

**SYSMAC**  
**C200H-NC111**  
**Position Control Unit**

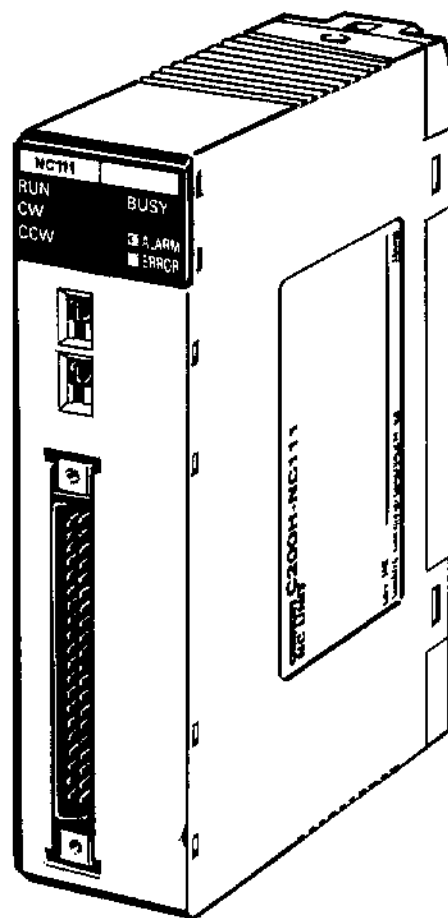
**OPERATION MANUAL**

**OMRON**

# SYSMAC C200H-NC111 Position Control Unit

## Operation Manual

*Revised September 2003*








## 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 property.

 **DANGER** Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

 **WARNING** Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

 **Caution** Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or property damage.

## 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:

The C200H–NC111 Position Control Unit is a Special I/O Unit for C200H PCs. It is designed to control equipment positioning through pulse train outputs to a motor driver. The degree of movement is based on the program installed into the PC and the external control inputs.

This manual covers the specifications and procedures necessary for installation and efficient operation. Before attempting to operate the C200H Position Control Unit, be sure to thoroughly familiarize yourself with the information contained within this and any other relevant manuals.

**Section 1** describes the basic features and components of the Position Control Unit. It also gives details on configurations for positioning control systems and their principles of operation.

**Section 2** describes how to incorporate the Positioning Control Unit into a system. It provides information on how to set switches so that the Unit provides the desired operating functions. It also gives mounting and wiring information.

**Section 3** gives details on the procedures for setting up and operating a positioning control system. It includes information on PC operations (such as flags, zone settings, the range of output pulses, backlash compensation, etc.), data areas and data formats.

**Section 4** outlines the thirteen commands available on the Positioning Control Unit. It describes each command, how it works, the data required, and the data areas used. Examples are given (in timing chart form) which show the status of the relevant inputs, outputs, bits, and flags during the execution of the commands.

**Section 5** provides programming examples which give practical illustrations of how the Positioning Control Unit commands can be used to implement effective positioning control.

**Section 6** explains various error and alarm conditions and the steps that can be taken to avoid and/or prevent them.

**Appendix A** provides more detailed information on alarm codes, including the type of operations in which the alarm may arise, the type of error, the alarm code, and the most probable cause.

**Appendix B** lists the error codes in numeric sequence and provides information on the cause of, and remedy for, the existing problem.

**Appendix C** describes the functions that each of the different parts of the DM Area performs.

**Appendix D** describes the functions for which each of the different parts of the IR Area can be used.

**Appendix E** provides the performance and electrical specifications for the Positioning Control Unit.

**Appendix F** lists the models which are used with the Positioning Control Unit.

A comprehensive **Glossary** is provided which explains many of the terms and abbreviations commonly used when referring to Positioning Control Units and PC Systems.



**WARNING** 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 (PCU), and related devices.

**The information contained in this section is important for the safe and reliable application of the Programmable Controller 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 PCU and keep this manual close at hand for reference during operation.

## 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.

 **WARNING** Provide safety measures in external circuits (i.e., not in the Programmable Controller), including the following items, to ensure safety in the system if an abnormality occurs due to malfunction of the PC or another external factor affecting the PC operation. Not doing so may result in serious accidents.

- Emergency stop circuits, interlock circuits, limit circuits, and similar safety measures must be provided in external control circuits.
- The PC will turn OFF all outputs when its self-diagnosis function detects any error or when a severe failure alarm (FALS) instruction is executed. As a countermeasure for such errors, external safety measures must be provided to ensure safety in the system.
- The PC outputs may remain ON or OFF due to deposits on or burning of the output relays, or destruction of the output transistors. As a countermeasure for such problems, external safety measures must be provided to ensure safety in the system.
- When the 24-V DC output (service power supply to the PC) is overloaded or short-circuited, the voltage may drop and result in the outputs being turned OFF. As a countermeasure for such problems, external safety measures must be provided to ensure safety in the system.


## 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.

## 5 Application Precautions

Observe the following precautions when using the Position Control Unit (PCU) and Programmable Controller (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 Power Supply Unit, I/O Units, CPU Unit, other Units, or Memory Cassettes.
  - Assembling the devices.
  - Setting DIP switches or rotary switches.
  - Wiring or connecting cables.
  - Connecting or disconnecting the 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.
- Install external breakers and take other safety measures against short-circuiting in external wiring.
- Tighten the PC mounting screws, terminal block screws, and cable screws to the torque specified in this manual.
- 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.
- Use crimp terminals for wiring. Do not connect bare stranded wires directly to terminals.
- Leave the dustproof labels affixed to the top of the Unit when wiring. After wiring, remove the labels for proper heat radiation.
- 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.
- Check the user program for proper execution before actually running it in the Unit.
- Be sure that the terminal blocks, memory units, extension cables, and other items with locking devices are properly locked.
- Double-check all the wiring before turning on the power supply.
- Disconnect the functional ground terminal when performing withstand voltage tests.
- Confirm that no adverse effect will occur in the system before performing the following operations:
  - Changing the operating mode of the PC.
  - Force-setting/resetting the relay contacts.
  - Changing the present values or set values.
  - Changing positioning data or parameters.
- Resume operation only after transferring to the new CPU Unit the contents of the DM and HR Areas required for operation.
- Do not attempt to disassemble, repair, or modify any Units.
- Do not pull on or bend the cables beyond their natural limit. Doing so may break the cables.
- Do not place heavy objects on top of the cables. Doing so may break the cables.
- Resume operation only after saving in the Position Control Unit the parameters and position data required for resuming operation.
- Be sure that the set parameters and data operate properly.
- Be sure to check the pin numbers before wiring the connectors.
- Perform wiring according to specified procedures.
- Before touching a Unit, be sure to first touch a grounded metallic object in order to discharge any static build-up from your body. Not doing so may result in malfunction or damage

# SECTION 1

## Introduction

The C200H-NC111 Position Control Unit is a Special I/O Unit that receives positioning commands either externally or from a Programmable Controller (PC) and uses that data to output control voltages to a stepping motor driver or a servomotor driver.

This section describes the basic features and components 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
1-2	Components .....	2
1-3	System Configuration .....	3
1-4	Control System Principles .....	5
1-4-1	Open-loop System .....	7
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## 1–1 Features

### Applicable Motor Drivers

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

- 1) Stepping motor driver
- 2) Servomotor driver designed for pulse train input

### Number of Control Axes and Controlling Capacity

The Position Control Unit is designed exclusively to control a single axis and is capable of controlling speeds and positions through parameters recorded in the DM area of the C200H PC.

### Manual Operation

Three commands enable manual positioning control: HIGH-SPEED JOG, LOW-SPEED JOG, and INCH.

### Data Transfer

Positioning actions, speeds, and other data contained in the DM area or other areas of the PC can be quickly transferred via a TRANSFER DATA command. Control scale can thus be expanded to exceed the data capacity of the Position Control Unit.

### Establishing Position

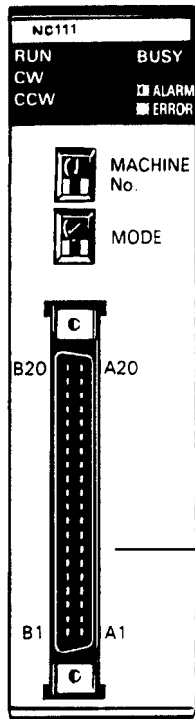
The TRANSFER DATA command can also be used to change the present position to any target value, including 0 (origin), anytime the Position Control Unit is not outputting pulses.

### Teaching

The present position can be written into the memory of the PC as positioning data whenever pulses are not being output.

## 1–2 Components

In addition to the front-panel components described on the following page, there is a DIP switch located on the back panel. Pin settings for this switch, which are described under *2–1 Switch Settings*, determine certain aspects of control system operation.



**Indicators**

RUN: indicates operation is in progress	BUSY: indicates operation/transfer is in progress
CW: indicates controlled system (motor) is revolving clockwise	ALARM: blinks when an abnormality has occurred
CCW: indicates controlled system (motor) is revolving counterclockwise	ERROR: lights when an error has occurred

**Setting switches**

MACHINE No.	Allocates a unit number (0 to 9) to the Position Control Unit
MODE	Not used

**Connector**

Used to connect the Position Control Unit to a stepping motor driver or servomotor driver.  
Attach the enclosed connector to the proper cable.

When setting the switches, use a screwdriver if necessary. Do not apply an excessive force to the switches. Do not leave the switches halfway between two setting points or the Position Control Unit may malfunction. Before operating these switches, make sure that power to the PC is off.

**Indicators**

Position Control Unit indicators (LEDs) are used to quickly determine operating status. They are particularly valuable in initial system activation and debugging, but can also be used to monitor and check Unit operation.

Indicator	Color	Function
RUN	Green	Lit during normal operation. Goes out for errors.
CW	Green	Lit during output of CW (clockwise) pulses.
CCW	Green	Lit during output of CCW (counterclockwise) pulses.
BUSY	Green	Lit during positioning or data transfer.
ALARM (flashing)	Red	Flashing when a BCD error exists in initial data, speed data, or positioning data updated with TRANSFER DATA.
ERROR	Red	Lit when an error has occurred causing operation to stop.

**1-3 System Configuration**

The basic system configuration is shown below. Position Control Unit outputs are connected to a motor driver, either for a stepping motor or for a servomotor (either AC or DC) capable of receiving pulse train inputs. The Unit is controlled by inputs from devices and/or a control panel. It, in turn, outputs pulse trains and direction signals to control the motor driver.

The motor driver controls either a stepping motor or a servomotor, depending on whether an open-loop or semiclosed-loop system is employed. (See *1-4 Control System Principles*). The stepping motor (or servomotor) controls some type of positioning device (such as a feed screw, for example). An independent power supply must be used. Some configurations also require an Input Unit on the C200H PC to control the motor driver.

### Maximum Number of Special I/O Units per PC

A maximum of 10 Special I/O Units, including Position Control Units, High-Speed Counters, etc., can be mounted under the same PC, regardless of whether they are on the CPU Rack, an Expansion I/O Rack, or a rack containing a Remote I/O Slave Unit controlled by the PC. No more than four of these can be mounted onto any one rack containing a Remote I/O Slave Unit.

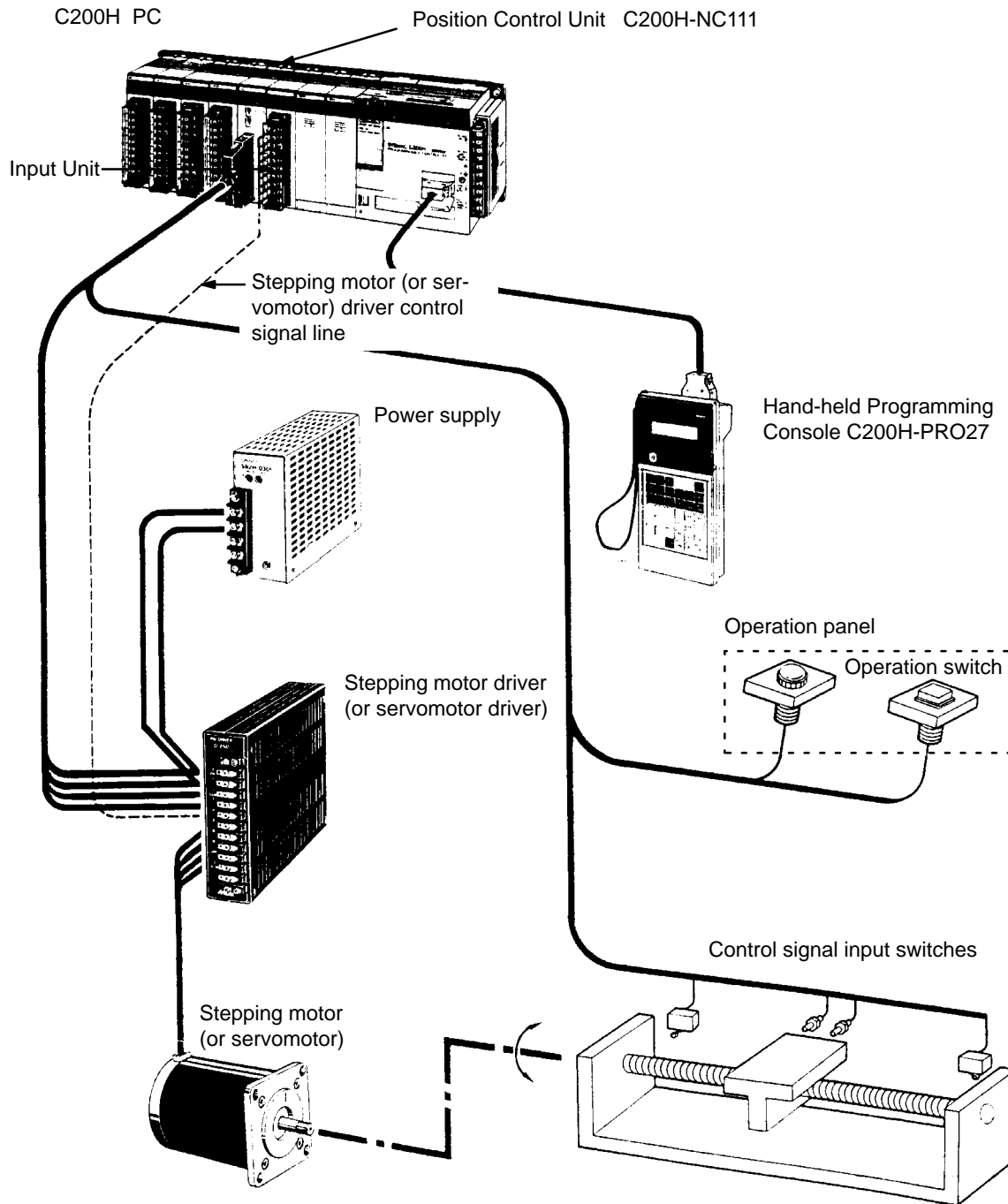
### Mounting Location

The Position Control Unit can be mounted to any but the 2 rightmost CPU Rack slots. Mounting the Unit to either of these slots will prevent you from mounting devices directly to the PC's CPU. The back-panel DIP switch must be set before the Unit is mounted. This switch is inaccessible on a mounted Unit. (See *2-1 Switch Settings*.)

### Basic Configuration

Although Unit operation can be indirectly controlled from a host computer, Remote I/O Master Unit, or other control system or peripheral device, direct control comes from the program of the PC or from connections to external inputs (e.g., control panel switches). (A list of Position Control Unit inputs and outputs can be found under *I/O Circuits* in *2-2 Wiring*.) The following configuration diagrams show only the positioning system itself. Refer to the operating manuals for other Omron control devices for details on extended control system operation.





## 1-4 Control System Principles

Control systems can be quite simple or relatively complex. The most basic is an open-loop system, in which a particular operation is carried out, according to programmed instructions, but in which adjustments are not made directly by the PC. Instead, the open-loop system typically displays or prints out information to assist a human operator in making any required adjustments. The C200H-NC111 Position Control Unit can be used in an open-loop system in conjunction with a stepping motor.

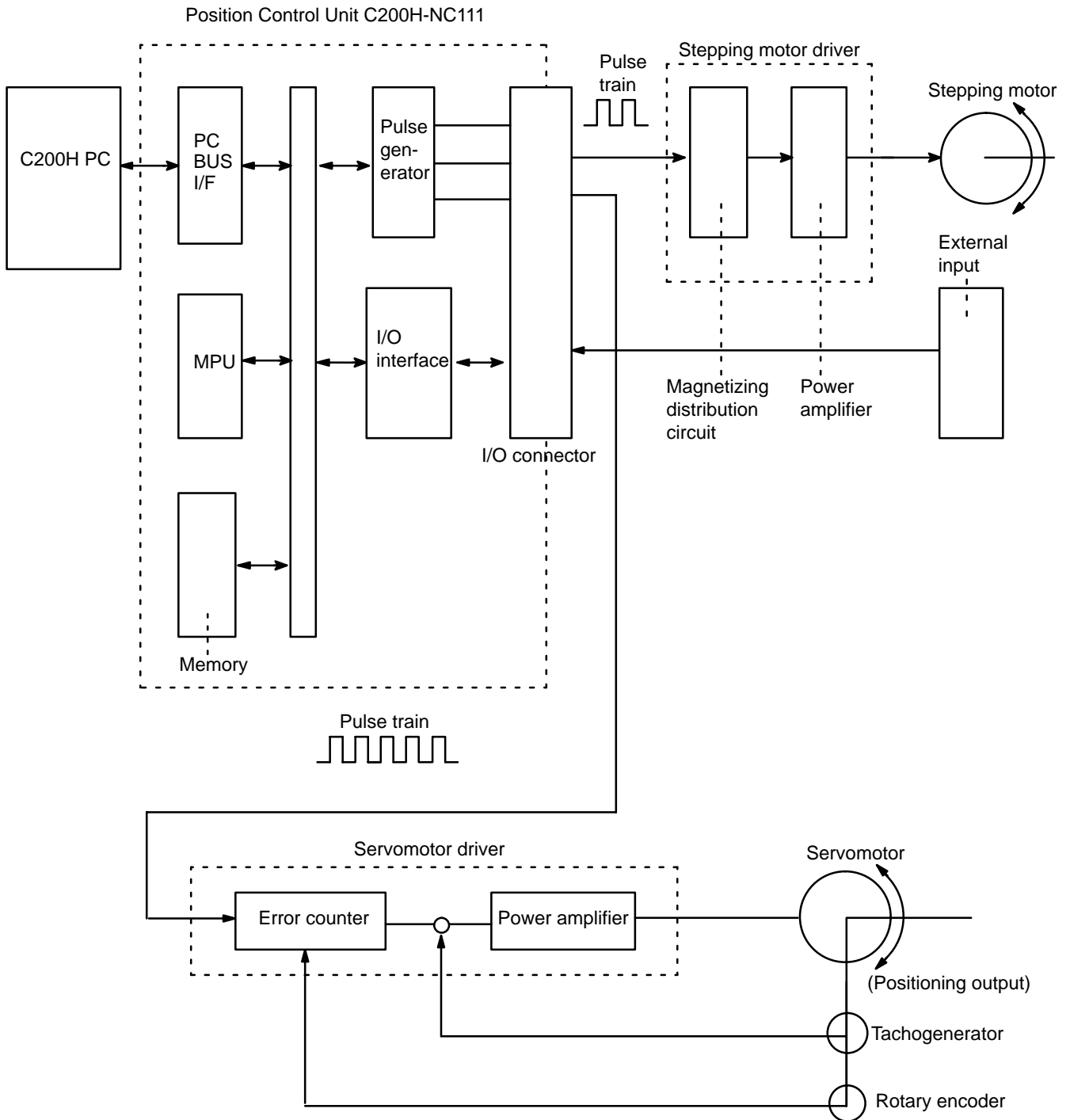
In a closed-loop system, on the other hand, the PC controls an external process without human intervention. The servomotor provides direct feedback so that actual values (of positions, speeds, and so on) are continuously adjusted

to bring them more closely in line with target values. In some systems, the digital feedback signals will be transmitted to a digital-to-analog converter to complete the feedback loop, thereby permitting automated control of the process.

A semiclosed-loop system is similar to a closed-loop system, except that feedback is provided by a tachogenerator and a rotary encoder rather than directly by the servomotor. If the C200H-NC111 Position Control Unit is used with a servomotor, the servomotor driver must be able to handle digital signals, and there is no need for a D/A converter. In addition, the servomotor is connected to a tachogenerator and a rotary encoder. The Unit can thus be used in either an open-loop or a semiclosed-loop system.

Both open-loop and semiclosed-loop systems are described in more detail on the following pages.

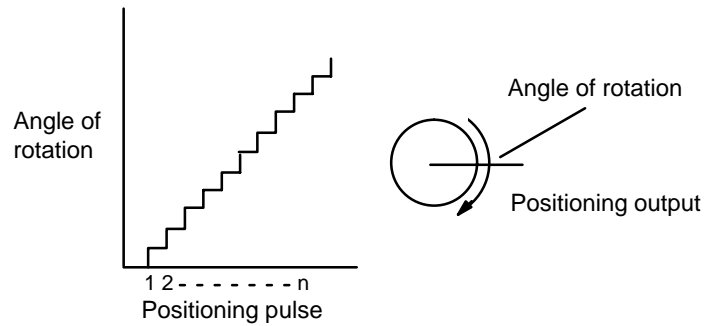
Data Flow



1-4-1 Open-loop System

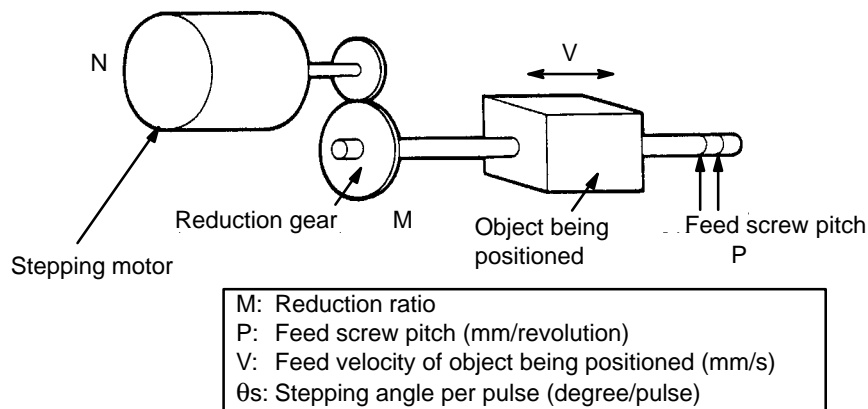
In an open-loop system, the Position Control Unit outputs pulse trains as specified by the PC program to control the angle of rotation of the motor. Because the Unit outputs pulse trains, it is generally used with a stepping motor. The angle of rotation of a stepping motor can be controlled through the 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.



## Simplified Positioning System Design

The following diagram and parameters illustrate a simplified positioning system.



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

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

The required pulse frequency from the Unit in pulses per second is computed as follows:

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

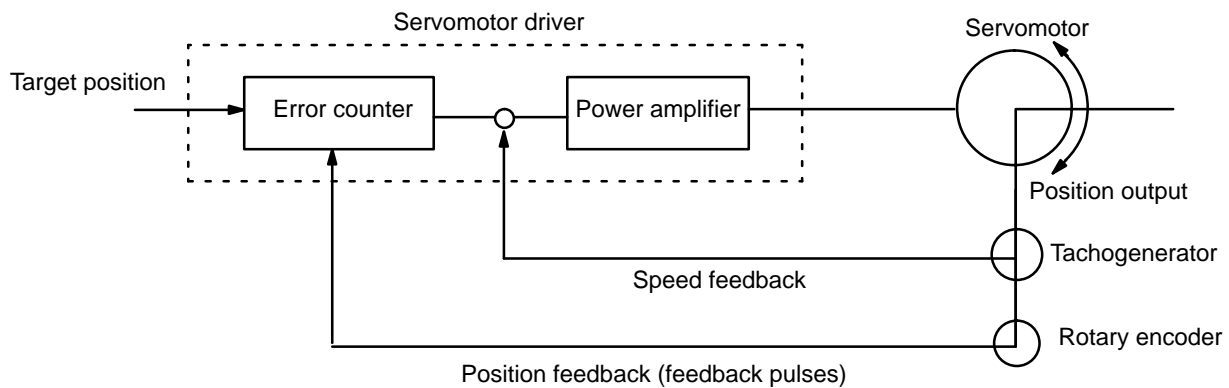
And the required number of pulses to feed an object by a distance L in mm is computed as follows:

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

## 1-4-2 Semi-closed-loop System

When the Position Control Unit is used in a semiclosed-loop system, the system supplies feedback to compensate for any discrepancy between target values and actual values in position or speed. This system detects motor ro-

tation amounts, for example, computes the error between the target value and actual movement value, and zeroes the error through feedback. The diagram below illustrates the basic configuration of a semiclosed-loop system.



- 1) First, the target position is transmitted to the error counter in units of encoder pulses. The servomotor driver must be able to handle digital input.
- 2) The motor rotates at a speed corresponding to the speed voltage. The rotary encoder connected to the motor axis rotates in sync with the motor, generates feedback pulses, and subtracts error counter contents.
- 3) Consequently, the encoder rotation is equivalent to the target position, and the motor stops rotating when the error counter count and the speed voltage become zero.
- 4) While the motor is stopped, the rotary encoder constantly maintains the stopped position through correction. In the event that the motor axis slightly moves, the error counter receives a feedback pulse from the rotary encoder, whereby a rotation voltage is emitted in the reverse direction from which the rotary encoder moved, causing the motor to rotate toward its original position. This operation is called servolock or servoclamp.
- 5) In order to execute positioning with acceleration and deceleration, target positions are set consecutively in the error counter for processing.
- 6) The target position becomes the count for the error counter and controls the motor by conversion to a speed voltage for the servomotor driver. The position thus equals the total count of target positions and the speed will depend on the target position per unit time.

# SECTION 2

## Before Operation

Before the Position Control Unit can be operated, switch settings and wiring must be correct. This section presents the settings and functions of switches, provides examples of and precautions for wiring, and gives dimensions of Units both when mounted and unmounted. Be sure that all settings and wiring match your positioning system specifications.

2-1	Switch Settings .....	12
2-2	Wiring .....	13
2-3	Dimensions .....	24

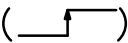
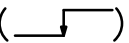
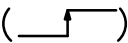
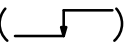
## 2-1 Switch Settings

Always turn off PC power before setting the unit number switch. Use a regular screwdriver, being careful not to damage the slot in the screw. Be sure not to leave the switch midway between settings.

Switch	Function
Unit number ("Machine no.")	Used to set the unit number (between 0 and 9). Do not set the same number for more than one Unit. Doing so will cause an error and prevent operation.
Mode	Not used.

### Back Panel DIP Switch

These pins must be set before the Position Control Unit is mounted.

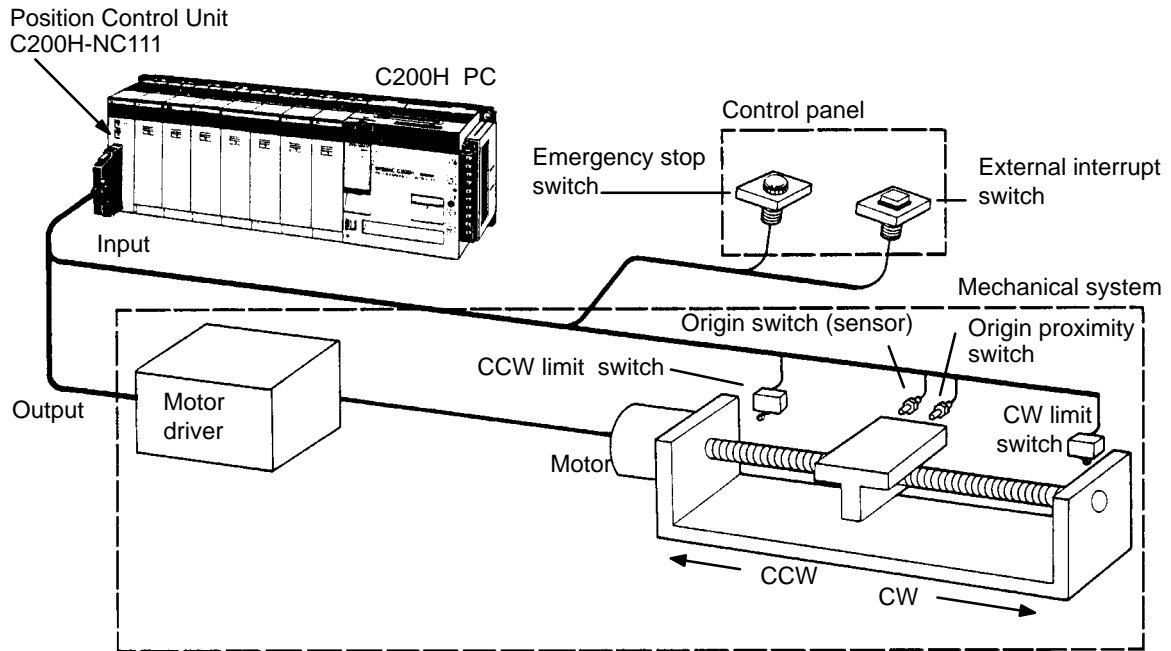
Pin no.	Name	ON	OFF
1	Output pulse selector	Nondirectional pulse and direction signal outputs.	Separate CW and CCW pulse outputs
2	Origin search direction	CCW	CW
3	Origin proximity present/absent	Present	Absent
4	Origin proximity signal type	N.O. input (  )	N.C. input (  )
5	Origin signal type	N.O. input (  )	N.C. input (  )
6	External interrupt selection*	Fixed via pin #7	Determined by IR bit (word n, bit 06)
7	External interrupt response*	CHANGE SPEED	STOP
8	Not used.		

\*External interrupt processing is determined by pins #6 and #7 in combination with bit 06 of IR word n ( $n = 100 + 10 \times \text{unit number}$ ). Refer to 4-10 *External Interrupt Commands* for details.

## 2-2 Wiring

### External I/O Connections

The example diagram below shows I/O connections.





## Connector Pin Arrangement

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

Row B	Pin no.	Row A
Emergency stop input (0 V)	20	Emergency stop input (12 to 24 VDC)
Emergency interrupt input (0 V)	19	External interrupt input (12 to 24 VDC)
	18	
	17	
	16	
	15	
	14	
CW limit input (0 V)	13	CW limit input (12 to 24 VDC)
CCW limit input (0 V)	12	CCW limit input (12 to 24 VDC)
Origin input (0 V)	11	Origin input (12 to 24 VDC)
Origin proximity input (0 V)	10	Origin proximity input (12 to 24 VDC)
	9	
	8	
	7	
	6	
Output power (0 V)	5	Output power (0 V)
CW pulse or nondirectional pulse output	4	CW pulse or nondirectional pulse output (1.6 k $\Omega$ )
CW pulse or direction signal output	3	CCW pulse or direction signal output (1.6 k $\Omega$ )
5-VDC power supply input	2	
	1	24-VDC power supply input

External connector: FCN-361J040 (Fujitsu solder-type; included as an accessory.)

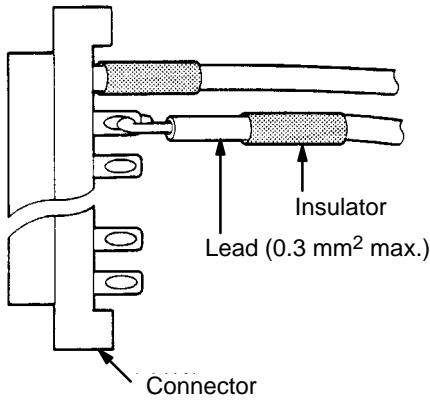


### Caution

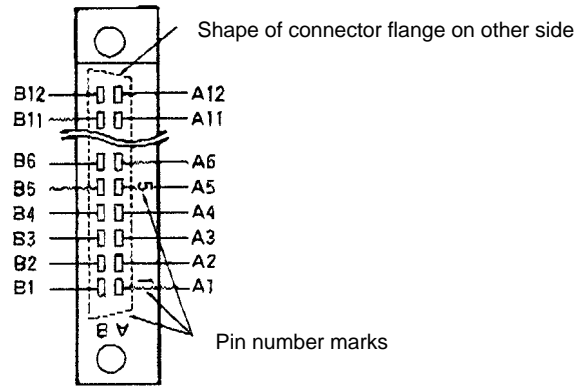
Output power should be either 24 or 5 VDC. Never connect both the 24 and 5 VDC pins at the same time. In other words, never use power supplies of different voltages.

## Wiring to Connectors

- Solder-type connectors are included with the Unit.
- Use wire with a cross-sectional area of 0.3 mm<sup>2</sup> or less.
- When soldering, do not short-circuit an adjacent terminal; cover the soldered section with an insulation.
- When using multi-core cable, wire output and input cables separately.

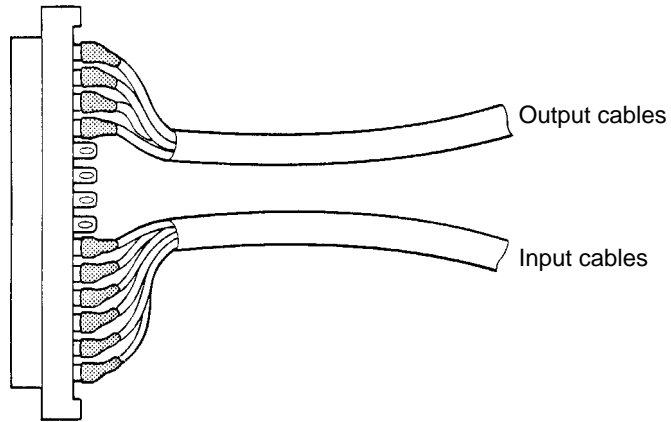


**Connector Pin Numbers**  
 The connector pin numbers are shown in the following figure. Wire the connector correctly according to the pin numbers.

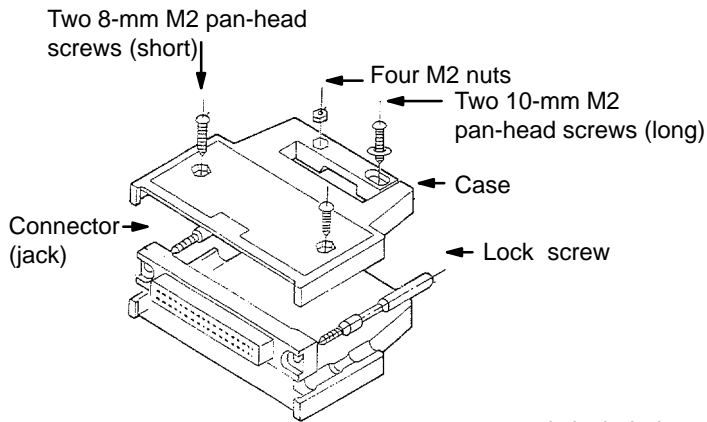


Connector Viewed from Soldered Side

**Differentiating Cables**



**Assembling Connectors**



Usable connectors:

Fujitsu model 360 jack

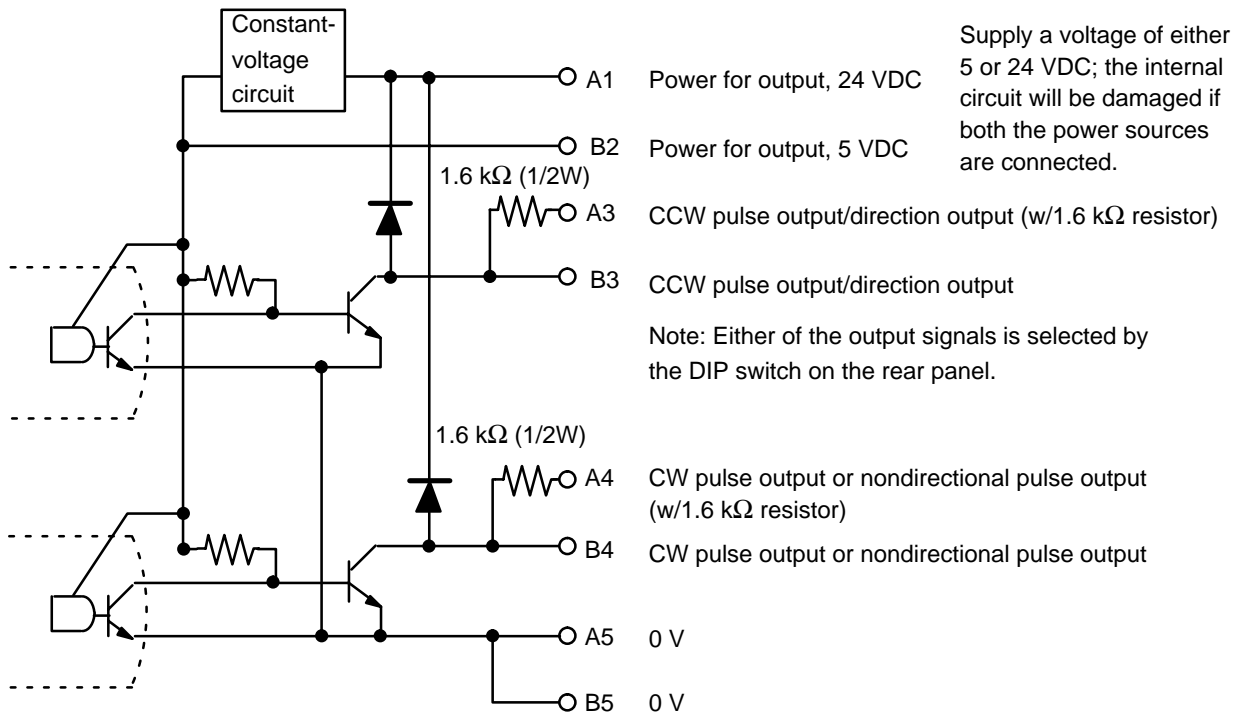
1. FCN-361J040-AU (solder)  
 FCN-360C040-B (connector cover)
2. FCN-363J040 (solderless)  
 FCN-363J-AU (contact)  
 FCN-360C040-B (connector cover)
3. FCN-367J040-AU/F (solderless)

1. is included as an accessory.

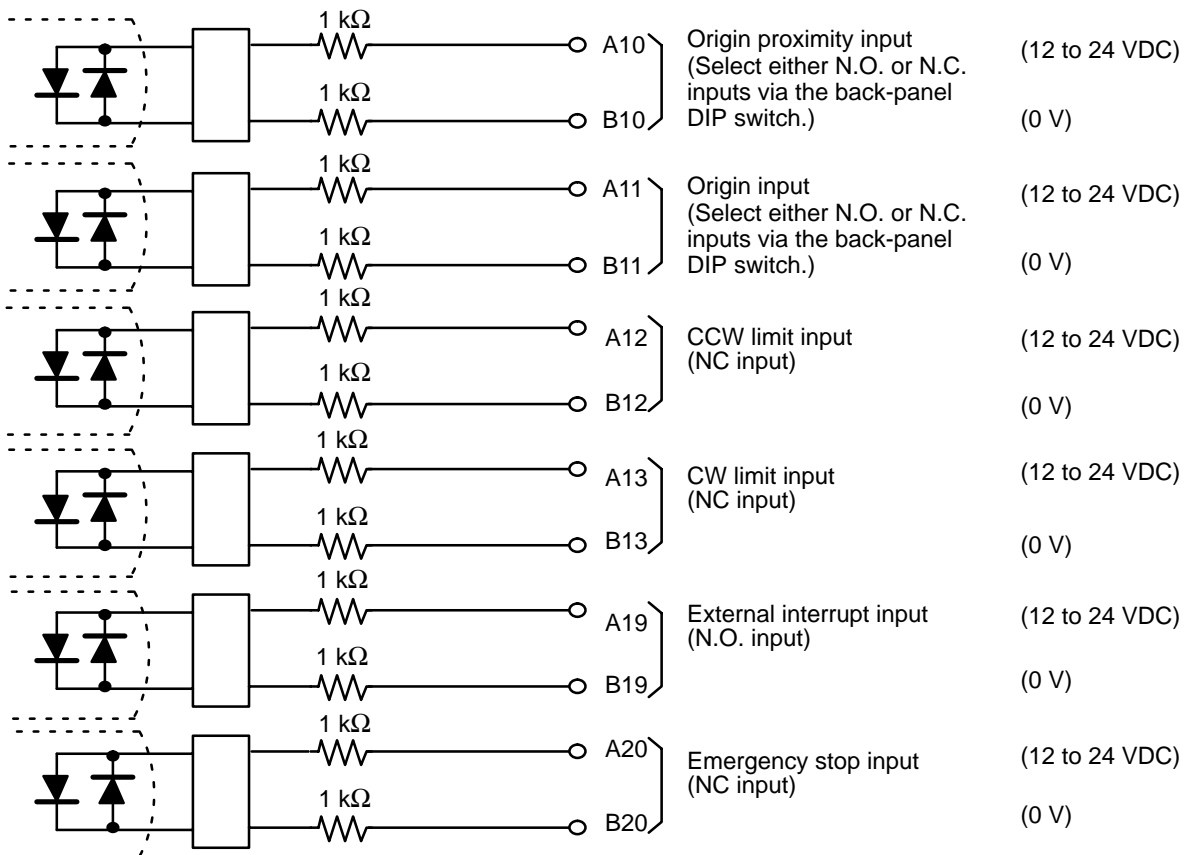
**I/O Circuits**

In the I/O circuits depicted in the following diagrams, pin numbers on the connector actually start from 1 at the bottom of the connector and run through 20 at the top.

Outputs



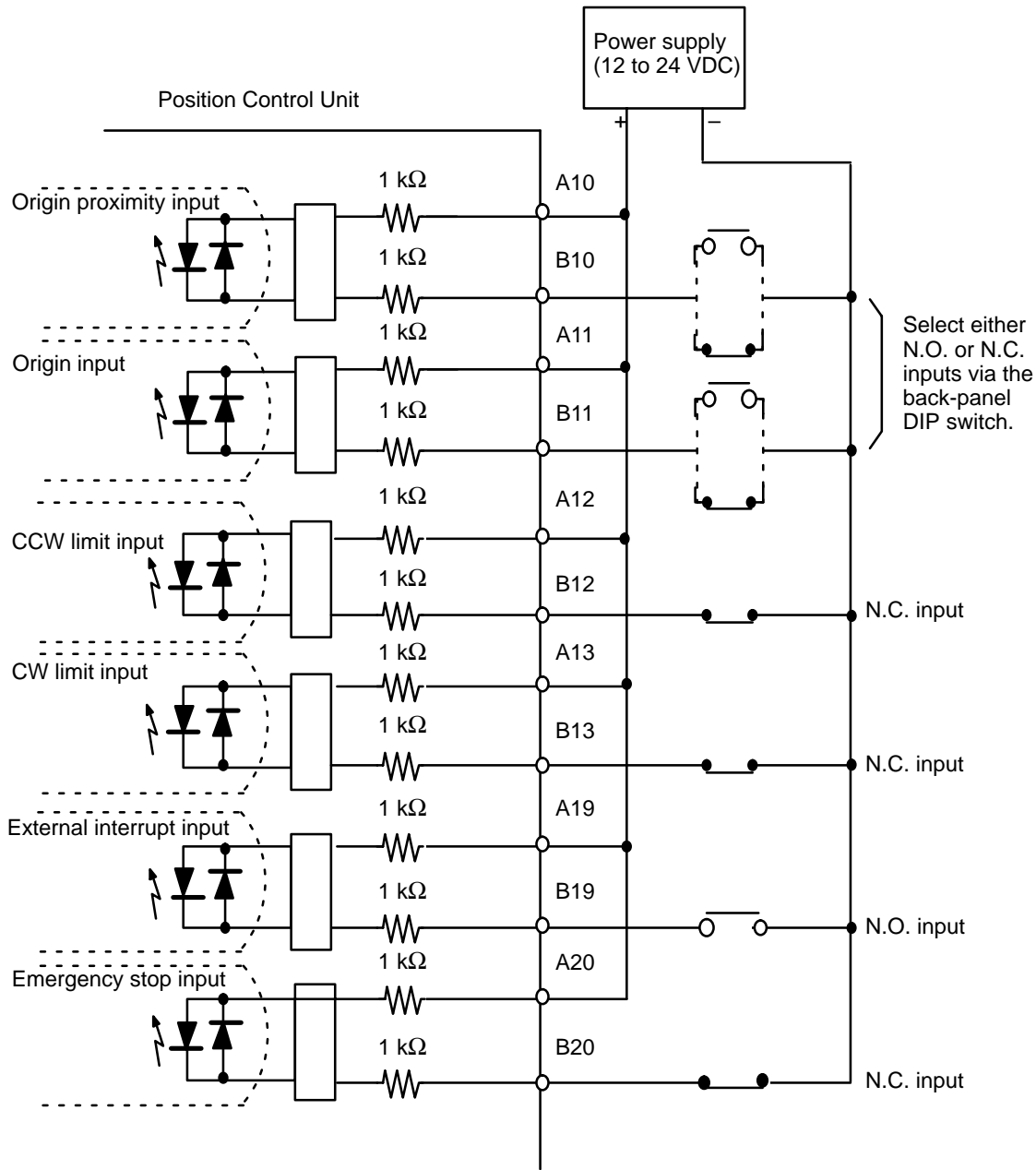
Inputs



### Input Connection Example

Each input is provided with both a N.O. (normally open) input or N.C. (normally closed) input that can be used according to specifications.

Leave unused N.O. inputs open and connect unused N.C. inputs to the power supply.



- All inputs have independent grounds (commons) and are bidirectional. Connect switches of at least 12-mA capacity.
- Use a non-contact sensor (such as a proximity sensor) for the origin input to reduce wear and deterioration.

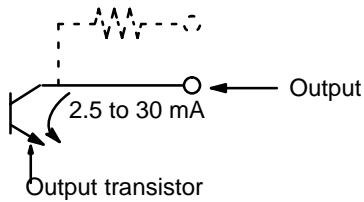
### Output Connection Examples

The following figures illustrate examples of connections to motor drivers. Always confirm motor driver specifications before making connections.

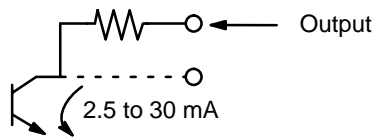
The Unit outputs only pulse trains and a direction output, or separate CW and CCW pulse trains, to control the motor driver. If other control signals, such as a deflection counter reset signal or motor excitation release signal, are required, use a C200H I/O Unit and program in the required control actions.

Connect between 2.5-mA and 30-mA loads to outputs of the Unit, or add bypass resistance for loads less than 2.5 mA. Some output terminals have 1.6-kΩ (0.5 W) resistance built in. Use these as necessary according to power supply and motor driver specifications. For voltage-level outputs, the output goes low for ON and high for OFF.

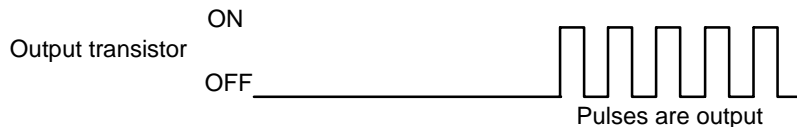
Open collector output



Open collector output with 1.6 kΩ series resistance

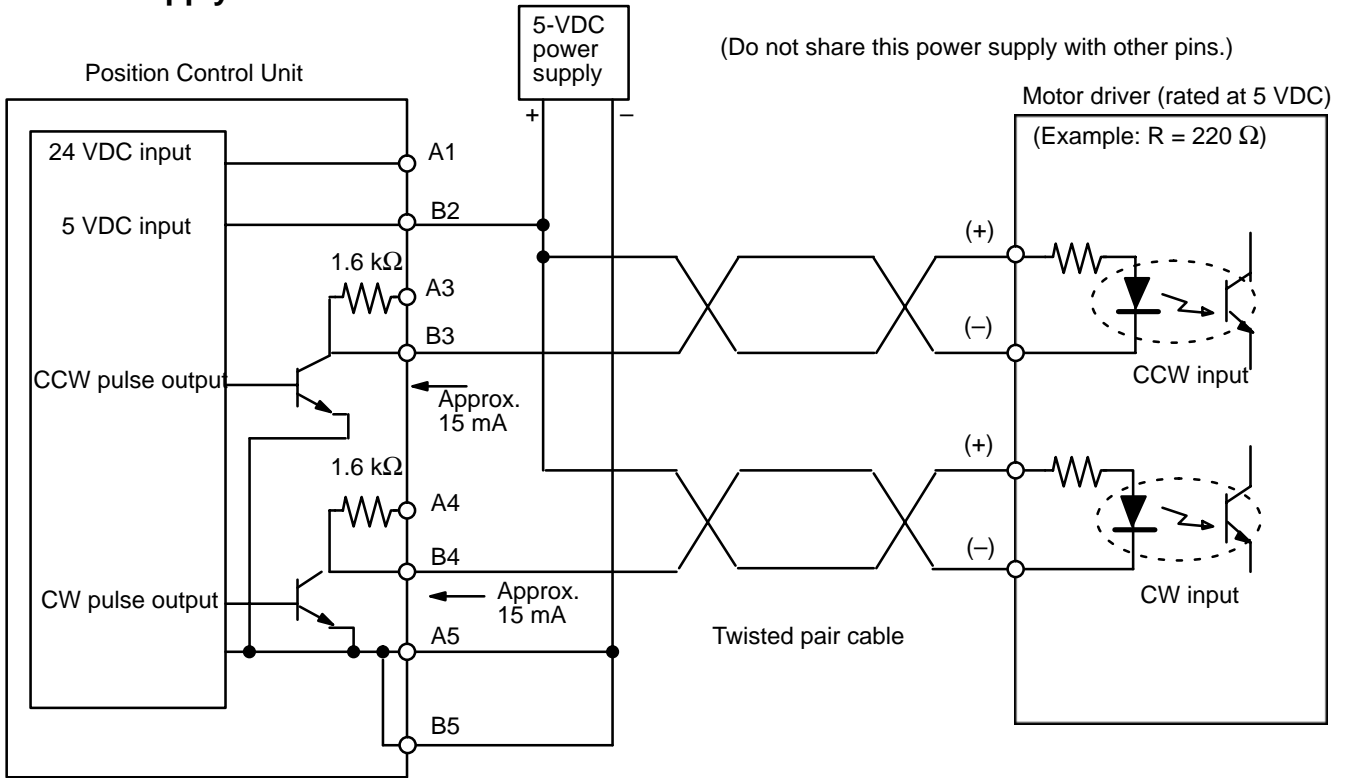


Pulses are not output when the output transistor in the pulse output section is OFF. (For direction output, OFF indicates CCW.)

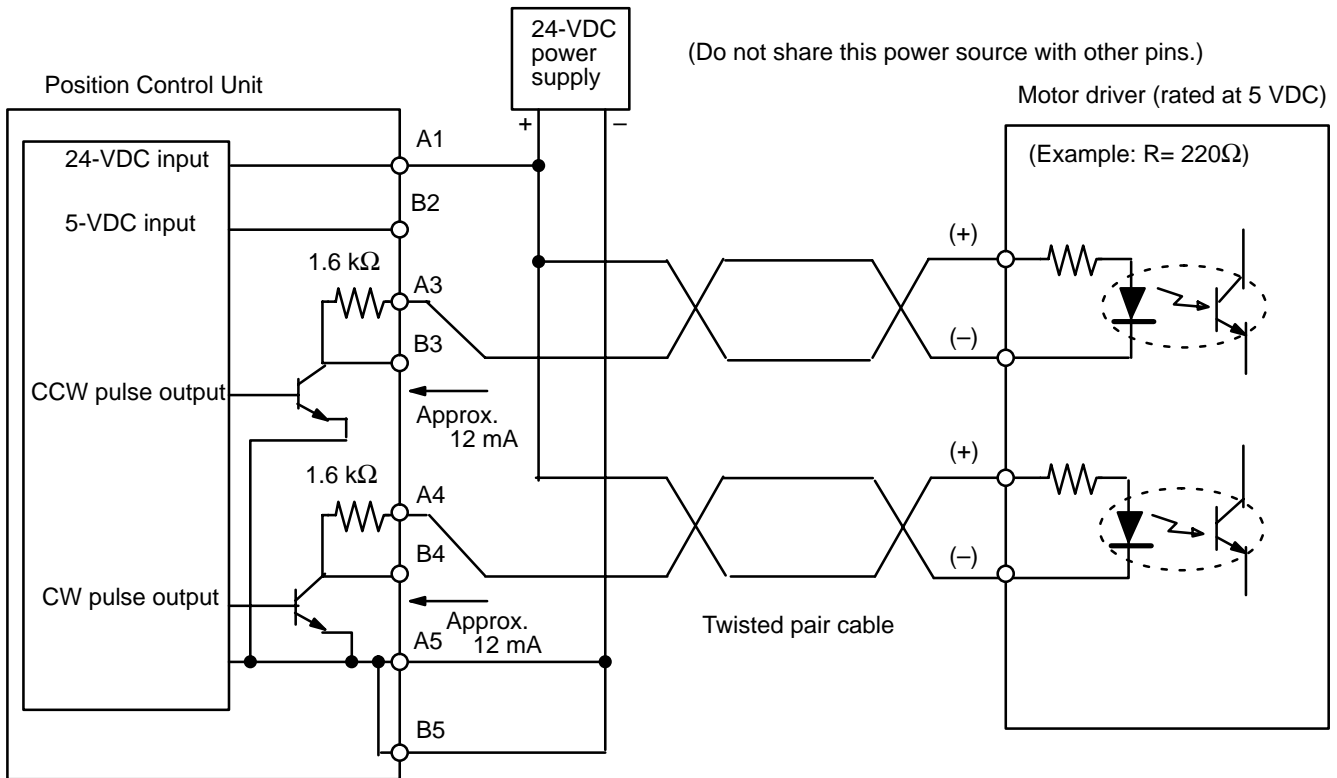


**⚠ Caution** Output power should be either 24 or 5 VDC. Never connect both the 24 and 5 VDC pins at the same time. In other words, never use power supplies of different voltages.

**Example 1:  
Outputting CW and CCW  
Pulses With a 5-VDC  
Power Supply**

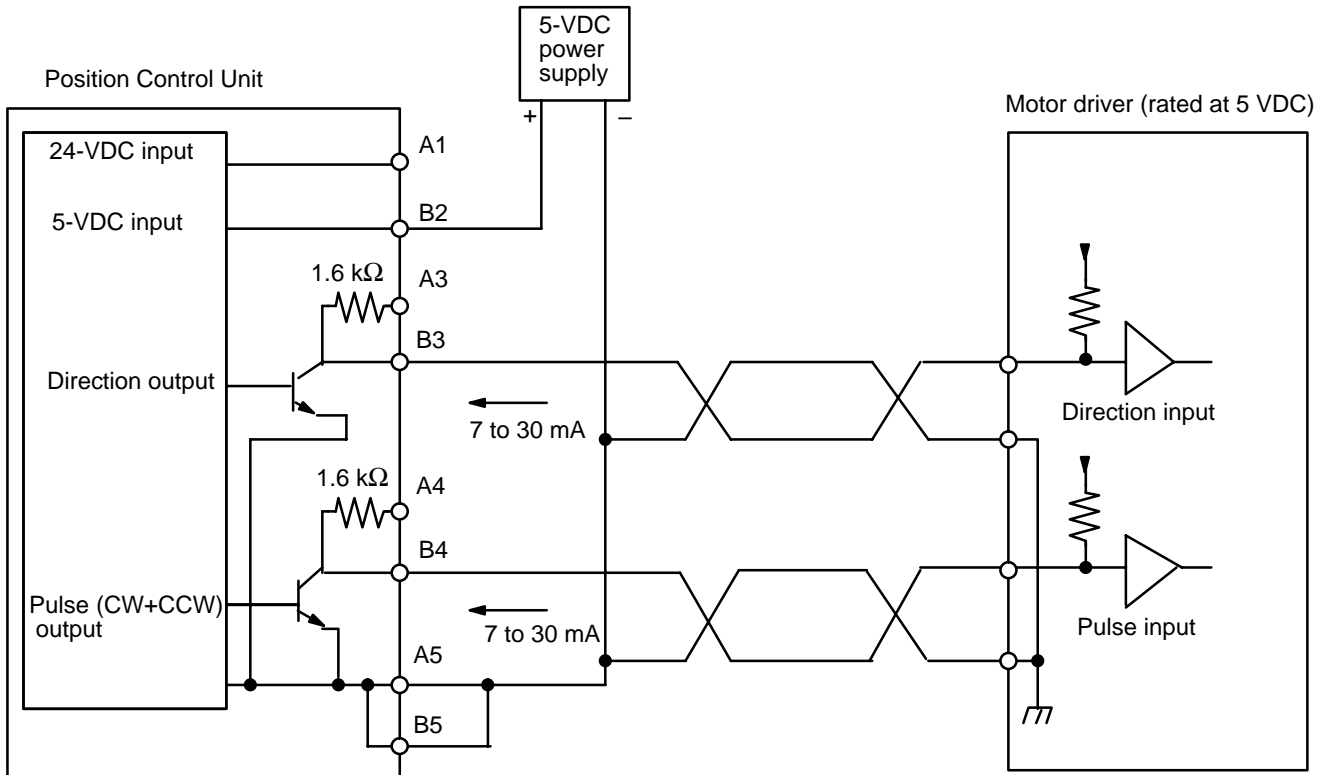


**Example 2:  
Outputting CW and CCW Pulses With a 24-VDC Power Supply and a Motor Driver Rated at 5 VDC**



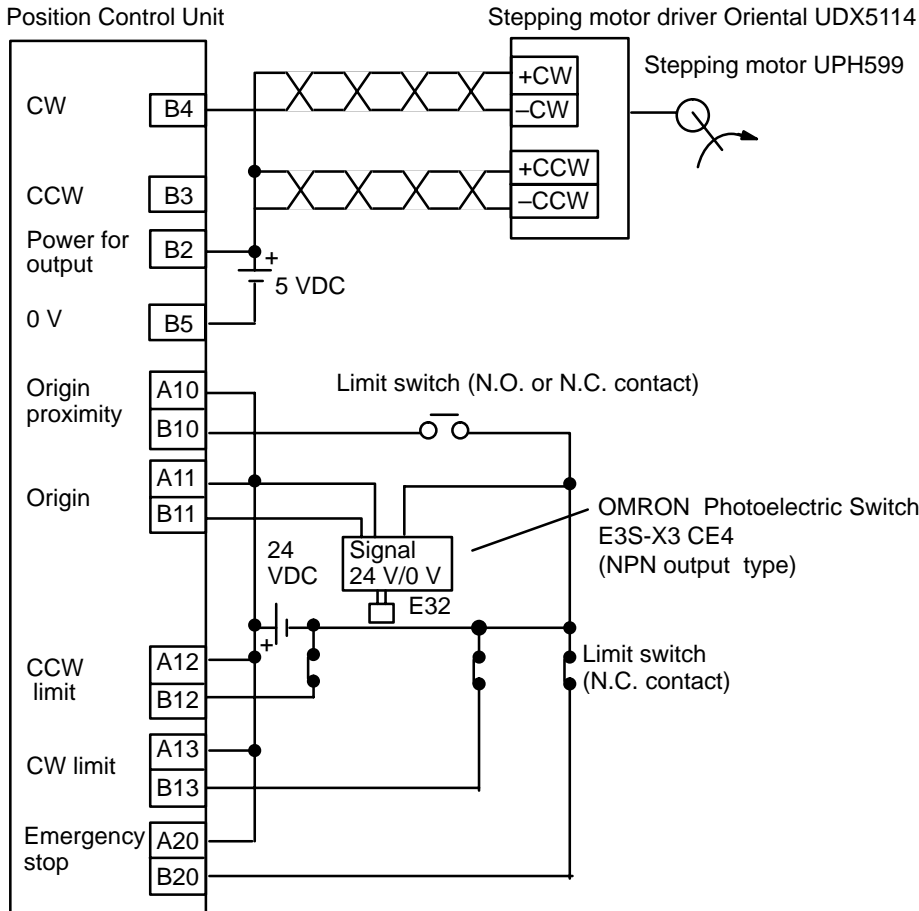
**Note** In this example, a 5-V input motor driver is being used with a 24-V DC power supply. The limit resistors (1.6 KΩ) of the NC111 are thus being used. Check the driver current of the motor driver.

**Example 3:  
Outputting Pulse and Direction Signals with a 5-VDC Power Supply**



When the Position Control Unit is used to output voltage levels, the low level is obtained when the output transistor turns ON, while the level goes high when the transistor turns OFF.

**Example 4:  
Stepping-Motor Driver  
Connection**

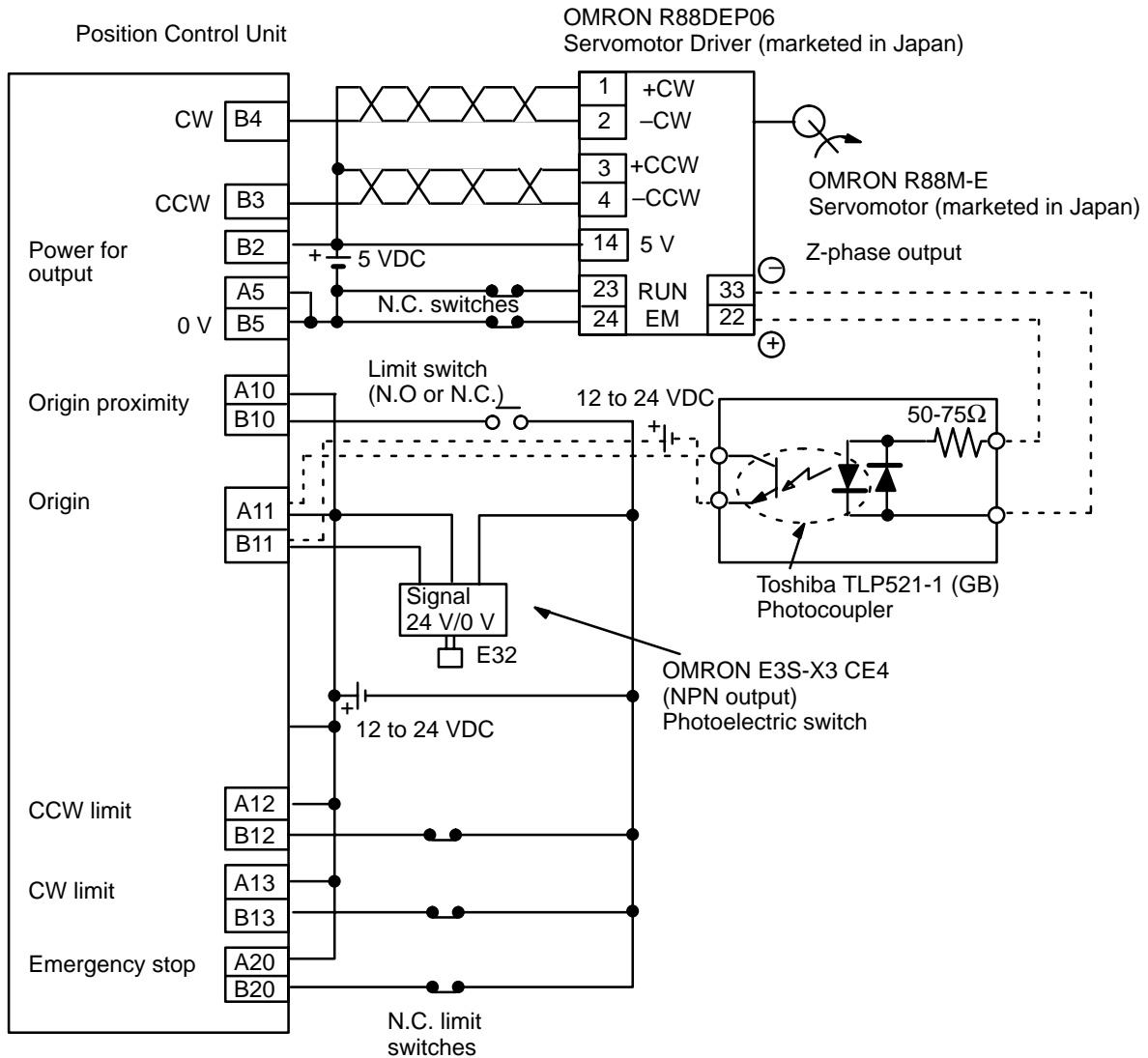


**Example 5:  
Servomotor Driver  
Connection**

When applying the servomotor driver Z-phase output to the origin input of the Position Control Unit, the line input/open collector conversion circuit is re-



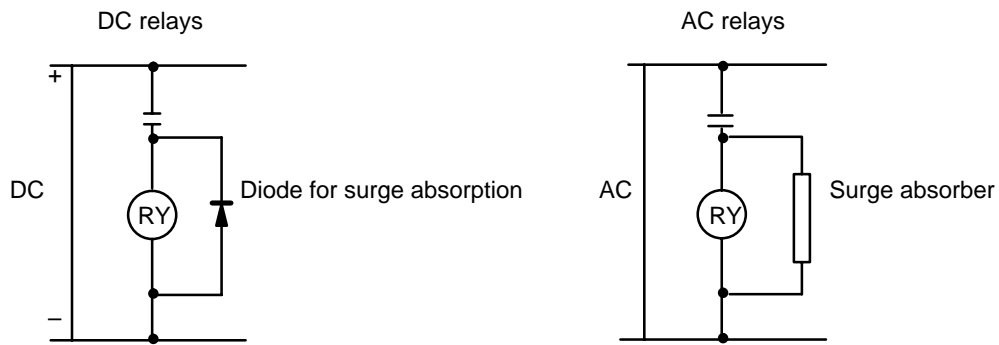
quired, as shown in the example diagram on the following page.



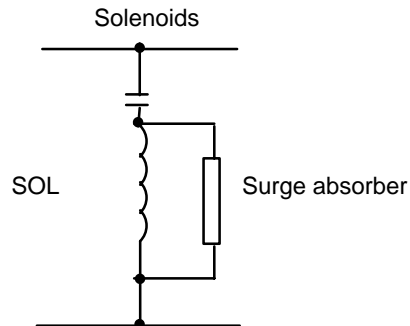
## Wiring Precautions

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-originating operational errors and thus improve system reliability, always abide by the following precautions in wiring the system.

- 1, 2, 3... 1. Cables must be of the required diameter.
2. 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.
3. Use shielded cable for control lines.
4. Attach a surge absorber to all inductive loads, such as relays, solenoids, and solenoid valves.

**Note:**

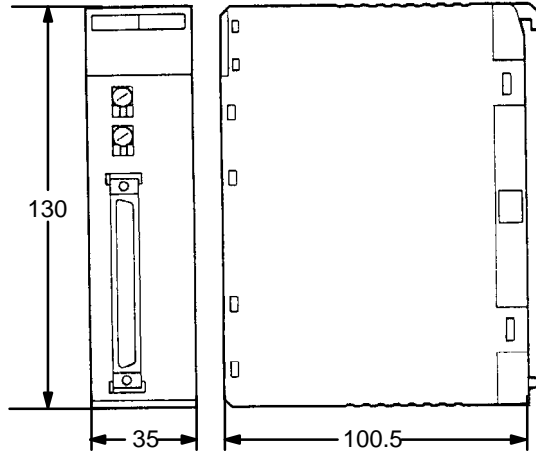
Connect the diode and surge absorber as close as possible to the relay. Use a diode capable of withstanding a voltage five times higher than the circuit voltage.



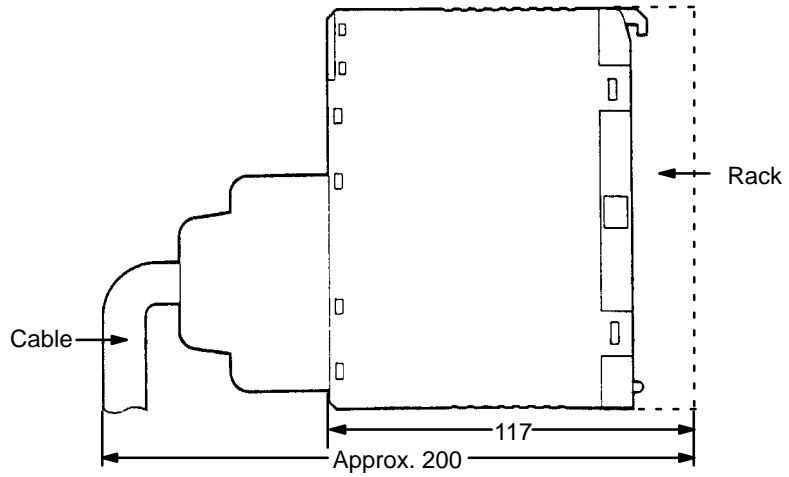
5. Insert a noise filter into the power supply inlet if noise enters the power line (e.g., when it is connected to the same power supply as an electric welder or an electric spark machine or when there is any source generating high frequency noise).
6. Twisted pair cable is recommended for power lines.
7. For grounds, use thick cable with a cross-sectional area of at least 1.25 mm<sup>2</sup>.

## 2-3 Dimensions

### Unit Dimensions (Unit: mm)



### Mounted Dimensions (Unit: mm)



# SECTION 3

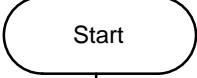
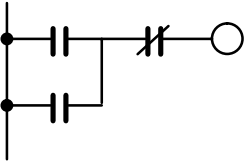
## Operation

This section covers all aspects of Position Control Unit operation other than commands, which are covered in the following section. Included in this section are the basic operating procedure, the type of output pulses possible, the basic data format and configuration, some special features to aid operation, such as flags, zone settings, backlash compensation and internal limits, and the internal data calculation methods used in processing user-input data.

3-1	Operational Flow .....	26
3-2	Output Pulses .....	28
3-3	Writing Data .....	28
3-4	Data Configuration and Allocation .....	29
3-5	IR Area Data Format .....	32
3-6	Flags and Other Input Data .....	33
3-7	DM Area Allocation .....	33
3-7-1	Zones .....	35
3-7-2	Backlash Compensation .....	36
3-7-3	Internal CW/CCW Limits .....	37
3-7-4	Data Calculations .....	38

### 3-1 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.

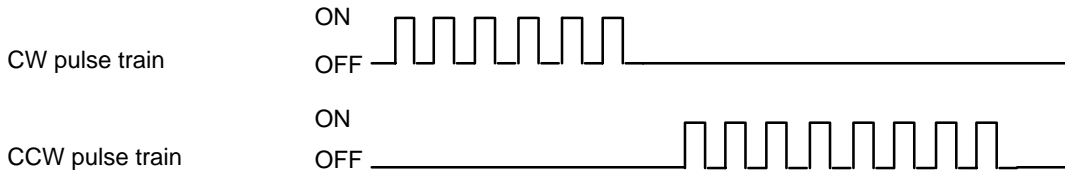
Item	Procedure	Refer to:
Wiring	<p>Start</p> 	
	<p>Wiring external inputs</p> <p>Origin, origin proximity, CW/CCW limits, emergency stop, external interrupt</p>	2-2 Wiring
	<p>Wiring motor to driver</p> <p>Follow motor and driver and instruction manuals for wiring details</p> <p>Wiring Position Control Unit to driver</p>	
Data setting	<p>Setting back-panel DIP switch</p> <p>.Output pulse selection .Origin search direction .Origin proximity signal type .Origin signal type .External interrupt signal type</p>	3-4 Data Configuration 2-1 Switch Settings
	<p>Data setting</p> <p>DM area (key input via Programming Console) .Parameters .Positioning actions .Speeds</p>	Section 4 Commands 3-7-4 Data Calculations
	<p>Writing PC program</p> <p>Programming IR area (key input via Programming Console)</p> 	Section 5 Programming Examples

Item	Procedure	Refer to:
Trial run	<p style="text-align: right;">Position Control Unit reads DM area</p> <pre> graph TD     Start([Restart by resetting power or AR area restart bit]) --&gt; Search[ORIGIN SEARCH, manual operation, start, etc.]     Search --&gt; Lit{Alarm/error LED lit?}     Lit -- No --&gt; ReadError[READ ERROR]     Lit -- Yes --&gt; ErrorExists[Error exists]     </pre>	<p>6-4 Troubleshooting From the PC</p> <p>AR area error and restart bits for Special I/O Units</p>
Error processing	<pre> graph TD     ErrorExists[Error exists] --&gt; ReadError1[READ ERROR]     ReadError1 --&gt; Correct1[Correct error]     Correct1 --&gt; Flashes{Alarm/error LED flashes?}     Flashes -- No --&gt; ReadError2[READ ERROR]     Flashes -- Yes --&gt; ReadError2     ReadError2 --&gt; Correct2[Correct data causing alarm]     Correct2 --&gt; Lit     </pre>	<p>4-5 READ ERROR</p> <p>Section 6 Error Processing</p>

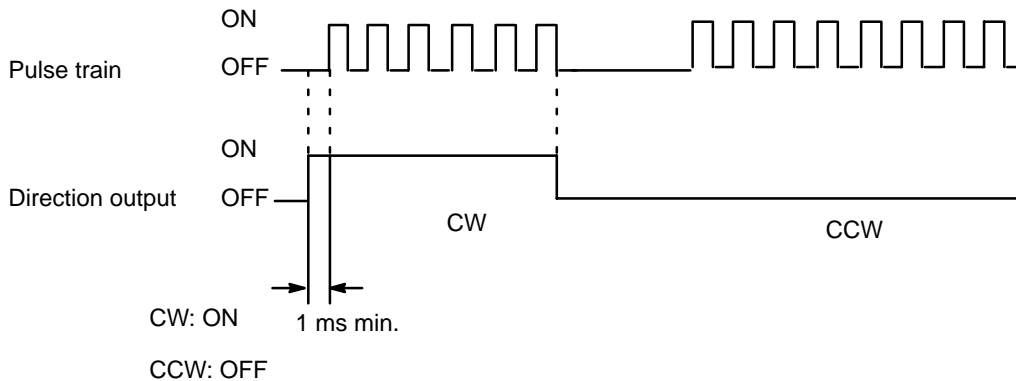
### 3-2 Output Pulses

The Position Control Unit can be set to output either independent CW and CCW pulses or a nondirectional pulse and a direction signal. Set pin #1 on the back-panel DIP switch to designate the target type of output. (See 2-1 Switch Settings.)

#### CW and CCW Pulse Outputs



#### Nondirectional Pulse and Direction Signal Outputs



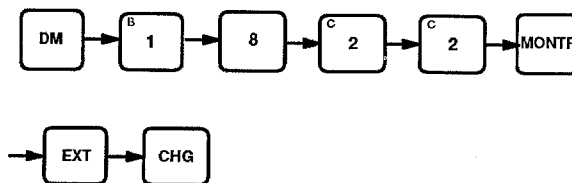
### 3-3 Writing Data

Data is written, via the Programming Console, into the section of the DM area designated for Special I/O Units. The specific words are DM 1000-1999, with 100 of these words allocated for each unit number assigned to a Position Control Unit. Written data is effective the next time power is turned on or when the system is restarted with the restart bit in the AR area. To write data, use the 3-word change operation of the Programming Console.

Programming Console Display

Key Input Sequence

```
D1824D1823D1822
0012 5000 2000
```



The above procedure prepares DM 1824 for change, and new data can be keyed in. Pressing the CHG key again moves the cursor to DM 1823. After inputting data, press the write key to execute the rewrite. In the above example, positioning action #0 of Unit #8 is shown.

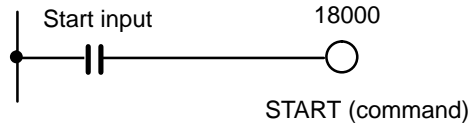
#### Starting

When starting the Position Control Unit, the OUT refresh area is used. (The OUT refresh area comprises the first five of the ten IR words allocated to each Unit as refresh area. See 3-4 Data Configuration and Allocation for de-

tails.) The busy flag and present position status can be read out from the IN refresh area, the last five of these words.

To start the Unit, set (i.e., turn ON) the command bit regardless of whether the Unit is in RUN or PROGRAM mode. Do not shift the mode between MONITOR and PROGRAM while pulses are being output. Doing so will generate an error, preventing Unit operation.

Example: Starting Unit #8 in MONITOR or PROGRAM Mode



In the above example, IR words 180 through 184 are allocated as the OUT refresh area; IR words 185 through 190, as the IN refresh area.

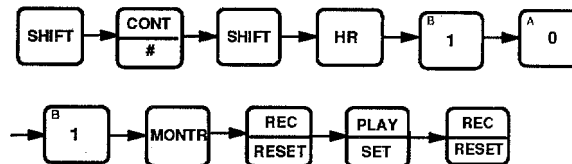
### Special I/O Unit Restart Bits AR Word 1

Restart bits can be used to transfer altered DM area data to the Unit without turning power off and on. Refer to 6-3 *Troubleshooting From the PC* for restart bit allocations. The following Programming Console operation example shows how to access the restart bit for Unit #0. The ladder diagram section below it shows how to achieve the same operation through programming.

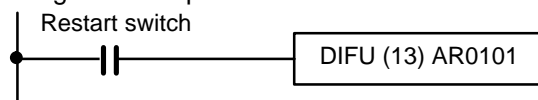
Programming Console Display



Key Input Sequence



Program example: Unit #1



## 3-4 Data Configuration and Allocation

IR words 100 through 199 are allocated as I/O refresh areas. Each Position Control Unit is allocated ten consecutive words. The first word for each Unit, designated in this manual as n, can be computed from the unit number as follows:

$$n = 100 + 10 \times \text{unit number.}$$

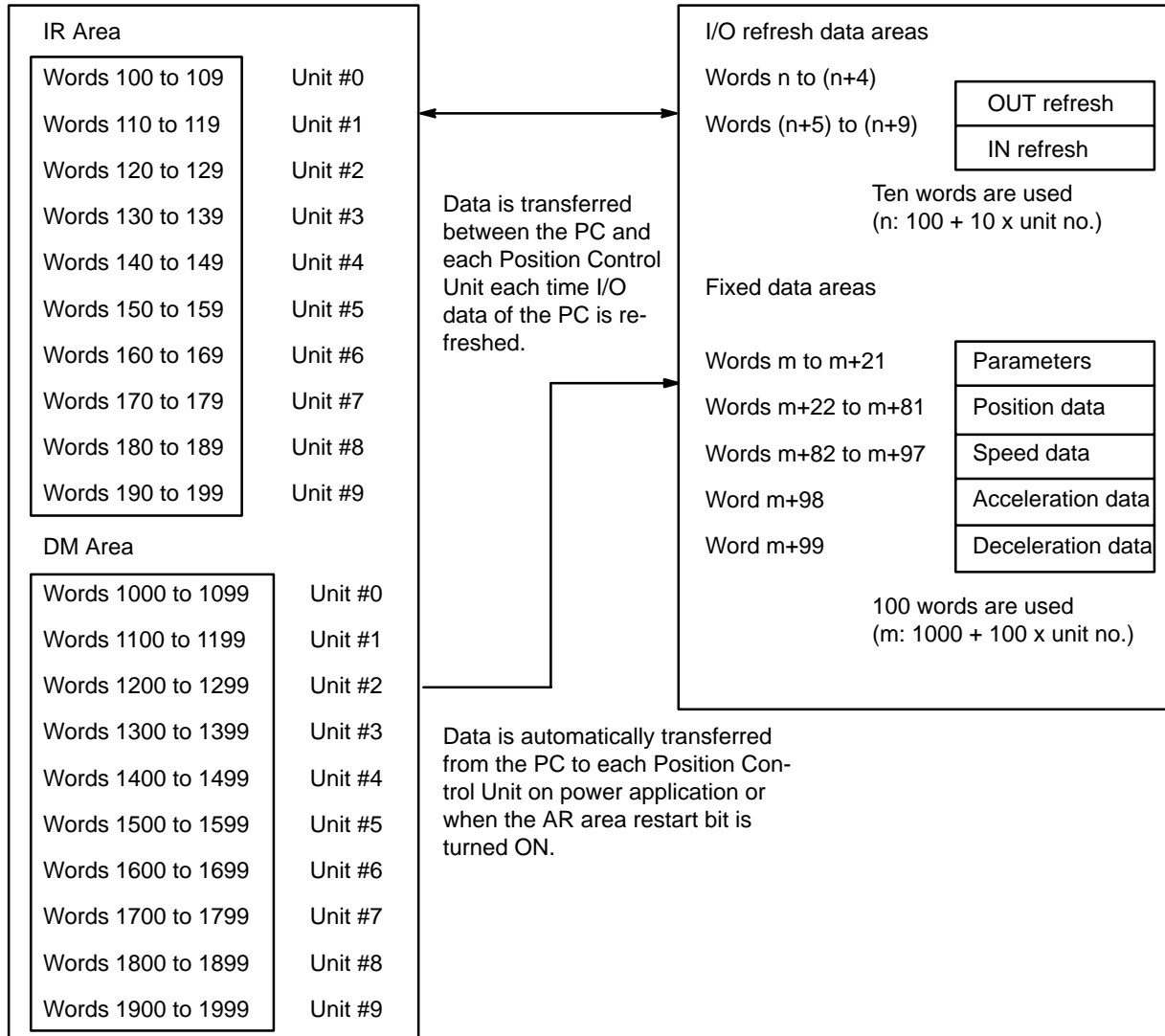
Each Unit is also allocated 100 consecutive words as a fixed data area. These words are in the DM area and run from DM 1000 through DM 1999. The first word for each Unit, m, can also be computed from the unit number:

$$m = 1000 + 100 \times \text{unit number.}$$

These allocations are shown below for all unit numbers. Details of allocations within these words are given under the operations or commands to which they apply. The tables on the following pages give a quick overview of word and bit allocations. For a more complete overview, see Appendix C DM Area Allocations and Appendix D IR Area Allocations.



**Data Configuration**  
C200H PC



IR Area Allocations

"n" is the first IR word allocated to the Unit and equals 100 plus 10 times the unit number.

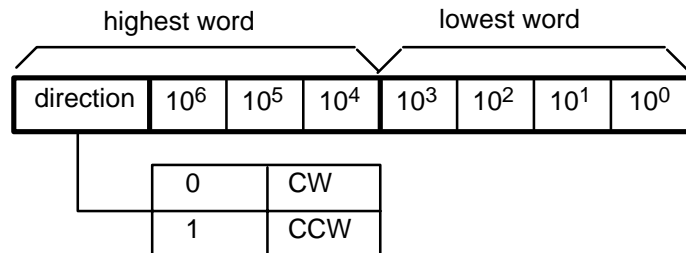
Word	n	n+1	n+2	n+3	n+4
Bit	00	START	Initial positioning action no.	Speed coefficient	PC data area (for TRANSFER DATA)
	01	Valid initial positioning action number			
	02	ORIGIN SEARCH			
	03	ORIGIN RETURN			
	04	RELEASE PROHIBIT			
	05	READ ERROR			
	06	CHANGE SPEED			
	07	Valid speed coefficient	Beginning word no. (for TRANSFER DATA)	Beginning transfer no.	Number of transfers (for TRANSFER DATA)
	08	RESET ORIGIN			
	09	TEACH			
	10	TRANSFER DATA			
	11	HIGH-SPEED JOG			
	12	JOG direction			
	13	LOW SPEED JOG			
	14	INCH			
15	STOP	TRANSFER DATA type			

(continued on next page)

Word	n+5	n+6	n+7	n+8	n+9
Bit	00 Positioning completed flag	Error code	Positioning action no.	Present position (rightmost 4 digits)	Direction digit
	01 Bank completed flag				
	02 At-origin flag				
	03 Alarm flag				
	04 Emergency stop flag				
	05 Error flag				
	06 Zone 0 flag				
	07 Zone 1 flag				
	08 Zone 2 flag				
	09 Teaching completed flag				
	10 Transfer completed flag				
	11 No-origin flag		Output code		
	12 Busy flag				
	13 CW limit flag				
	14 CCW limit flag				
	15 STOP flag				
	Emergency stop signal				
	External interrupt signal				
	Origin signal				
	Origin proximity signal				
				Present position (leftmost 3 digits)	

### 3-5 IR Area Data Format

Data is allocated either by bit or by word, though it is often input and output by decimal digit, i.e., four bits (BCD). Position data is held in two adjacent words, generally with a direction digit, in the following format.



Note that the rightmost word is always the lowest word. If the two words were n+8 and n+9, for example, the rightmost word would be n+8 and the leftmost would be n+9. Furthermore, the rightmost digit in each word begins in the lowest bits. Thus, the digits  $\times 10^4$  and  $\times 10^0$  above would be held in bits 00 through 03 of their respective words. The direction digit also provides other information when required.

### Speeds, Acceleration, and Deceleration

Only one word is used to store speeds, the acceleration, and the deceleration. The formats for these are as follows:

**Speeds**

$10^3$	$10^2$	$10^1$	$10^0$
--------	--------	--------	--------

**Acceleration and Deceleration**

/	$10^2$	$10^1$	$10^0$
---	--------	--------	--------

**Data Coding**

Although decimal notation is generally used for data in this manual, data is handled in the system as binary-coded decimal (BCD) unless otherwise noted. Note that this data is generally input as decimal, whereas hexadecimal data is input as hexadecimal. The number of digits given for certain data refers to the decimal digits. For example, "7 digits with direction" indicates that the lowest word and rightmost 12 bits of the highest word are allocated to the 7-digit decimal value; the leftmost four bits are allocated to the direction digit.

**3–6 Flags and Other Input Data**

IR words n+5 to n+9 are allocated to flags and other inputs that supply information about positioning system operation. Although some of these are described under specific operations or commands, they are presented together in Appendix D IR Area Allocations for convenience. Of these, an output code has been provided for user application and four signals, the last four in the list, have been provided for system debugging.

**3–7 DM Area Allocation****Coding Sheet**

The table on the following page can serve as a general coding sheet for the DM area. For a more detailed table describing the functions of all of the bits in the DM area, see Appendix C DM Area Allocations.

The numbers shown for the DM words in the following table represent only the final two digits of each word number. In other words, the first two digits (which would be the same for all words) are not shown. The value of the first two digits can be obtained by computing the first DM word allocated to the Unit. This word, designated m, is equal to 1000 plus 100 times the unit number. Thus, for example, it would be 1000 for Unit #0, 1100 for Unit #1, and so on.

W	15	00	Function	W	15	00	Function	W	15	00	Function		
00			Initial position nos.; speed nos.	Transfer no. <input type="text"/>				Transfer no. <input type="text"/>					
01			Origin compensation and direction	34			Positioning action #4	4	67		Positioning action #15	15	
02				35				68					
03				36				69					
04			Backlash compensation	37			Positioning action #5	5	70		Positioning action #16	16	
05			CW limit	38				71					
06				39				72					
07			CCW limit	40			Positioning action #6	6	73		Positioning action #17	17	
08					41				74				
09			Zone 0 CW limit	42				75					
10			Zone 0 CCW limit	43			Positioning action #7	7	76		Positioning action #18	18	
11					44				77				
12					45				78				
13			Zone 1 CW limit	46			Positioning action #8	8	79		Positioning action #19	19	
14					47				80				
15			Zone 1 CCW limit	48				81					
16			Zone 2 CW limit	49			Positioning action #9	9	82		Speed #1	20	
17					50				83				Speed #2
18					51				84				Speed #3
19			Zone 2 CCW limit	52			Positioning action #10	10	85		Speed #4	21	
20					53				86				Speed #5
21				Not used	54				87				Speed #6
22			Positioning action #0	0	55		Positioning action #11	11	88		Speed #7	22	
23					56				89				Speed #8
24					57				90				Speed #9
25			Positioning action #1	1	58		Positioning action #12	12	91		Speed #10	23	
26					59				92				Speed #11
27					60				93				Speed #12
28			Positioning action #2	2	61		Positioning action #13	13	94		Speed #13	24	
29					62				95				Speed #14
30					63				96				Speed #15
31			Positioning action #3	3	64		Positioning action #14	14	97		Speed units	25	
32					65				98				Acceleration
33					66				99				Deceleration

### 3-7-1 Zones

Up to three zones can be set in the DM area. If one or more zones have been set, zone flags in the IR area can be used to determine if the present position is within any established zones. A zone flag is ON (1) when the present position is within the zone; OFF (0) when it is not. Zones can be set to cover a wide range of positions or narrowed to cover only part of a single positioning action. Zones can also be set to overlap, if target. For application example, see programming example 8 in Section 5.

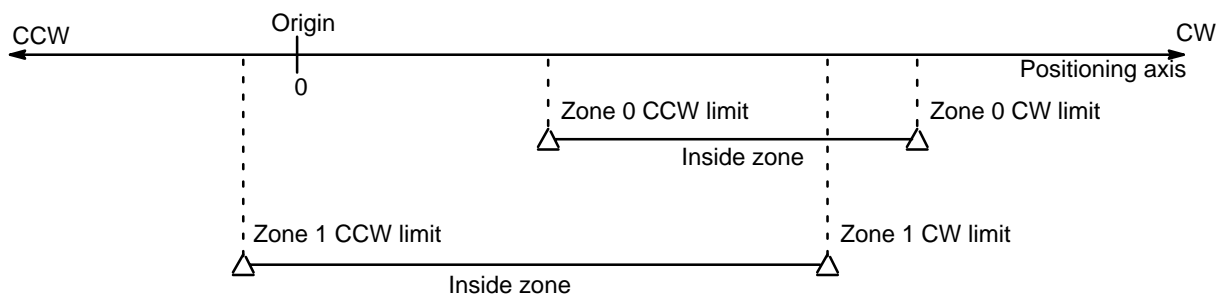
#### CW and CCW Limit Settings

The CW and CCW limits for any one zone are set in separate word pairs, i.e., four words total are required to establish one zone. These words are allocated as follows:

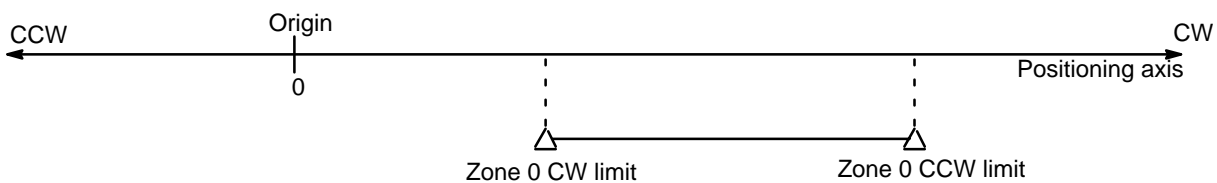
- Zone 0 CW limit: m+9 and m+10, 7 digits with direction
- Zone 0 CCW limit: m+11 and m+12, 7 digits with direction
- Zone 1 CW limit: m+13 and m+14, 7 digits with direction
- Zone 1 CCW limit: m+15 and m+16, 7 digits with direction
- Zone 2 CW limit: m+17 and m+18, 7 digits with direction
- Zone 2 CCW limit: m+19 and m+20, 7 digits with direction

Note that the CW limit for any of the zones can be on the CCW side of the origin; the CCW limit, on the CW side. In other words, a zone can either cross the origin or be completely on one side of it. An alarm will be generated, however, if the CCW limit of a zone is set on the CW side of the CW limit.

#### Example 1: Correct Setting

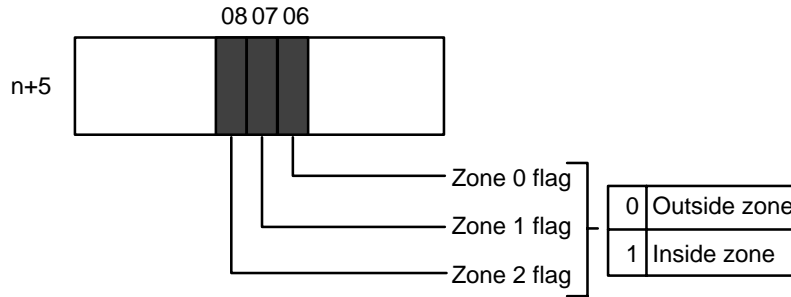


#### Example 2: Incorrect Setting



### Zone Flags

When the present position is in one or more of the zones, zone flags in the IR area are turned ON (1). The PC's scan time, however, can produce a delay in indication during pulse output. Flag allocations are as follows:



### 3-7-2 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.

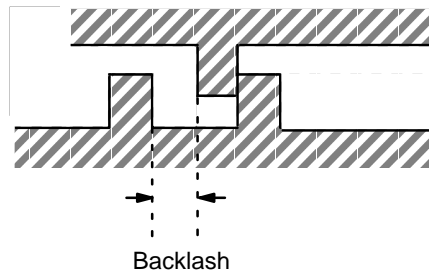
#### Setting Parameters

There is only one parameter that needs to be set to compensate for backlash:

Backlash Compensation

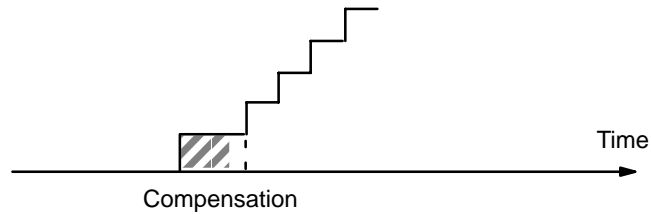
DM word m+4

Set to between 0000 and 9999 pulses.

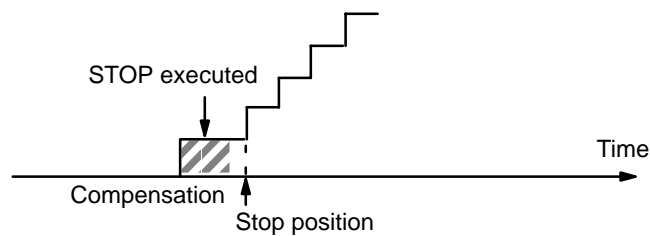


### Using Backlash Compensation

When the feeding direction is reversed, the number of pulses set in DM area is output at the initial speed, and the Unit then proceeds with normal operations.

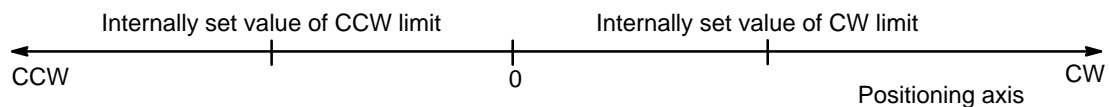


If STOP is executed during backlash compensation for any operations requiring acceleration or deceleration (HIGH-SPEED JOG, ORIGIN SEARCH, ORIGIN RETURN, and START), the Unit will stop feeding immediately after outputting the initial step of the acceleration or deceleration, which will include the backlash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



### 3-7-3 Internal CW/CCW Limits

Limits on the CW and CCW sides of the origin can be set internally to restrict Unit operation to within these limits.



#### Internal CW Limit

DM words m+6 through m+5, 7 digits  
Set to between 1 and 8388606.

#### Internal CCW Limit

DM words m+8 through m+7, 7 digits  
Set to between 1 and 8388607.

The following values will be automatically set if the internal limit settings are 0.

CW: 8388607  
CCW: 8388608

#### Operation

##### START (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.

**3-7-4 Data Calculations**

**Speeds**

Slight differences exist between speeds set in the DM area and actual speeds. These differences do not affect positioning accuracy.

**Settings between 201 and 99,990 pps**

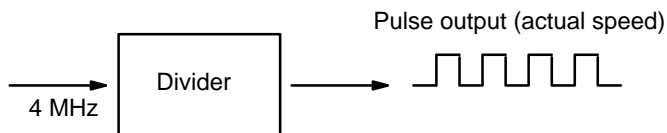
$$\text{Actual speed (pps)} = \frac{4,000,000}{\text{INT}(4,000,000/\text{set value})}$$

where,

INT: Nearest integer

INT(4,000,000/set value): Divider ratio

pps: pulses per second



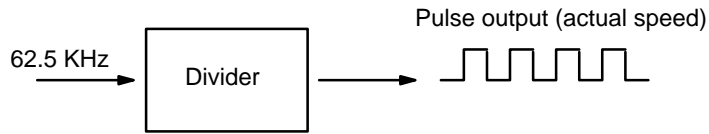
A 4-MHz source clock is divided by the integral divider ratio.

**Example Values**

Set Value (pps)	Actual Speed (pps)
99,900	100,000.00
70,000	70,175.44
40,000	40,000.00
9,999	10,000.00
2,400	2,400.96
201	201.01

**Settings between 1 and 200 pps**

$$\text{Actual speed (pps)} = \frac{62,500}{\text{INT}(62,500/\text{set value})}$$



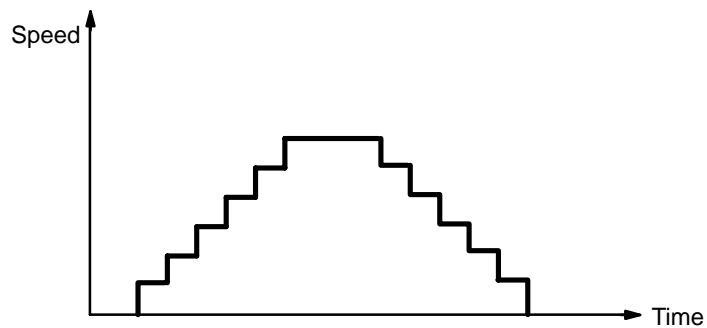
A 62.5-KHz source clock is divided by the integral divider ratio.

**Example Values**

Set Value (pps)	Actual Speed (pps)
200	200.32
120	120.19

**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. To achieve this, acceleration and deceleration tables are created internally when the Unit is first operated or when TRANSFER DATA is used to alter data.

**Table Creation**

The internal processing of the Position Control Unit is as follows during table creation.

- 1, 2, 3... 1. The speed difference,  $\Delta V$ , is obtained to express the range of speed settings.

$$\Delta V = \text{MAX} - \text{MIN}$$

where,

MAX: Twice the maximum set value (not to exceed 100,000).

MIN: Speed indicated by initial speed number.

2. The number of division steps, L, is determined such that the unit time for each step is 4 ms. The maximum number of steps is 250.

$$L = \frac{(\Delta V/R)}{4}$$

where,

R: Acceleration or deceleration data, whichever greater.

$\Delta V/R$ : Acceleration (or deceleration) time between MAX and MIN

3. Next, the speed difference ( $\Delta v$ ) for each step is obtained.

$$\Delta v = (\Delta V/L)$$

4. The divider ratios for all steps are calculated and set in a table.

Step	Target (step) speed	Division ratio
1	MIN	
2	MIN + $\Delta v$	
3	MIN + 2 x $\Delta v$	
⋮	⋮	
L	MAX	

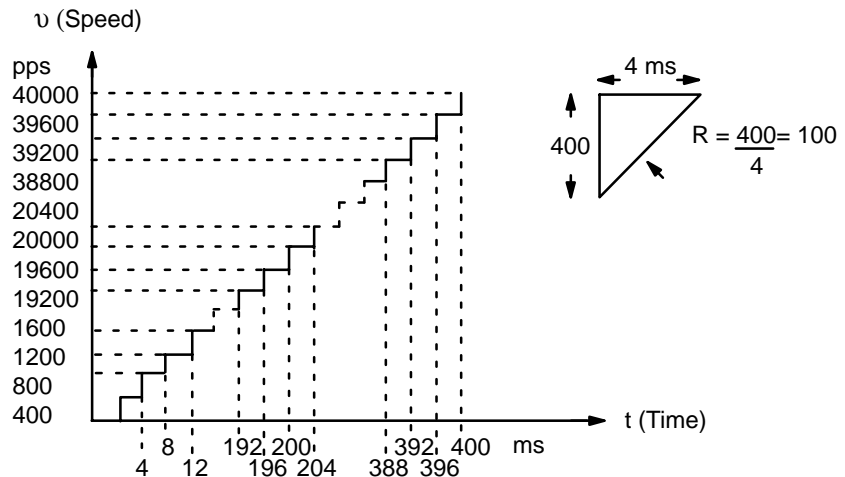
5. Example

Start speed	0 (pps)
Maximum value of speed data Nos. 1 to 15	20000 (pps)
Acceleration	100 (pps/1ms)
Deceleration	100 (pps/1ms)

$$\Delta V = 20000 \times 2 = 40000$$

$$L = \frac{(\Delta V/R)}{4} = \frac{(40000/100)}{4} = 100$$

$$\Delta v = 40000/100 = 400$$



### START Activation Time

The time required between START command bit recognition and the beginning of pulse output is 0.1 second or less.

Only about 10 ms is required to begin execution of positioning actions with "single" positioning actions.

### External Interrupt Response Time

The time required between CHANGE SPEED or STOP command bit recognition and the beginning of execution is at least 10 ms.

### Data Transfer Time

When executing TRANSFER DATA, the busy flag (bit 12 of word  $n + 5$ ) will be ON during data transfer and processing for the following time periods:

#### Positioning Action Data Only (positioning actions #0 through #19)

Maximum: 0.1 s + k (scan time)

#### When Speed Data (Transfers #20 through #25) Are Included

Maximum: 0.2 s + k (scan time)

The value of "k" depends on the number of transfers being made, as illustrated in the following table.

Number of transfers	k
1 to 6	1
7 to 13	2
14 to 20	3
21 to 26	4

### Influence on PC Scan Time

Mounting one Position Control Unit on a PC extends the PC's scan time by about 3 ms. In addition, when transferring data, the scan time during which data is transferred increases by another 5 ms. For example, to transfer all 20 positioning actions, TRANSFER DATA only needs to be executed once, but both the PC and Position Control Unit require 3 scans. Each of these 3 scan times will be 5 ms longer than the normal scan time.

# SECTION 4

## Commands

The Positioning Control Unit provides thirteen commands to execute automatic and manual positioning actions, define and establish position, transfer data, and handle interrupts and errors. Although the data required for execution is listed under each command, much of this data is used by more than one command. Refer to *3-4 Data Configuration and Allocation* for an outline of the structure of Unit data, and to *3-5 IR Area Data Format* for format specifications for particular types of data. *Appendix C DM Area Allocations* and *Appendix D IR Area Allocations* also provide convenient overviews of data allocation. Applications of most commands are presented in *Section 5 Programming Examples*.

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## 4-1 Start

The START command bit, bit 00 of word n, is set to begin execution of positioning actions (effective on signal's rising edge). The actions are executed in order from either the initial positioning action designated in the DM area or that designated in the IR area. Positioning actions are executed in order until a "single" or "bank end" positioning action is reached, at which time START is again required in order to begin execution of positioning actions.

When a bank end positioning action is reached or when positioning action #19 has been performed, the initial positioning action designated in the DM area is performed next. The valid initial positioning action and completion codes (i.e., single, pause, continuous, bank end, and extended) are described later in this subsection.

### 4-1-1 DM Area Settings

Bits 1000 to 1999 of the DM area of the PC are used as data storage areas for the Position Control Unit, storing data such as initial positioning action numbers, initial speed numbers, speed data, acceleration/deceleration data, position data, completion codes, dwell times, and output codes. (Refer to 3-4 *Data Configuration and Allocation* for details.)

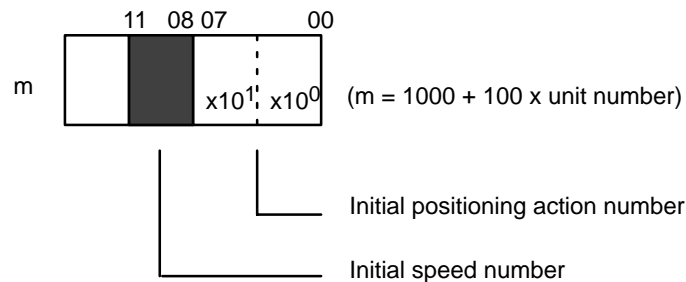
#### Initial Positioning Action Number

DM word m, bits 07-00

Set to a value between 00 and 19. This number is used at:

- Initial START after turning on the Unit (if bit 01 of word n is 0)
- START after bank ends
- START after completion of positioning action #19

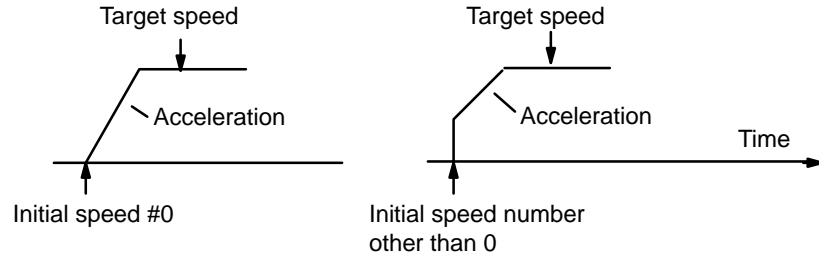
If bit 01 of word n is 1, the initial positioning action number designated in the IR area is used for the initial START after turning on the Unit, allowing for a different starting point for positioning system initialization.



#### Initial Speed Number

DM word m, bits 11-08

Set to a value between 0 and F (hex). An initial speed number of 0 indicates a speed of 0. All the other speed numbers set here refer to the speeds set in DM words m+82 through m+96.

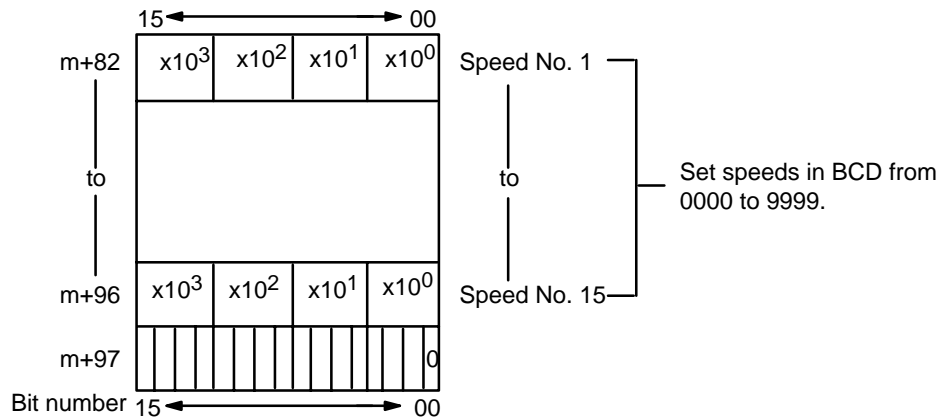


**Speeds**

DM words m+82 through m+96

Set each word to a value between 0000 and 9999 pps (4 digits)

Each of these values, when multiplied by the relevant speed unit in word m+97, is referred to by number to set speeds for this and several other commands.



**Speed Units**

DM word m+97

Each of the bits in this word is assigned to one of the speeds set in words m+82 through m+96. If the bit is set to 0, the speed is multiplied by 1; if the bit is set to 1, then the speed is multiplied by, by 10. Bit assignments are as follows:

Bit 00 is not used. Bit 01 is assigned to speed #1, bit 02 to speed #2, bit 03 to speed #3, and so on, up to bit 15.

**Acceleration**

DM word m+98, bits 11-00, 3 digits

Acceleration is in pps per ms.

**Deceleration**

DM word m+99, bits 11-00, 3 digits

Deceleration is in pps per ms.

**Positioning Actions**

DM words m+22 through m+81

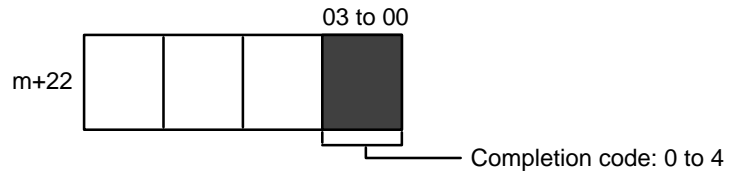


Positioning actions (or sequences) consist of a completion code, dwell time, output code, speed number, and target position. These actions are generally referred to by number and completion code. For example, "#6, continuous" indicates positioning action #6 with a completion code of 2 (continuous). The settings for positioning action #0, DM words m+22 through m+24, are explained below. The same procedure is followed for any other positioning action. See *Appendix C DM Area Allocations* for detailed word and bit allocations.

### Completion Code

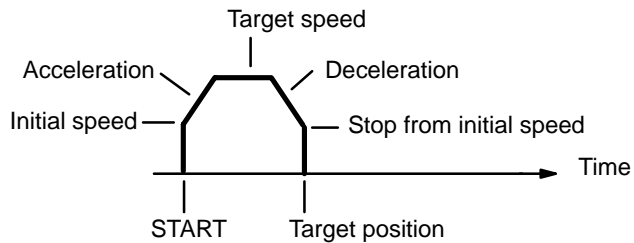
DM word m+22, bits 03-00

Set to between 0 and 4 to specify the five types of completions (described below). See also *4-1-3 Execution Examples*.



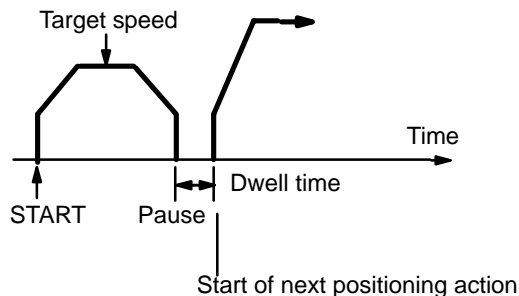
### 0: Single

The target position and target speed are reached and feeding stops. After completion of this action, START is necessary in order to execute the next positioning action(s).



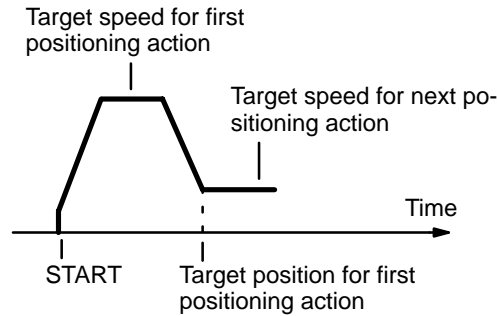
### 1: Pause

The target position and target speed are reached, and the next positioning action is automatically started following the dwell time.



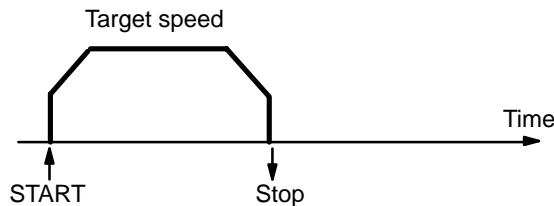
### 2: Continuous

As soon as the target position for the first positioning action is reached, the next positioning action is started. The first target position is reached at the target speed set for the next positioning action, so that the next positioning action can be executed immediately.



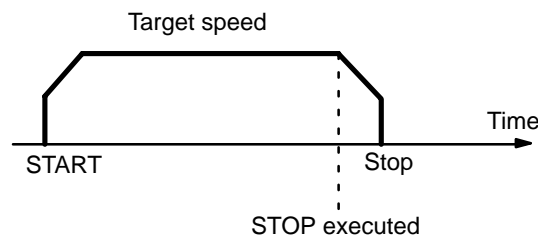
### 3: Bank end

The term "bank" refers to a combination of several positioning actions or sequences. The target position and target speed are reached and feeding stops. The next positioning action to be executed will be the initial positioning action number in bits 07-00 of DM word m. START is required in order to resume execution of positioning actions.



### 4: Extended

The Unit continually outputs pulses at the speed set for the positioning action. The Unit will not calculate the present position, and the no-origin flag (bit 11 of word n+5) will go ON during operation. The direction of pulse output is determined by the direction digit set in the positioning data. (See Appendix C DM Area Allocations.) Extended positioning actions are terminated with STOP. START is required in order to resume execution of positioning actions.



### Dwell Time

DM word m+22, bits 07-04

Set to a value between 0 and F (hex). (Unit: 0.1 s)

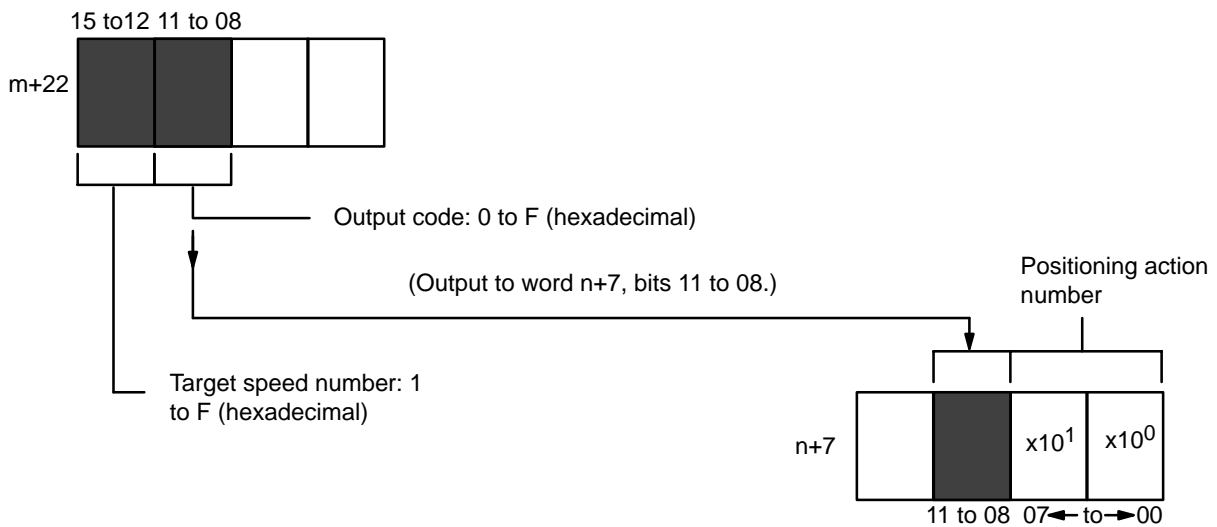
The next action can be executed when the busy flag turns OFF after the dwell time has expired. In other words, the positioning completed flag remains OFF and the busy flag remains ON until the dwell time has expired. (See 4-1-3 Execution Examples.)

**Output Code**

DM word m+22, bits 11-08

Set to an integer between 0-F (hex).

These codes can be set as target by the user. Upon completion of the positioning action, they are output to word n+7 bits 11-08, of the OUT refresh area.



**Target Speed Number**

DM word m+22, bits 15-12

Set to a value between 1 and F (hex).

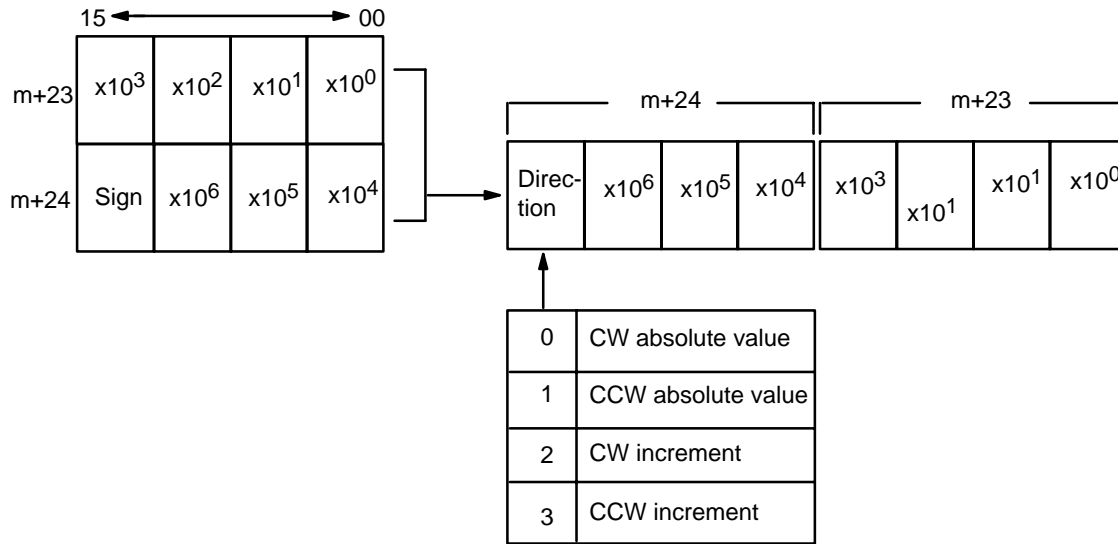
The speed number set here refers to the speeds set in DM words m+82 through m+96.

**Target Position**

DM words m+23 through m+24

The target position is set with the lowest seven digits, i.e., all four digits of word 23 and the lowest three digits of word 24. The remaining digit of word

24 is used as a direction digit. (See Appendix C DM Area Allocations.)

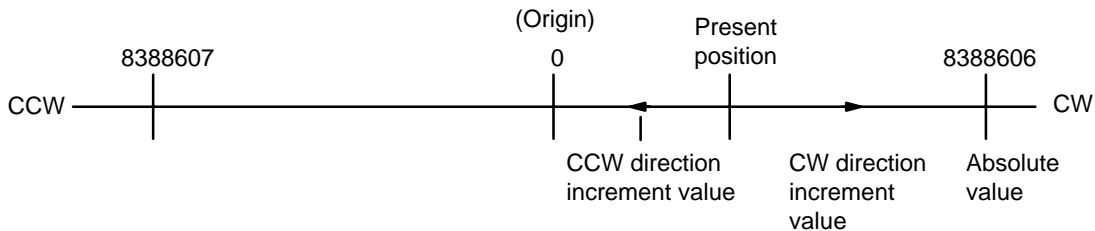


Maximum values are as follows:

CW: 8388606 pulses

CCW: 8388607 pulses

Absolute values are measured from the origin. Increment values are measured from the present position. Positions resulting from increments must be between -8,388,607 and +8,388,606.

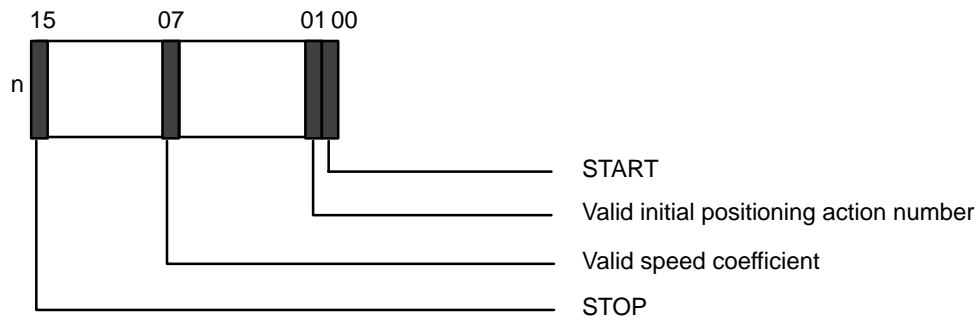


Note that the TEACH command can be used to write target positions into the DM area. See 4-7 TEACH for details.

### 4-1-2 IR Area settings

In C200H PCs, IR words 100 to 199 are used for Special I/O Units. When a Position Control Unit is used, they are allocated as I/O refresh areas. For a detailed explanation, see 3-4 Data Configuration and Allocation. For a detailed table of words and bits in the IR area, see Appendix D IR Area Allocation.

tions.



## START

word n, bit 00

When bit 00 is ON (i.e., set at 1), bits 01 and 07 are referred to and positioning begins.

## Valid Initial Positioning Action Number

word n, bit 01

This is used when the initial positioning number is designated in the I/O refresh areas. After the initial position is set with bits 07 to 00 of word n+1, the START command is set with this bit. These values are set within the same scan.

1: Initial position number set in bits 07-00 of IR word n+1 is valid.

0: Initial position number set in bits 07-00 of DM word m is valid.

## Valid Speed Coefficient

word n, bit 07

This is used when the target speed of the positioning action is multiplied by a coefficient. After the speed coefficient is set with bits 07 to 00 of word n+2, the START command is set with this bit. These values are set within the same scan. This bit can function simultaneously with bit 01 (described above).

1: Coefficient in bits 07-00 of word n+2 is valid.

0: Coefficient is 1.0.

## Deceleration/Stop Command (STOP)

word n, bit 15

This bit turns ON when STOP is executed during pulse output. Pulse output cannot be executed as long as this bit remains ON. See 4-10-1 STOP for a more detailed explanation and several STOP execution examples.

## Initial Positioning Action Number

word n+1, bits 07-00

Set to an integer between 00 and 19.

START will be executed from the positioning action number specified here if bit 01 of word n is 1 when the START command bit (bit 00 of word n) is set.

## Speed Coefficient

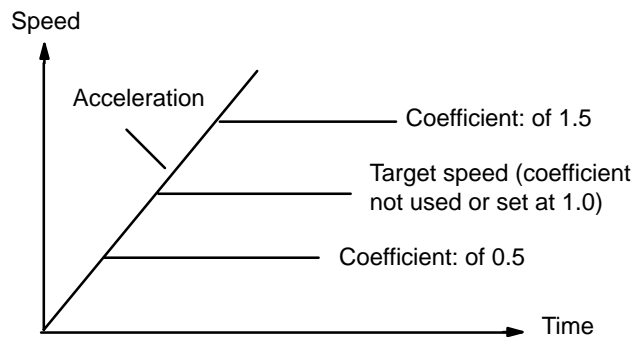
word n+2, bits 07-00

Set a value between 00 and 20 (in units of 0.1). In other words, a setting of 15, for example, will represent an actual value of 1.5.

This coefficient is valid if bit 07 of word n is 1 when the START command bit (bit 00 of word n) is set. It is valid only during START and cannot be changed during an operation.

The speed coefficient represents the coefficient with regard to the target speed. If the value is set at 00, the speed will be considered to be 100 and a coefficient of 1.0 will be used. If the value is set anywhere from 01 to 20, the set value will be multiplied by 0.1 to determine the coefficient. The speed coefficient can thus be set in increments anywhere from 0.1 to 2.0.

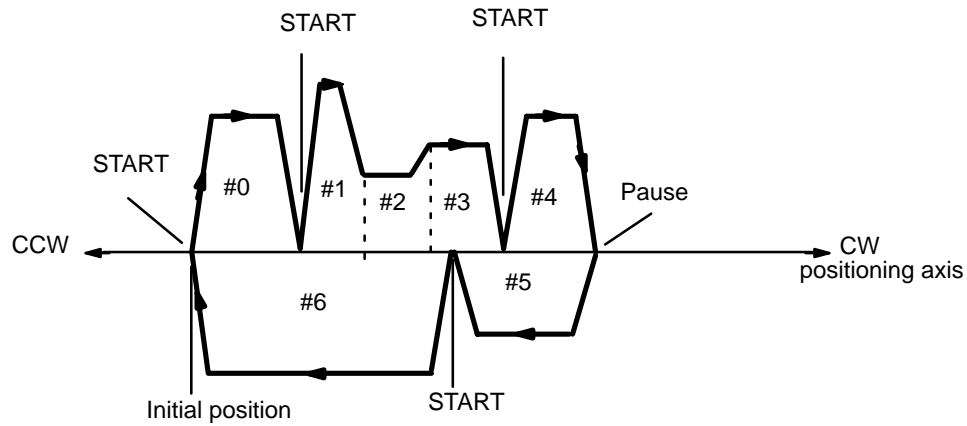
If the speed resulting from the coefficient exceeds 100 kpps or falls below 1 kpps, the speed will be set at 100 kpps or 1 kpps, respectively. Speed coefficients will have no effect on accelerations and decelerations.



### 4-1-3 Execution Examples

#### Example 1: Using Completion Codes

In example diagram on the following page, the initial position and the target position at bank end are the same and the valid initial positioning action number is 0. Positioning actions in these and all following diagrams are indicated simply by their numbers.



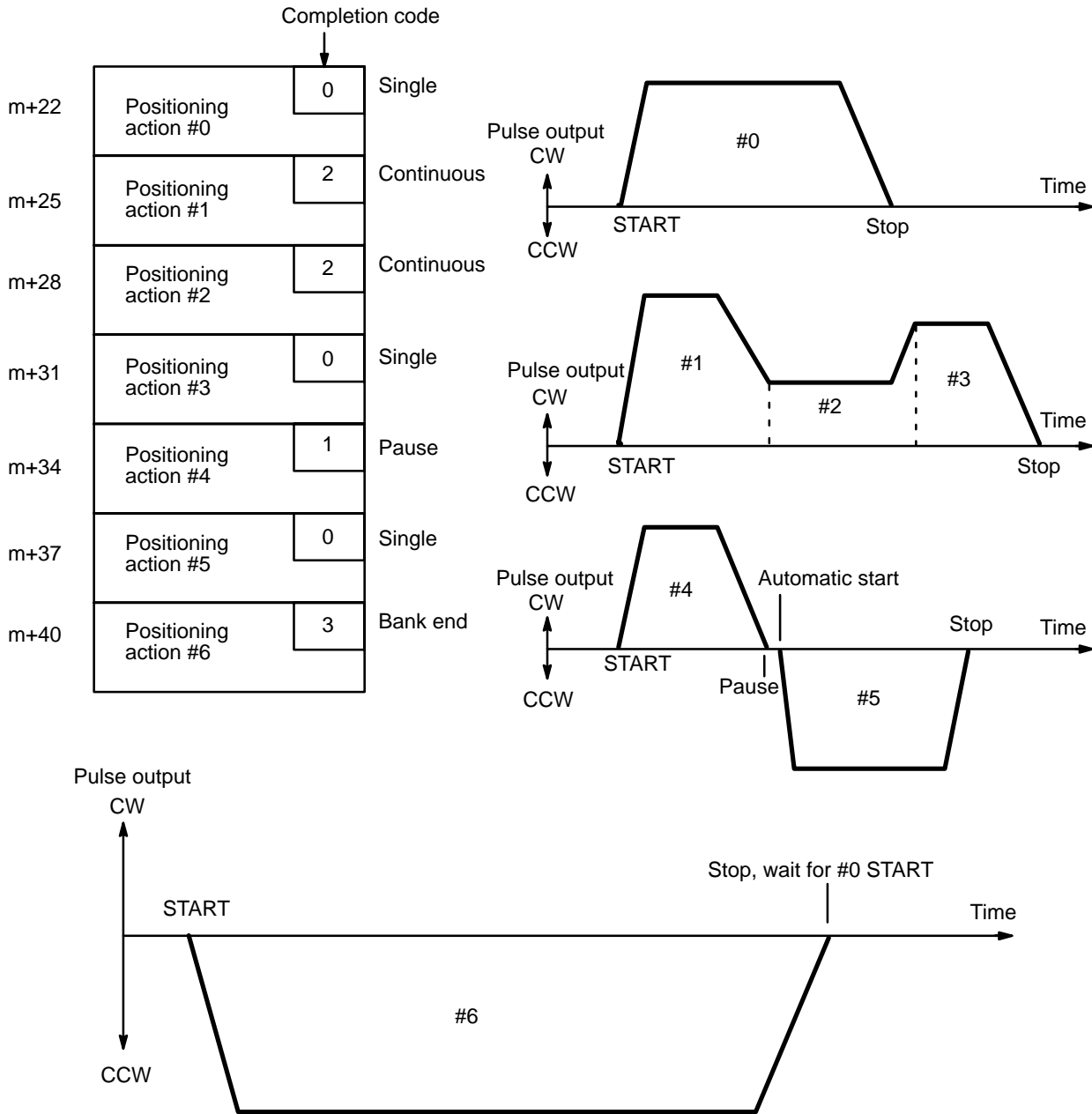
The completion code for positioning action #0 is set at 0, making it a single action. Positioning stops after completion of this action, and START is necessary for operation to begin again.

The completion codes for positioning actions #1 and #2 are set at 2, making them continuous actions. Positioning actions #1, #2, and #3 are thus executed consecutively, with each action reaching its target position at the target speed set for the subsequent action. The completion code for positioning action #3 is set at 0, making it a single action and causing positioning to stop after completion of this sequence of actions.

The completion code for positioning action #4 is set at 1, making it a pause action. Upon completion of this action, there will be a pause (set as dwell time); following the pause, the next positioning action will start automatically. Positioning actions #4 and #5 are thus executed consecutively, with a preset pause in between. Since the completion code for positioning action #5 is set at 1 (single), positioning will stop after completion of this sequence.

The completion code for positioning action #6 is set at 3, making it a bank end. Completion of this action will thereby signal completion of the entire bank of actions. Upon completion of this action, the Unit will be prepared to execute positioning action #0 but will wait for START before beginning.

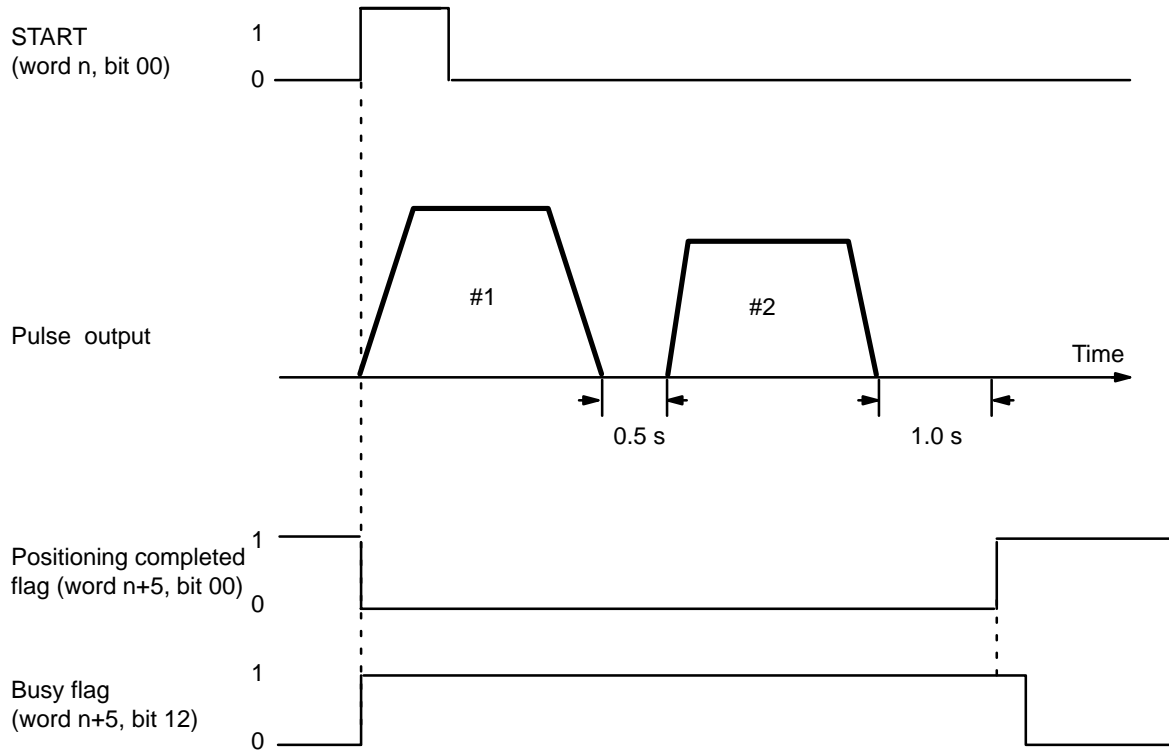
Refer to the more detailed example diagrams on the following page.





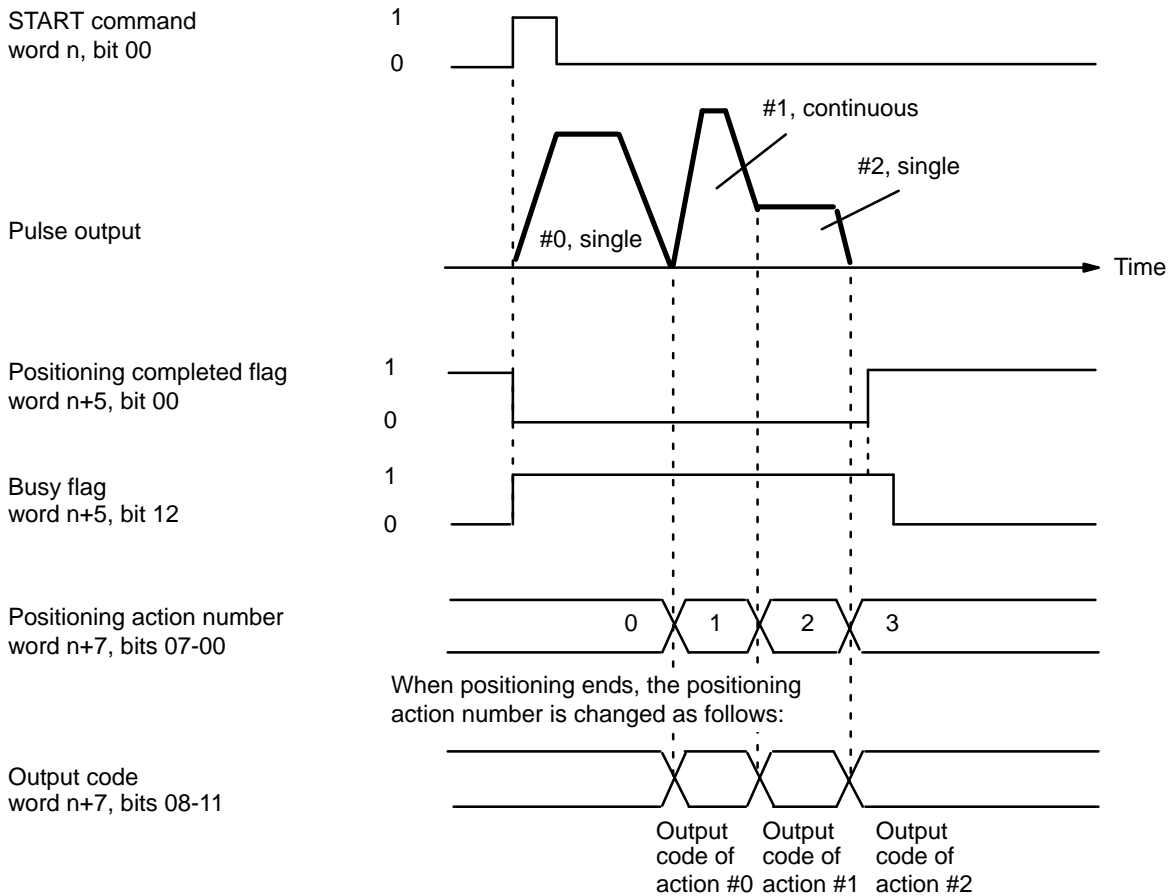
### Example 2: Using Dwell Time

In this example, the completion code for positioning action #1 is set at 1 (pause), with the dwell time set at 0.5 s. The completion code for positioning action #2 is set at 0 (single), with the dwell time set at 1.0 s.



### Example 3: Using START With Single or Bank End Positioning Actions

Positioning sequences combining several pause and/or continuous positioning actions normally are ended by a single or bank end positioning action. When the last positioning action is completed, including any dwell time designated for it, the positioning completed flag turns ON and busy flag turns OFF. START is then required to begin further execution of positioning actions. START is also required to restart operation after the STOP command has been executed. (See 4-10 *External Interrupt Commands* for details and examples.)



## 4-2 Origin Search

The ORIGIN SEARCH command bit, bit 02 of word n, is set to establish the position of the origin through inputs from an origin sensor and, if provided, an origin proximity sensor (effective on signal's rising edge). Before using ORIGIN SEARCH, set the DIP switch as described in 2-1 *Switch Settings* to establish the direction from which the search will be made, the presence or absence of a proximity sensor, and the type of input used.

### 4-2-1 DM Area Settings

In addition to the settings described in detail in this section, the data listed below must also be set in order to execute ORIGIN SEARCH. They are the same as those set for START, so they can be set by following the instructions contained in 4-1 *START*.

**Initial Speed Number** Bits 11-08 of DM word m

**Speeds** DM words m+82 through m+96

**Speed Units** DM word m+97

**Acceleration** Bits 11-00 of DM word m+98

**Deceleration** Bits 11-00 of DM word m+99

## ORIGIN SEARCH Proximity Speed Number (Low Speed)

DM word m+1, bits 03-00

Set to an integer between 1-F (hex). The speed number set here refers to one of the speeds set in DM words m+82 through m+96. It cannot be set higher than the ORIGIN SEARCH high speed number. If there is no origin proximity signal, the speed designated here is used for the entire ORIGIN SEARCH operation.

## ORIGIN SEARCH High Speed Number

DM word m+1, bits 07-04

Set to an integer between 1-F (hex). The speed number set here refers to one of the speeds set in DM words m+82 through m+96. The speed designated here is used only if an origin proximity signal is present.

## Origin Compensation

DM words m+2 and m+3

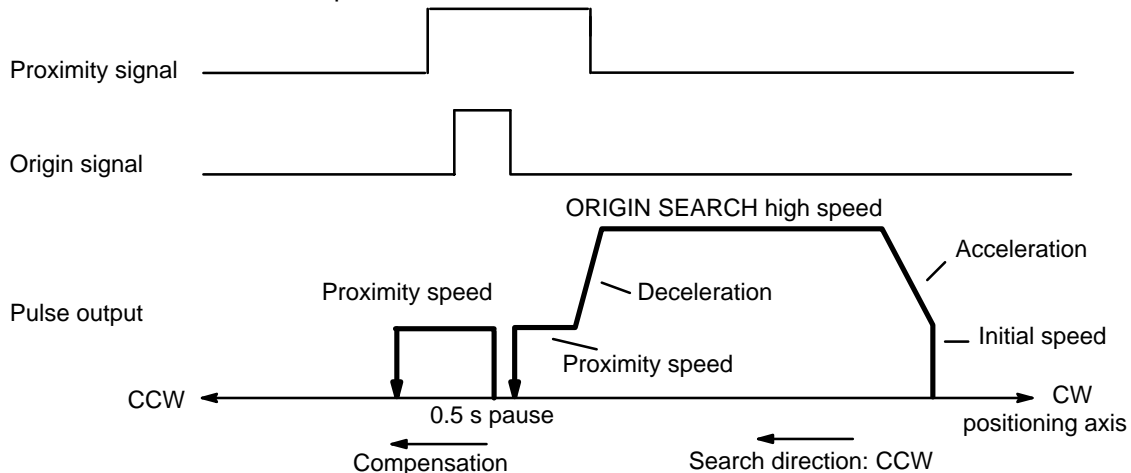
Set word m+2 to a value between 0000 and 9999 pulses.

Set bit 00 of word m+3 to set the direction of compensation:

- 0: CW
- 1: CCW

If the position determined by origin signal input is to be treated as the origin (position 0), set word m+2 to 0. Otherwise set the value and direction necessary to obtain the required origin. If there is an origin compensation value set in word m+2, then, after reaching the position determined by origin signal input, compensation will be executed at proximity speed in the direction set at bit 00 of word m+3. See the example given below and *4-2-3 Execution Examples* for application.

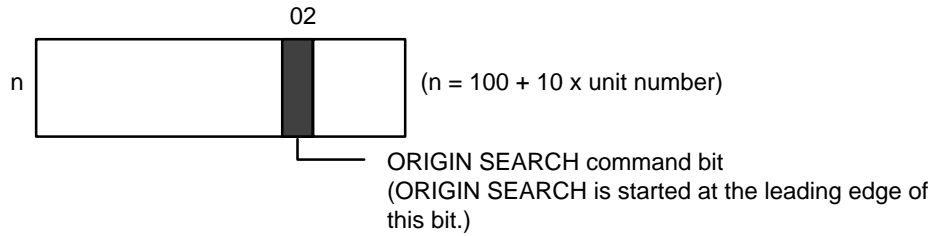
In the example diagram below, bit 00 of word m+3 is set at 1, so origin compensation is counterclockwise.



## 4-2-2 IR Area Settings

In C200H PCs, IR words 100 to 199 are used for Special I/O Units. When a Position Control Unit is used, they are allocated as I/O refresh areas. For a detailed explanation, see *3-4 Data Configuration and Allocation*. For a detailed table of words and bits in the IR area, see *Appendix D IR Area Allocations*.

In the IR area, the ORIGIN SEARCH command is set with bit 02 of word n. ORIGIN SEARCH begins when this bit is turned ON.



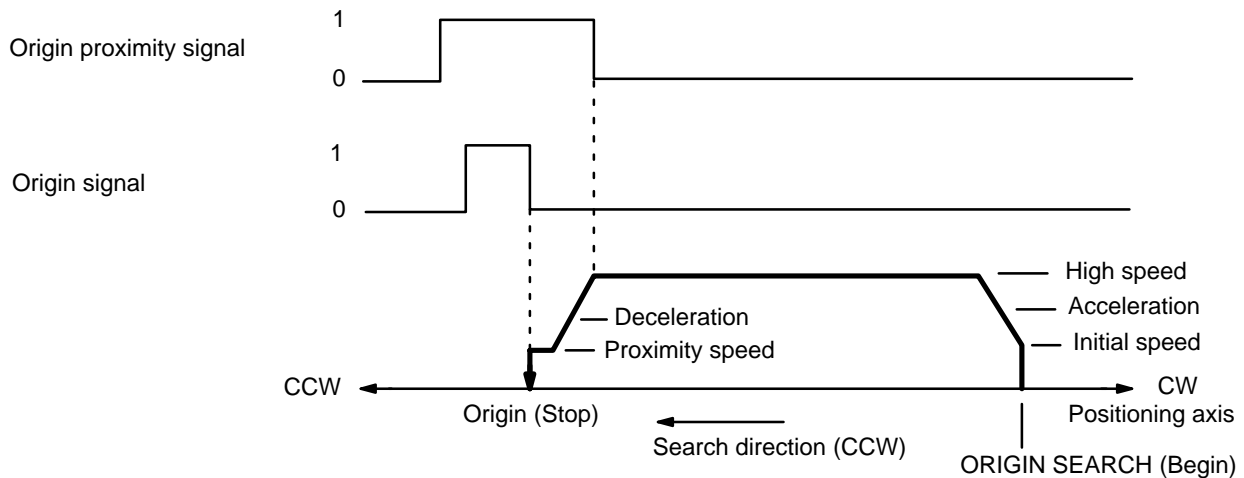
### 4-2-3 Execution Examples

#### Search Patterns With Origin Proximity Signal

There are basically three possible search patterns when an origin proximity signal is present (i.e., when DIP switch no. 3 is ON). The pattern executed depends on the position of the origin with respect to the starting position and search direction. N.O. inputs are used in the following example diagrams.

#### Example 1

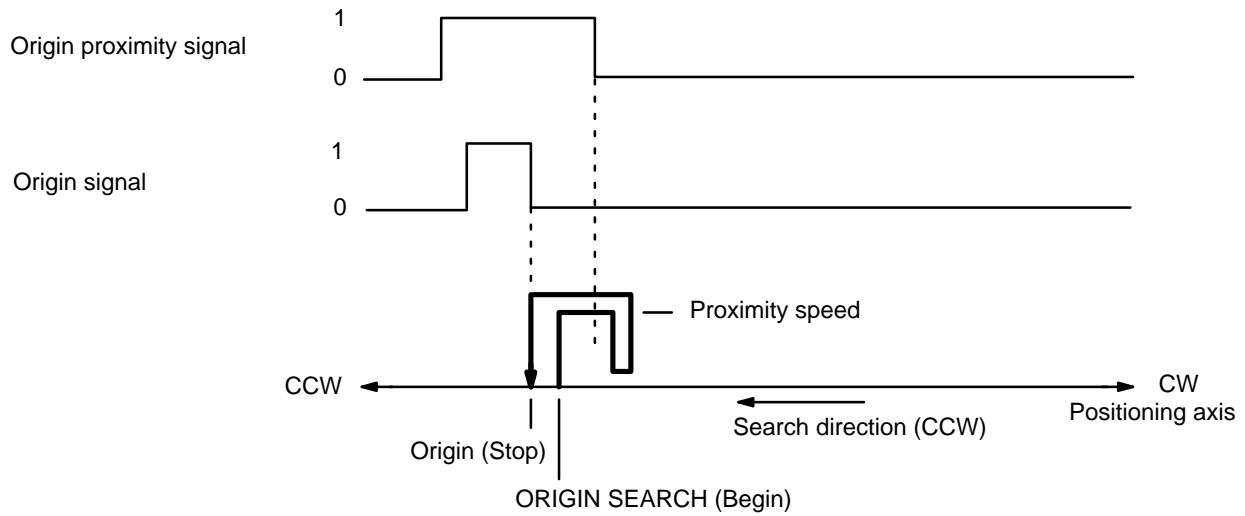
The first diagram illustrates the simplest search pattern, i.e., that in which both the origin proximity and origin signal activation points are in the search direction from the initial position.



#### Example 2

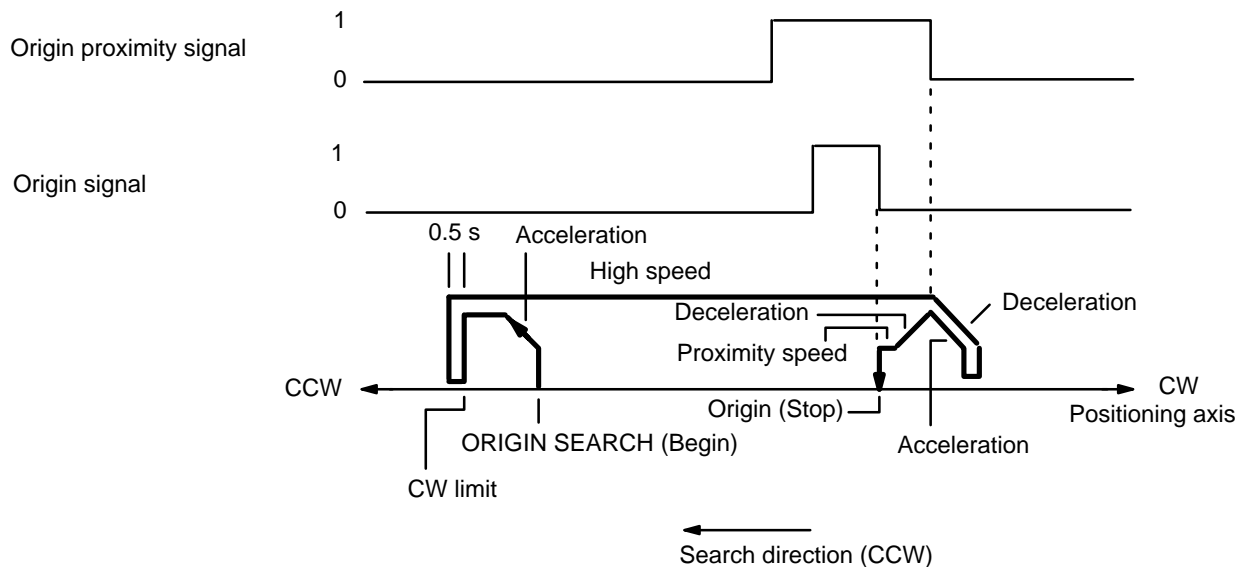
When beginning ORIGIN SEARCH from inside the activation points for the origin proximity signal, the Unit first feeds beyond the activation point, and

then begins searching in the search direction.



**Example 3**

When reaching the CW or CCW limit during ORIGIN SEARCH, the Unit pauses for 0.5 s, returns beyond the activation point for the origin proximity signal, and then begins searching in the search direction.



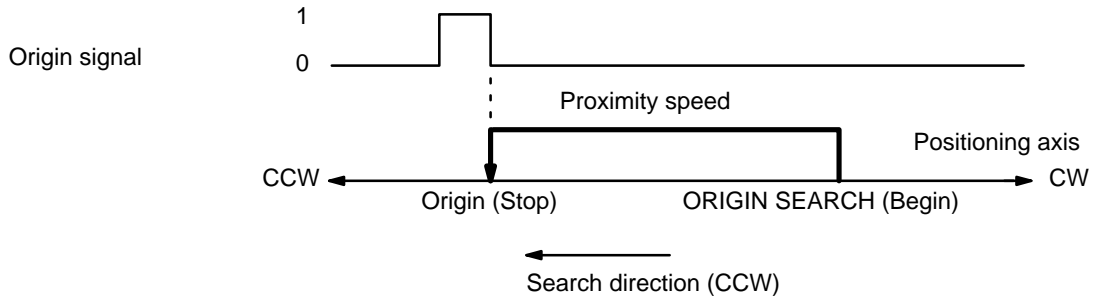
**Search Patterns Without Origin Proximity Signal**

When an origin proximity signal is not present, only the ORIGIN SEARCH proximity speed is used for ORIGIN SEARCH. This affects the three search

patterns only by eliminating accelerations and decelerations. All other aspects remain the same.

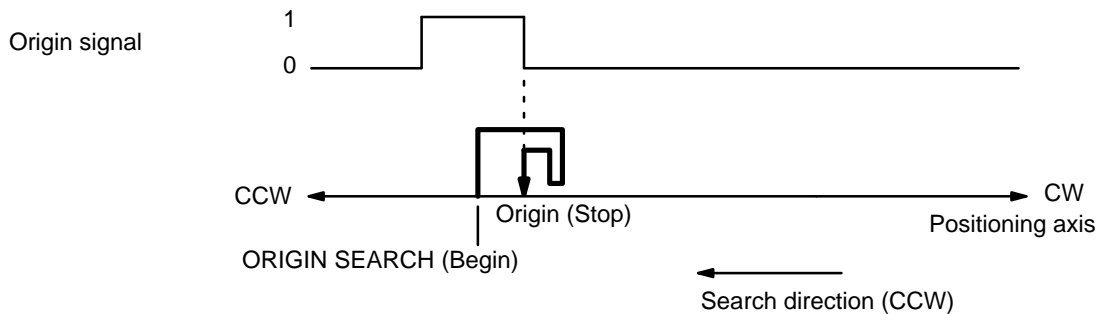
**Example 1**

The first diagram illustrates the simplest search pattern, as in Example 1 above.



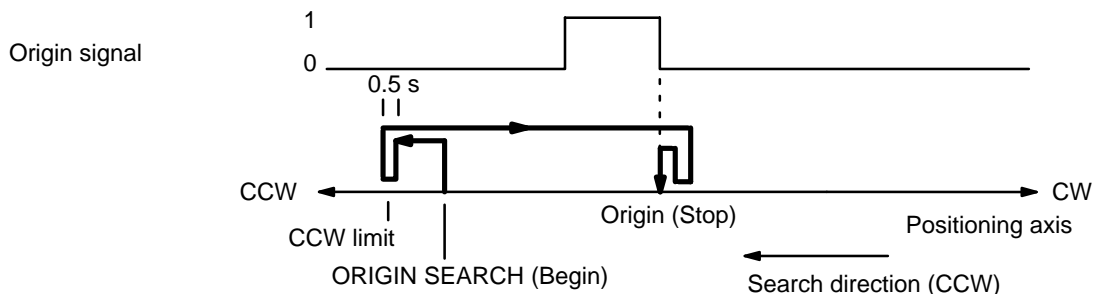
**Example 2**

As in Example 2 on the previous page, when beginning ORIGIN SEARCH from inside the activation points for the origin proximity signal, the Unit first feeds beyond the activation point, and then begins searching in the search direction.



**Example 3**

As in Example 3 on the previous page, when reaching the CW or CCW limit during ORIGIN SEARCH, the Unit pauses for 0.5 s, returns beyond the activation point for the origin proximity signal, and then begins searching in the search direction.

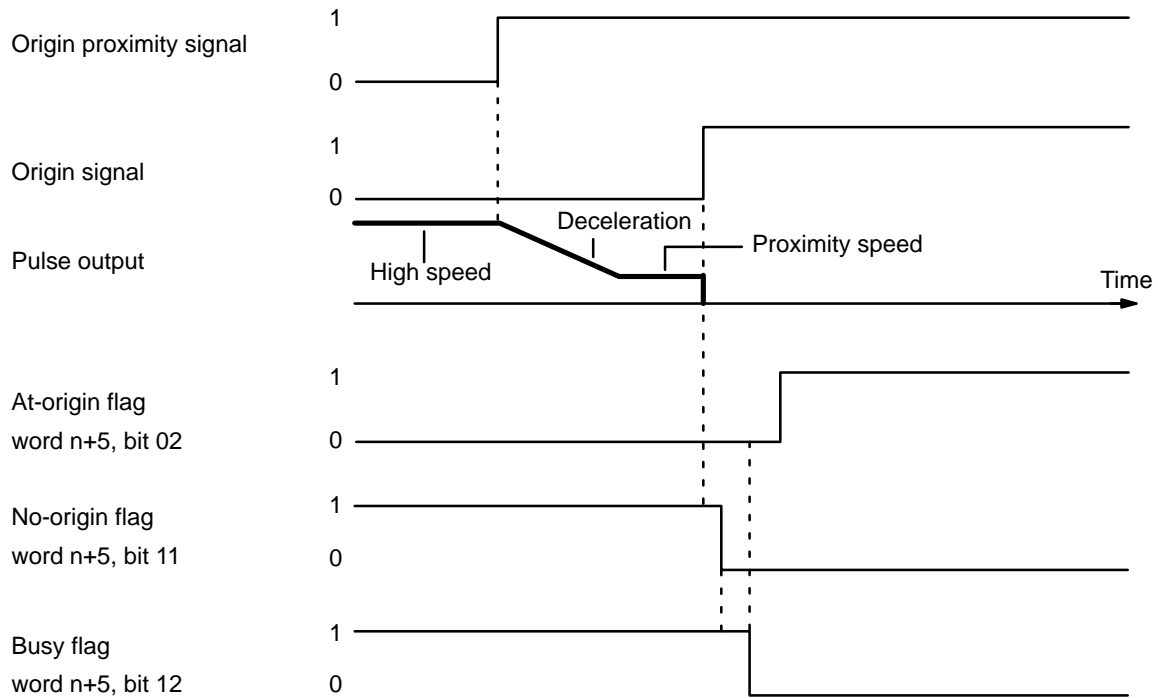


### 4-2-4 Completion Examples

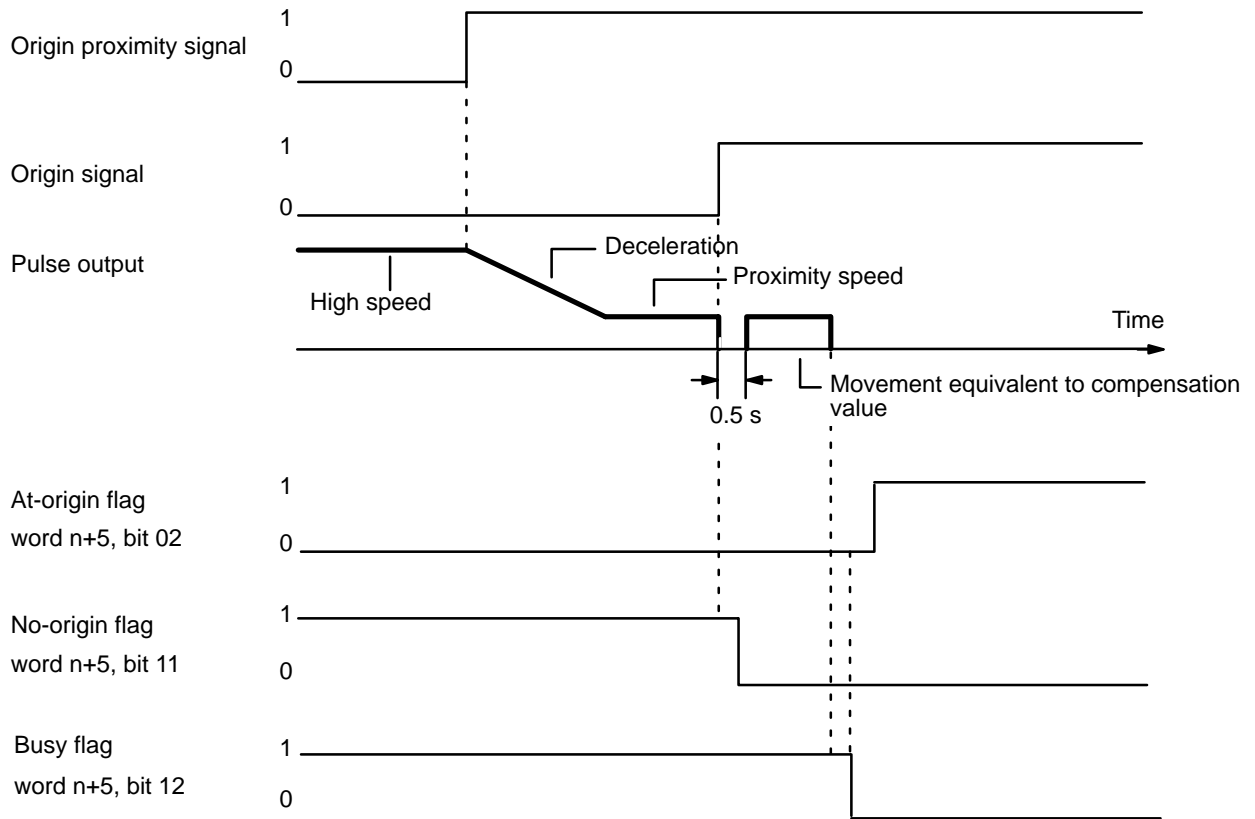
#### Completion Patterns With an Origin Proximity Signal

The following two example diagrams both illustrate completion of ORIGIN SEARCH when an origin proximity signal is present (i.e., when DIP switch no. 3 is ON). There is an origin compensation value set in the second example, but not in the first.

#### Example 1: Without Origin Compensation



### Example 2: With Origin Compensation

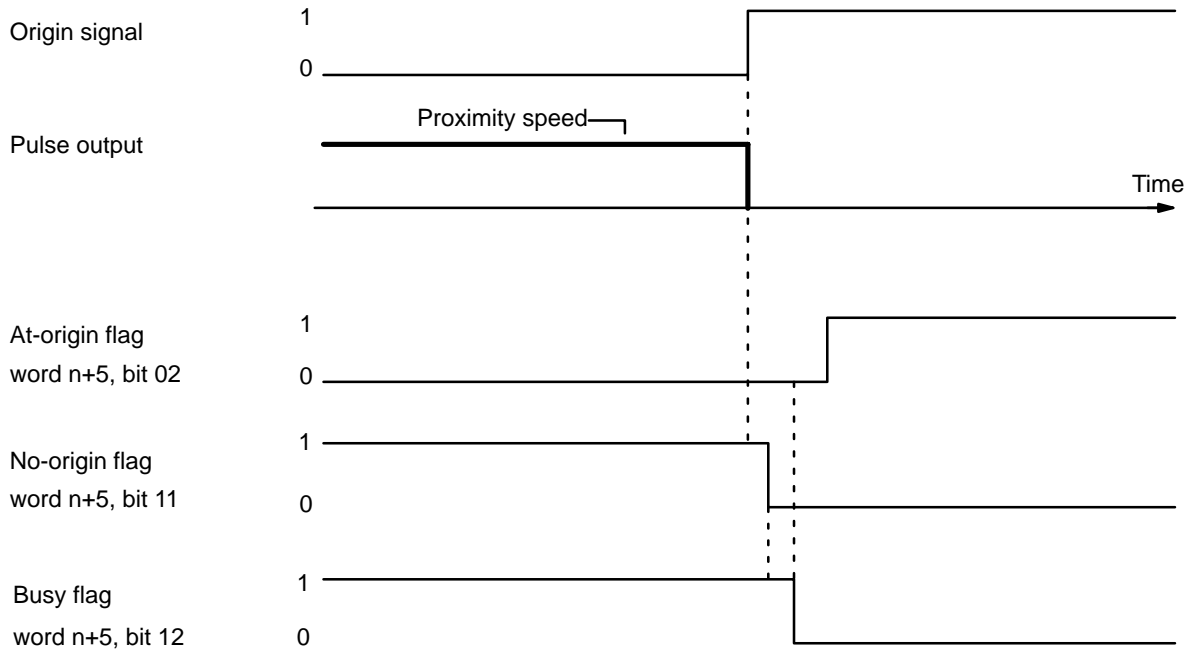




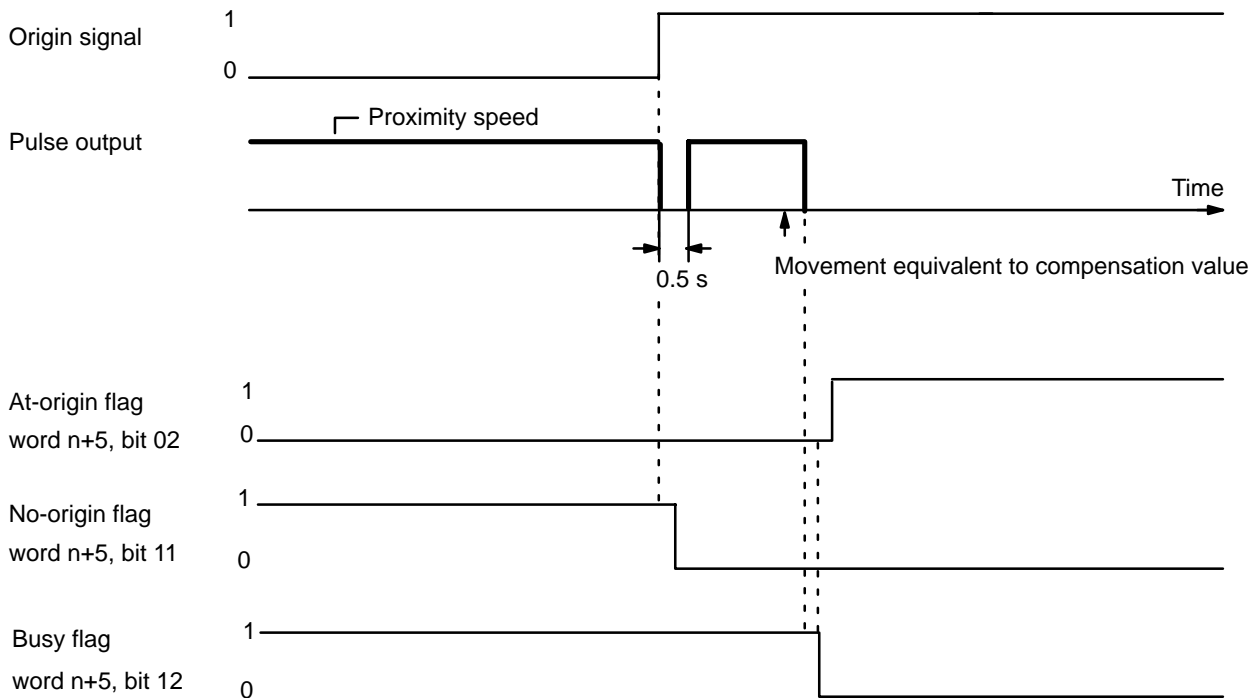
**Completion Patterns  
Without an Origin  
Proximity Signal**

The following two example diagrams both illustrate completion of ORIGIN SEARCH when no origin proximity signal is present (i.e., when DIP switch no. 3 is OFF). There is an origin compensation value set in the second example, but not in the first.

**Example 1: Without  
Origin Compensation**



## Example 2: With Origin Compensation



## 4-3 Origin Return

The ORIGIN RETURN command bit, bit 03 of IR word n, is set to return to the origin (effective on signal's rising edge). Because origin and origin proximity signals are not used, the present position relative to the origin must be known. ORIGIN SEARCH or TRANSFER DATA (to preset the present position) must therefore be used to establish position before ORIGIN RETURN is executed.

### 4-3-1 DM Area Settings

In addition to the ORIGIN RETURN speed number (described below), the following data must also be set in order to execute ORIGIN RETURN. They are the same as those set for START, so they can be set by following the instructions contained in 4-1 START.

**Initial Speed Number** Bits 11-08 of DM word m

**Speeds** DM words m+82 through m+96

**Speed Units** DM word m+97

**Acceleration** Bits 11-00 of DM word m+98

**Deceleration** Bits 11-00 of DM word m+99

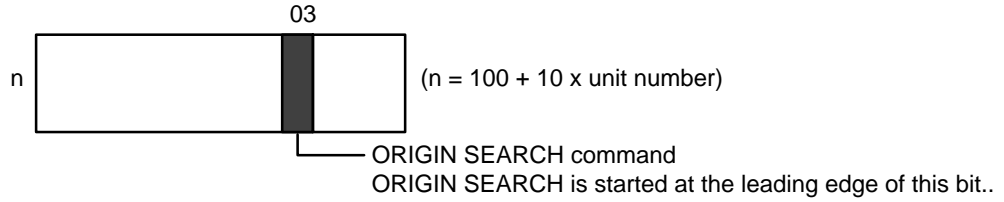
### ORIGIN RETURN Speed Number

DM word m, bits 15-12

Set from 1 to F (hexadecimal).

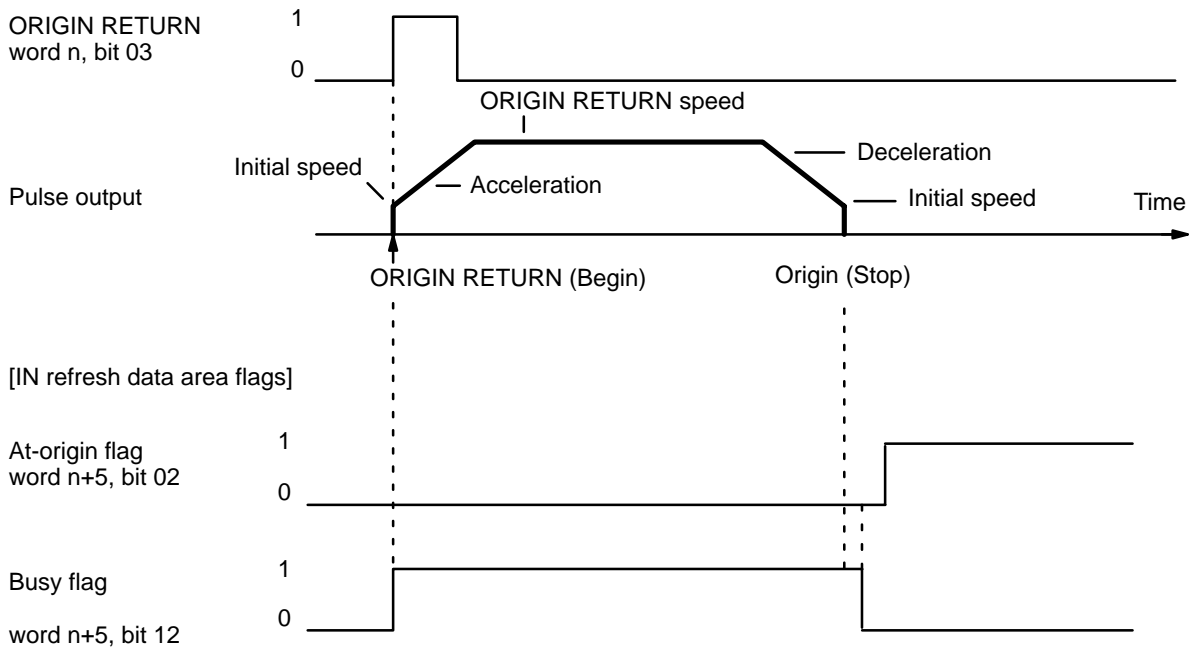
### 4-3-2 IR Area Settings

The ORIGIN RETURN command is valid when bit 03 of word n is ON.



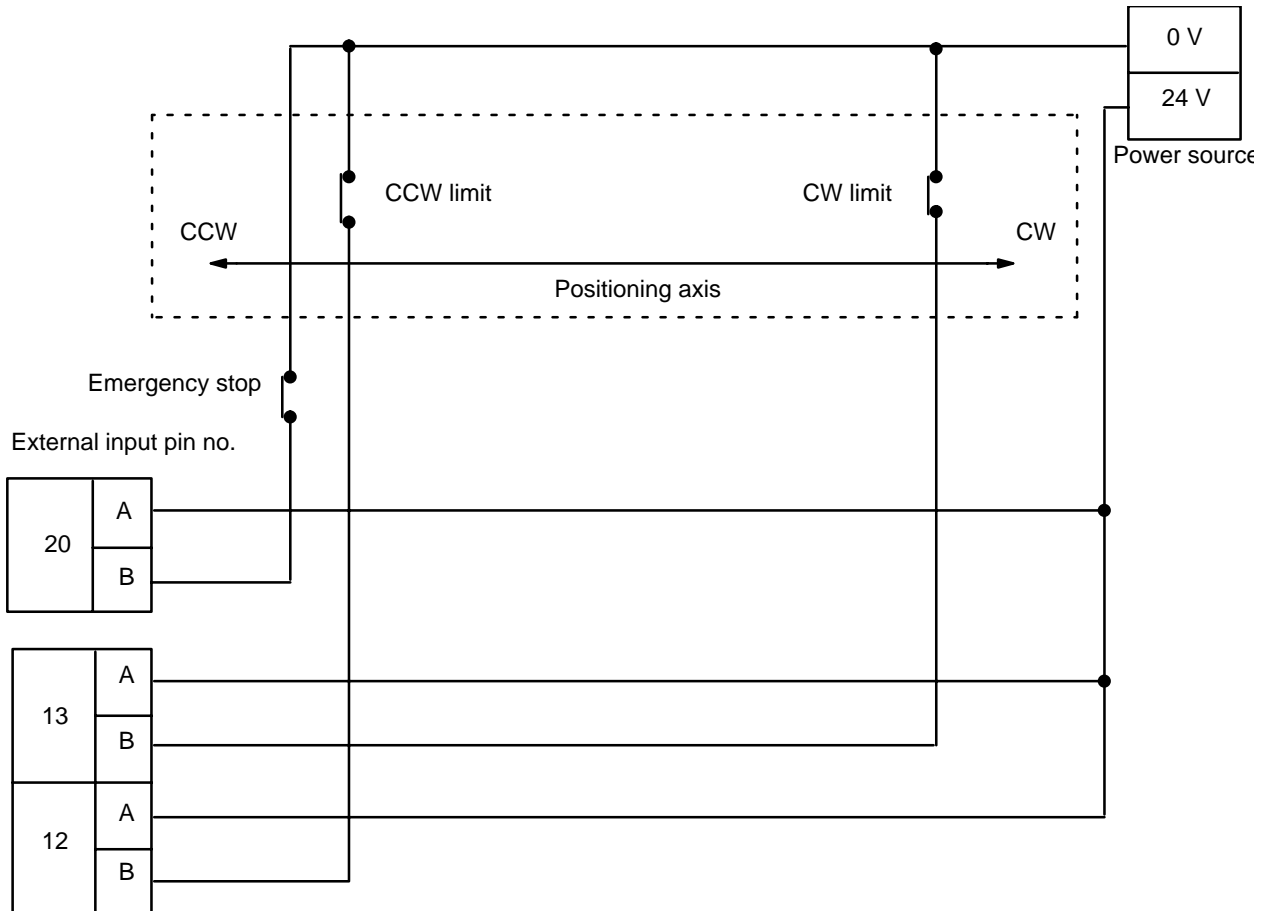
### 4-3-3 Execution Example

ORIGIN RETURN can only be executed when the origin (0) is known. As shown in this example diagram, acceleration and deceleration automatically form a trapezoidal pattern, stopping at the origin.



### 4-4 Release Prohibit

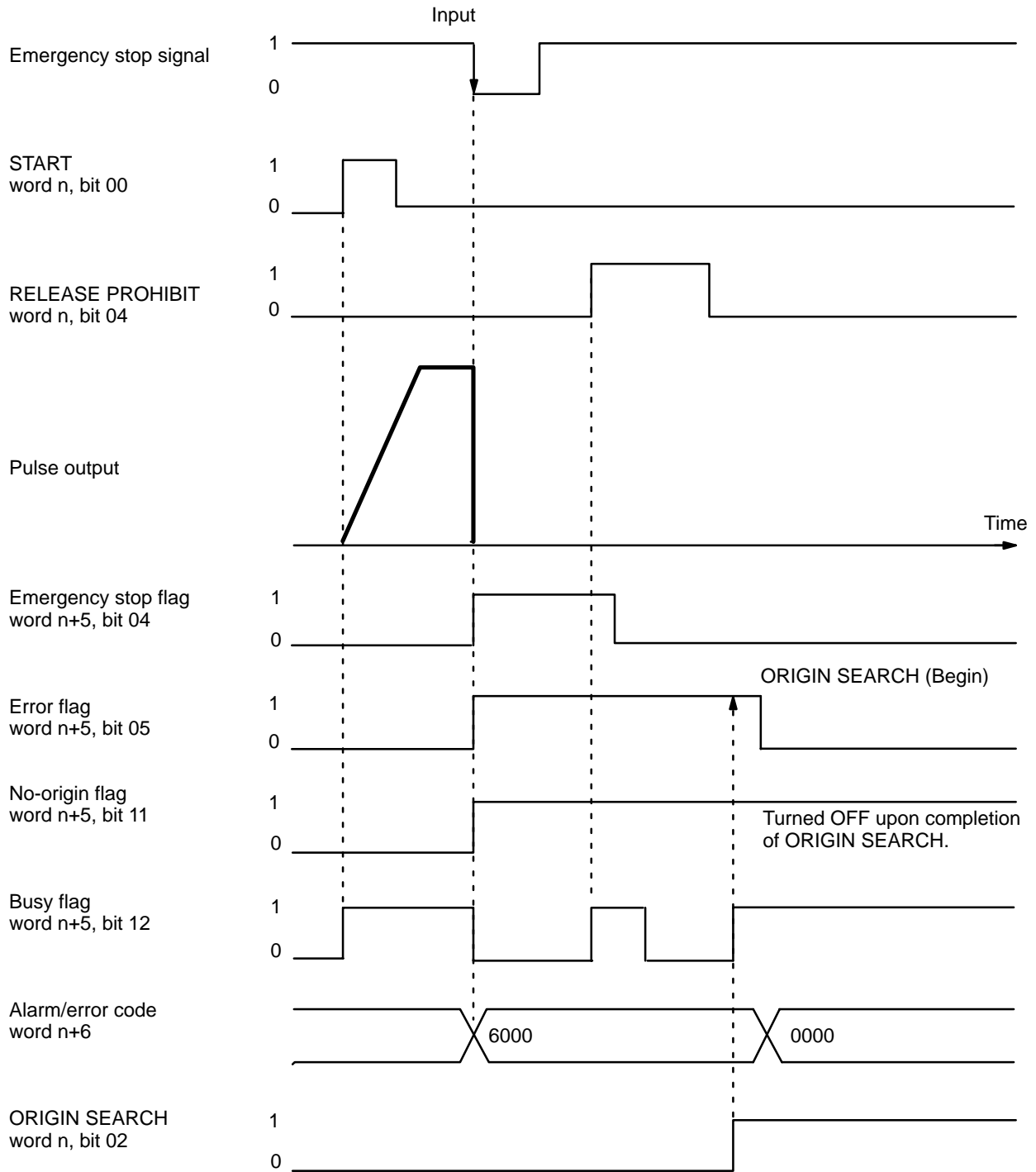
When Position Control Unit operation is stopped as a result of input of an emergency stop, CW limit, or CCW limit signal, (i.e., when the N.C. input of any of these turns ON), further pulse output is prohibited. In order to resume pulse output, it is necessary to cancel this prohibition by means of the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



### 4-4-1 Execution Examples

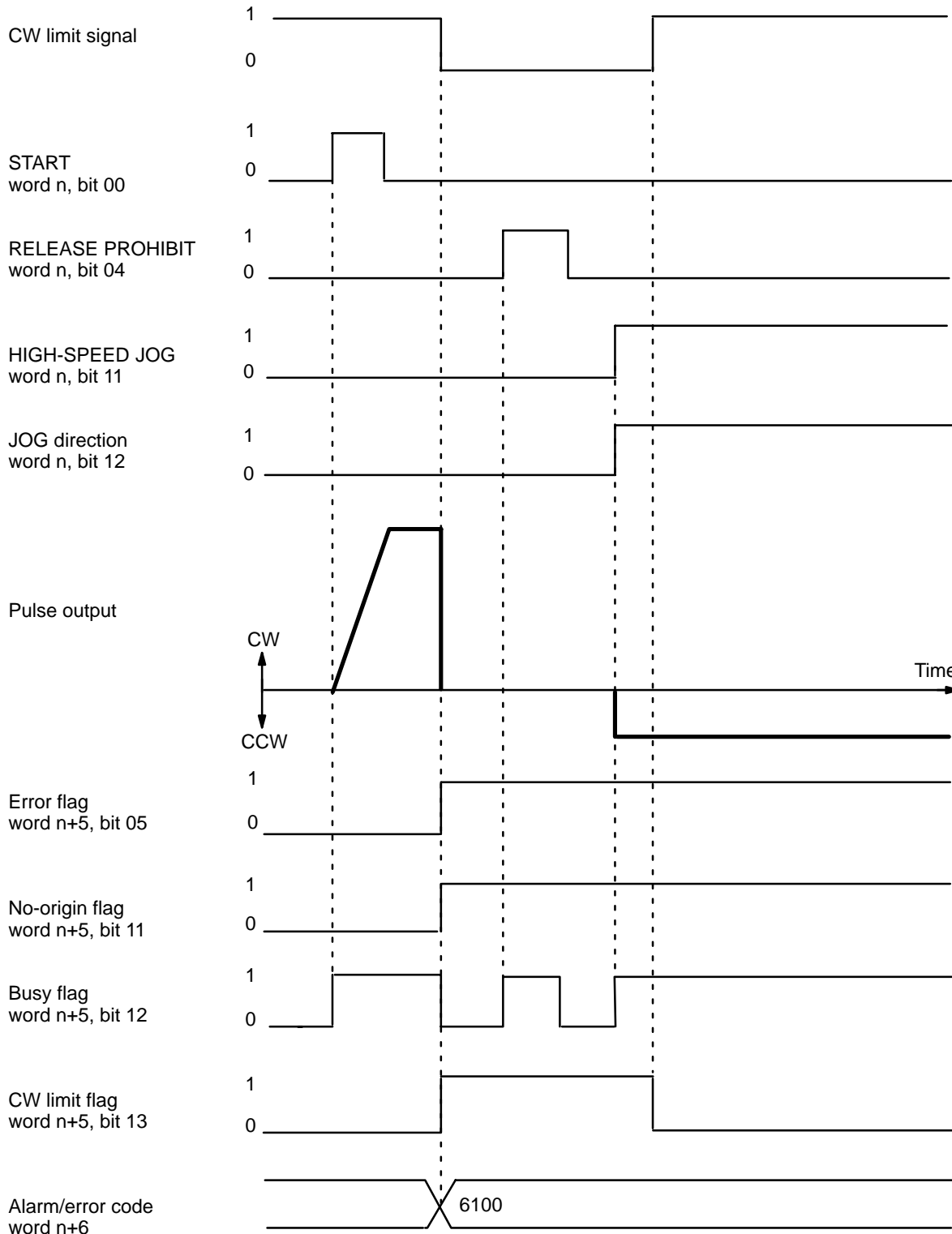
#### Example 1: Emergency Stop

The present position is lost during an emergency stop, and positioning cannot be started again directly after RELEASE PROHIBIT. Execute ORIGIN SEARCH before proceeding.



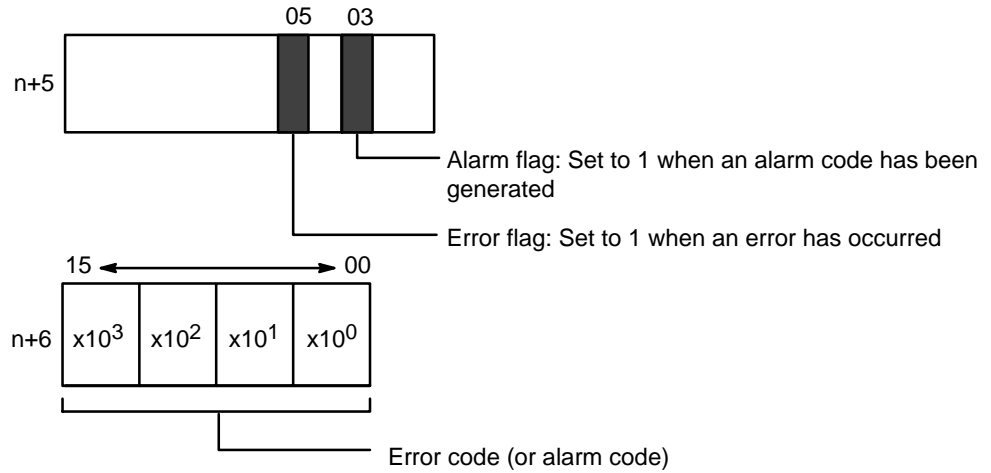
### Example 2: Exceeding CW or CCW Limit

The emergency stop flag is not affected by exceeding the CW or CCW limit. When a limit is exceeded, only pulse output in the opposite direction is possible. In other words, when the CW limit is exceeded, only CCW pulse output is possible. Although a CCW HIGH-SPEED JOG is used to clear the CW limit flag in the example, LOW-SPEED JOG or ORIGIN SEARCH may also be used.



## 4-5 Read Error

The READ ERROR command bit, bit 05 of word n, is set to access error and alarm codes when more than one of these is present (effective on signal's rising edge). The codes are consecutively output to word n+6. Errors and alarms have separate flags, as follows:



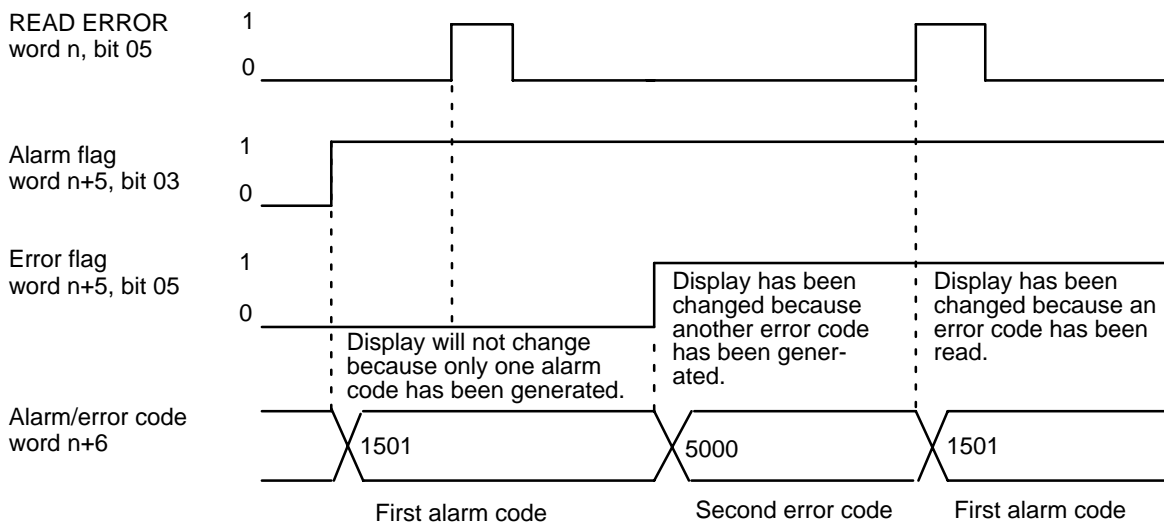
word n+6 shows four digits in BCD when displayed on the Programming Console. If there are no errors or alarms, 0000 will be displayed. If there are any errors or alarms, they will be displayed in code. The codes will be displayed in order as READ ERROR is executed. (If there is only one code, however, the display will not change when READ ERROR is executed.)

The error or alarm code (word n+6) is updated via I/O refreshing immediately after the READ ERROR command bit is turned ON. The busy flag does not turn ON. READ ERROR can be used within a signal scan.

For further information and details, refer to *Section 6 Error Processing*. For a complete list of alarm codes, refer to *Appendix A Alarm Code List*.

### 4-5-1 Execution Example

The following diagram shows an example in which first the alarm code 1501 and then the error code 5000 are displayed.



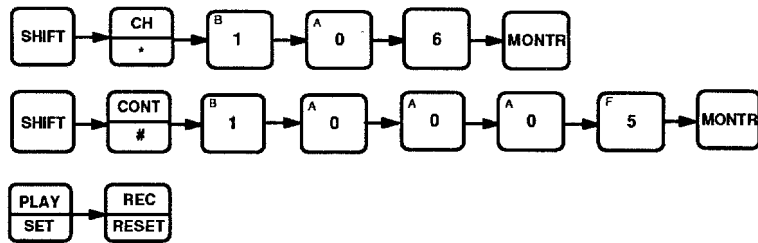
### 4-5-2 Reading from the Programming Console

The following example diagram (for Unit #1) shows how to read an alarm/error code from the Programming Console.

Programming Console Display:

C106	
1501	
10005	C106
^OFF	1501
10005	C106
^OFF	5000

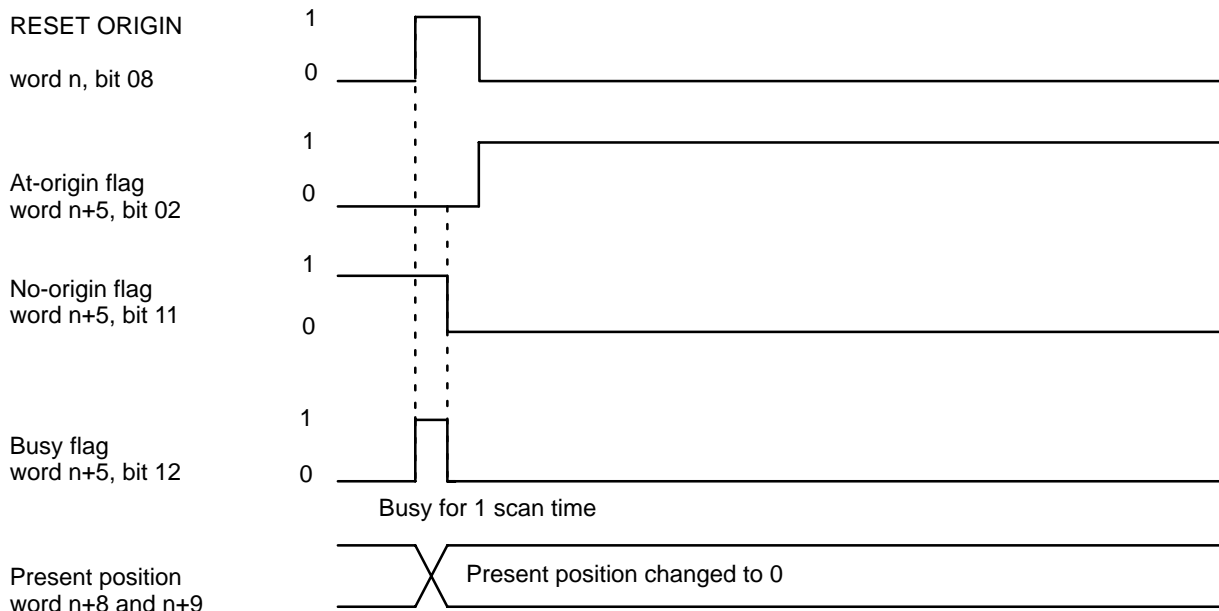
Key sequence:



### 4-6 Reset Origin

The RESET ORIGIN command bit, bit 08 of word n, is set to redefine the present position as the origin (effective on signal's rising edge).

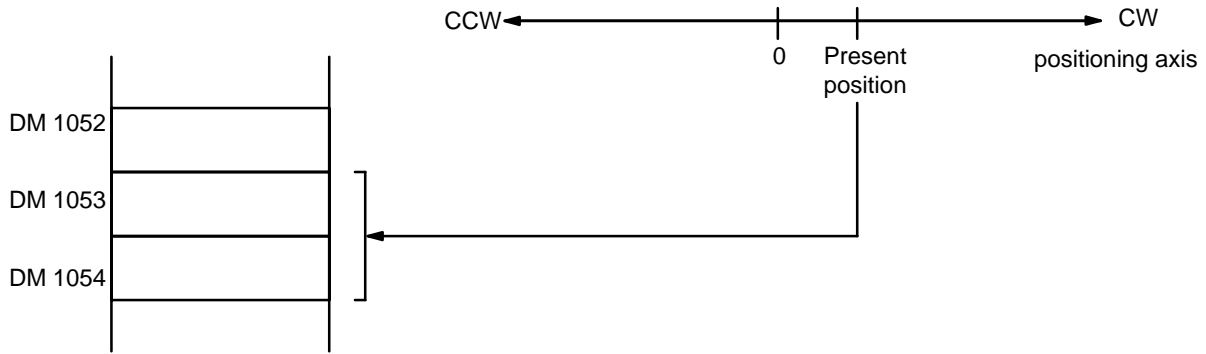
#### Execution Example



### 4-7 Teach

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 as fixed data into the C200H PC's DM area available for use by Special I/O Units. The TEACH command bit, bit 09 of word n, is set to write the present position as the target position for the designated positioning action. Data is set as absolute positions, and not as increments. TEACH can be executed within a single scan. The following diagram uses Unit #10 as an example.





Data set using TEACH is valid immediately and can be used for positioning actions without turning off the power or transferring data. Note that data rewritten using the Programming Console is not valid until data has been transferred again.

### 4-7-1 IR Area Settings

In C200H PCs, IR words 100 to 199 are used for Special I/O Units. When a Position Control Unit is used, they are allocated as I/O refresh areas. For a detailed explanation, see *3-4 Data Configuration and Allocation*. For a detailed table of words and bits in the IR area, see *Appendix D IR Area Allocations*.

#### Present Position

When the no-origin flag is OFF, and pulse output is stopped at the position to be taught, the present position is set in words  $n+8$  and  $n+9$ .

#### TEACH Positioning Action Number

word  $n+1$ , bits 15-08

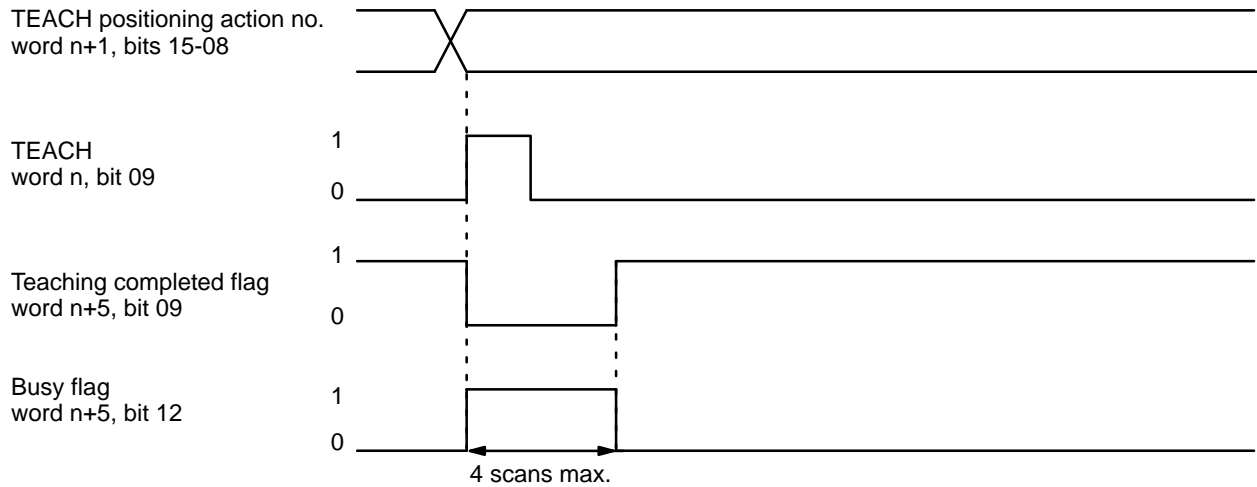
Set an integer between 00 and 19. The number set here indicates the positioning action under START for which the present position is to be set as the target position.

#### TEACH Command Bit

word  $n$ , bit 09

TEACH is executed when this bit is ON.

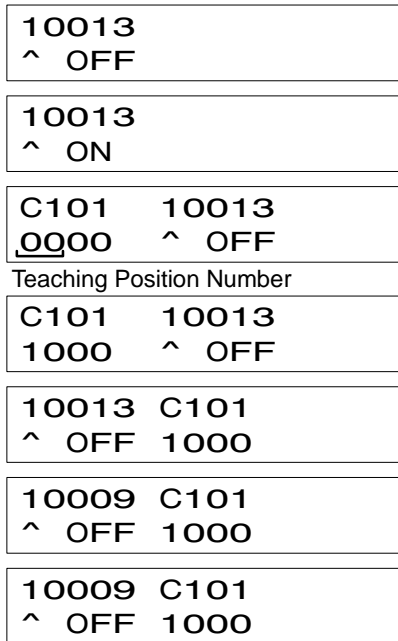
### 4-7-2 Execution Example



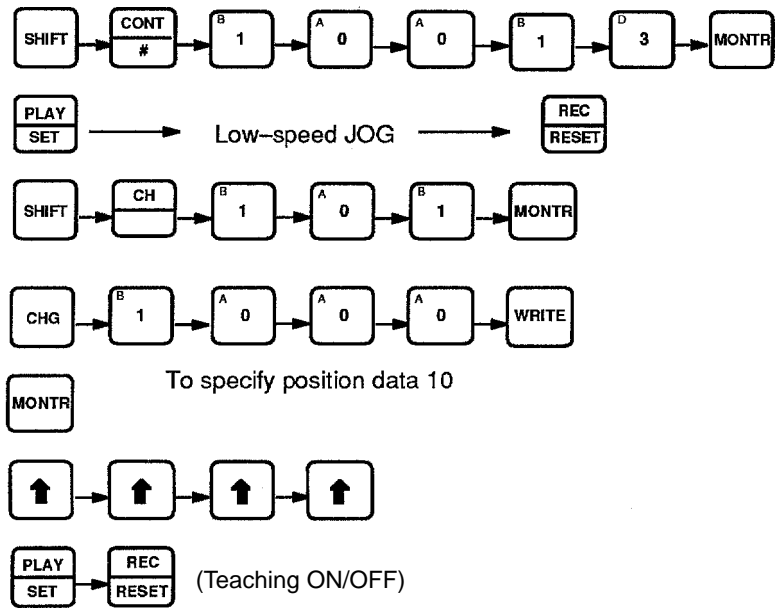
### 4-7-3 Teaching from the Programming Console

The following example shows how to teach positions from the Programming Console for Unit #0. It assumes that ORIGIN SEARCH has been executed, and writes the present position into words DM 1053 and DM 1054 as an absolute position (i.e., relative to the origin).

Programming Console Display



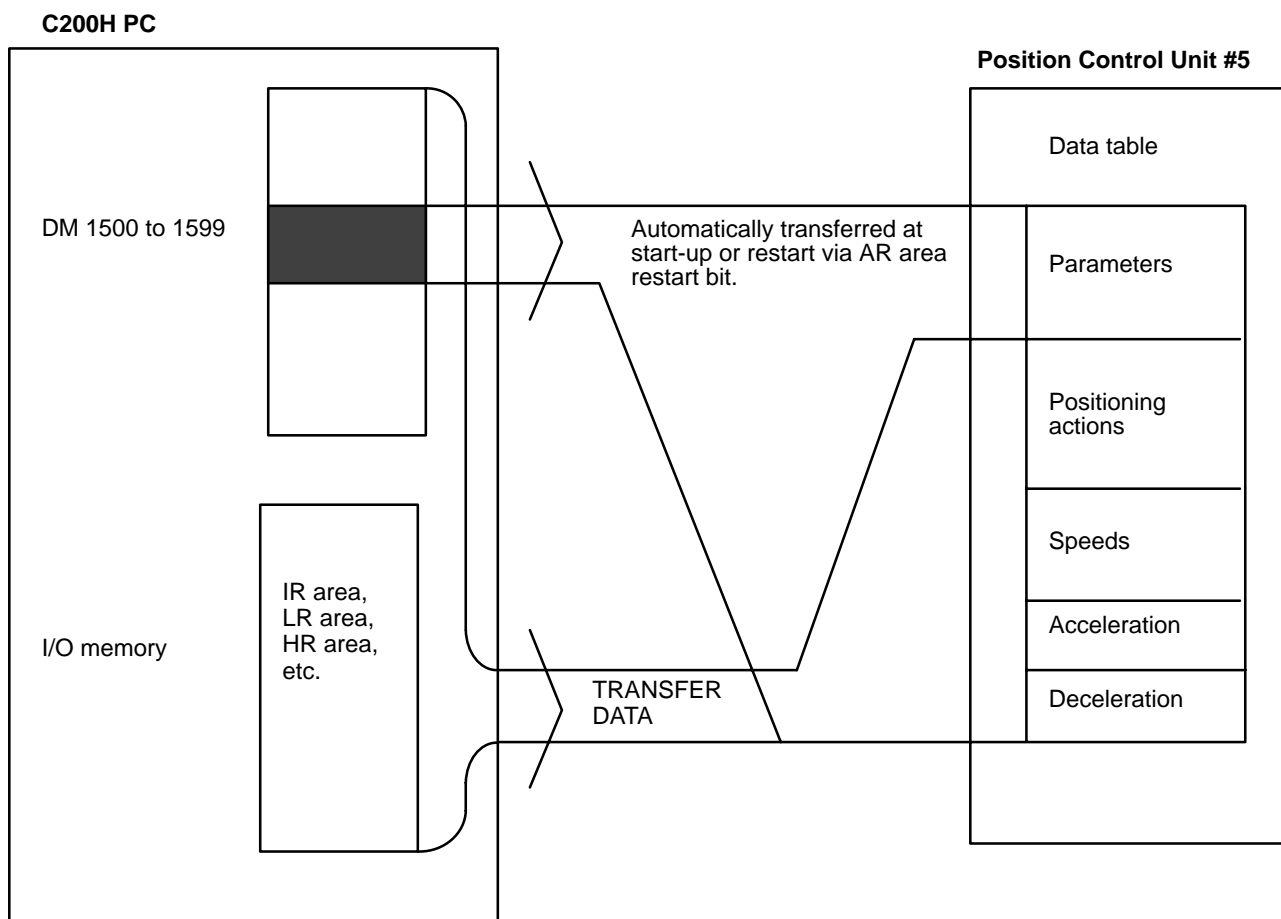
Key sequence



### 4-8 Transfer Data

Use TRANSFER DATA when the set data automatically transferred from the C200H PC to the Position Control Unit is insufficient. Although only the data from the area designated for any particular Unit is automatically transferred, TRANSFER DATA can be used to access data from any data area in the PC. In other words (as described in 3-4 Data Configuration and Allocation), Position Control Units are consecutively allocated 100 words each from the DM

area, and this data is automatically transferred. TRANSFER DATA, however, can transfer data from other parts of the DM area as well as from the LR, HR, and other areas.



TRANSFER DATA can be executed either to rewrite positioning data set in the Unit or to change the present position to any target position. The type of transfer is determined by the following setting.

### TRANSFER DATA type

IR word n+2, bit 15

- 1: Preset position
- 0: Normal transfer

If this bit is 0, then bits 15 through 08 of word n+2 determine the beginning transfer number, as explained below. (Bit 15 of word n+2 will always be 0 when a beginning transfer number is designated. When this bit is set to 1, bits 14 through 08 are ignored and only the present position is affected.) This command can be executed within a single scan.

#### 4-8-1 Normal Transfer

If bit 15 of word n+2 is 0, the TRANSFER DATA command bit, bit 10 of word n, is set to transfer the positioning actions, speeds, acceleration, and deceleration from a data area of the PC other than the one allocated to the Position Control Unit. Any data area in the C200H PC may be designated. This data is directly transferred from the designated area to memory within the Unit; the data set for the Unit in the allocated section of DM area is not af-

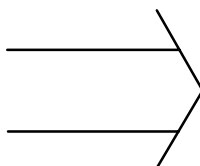
ected. Parameters set in DM words m through m+21 are not changed when TRANSFER DATA is executed.

### Data Preparation

Up to 26 transfers (three words each) can be made each time TRANSFER DATA is executed. Each transfer consists of one positioning action, three speeds, or the speed units, acceleration, and deceleration. In any case, three words are required for each transfer. This data must be prepared in a PC data area in the required format and in consecutive words. (See *Appendix C DM Area Allocations* for the content of each word/bit.)

PC Data Areas Available for TRANSFER DATA

Data Area	Words
DM area	0000 to 0999
DM area ( for Special I/O Units)	1000 to 1999
I/O area	000 to 255
LR area	000 to 63
HR area	00 to 99
AR area	00 to 27



Position Control Unit's Rewritten Data

Transfer #0	Positioning action #0
Transfer #1	Positioning action #1
↓	↓
Transfer #19	Positioning action #19
Transfer #20	Speed #1 Speed #2 Speed #3
Transfer #21	Speed #4 Speed #5 Speed #6
↓	↓
Transfer #24	Speed #13 Speed #14 Speed #15
Transfer #25	Speed units Acceleration Deceleration

### 4–8–2 IR Area Settings

In C200H PCs, IR words 100 to 199 are used for Special I/O Units. When a Position Control Unit is used, they are allocated as I/O refresh areas. For a detailed explanation, see *3–4 Data Configuration and Allocation*. For a detailed table of words and bits in the IR area, see *Appendix D IR Area Allocations*.

**Beginning Transfer Number**

word n+2, bits 15-08

Set an integer between 00 and 25.

This number indicates the position where the first transfer is to be made. The designated number of transfers will be transferred continuously from this point.

See *Appendix C DM Area Allocations* for the words transferred with each transfer number.

**Beginning Word Number**

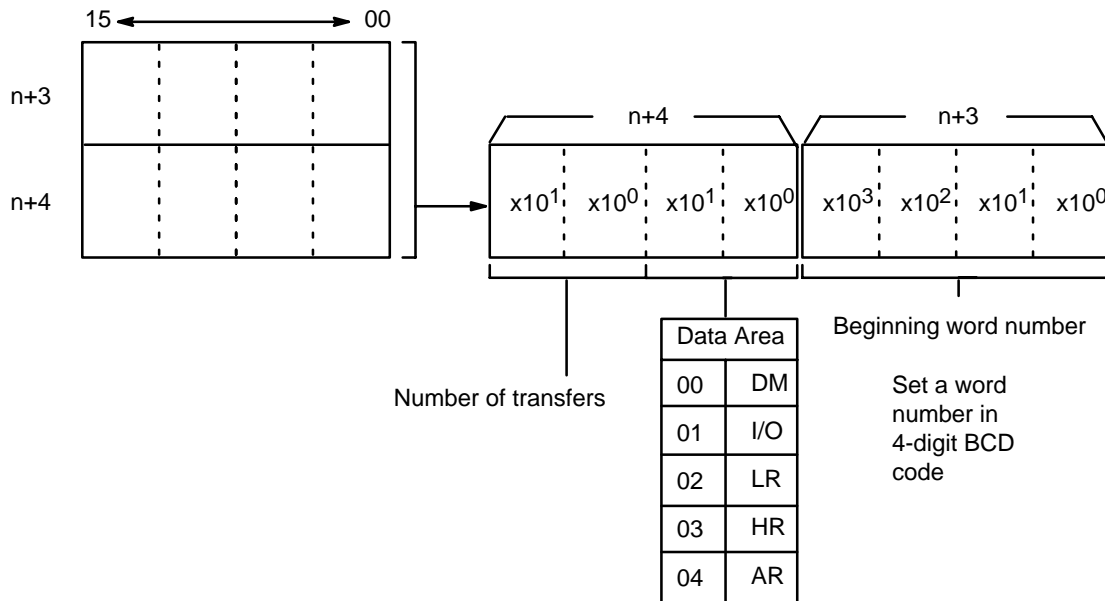
word n+3, bits 15-00

This is the first word in the PC data area that is to be transferred into the Position Control Unit beginning at the transfer number designated above. The beginning word and ending word (computed from the number of transfers) must be within one of the data areas designated during data preparation. (See Data Preparation under *4-8-1 Normal Transfer*.)

**PC Data Area**

word n+4, bits 07-00

Set the data area (in four digits BCD) from which the transfer is to be made.



**Number of Transfers**

word n+4, bits 15-08

Set an integer between 01 and 26.

**TRANSFER DATA Command Bit**

word n, bit 10

After the above settings are made, TRANSFER DATA is executed with this bit. This can all be done in one scan.

**Execution Example  
(Normal Transfer)**

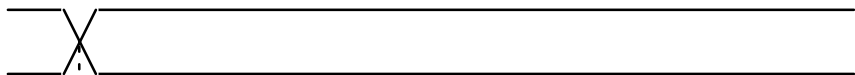
This example assumes that bit 15 of word n+2 is 0.

Preparation of data  
in PC's data areas



Set necessary information in IR area.

Beginning transfer number  
word n+2, bits 15-08



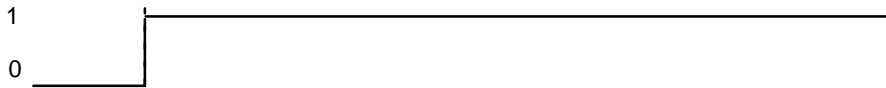
Beginning word number  
word n+3



PC data area/no. of transfers  
word n+4



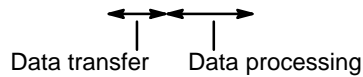
TRANSFER DATA  
word n, bit 10



Transfer completed flag  
word n+5, bit 10



Busy flag  
word n+5, bit 12



**4-8-3 Present Position Preset**

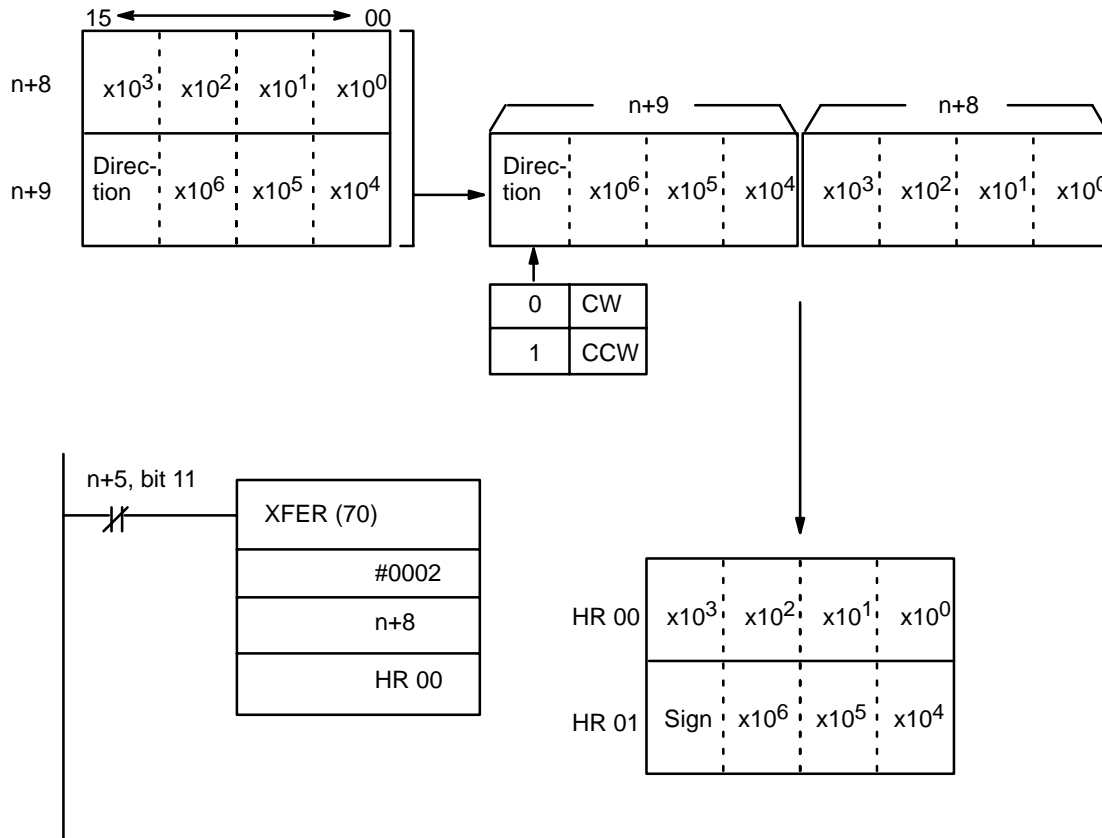
If bit 15 of word n+2 is 1, the TRANSFER DATA command bit, bit 10 of word n, is set to either preset or change the present position. This command can be used to eliminate the need to execute ORIGIN SEARCH to establish position. Since the origin, present position, and so on, are not known when the Unit is powered up, it is ordinarily necessary to execute ORIGIN SEARCH first. However, when you want to know the absolute position and set a particular numerical value, you can use the preset function.

**Retaining Present Position**

No data is retained in the Position Control Unit once power is turned OFF. When the present position needs to be retained, copy it (words n+8 and n+9)

to either the HR or DM area, and then restore by using TRANSFER DATA the next time the Unit is powered up.

The following programming example shows word n+8 data moving to word HR 00 and word n+9 data moving to word HR 01. If there is no origin, bit 11 of word n+5 (the no-origin flag) turns ON (goes to 1). As long as there is an origin and the present position data is valid, the present position will be transferred.



### Data Preparation

Data must be prepared in the same manner as for normal execution of TRANSFER DATA, except that only two words indicating the target position are necessary.

### Present Position Preset Bit

word n+2, bit 15

Set this bit to 1 in order to use the preset function. If this bit is set to 0, the beginning transfer number is set in bits 15-08 as described in Beginning Word Number under 4-8-2 IR Area Settings.

### Beginning word Number

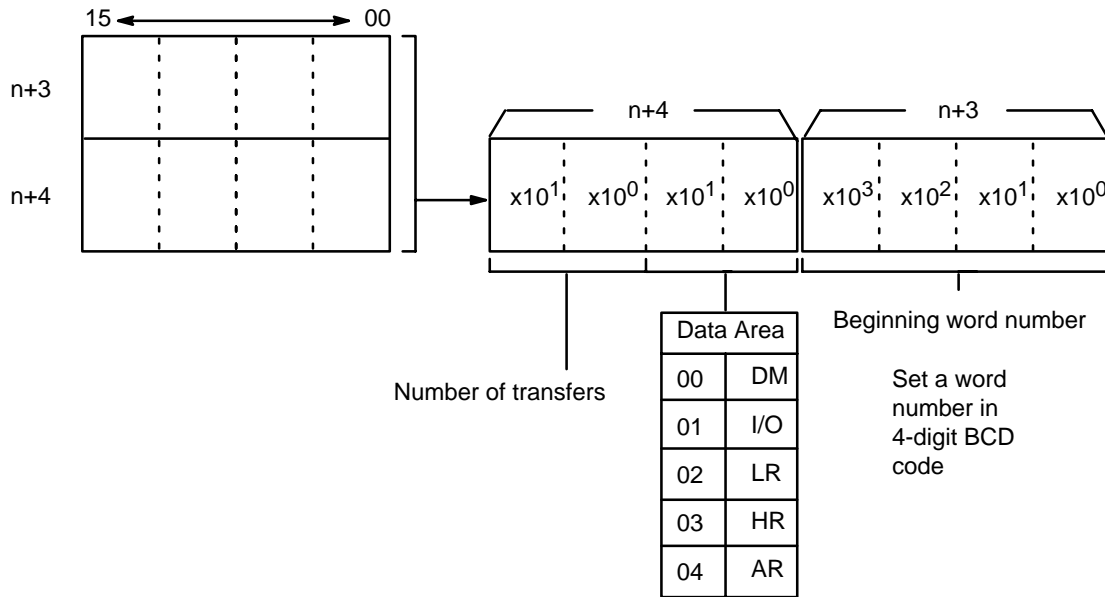
word n+3, bits 15-00

This number indicates the first of the two words to be transferred in as the present position. The two words must be within one of the data areas designated for Data Preparation toward the beginning of 4-8-1 Normal Transfer.

**PC Data Area**

word n+4, bits 07-00

Set the data area (in four digits BCD) from which the transfer is to be made.



**TRANSFER DATA  
Command Bit**

word n, bit 10

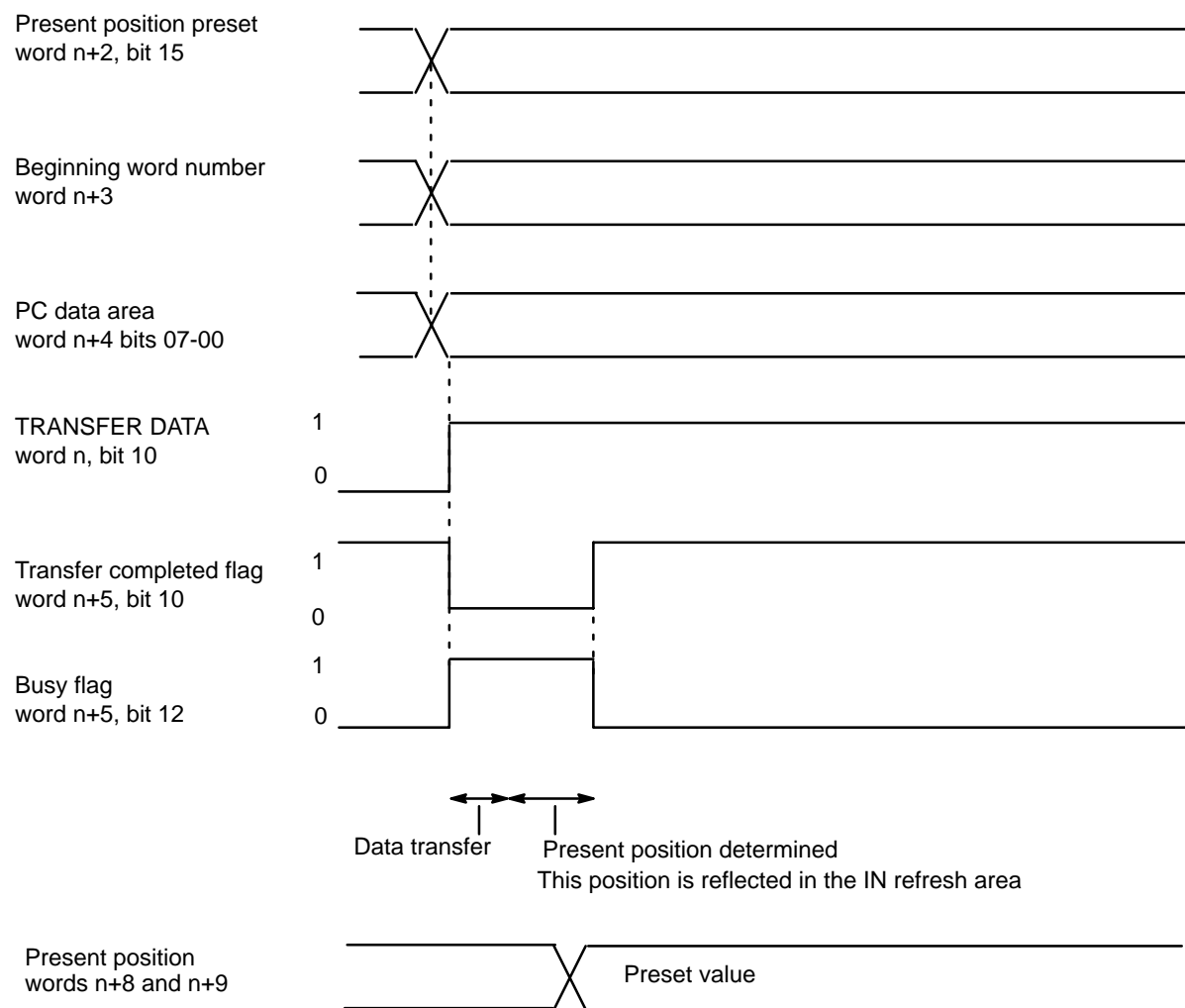
After the above settings are made, TRANSFER DATA is executed with this bit. This can all be done in one scan.



### Execution Example (Preset)

The following example assumes that bit 15 of word n+2 has been set to 1.

Set necessary information in IR area.



## 4-9 Manual Operations

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.

### 4-9-1 DM Area Settings

In addition to the settings described in this section, the following data must also be set in order to execute HIGH-SPEED JOG. They are the same as those set for START, so they can be set by following the instructions contained in 4-1 START. Only the first three of these need be set for LOW-SPEED JOG.

**Initial Speed Number** Bits 11-08 of DM word m

**Speeds** DM words m+82 through m+96

**Speed Units** DM word m+97

**Acceleration** Bits 11-00 of DM word m+98

**Deceleration** Bits 11-00 of DM word m+99

### HIGH-SPEED JOG Speed Number

word m+1, bits 15-12

Set an integer between 1 and F (hex).

The speed number set here refers to one of the speeds set in DM words m+82 through m+96.

### LOW-SPEED JOG Speed Number

word m+1, bits 11-08

Set an integer between 1 and F (hex).

The speed number set here refers to one of the speeds set in DM words m+82 through m+96.

## 4–9–2 IR Area Settings

In C200H PCs, IR words 100 to 199 are used for Special I/O Units. When a Position Control Unit is used, they are allocated as I/O refresh areas. For a detailed explanation, see *3–4 Data Configuration and Allocation*. For a detailed table of words and bits in the IR area, see *Appendix D IR Area Allocations*.

### HIGH-SPEED JOG Command

word n, bit 11

- 0: Stop
- 1: Operate

### JOG Direction

word n, bit 12:

- 0: CW
- 1: CCW

### LOW-SPEED JOG Command

word n, bit 13

- 0: Stop
- 1: Operate

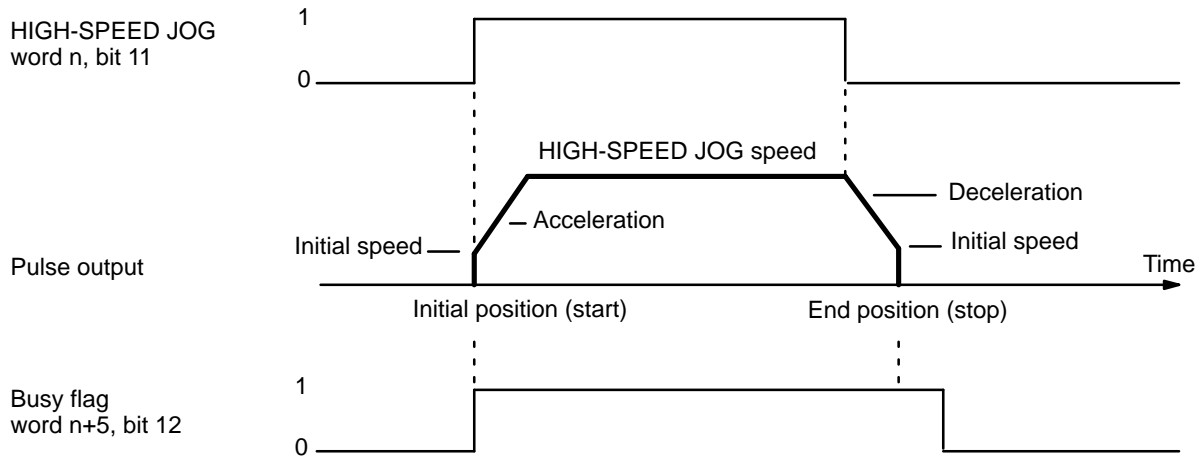
### INCH Command

word n, bit 14

- 0: Stop
- 1: Operate

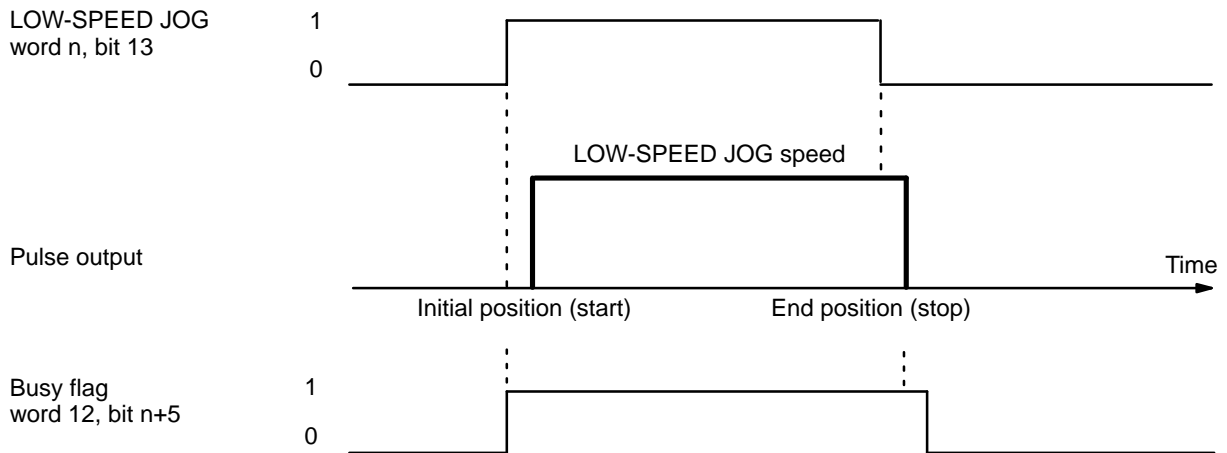
### 4-9-3 High-speed Jog

The HIGH-SPEED JOG command bit (word n, bit 11) of is set to manually feed at the designated speed (effective on signal's rising edge). Feeding starts when the command bit is set and continues until it is reset.



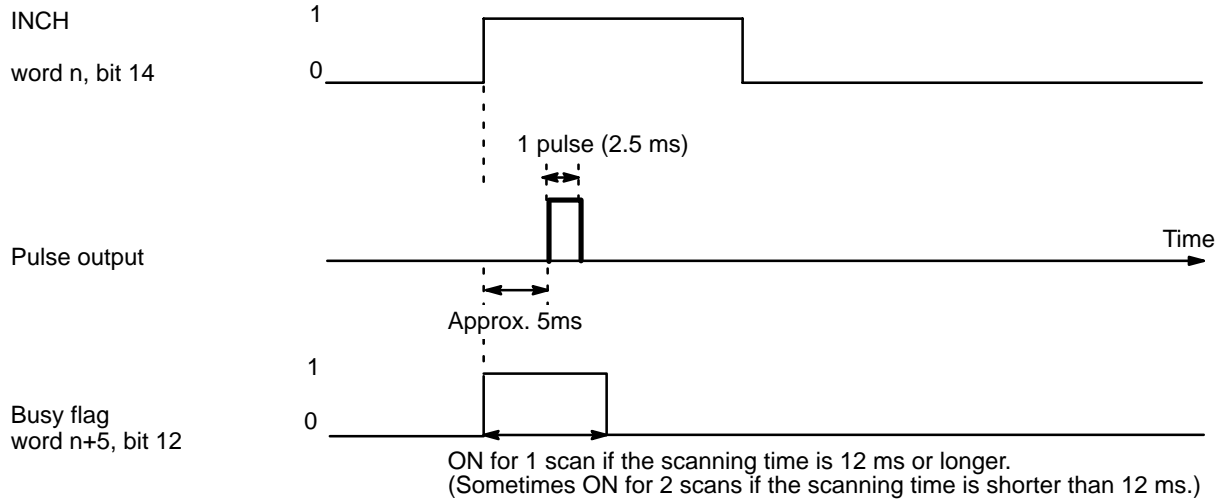
### 4-9-4 Low-speed Jog

The LOW-SPEED JOG command bit, bit 13 of word n, is set to manually feed at the designated speed (effective on signal's rising edge). Feeding starts when the command bit is set and continues until it is reset.



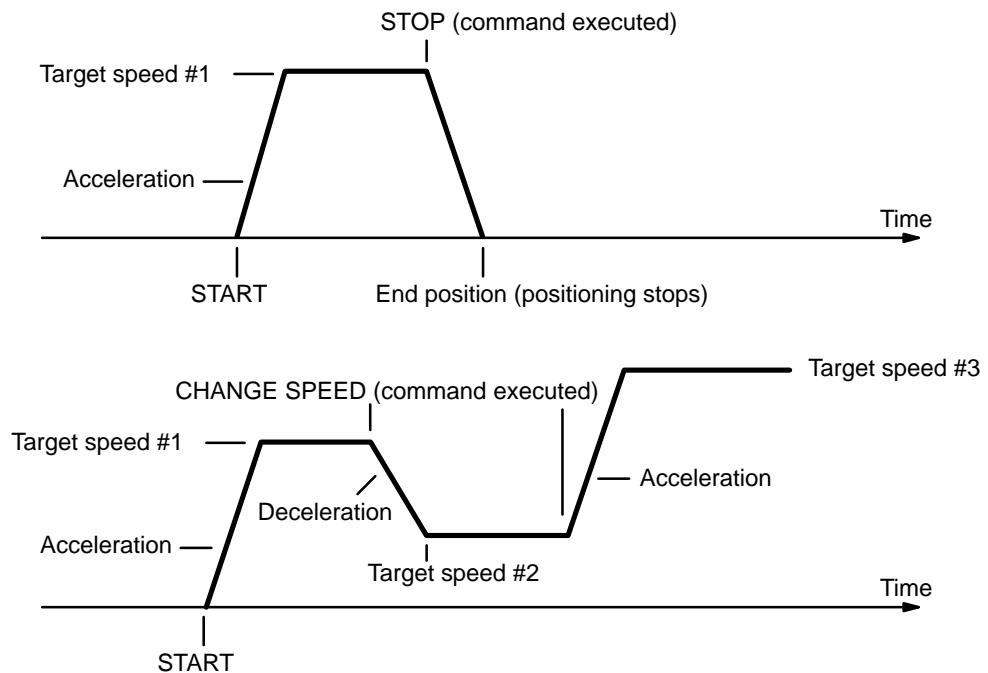
### 4-9-5 Inch

The INCH command bit, bit 14 of word n, is set to manually inch one pulse at a time (effective on signal's rising edge). One pulse will be feed each time this bit is set.



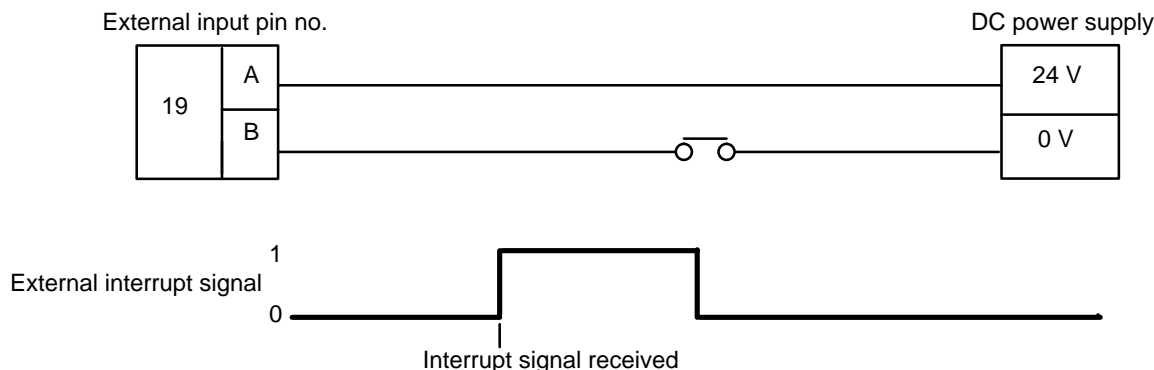
## 4-10 External Interrupt Commands

Positioning can be stopped and speeds can be changed by either the bits set in the IR area or by external interrupt commands. The target speeds used during CHANGE SPEED are taken in order, beginning with the lowest speed number, from the DM area.



### Connection for External Interrupt Signal

The signal level's rising edge is taken as the input signal.



### DIP Switch Settings

The setting of pin #6 on the back-panel DIP switch determines the function of bit 06 of IR word n. If pin #6 is ON, the function of bit 06 is determined by pin #7. If pin #6 is OFF, bit 06 defines the response to external interrupts as follows:

- 0: STOP executed in response to external interrupts
- 1: CHANGE SPEED executed in response to external interrupts

If pin #6 is ON and pin #7 is OFF, STOP is executed in response to external interrupts. If pin #6 and pin #7 are both ON, CHANGE SPEED is executed in response to external interrupts. The external interrupt signal is acknowledged on its rising edge.

There are thus two ways to execute STOP: through an external interrupt or through the command bit, bit 15 of word n. Both of these methods are available at the same time if bit 06 of word n is set to 0 and pin #6 on the back-panel DIP switch is OFF, or if pin #6 is ON and pin #7 is OFF.

There are also two ways to execute CHANGE SPEED: through an external interrupt or, if pin #6 is ON, directly by using bit 06 of word n as the command bit. Execution through an external interrupt is available if bit 06 of word n is set to 1 and pin #6 on the DIP switch is OFF, or if pins #6 and #7 are both ON. In the latter case, execution through the command bit and through an external interrupt are both available.

### DM Area Settings

The following data must be set to execute STOP and CHANGE SPEED, but it is the same as that set for START. Refer to 4-1 START for details.

**Acceleration** Bits 11-00 of DM word m+98

**Deceleration** Bits 11-00 of DM word m+99

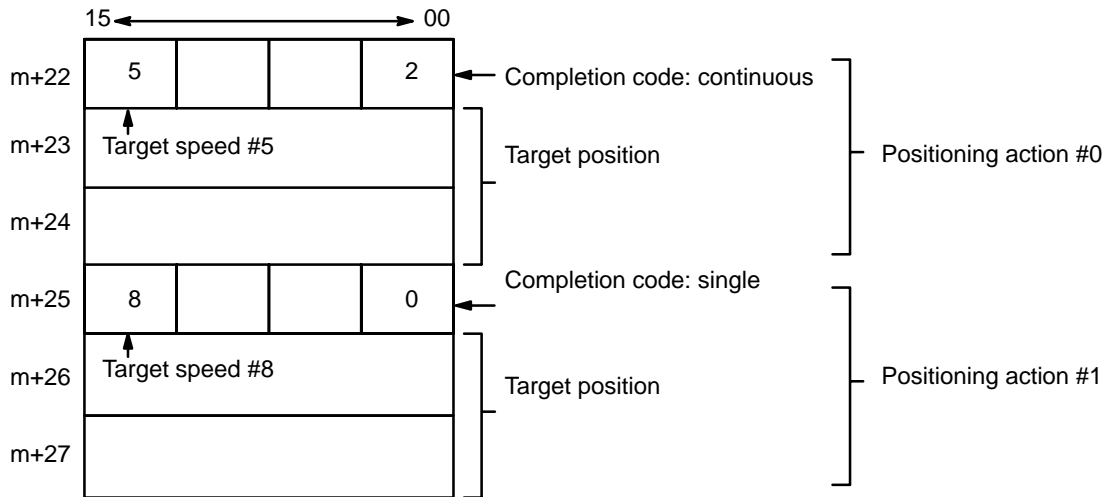
### 4-10-1 Stop

STOP can be executed during pulse output for START, ORIGIN SEARCH, ORIGIN RETURN, HIGH-SPEED JOG, and LOW-SPEED JOG to decelerate to a stop (effective on signal's rising edge). Note, however, that the next START cannot be executed as long as STOP (either from bit 15 of word n or from an external interrupt signal) is in effect.

### STOP Executed During START

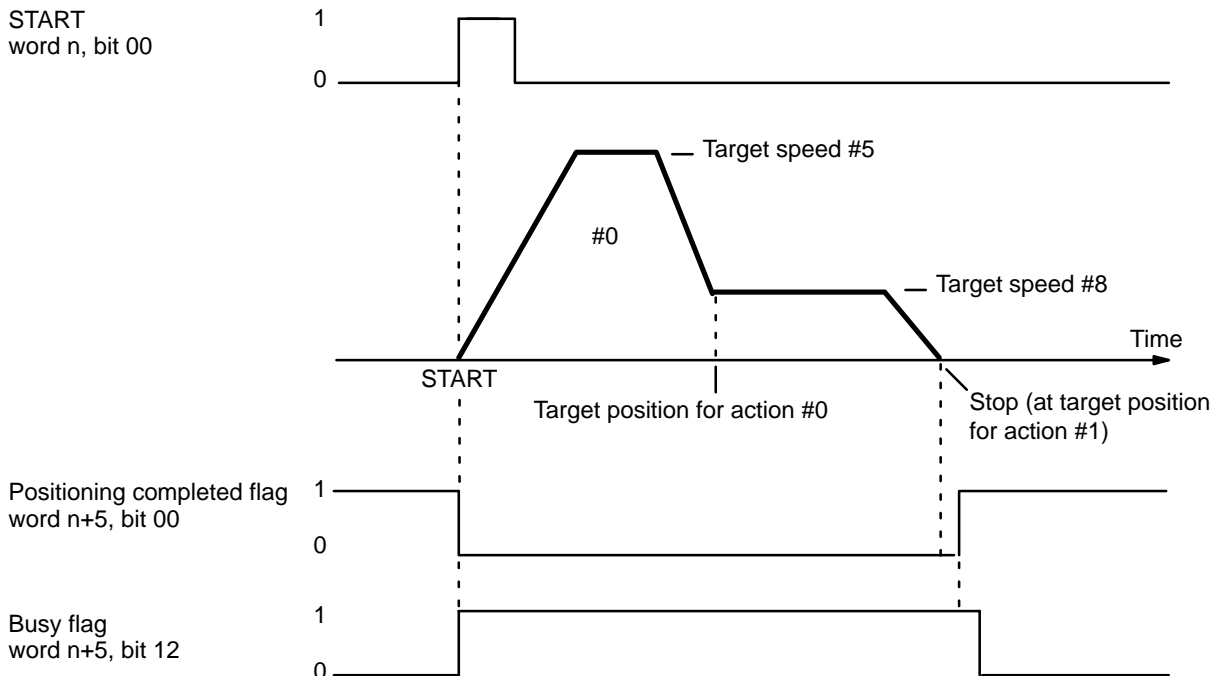
When the STOP command bit is set during execution of a positioning action under START, the positioning completed flag is not turned ON, and the positioning action number is not changed. When START is next executed, the target position and speed of that action will be used, as long as the target position has not been exceeded. The busy flag, however, turns OFF, allowing manual operations to be used up to the next START.

Let's take, for example, a case in which the following DM words and data are used.



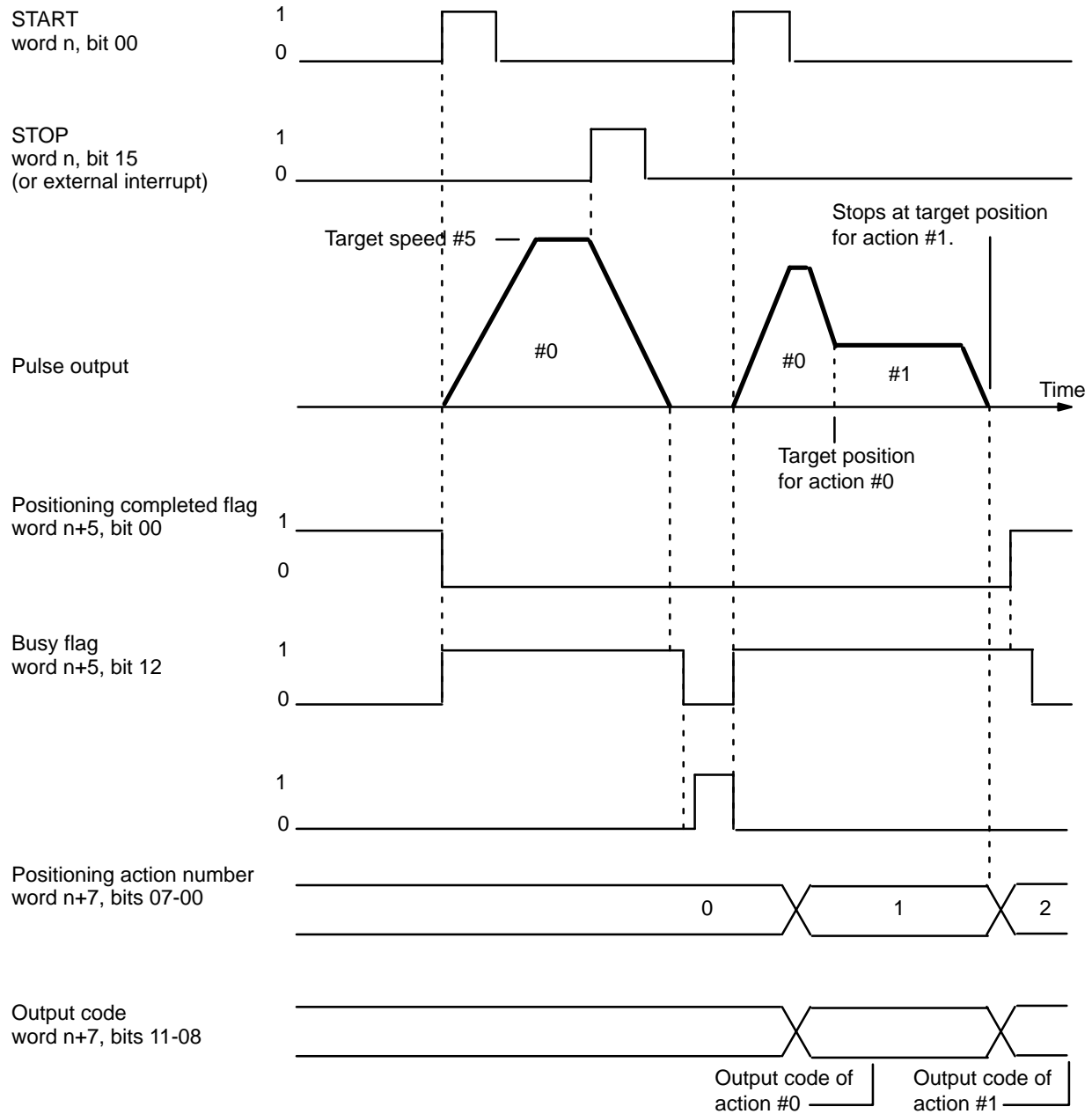
### Example 1

First of all, the following diagram shows the situation when STOP is not executed.



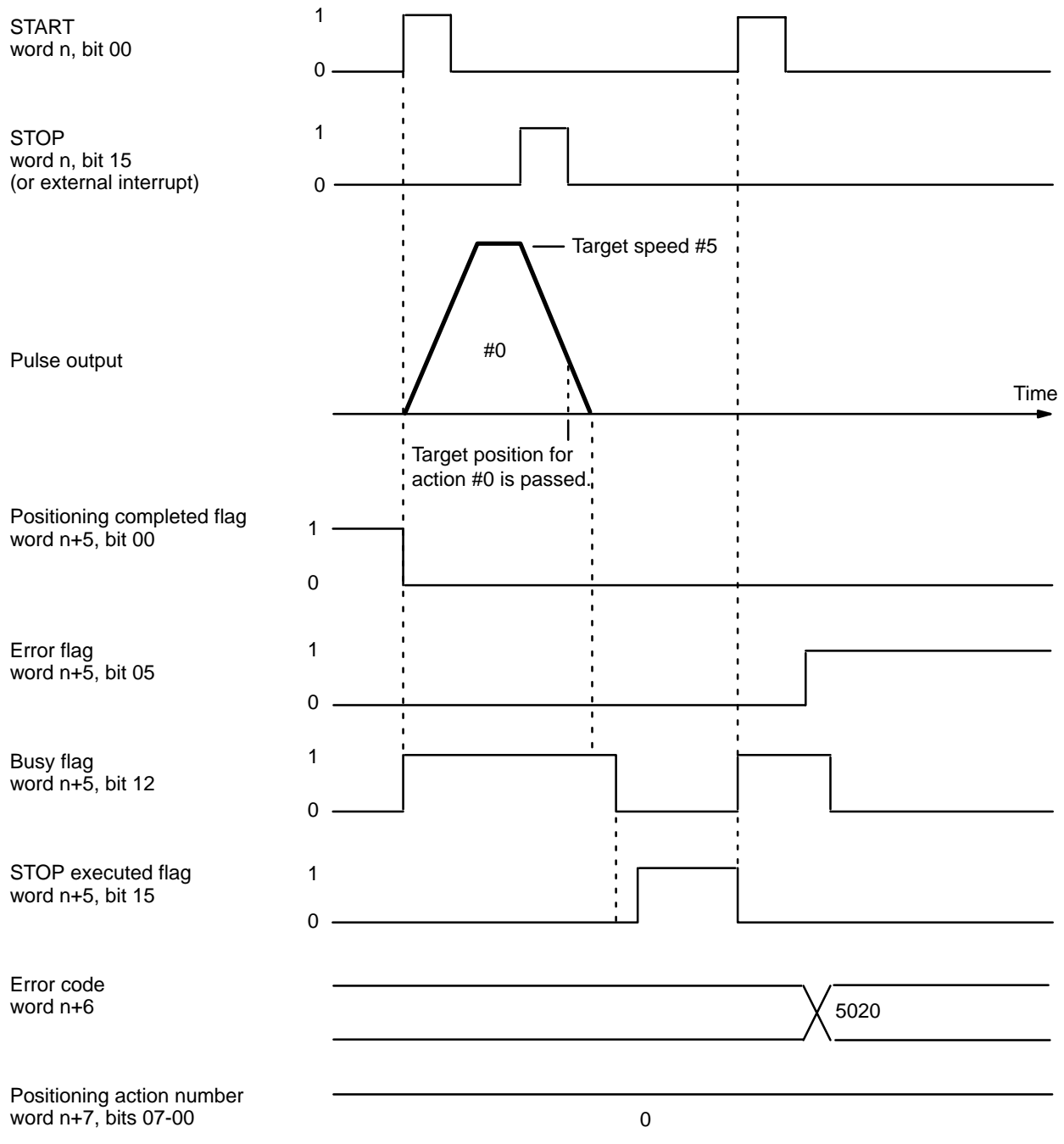
**Example 2**

This example shows STOP execution if the target position is not exceeded when the target position is designated from the origin (i.e., not an increment). When START is next executed, the data from the positioning action at the time of STOP is taken as the target position.



**Example 3**

This example shows execution when a target position designated from the origin (i.e., not an increment) is exceeded during deceleration for STOP, as can happen when STOP is executed during the end of a continuous positioning action. If START is next executed before this situation is corrected, the feeding direction for the action will be wrong, and an error (code 5020) will be generated due to inability to begin the action. The Unit can be restarted after manually feeding (with JOG) back to the other side of the target position for action #0.

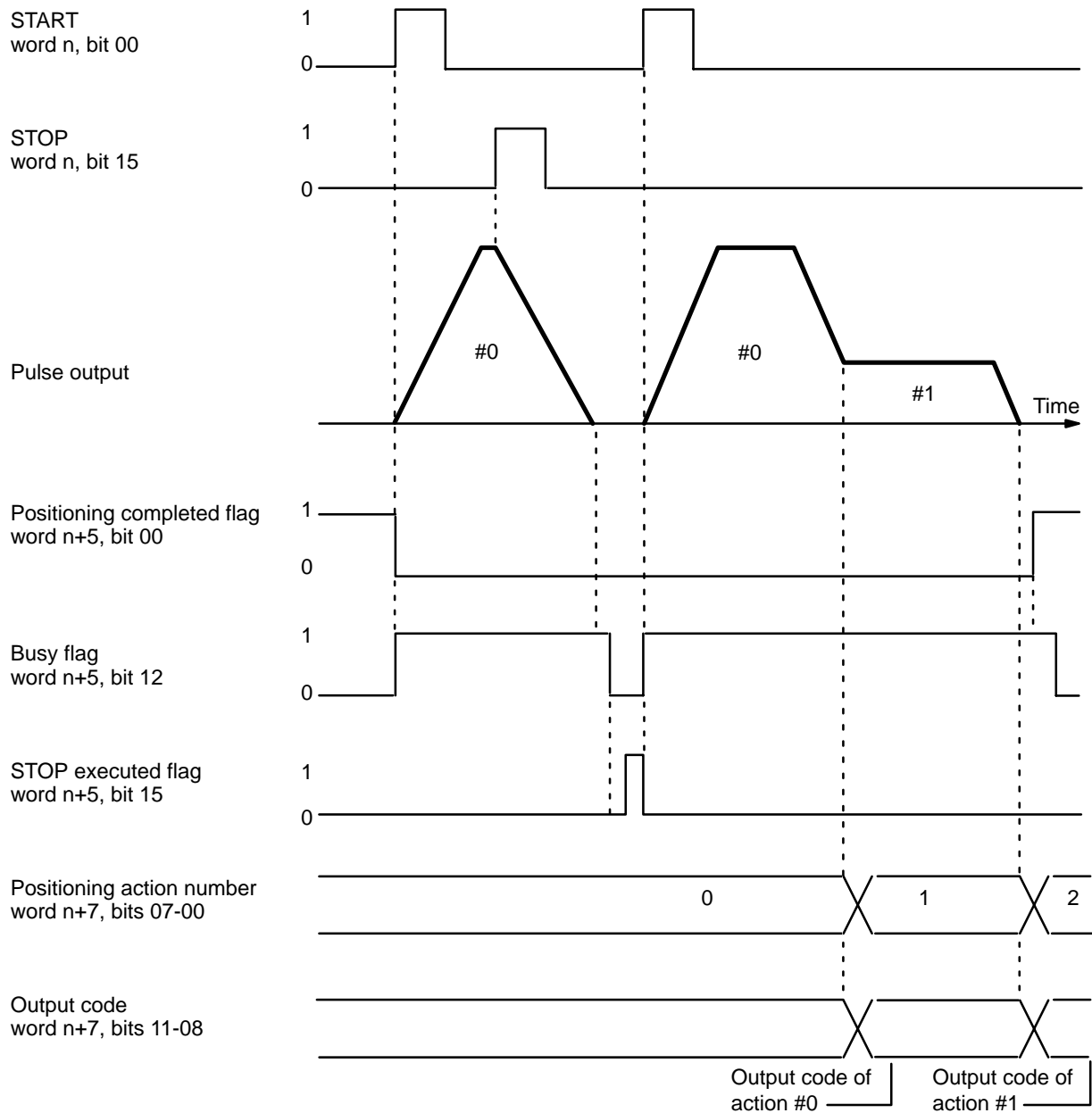


This error will also be generated if the target position for action #0 is exceeded through manual operations before START is executed following STOP.



**Example 4**

When the target position is expressed as an increment, the positioning action will be automatically started over from the position arrived at after STOP was executed.

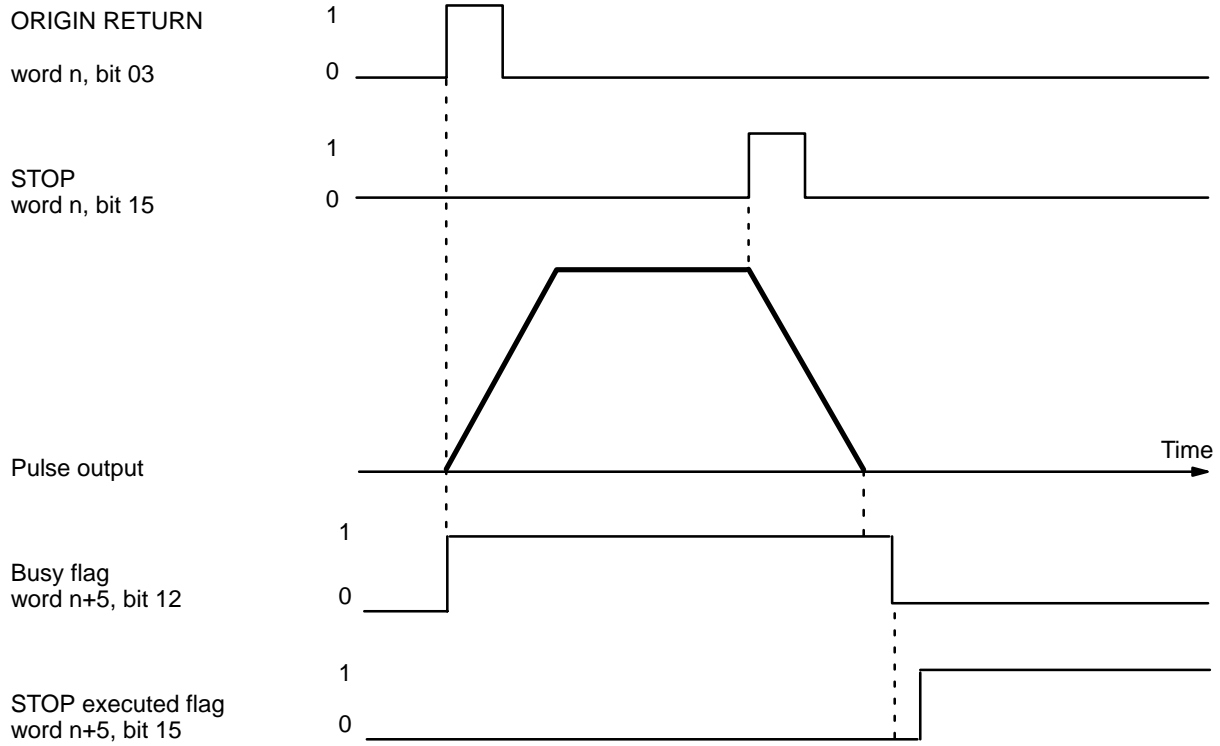


### STOP During ORIGIN SEARCH

Feeding will be decelerated to a stop and the command must be reexecuted from the position reached at the end of STOP.

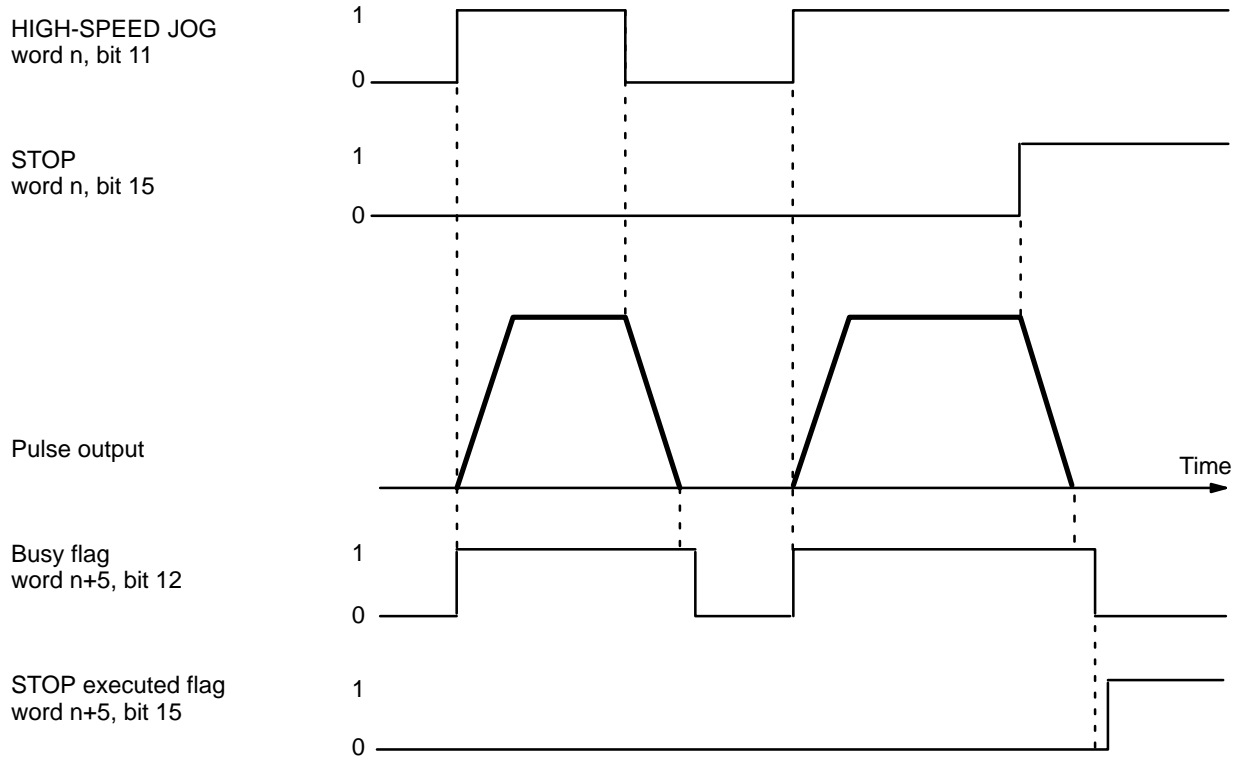
### STOP During ORIGIN RETURN

Feeding stops according to the deceleration rate.



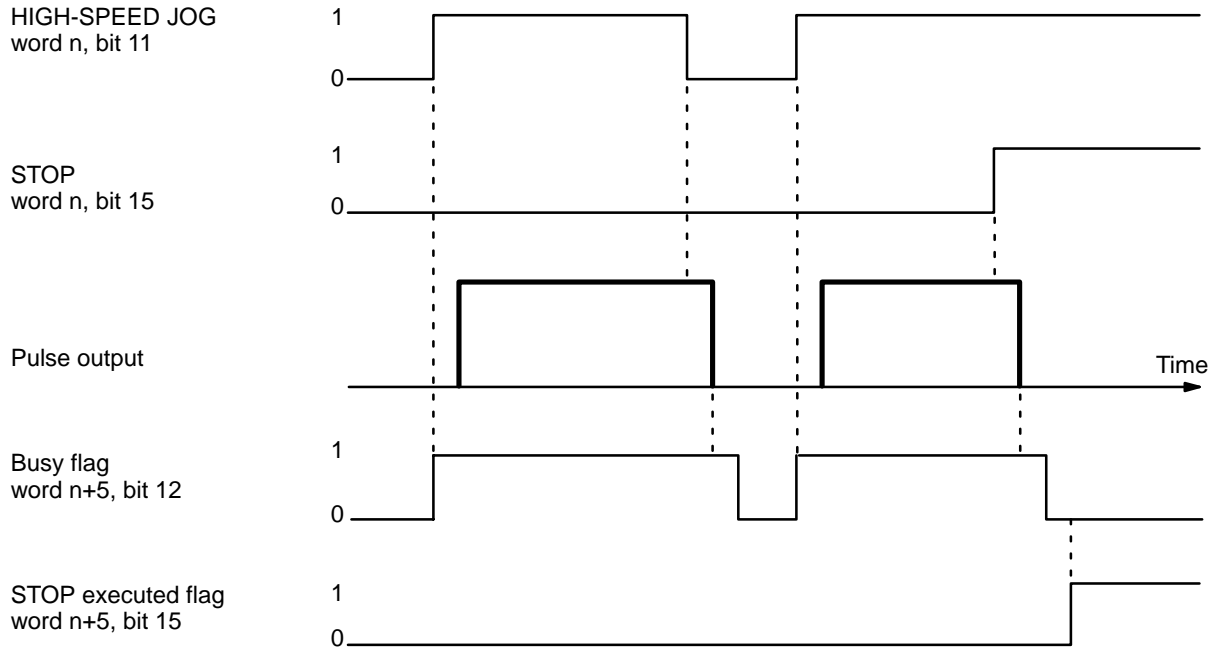
### STOP During HIGH-SPEED JOG

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



### STOP During LOW-SPEED JOG

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

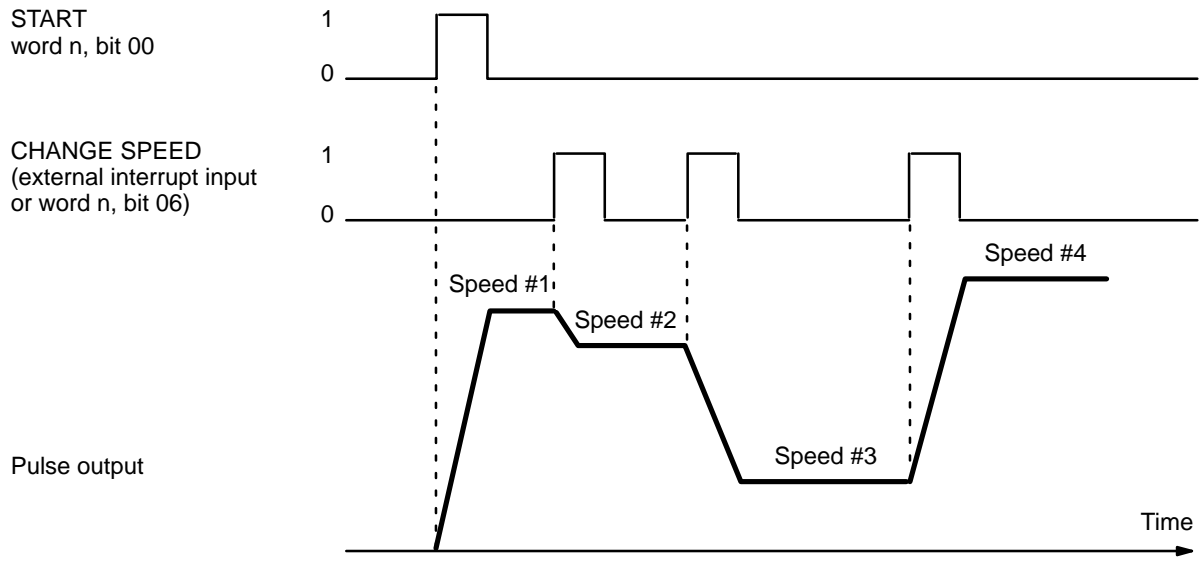


### 4-10-2 Change Speed

CHANGE SPEED can only be executed during positioning activities initiated with START. When CHANGE SPEED is executed (effective on signal's rising edge), the speed number in the present positioning action will be incremented by 1. If CHANGE SPEED is executed again, the speed number will be incremented again. Incrementation will continue for each CHANGE SPEED execution (speed #15 increments to speed #1). CHANGE SPEED will not affect the target position or execution of the next action. In other words, normal deceleration to end at the target position will be carried out for single, pause, or bank end positioning action, and the speed for the next positioning action will take priority for a continuous positioning action.

Execution Example

In the following example diagram, speed number 1 is used for the positioning action executed first.



# SECTION 5

## Programming Examples

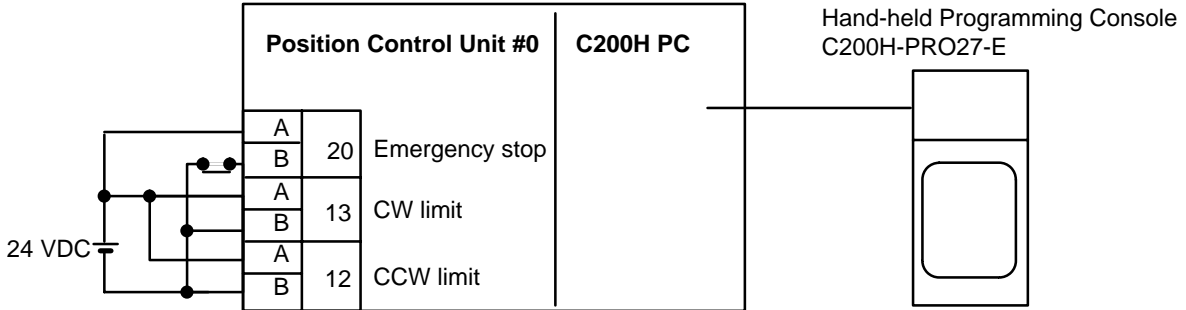
This section contains examples of possible applications of Positioning Control Unit commands, inputs, and outputs. Example 1 shows the minimum data required for operation. Example 2 shows the use of only one positioning action under START augmented by RESET ORIGIN. Example 3 demonstrates the use of external switches to control positioning actions, while Examples 4 and 5 show use of TRANSFER DATA: Example 4, from the PC, and Example 5, from external switches. Example 6 shows a complex series of positioning actions under START. Example 7 illustrates possible search patterns under ORIGIN SEARCH, while Example 8 illustrates one possible use of zones: controlling manual feeding operations. Finally, Example 9 describes special considerations when connecting to a servo driver with a Z-phase output. Refer to the Appendixes or individual operation or command descriptions for details.

5-1	Operation with Minimum Data: Displaying JOG Positions . . . . .	92
5-2	Positioning at Intervals: Using RESET ORIGIN . . . . .	94
5-3	Feeding Selectively with START . . . . .	96
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# 5-1 Operation with Minimum Data: Displaying JOG Positions

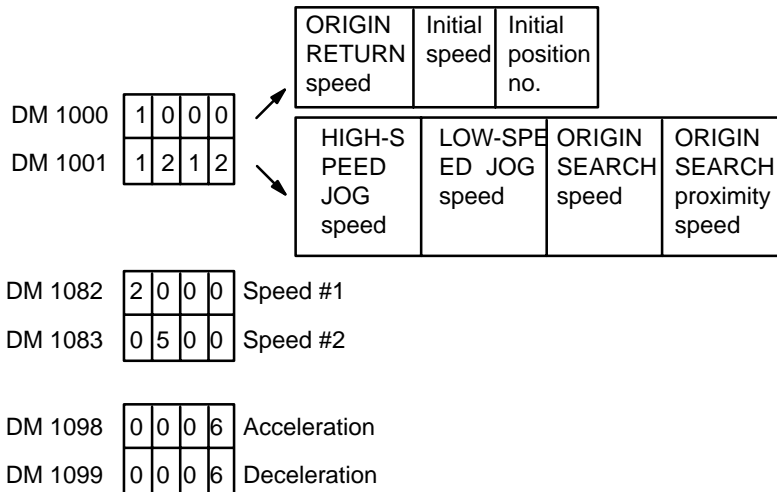
## Wiring

The wiring shown below is the simplest possible for Position Control Unit operation.



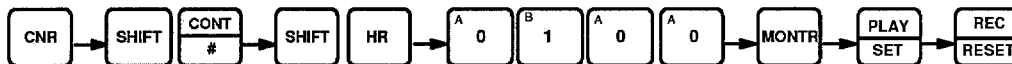
## DM Area Settings

The data settings shown below are the minimum required to prevent the alarm/error LED from flashing.



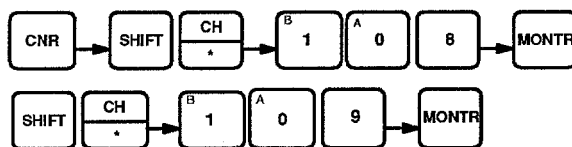
## Procedure

- 1, 2, 3... 1. Set the PC to PROGRAM mode, and then begin operation from the Programming Console.
2. Write data into the DM area and restart.



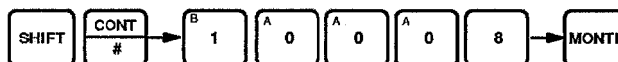
```
AO100
^ OFF
```

3. Monitor the present position words.



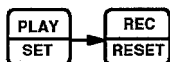
```
C109 C108
0999 9911
```

4. Monitor the RESET ORIGIN command bit.



```
10008 C109 C108
^ OFF 0999 9911
```

5. Reset the present position.



```
10008 C109 C108
^ OFF 0000 0000
```

6. Set LOW-SPEED JOG command bit.

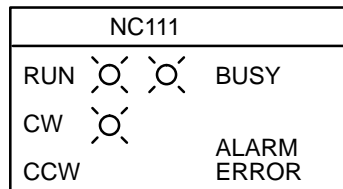


Programming Console Display

```
10013 C109 C108
^ ON 0000 2340
```

The values of the present position increase or decrease.

Indicators on Position Control Unit



10012 is OFF.  
CW and busy LEDs light.

7. Stop LOW-SPEED JOG.



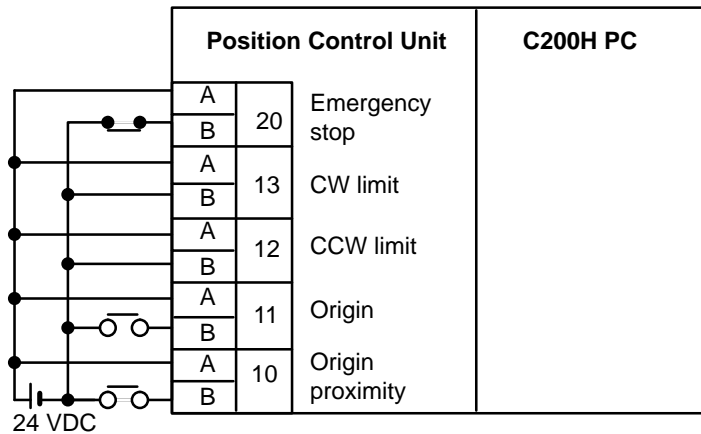
```
10013 C109 C108
^ OFF 0001 0615
```



## 5-2 Positioning at Intervals: Using RESET ORIGIN

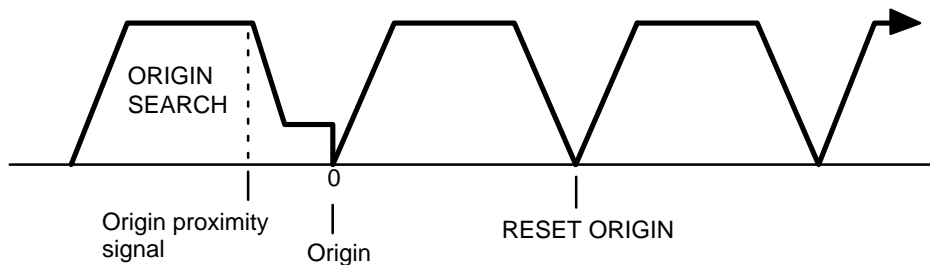
In this example, the Position Control Unit is assumed to be assigned unit number 0.

### Configuration

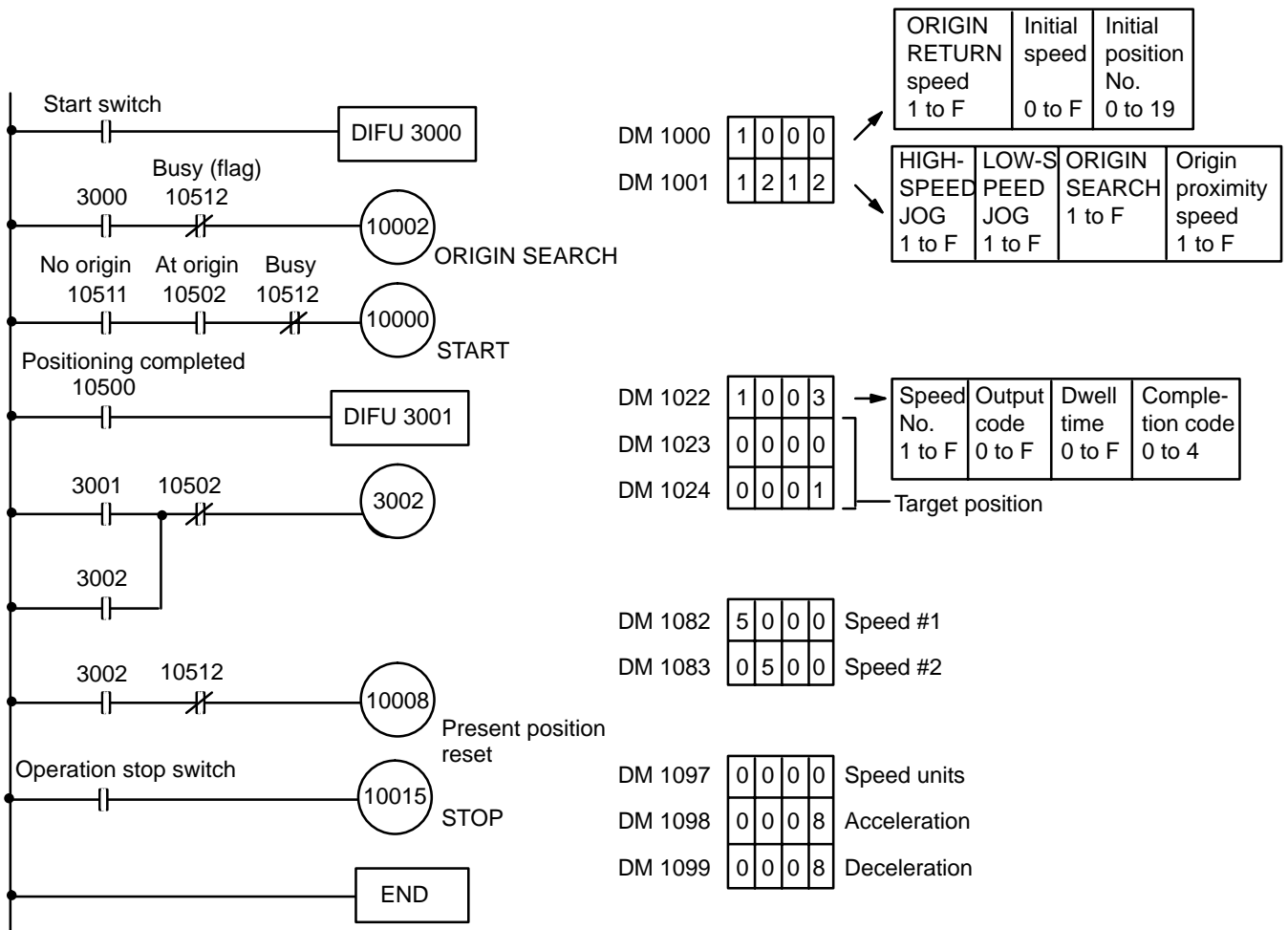


### Operation

Feeding is executed to positions lying at equal distances in the same direction from a specific point, repeatedly using the same positioning action and then RESET ORIGIN.



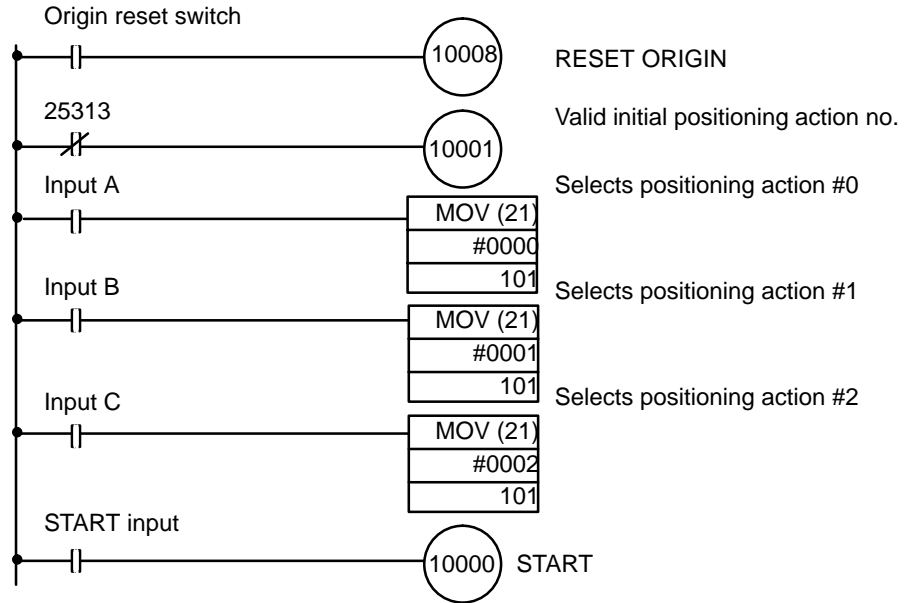
Programming



### 5-3 Feeding Selectively with START

Configuration  
Ladder Diagram

With the following programming, input A, B or C can be selected and START executed to feed the target number of pulses.

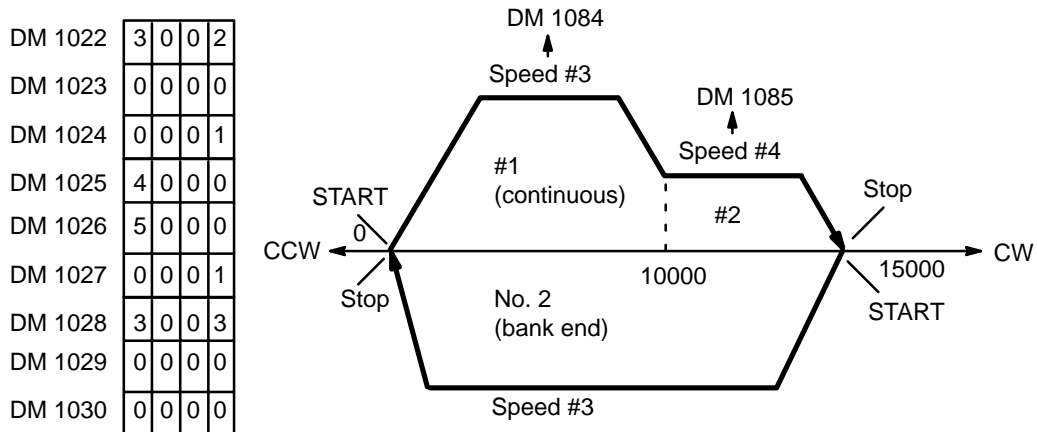


### 5-4 Transfer Data from Other PC Areas

This example program shows data for three positioning actions transferred from DM word 10. Note that TRANSFER DATA immediately rewrites the Position Control Unit's memory. Therefore the transfer program must be executed a second time, this time from DM1022, if the previous origin positioning action is to be repeated.

Initial Data

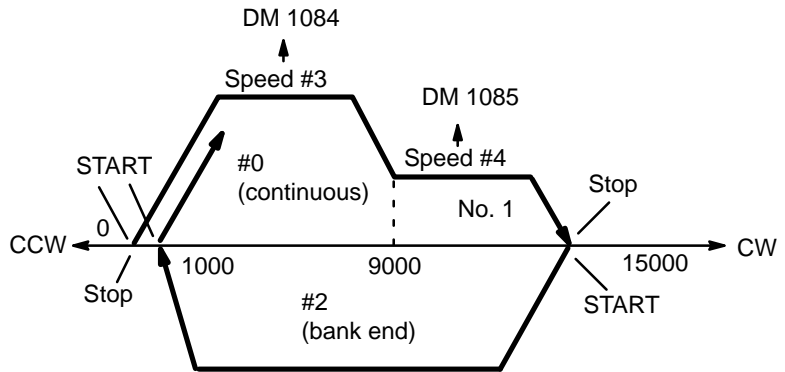
The initial data is entered in DM words 1002 to 1030. The data and positioning actions are shown below.



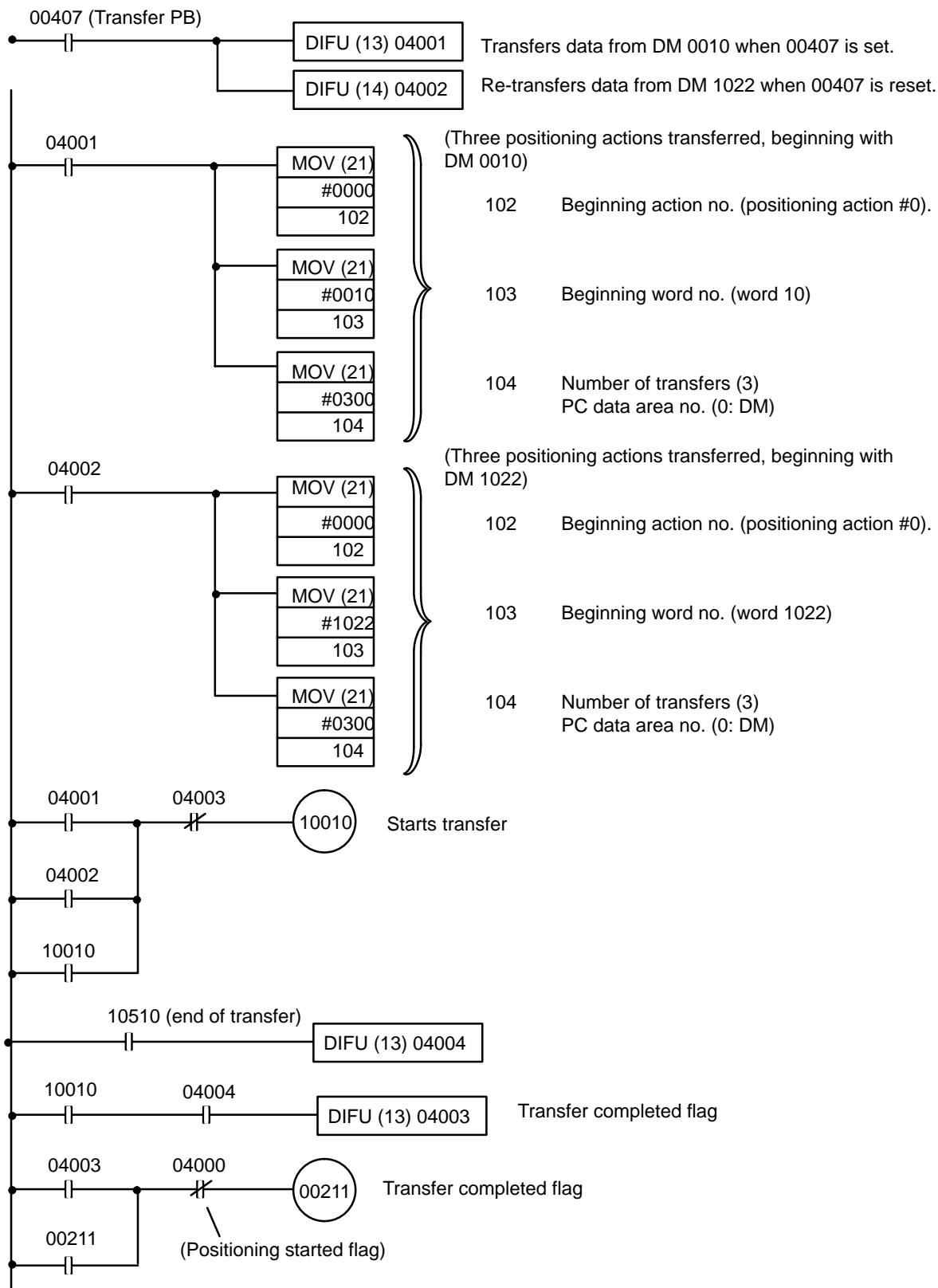
Data To Be Transferred

The transfer data is entered in DM words 0010 to 0018. The data and positioning actions are shown below.

DM 0010	3	0	0	2
DM 0011	9	0	0	0
DM 0012	0	0	0	0
DM 0013	4	0	0	0
DM 0014	5	0	0	0
DM 0015	0	0	0	1
DM 0016	3	0	0	3
DM 0017	1	0	0	0
DM 0018	0	0 <td 0	0	



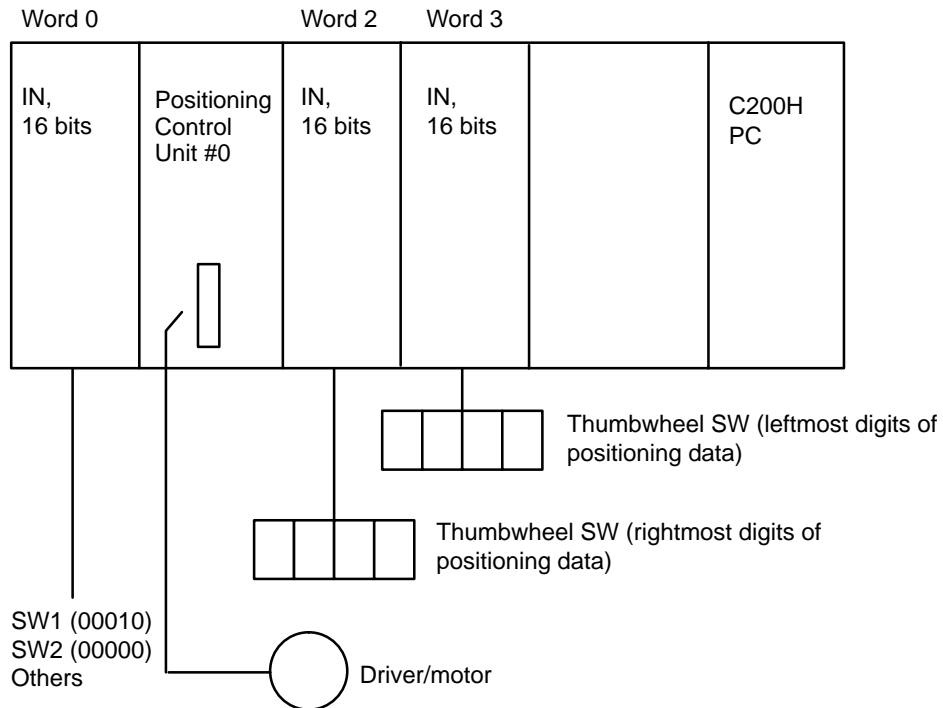
Program



## 5-5 Transfer Data from External Switches

In this example, positioning is executed in accordance with the number of pulses set by external thumbwheel switches.

### Configuration



### Data Memory

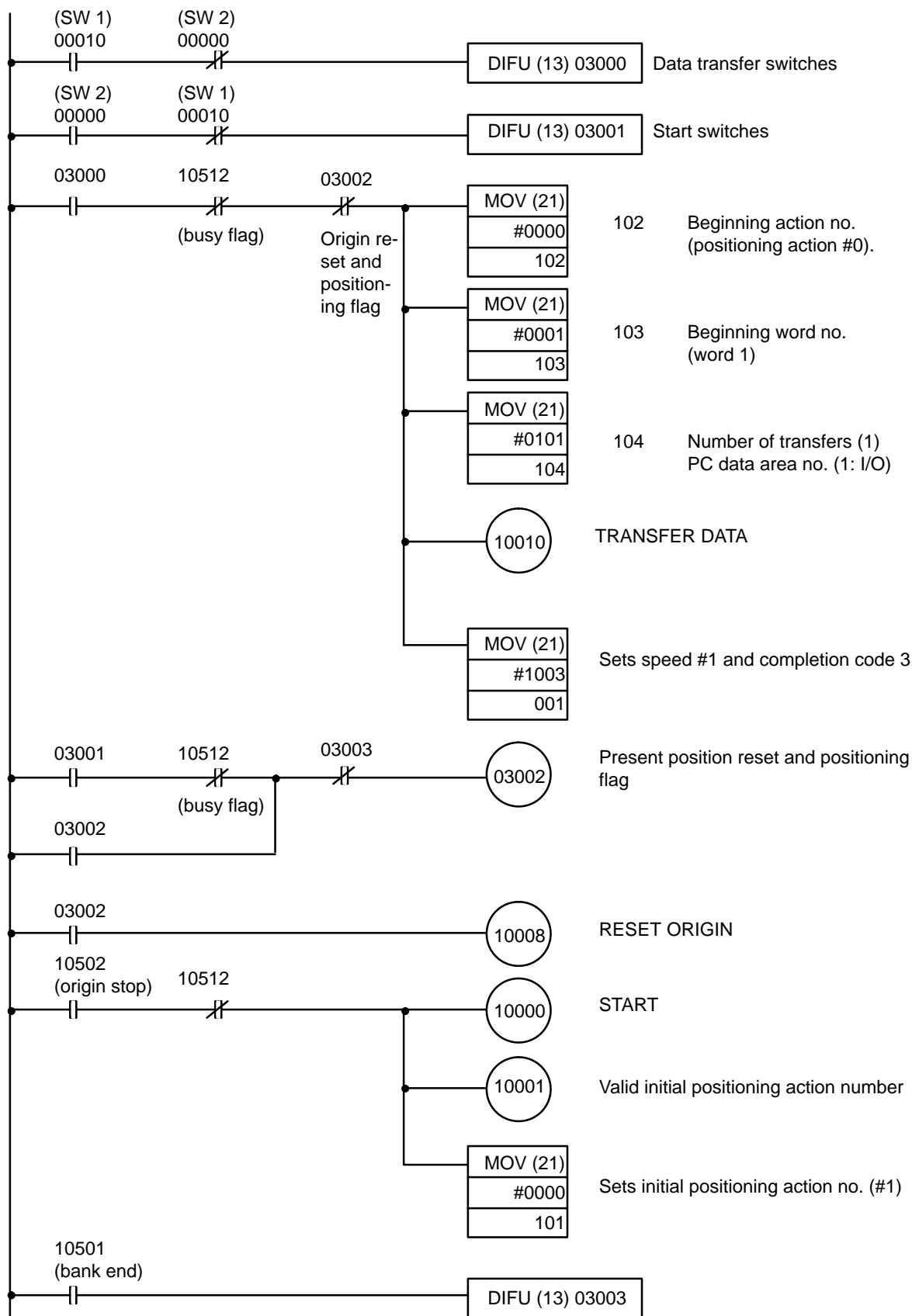
The following is the minimum data required so that an alarm will not be generated.

DM 1000	1	0	0	0	<table border="1"> <tr> <td>ORIGIN RETURN speed</td> <td>Initial speed</td> <td>Initial position No.</td> </tr> <tr> <td>1 to F</td> <td>0 to F</td> <td>0 to 19</td> </tr> </table>	ORIGIN RETURN speed	Initial speed	Initial position No.	1 to F	0 to F	0 to 19		
ORIGIN RETURN speed	Initial speed	Initial position No.											
1 to F	0 to F	0 to 19											
DM 1001	1	2	1	2	<table border="1"> <tr> <td>HIGH-SPEED JOG</td> <td>LOW-SPEED JOG</td> <td>ORIGIN SEARCH</td> <td>Origin proximity speed 1</td> </tr> <tr> <td>1 to F</td> <td>1 to F</td> <td>1 to F</td> <td>1 to F</td> </tr> </table>	HIGH-SPEED JOG	LOW-SPEED JOG	ORIGIN SEARCH	Origin proximity speed 1	1 to F	1 to F	1 to F	1 to F
HIGH-SPEED JOG	LOW-SPEED JOG	ORIGIN SEARCH	Origin proximity speed 1										
1 to F	1 to F	1 to F	1 to F										
DM 1082	2	0	0	0	Speed #1								
DM 1083	0	5	0	0	Speed #2								
DM 1098	0	0	0	6	Acceleration								
DM 1099	0	0	0	6	Deceleration								

### Data To Be Transferred

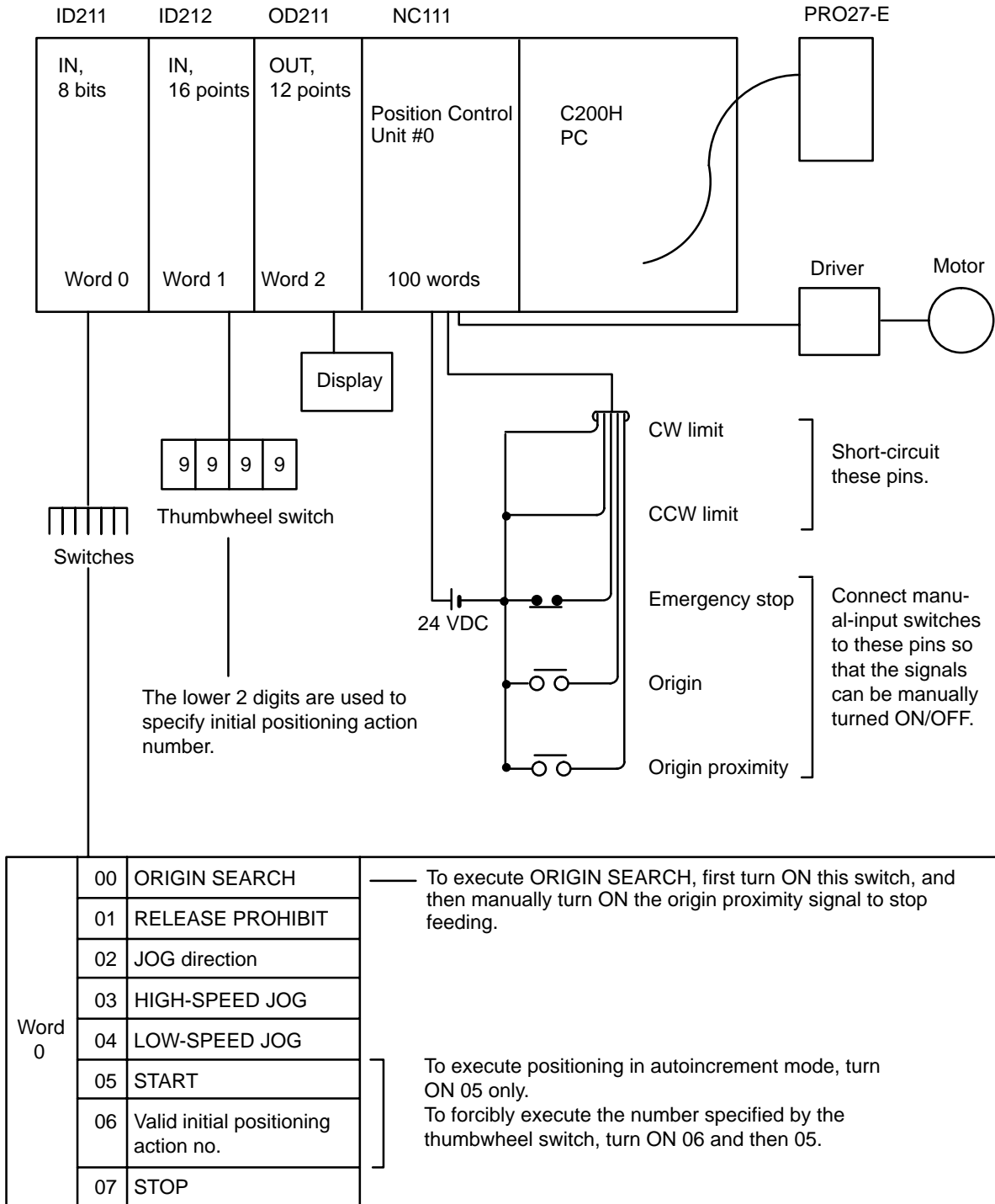
Three consecutive words are transferred for positioning action #0. The bits of the first word, which is allocated to the Position Control Unit, are used as internal relays. The next two words are input from rotary switch connected to Input Units allocated word 2 and word 3. Thus, when TRANSFER DATA is executed with the beginning word designated as word 1, external data, which has been prepared according to the data format for positioning action data, can be used to achieve externally designated positioning actions.

Program



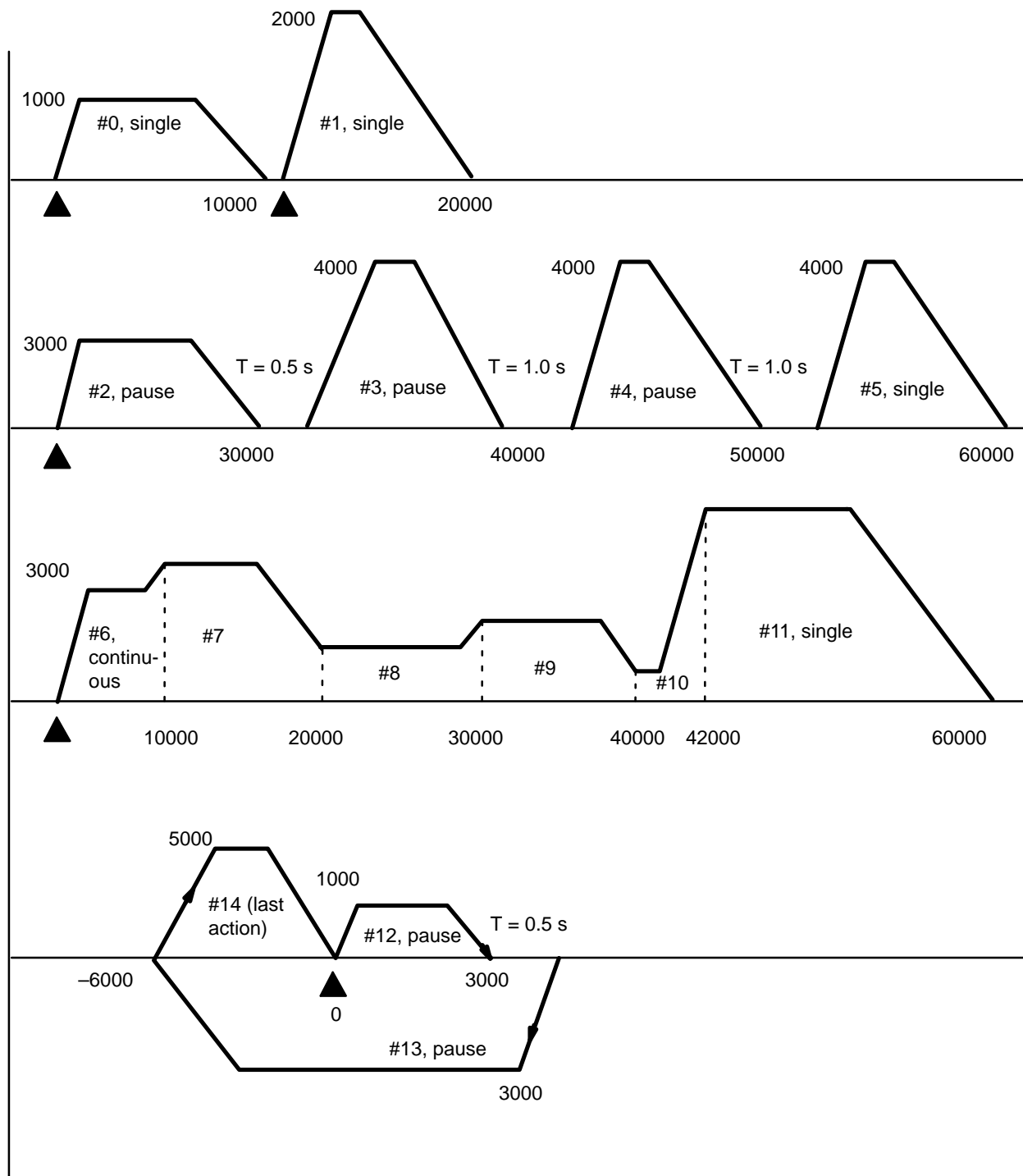
# 5-6 Using START to Carry Out Positioning Actions

## Wiring (Details Omitted)

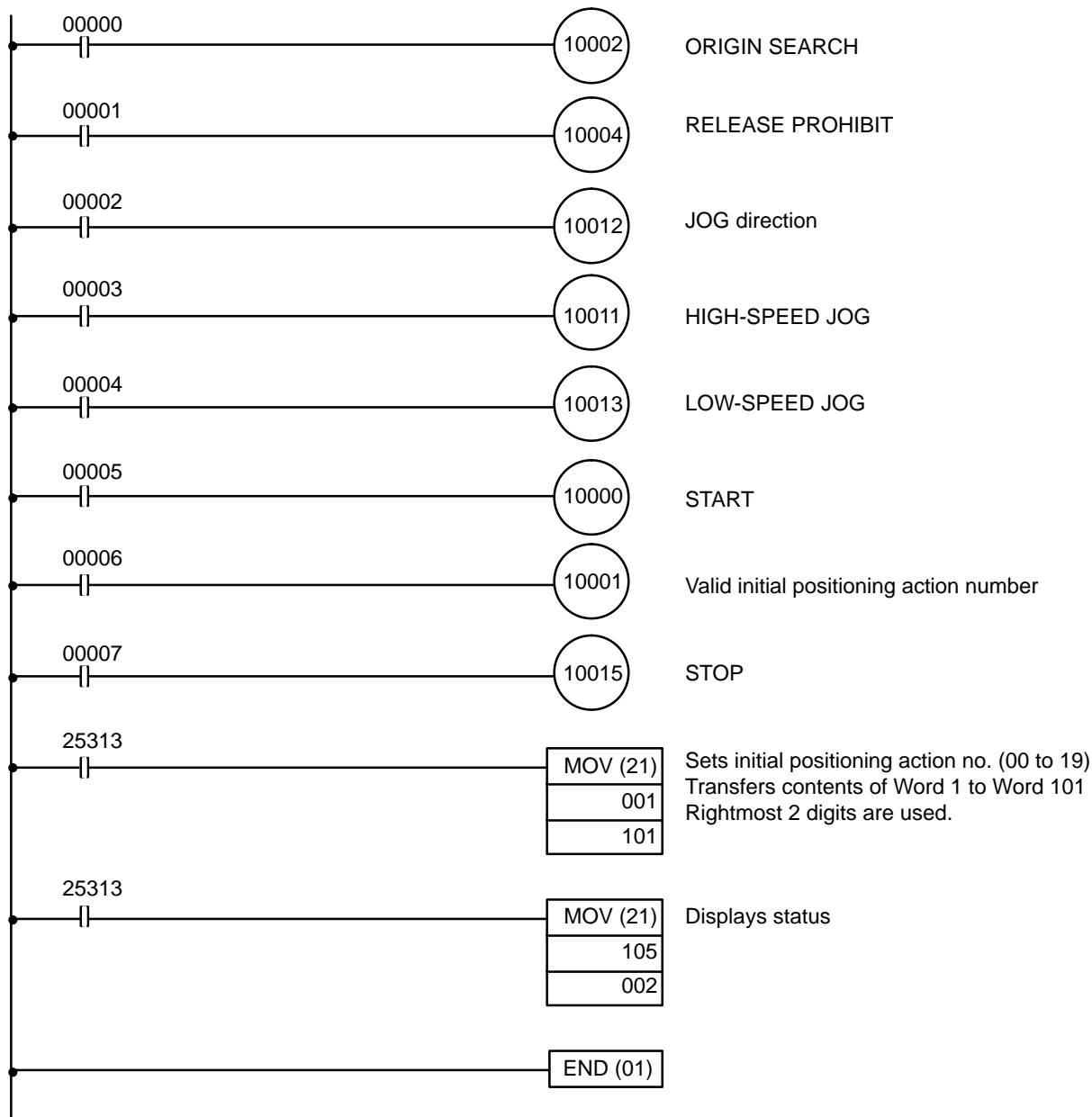




Feeding Pattern



Program



DM Area Coding Sheet

Unit Number: 0

Allocated DM words:

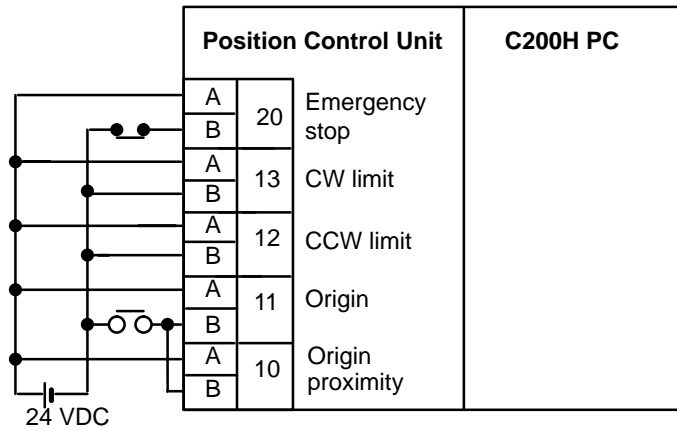
DM 1000 through DM 1099

The first two digits of the word number have been eliminated from the following table. These are the same for all words and can be obtained by computing the first DM word allocated to the Unit, which in this example is DM 1000. This word, designated m, is equal to 1000 plus 100 times the unit number.

W	15 ← → 00				Function	W	15 ← → 00				Function	W	15 ← → 00				Function				
00	1	0	1	2	Initial position nos.; speed nos.	Transfer no. <input type="text"/>					Transfer no. <input type="text"/>										
01	2	3	4	5		34	9	1	A	1	Positioning action #4	4	67				Positioning action #15	15			
02	2	0	0	0	35	0	0	0	0	68											
03	0	0	0	0	36	0	0	0	5	69											
04	0	0	0	0	Backlash compensation	37	9	1	0	0	Positioning action #5	5	70				Positioning action #16	16			
05	0	0	0	0	CW limit	38	0	0	0	0		71									
06	0	8	0	0	CCW limit	39	0	0	0	6	72										
07	0	0	0	0		40	8	1	0	2	Positioning action #6	6	73				Positioning action #17	17			
08	0	8	0	0		41	0	0	0	0		74									
09	0	5	0	0	Zone 0 CW limit	42	0	0	0	1	Positioning action #7	7	75				Positioning action #18	18			
10	0	0	0	0		43	9	2	0	2		76									
11	0	5	0	0	Zone 0 CCW limit	44	0	0	0	0	Positioning action #8	8	77				Positioning action #19	19			
12	1	0	0	0		45	0	0	0	2		78									
13	0	0	0	0	Zone 1 CW limit	46	6	3	0	2		Positioning action #9	9	79						Speed #1	20
14	0	0	0	1		47	0	0	0	0	80										
15	8	0	0	0	Zone 1 CCW limit	48	0	0	0	3	Positioning action #10	10	81				Speed #2	21			
16	0	0	0	0		49	7	4	0	2		82	5	0	0	0					
17	0	0	0	0	Zone 2 CW limit	50	0	0	0	0		83	5	0	0	0			Speed #3		
18	0	0	0	2		51	0	0	0	4	84	0	5	0	0						
19	5	0	0	0	Zone 2 CCW limit	52	3	5	0	2	Positioning action #11	11	85	4	0	0	0	Speed #4	22		
20	0	0	0	1		53	2	0	0	0		86	0	3	0	0	Speed #5				
21	0	0	0	0	Not used	54	0	0	0	4	Positioning action #12	12	87	1	0	0	0	Speed #6	23		
22	6	0	0	0	Positioning action #0	55	A	6	0	0		Positioning action #13	13	88	2	0	0	0		Speed #7	
23	0	0	0	0		0	56	0	0	0			0	89	3	0	0	0		Speed #8	
24	0	0	0	1	Positioning action #1	57	0	0	0	6	Positioning action #14	14	90	4	0	0	0	Speed #9	24		
25	7	0	0	0		1	58	6	0	5		1	Positioning action #15	15	91	5	0	0		0	Speed #10
26	0	0	0	0		1	59	3	0	0		0		92	6	0	0	0		Speed #11	
27	0	0	0	2	Positioning action #2	60	0	0	0	0	Positioning action #16	16	93	7	0	0	0	Speed #12	25		
28	8	1	5	1		2	61	8	0	0		1	Positioning action #17	17	94	8	0	0		0	Speed #13
29	0	0	0	0		2	62	6	0	0		0		95	9	0	0	0		Speed #14	
30	0	0	0	3	Positioning action #3	63	1	0	0	0	Positioning action #18	18	96	1	0	0	0	Speed #15	26		
31	9	1	A	1		3	64	A	0	0		3	Positioning action #19	19	97	8	0	0		0	Speed units
32	0	0	0	0	3	65	0	0	0	0	98	0		1	0	0	Acceleration				
33	0	0	0	4	3	66	0	0	0	0	99	0		0	5	0	Deceleration				

## 5-7 Using Origin and Origin Proximity Signals

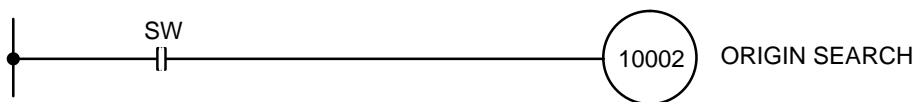
### Configuration



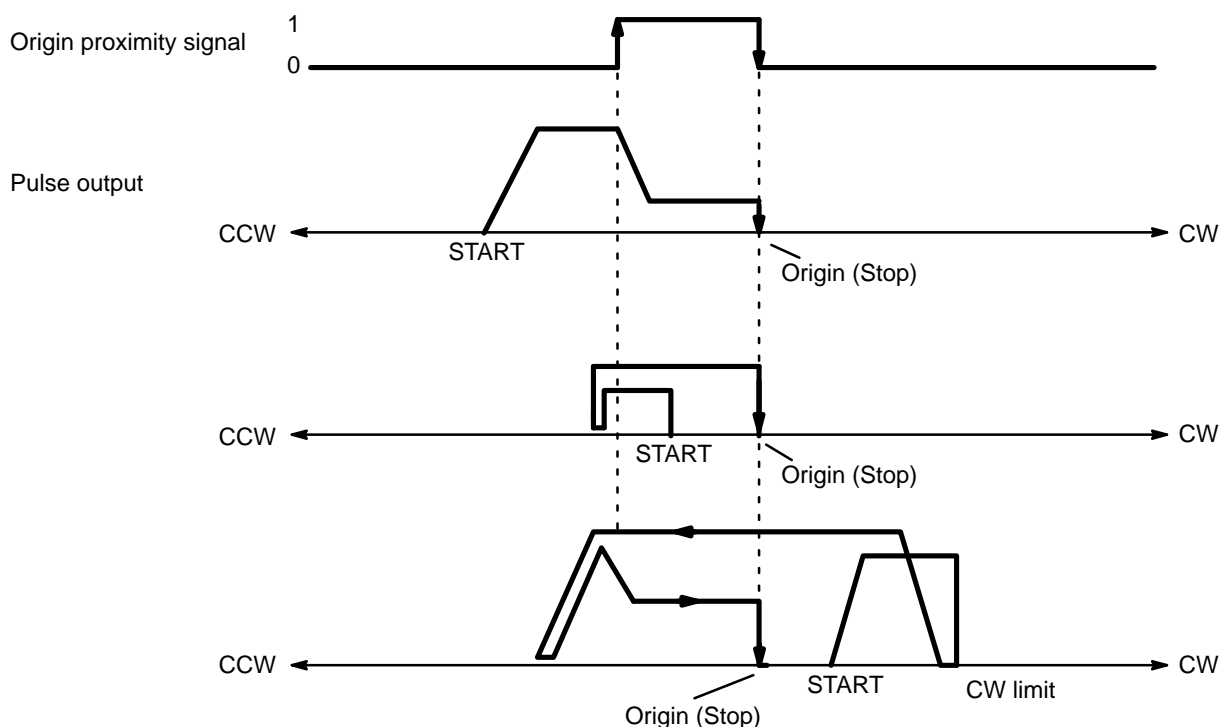
### DIP Switch Settings

- Pin 3            ON (Designating presence of origin proximity signal)
- Pin 4            ON (Designating N.O. contact for origin proximity signal)
- Pin 5            ON (Designating N.C. contact for origin signal)

Operation



The possible search patterns for ORIGIN SEARCH using both an origin signal and an origin proximity signal are as follows.

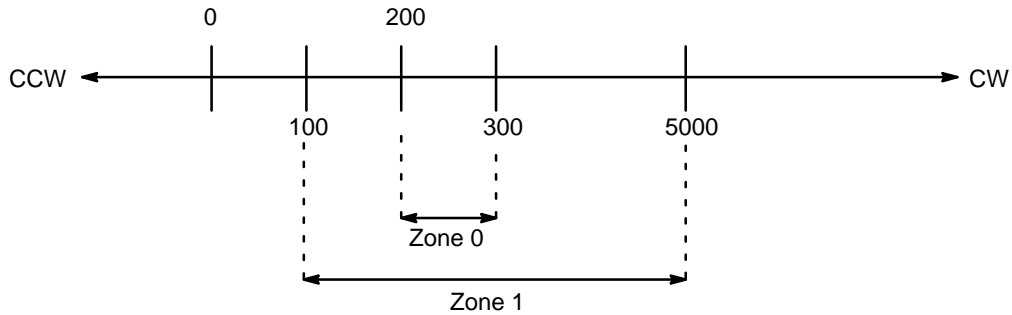


## 5-8 Using Zones to Control Jogging

Operation

This examples shows how to use zones to change conditions for manual operations (jogging and inching). With the following setup and data, all manual operations are possible in zone 0 except for the part of it occupied by zone 1.

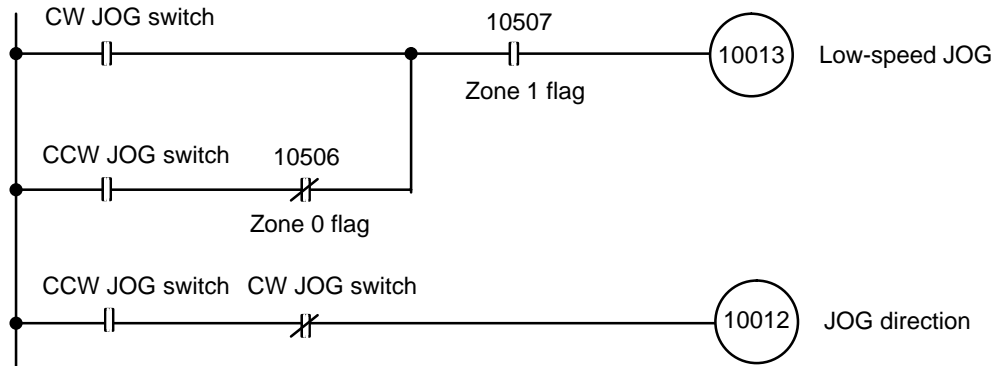
In zone 1, CCW manual feeding is prohibited.



**DM Area Settings  
(Zone Data)**

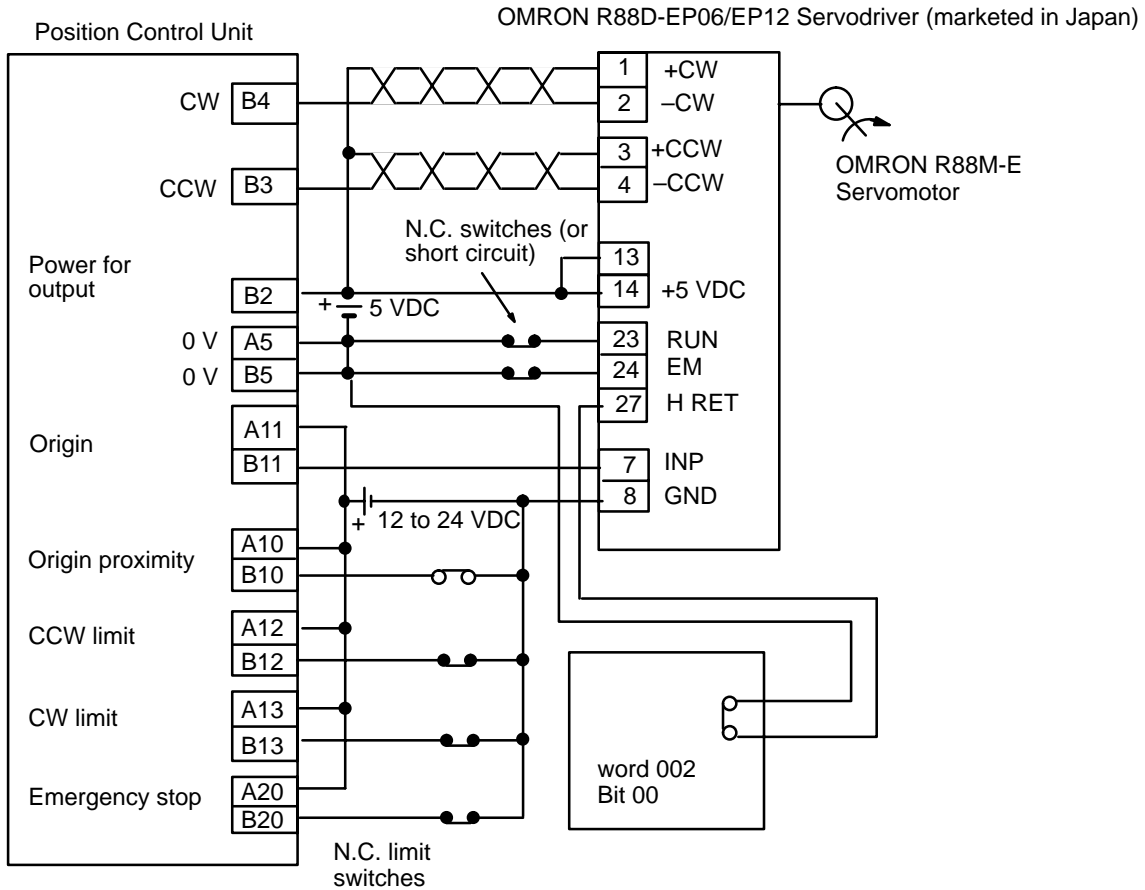
DM 1009	0	3	0	0	Zone 0 CW limit	Zone 0	
DM 1010	0	0	0	0			
DM 1011	0	2	0	0			Zone 0 CCW limit
DM 1012	0	0	0	0			
DM 1013	5	0	0	0	Zone 1 CW limit	Zone 1	
DM 1014	0	0	0	0			
DM 1015	0	1	0	0	Zone 1 CCW limit		
DM 1016	0	0	0	0			

**Program**



**5-9 Controlling an R88D-EP06 Servodriver**

In this connection example, an Omron R88D-EP06 Servodriver is used, and wiring employs the origin adjustment function of this model. The example demonstrates how to use a faster ORIGIN SEARCH proximity speed and yet increase ORIGIN SEARCH accuracy. The Z-phase input is employed as the origin signal for the Position Control Unit; the C200H-OC223 output-type relay is employed as the H RET signal input for the servodriver.

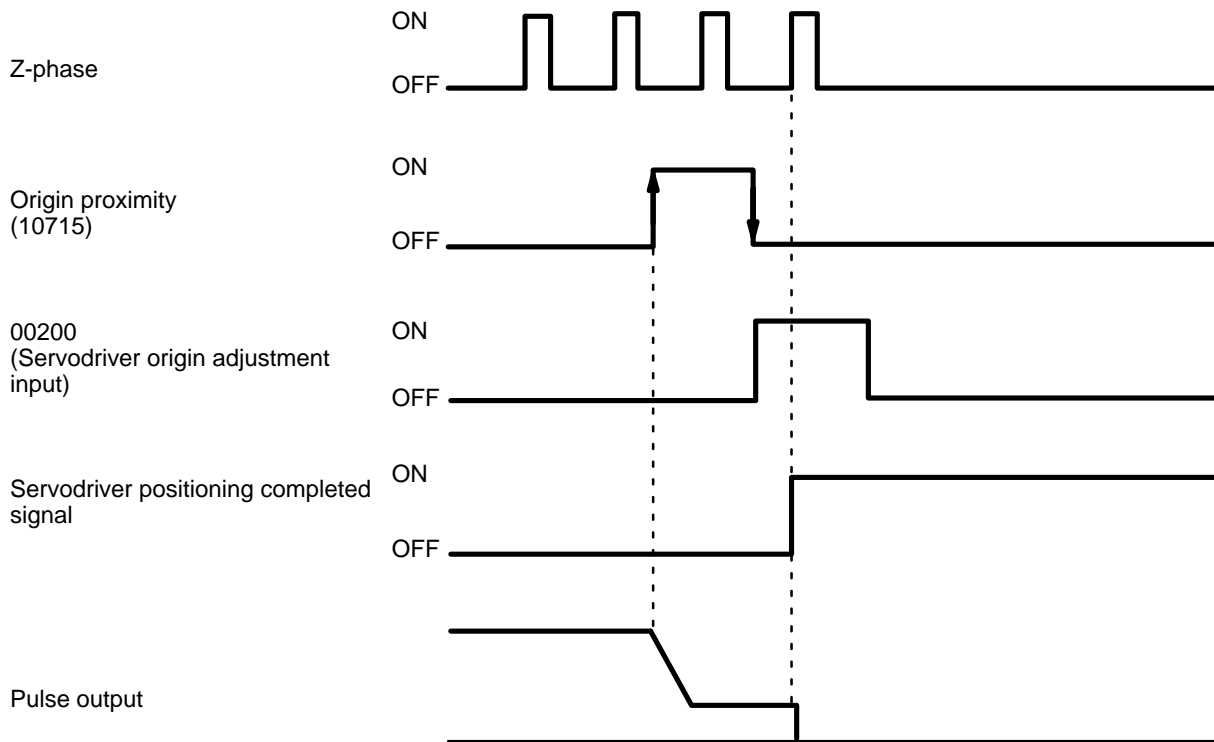


### Operation

This example shows use of the ORIGIN SEARCH command. It assumes that the unit number of the Positioning Control Unit has been set to number 0, and that word 002, bit 00 has been set for the H RET output.

After ORIGIN SEARCH, the servodriver H RET input (origin adjustment input) goes ON at the falling edge of the origin proximity signal. The servodriver automatically positions according to the Z-phase input. Execution of ORIGIN SEARCH is completed when the origin input (servodriver's positioning completed signal, INP) goes ON.

**Timing Chart**

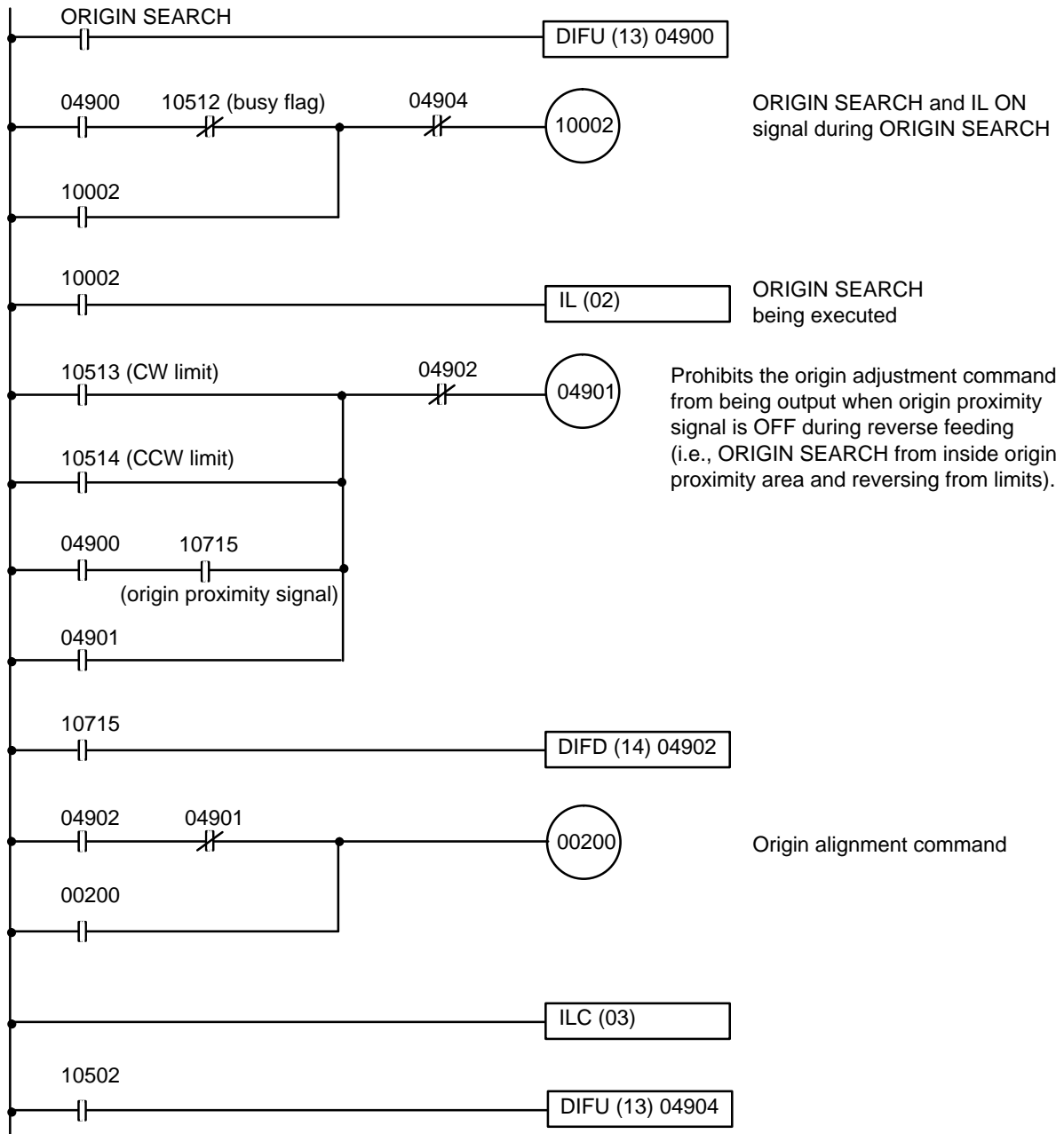


**DIP Switch Settings**

- Pin 1: OFF
- Pin 2: ON or OFF
- Pin 3: ON
- Pin 4: ON
- Pin 5: ON
- Pin 6: OFF
- Pin 7: OFF
- Pin 8: OFF



Program



### 5–10 Controlling a V-series Servodriver

The wiring is similar to and the program is the same as that for a DC servodriver (see Section 5–9).

## SECTION 6

### Error Processing

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## 6-1 Alarms and Errors

### Alarms

Whenever the Position Control Unit is powered up, or data is transferred into the Unit, checks are performed to ensure that the data is in proper form and can be used for operation. If an error exists in speed or positioning action data at this time, an alarm code is generated. Errors that result in alarms include BCD errors, out-of-range data, and no-data errors (when required data is set at 0). An alarm will thus be generated, for example, if the required settings are not made in the DM area of the PC. Operation can be continued even after an alarm has been generated, however, as long as the data that generated the alarm is not used.

### 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.

Refer to Appendix A and Appendix B for specific alarm and error codes.

## 6-2 Outputs to the IR Area

### Alarm Flag

word n+5, bit 03

1: Alarm exists.

### Error flag

word n+5, bit 5

1: Error exists.

### Alarm/Error Codes

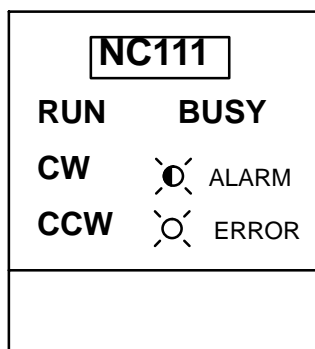
word n+6

This word contains only the most recent alarm or error code. Several error and/or alarm codes can be read out in sequence by setting the READ ERROR command bit (bit 05 of word n). See 4-5 *READ ERROR* for details.

## 6-3 Alarm/Error Indicators

The existence of an alarm or error code is indicated both by the alarm/error LED on the front panel (see figure below) and by the flags (see above) in the IR area of the PC.

### Front Panel LED



ALARM indicator flashes when an alarm code has been output and ERROR indicator lights when an error has occurred.

## 6-4 Troubleshooting from the PC

Abnormalities in the Position Control Unit can be monitored from the C200H PC. It is monitored as a Special I/O Unit, and as such is treated the same as a High-Speed Counter.

### 6-4-1 Error List for Special I/O Units

Error	Causes of Abnormality and Operating Status	Correction
Waiting for Special I/O Unit start-up.	Special I/O Unit has a hardware malfunction.  PC will not begin operation.	Replace the abnormal Special I/O Unit with a new Unit.  (The abnormal Unit displays only "\$" when the I/O table is read.)
Too many Special I/O Units.	Same unit number has been assigned to more than one Special I/O Unit.  PC will not begin operation. SR bit 25415 is ON.	Set unit numbers so that each is used only once.  (Unit numbers can be accessed by reading the I/O table.)
Error in Special I/O Unit.	Refreshing between the CPU and the Special I/O Unit was not executed correctly.  Only the abnormal Unit will stop operating. SR bit 25415 is ON.	Obtain the abnormal unit number by reading AR bits 0000-0009 and remove the cause of the error. Then restart by turning on, then back off, the appropriate restart bit (AR bits 0100-0109). If the Unit does not recover normal operation after restarting, replace it with a new one.

### 6-4-2 AR Area Error and Restart Bits for Special I/O Units

#### Error Flags

The following error flags will turn ON when the same unit number is assigned to more than one Special I/O Unit, or when the refreshing operation between the PC and the Special I/O Unit is not executed properly.

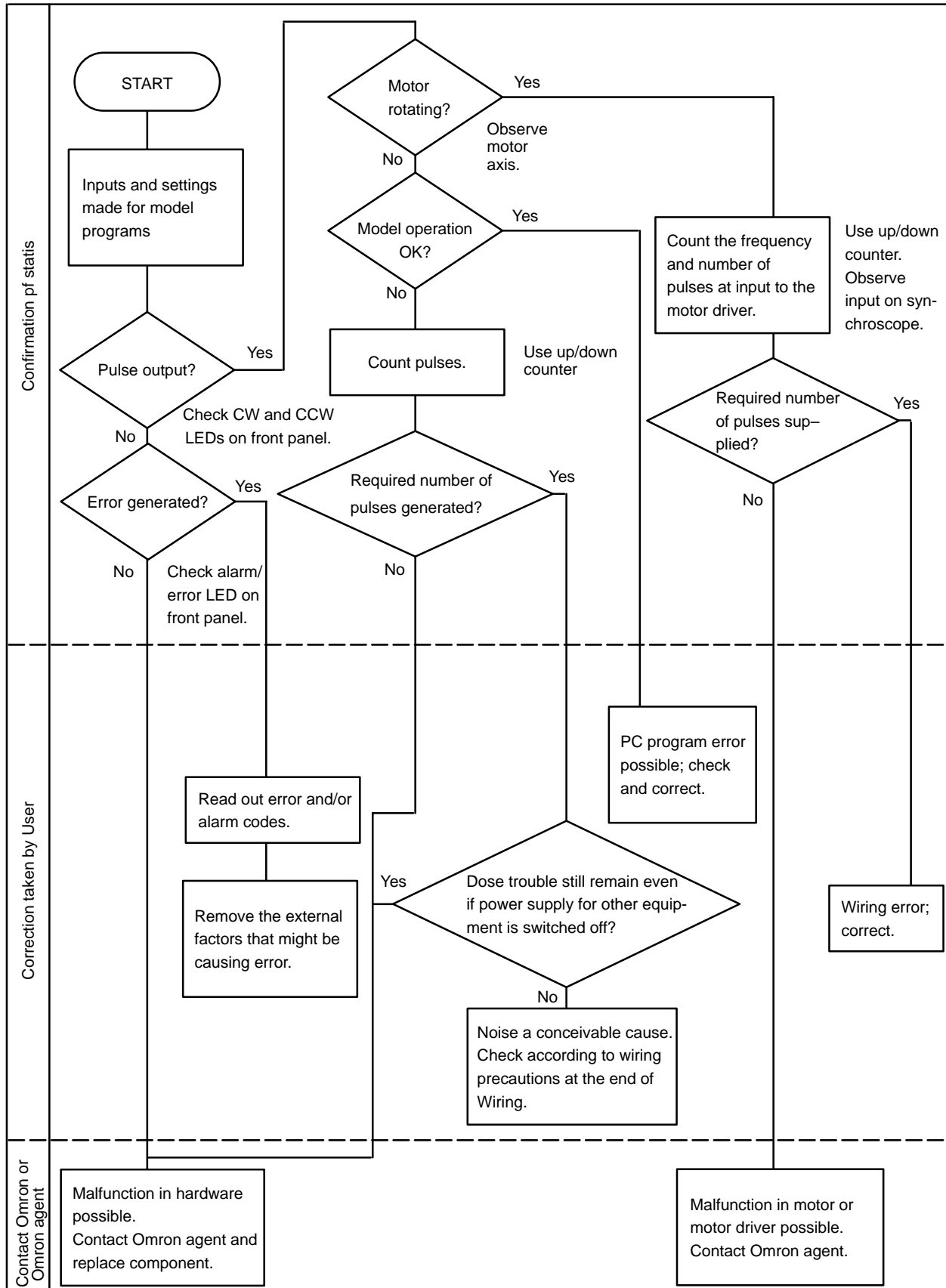
Bit	Unit Number
AR 000	0
AR 001	1
AR 002	2
AR 003	3
AR 004	4
AR 005	5
AR 006	6
AR 007	7
AR 008	8
AR 009	9

**Restart Bits**

The following restart bits are turned off, on, then back off again to restart Special I/O Units. It is not necessary to turn off power to the Unit when its restart bit is used.

<b>Bit</b>	<b>Unit Number</b>
AR 1000	0
AR 0101	1
AR 0102	2
AR 0103	3
AR 0104	4
AR 0105	5
AR 0106	6
AR 0107	7
AR 0108	8
AR 0109	9

# 6-5 Basic Troubleshooting Chart



## 6-6 Detection of Abnormal Pulse Outputs

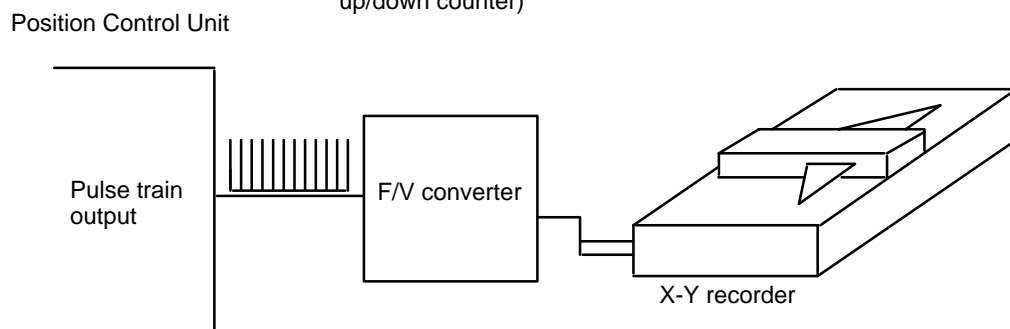
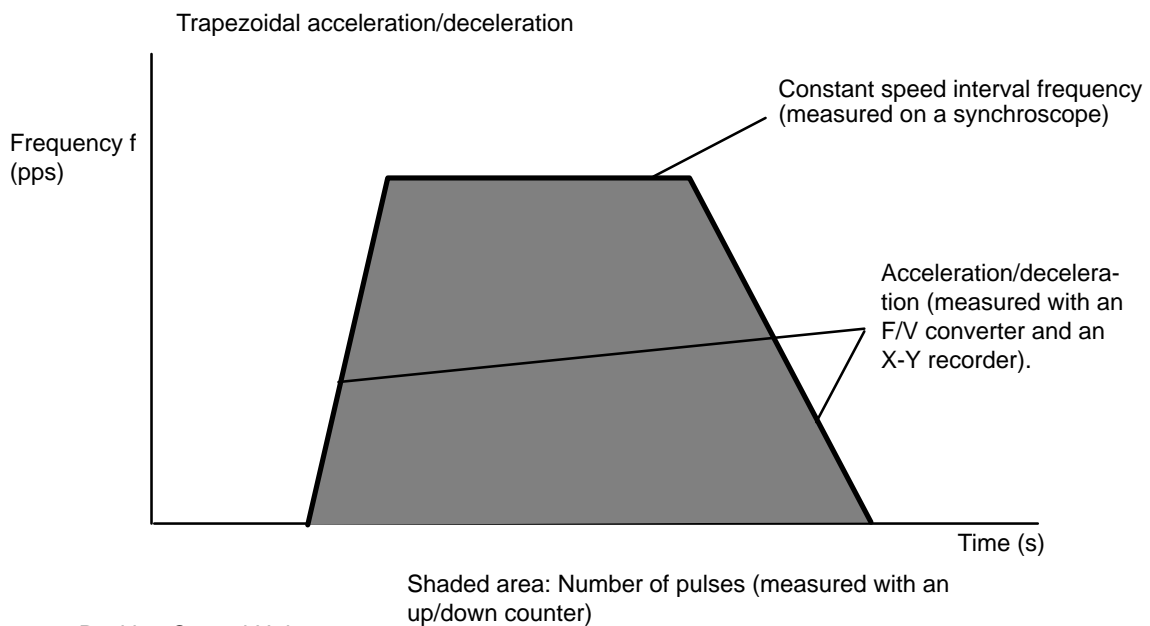
The Position Control Unit outputs pulse trains in accordance with the programmed data. When tracing an abnormality, the following should be taken into consideration.

### Number of Pulses in Pulse Train

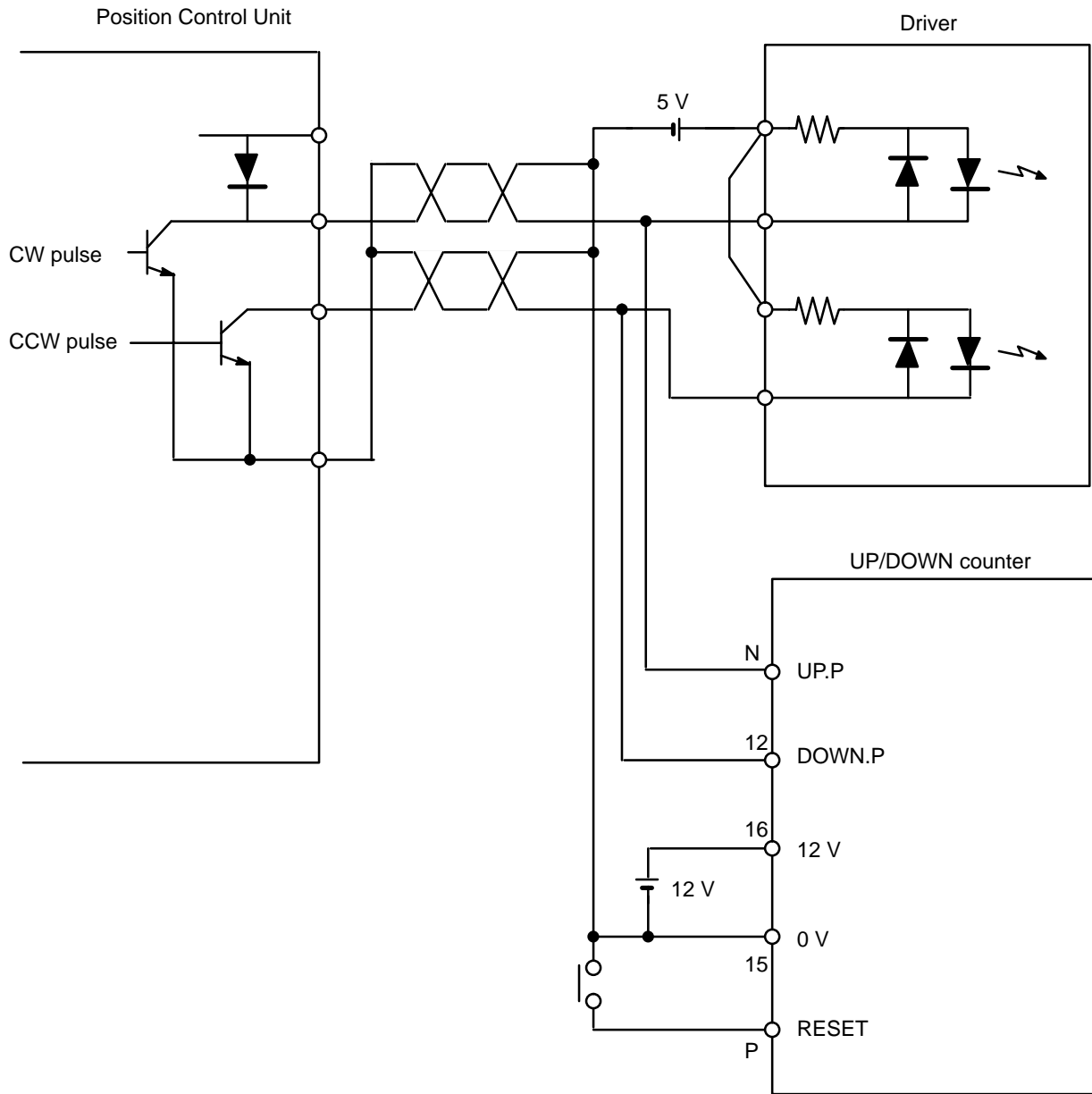
The Unit only outputs the number of pulses required to reach the desired position. Count the number of pulses being output with an up/down counter and check to see if the proper number of pulses is being output.

### Frequency of Pulse Train Output

The frequency of pulse train output can be observed on a synchroscope at the constant speed interval of the trapezoidal acceleration/deceleration. To measure the frequency during acceleration and deceleration, an F/V converter and X-Y recorder can be used.



### Connections to an Up/Down Counter





# Appendix A

## Alarm Code List

Area	Item	Alarm Code	Problem
Initial speed	BCD error	1000	There is a BCD error in the speed indicated by the initial speed number.
Initial positioning action no.	Limit error	1100	Initial positioning action number is not between 00 and 19.
Jog operations	HIGH-SPEED JOG speed error	1200	HIGH-SPEED JOG speed number is 0, or there is a BCD error in the speed designated by the number.
	LOW-SPEED JOG speed error	1201	LOW-SPEED JOG speed number is 0, or there is a BCD error in the speed designated by the number.
	Speed contradiction	1202	The LOW-SPEED JOG is faster than the HIGH SPEED JOG.
Acceleration/ deceleration	Acceleration error	1300	Acceleration is 0, or contains a BCD error.
	Deceleration error	1301	Deceleration is 0 or contains a BCD error.
ORIGIN RETURN	Speed error	1400	ORIGIN RETURN speed designated by the number is 0, or there is a BCD error in the speed designated by the number.
Speeds	Speed contradiction	1500	Table for trapezoidal acceleration/deceleration cannot be created due to error in speed, acceleration, or deceleration.
	BCD error	1501	There is a BCD error in speed #1 (m+82).
		1502-1515	There is a BCD error in a speed #2 to #15 (m+83 to m+96). The last two digits of the alarm code is the number of the speed with the error.
ORIGIN SEARCH	Origin compensation BCD error	1600	Origin compensation contains a BCD error or exceeds the internal limit.

Area	Item	Alarm code	Problem
ORIGIN SEARCH	High speed error	1601	ORIGIN SEARCH high speed number is 0, or there is a BCD error in the speed designated by the number.
	Proximity speed error	1602	ORIGIN SEARCH proximity speed number is 0, or there is a BCD error in the speed designated by the number.
	Speed contradiction	1603	High speed is slower than proximity speed.
Backlash compensation	BCD error	1700	There is a BCD error in the backlash compensation.
Internal limits	CW limit	1800	There is a BCD error in internal CW limit setting or the setting is not between 0 and 8,388,606.
	CCW limit	1801	There is a BCD error in internal CCW limit setting or the setting is not between 0 and 8,388,607.
Zones	Zone 0 CW error	1900	There is a BCD error in setting for CW limit of zone 0 or setting is not between -8,388,607 and 8,388,606.
	Zone 0 CCW error	1901	There is a BCD error in setting for CCW limit of zone 0 or setting is not between -8,388,607 and 8,388,606.
	Zone 0 contradiction	1902	CW and CCW limit setting for zone 0 are reversed (i.e., CW limit is counterclockwise of CCW limit).
	Zone I CW error	1910	Problems are identical to those for zone 0.
	Zone I CCW error	1911	
	Zone I contradiction	1912	

(continued)

Area	Item	Alarm code	Problem
Zones	Zone 2 CW error	1920	Problems are identical to those for zone 0.
	Zone 2 CCW error	1921	
	Zone 2 contradiction	1922	
Positioning actions	Desired position BCD error	2000	There is a BCD error in the desired position for positioning action #0 (m+22 to m+24).
		2001-2019	There is a BCD error in the desired position for a positioning action #1 to #19 (m+25 to m+81). The last two digits of the alarm code is the number of the positioning action with the error.
	Speed BCD error	2100	There is a BCD error in the speed (m+82 to m+96) designated by the speed number for positioning action #0 (m+22 to m+24).
		2101-2119	There is a BCD error in the speed (m+82 to m+96) for a positioning action #1 to #19 (m+25 to m+81). The last two digits of the alarm code is the number of the positioning action.
	Position contradiction	2200	The completion codes for all positioning actions are 2 (continuous); the Unit cannot begin operation.
	Completion code error	2300	Completion code for positioning action #0 is not between 0 and 4.
2301-2319		Completion code for the positioning action indicated by the last two digits of the alarm code is not between 0 and 4.	

## Appendix B Error Code List

Error	Error code	Problem	Correction
START	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 desired position.	Read out alarm code, correct data accordingly, and TRANSFER DATA or RESTART. The error code will be erased for the next START if data has been properly corrected.
Direction reversed	5020	Pulse output is not possible because the direction was reversed following a continuous positioning action.	Check positioning actions, correct data accordingly, and TRANSFER DATA or RESTART.
CW limit	5030	Pulse output is not possible because the internal CW limit would be passed.	
CCW limit	5031	Pulse output is not possible because the internal CCW limit would be passed.	
Present position undefined	5040	Execution of START, TEACH, or ORIGIN RETURN is not possible because the present position has not been established.	Execute ORIGIN SEARCH, RESET ORIGIN, or preset the present position with TRANSFER DATA.
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.
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 disabled	5100	ORIGIN SEARCH cannot be executed because of data for the origin compensation, search speeds, or backlash compensation that generated an alarm code.	Read out alarm code and correct data accordingly.

(continued)

<b>Error</b>	<b>Error code</b>	<b>Problem</b>	<b>Correction</b>
ORIGIN RETURN disabled	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.
HIGH-SPEED JOG disabled	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 disabled	5400	LOW-SPEED JOG cannot be executed because of data for LOW-SPEED JOG speed, initial speed, or backlash compensation that generated an alarm.	
INCH disabled	5500	INCH cannot be executed because of data for backlash compensation that generated an alarm.	
Emergency stop executed	6000	Feeding has been stopped by emergency stop signal input.	Check wiring. Turn off emergency stop signal and execute RELEASE PROHIBIT and ORIGIN SEARCH.
CW limit	6100	Feeding has been stopped by CW limit signal input.	Check wiring. Execute RELEASE PROHIBIT and then feed counter-clockwise using HIGH-SPEED JOG, LOW-SPEED JOG, or INCH (or execute ORIGIN SEARCH, RESET ORIGIN or TRANSFER DATA after RELEASE PROHIBIT).
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, RESET ORIGIN or TRANSFER DATA after RELEASE PROHIBIT).
No origin proximity signal	6200	No proximity signal is detected between the CCW and CW limits even though pin #3 on DIP switch designates a proximity signal.	Check DIP switch setting, wiring of proximity signal, and signal type (N.C. or N.O.).

(continued)

Error	Error code	Problem	Correction
No-origin flag	6201	The origin signal is not detected between CCW and CW limits.	Check wiring of origin signal and signal type (N.C. or N.O.)
Origin signal position	6202	Feeding was stopped by origin signal input during ORIGIN SEARCH before the proximity speed was reached, i.e., proximity signal and origin signal are too close relative to time required for deceleration from high speed to proximity speed	Check position of origin signal and proximity signal relative to required deceleration.
Counterclockwise CW limit	6400	CW limit signal was input while feeding counterclockwise .	Check wiring of limit signals.
Clockwise CCW limit	6401	CCW limit signal was input while feeding clockwise.	Check wiring of limit signals.
PC mode change	6600	PC mode was changed between MONITOR and PROGRAM during pulse output.	Execute ORIGIN SEARCH to obtain present position.
CHANGE SPEED	6700	Feeding has been stopped following CHANGE SPEED due to data for the speed of the next positioning action for which an alarm was generated.	Check speed data. If problem is corrected, this error code will be erased by the next START.
Multiple command	8000	More than one command bit among 00, 02, 03, 04, 08, 09, 10, 11, 13 and 14, of word n, has been set.	Check program. This error code will be erased when only one command bit in word n remains set.
Initial positioning action no.	8100	Initial positioning action number contained in IR area is not between 00 and 19.	Check program. If problem is corrected, this error code will be erased by the next START.
TEACH positioning action no.	8200	TEACH positioning action number is not between 00 and 19.	Check program. If problem is corrected, this error code will be erased by the next TEACH.

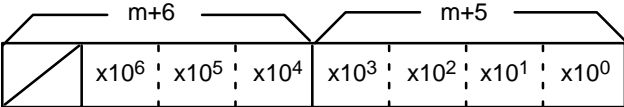
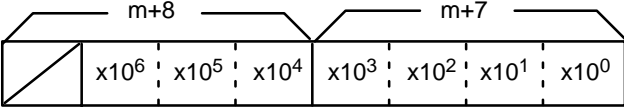
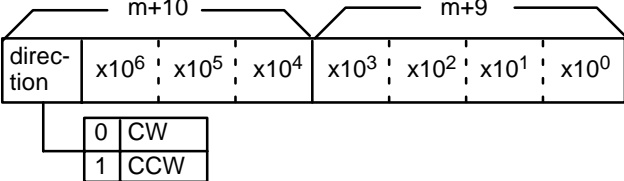
(continued)

Error	Error code	Problem	Correction
ROM in PC	8210	TEACH cannot be executed because PC user program memory is ROM.	Check program. This error code will be erased by the next TRANSFER DATA.
Transferred positioning action no.	8300	Beginning transfer number for TRANSFER DATA is not between 00 and 25.	
PC beginning word number	8301	Beginning PC word number for TRANSFER DATA is out of range or becomes out of range when the designated number of transfers is added. (See 4–8 TRANSFER DATA for range details.)	
PC area number	8302	PC area number for TRANSFER DATA is not between 0 and 4.	Check program. This error code will be erased by the next TRANSFER DATA.
Number of transfers	8303	The number of transfers for TRANSFER DATA is not between 1 and 26.	Check program. This error code will be erased by the next TRANSFER DATA.
Present position preset	8304	The position preset with TRANSFER DATA contains a BCD error or is out of range.	Check program and data in PC.
Hardware	9000	LSI operation at start-up is not completed normally.	Hardware is possibly faulty.
	9100	Desired position for a positioning action has been exceeded.	Hardware is possibly faulty or error is possibly caused by noise.
	9200	Speed for a positioning action has been exceeded.	

# Appendix C

## DM Area Allocations

The first two digits of the word number have been eliminated from the following table. These are the same for all words and can be obtained by computing the first DM word allocated to the Unit. This word, designated m, is equal to 1000 plus 100 times the unit number.

Word	Bit	Function
m	07 to 00	Initial position no., 00 to 19 (BCD): Initial START and START after bank end.
	11 to 08	Initial speed no., 0 to F (hexadecimal)
	15 to 12	ORIGIN RETURN speed no., 1 to F (hexadecimal)
m+1	03 to 00	ORIGIN SEARCH proximity speed no., 1 to F (hexadecimal)
	07 to 04	ORIGIN SEARCH high speed no., 1 to F (hexadecimal)
	11 to 08	LOW-SPEED JOG speed no., 1 to F (hexadecimal)
	15 to 12	HIGH-SPEED JOG speed no., 1 to F (hexadecimal)
m+2	15 to 00	Origin compensation value, 0000 to 9999 (BCD)
m+3	00	Origin compensation direction digit (0: CW; 1: CCW)
	15 to 01	Not used
m+4	15 to 00	Backlash compensation value, 0000 to 9999 (BCD)
m+5	15 to 00	Internally set value of CW limit
m+6	11 to 00	 (7 digits BCD)
	15 to 12	Not used
m+7	15 to 00	Internally set value of CCW limit
m+8	11 to 00	 (7 digits BCD)
	15 to 12	Not used
m+9	15 to 00	Zone 0: CW side
m+10	15 to 00	 (7 digits BCD with direction digit)



Word	Bit	Function
m+11	15 to 00	Zone 0: CCW side
m+12	15 to 00	<p>(7 digits BCD with direction digit)</p>
m+13	15 to 00	Zone 1: CW side
m+14	15 to 00	<p>(7 digits BCD with direction digit)</p>
m+15	15 to 00	Zone 1: CCW side
m+16	15 to 00	<p>(7 digits BCD with direction digit)</p>
m+17	15 to 00	Zone 2: CW side
m+18	15 to 00	<p>(7 digits BCD with direction digit)</p>
m+19	15 to 00	Zone 2: CCW side
m+20	15 to 00	<p>(7 digits BCD with direction digit)</p>

Word	Bit	Function											
m+21		Not used											
m+22	03 to 00	Completion code	0: Single 1: Pause 2: Continuous 3: Bank end 4: Extended										
	07 to 04	Dwell time	0 to F (hexadecimal) in units of 0.1 s										
	11 to 08	Output code	0 to F (hexadecimal)										
	15 to 12	Desired speed no.	1 to F (hexadecimal)										
m+23	15 to 00	Desired position (pulses)											
m+24	15 to 00	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>0</td> <td>CW</td> <td rowspan="2">Absolute</td> </tr> <tr> <td>1</td> <td>CCW</td> </tr> <tr> <td>2</td> <td>CW</td> <td rowspan="2">Incremental</td> </tr> <tr> <td>3</td> <td>CCW</td> </tr> </table>		0	CW	Absolute	1	CCW	2	CW	Incremental	3	CCW
		0	CW	Absolute									
1	CCW												
2	CW	Incremental											
3	CCW												
m+25 m+26 m+27		Data format same as for positioning action #0	Positioning action #1 (Transfer data #1)										
m+28 m+29 m+30		Data format same as for positioning action #0	Positioning action #2 (Transfer data #2)										
m+31 m+32 m+33		Data format same as for positioning action #0	Positioning action #3 (Transfer data #3)										
m+34 m+35 m+36		Data format same as for positioning action #0	Positioning action #4 (Transfer data #4)										
m+37 m+38 m+39		Data format same as for positioning action #0	Positioning action #5 (Transfer data #5)										
m+40 m+41 m+42		Data format same as for positioning action #0	Positioning action #6 (Transfer data #6)										
m+43 m+44 m+45		Data format same as for positioning action #0	Positioning action #7 (Transfer data #7)										
m+46 m+47 m+48		Data format same as for positioning action #0	Positioning action #8 (Transfer data #8)										
m+49 m+50 m+51		Data format same as for positioning action #0	Positioning action #9 (Transfer data #9)										

Word	Bit	Function	
m+52 m+53 m+54		Data format same as for positioning action #0	Positioning action #10 (Transfer data #10)
m+55 m+56 m+57		Data format same as for positioning action #0	Positioning action #11 (Transfer data #11)
m+58 m+59 m+60		Data format same as for positioning action #0	Positioning action #12 (Transfer data #12)
m+61 m+62 m+63		Data format same as for positioning action #0	Positioning action #13 (Transfer data #13)
m+64 m+65 m+66		Data format same as for positioning action #0	Positioning action #14 (Transfer data #14)
m+67 m+68 m+69		Data format same as for positioning action #0	Positioning action #15 (Transfer data #15)
m+70 m+71 m+72		Data format same as for positioning action #0	Positioning action #16 (Transfer data #16)
m+73 m+74 m+75		Data format same as for positioning action #0	Positioning action #17 (Transfer data #17)
m+76 m+77 m+78		Data format same as for positioning action #0	Positioning action #18 (Transfer data #18)
m+79 m+80 m+81		Data format same as for positioning action #0	Positioning action #19 (Transfer data #19)
m+82	15 to 00	Speed #1 0000 to 9999 (BCD)	Transfer data #20
m+83	15 to 00	Speed #2 0000 to 9999 (BCD)	
m+84	15 to 00	Speed #3 0000 to 9999 (BCD)	
m+85	15 to 00	Speed #4 0000 to 9999 (BCD)	Transfer data #21
m+86	15 to 00	Speed #5 0000 to 9999 (BCD)	
m+87	15 to 00	Speed #6 0000 to 9999 (BCD)	
m+88	15 to 00	Speed #7 0000 to 9999 (BCD)	Transfer data #22
m+89	15 to 00	Speed #8 0000 to 9999 (BCD)	
m+90	15 to 00	Speed #9 0000 to 9999 (BCD)	

Word	Bit	Function	
m+91	15 to 00	Speed #10 0000 to 9999 (BCD)	
m+92	15 to 00	Speed #11 0000 to 9999 (BCD)	
m+93	15 to 00	Speed #12 0000 to 9999 (BCD)	
m+94	15 to 00	Speed #13 0000 to 9999 (BCD)	
m+95	15 to 00	Speed #14 0000 to 9999 (BCD)	
m+96	15 to 00	Speed #15 0000 to 9999 (BCD)	
m+97	00	Not used	
	01	Unit for speed #1	
	02	Unit for speed #2	
	03	Unit for speed #3	
	04	Unit for speed #4	
	05	Unit for speed #5	
	06	Unit for speed #6	
	07	Unit for speed #7	
	08	Unit for speed #8	
	09	Unit for speed #9	
	10	Unit for speed #10	
	11	Unit for speed #11	
	12	Unit for speed #12	
	13	Unit for speed #13	
	14	Unit for speed #14	
	15	Unit for speed #15	
m+98	11 to 00	Acceleration data 001 to 999 (BCD) (speed incremented in ms)	
	15 to 12	Not used	
m+99	11 to 00	Deceleration data 001 to 999 (BCD) (speed decremented in ms)	
	15 to 12	Not used	

0	x 1 pps
1	x 10 pps

# Appendix D

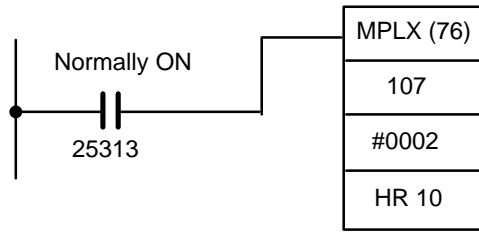
## IR Area Allocations

	Word	Bit	Function (  : leading edge;  : trailing edge)
Outputs (n = 10 x unit no.)	n	00	START: At the leading edge (  ) of this bit, the Position Control Unit references bits 01 and 07 of ch n and begins positioning.
		01	Valid initial positioning no.: When set to 1, the initial positioning no. set in bits 07 to 00 of word n+1 is valid. When set to 0, the initial positioning no. set in bits 07 to 00 of DM word m is valid.
		02	ORIGIN SEARCH: (  ) Searches for origin proximity signals and origin signals, and determines the origin.
		03	ORIGIN RETURN: (  ) Returns to the origin (as long as the origin has already been determined).
		04	RELEASE PROHIBIT: (  )
		05	READ ERROR: (  )
		06	CHANGE SPEED: (  ) if DIP switch pin no. 6 is ON. If pin no. 6 is OFF, then this bit executes CHANGE SPEED when set to 1 and STOP when set to 0.
		07	Valid speed coefficient:: When set to 1, the speed coefficient set in bits 07 to 00 of word n+2 is valid. When set to 0, the speed coefficient of the desired speed is set at 1.0.
		08	RESET ORIGIN: (  )
		09	TEACH: (  ) References bits 15 to 08 of word n+1 and registers the present position.
		10	TRANSFER DATA: (  ) References words n+2 to n+4 and begins the transfer of data.
		11	HIGH-SPEED JOG: (0: stops, 1: operates) in the direction indicated by bit 12 of word n.
		12	INCH/JOG direction: (0: CW, 1: CCW)
		13	LOW-SPEED JOG: (0: stops, 1: operates) in the direction indicated by bit 12 of word n.
		14	INCH: (  ) Outputs one pulse.
	15	STOP: (  ) The Positioning cannot be restarted while this bit is set to 1.	
	n+1	07 to 00	Initial positioning action number: 00 to 19 (BCD)
		15 to 08	TEACH positioning action number: 00 to 19 (BCD)
	n+2	07 to 00	Speed coefficient:: 00 to 20 (BCD) in units of x 0.1
		14 to 08	Beginning transfer number: 00 to 25 (BCD)
15		When set to 1, presets the present position during DATA TRANSFER.	
n+3	15 to 00	Beginning word number for DATA TRANSFER (4 digits BCD)	
n+4	07 to 00	PC data area for DATA TRANSFER: 00 to 04 (BCD) (00: DM, 01: I/O, 02: LR, 03: HR, 04: AR)	
	15 to 08	Number of transfers for DATA TRANSFER: 01 to 26 (BCD)	

Word	Bit	Function ( $\uparrow$ : leading edge; $\downarrow$ : trailing edge)
n+5	00	Positioning completed flag: ( $\uparrow$ : completed, $\downarrow$ : starting
	01	Bank completed flag: ( $\uparrow$ : bank completed, $\downarrow$ : starting
	02	At-origin flag: (1: stopped at origin)
	03	Alarm flag: (1: alarm)
	04	Emergency stop flag: ( $\uparrow$ : Emergency stop, $\downarrow$ : pulse output enabled
	05	Error flag: (1: error)
	06	Zone 0 flag: (0: outside zone 0, 1: inside zone 0)
	07	Zone 1 flag: (0: outside zone 1, 1: inside zone 1)
	08	Zone 2 flag: (0: outside zone 2, 1: inside zone 2)
	09	Teaching completed flag: ( $\uparrow$ : completed, $\downarrow$ : starting)
	10	Transfer completed flag: ( $\uparrow$ : completed, $\downarrow$ : starting)
	11	No-origin flag: (1: no origin)
	12	Busy flag: (1: busy) during transfer or pulse output
	13	CW limit flag: (1: CW limit signal is being input.)
	14	CCW limit flag: (1: CCW limit signal is being input.)
15	STOP flag: ( $\uparrow$ : STOP executed, $\downarrow$ : operation begins)	
n+6	15 to 00	Error code: 4 digits (BCD)
	07 to 00	Positioning action number: 00 to 19 (BCD)
	11 to 08	Output code: 0 to F (BCD)
n+7	12	Emergency stop signal: (1: Emergency stop signal is being input.)
	13	External interrupt signal: (1: External interrupt signal is being input.)
	14	Origin signal: (1: Origin signal is being input.)
	15	Origin proximity signal: (1: Origin proximity signal is being input.)
n+8	15 to 00	Present position
n+9	15 to 00	<p>(7 digits BCD with direction digit)</p>

## Detailed IR Area Allocation Table

Word	Bit	Function
n+5	00	<b>Positioning completed flag</b> This bit turns OFF when positioning, ORIGIN SEARCH, or ORIGIN RETURN are started. It turns ON when positioning is completed (for single or bank end positioning actions). It does not turn when STOP is executed during operation.
	01	<b>Bank completed flag</b> This bit turns OFF when positioning, ORIGIN SEARCH, or ORIGIN RETURN are started. It turns ON when positioning is completed for a bank.
	02	<b>At-origin flag</b> This bit turns ON when positioning stops at the origin. It does not turn ON when the origin is passed during operation.
	03	<b>Alarm flag</b> This bit turns ON when an alarm code (1*** or 2***) has been generated.
	04	<b>Emergency stop flag</b> This bit turns ON when an emergency stop signal is externally input, regardless of whether the Position Control Unit is operating or not. Pulse output is prohibited during this time. This bit turns OFF when the emergency stop signal is turned off and RELEASE PROHIBIT (bit 04 of word n) is turned ON.
	05	<b>Error flag</b> This bit turns ON when error code (5*** or 9***) has been generated.
	000 007 008	<b>Zone 0 flag</b> <b>Zone 1 flag</b> <b>Zone 2 flag</b> These bits turn ON when the present position is within the zone ranges set in DM words m+9 and m+20.
	009	<b>Teaching completed flag</b> This bit turns OFF when TEACH is executed and ON when teaching is completed.
	010	<b>Transfer completed flag</b> This bit turns OFF when TRANSFER DATA is executed and ON when data transfer is completed.
	011	<b>No-origin flag</b> This bit turns ON during initial processing and OFF when the origin has been determined. The following conditions cause this bit to turn ON: <ul style="list-style-type: none"> <li>• When positioning is stopped by an emergency stop or by a CW/CCW limit signal.</li> <li>• When an extended completion code is executed.</li> <li>• When positioning is stopped due to changing the PC's mode during pulse output. (i.e., changing RUN to PROGRAM).</li> <li>• When positioning is stopped during operation due to a hardware error.</li> <li>• When ORIGIN SEARCH is executed.</li> </ul> The following conditions cause this bit to turn OFF: <ul style="list-style-type: none"> <li>• When the origin signal is input during ORIGIN SEARCH.</li> <li>• When RESET ORIGIN is completed.</li> <li>• When the present position has been reset.</li> </ul>
	012	<b>Busy flag</b> This bit remains ON during initial data transfer or during calculation. It turns ON whenever processing is started and OFF when it is completed. It also turns OFF after information has been set for completion flags (such as for positioning, teaching, and transfer), or after an error is generated and the error code and error flag are set. If the positioning time is too short, it may not be possible to read the ON status of this flag during the ladder scan.

Word	Bit	Function				
n+5	13 1	<b>CW limit flag</b> <b>CCW limit flag</b> These bits turn ON while the respective external signals are being input.				
	15	<b>STOP flag</b> This bit goes ON when positioning, ORIGIN SEARCH, ORIGIN RETURN, or JOG stop in response to either an external interrupt signal or the STOP command bit (word n, bit 15). It goes OFF when any of the above operations is started.				
n+6	15 to 00	<b>Error code</b> Only the most recent error code is output. Further codes can be accessed in order by executing READ ERROR (word n, bit 05). Read-out does not erase error codes.				
n+7	07 to 00	<b>Positioning action number</b> These bits output a positioning action number during positioning. Upon completion of positioning, they output the next positioning action number to be executed. The positioning action number is automatically incremented except in cases where STOP has been executed during positioning. In such cases, the number which was being executed at the time is taken as the next number to be executed. After the bank has been completed, or after positioning action #19 has been executed, the initial position set in DM word m is output.				
	11 to 08	<p><b>Output code</b> These bits output the output code for the completed positioning action. Use this data (0 to F) as a bit in a program as follows:</p> 				
	12 13 14 15	<p><b>Emergency stop signal</b> <b>External interrupt signal</b> <b>Origin signal</b> <b>Origin proximity signal</b></p> <p>Each of these bits turns ON when its respective signal is input.. These bits are used for system debugging. Confirm wiring by reading these bits on the Programming Console while pressing switches by hand or using JOG to pass over switches. The bits turn ON at the trailing edge when the signal is input through an N.C. contact, and at the leading edge when input through an N.O. contact. Do not use use during programming.</p>				
n+8 n+9	15 to 00 15 to 00	<p><b>Present position</b> The present position is always output as an absolute value (i.e., not as an increment) through these channels. After powering up, output is as follows:</p> <table border="1" data-bbox="590 1522 758 1617"> <tr> <td>n+9</td> <td>n+8</td> </tr> <tr> <td>0999</td> <td>99xx</td> </tr> </table>	n+9	n+8	0999	99xx
n+9	n+8					
0999	99xx					



# Appendix E

## Specifications

### General

Conform to C-Series specifications.

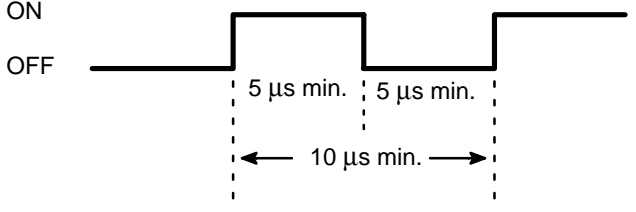
### Performance

Item	Specifications
Number of axes	1 per Unit
Control system	Automatic trapezoidal acceleration/deceleration system
Positions	-8,388,607 pulses to +8,388,606 pulses
Number of positions	20
Speeds	1 to 99,990 pps
Number of speeds	15
Acceleration/deceleration	1 to 999 pps/ms
Origin search	Origin proximity: Either absent, N.O. input, or N.C. input (selectable) Origin signal: Either N.O. input or N.C. input (selectable) Origin compensation: 0 to 9,999 pulses. Origin search speeds: High speed and proximity speed available
Backlash compensation	0 to 9,999 pulses
Manual operation	High-speed jog, low-speed jog, and inching
Internal current	200 mA max. at 5 VDC (consumption from Rack)
Dimensions (mm)	130 (h) x 35 (w) x 100.5 (d)
Weight	400 g max. (excluding connectors)

### Electrical Input

Item	Specifications
Voltage	10.8 to 26.4 VDC $\pm$ 10%
Current	5 mA (at 12 V) to 11 mA (at 24 V)
ON voltage	10.2 VDC min.
OFF voltage	3.0 VDC max.
ON response time	1 ms max.
OFF response time	1 ms max.

Electrical Output

Item	Specifications
Max. switching capacity	30 mA at 4.5 to 26.4 VDC $\pm 10\%$ , NPN open collector
Min. switching capacity	2.5 mA at 4.5 to 26.4 VDC, NPN open collector
Leakage current	0.1 mA max.
Residual voltage	0.4 V max.
Power for external supply	5 VDC $\pm 5\%$ , 24 VDC $^{+10\%}_{-25\%}$ (30 mA max.)
Duty factor	50% $\pm 15\%$
Min. pulse width (at 100-kpps output)	 <p>ON</p> <p>OFF</p> <p>5 <math>\mu</math>s min.</p> <p>5 <math>\mu</math>s min.</p> <p>10 <math>\mu</math>s min.</p>

## Appendix F Standard Models

Name	Remarks		Model
CPU	Output current: 3 A (1.6 A to I/O Units)	100 to 120/200 to 240 VAC	C200H-CPU01-E
		24 VDC	C200H-CPU03-E
	SYSMAC NET Link Unit/SYSMAC Link Unit is mountable	100 to 120/200 to 240 VAC	C200H-CPU11-E
Programming Console	Vertical type, w/backlight		C200H-PR027-E
Programming Console and Data Access Console Connecting Cable	For vertical type: 2 m		C200H-CN222
	4 m		C200H-CN422
Position Control	Pulse string output		C200H-NC111

# Glossary

## **absolute target position**

A target position given in respect to the origin rather than in respect to the present position.

## **alarm code**

A four-digit code which is output to a word in the IR area to identify the type of alarm which has occurred.

## **AR area**

A PC data area which is used for system flags and status information. Data is retained in this area during a power failure.

## **backlash compensation**

Compensation for the amount of mechanical play, or 'looseness' present in gears. Such play can create positioning inaccuracy when the direction of positioning changes.

## **bank**

A combination of several positioning actions or sequences. A bank begins when START is executed for the initial positioning action and ends when a position action with a "bank end" completion code has been executed.

## **bank end (completion)**

A positioning action completion code that designates the positioning action as the final one in a bank.

## **BCD**

An acronym for binary-coded decimal. This is used to refer to decimal numbers encoded in binary.

## **completion code**

A parameter for positioning actions that designates what is to happen when a particular positioning action has been completed. The four possible completion codes are as follows: single, pause, continuous, bank end, and extended.

## **continuous (completion)**

A positioning action completion code that causes the next positioning action to be executed immediately upon completion of the current one.

## **CW and CCW**

Abbreviations for clockwise (CW) and counterclockwise (CCW). CW and CCW are defined for a motor shaft in reference to a viewer facing the shaft on the end of the motor from which the shaft extends from the motor for connection.

## **CW/CCW limits**

Limits on the CW and CCW sides of the origin which can be internally set to restrict Position Control Unit operation.

## **data area**

A memory storage area in the PC. Different types of memory blocks, with differing functions, are stored in the various data areas of the PC. These blocks of memory are built up from single units, or bits, which are grouped into 16-bit words.

<b>DM area</b>	A PC data area in which general operating parameters, speeds, and parameters for positioning actions are stored.
<b>dwel time</b>	A parameter that specifies the period of time during which positioning will stop before execution of the next positioning action following a positioning action with a pause completion code.
<b>error code</b>	A four-digit code which is output to a word in the IR area to identify the type of error which has occurred.
<b>error counter</b>	A device used to ensure positioning accuracy when positioning via pulse trains. The error counter receives a target position as a specific number of pulses in a pulse train from the Position Control Unit and outputs analog speed voltages to drive a servomotor accordingly. The specified number of pulses in the error counter is counted down by feedback from an encoder measuring actual motor shaft movement, causing voltage output to stop when the number of pulses equals zero, i.e., when the target position has been reached.
<b>external interrupt</b>	A function whereby positioning may be stopped or speed may be changed, during operation, in response to an external command.
<b>flag</b>	A bit that is turned ON and OFF automatically by the system to provide status information.
<b>host computer</b>	A computer that is used to transfer data to or receive data from a PC in a Host Link System. The host computer is used for data management and overall system control. Host computers are generally small personal or business computers.
<b>IN refresh area</b>	The last five of the ten IR words allocated to each Position Control Unit as refresh areas.
<b>inching</b>	Manual feeding wherein positioning is executed one pulse at a time.
<b>incremental target position</b>	A target position given in respect to the present position, rather than in respect to the origin.
<b>initial position</b>	The present position when START is executed.
<b>IR area</b>	A PC data area allocated for inputs, outputs, and work bits. In the C200H, words 100 through 199 of this area are reserved for Special I/O Units, including the Position Control Unit. The Position Control Unit uses these words for I/O refresh areas.
<b>N.C. contacts</b>	Normally-closed contacts. A pair of contacts on a relay that open when the relay is energized.

**N.O. contacts**

Normally-open contacts. A pair of contacts on a relay that close when the relay is energized.

**open-loop system**

A control system in which operations are carried out according to programmed instructions, but in which feedback is not provided for automatic adjustments.

**origin compensation**

A parameter used to correct the origin from the position determined according to the origin input signal.

**origin proximity signal**

A signal input to indicate when the position is near the origin to enable shifting to a lower speed.

**origin proximity**

The region near the origin. When positioning enters this region, a proximity switch may output a signal for deceleration.

**origin**

The point which is designated as 0 at any given time.

**OUT refresh area**

The first five of the ten IR words allocated to each Position Control Unit as refresh areas.

**output code**

User-defined codes output following completion of a positioning action.

**parameters**

Data which determines limits and other conditions under which an operation will be carried out. The Position Control Unit has both general parameters and parameters specific to individual positioning actions.

**pause (completion)**

A positioning action completion code that creates a pause after reaching the target position for the positioning action and then automatically begins the next positioning action. The length of the pause is specified by the dwell time.

**positioning action**

The smallest increment of positioning possible. A positioning action is defined by its completion code, dwell time, output code, speed number, and target position. These actions are generally referred to by number and completion code. For example, "#6, continuous" indicates positioning action #6 with a continuous completion code.

**present position**

The numeric value in pulses defined as being the 'location' of the positioning system at any one point in time. The present position is not absolute, but rather can be defined or redefined as required by positioning operations.

**proximity speed**

A low speed at which positioning is executed near the origin.

**pulse rate**

The distance moved by an object driven by a motor divided by the number of pulses required for that movement.

**pulse train**

A series of pulses output together.

**pulses**

Discrete signals sent at a certain rate. The Position Control Unit outputs pulses, each of which designates a certain amount of movement. Such pulses are converted to an equivalent control voltage in actual positioning.

**Remote I/O Master Unit**

The Unit in a Remote I/O System through which signals are sent to all other Remote I/O Units. The Remote I/O Master Unit is mounted either to a CPU Rack or to an Expansion I/O Rack connected to the CPU Rack.

**Remote I/O System**

A system in which remote I/O points are controlled through a Master mounted to a CPU Rack or an Expansion I/O Rack connected to the CPU Rack.

**Remote I/O Units**

Any of the Units in a Remote I/O System. Remote I/O Units include Masters, Slaves, Optical I/O Units, I/O Link Units, and Remote Terminals.

**response time**

The time it takes for the PC to output a control signal after it has received an input signal. The response time depends on factors such as the system configuration and when the CPU receives the input signal relative to the start of a scan.

**scan time**

The total time required for the PC to perform all of the operations involved in executing the program in its memory. The duration of the scan time differs depending on the configuration of the system, the number of I/O points, the programming instructions used, and so on.

**search pattern**

The pattern in which origin search is carried out. The particular search pattern performed depends on the position of the origin with respect to the initial position and the search direction (CW or CCW).

**semiclosed-loop system**

A control system in which a PC controls an external process without human intervention. This system provides feedback (via a tachogenerator and a rotary encoder) so that actual values (of positions, speeds, and so on) are continuously adjusted to bring them more closely in line with target values.

**servolock**

An operation whereby a rotary encoder is used to maintain the position of a motor while it is stopped. Whenever the motor axis moves, the rotary encoder sends a feedback pulse to an error counter, causing a rotation voltage to be generated in the reverse direction so that the motor rotates back to its original position.

**single (completion)**

A positioning action completion code that causes positioning to stop after the target position has been reached.

**Special I/O Unit**

A dedicated Unit, such as a Position Control Unit, High-Speed Counter Unit, or Analog Timer Unit, which is designed for a special purpose.

**speed coefficient**

An IR area setting which determines the coefficient with regard to the target speed.

**speed number**

A number used to designate (as a parameter for an operation) one of fifteen speeds registered in memory.

**speed unit**

A word in the DM area which can be set to multiply the speed to which it is assigned by a factor of one or ten.

**target position**

A parameter for a positioning action that designates what position is to be reached at the completion of the action.

**teaching**

Writing the present position into the DM area of the PC as the target position for the designated positioning action.

**trapezoidal  
acceleration/deceleration**

Accelerating and decelerating in a stepwise pattern such that a trapezoidal figure is formed.

**unit numbers**

Numbers assigned to Position Control Units for the purpose of allocating specific I/O words to each Unit.

**work bits**

IR area bits that can be used for data calculation or other manipulation in programming. In the IR area, all bits not used as input or output bits can be used as work bits.

**zone**

A range of positions which can be defined so that flags are turned ON whenever the present position is within the range. Up to three zones, each with its own flag, can be defined.



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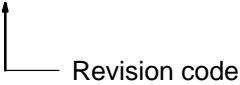
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## Revision History

A manual revision code appears as a suffix to the catalog number on the front cover of the manual.

Cat. No. W137–E1–04  
 Revision code

The following table outlines the changes made to the manual during each revision. Unless noted, page numbers refer to the previous version.

Revision code	Date	Revised content
1	1990	Original production
2	1990	Minor corrections
3	April 1991	<p>The format was updated to present standards.</p> <p>Pages for the following corrections refer to version 3.</p> <p><b>Page 12:</b> “ch n” corrected to “word n” and arrows added.</p> <p><b>Page 18:</b> Amperages corrected in diagrams.</p> <p><b>Page 21:</b> Manufacturer of stepping motor provided.</p> <p><b>Page 22/108:</b> “Marketed in Japan” added for Servomotor Driver.</p> <p><b>Page 28:</b> Diagram and Programming Console display corrected.</p> <p><b>Page 69:</b> Programming Console displays corrected.</p> <p><b>Pages 72/75/78:</b> Diagrams clarified.</p> <p><b>Pages 92/101:</b> C200H-PR027 corrected to C200H-PRO27-E</p> <p><b>Page 104:</b> Content of rightmost digit in word 00 corrected to “2.”</p> <p><b>Page 139:</b> Power supply voltages provided for CPUs.</p> <p>Corrections were also made to graphics on the following version 3 pages:                      54, 55, 60, 61, 62, 63, 64, 66, 69, 71, 80, 81, 83, 85, 86, 87, 88, 89</p>
04	May 2004	<p><b>Page v:</b> Entire page except for copyright notice redone.</p> <p><b>Page ix:</b> Warning added to bottom of page.</p> <p><b>Page 1:</b> PLP section added.</p> <p><b>Page 14:</b> Last part of caution deleted and caution reformatted.</p> <p><b>Page 15:</b> Graphic added at upper right of page.</p> <p><b>Page 18:</b> Caution added.</p> <p><b>Page 20:</b> Note added in middle of page.</p> <p><b>Page 98:</b> Bottom portion of ladder diagram changed.</p> <p><b>Page 104:</b> Second digit in word 00 corrected.</p> <p><b>Page 116:</b> Last sentence in third paragraph deleted.</p> <p><b>Page 119:</b> Description of 1502–1515 rewritten.</p> <p><b>Page 121:</b> Descriptions of 2001–2019 and 2101–2119 rewritten.</p> <p><b>Page 135:</b> Sentence added at end of description of bit 12.</p>

**OMRON Corporation**

FA Systems Division H.Q.

66 Matsumoto

Mishima-city, Shizuoka 411-8511

Japan

Tel: (81)55-977-9181/Fax: (81)55-977-9045

**Regional Headquarters**

**OMRON EUROPE B.V.**

Wegalaan 67-69, NL-2132 JD Hoofddorp

The Netherlands

Tel: (31)2356-81-300/Fax: (31)2356-81-388

**OMRON ELECTRONICS LLC**

1 East Commerce Drive, Schaumburg, IL 60173

U.S.A.

Tel: (1)847-843-7900/Fax: (1)847-843-8568

**OMRON ASIA PACIFIC PTE. LTD.**

83 Clemenceau Avenue,

#11-01, UE Square,

Singapore 239920

Tel: (65)6835-3011/Fax: (65)6835-2711

# OMRON

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