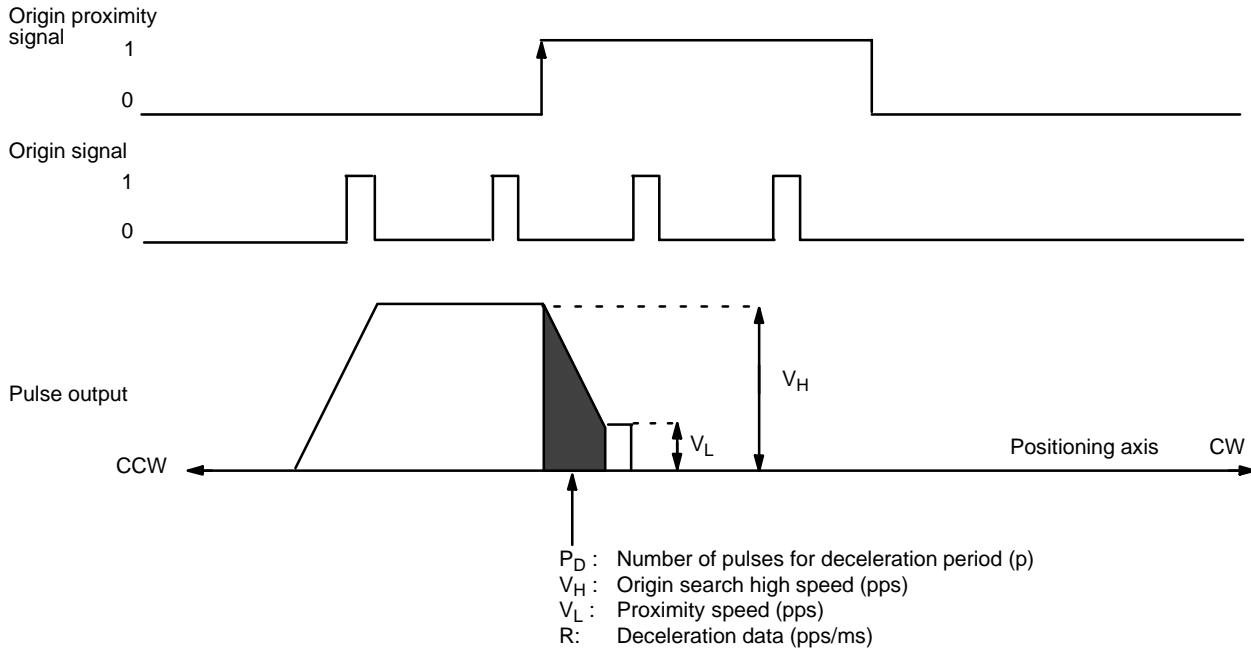
In this example, origin proximity reverse is not used. Positioning stops when the first origin signal is input after deceleration has ended. Bit 01 (proximity signal) and 04 (proximity reverse) of addresses 2021 (X axis) and 6021 (Y axis) are ON and OFF respectively.



Note that when there is an origin signal during deceleration, the stop position depends on the length of the deceleration interval. This is because positioning stops with the first origin signal input after the completion of deceleration.



As in this example diagram, complete the deceleration from origin search high speed to proximity speed (low speed) in the period between the origin proximity signal and the first origin signal.

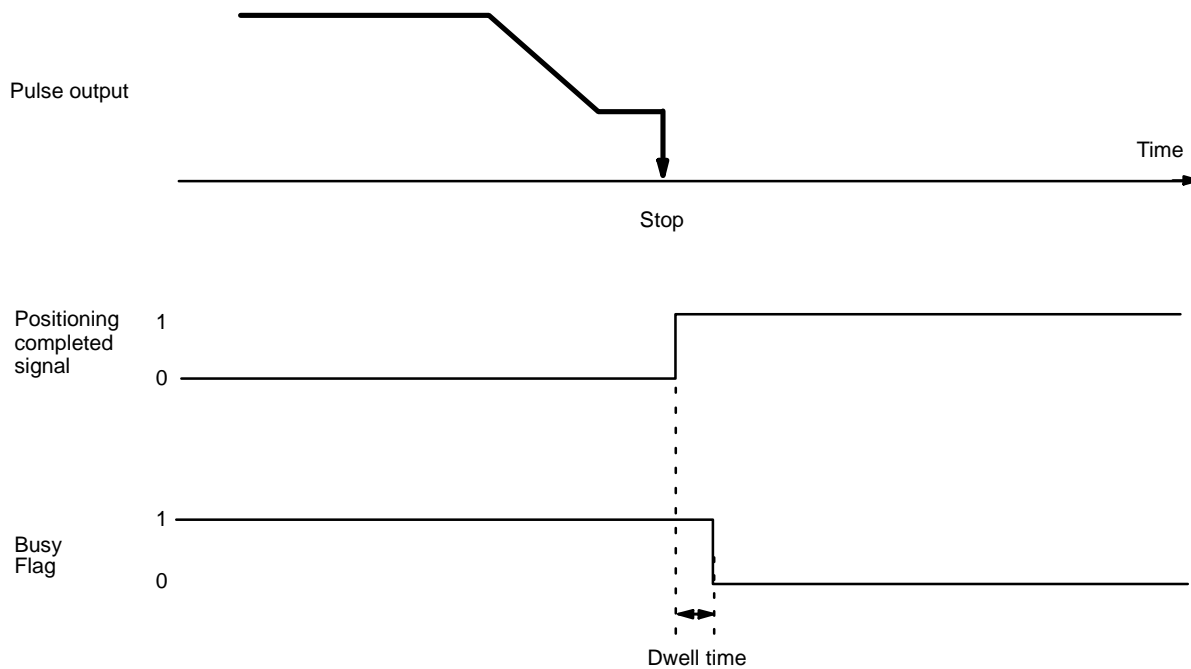


$$P_D = [(V_H + V_L) \times (V_H - V_L/1000 \times R)]/2 = (V_H^2 - V_L^2/2000 \times R)$$

Set the values of  $V_H$  and  $R$ , using this expression, so that the value of  $P_D$  falls within the range shown in the above figure (from when the proximity signal turns ON until the origin signal turns ON).

**Mode 2**

This mode is similar to Mode 1, but the servomotor driver positioning completed signal is also used. For the connection of this signal, refer to *Section 3 Wiring*. When the positioning completed signal is input, the Busy Flag turns OFF. The Busy Flag extends if there is a dwell time.

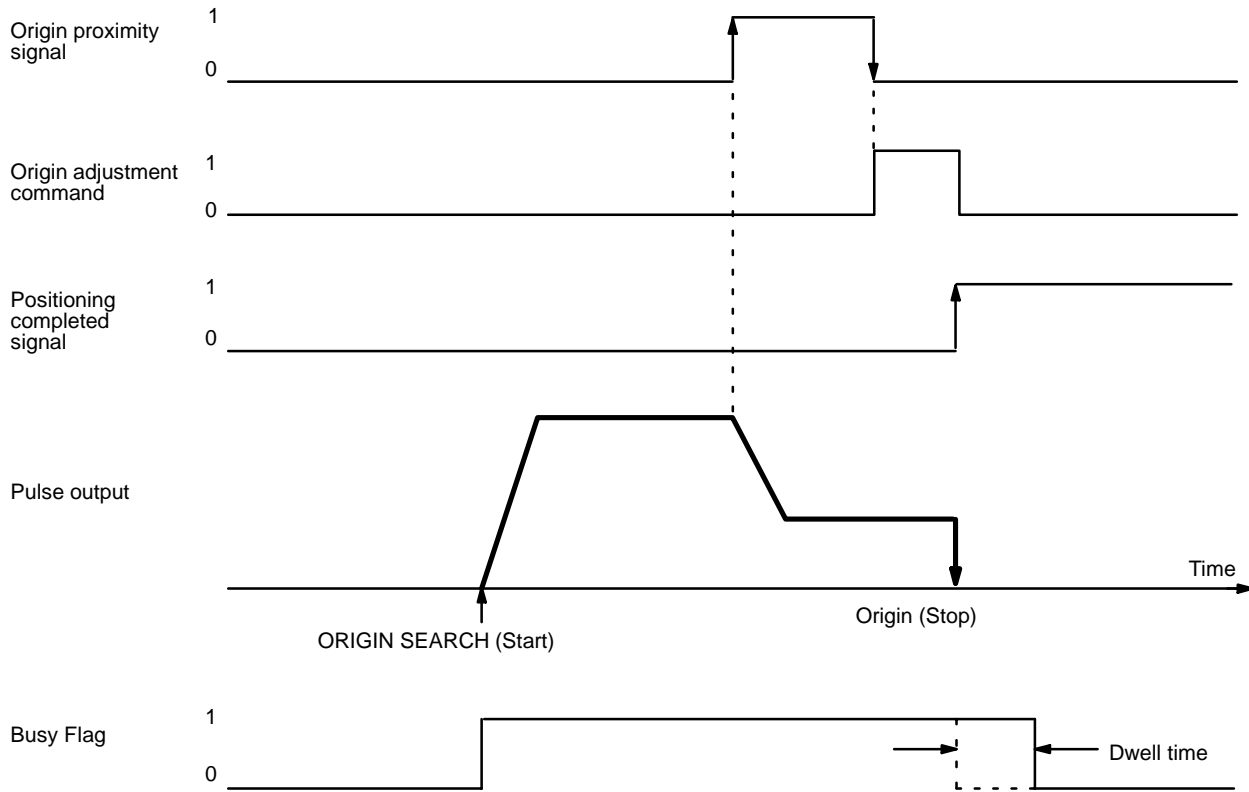


**Mode 3**

Mode 3 makes use of the origin adjustment functions of OMRON Servomotor Driver R88D-H. The servomotor's positioning completed signal (INP) is used as the origin search completion signal. Do not use an origin, Z-phase, or error counter reset signal.

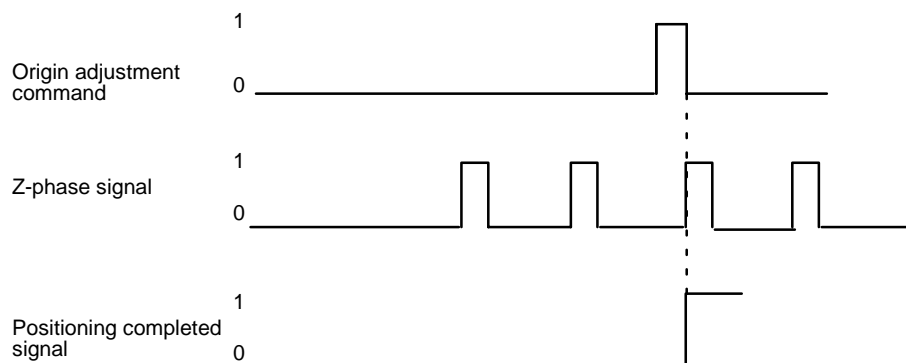
**When Origin Proximity Reverse is Enabled**

Use the origin proximity signal to ensure sufficient deceleration time when origin proximity reverse is needed. Bit 01 (proximity signal) and 04 (proximity reverse) of addresses 2021 (X axis) and 6021 (Y axis) are ON.



When the servomotor driver receives the origin adjustment command (H.RET) from the Position Control Unit, the error counter of the servomotor driver is internally reset by the Z-phase signal (which is output by the encoder) and the servomotor driver stops.

Servomotor Driver Processing:

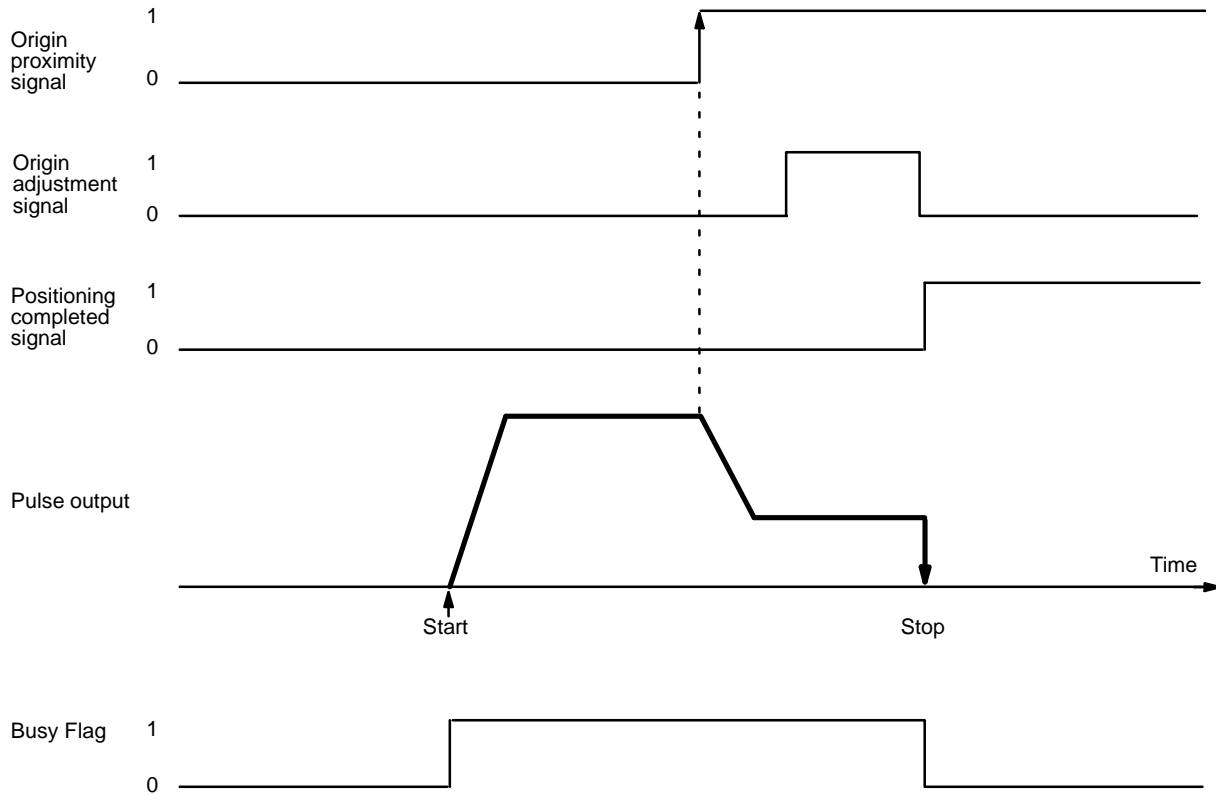


The point at which positioning stops is the same as in modes 1 and 2. There are some differences in operation depending on the starting position for ORIGIN SEARCH. For details, refer to the examples under Mode 1.

Refer also to the examples under Mode 1 for certain precautions concerning the length of the origin proximity signal. In mode 3, if deceleration has not ended by the time the origin proximity signal has turned OFF, the origin adjustment signal is output when deceleration ends.

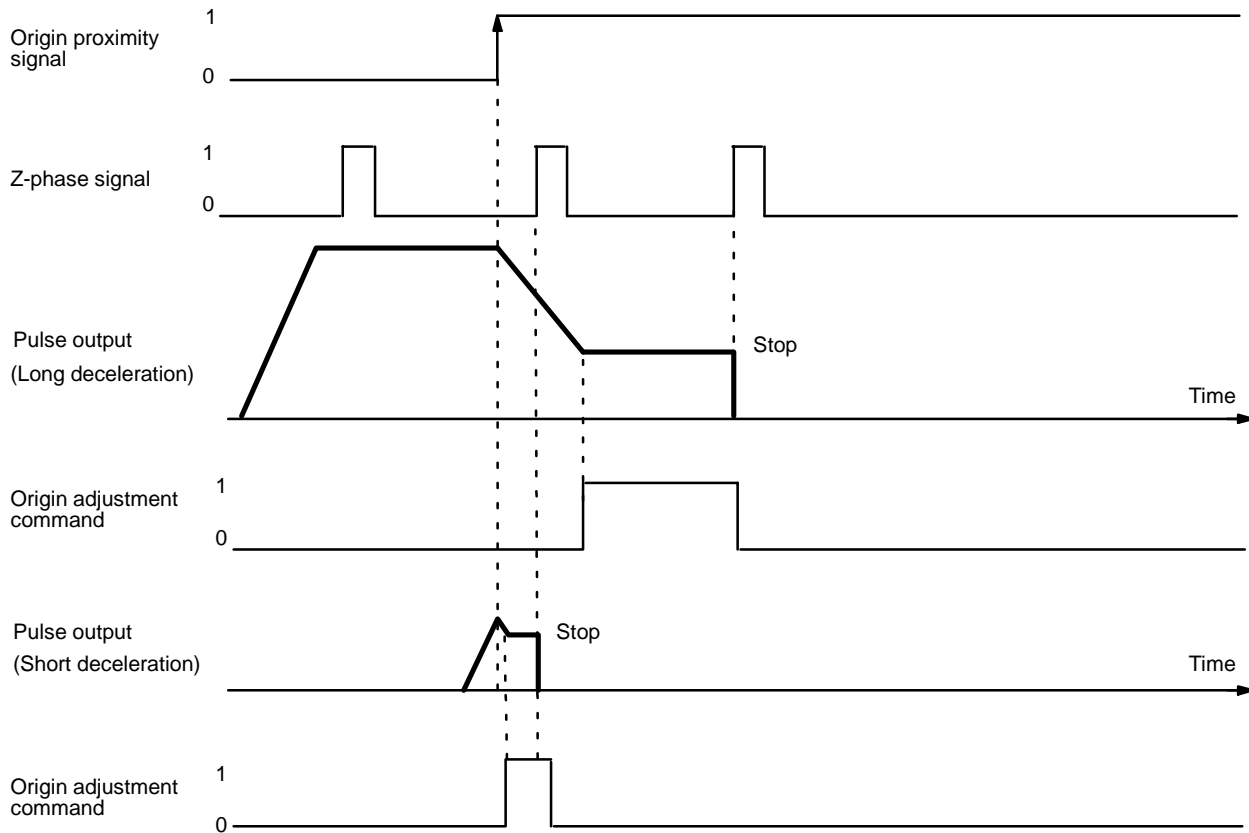
**When Origin Proximity Reverse is Disabled**

In this example, origin proximity reverse is not used. The origin adjustment command is output after deceleration has ended. Bit 01 (proximity signal) and 04 (proximity reverse) of addresses 2021 (X axis) and 6021 (Y axis) are ON and OFF respectively.



If the Z-phase signal is input from the encoder during deceleration, the point at which positioning is stopped differs depending on the length of the deceleration period.

For details on calculating the number of pulses during deceleration, refer to Mode 1, *When Origin Proximity Reverse is Disabled*.

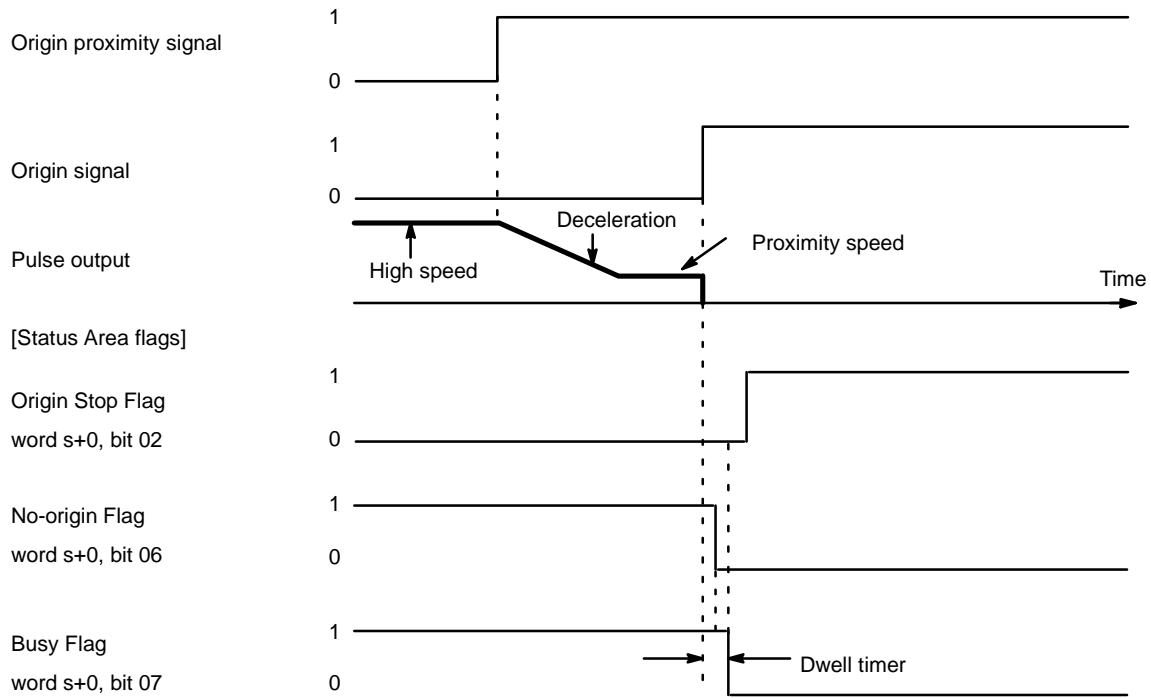


### 9-3-4 ORIGIN SEARCH Completion Examples

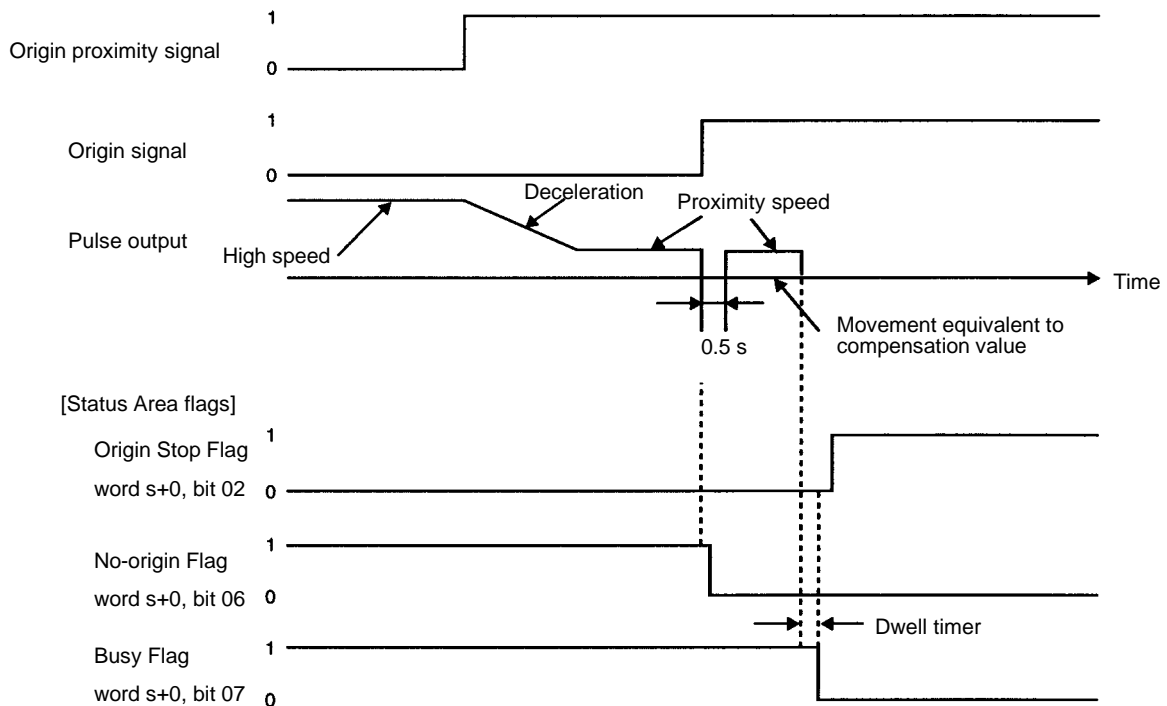
#### With an Origin Proximity Signal

The following two example diagrams both illustrate completion of ORIGIN SEARCH when an origin proximity signal is present. There is an origin compensation value set in the second example, but not in the first. Bit 01 (proximity signal) of addresses 2021 (X axis) and 6021 (Y axis) is ON.

**Example 1: Without Origin Compensation**



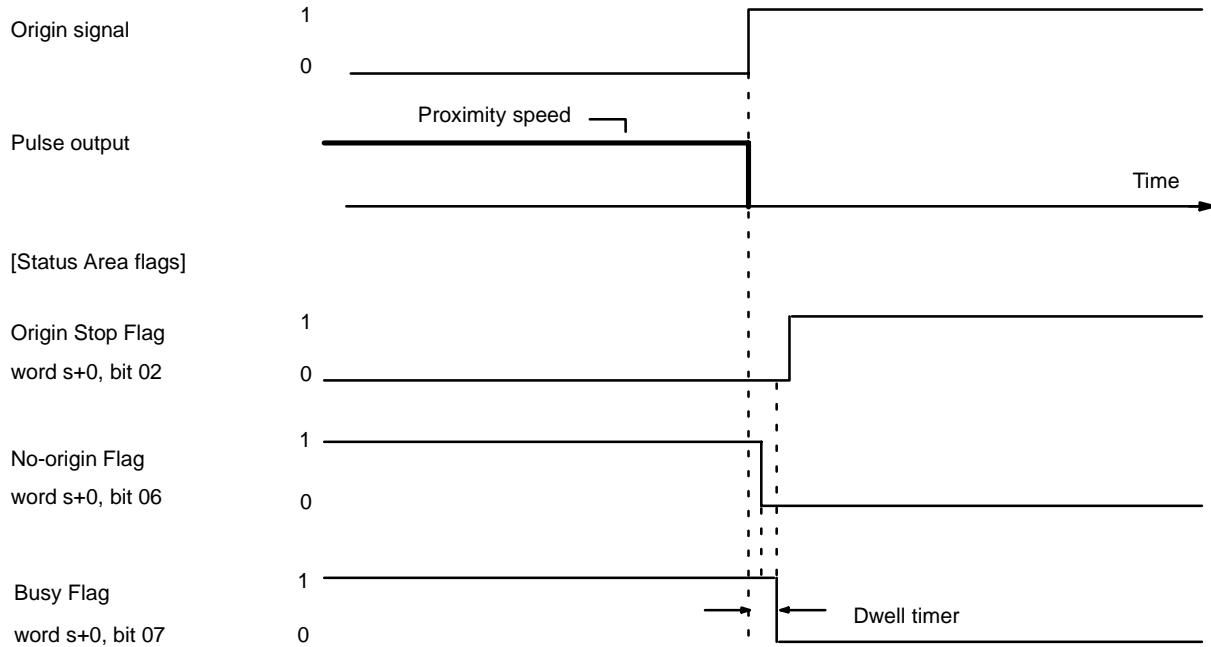
**Example 2: With Origin Compensation**



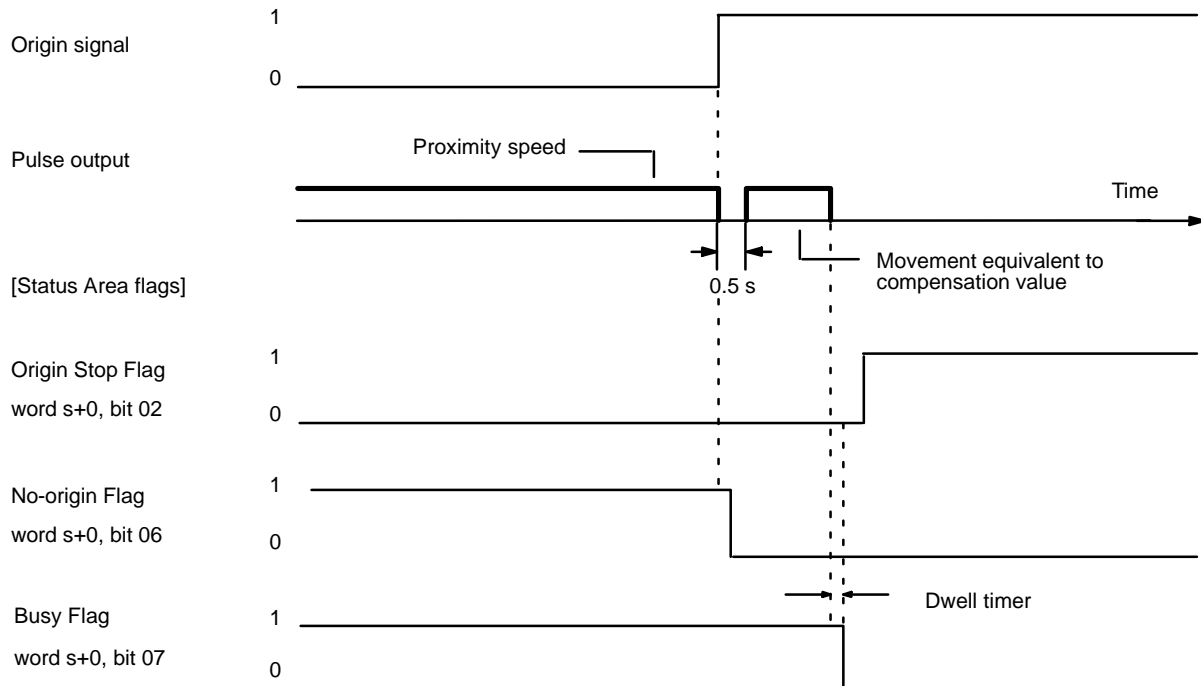
**Without an Origin Proximity Signal**

The following two example diagrams both illustrate completion of ORIGIN SEARCH when no origin proximity signal is present. There is an origin compensation value set in the second example, but not in the first. Bit 01 (proximity signal) of addresses 2021 (X axis) and 6021 (Y axis) is OFF.

**Example 1: Without Origin Compensation**



**Example 2: With Origin Compensation**

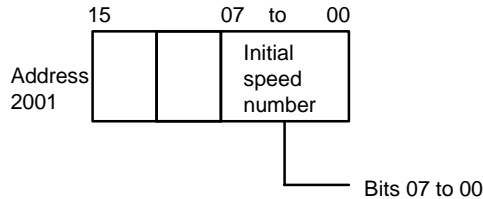


## 9-4 ORIGIN RETURN

The ORIGIN RETURN command returns positioning to the origin. Although the settings are explained here in terms of the X axis, the procedures are the same for the Y axis of the NC211.

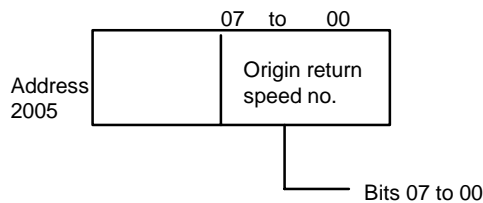
### 9-4-1 Data Settings

#### Initial Speed Number (X Axis: 2001; Y Axis: 6001)

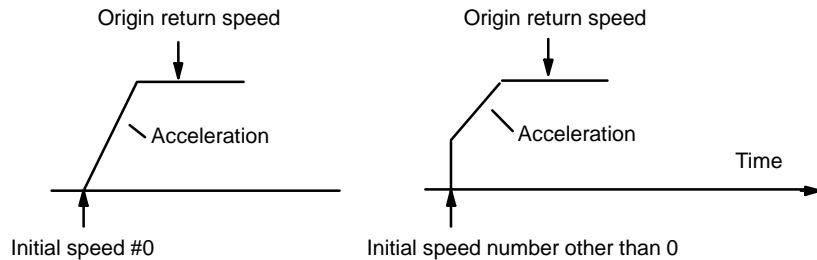


- Set the initial speed number (bits 07 to 00) from 0 to 49.
- Speed addresses 4000 to 4049 (for the X axis) are referenced according to this setting.

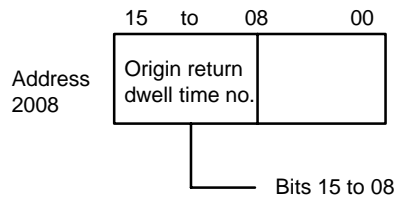
#### Origin Return Speed Number (X Axis: 2005; Y Axis: 6005)



- Set the origin return speed number (bits 07 to 00) from 0 to 49.
- Speed addresses 4000 to 4049 (for the X axis) are referenced according to this setting.



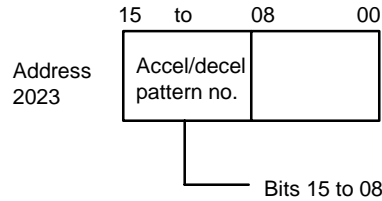
#### Origin Return Dwell Time Number (X Axis: 2008; Y Axis: 6008)



- Set the dwell time number (bits 15 to 08) from 0 to 29 (BCD).
- Dwell time addresses 9000 to 9029 are referenced according to this setting.
- When the dwell time elapses after an origin return operation is completed, the Busy Flag turns OFF and the next operation can be executed.

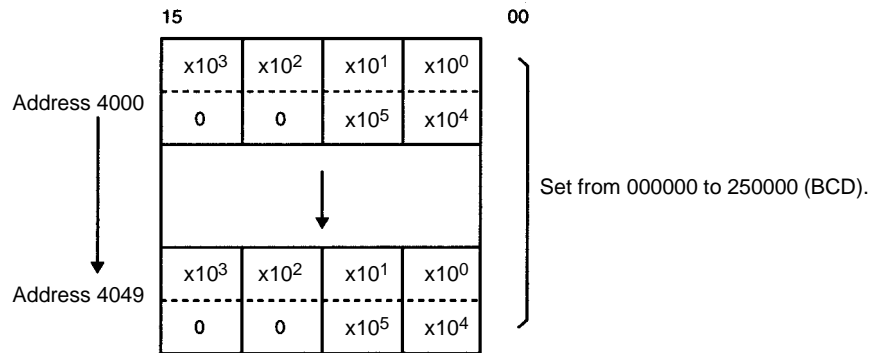


**Origin Return Acceleration/Deceleration Pattern Number (X Axis: 2023; Y Axis: 6023)**

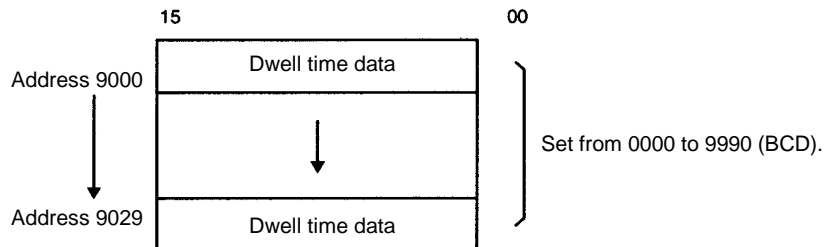


- Set the origin return acceleration/deceleration pattern number from 0 to 99.
- Origin return acceleration/deceleration pattern addresses 3000 to 3099 (X axis) are referenced according to this setting.

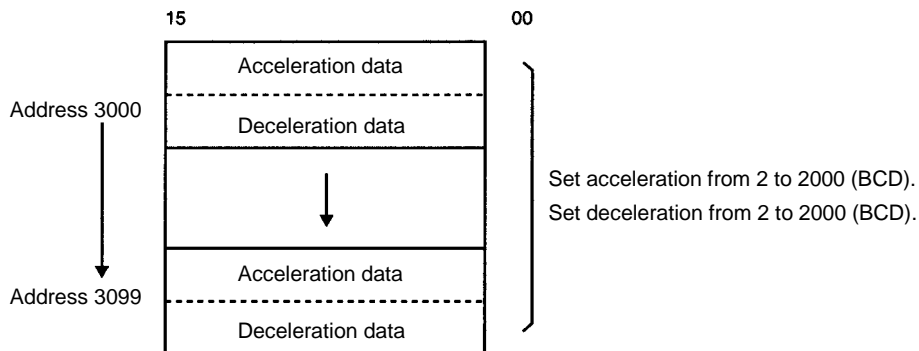
**Speeds (X Axis: 4000 to 4049; Y Axis: 8000 to 8049)**



**Dwell Times (X/Y Axes Together: 9000 to 9029)**



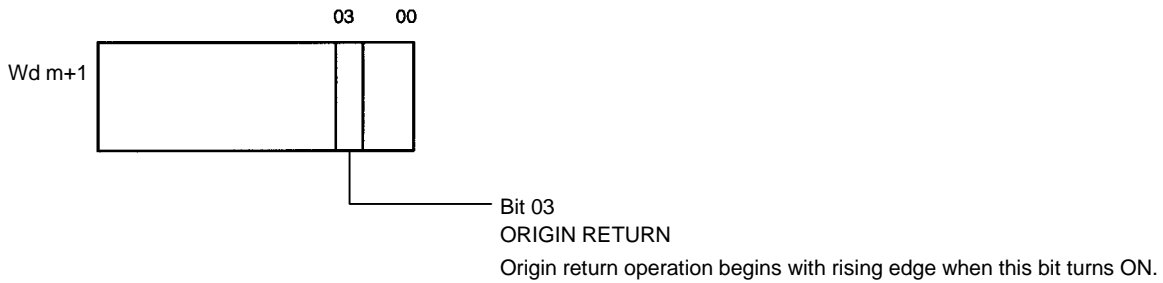
**Acceleration/Deceleration Settings (X Axis: 3000 to 3099; Y Axis: 7000 to 7099)**



The acceleration and deceleration indicate the increase or decrease per ms of speed (pps: pulses/second).

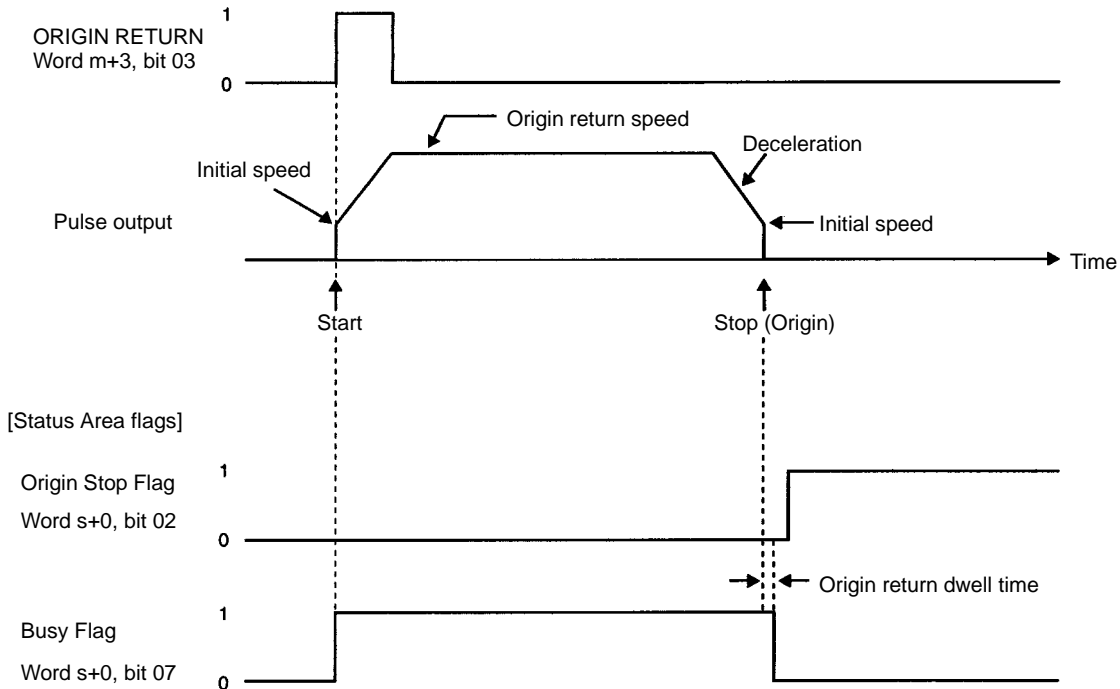
### 9-4-2 Command Settings

ORIGIN RETURN (Word m+1/m+5, bit 03) (X/Y axis)



### 9-4-3 Executing ORIGIN RETURN

Origin return operations can only be performed when the origin position has already been established. If the origin position has not been established, a 5040 error (unknown present position) occurs. When the ORIGIN RETURN command is executed, the axis is returned to the origin in an automatic trapezoidal acceleration/deceleration pattern.



The above diagram shows the operation when the origin search mode is set to 0 or 1. When the mode is set to 2 or 3 after the position completed signal from the servomotor driver turns ON, the Busy Flag turns OFF when the dwell time elapses.

## 9-5 RELEASE PROHIBIT

### 9-5-1 Operation

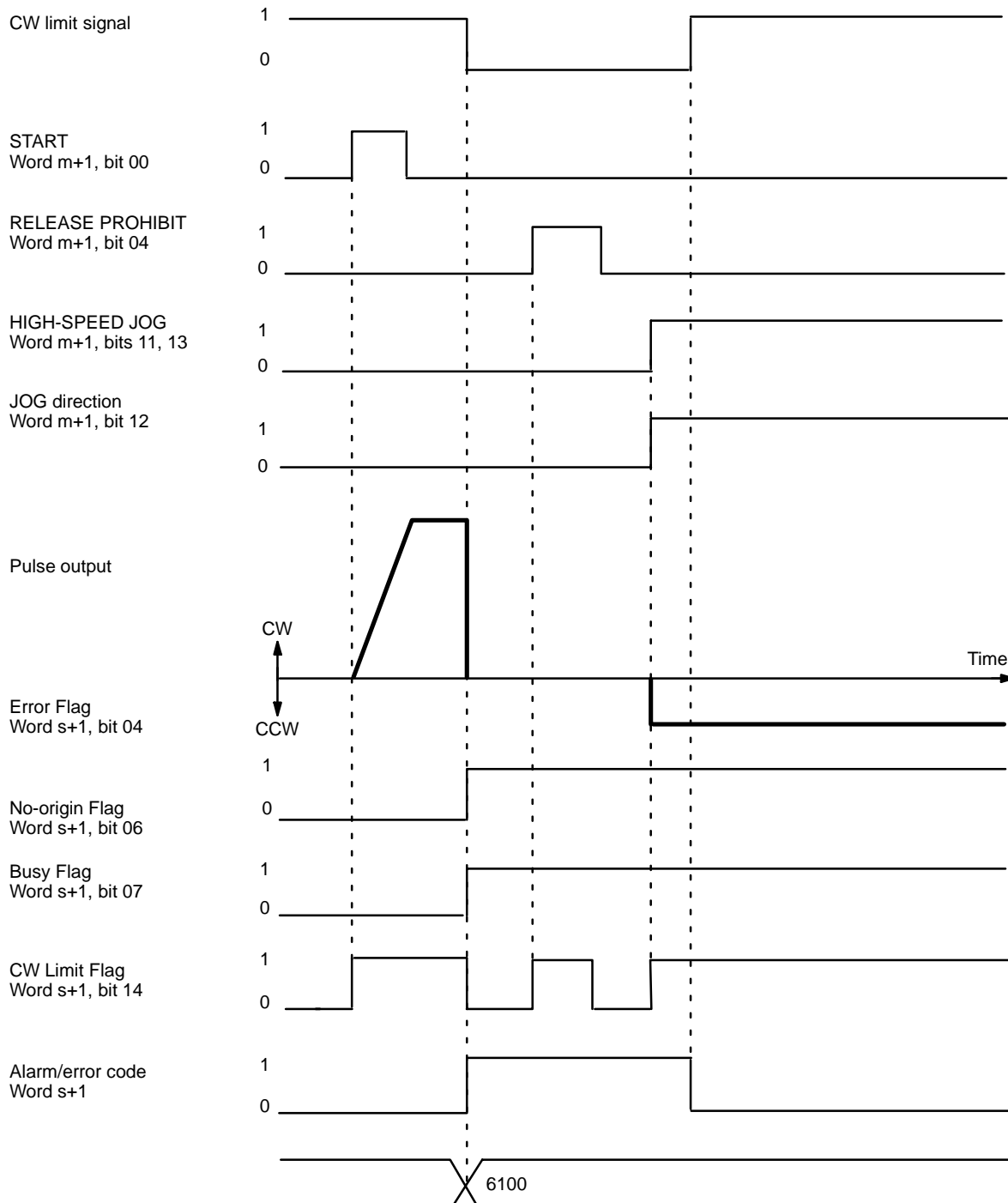
When Position Control Unit operation is stopped as a result of input of an emergency stop, CW limit, or CCW limit signal, (i.e., when the N.C. input of any of these turns OFF), further pulse output is prohibited. In order to resume pulse output, it is necessary to cancel this prohibition by means of the RELEASE PROHIBIT command bit (bit 04 of word m+1/m+5) and release of the external emergency stop switch.

After the pulse prohibition has been released, the current position will not be known (i.e., no origin), so it will be necessary to execute an origin search before positioning can be resumed. Once the origin search has been executed, the Error Flag will turn OFF.

### 9-5-2 Executing RELEASE PROHIBIT

Although the operation is explained here in terms of the X axis, the operation is the same for the Y axis of the NC211.

#### Example: Exceeding CW Limit



If the CW or CCW limit is exceeded, pulse output is possible in only the opposite direction even after the pulse prohibition has been released. The CW limit is exceeded here, so only CCW output is possible. The error code and Error Flag are not cleared. This example uses JOG to clear the Limit Flag, but ORIGIN SEARCH may also be used.

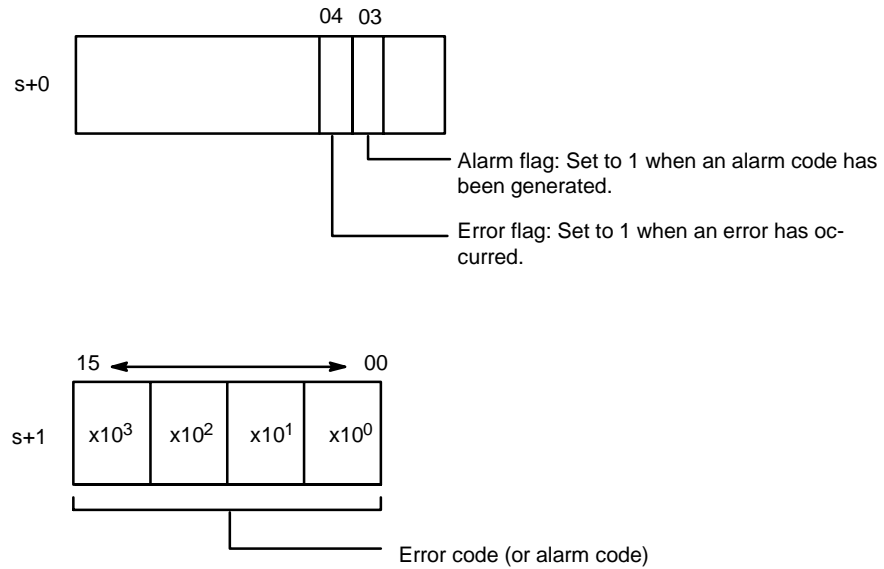
## 9-6 READ ERROR

The READ ERROR command bit, bit 05 of word m+1, is set to access error and alarm codes when more than one of these is present (effective on the signal's rising edge). Although the operation is explained here in terms of the X axis, the operation is the same for the Y axis of the NC211.

### Error and Alarm Generation

#### Flags and Error Codes

Error flags, alarm flags, and error (or alarm) codes are indicated in the Status Area (X axis: words s+0 to s+1; Y axis words s+8 to s+9).

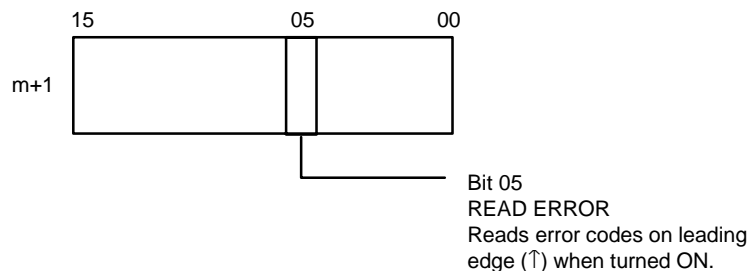


#### Error Code Output

Use READ ERROR when there are multiple error or alarm codes. If there are no errors or alarms when status word s+1 is displayed on the Programming Console, "0000" will be displayed. If there are any errors or alarms, they will be displayed in code. The codes will be displayed in order as READ ERROR is executed. (If there is only one code, however, the display will not change when READ ERROR is executed.)

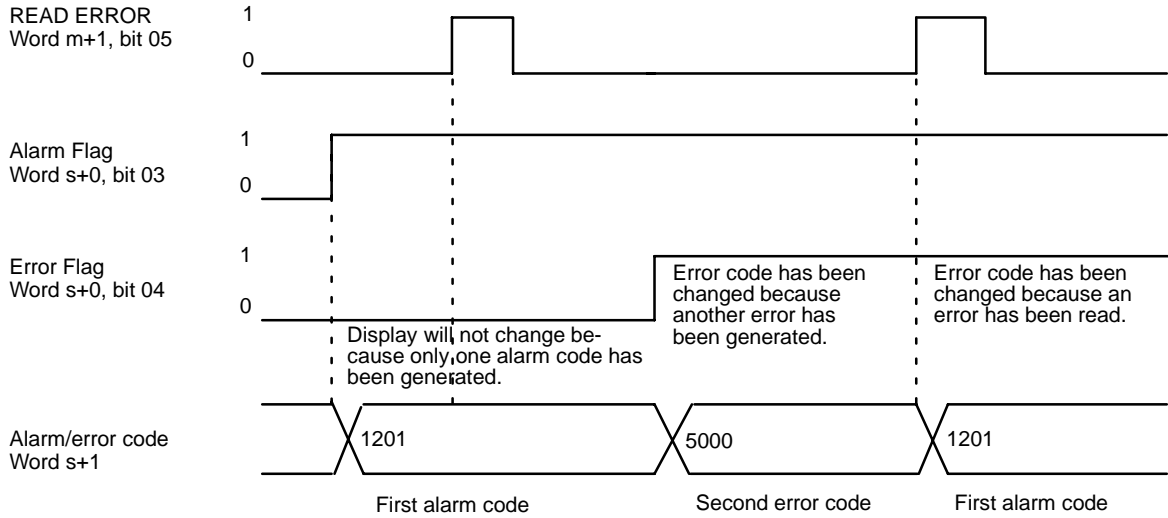
#### READ ERROR Setting

Bit 05 of word m+1/m+5 (X/Y axis)



**Execution Example**

When the READ ERROR command bit (bit 05 of word m+1/m+5) is turned ON, the error code (word s+1/s+9) in the Status Area is refreshed. The Busy Flag will not turn ON. The error code will be defined when the Read Error Completed bit (words s+6/s+14, bit 04) turns ON. The following diagram shows an example in which first the alarm code 1201 and then the error code 5000 are displayed.



**Note** When either axis is in the middle of data transfer or when the Busy Flag is turned ON, the latest error code may not be read because a new error may occur during data transfer or axial movements.

When clearing errors or alarms, refer to *12-4 Error Code List* and *12-3 Alarm Code List*.

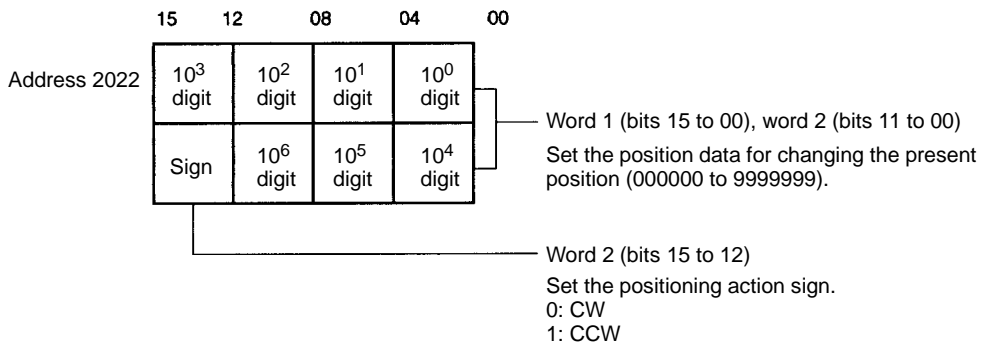
To clear an alarm, for example, correct the data that caused the alarm. To clear an emergency stop, clear the external emergency stop signal and then execute the RELEASE PROHIBIT command and perform an origin search.

**9-7 RESET PRESENT POSITION**

The RESET PRESENT POSITION command bit is bit 08 of word m+1. When this bit is turned ON (↑), the present position is forcibly reset to the value set in parameter addresses 2022 (X axis) and 6022 (Y axis). Although the operation is explained here in terms of the X axis, the operation is the same for the Y axis of the NC211.

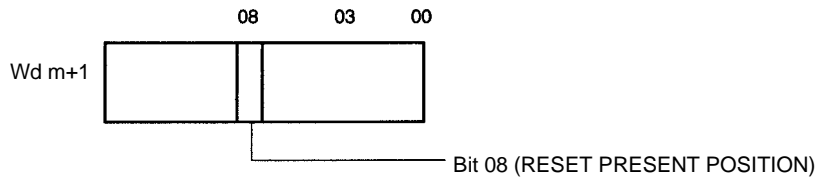
**9-7-1 Data Settings**

Set the RESET PRESENT POSITION data in addresses 2022 (X axis) and 6022 (Y axis).



### 9-7-2 Command Settings

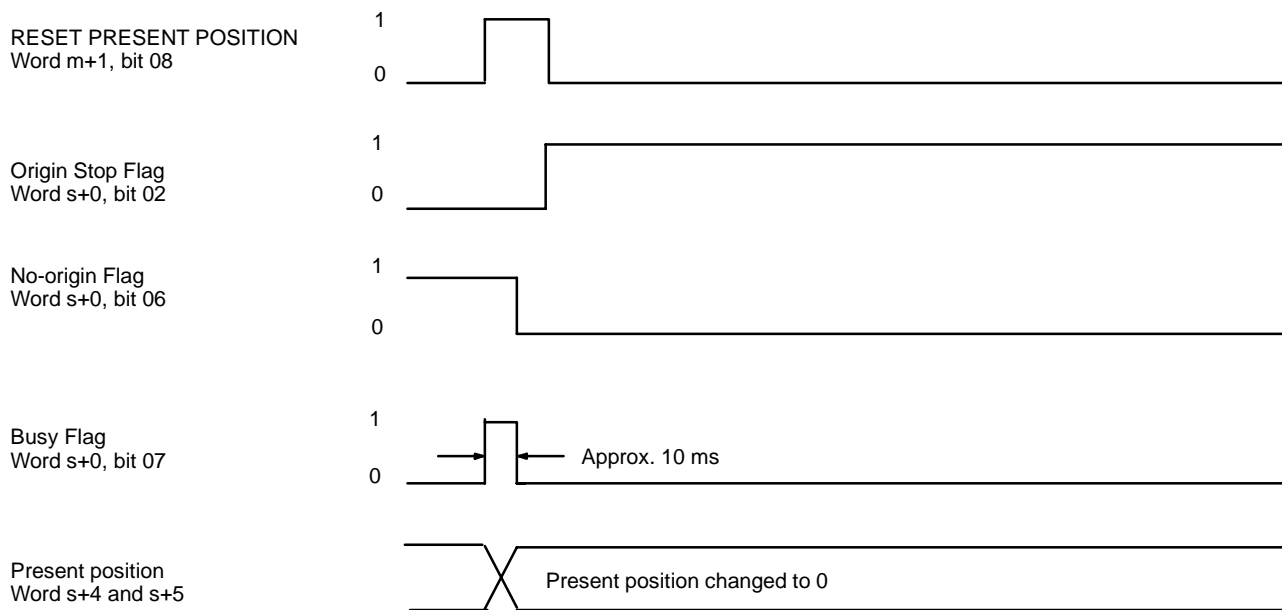
The RESET PRESENT POSITION command is set in bit 08 of word m+1/m+5 (X/Y axis).



- When bit 08 of word m+1 is turned ON (↑), the present position is changed to the value that was previously set in the parameters.
- When RESET PRESENT POSITION is executed before an origin search, the No-origin Flag (word s+0/s+8, bit 06) in the Status Area turns OFF.

### 9-7-3 Executing RESET PRESENT POSITION

The following timing chart illustrates the execution of a RESET PRESENT POSITION command before an origin search operation.



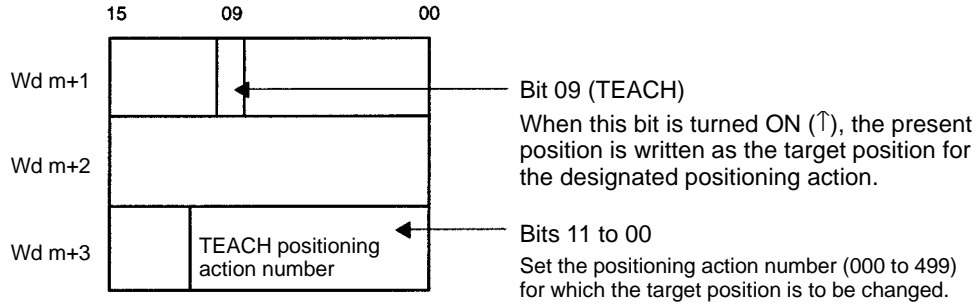
## 9-8 TEACH

This section explains the TEACH command. When the origin and present position are defined (i.e., when the No-origin Flag is OFF), you can use TEACH to write the present position to the positioning action corresponding to the teaching positioning action address in bits 11 to 00 of words m+3 (X axis) and m+7 (Y axis). Setting the positioning action address and turning ON the TEACH command bit (bit 09 of word m+1 for the X axis, bit 09 of word m+5 for the Y axis) writes the present position as the target position for the designated positioning action. Data are set as absolute positions rather than increments.

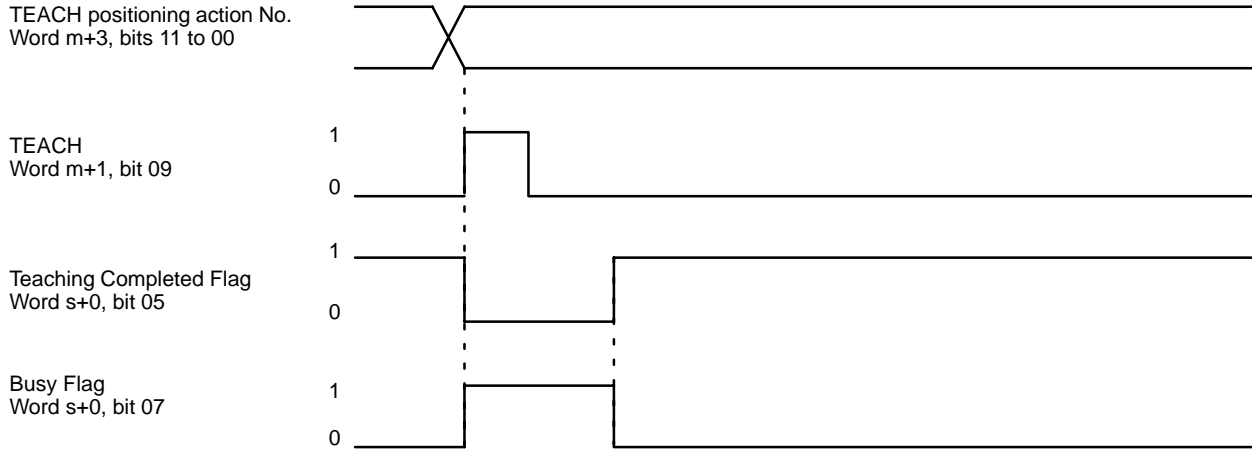
Although the operation is explained here in terms of the X axis, the procedures are the same for the Y axis of the NC211.

**Command Settings**

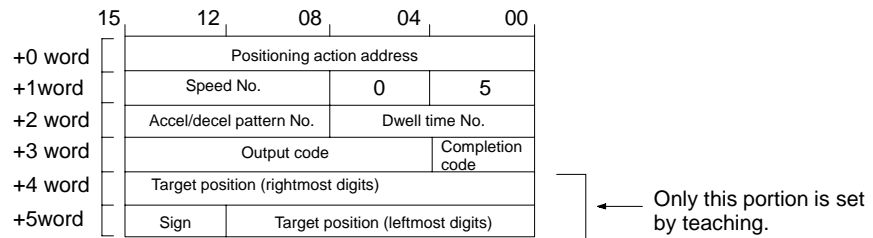
Bit 09 of word m+1/m+5 (X/Y axis)



**Command Execution**



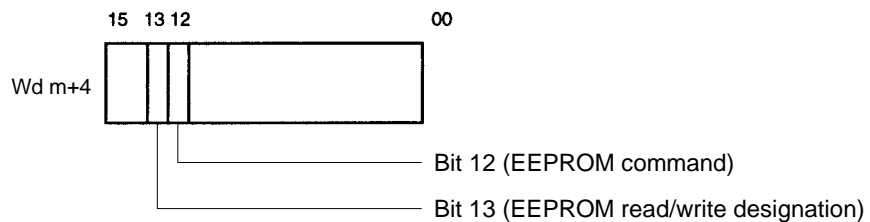
**Note** The only portion of the positioning action data that is set by the teaching operation is that shown below. The rest of the data must be set in advance, before TEACH is executed. The following diagram shows the data configuration for the positioning action.



## 9-9 EEPROM Reading and Writing

Depending on the EEPROM read/write designation (word m+4, bit 13), either the data stored in EEPROM (positioning actions, parameters, acceleration/deceleration patterns, speeds, dwell times) is read to the internal RAM or the contents of the internal RAM are written to EEPROM when the EEPROM command (word m+4, bit 12) is executed.

**Settings**



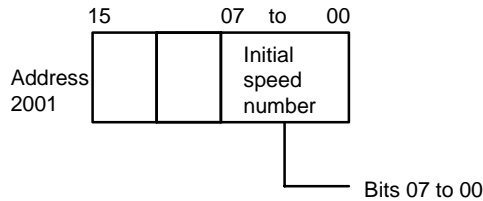
- When bit 12 is turned ON (↑), the EEPROM read/write designation (word m+4/m+8, bit 13) is referenced and data is either read from or written to EEPROM.
- The setting of bit 13 determines whether data is to be written to EEPROM from the internal RAM or read to internal RAM from EEPROM.
  - 0: Write to EEPROM
  - 1: Read from EEPROM

## 9-10 Manual Operation

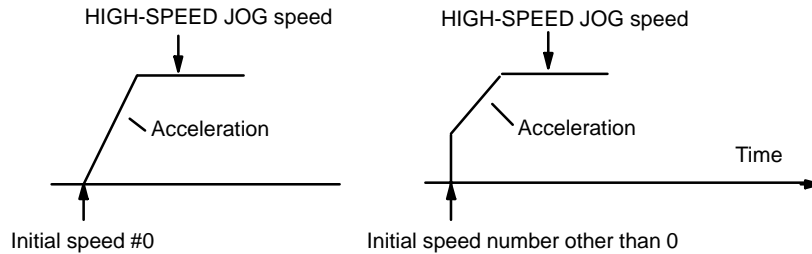
There are three manual feeding commands: HIGH-SPEED JOG, LOW-SPEED JOG and INCH. Acceleration and deceleration are possible with HIGH-SPEED JOG, but not with LOW-SPEED JOG. INCH operates one pulse at a time (from 1 to 100)). Although the following explanations are made with respect to the X-axis, the explanations are the same for the Y-axis of the NC211.

### 9-10-1 Data Settings

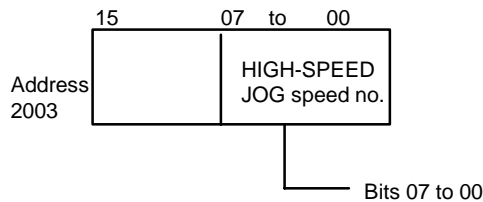
#### Initial Speed Number (X Axis: 2001; Y Axis: 6001)



- Set the initial speed number (bits 07 to 00) from 0 to 49.
- Speed addresses 4000 to 4049 (for the X axis) are referenced according to this setting.

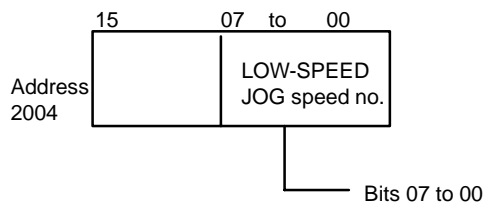


#### HIGH-SPEED JOG Speed Number (X Axis: 2003; Y Axis: 6003)



- Set the HIGH-SPEED JOG speed number (bits 07 to 00) from 0 to 49.
- Speed addresses 4000 to 4049 are referenced according to this setting.

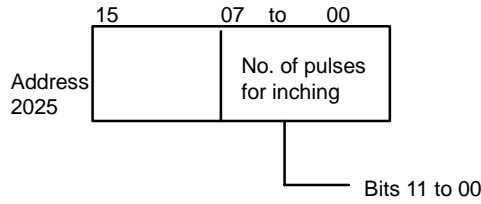
#### LOW-SPEED JOG Speed Number (X Axis: 2004; Y Axis: 6004)





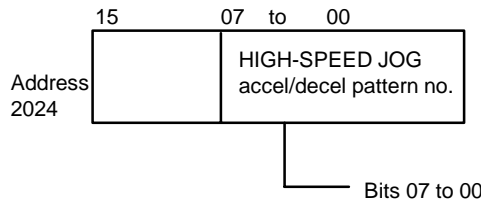
- Set the LOW-SPEED JOG speed number (bits 07 to 00) from 0 to 49.
- Speed addresses 4000 to 4049 are referenced according to this setting.

**Number of Pulses for Inching (X Axis: 2025; Y Axis: 6025)**



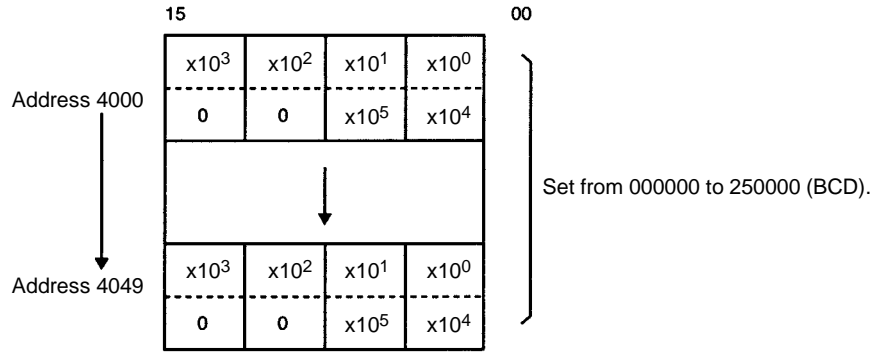
- Set the number of pulses (1 to 100 BCD) to be moved when INCH is executed.
- The INCH speed is the same as the LOW-SPEED JOG speed. The STOP command is ignored.

**HIGH-SPEED JOG Acceleration/Deceleration Pattern Number (X Axis: 2024; Y Axis: 6024)**

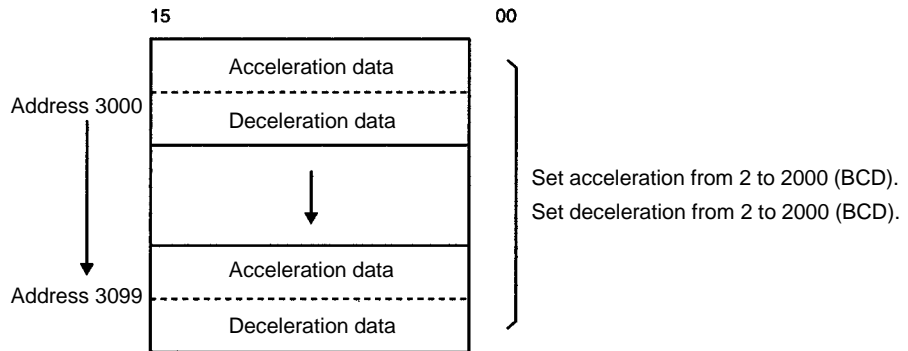


- Set the HIGH-SPEED acceleration/deceleration pattern number (bits 07 to 00) from 0 to 99.
- Acceleration/deceleration pattern addresses 3000 to 3099 are referenced according to this setting.

**Speeds (X Axis: 4000 to 4049; Y Axis: 8000 to 8049)**



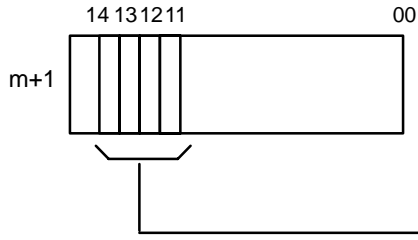
**Acceleration/Deceleration Settings (X Axis: 3000 to 3099; Y Axis: 7000 to 7099)**



The acceleration and deceleration indicate the increase or decrease per ms of speed (pps: pulses/second).

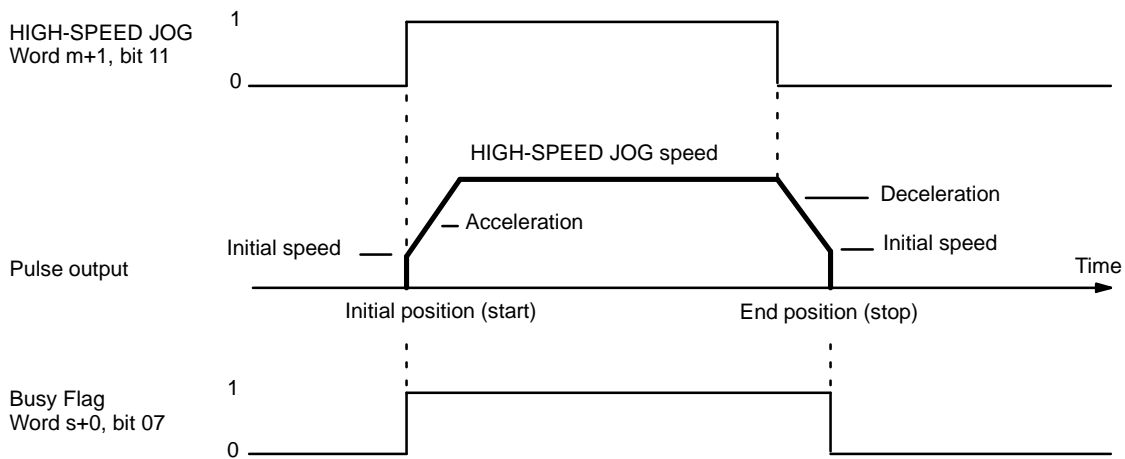
### 9-10-2 Command Settings

The settings for the manual operation commands are made in bits 14 to 11 of word m+1/m+5 (X/Y axis).

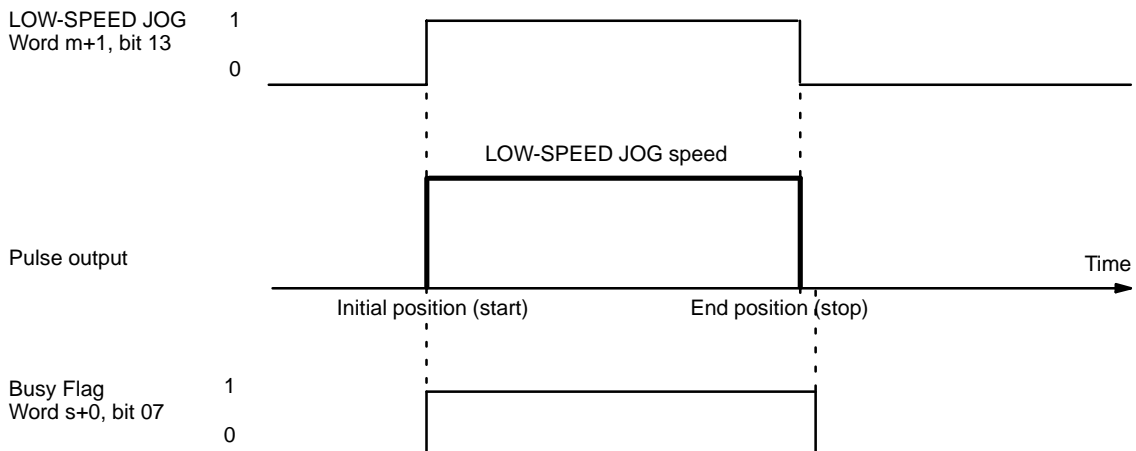


Bit	Designation	1	0
11	HIGH-SPEED JOG	High-speed jogging begins when this bit turns ON (↑).	
12	JOG/INCH direction	CCW	CW
13	LOW-SPEED JOG	Low-speed jogging begins when this bit turns ON (↑).	
14	INCH	Inching begins when this bit turns ON (↑).	

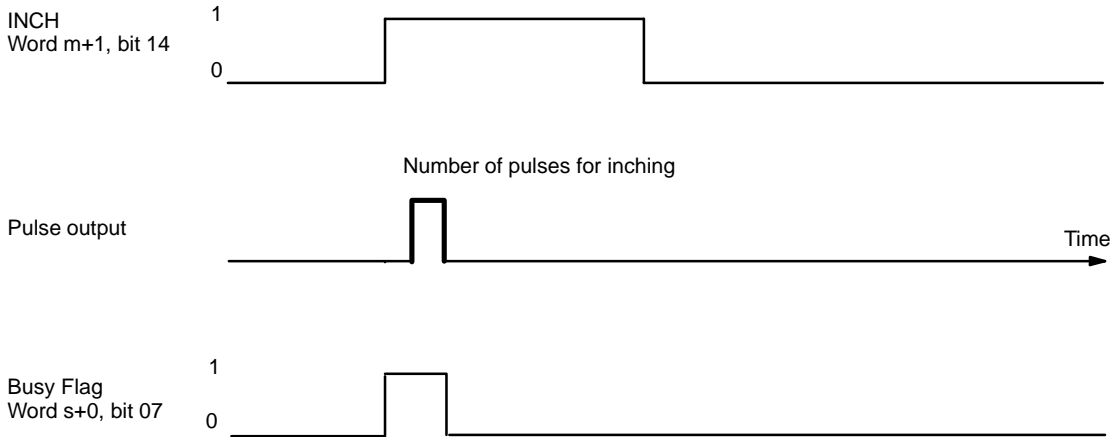
#### HIGH-SPEED JOG



#### LOW-SPEED JOG



**INCH**



**Note** With manual operations and with the external interrupt commands explained in the following section, the final pulse width may vary slightly depending on the difference between the internal processing time and the pulse output time.

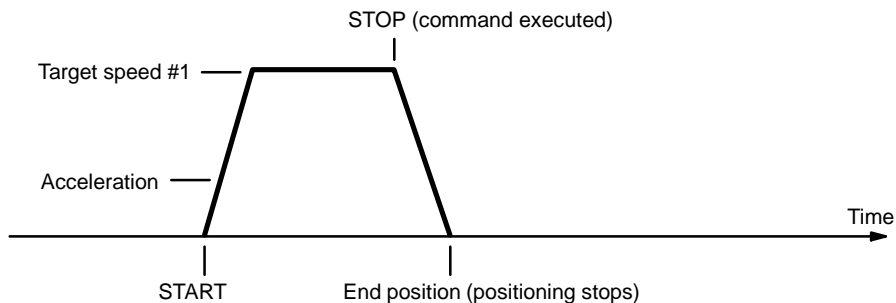
The above diagram shows the operation when the origin search mode is set to 0 or 1. When the mode is set to 2 or 3, after the Positioning Completed signal from the servomotor driver turns ON, the Busy Flag turns OFF.

**9-11 STOP and CHANGE SPEED**

Operations can be decelerated to a stop and speeds can be changed by means of external interrupts or commands. In either case, acceleration and deceleration are executed according to the acceleration/deceleration patterns that have been set.

Although the following explanations are made with respect to the X-axis, the explanations are the same for the Y-axis of the NC211.

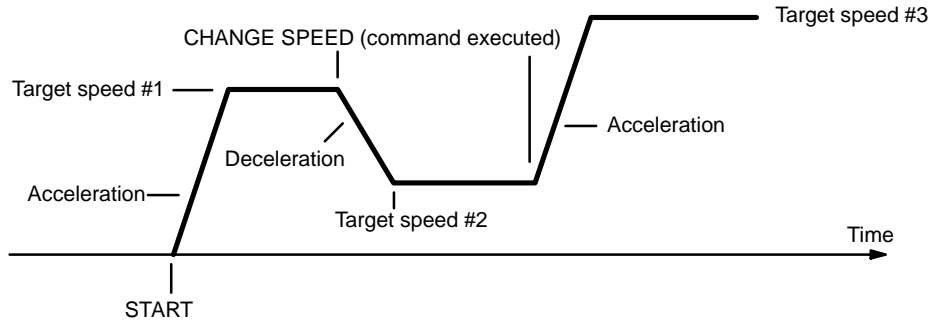
**STOP**



Either of the methods described in the following table can be used.

By command	Executed by turning ON (↑) bit 15 of words m+1 (X axis), m+5 (Y axis)
By external interrupt	When one of the following applies: 1. Interrupt input signal type: 0; bit 06 of words m+1 (X axis) and m+5 (Y axis): 0; interrupt signal emergency stop parameter data: 0 2. Interrupt input signal type: 1; interrupt input signal definition: 0; interrupt signal emergency stop parameter data: 0

CHANGE SPEED



Either of the methods described in the following table can be used.

By command	When interrupt input signal type is 1.	Turning ON (↑) bit 06 of words m+1 (X axis) and m+5 (Y axis) changes the speed to the speed number set in bits 07 to 00 of words m+4 (X axis) and m+8 (Y axis). (See note.)
By external interrupt	When one of the following applies: 1. Interrupt input signal type: 0; bit 06 of words m+1 (X axis) and m+5 (Y axis): 1 2. Interrupt input signal type: 1; interrupt input signal definition: 1	Turning ON (↑) an interrupt signal changes the speed to the speed number set in bits 07 to 00 of words m+4 (X axis) and m+8 (Y axis). (See note.)

**Note** If the value set in bits 07 to 00 of words m+4 (X axis) and m+8 (Y axis) is 00, the speed set for the speed number immediately after the one currently being executed will be taken as the target speed.

**STOP Execution**

STOP is enabled during operations involving pulse output. The acceleration/deceleration pattern that is followed varies as follows:

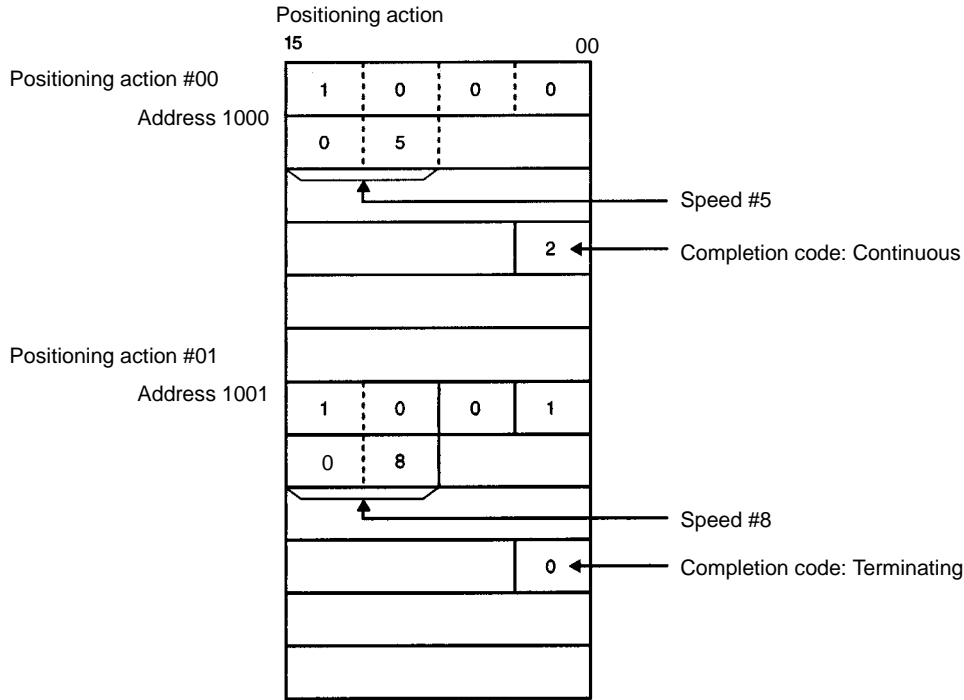
- 1, 2, 3... 1. During positioning: The acceleration/deceleration pattern for the positioning action is followed.
- 2. During an origin search: The origin search acceleration/deceleration pattern is followed.
- 3. During high-speed jogging: The high-speed jogging acceleration/deceleration pattern is followed.
- 4. During low-speed jogging: Stops without using deceleration.
- 5. During interrupt feeding (completion code 5): With the first STOP command, positioning (interrupt feeding) is executed by the positioning action. With the second STOP command, that positioning is interrupted and decelerated to a stop according to the positioning action's acceleration/deceleration pattern. Operation cannot be restarted as long as the STOP command bit (word m+1/m+5, bit 15) is ON.

When the origin search mode is set to 0 or 1, after the pulse output is completed, the Busy Flag will turn OFF if the Unit stops with the deceleration stop.

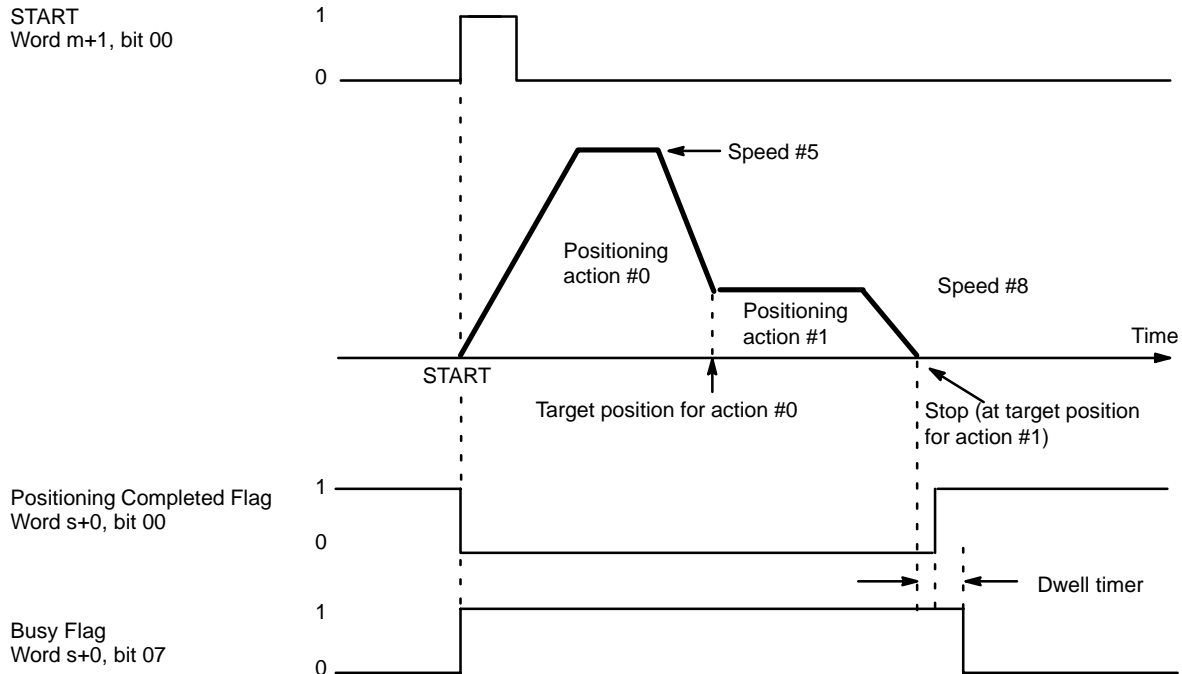
When the origin search mode is set to 2 or 3, after the Positioning Completed signal from the servomotor driver turns ON, the Busy Flag will turn OFF if the Unit stops with the deceleration stop.

**STOP during Positioning**

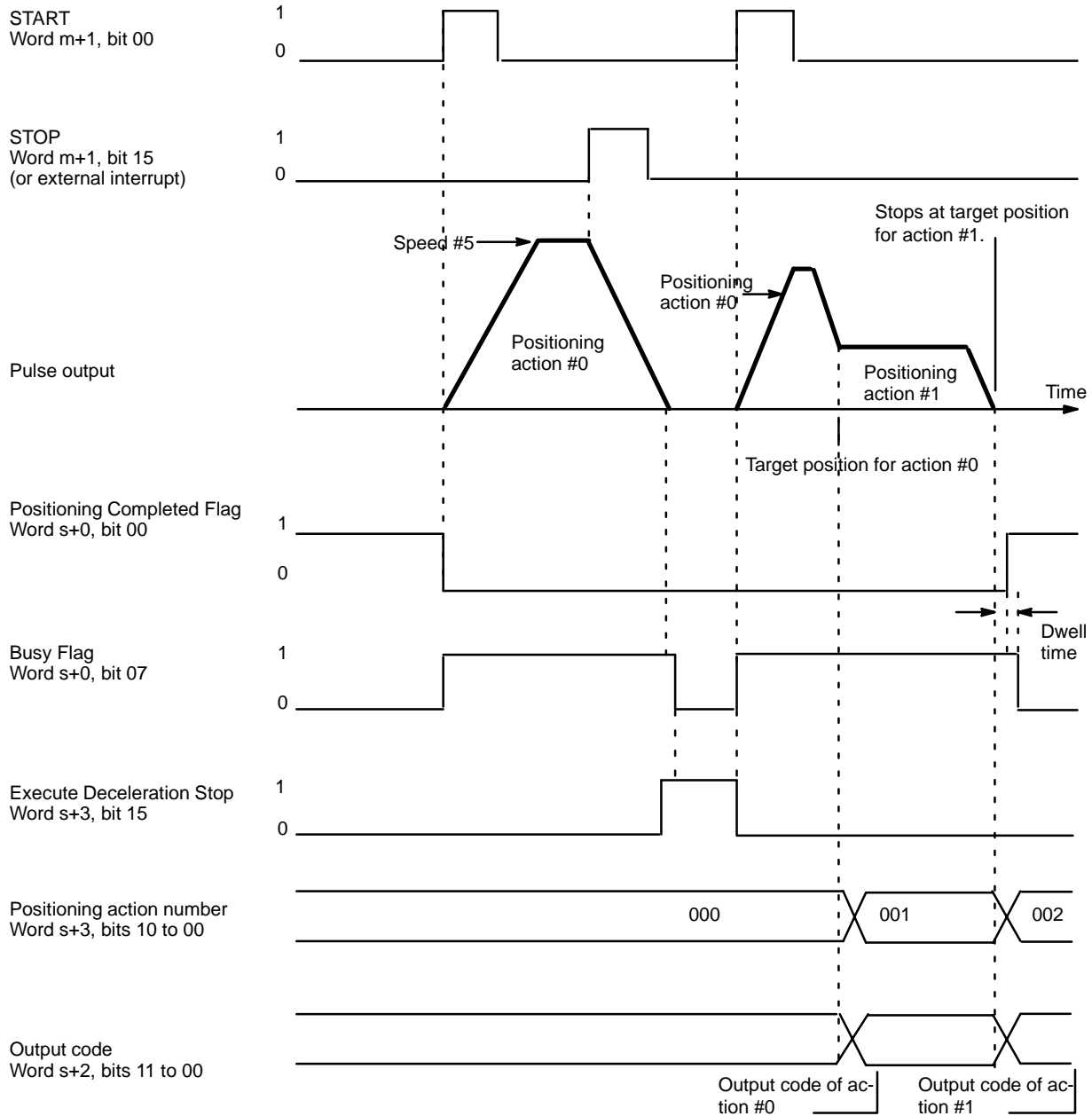
Positioning is decelerated to a stop according to the positioning action's acceleration/deceleration pattern. The Positioning Completed Flag does not turn ON, and the positioning address does not change (i.e., the address of the positioning action currently being executed remains in effect). When operation resumes, the target position and target speed from that same positioning action are used.



1, 2, 3... 1. In the first example diagram (below), this data is used but there is no STOP.

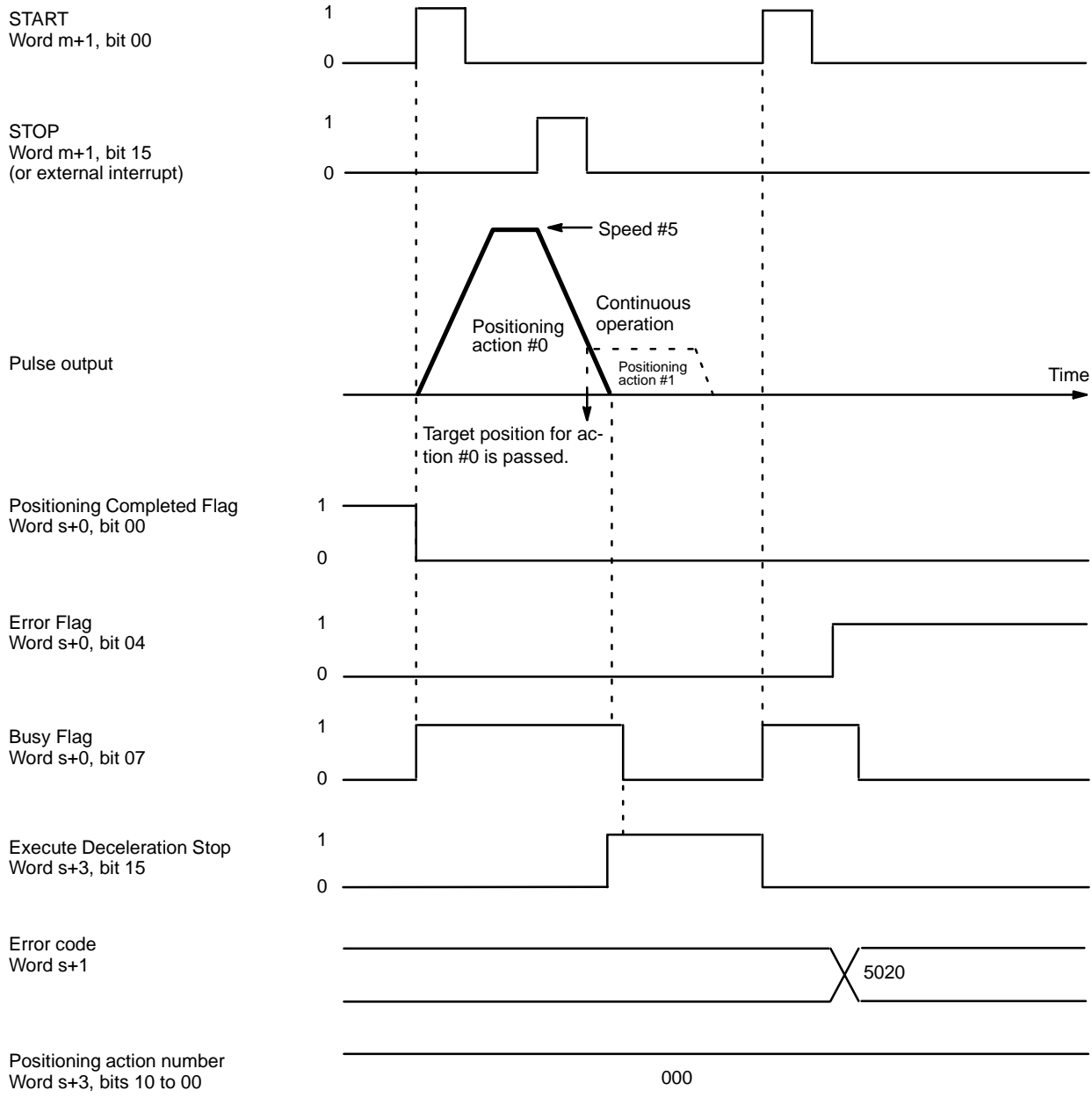


2. Next, in the following example diagram, a STOP is executed.



When START is next executed after execution of STOP, the data of the positioning action at the time of STOP is taken as the target position. In the above example diagram, the target position is absolute and START is next executed from relatively near the target position for the positioning action.

When interpolation (only NC211) is used, the operation is decelerated to a stop according to the interpolation data when the Execute Deceleration Stop for either the X or Y axis turns ON. Restart using the X-axis START command.

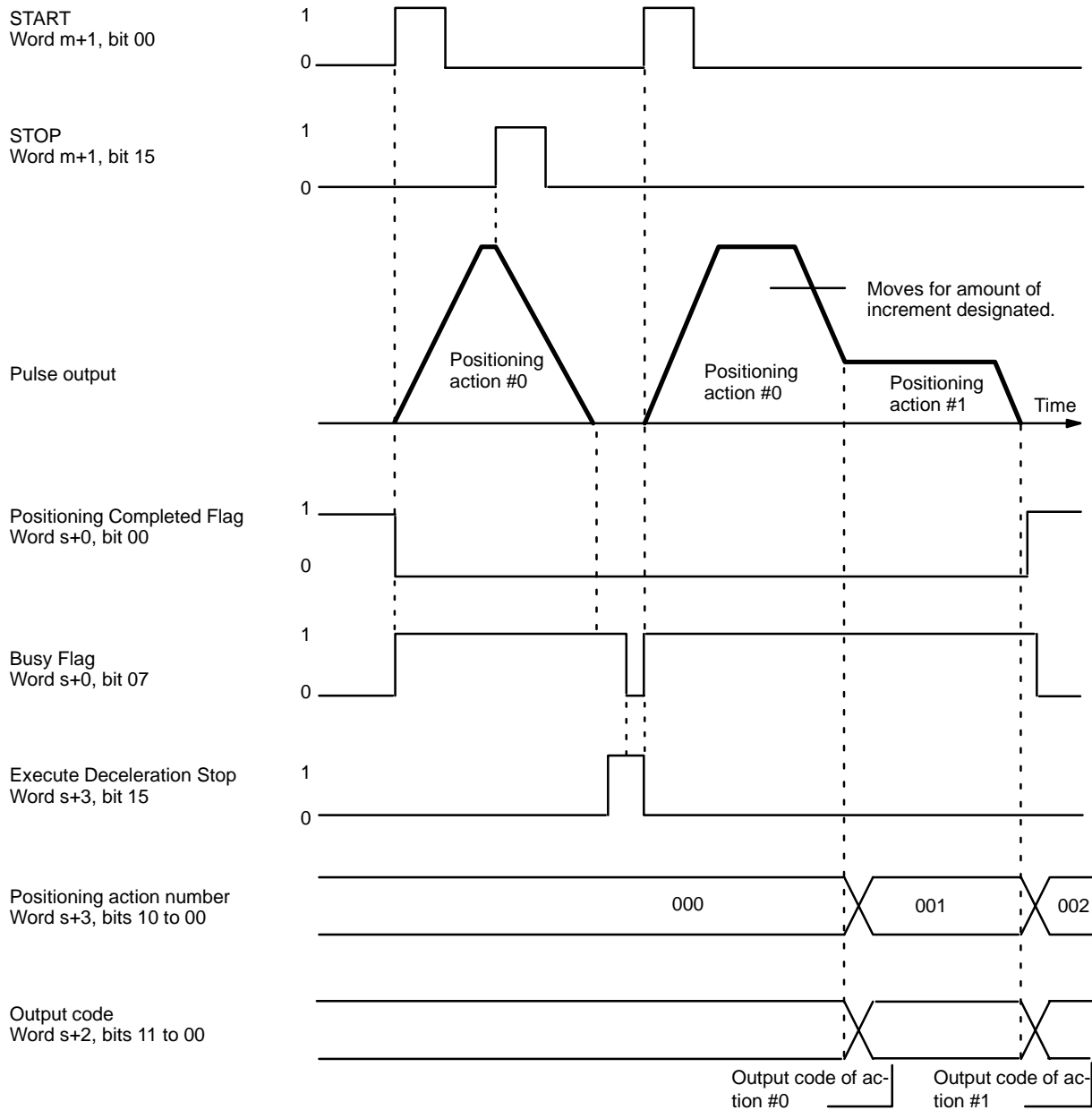


In the above example diagram, the target position is absolute and is exceeded during a deceleration stop, which can happen if STOP is executed at the end of a continuous positioning action. If START is executed again before this situation is corrected, the feeding direction for the action will be wrong, and an error (code 5020) will be generated because the action cannot begin. Operation can be restarted after manually feeding (with JOG) back to the other side of the target position for action #0.

This error is also generated if the target position for action #0 is exceeded by manual operations before START is executed following STOP.

With interpolation (only NC211), use JOG to return to the target position on both the X and Y axes.

3. When the target position is expressed as an increment, operation will be re-started from the position where it was stopped. Thus the stopping position will differ from when STOP is not executed.



For interpolation (NC211 only), the operation is the same as above, even if the target position is expressed as relative positions on both axes.

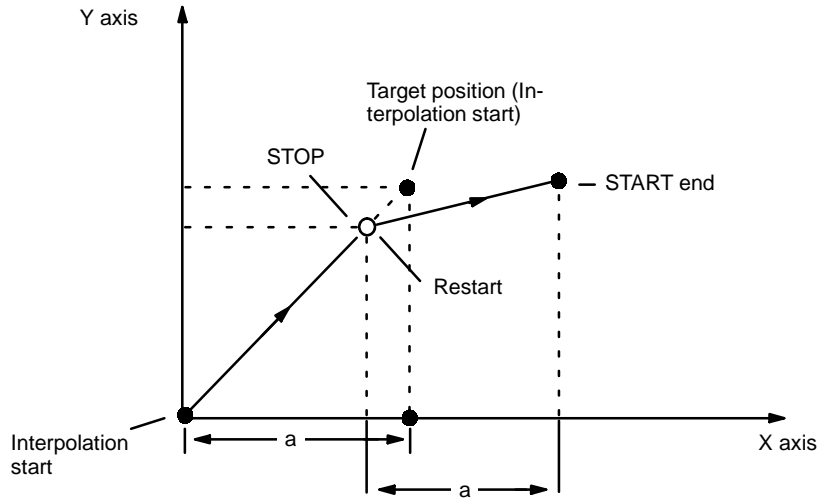
**Cautions for Using STOP during Interpolation (NC211 only)**

STOP is executed for the X axis when bit 15 of word m+1 turns ON, and for the Y axis when bit 15 of word m+5 turns ON. Restart both axes by means of the X axis START command bit (bit 00 of word m+1). If restarting is executed by the Y axis START command bit (bit 00 of word m+5), positioning will be carried out for only the Y axis. Restarting with interpolation is the same as restarting a single axis.

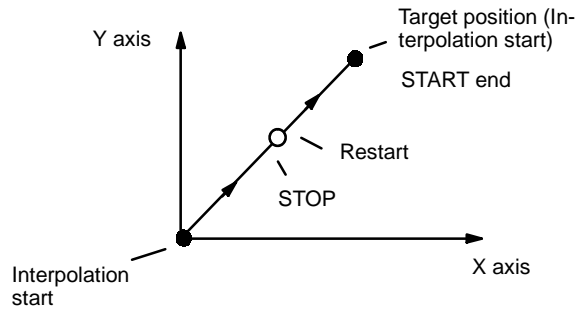
Note that a restart when one axis is in an absolute position and the other is in an incremental (relative) position begins execution with the axes in those states (one axis absolute, the other incremental).



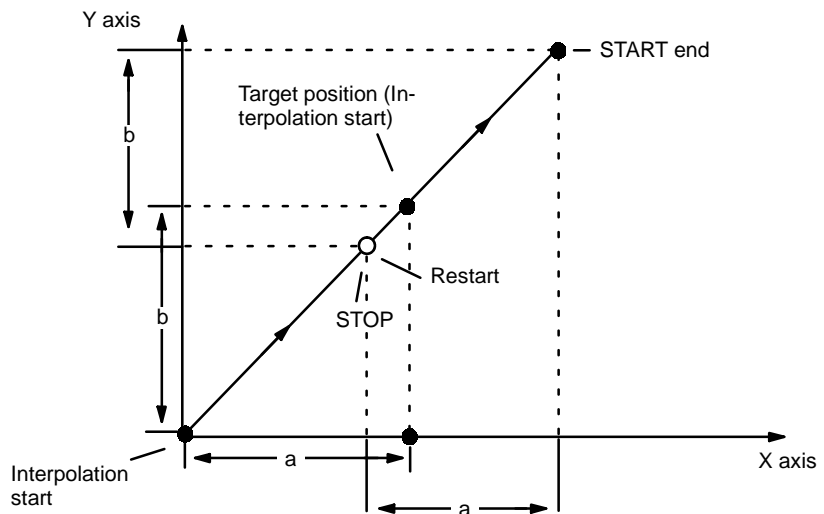
X Axis: Relative Position  
Y Axis: Absolute Position



X Axis: Absolute Position  
Y Axis: Absolute Position



X Axis: Relative Position  
Y Axis: Relative Position

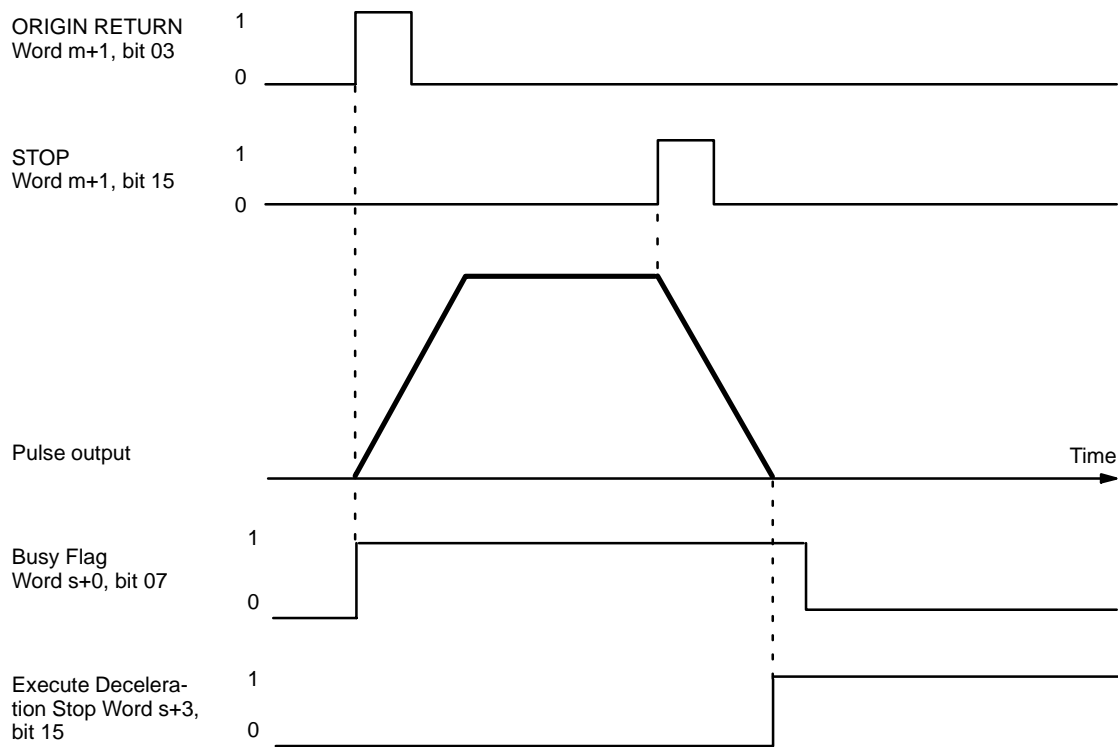


**STOP During Origin Search**

When STOP is executed during an origin search, operation is decelerated to a stop according to the origin search acceleration/deceleration pattern set in addresses 2023 (X axis) and 6023 (Y axis). The origin search operation is interrupted and the ORIGIN SEARCH command must be re-executed from the position reached at the end of STOP.

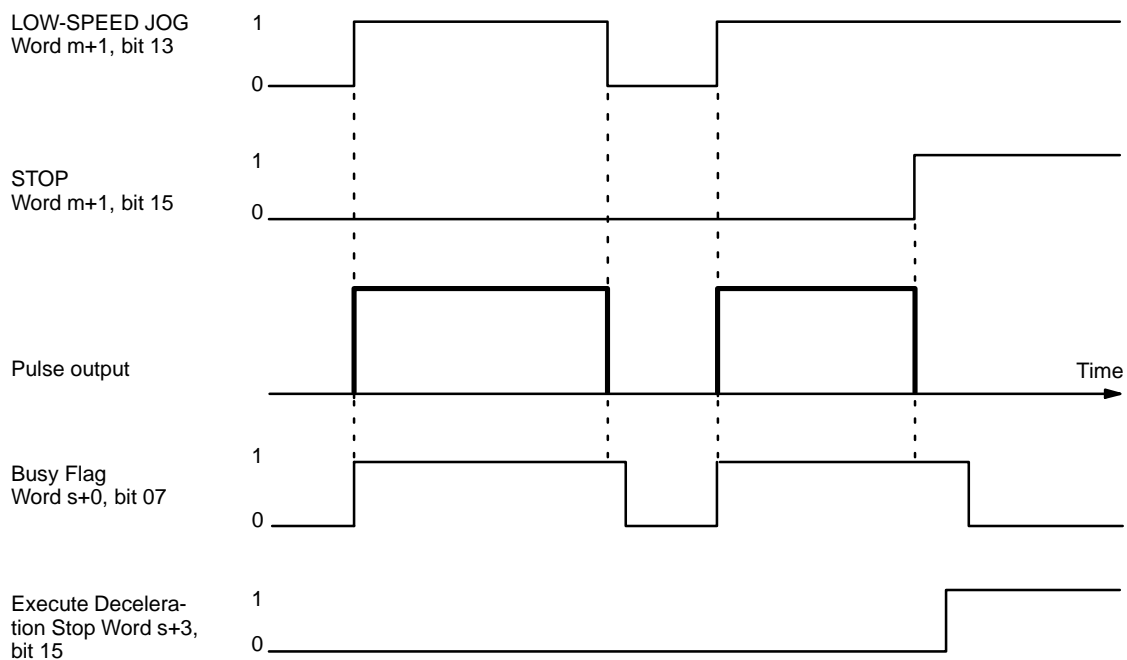
**STOP During Origin Return**

When STOP is executed during an origin return, operation is decelerated to a stop according to the origin return acceleration/deceleration pattern set in addresses 2023 (X axis) and 6023 (Y axis).



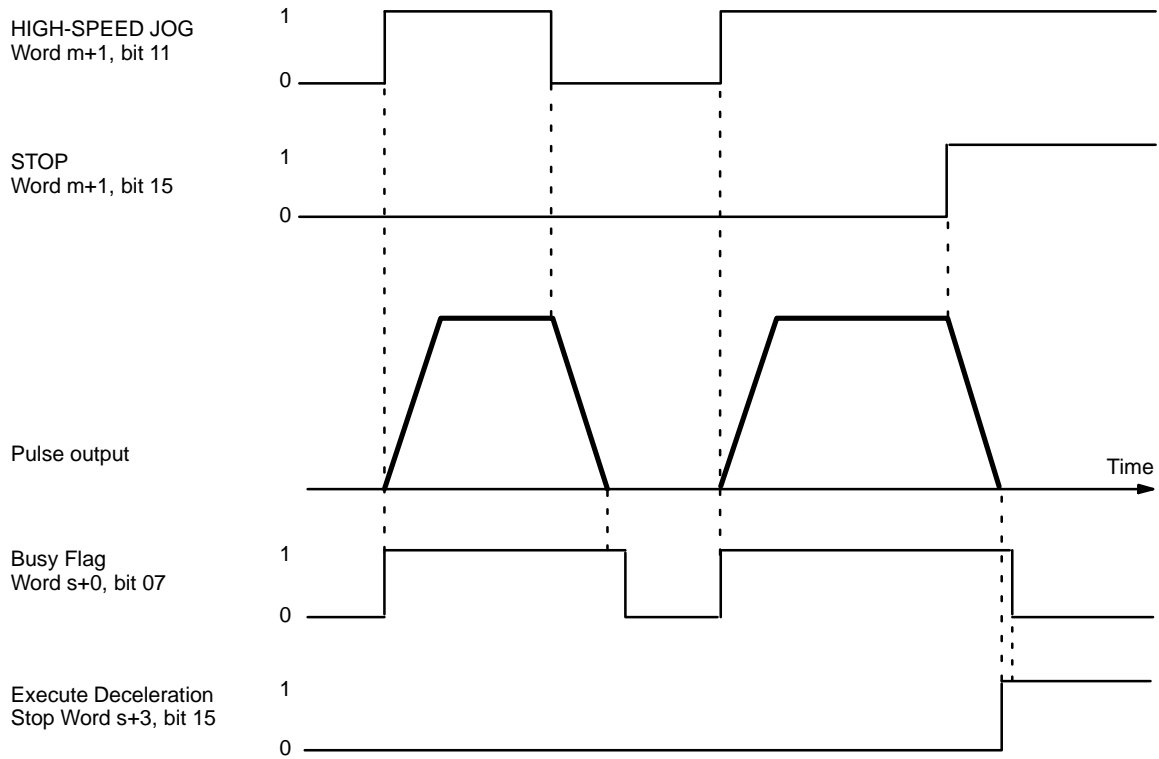
**STOP During Low-speed Jogging**

If STOP is executed during low-speed jogging, feeding will be stopped just as if the LOW-SPEED JOG command bit (bit 13 of word m+1) were reset to "0." The command bit, however, will remain at "1."



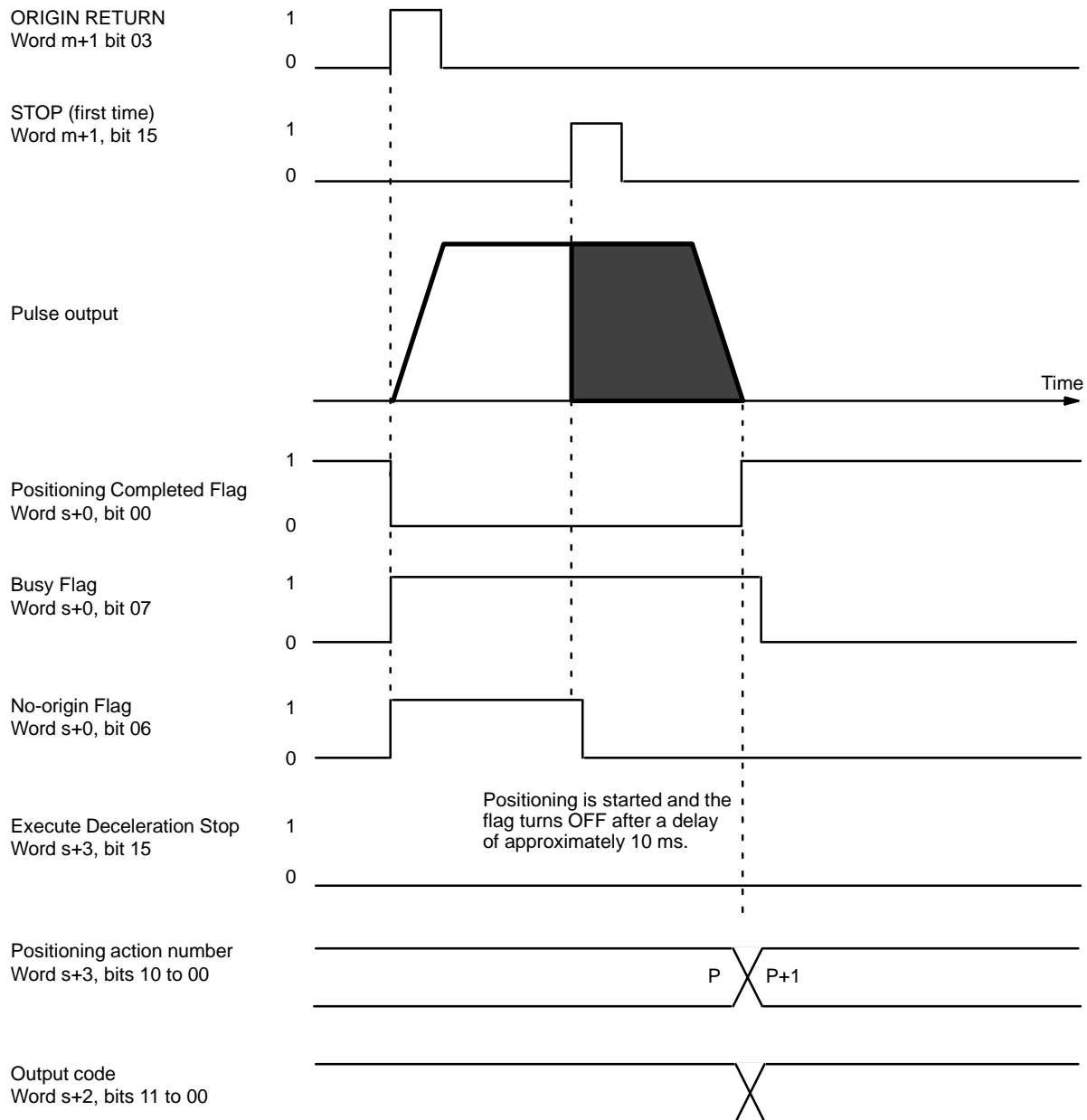
**STOP During High-speed Jogging**

If STOP is executed during high-speed jogging, feeding will be stopped just as if the HIGH-SPEED JOG command bit (bit 11 of word m+1) were reset to "0." The command bit, however, will remain at "1."



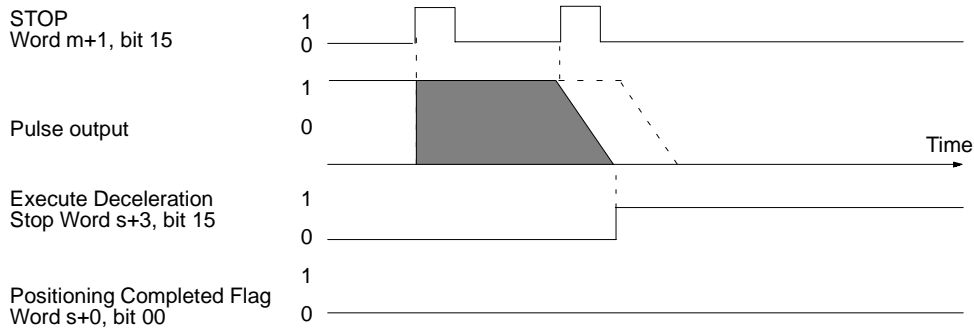
**STOP During a Positioning Action with Completion Code 5 (Interrupt Feeding)**

When STOP is executed for the first time during a positioning action with a completion code of 5, positioning will be executed according to whatever data is set for that positioning action (with interrupt feeding). When it is executed for a second time (see the example diagram on the following page), positioning is interrupted and decelerates to a stop.



Positioning cannot be restarted as long as the signal defined as the STOP command (either word m+1, bit 15, or an external interrupt signal) is ON, i.e., set to "1."

When STOP is executed for the second time, positioning is interrupted and deceleration comes to a stop.



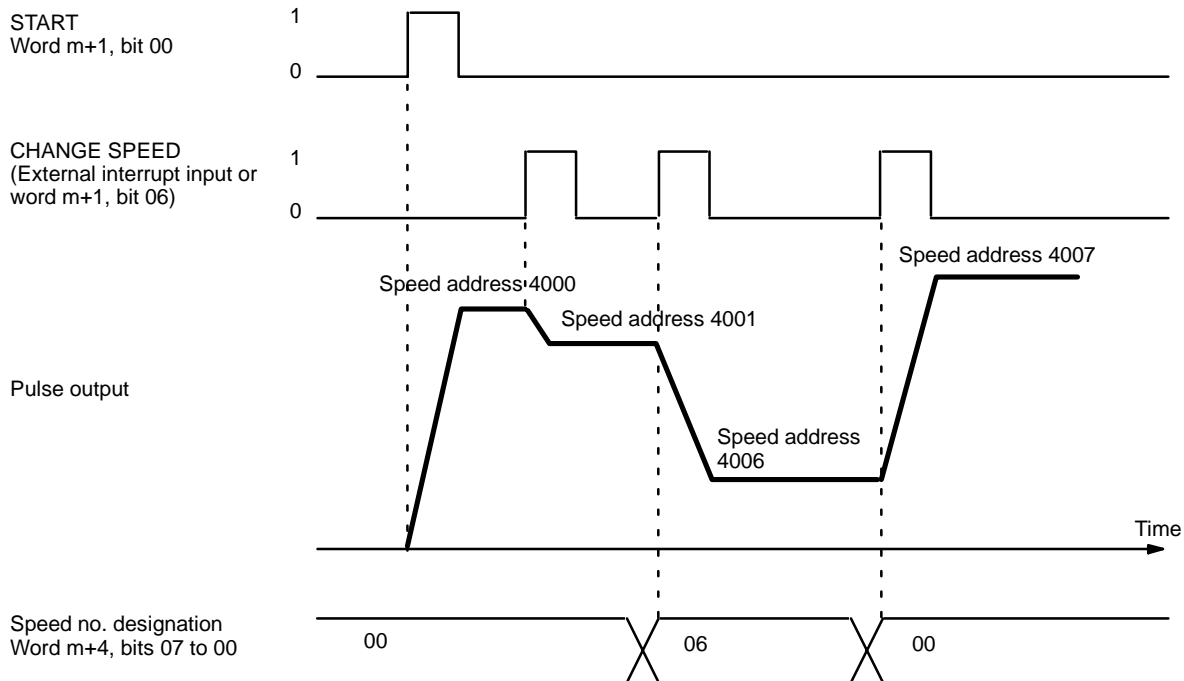
The positioning action number and output code will not be updated.

**CHANGE SPEED**

CHANGE SPEED can only be executed during positioning initiated with START. CHANGE SPEED can be executed several times consecutively. If the speed number designation in word m+4/m+8 is set to "00," the next speed number (i.e., the present speed number m+1/m+5) will be used. If the speed number designation is set from 1 to 49, the speed set for that number will be taken as the target speed.

**Note** If bit 06 is used to execute CHANGE SPEED, the data in word m+4/m+8 will be executed simultaneously by the program. With an external interrupt signal, however, you must input the data at least one scan before the scan in which it is to be used.

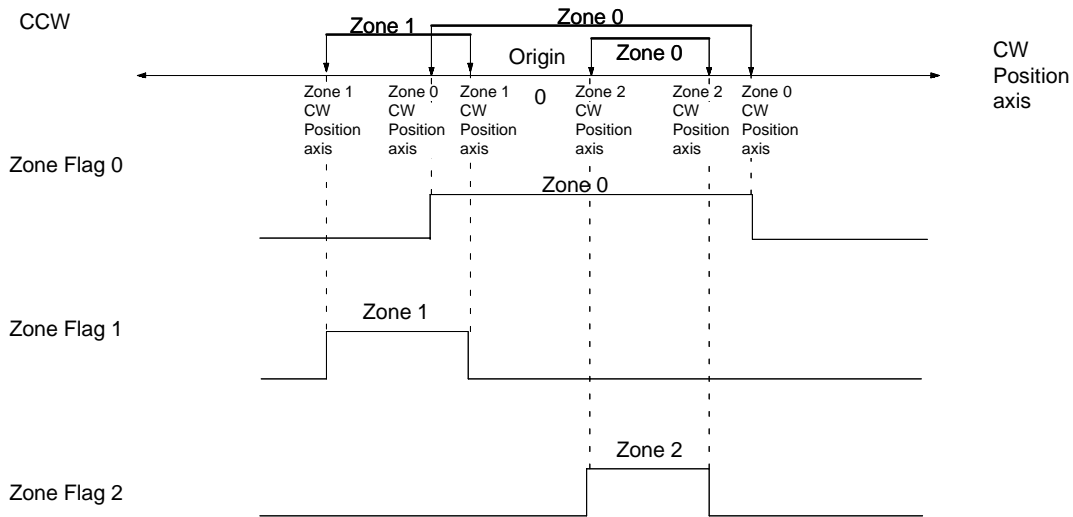
When the target position is being approached, deceleration for that purpose will be given priority. In other words, normal deceleration to end at the target position will be carried out for single, pause, or bank end positioning actions and the target speed for the next positioning action will take priority for a continuous positioning action.



With the interpolation (NC211 only), CHANGE SPEED is effective only for X axis commands. Y axis commands are ignored. X axis data becomes the interpolation data.

# 9-12 Zones

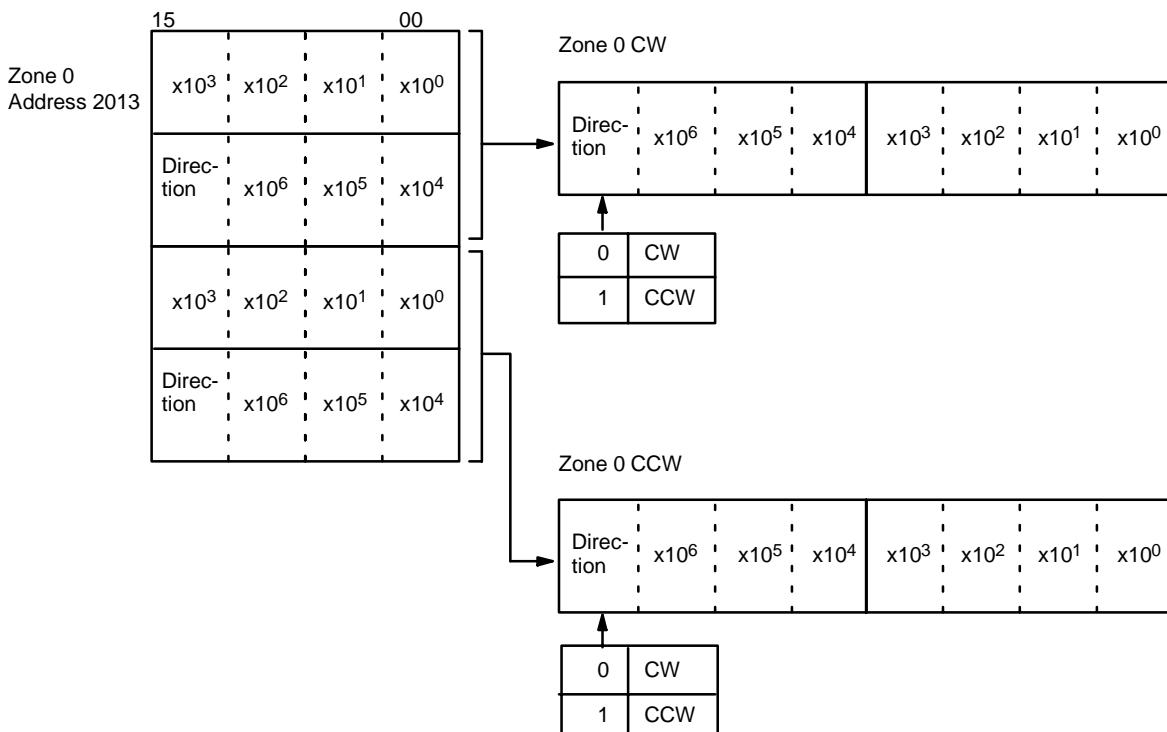
The ranges for up to eight zones can be set in advance in the parameters. When the present position enters the range set for one of the zones, the flag for that zone will turn ON in the Status Area, and the flag will turn OFF when the present position leaves the zone. Zones can be set to cover a wide range of positions or narrowed to cover only part of a single positioning action. Only zones 0 to 2 are shown here, but the operation is the same for zones 3 to 7. Although this explanation is made with respect to the X-axis, the operation is the same for the Y axis of the NC211.



Zone ranges can be set to span multiple positioning actions, or smaller ranges may be freely set independent of positioning actions, and information can be obtained as to whether the current position lies inside or outside the range

## Zone Settings

Set the zones in addresses 2013 to 2020 for the X axis and 6013 to 6020 for the Y axis.



Zones 1 to 7, CW/CCW are set similarly.

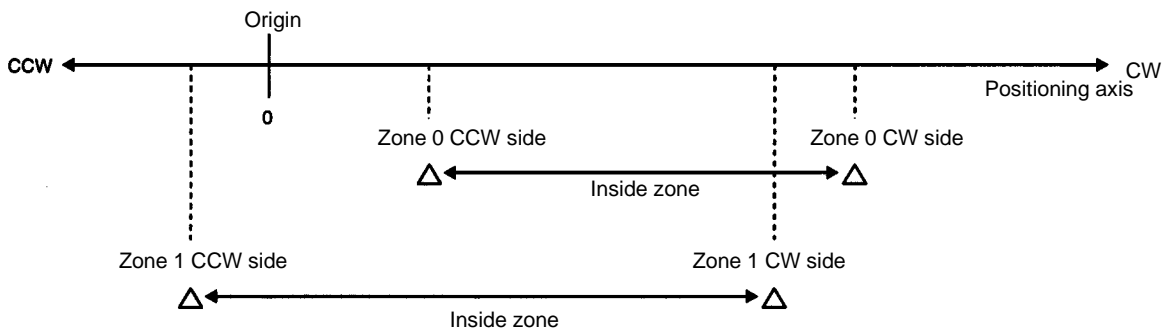
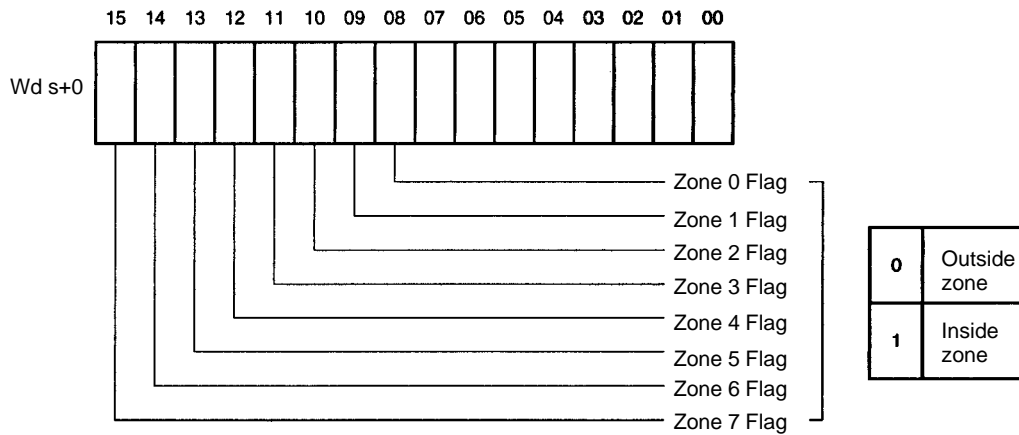
Address 2014	Zone 1
Address 2015	Zone 2
Address 2016	Zone 3
Address 2017	Zone 4
Address 2018	Zone 5
Address 2019	Zone 6
Address 2020	Zone 7

The CW and CCW sides of Zones 0, 1 and 2 form two sets of data. When the values of all four word are 0, it is assumed that there is no zone setting and no decision is executed. When the origin is confirmed and the present position is acquired, this decision is executed.

If the values for both the CW and CCW sides of a zone are set to "0," it is regarded as if no zone is set, and no determination is made. When the origin is confirmed and the present position is acquired, this determination is made. When no determination is made, the Zone Flag turns OFF.

**Zone Flag Outputs**

The determination as to whether the present position is inside or outside a given zone is output as "1" or "0" to word 0, bits 15 to 08, in the Status Area.



Zones 0 to 7 can be set independently.

### 9-13 Backlash Compensation

Backlash compensation can be used to compensate for the amount of mechanical play present in gears, particularly when the direction of positioning actions changes. Although this explanation relates to the X axis, the same format is used for the Y axis of the NC211.

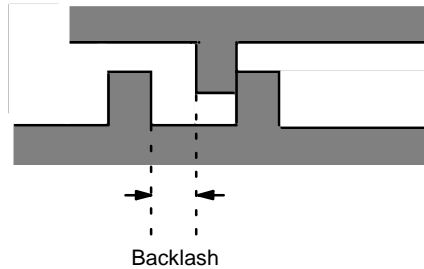
**Data Settings**

There is only one parameter that needs to be set to compensate for backlash. (X axis: 2009; Y axis: 6009).

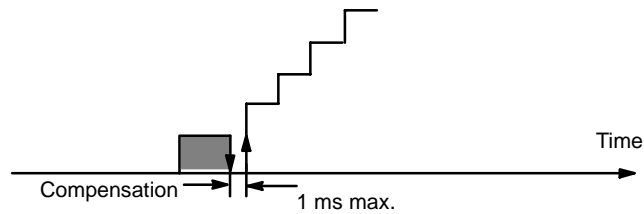
	15			00	
Address 2009	$\times 10^3$	$\times 10^2$	$\times 10^1$	$\times 10^0$	Set from 00000 to 99999 (BCD). (Unit: pulses)
	0	0	0	$\times 10^4$	

**Using Backlash Compensation**

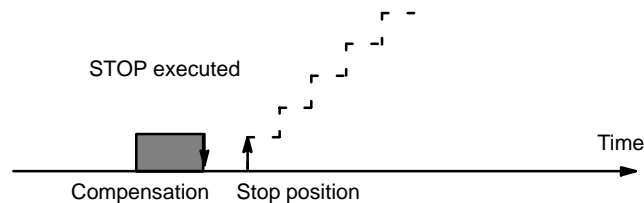
Backlash compensation can correct the sort of mechanical interlocking error shown in the illustration.



When the CW and CCW directions are reversed, the number of pulses set for the backlash value are output at the rate corresponding to the initial speed, and then normal control proceeds.



If STOP is executed during backlash compensation for any operations requiring acceleration or deceleration (HIGH-SPEED JOG, ORIGIN SEARCH, ORIGIN RETURN, and START), the Unit will stop feeding immediately after outputting the initial step of the acceleration or deceleration, which will include the backlash compensation set above.

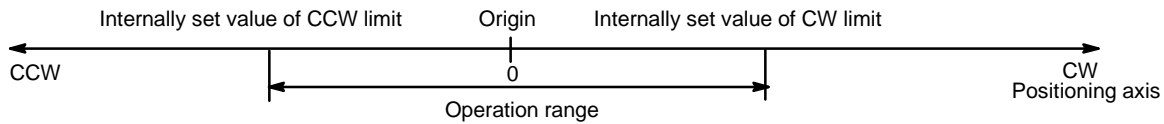


**Note** Backlash compensation is not performed if the origin is not established.



## 9-14 CW/CCW Limits

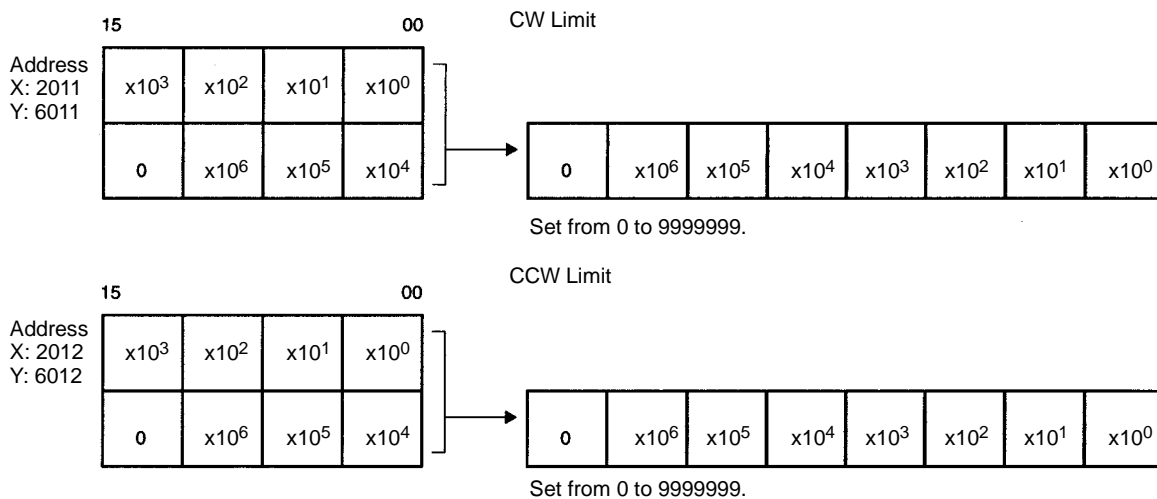
Limits on the CW and CCW sides of the origin can be set internally to restrict operation to within a set range.



### Data Settings

**CW Limit** X axis: 2011; Y axis: 6011

**CCW Limit** X axis: 2012; Y axis: 6012



If either the CW or CCW limit is set to "0," the limit for that side will be considered to be 9999999 pulses regardless of whether the unit is set to pulses, mm, or inches.

### Operation

**Positioning Actions** If either of these limits is reached during execution of positioning actions, pulse output will stop, and an error code, either 5030 or 5031, will be generated.

**Manual Operation** If either of these limits is reached during execution of LOW-SPEED JOG, HIGH-SPEED JOG, or INCH, pulse output will stop, and an error code, either 5070 or 5071, will be generated.

## 9-15 Programming Considerations

- 1, 2, 3... 1. When X axis and Y axis START are independently started at the same time (NC211 only), X-axis START receives priority. Since X-axis processing requires 10-50 ms, Y-axis START is delayed by this period.
2. Operation will not be started while STOP is being executed, even if the START command is given. If an interpolation START command is initiated for either the X or Y axis while STOP is being executed, operation will not be started and the command will be ignored (NC211 only).

## SECTION 10

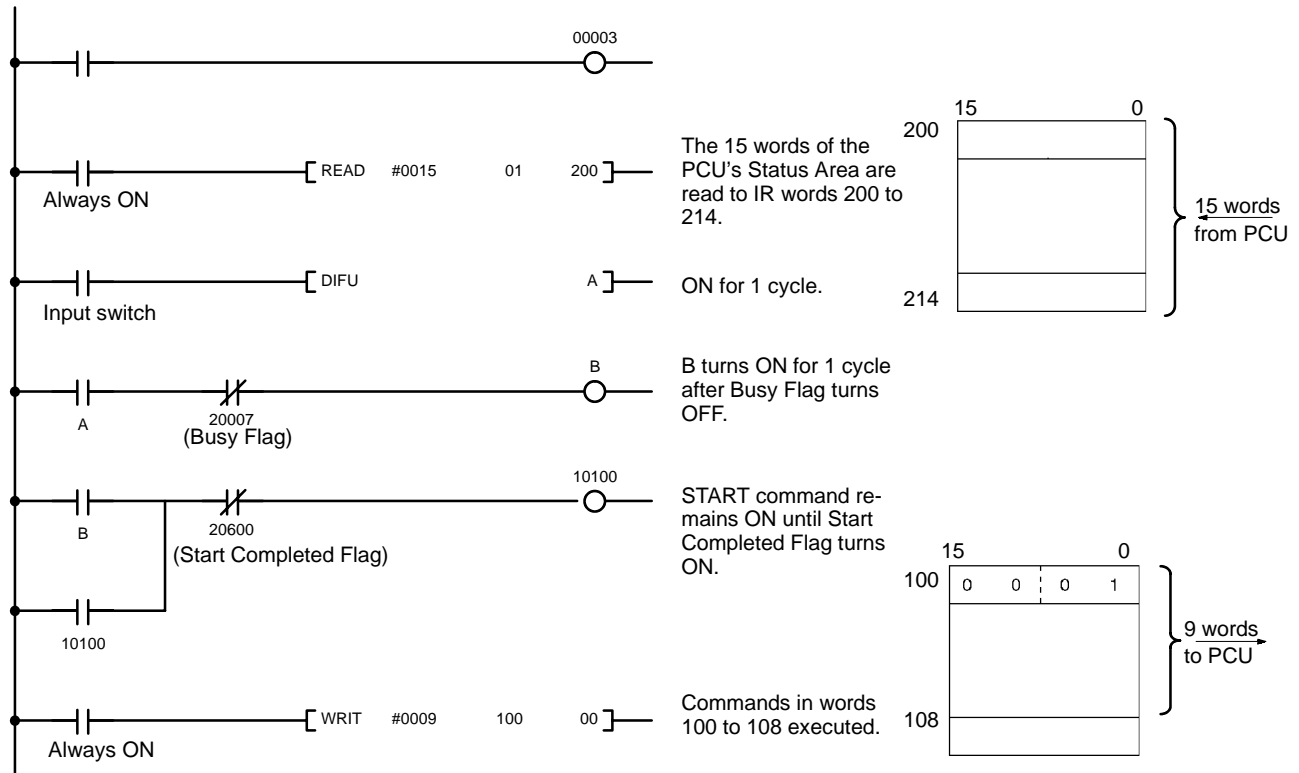
### Program Examples

This section provides examples of programs for some practical applications.

10-1 Ladder Program Examples .....	206
10-2 Using Interrupt Feeding .....	209
10-3 Using Continuous Operation .....	210
10-4 Controlling Speeds .....	210
10-5 Changing Speeds .....	211
10-6 Changing the Override During Operation .....	212
10-7 Resetting the Present Position .....	212
10-8 Setting Zones .....	213
10-9 Present Position Resetting Example .....	213
10-10 Feeding by START Data Selection .....	215

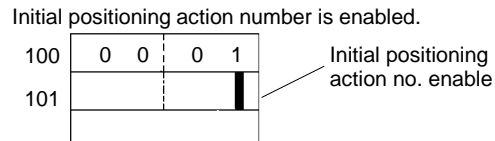
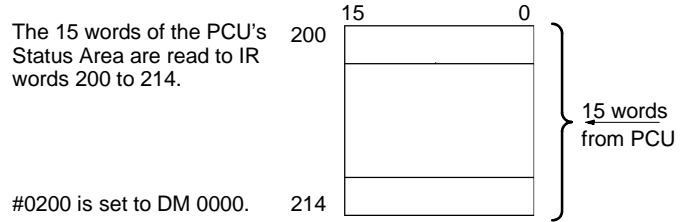
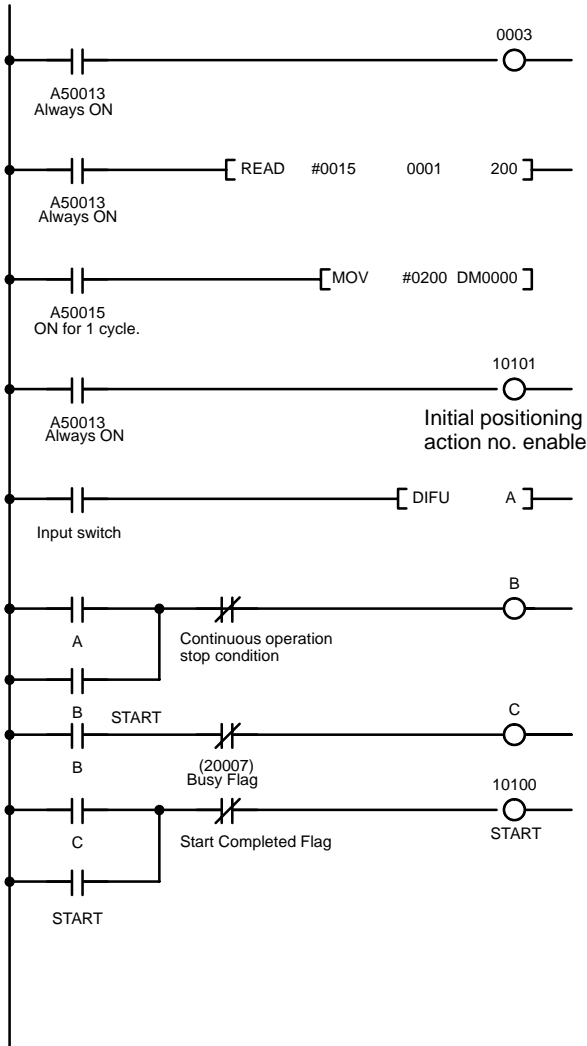
# 10-1 Ladder Program Examples

**Example 1** In this example program, an operation is performed each time a switch is pressed.



**Example 2**

In this example program, data is repeatedly written and positioning actions are executed. The data set in DM 0100 to 0105 and DM 0200 to 0205 is alternately transferred to the Position Control Unit as positioning actions.

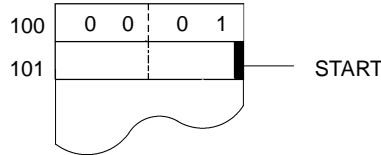


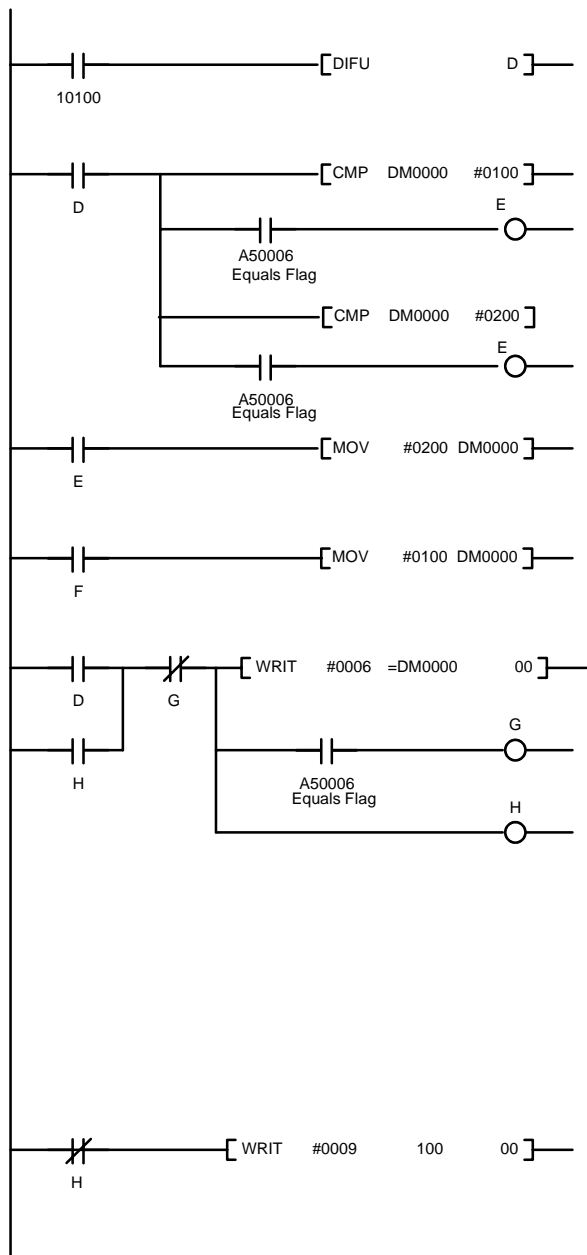
When input switch is turned ON, "A" turns ON for one cycle.

By "A" turning ON for one cycle, "B" remains ON. While "B" remains ON, data is repeatedly written and positioning actions are executed. When the continuous operation stop condition turns ON, operation is halted.

When "B" is ON, "C" turns ON when the Busy Flag turns OFF.

When "C" turns ON, the START command turns ON.





#0100 is compared to contents of DM 0000.

"E" turns ON if DM 0000 is #0100.

#0200 is compared to contents of DM 0000.

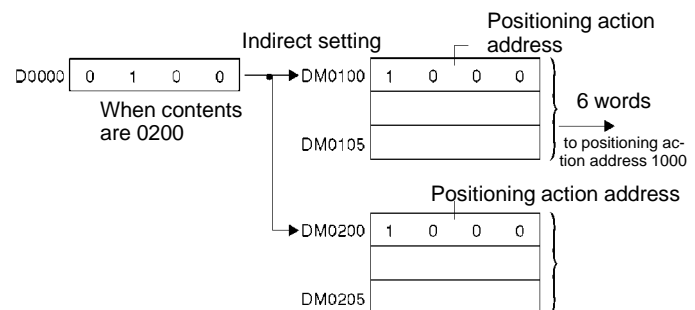
"F" turns ON if DM 0000 is #0200.

If contents of DM 0000 are #0100, they are changed to #0200.

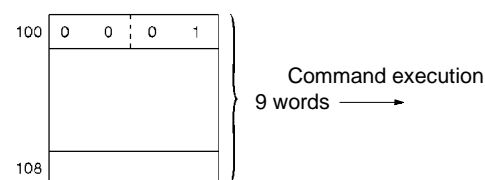
If contents of DM 0000 are #0200, they are changed to #0100.

Positioning action transfer

The data in DM 0000 is indirectly set, and six words beginning with that DM address are written to the Position Control Unit allocated to work 000.

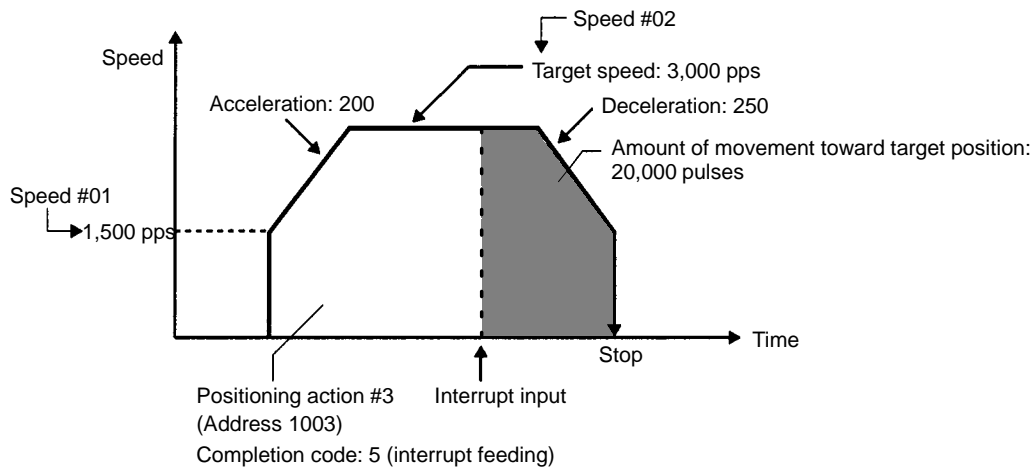
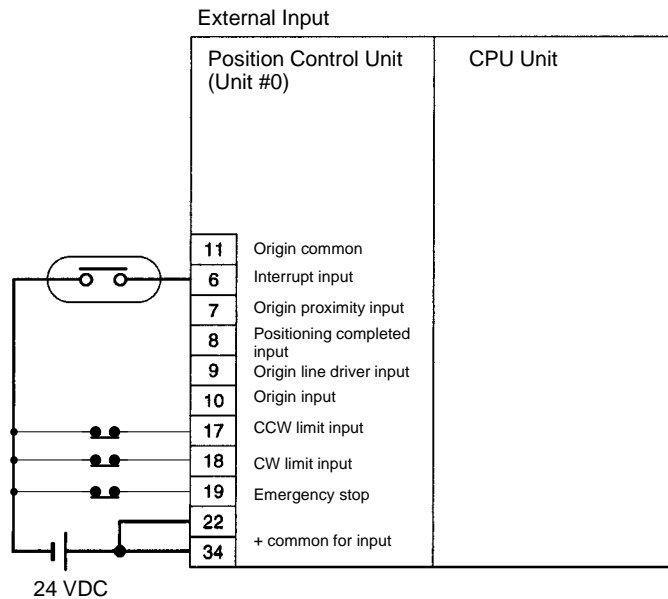


Command execution after positioning action transfer (with Equals Flag ON)



## 10-2 Using Interrupt Feeding

In this example, it is assumed that the positioning action's completion code is set to 5 (interrupt feeding). When an interrupt input is turned from OFF to ON during speed control at the target speed, the present position at that point in time becomes "0" and the axes are then moved for a specified amount.



### Settings

Parameter Editing Screen

- Initial positioning action: #03
- Initial speed: #01
- Interrupt input signal type: 1 (fixed)
- Interrupt input signal definition: 0 (deceleration stop)
- Interrupt input emergency stop: 0 (deceleration stop)

Positioning Action Editing Screen

Position      Speed      Acceleration/ Completion/ deceleration      code

No. 03: 20,000      02

05      5  
Interrupt feeding

Speed Editing Screen

No.01: 1,500 pps  
02: 3,000 pps

Acceleration/Deceleration Editing Screen  
No. 05: 200 (acceleration)  
250 (deceleration)

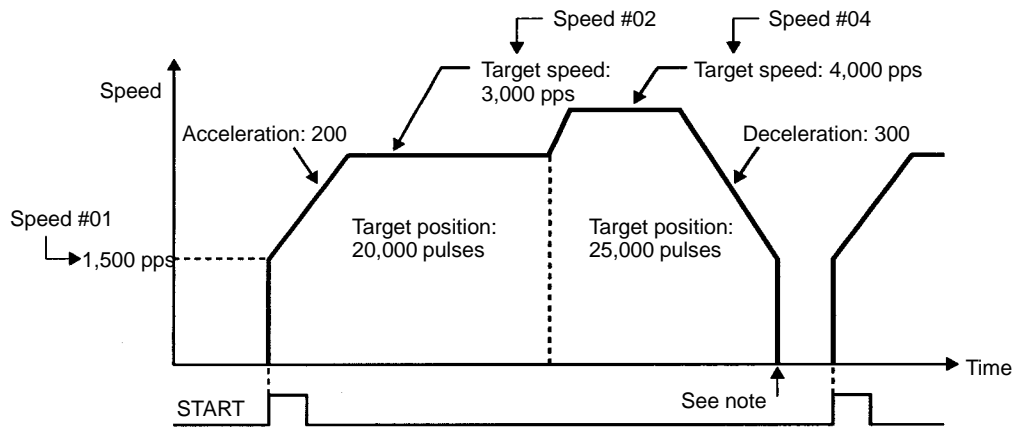
### Command

Turn ON the START command (bit 00 of word m+1) and use WRIT (Intelligent I/O Write) to send the command to the Position Control Unit.

### Interrupt Input

To execute the interrupt feeding, turn the interrupt input (6) from OFF to ON.

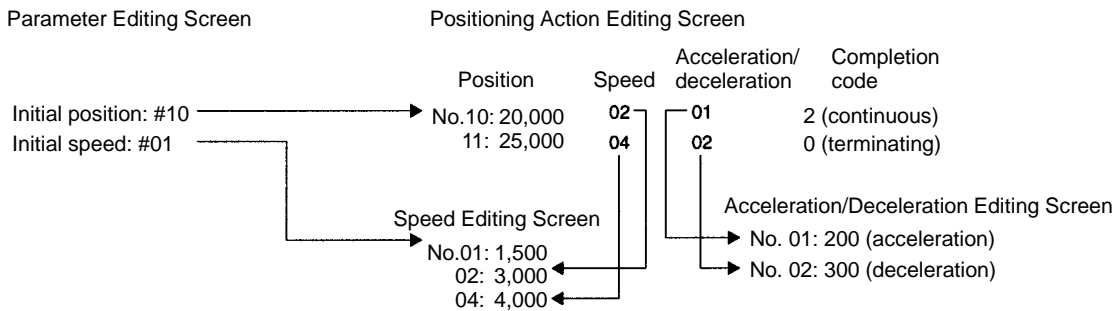
### 10-3 Using Continuous Operation



Positioning action number	10	11	12
Completion code	2 (continuous)	0 (terminating)	<b>Note</b> When START is executed after a terminating completion code, the next positioning action will be executed.

After completion of a continuous completion code, the speed will be decelerated toward the target speed of the next positioning action (no. 11).

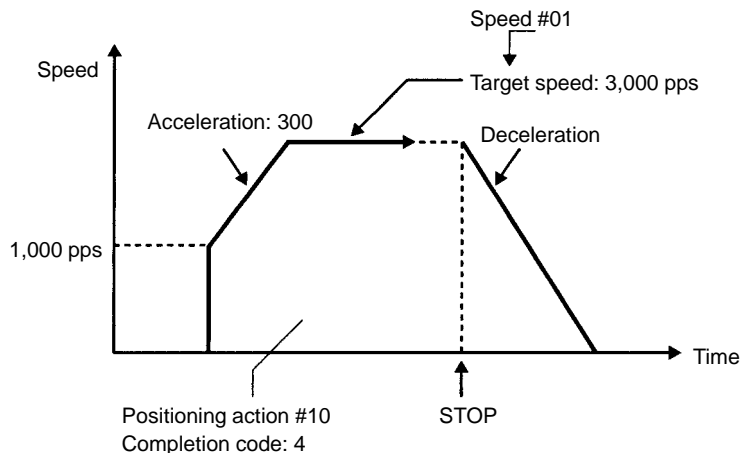
#### Settings



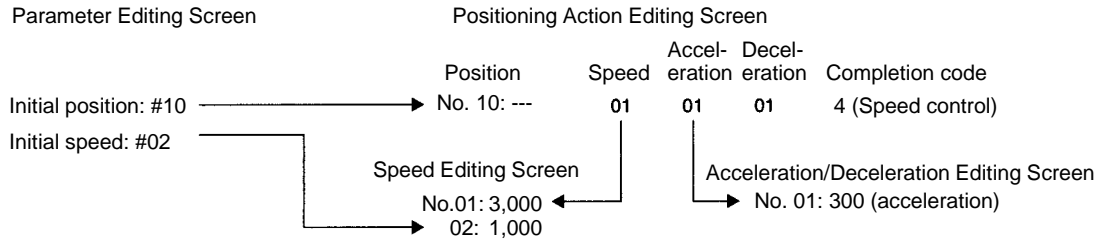
#### Command

Turn ON the START command (bit 00 of word m+1) and use WRIT (Intelligent I/O Write) to send the command to the Position Control Unit.

### 10-4 Controlling Speeds



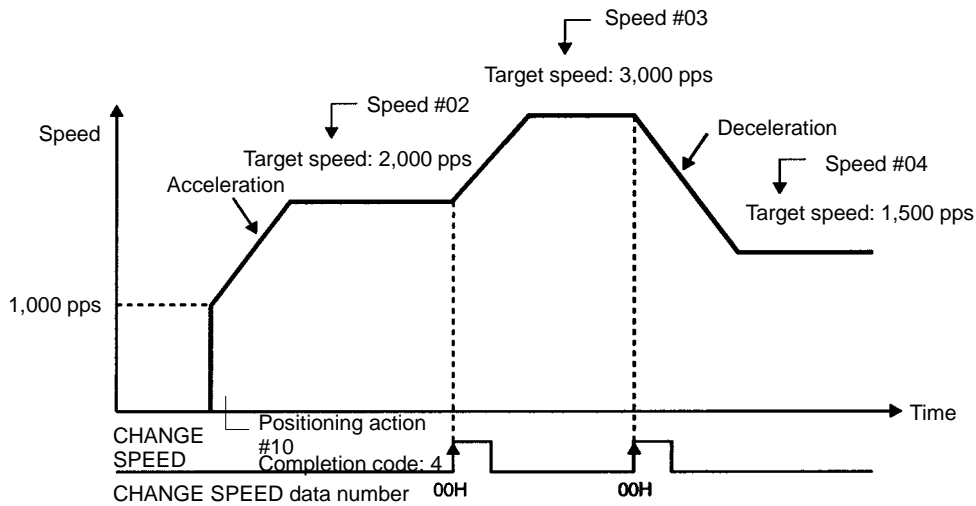
Settings



Command

Turn ON the START command (bit 00 of word m+1), turn the STOP command (bit 15 of word m+1) from OFF to ON.

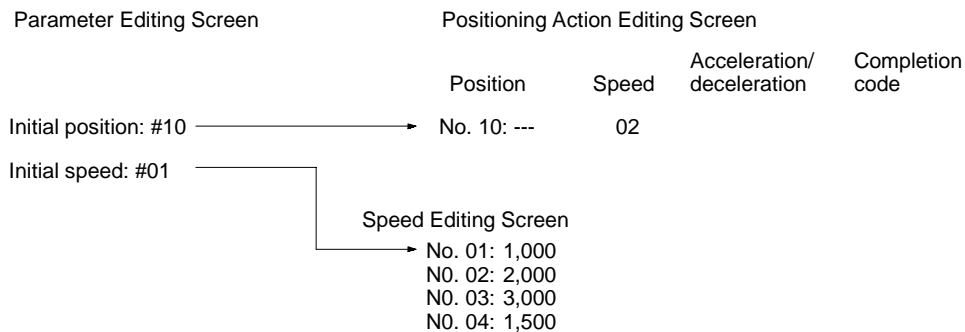
### 10-5 Changing Speeds



Changing speeds is only possible while the initial positioning action is being executed. When the speed number for the target speed change (bits 00 to 07 of command word m+4) is "00," the CHANGE SPEED command (bit 06 of command word m+1) will execute a change to the next speed number (i.e., the current speed number +1).

**Note** When the speed number for the target speed change (bits 00 to 07 of command word m+4) is other than "00" (i.e., 01 to 49), the speed set for that speed number will be executed.

Settings

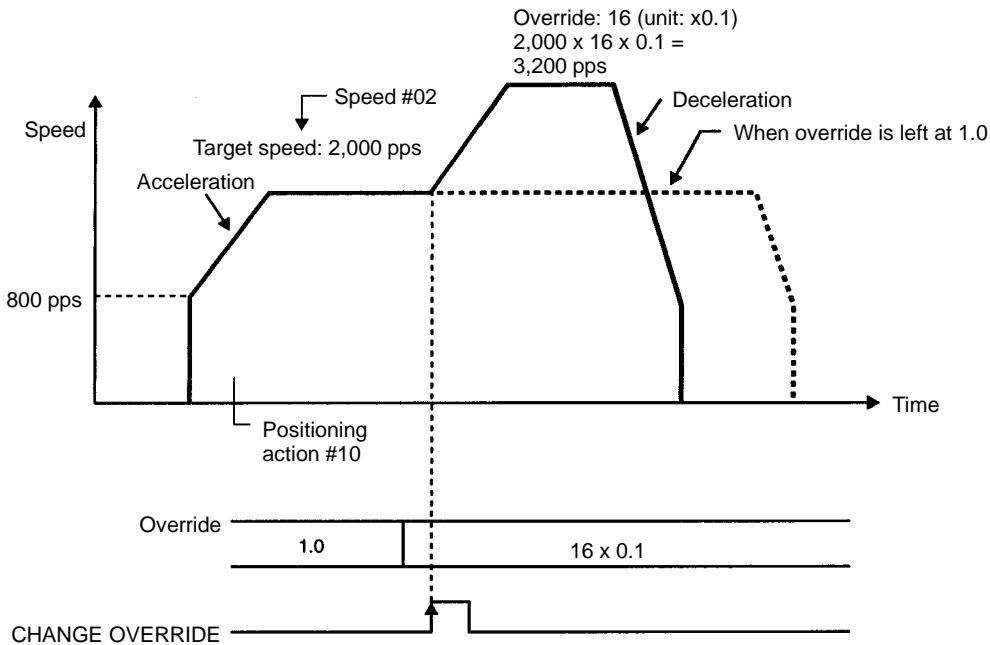


Command

When the START command (bit 00 of word m+1) is turned from OFF to ON, the speed number (bits 00 to 07 or word m+4) is set to "00" (BCD) and the CHANGE SPEED command (bit 06 of word m+1) is turned ON.



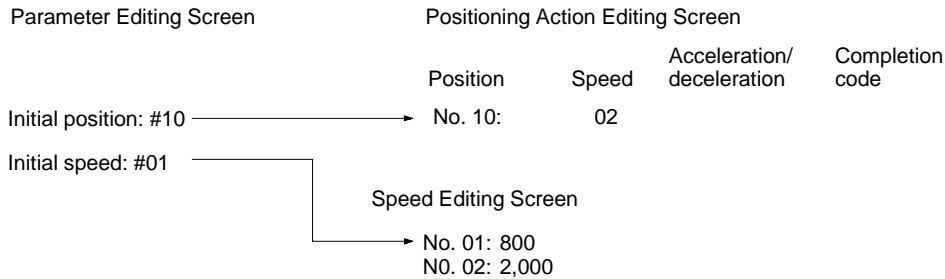
## 10-6 Changing the Override During Operation



There are two ways to use the override.

- Apply the override to all operations from start to finish by turning ON the override enable/disable (bit 07 of command word m+1) and executing START.
- Apply the override to operations following execution of the CHANGE OVERRIDE command. Set the override in advance and then make the change by turning ON the CHANGE OVERRIDE bit (bit 12 of command word m+2). This second method, changing the override during positioning, is the way that is illustrated in this example.

### Settings



### Command

Set the OVERRIDE bit (bit 00 to 07 of word m+4) to "16" (BCD). Turn the CHANGE OVERRIDE bit (bit 12 of word m+2) from OFF to ON.

## 10-7 Resetting the Present Position

When CHANGE PRESENT POSITION (bit 08 of word m+1) is turned ON (i.e., at the leading edge), the position where operation is currently stopped becomes the parameter's present position change setting (example: 0 pulse).

### Setting

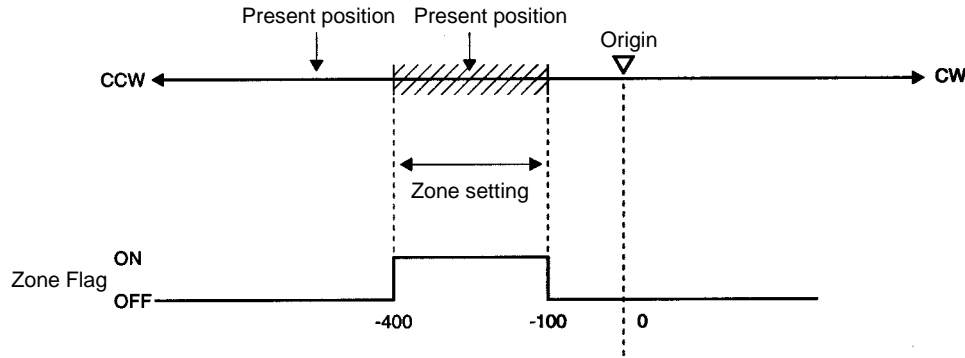
Present position change setting: 0

### Command

Turn the CHANGE PRESENT POSITION command bit (bit 08 of word m+1) from OFF to ON.

### 10-8 Setting Zones

When the present position is within the range set for a zone, the flag for that zone turns ON.



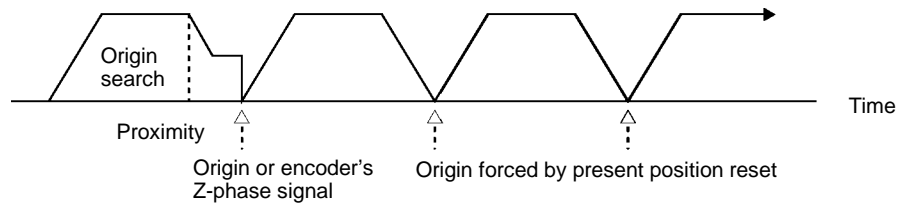
**Settings**

Zone 1 CW side: -100  
 Zone 1 CCW side: -400

### 10-9 Present Position Resetting Example

**Operation**

In this example, feeding is executed (using INDEPENDENT START) with a given point as the basis. The same positioning action and the present position reset are used alternately.



**Data Settings**

**Positioning Action (Addresses 1000, 5000)**

- Speed number: 0
- Acceleration/deceleration pattern: 0
- Dwell time: 0
- Output code: 0
- Completion code: 3
- Target position: CW 10,000 pulses (absolute)

**Parameters**

- Origin return speed number (addresses 2000, 6000): 0
- Initial speed number (addresses 2001, 6001): 0
- Initial position number (addresses 2002, 6002): 0
- Origin search high speed number (addresses 2005, 6005): 1
- Origin search proximity speed number (addresses 2006, 6006): 2
- Present position change set value (addresses 2022, 6022): 0
- Origin search mode, origin search pattern, origin type (addresses 2021, 6021)
- Origin search mode: 0
- Origin search pattern: 0
- Origin search direction: CW
- Origin proximity signal enable: Enabled
- Origin proximity signal type: N.O. contact
- Origin signal type: N.O. contact
- Origin search method: No proximity reversal

Speeds

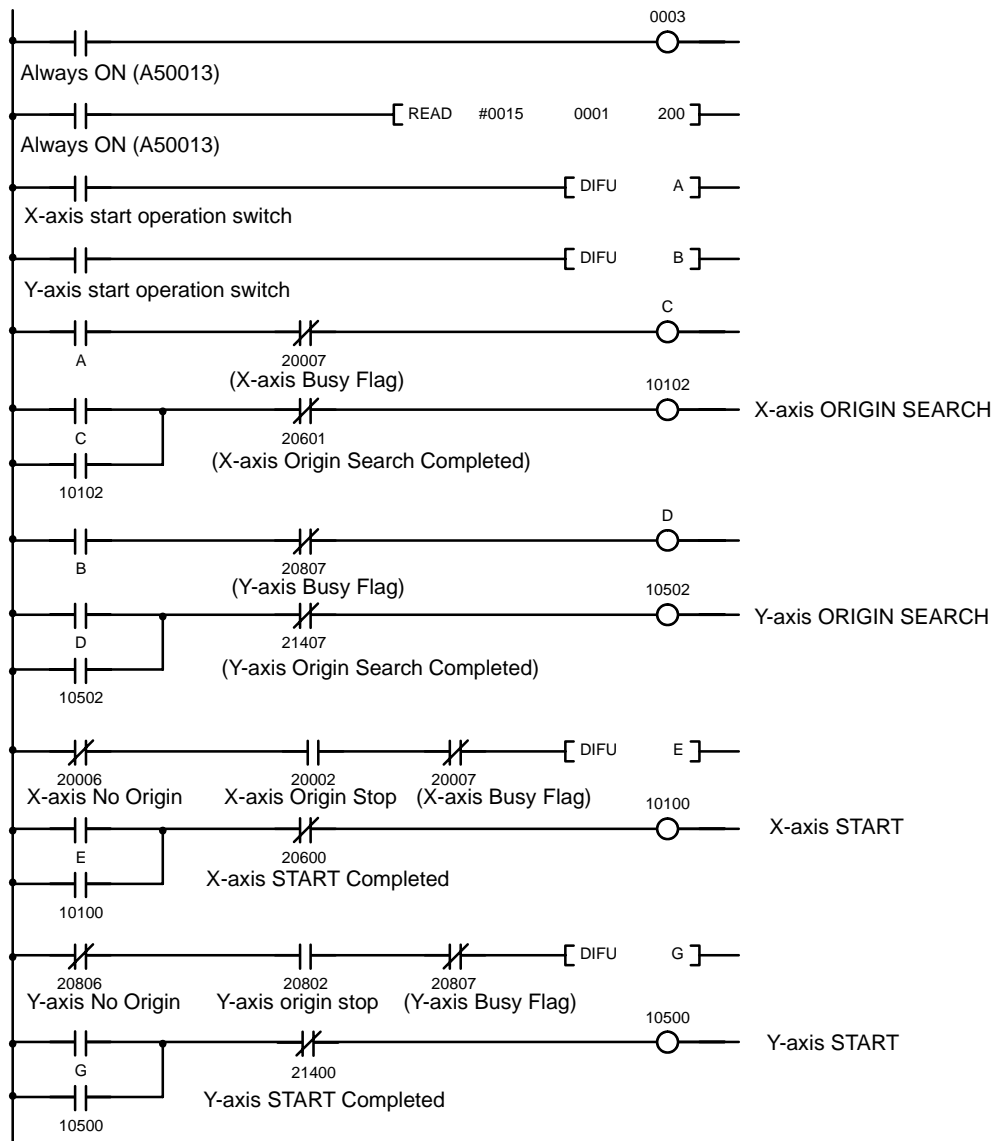
Speed #0 (addresses 4000, 8000): 5,000 pps  
 Speed #1 (addresses 4001, 8001): 5,000 pps  
 Speed #2 (addresses 4002, 8002): 500 pps

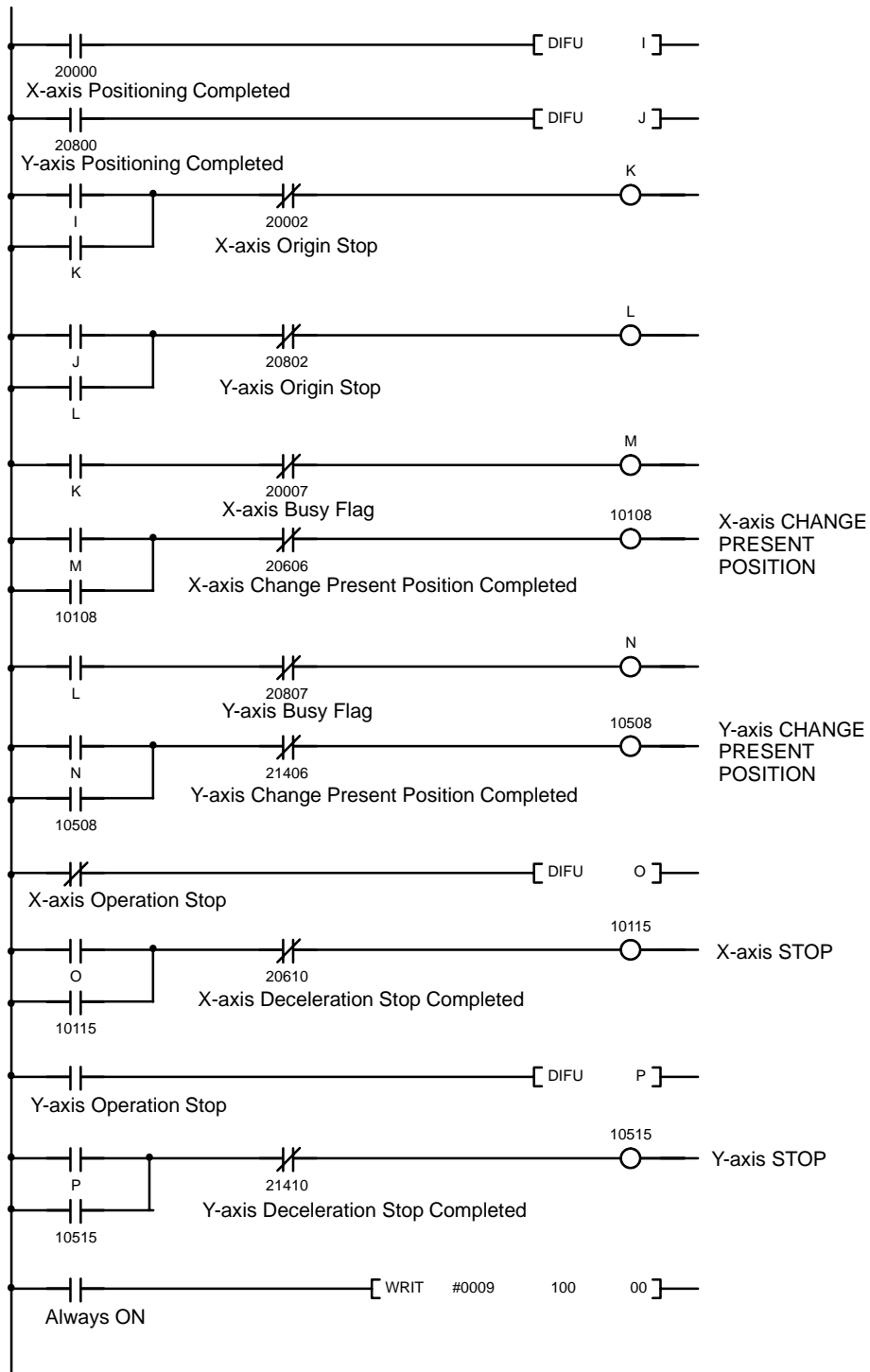
Acceleration/deceleration pattern

Acceleration/deceleration #0 (addresses 3000, 7000):  
 100 pps/ms, 100 pps/ms

Dwell time

Dwell time #0 (address 9000): 0 ms

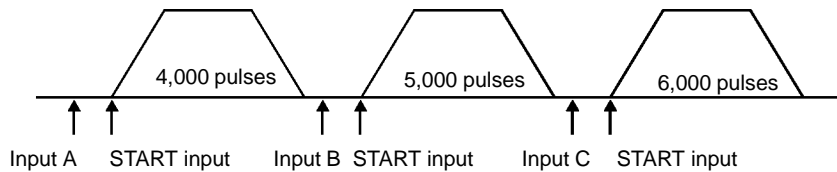




## 10-10 Feeding by START Data Selection

### Operation

By means of a selection in the user's program, X-axis feeding can be executed for 4,000 or 5,000 or 6,000 pulses, at a speed of 2,000 pps.



**Data Settings**

Set the acceleration/deceleration pattern and dwell time parameters the same as for the example provided in *10-9 Present Position Resetting Example*.

## Positioning Action #1 (Address 1000)

Speed number:	0
Acceleration/deceleration pattern:	0
Dwell time:	0
Output code:	0
Completion code:	3
Target position:	CW 4,000 pulses (incremental)

## Positioning Action #2 (Address 1001)

Speed number:	0
Acceleration/deceleration pattern:	0
Dwell time:	0
Output code:	0
Completion code:	3
Target position:	CW 5,000 pulses (incremental)

## Positioning Action #3 (Address 1002)

Speed number:	0
Acceleration/deceleration pattern:	0
Dwell time:	0
Output code:	0
Completion code:	3
Target position:	CW 6,000 pulses (incremental)

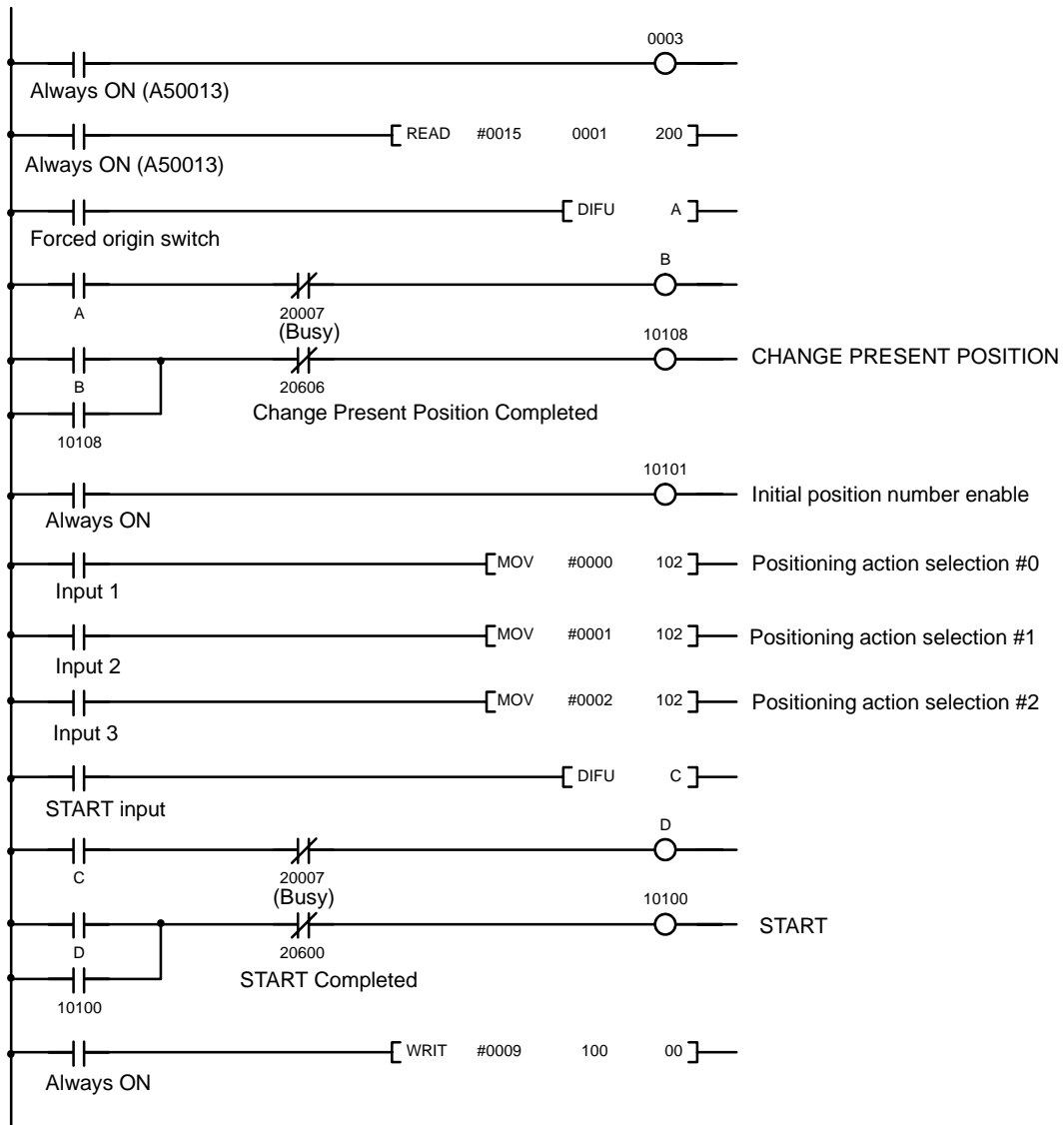
Speeds

Speed #0 (address 4000):

2,000 pps

Speed #1 (address 4001)

2,000 pps



# SECTION 11

## Data Calculation Standards

This section explains the internal processing of the NC211 and NC113 Position Control Units.

11-1	Speeds .....	220
11-2	Trapezoidal Acceleration/ Deceleration .....	221
11-3	START Time .....	222
11-4	External Interrupt Processing Time .....	222

# 11-1 Speeds

There may be a difference between set values and actual speeds. The reason for that is as follows:

### Settings between 122 and 250,000 pps:

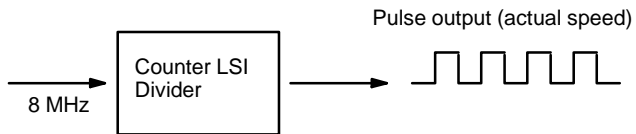
$$\text{Actual speed (pps)} = \frac{8,000,000}{\text{INT}(8,000,000/\text{set value})}$$

where,

INT: Nearest integer

INT(8,000,000/set value): Divider ratio

pps: pulses per second



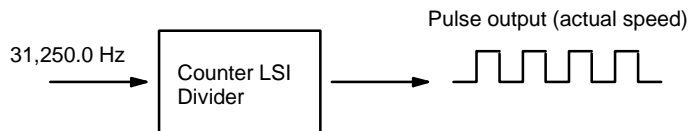
The slight difference occurs because a 8-MHz source clock is divided by the integer divider ratio.

### Example Values:

Set Value (pps)	Actual Speed (pps)
250,000	250,000.00
180,000	181818.18
140,000	140,350.87
95,000	95,238.09
3,500	3,501.09
122	122.00

### Settings between 1 and 121 pps:

$$\text{Actual speed (pps)} = \frac{31,250.0}{\text{INT}(31,250.0/\text{set value})}$$



A 31,250.0 Hz source clock is divided by the integer divider ratio.

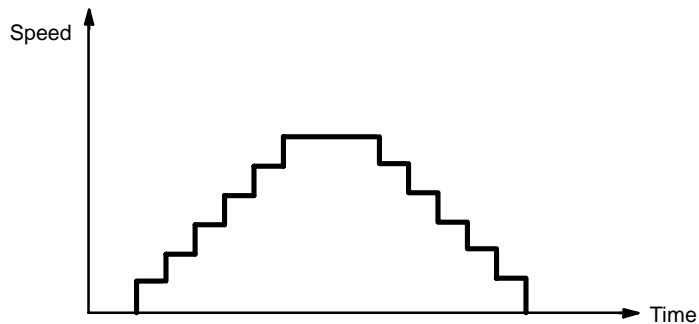
### Example Values:

Set Value (pps)	Actual Speed (pps)
121	121.12
60	60.09



## 11-2 Trapezoidal Acceleration/ Deceleration

An internal calculation process is used to create a trapezoidal figure from speed, acceleration, and deceleration settings.



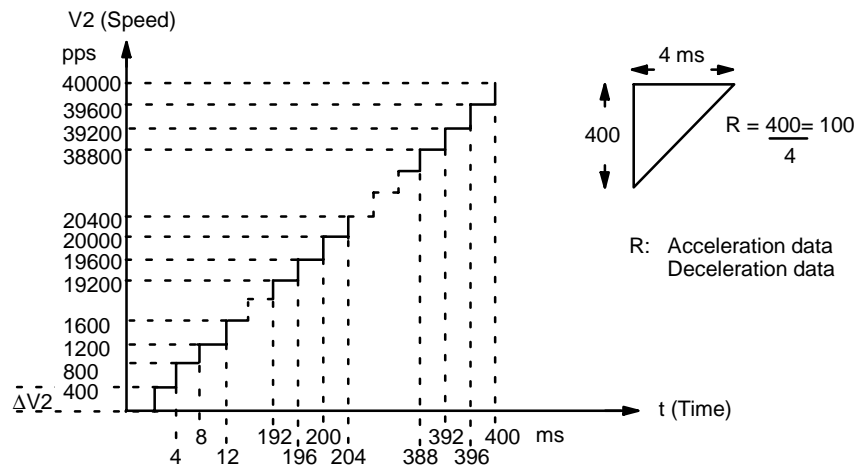
When accelerating or decelerating between two speeds, the speed is varied every unit time in a stepwise fashion.

Example:

Start speed	0 (pps)
Maximum value of speed data Nos. 1 to 15	40,000 (pps)
Acceleration	100 (pps/1ms)
Deceleration	100 (pps/1ms)

$$\Delta V2 = 100 \times 4 = 400$$

Internal processing is performed every 4 ms, so V2 (speed) is increased 400 pps at a time.

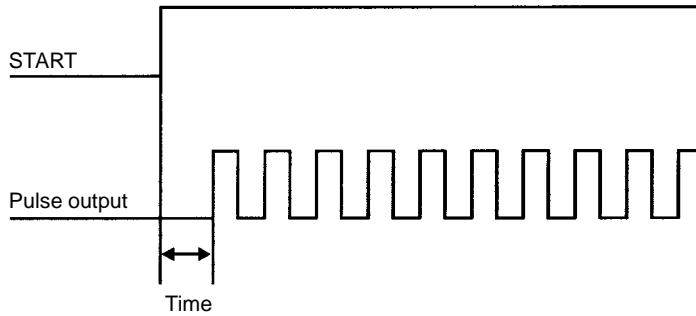


**Note** Pulse outputs are given priority, so there may be some slight variations in acceleration and deceleration times.

For example, if  $\Delta V2$  is less than 250 pps in the above graph, the acceleration/deceleration time will become larger than 4 ms because the pulse output per internal calculation process (for every 4 ms) will become less than 1.

### 11-3 START Time

The time from the moment when the Position Control Unit receives the START command to the moment when the pulse is output is as shown below. The time depends on the combination of positioning actions executed.



Pattern	START time		
	X-axis independent operation (NC113); Y-axis independent operation while X axis is stopped (NC211); X-axis independent operation while Y axis is stopped (NC211)	Y-axis independent operation while X axis is operating (NC211); X-axis independent operation while Y axis is operating (NC211)	Interpolation start
Pattern 0	Approx. 5 ms	Approx. 6 ms	Approx. 17 ms
Pattern 1 (Data items = 2)	Approx. 5 ms	Approx. 6 ms	Approx. 14 ms
Pattern 1 (Data items = maximum)	Approx. 5 ms	Approx. 6 ms	Approx. 14 ms
Pattern 2 (Speeds = 2)	Approx. 5 ms	Approx. 6 ms	Approx. 14 ms
Pattern 2 (Speeds = maximum)	Approx. 180 ms	Approx. 210 ms	Approx. 350 ms
Pattern 3	Approx. 5 ms	Approx. 6 ms	Approx. 14 ms
Pattern 4	Approx. 5 ms	Approx. 6 ms	---
Pattern 5	Approx. 6 ms	Approx. 6 ms	---

The above times do not include the following:

- Cycle time delay for executing ladder programs.
- Time required for transferring the WRIT command.
- Time (10 ms max.) required for the Position Control Unit to scan the command.

### 11-4 External Interrupt Processing Time

The time from when a CHANGE SPEED or STOP command is executed until the actual change begins is at least 4 ms.

# SECTION 12

## Error Processing

This section explains the error processing procedures for the Position Control Unit, including error codes, alarm codes, displays, and troubleshooting.

12-1 Alarms and Errors .....	224
12-2 Alarm/Error Indicators .....	225
12-3 Alarm Code List .....	227
12-4 Error Code List .....	227

# 12-1 Alarms and Errors

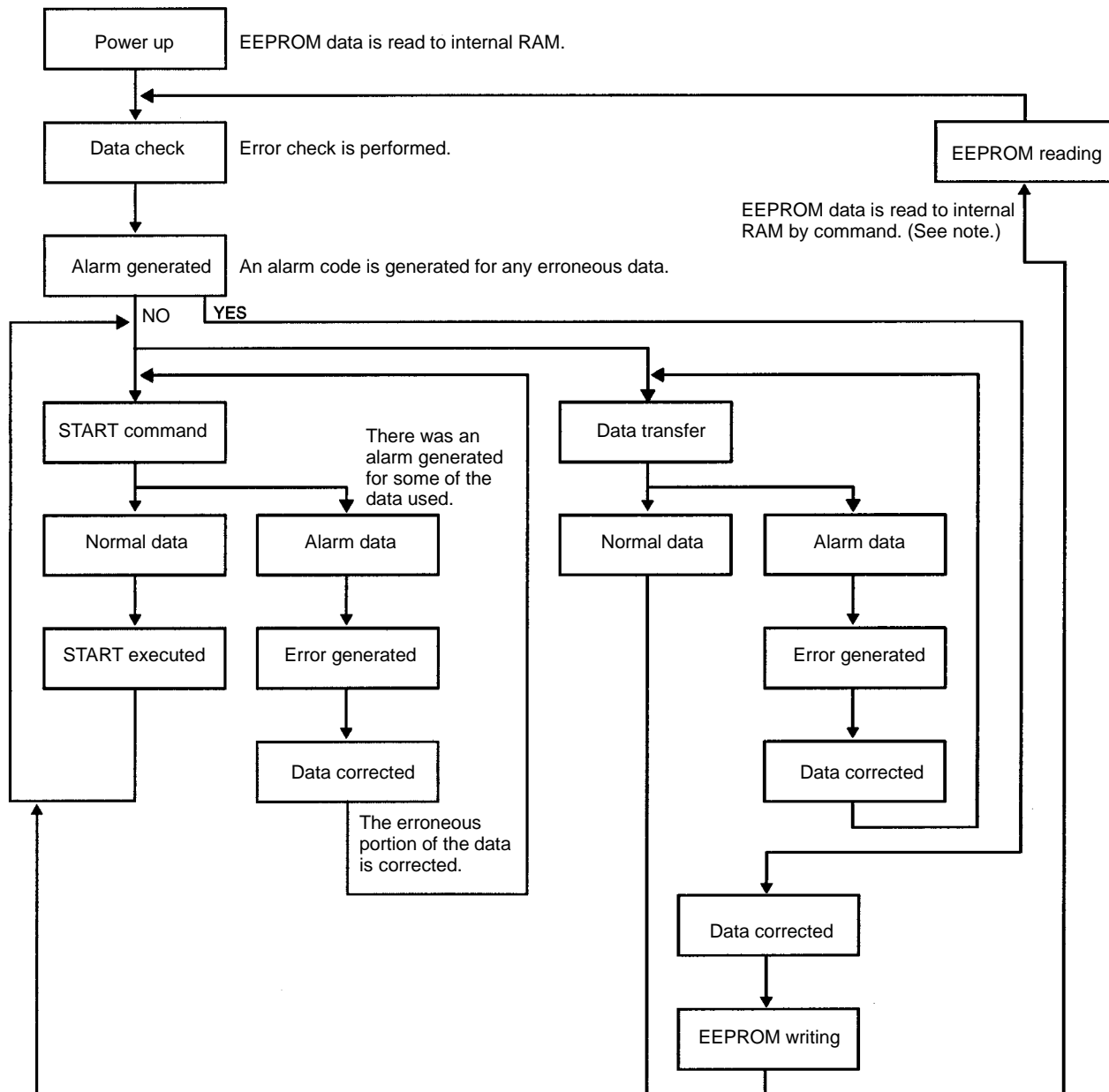
## Alarms

An alarm code is generated if there are any errors in parameter or speed data when the Position Control Unit is powered up or data is read from EEPROM to the PCU's internal RAM.

## Errors

If operation is attempted with data for which an alarm has been generated, an error code will be generated and further operation will not be possible. Error codes can also be generated during pulse output, e.g., when an emergency stop results from CW limit input.

### Relationship between Alarms and Errors



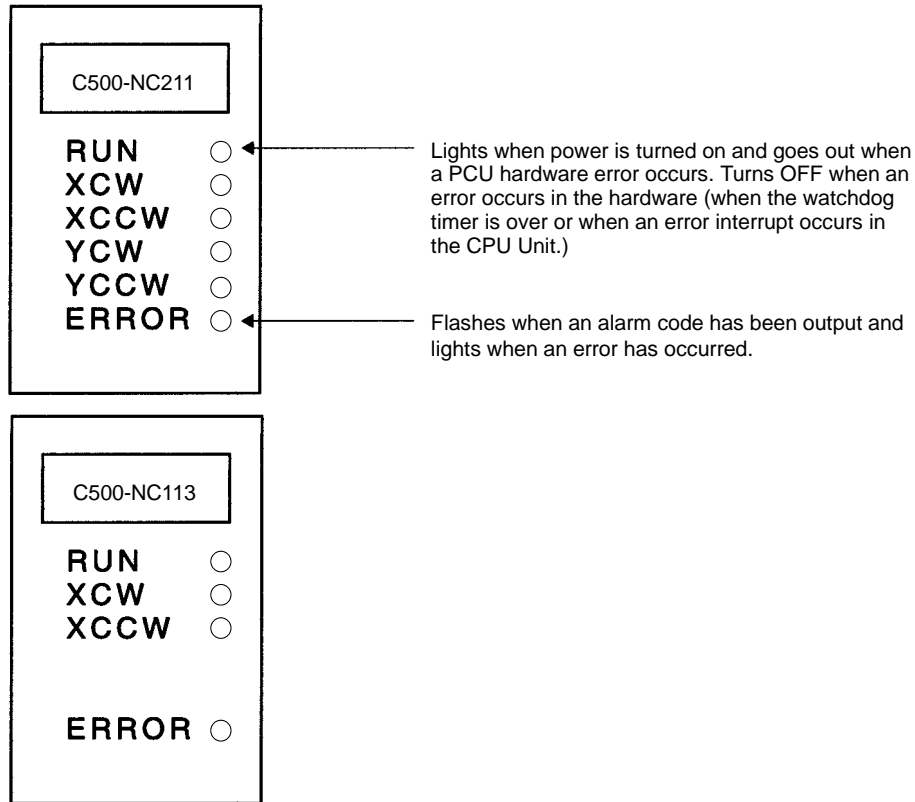
**Note** If the data is corrected without reading from EEPROM, operations such as START will be enabled. The status of the following, however, will not be cleared.

- Alarm flag ON
- Alarm code output
- Error LED indicator flashing

## 12-2 Alarm/Error Indicators

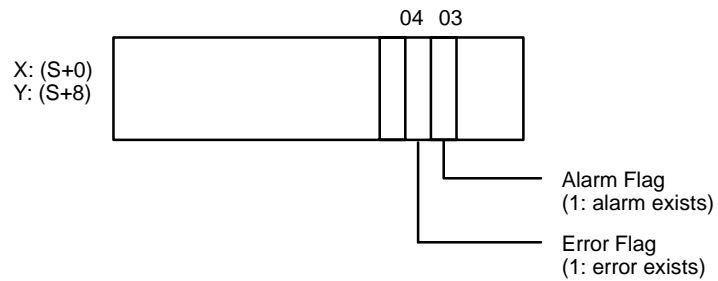
The existence of an alarm or error code is indicated both by the ERROR LED indicator on the front panel (see figure below) and by the flags in the status area.

### Front Panel LED

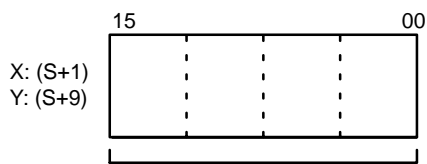


### Outputs to the Status Area

Alarm Flag X axis: Bit 03 of word S+0  
 Y axis: Bit 03 of word S+8  
 Error Flag X axis: Bit 04 of word S+0  
 Y axis: Bit 04 of word S+8



Alarm/Error codes X axis: Word S+1  
Y axis: Word S+9



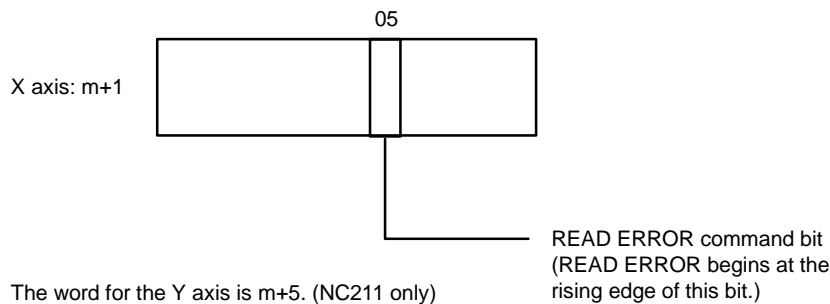
Error code (or alarm code)  
Generally, a new error (or alarm) outputs a single error code. When the READ ERROR command bit (word n+1, bit 05) turns ON, multiple error or alarm codes (or alarm codes) can be read sequentially.

**Note** The NC113 is provided with the X axis only.

**Error Code Outputs**

If there are multiple errors or alarms, use the READ ERROR command. The error code from the NC Support Tool or the contents of words s+1 and s+9 can be displayed on the Programming Console. If there are no errors or alarms, 0000 will be displayed. If there are any errors or alarms, they will be displayed in code. The codes will be displayed in order as READ ERROR is executed. (If there is only one code, however, the display will not change when READ ERROR is executed.)

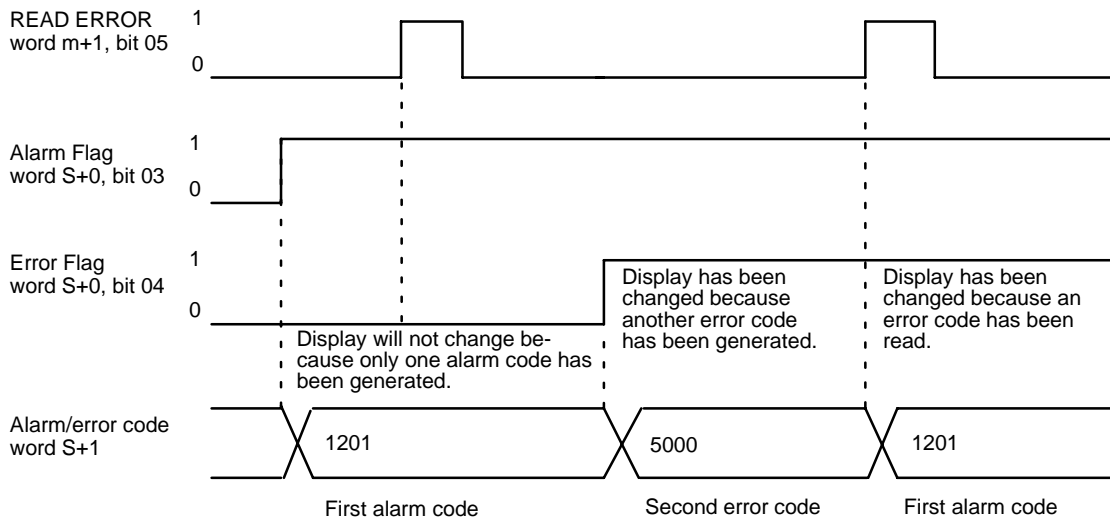
**READ ERROR Settings**



**Execution Example**

The following diagram shows an example in which first the alarm code 1201 and then the error code 5000 are displayed.

The error or alarm code (word s+1) is refreshed immediately after the READ ERROR command bit is turned ON. The Busy Flag does not turn ON.



## 12-3 Alarm Code List

Area	Item	Alarm Code	Problem and Correction
Jog operations	High-speed jog speed error	1000	The speed indicated by the high-speed jog speed number is 0, or there is a BCD error in the speed designated by the number. Correct the settings.
	Low-speed jog speed error	1001	The speed indicated by the low-speed jog speed number is 0, or there is a BCD error in the speed designated by the number. Correct the settings.
	Speed contradiction	1002	High speed is lower than low speed. Correct the settings.
ORIGIN RETURN	Speed error	1100	ORIGIN RETURN speed designated by the number is 0, or there is a BCD error in the speed designated by the number. Correct the settings.
ORIGIN SEARCH	High speed error	1201	The speed data indicated by the ORIGIN SEARCH high speed number is 0, or there is a BCD error in the speed designated by the number. Correct the settings.
	Proximity speed error	1202	The speed indicated by the ORIGIN SEARCH proximity speed number is 0, or there is a BCD error in the speed designated by the number. Correct the settings.
	Speed contradiction	1203	High speed is lower than proximity speed. Correct the settings.

## 12-4 Error Code List

Error	Error code	Problem	Correction
STARTUP ERROR	5000	Pulses cannot be output for START command because of data that generated an alarm. This data includes the initial speed, initial positioning action number, acceleration, deceleration, backlash compensation, internal CW limit, internal CCW limit, speed and target position.	Read out alarm code and correct data accordingly. Read the positioning action number is status word s+3 and check the settings. The error code will be cleared for the next START if data has been properly corrected.
Interpolation data error	5010	Single-axis and interpolation data are mixed when operation is started with a continuous completion code. (Speed control or interrupt feeding with interpolation.) This is not permitted.	Check positioning actions and correct data. The error code will be cleared for the next START if data has been properly corrected.
Speed reverse	5020	Pulse output is not possible because the direction was reversed without stopping following a continuous positioning action.	Check positioning actions and correct data. The error code will be cleared for the next START if data has been properly corrected.
CW limit	5030	Pulse output is not possible because the CW limit would be passed.	
CCW limit	5031	Pulse output is not possible because the CCW limit would be passed.	
Current position unknown	5040	Execution of START, TEACH, or ORIGIN RETURN is not possible because the present position has not been established.	Execute ORIGIN SEARCH or RESET PRESENT POSITION to clear the error.
Stopped at CW limit	5060	An attempt was made to feed clockwise using HIGH-SPEED JOG, LOW-SPEED JOG, or INCH following RELEASE PROHIBIT after feeding had been stopped at CCW limit.	
Stopped at CCW limit	5061	An attempt was made to feed counterclockwise using HIGH-SPEED JOG, LOW-SPEED JOG, or INCH following RELEASE PROHIBIT after feeding had been stopped at CCW limit.	
Manual CW limit	5070	The internal CW limit was reached and feeding stopped during execution of HIGH-SPEED JOG, LOW-SPEED JOG, or INCH.	Feed counterclockwise.

Error	Error code	Problem	Correction
Manual CCW limit	5071	The internal CCW limit was reached and feeding stopped during execution of HIGH-SPEED JOG, LOW-SPEED JOG, or INCH.	Feed clockwise.
ORIGIN SEARCH not possible	5100	<ul style="list-style-type: none"> <li>ORIGIN SEARCH cannot be executed because of data for the origin compensation, search speeds, origin return speeds, or backlash compensation that generated an alarm code.</li> <li>ORIGIN SEARCH cannot be executed because the external input protect is ON.</li> <li>ORIGIN SEARCH cannot be executed because the CW/CCW limit input was turned ON at the same time.</li> </ul>	<ul style="list-style-type: none"> <li>Read out alarm code and correct data accordingly.</li> <li>Turn OFF the external input protect and execute ORIGIN SEARCH again.</li> <li>Check the CW/CCW limit input wiring.</li> </ul>
ORIGIN RETURN not possible	5200	ORIGIN RETURN cannot be executed because of data for ORIGIN RETURN speed or backlash compensation that generated alarm.	Read out alarm code and correct and correct data accordingly. The error code will be cleared for the next operation if data has been properly corrected.
HIGH-SPEED JOG not possible	5300	HIGH-SPEED JOG cannot be executed because of data for HIGH-SPEED JOG speed, initial speed, acceleration, deceleration, or backlash compensation that generated an alarm.	
LOW-SPEED JOG not possible	5400	LOW-SPEED JOG cannot be executed because of data for LOW-SPEED JOG speed, initial speed, or backlash compensation that generated an alarm.	
INCHING not possible	5500	INCH cannot be executed because of data for backlash compensation that generated an alarm.	
Emergency stop performed	6000	Feeding has been stopped by emergency stop signal input. Feeding was stopped during an origin search because of chattering.	Check wiring. Turn off emergency stop signal and execute RELEASE PROHIBIT and ORIGIN SEARCH.
Stop for CW limit	6100	Feeding has been stopped by CW limit signal input.	Check wiring. Execute RELEASE PROHIBIT and then feed counterclockwise using HIGH-SPEED JOG, LOW-SPEED JOG, or INCH (or execute ORIGIN SEARCH or RESET PRESENT POSITION after RELEASE PROHIBIT).
Stop for CCW limit	6101	Feeding has been stopped by CCW limit signal input.	Check wiring. Execute RELEASE PROHIBIT and then feed clockwise using HIGH-SPEED JOG, LOW-SPEED JOG, or INCH (or execute ORIGIN SEARCH or RESET PRESENT POSITION after RELEASE PROHIBIT).
No origin proximity signal	6200	<p>No proximity signal is detected between the CCW and CW limits even though the DIP switch setting designates a proximity signal.</p> <p>When ORIGIN SEARCH is executed while the CW/CCW limit input is ON, the proximity signal is already ON at the initial position.</p> <p>The proximity signal is sought within the limit signal range.</p>	Check proximity signal wiring and signal type (N.C. or N.O.).



Error	Error code	Problem	Correction
No Origin signal	6201	There was no origin signal input during origin search. When ORIGIN SEARCH is executed while the CW/CCW limit input is ON, the origin signal is already ON at the initial position. The origin signal is not detected between CCW and CW limits.	Check origin signal wiring and signal type (N.C. or N.O.).
Origin signal error	6202	Feeding was stopped by origin signal input during ORIGIN SEARCH before the proximity speed was reached, i.e., the proximity signal and origin signal are too close relative to the time required for deceleration from high speed to proximity speed.	Check position of origin signal and proximity signal relative to required deceleration.
Error stop at CW limit	6400	CW limit signal was input while feeding counterclockwise.	Check wiring of limit signals.
Error stop at CCW limit	6401	CCW limit signal was input while feeding clockwise.	Check wiring of limit signals.
Speed change error	6700	Feeding has been stopped during pulse output following CHANGE SPEED because an alarm was generated for the next target speed. CHANGE OVERRIDE was executed during pulse output, but it was invalidated because of alarm data.	Check speed data. If problem is corrected, this error code will be cleared by the next START.
Multiplex Axis Start	8000	More than one command bit has been set simultaneously.  The external input protect was executed during operation.	Check program. This error code will be cleared when every command bit in word m+1 goes to 0 (and, if applicable, when the external input protect is turned OFF).  This error code will be cleared only when the external input protect command is OFF and when all command bits of m+1 words are set to 0.
Error occurred during EEPROM Read/Write	8001	A command was received during EEPROM reading or writing.	Execute the command again after the EEPROM reading or writing has been completed.
Start position data address error	8100	The initial positioning action number enable bit (bit 01 of word m+1) is ON, but the initial position action number set in bits 11 to 00 of word m+2 is outside of the range (0 to 499).	Check program. If problem is corrected, this error code will be cleared by the next START.
Teaching position data address error	8200	TEACH was executed but the teaching positioning action number set in bits 11 to 00 of word m+3 has a BCD error or is outside of the range (0 to 499).	Check program. If problem is corrected, this error code will be cleared by the next TEACH.
Data address error	8305	A data address outside of the defined range was sent by WRIT (the Intelligent I/O Write instruction).	Correct the command or data and send it again. This error will be cleared when correct data is sent.
Data length error	8306	Data of a length outside of the defined range was sent by WRIT (the Intelligent I/O Write instruction).	
Data setting timing error	8307	Data was sent by WRIT (the Intelligent I/O Write instruction) while the Busy Flag (bit 07 of word s+0) was ON.	Data cannot be transferred during operation. Resend the data while operation is stopped.

<b>Error</b>	<b>Error code</b>	<b>Problem</b>	<b>Correction</b>
Undefined error	8308	Data outside of the defined range was sent by WRIT (the Intelligent I/O Write instruction).	Correct the command or data and send it again. This error will be cleared when correct data is sent.
Format error	8309	A format outside of the defined range was sent by WRIT (the Intelligent I/O Write instruction).	
Communications device error	8400	An error occurred during the processing of data communications with the computer, and processing was stopped.	Check the cable connections and the communications settings. Re-send the data after correcting the problem.
Hardware error	9000	When the PCU is powered up, initial processing for the PCU's built-in LSI is not completed normally.	Hardware is possibly faulty.
	9100	Target position for a positioning action has been exceeded.	Hardware is possibly faulty or error is possibly caused by noise.
EEPROM read/write error	9200	When the data range check was performed for EEPROM read/write processing, an error was generated because the data was outside of the range. (The error was generated only for the X axis.)	The data unit and set unit do not match. Correct the data and execute EEPROM WRITE. Then execute EEPROM READ or turn on the power again.
		A verification error was generated when data was compared during EEPROM writing. Either the hardware is faulty or the EEPROM life has expired. (The error was generated only for the X axis.)	Replace the Unit.



# Parameters

	X axis
Address	2,000 to 2,029

Address	15 ↔ 00	Contents
		X-axis origin return speed address
		X-axis start speed address
		X-axis start positioning address
		X-axis high jog speed address
		X-axis low jog speed address
		X-axis origin search high speed address
		X-axis origin compensation sign
		X-axis origin search proximity speed address
		X-axis origin compensation
		X-axis origin return dwell time number
		X-axis origin search dwell time address
		X-axis backlash compensation
		X-axis home shift

Address	15 ↔ 00	Contents
		X-axis CW limit
		X-axis CCW limit
		X-axis zone 0, CW side
		X-axis zone 0, CCW side
		X-axis zone 1, CW side
		X-axis zone 1, CCW side
		X-axis zone 2, CW side
		X-axis zone 2, CCW side
		X-axis zone 3, CW side
		X-axis zone 3, CCW side
		X-axis zone 4, CW side
		X-axis zone 4, CCW side
		X-axis zone 5, CW side
		X-axis zone 5, CCW side

Address	15 ↔ 00	Contents
		X-axis zone 6, CW side
		X-axis zone 6, CCW side
		X-axis zone 7, CW side
		X-axis zone 7, CCW side
		X-axis origin search mode
		X-axis origin search pattern
		X-axis origin search type
		RESET PRESENT POSITION setting
		X-axis origin return acceleration/deceleration pattern address

Address	15 ↔ 00	Contents
		X-axis origin search acceleration/deceleration pattern address
		X-axis high-speed jogging acceleration/deceleration pattern address
		Number of pulses for X-axis inching
		X-axis unit setting
		X-axis pulse rate
		X-axis output pulse selection
		X-axis interrupt input signal definition
		X-axis interrupt input signal type
		X-axis interrupt input emergency stop parameter

	Y axis
Address	6,000 to 6,029

Address	15 ↔ 00	Contents
		Y-axis origin return speed address
		Y-axis start speed address
		Y-axis start positioning address
		Y-axis high jog speed address
		Y-axis low jog speed address
		Y-axis origin search high speed address
		Y-axis origin compensation sign
		Y-axis origin search proximity speed address
		Y-axis origin compensation
		Y-axis origin return dwell time address
		Y-axis origin search dwell time address
		Y-axis backlash compensation
		Y-axis home shift
		Y-axis CW limit

Address	15 ↔ 00	Contents
		Y-axis CCW limit
		Y-axis zone 0, CW side
		Y-axis zone 0, CCW side
		Y-axis zone 1, CW side
		Y-axis zone 1, CCW side
		Y-axis zone 2, CW side
		Y-axis zone 2, CCW side
		Y-axis zone 3, CW side
		Y-axis zone 3, CCW side
		Y-axis zone 4, CW side
		Y-axis zone 4, CCW side
		Y-axis zone 5, CW side
		Y-axis zone 5, CCW side
		Y-axis zone 6, CW side
		Y-axis zone 6, CCW side

Address	15 ↔ 00	Contents
		Y-axis zone 7, CW side
		Y-axis zone 7, CCW side
		Y-axis origin search mode
		Y-axis origin search pattern
		Y-axis origin search type
		RESET PRESENT POSITION setting
		Y-axis origin return acceleration/deceleration pattern address
		X-axis origin search acceleration/deceleration pattern address

Address	15 ↔ 00	Contents
		Y-axis high-speed jogging acceleration/deceleration pattern address
		Number of pulses for Y-axis inching
		Y-axis unit setting
		Y-axis pulse rate
		Y-axis output pulse selection
		Y-axis interrupt input signal definition
		Y-axis interrupt input signal type
		Y-axis interrupt input emergency stop parameter









## Appendix B

### Command and Status Charts

#### X-axis Command Format (Words m+1 to m+4)

Bit	Word				
	m+0	m+1	m+2	m+3	m+4
00	1	START	Initial positioning action number (000 to 499)	Teaching positioning action number (000 to 499)	Override: 00 to 20 (Unit x 0.1) (00: Override 1.0)  Speed number for target speed change (00 to 49) (00: Present speed number + 1)
01		Initial positioning action number enable			
02		ORIGIN SEARCH			
03		ORIGIN RETURN			
04	0	RELEASE PROHIBIT			
05		READ ERROR			
06		CHANGE SPEED/DEFINE INTERRUPT INPUT SIGNAL			
07		Override enable			
08	0	CHANGE PRESENT POSITION			Forced ON/OFF bit for error counter reset. Enabled only while operation is stopped.
09		TEACH			Forced ON/OFF bit for origin adjustment command outputs (See note 1.)
10		Not used.			0
11		HIGH-SPEED JOG			0
12	0	Jogging/inching direction	CHANGE OVERRIDE	0	EEPROM command
13		LOW-SPEED JOG	Home shift enable/disable setting (0: Disable; 1: Enable)	0	EEPROM read/write designation
14		INCH	0	0	PC protect
15		STOP	0	0	External input protect

- Note**
1. Enabled only when stopped or during manual operation.
  2. Commands shown in the shaded boxes for word m+1 are executed when their allocated bit turns ON.

Y-axis Command Format (Words m+5 to m+8)

Bit	Word				
	m+5	m+6	m+7	m+8	
00	START	Initial positioning action number (000 to 499)	Teaching positioning action number (000 to 499)	Override: 00 to 20 (Unit x 0.1) (00: Override 1.0) Speed data address for target speed change (00 to 49) (00: Present speed number + 1)	
01	Initial positioning action number enable				
02	ORIGIN SEARCH				
03	ORIGIN RETURN				
04	RELEASE PROHIBIT				
05	READ ERROR				
06	CHANGE SPEED/DEFINE INTERRUPT INPUT SIGNAL				
07	Override enable				
08	CHANGE PRESENT POSITION				Forced ON/OFF bit for error counter reset. Enabled only while operation is stopped.
09	TEACH				Forced ON/OFF bit for origin adjustment command outputs. Enabled only when stopped or during manual operation.
10	Not used.		0		
11	HIGH-SPEED JOG		0		
12	Jogging/inching direction	CHANGE OVERRIDE	0	0	
13	LOW-SPEED JOG	Home shift enable/disable setting (0: Disable; 1: Enable)	0	0	
14	INCH	0	0	0	
15	DECELERATION STOP	0	0	0	

- Note**
1. Commands shown in the shaded boxes for word m+1 are executed when their allocated bit turns ON.
  2. The Y-axis command area does not have the EEPROM command, EEPROM read/write designation, PC protect, or external input protect.

X-axis Status Area

Bit	Word								
	s+0	s+1	s+2	s+3	s+4	s+5	s+6		
00	Positioning Completed Flag	Error Code	Output Code	Current Positioning Action Number	Present Position (x 10 <sup>0</sup> )	Present Position (x 10 <sup>4</sup> )	Start Completed Flag		
01	Bank End Flag						Origin Search Completed Flag		
02	Origin Stop Flag						Origin Reset Flag		
03	Alarm Flag						Pulse Output Enabled Flag		
04	Error Flag				Present Position (x 10 <sup>1</sup> )	Present Position (x 10 <sup>5</sup> )	Error Read Completed Flag		
05	Teaching Completed Flag						Speed Changed Flag		
06	No Origin Flag						Change Present Position Flag		
07	Busy Flag				Present Position (x 10 <sup>2</sup> )	Present Position (x 10 <sup>6</sup> )	Teaching Completed Flag		
08	Zone 0						EEPROM Completed Flag		
09	Zone 1						Inching Completed Flag		
10	Zone 2						Deceleration Stop Completed Flag		
11	Zone 3				Positioning Completed Input Signal	Present Position (x 10 <sup>3</sup> )	Sign 0: CW 1: CCW	Speed Override Changed Flag	
12	Zone 4				Origin Input Signal			Emergency Stop Input Signal	Data Transfer Request Completed Flag
13	Zone 5				Origin Proximity Input Signal			External Interrupt input Signal	---
14	Zone 6				CW Limit Input Signal			Emergency Stop	---
15	Zone 7	CCW Limit Input Signal	Execute Deceleration Stop	---					

- Note**
1. During interpolation, the X-axis status area is used for transmitting the status.
  2. The Completed Flag for the word s+6 (X axis) and word s+14 (Y axis) turns ON only when commands are received. For example, an ORIGIN SEARCH command issued during the START operation will be disabled and the Origin Search Completed Flag will not turn ON.

**Common Status Area**

Bit	Word
	s+7
00	EEPROM Write Completed
01	EEPROM Writing
02	EEPROM Reading
03	---
04	---
05	---
06	---
07	---
08	---
09	---
10	---
11	---
12	---
13	---
14	---
15	---

Y-axis Status Area

Bit	Word							
	s+8	s+9	s+10	s+11	s+12	s+13	s+14	
00	Positioning Completed Flag	Error code	Output code	Current positioning action number	Present Position (x 10 <sup>0</sup> )	Present Position (x 10 <sup>4</sup> )	Start Completed Flag	
01	Bank End Flag						Origin Search Completed Flag	
02	Origin Stop Flag						Origin Reset Flag	
03	Alarm Flag						Pulse Output Enabled Flag	
04	Error Flag				Present Position (x 10 <sup>1</sup> )	Present Position (x 10 <sup>5</sup> )	Error Read Completed Flag	
05	Teaching Completed Flag						Speed Changed Flag	
06	No Origin Flag						Change Present Position Flag	
07	Busy Flag				Present Position (x 10 <sup>2</sup> )	Present Position (x 10 <sup>6</sup> )	Teaching Completed Flag	
08	Zone 0						---	
09	Zone 1						Inching Completed Flag	
10	Zone 2						Deceleration Stop Completed Flag	
11	Zone 3			Positioning Completed Input Signal	Present Position (x 10 <sup>3</sup> )	Sign 0: CW 1: CCW	Speed Override Changed Flag	
12	Zone 4			Origin Input Signal			Emergency Stop Input Signal	---
13	Zone 5			Origin Proximity Input Signal			External Interrupt Input Signal	---
14	Zone 6			CW Limit Input Signal			Emergency Stop	---
15	Zone 7	CCW Limit Input Signal	Execute Deceleration Stop	---				

**Note** Y-axis area is for the NC211 only.

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## Revision History

# C500-NC113 (One-axis Control) C500-NC211 (Two-axis Control) Position Control Units

## Operation Manual

A manual revision code appears as a suffix to the catalog number on the front cover of the manual.

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Revision code	Date	Revised content
W323-E1-1	October 1997	Original production
W323-E3-1	February 1998	This version is based on the October 1997 original W323-E1-1 production. Minor correction to Outputting Pulse and Direction Signals Chart on page 42.