

SYSMAC
C200H-NC112
Position Control Unit

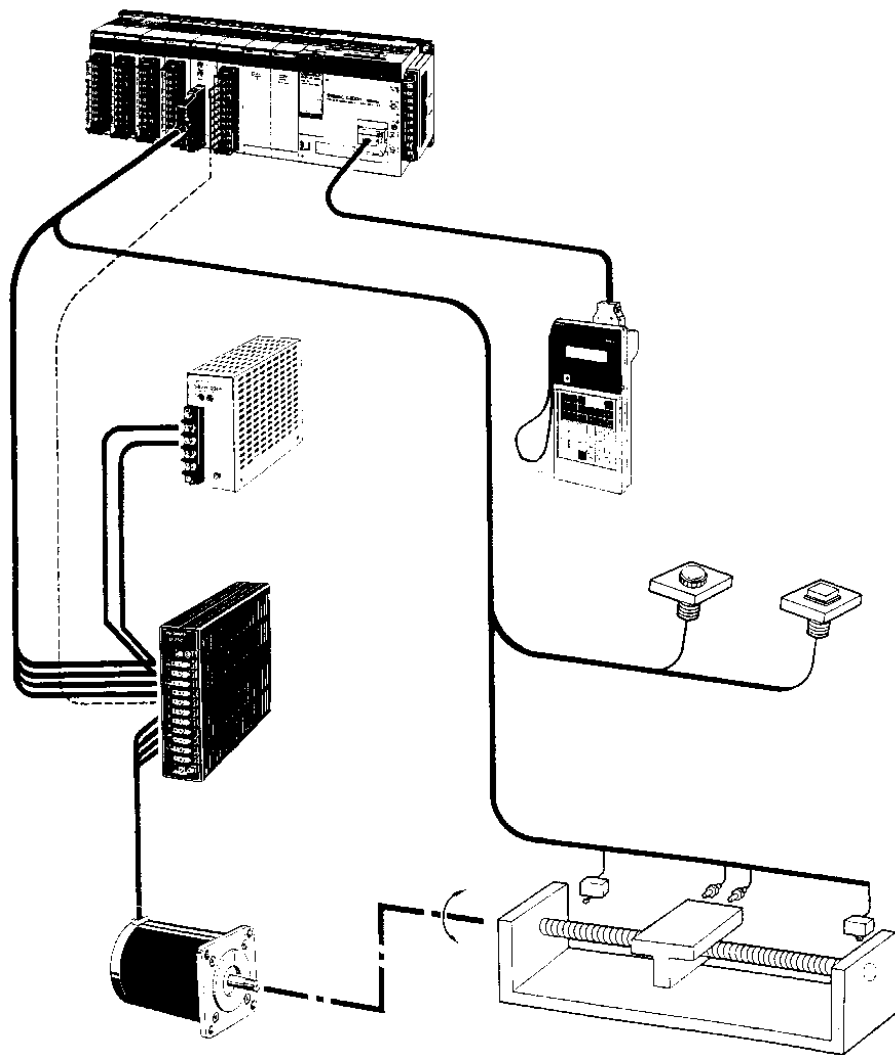
OPERATION MANUAL

OMRON

C200H-NC112 Position Control Unit

Operation Manual




September 2000



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.
- Reference** Indicates supplementary information on related topics that may be of interest to the user.
- 1, 2, 3...** 1. Indicates lists of one sort or another, such as procedures, checklists, etc.

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No patent liability is assumed with respect to the use of the information contained herein. Moreover, because OMRON is constantly striving to improve its high-quality products, the information contained in this manual is subject to change without notice. Every precaution has been taken in the preparation of this manual. Nevertheless, OMRON assumes no responsibility for errors or omissions. Neither is any liability assumed for damages resulting from the use of the information contained in this publication.

About this Manual:

The OMRON C200H-NC112 Position Control Unit is a Special I/O Unit for C200H PCs. It is designed to control positioning actions through pulse train outputs to a motor driver, based on PC programming and external control inputs.

This manual covers the specifications and procedures necessary for operation and installation. Before attempting to operate the C200H Position Control Unit, be sure to thoroughly familiarize yourself with the information contained herein.

During operation, refer to the C200H PC Operation Manual as necessary for programming and system details. Note that the term “channel” employed in the C200H PC Operation Manual (and other earlier manuals) has been replaced by the term “word” in this manual, where it refers to a 16-bit address. Wherever the term “channel” (either written in full or abbreviated as “ch”) continues to appear, whether in earlier manuals, on displays, or on the Units themselves, it can be taken to have the same meaning as “word.”

Section 1 describes the basic features, components, and operation of the Position Control Unit, as well as the basic configuration and principles of positioning control systems. Reading this section first will give you a familiarity with the essential terminology used in this manual and an understanding of the fundamentals necessary for successful operation.

Section 2 covers procedures such as wiring and switch setting which are necessary before operation.

Section 3 explains data format and configuration, basic operating procedure, and various aspects of Position Control Unit operation other than commands.

Section 4 covers commands and the data settings which are necessary for their execution.

Section 5 provides examples of possible applications of PCU commands, inputs, and outputs.

Section 6 outlines the procedures for handling errors and alarms that occur during Position Control Unit operation.

The appendices contain lists of error and alarm codes, DM and IR area data allocation charts, specifications, and a table of standard models. There are also an index and a glossary of terms at the back of the manual.



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.

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PRECAUTIONS

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

The information contained in this section is important for the safe and reliable application of the Programmable Controller. 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 relevant 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 the Unit. Be sure to read this manual before attempting to use the Unit and keep this manual close at hand for reference during operation.


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

3 Safety Precautions


 **WARNING** Do not attempt to take any Unit apart while the power is being supplied. Doing so may result in electric shock.

 **WARNING** Do not touch any of the terminals or terminal blocks while the power is being supplied. Doing so may result in electric shock.

 **WARNING** Do not attempt to disassemble, repair, or modify any Units. Any attempt to do so may result in malfunction, fire, or electric shock.


 **Caution** Confirm safety at the destination node before transferring a program to another node or changing contents of the I/O memory area. Doing either of these without confirming safety may result in injury.

4 Operating Environment Precautions


 **Caution** Do not operate the control system in the following locations:

- 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 exposure to water, oil, or chemicals.
- Locations subject to shock or vibration.


 **Caution** 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 electromagnetic fields.
- Locations subject to possible exposure to radioactivity.
- Locations close to power supplies.


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

5 Application Precautions

Observe the following precautions when using the PC system.

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

- Always ground the system to 100 Ω or less when installing the Units. Not connecting to a ground of 100 Ω or less may result in electric shock.
- Always turn OFF the power supply to the PC before attempting any of the following. Not turning OFF the power supply may result in malfunction or electric shock.
 - Mounting or dismounting Power Supply Units, I/O Units, CPU Units, Memory Units, or any other Units.
 - Assembling the Units.
 - Setting DIP switches or rotary switches.
 - Connecting cables or wiring the system.
 - 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 in external circuits (i.e., not in the Programmable Controller) must be provided by the customer.
- Always use the power supply voltages specified in this manual. An incorrect voltage may result in malfunction or burning.
- 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. An incorrect power supply may result in malfunction.
- Install external breakers and take other safety measures against short-circuiting in external wiring. Insufficient safety measures against short-circuiting may result in burning.

- Do not apply voltages to the Input Units in excess of the rated input voltage. Excess voltages may result in burning.
- Do not apply voltages or connect loads to the Output Units in excess of the maximum switching capacity. Excess voltage or loads may result in burning.
- Disconnect the functional ground terminal when performing withstand voltage tests. Not disconnecting the functional ground terminal may result in burning.
- Be sure that all the mounting screws, terminal screws, and cable connector screws are tightened to the torque specified in this manual. Incorrect tightening torque may result in malfunction.
- Leave the label attached to the Unit when wiring. Removing the label may result in malfunction if foreign matter enters the Unit.
- Remove the label after the completion of wiring to ensure proper heat dissipation. Leaving the label attached may result in malfunction.
- Double-check all wiring and switch settings before turning ON the power supply. Incorrect wiring may result in burning.
- Wire correctly. Incorrect wiring may result in burning.
- Mount Units only after checking terminal blocks and connectors completely.
- Be sure that the terminal blocks, Memory Units, expansion cables, and other items with locking devices are properly locked into place. Improper locking may result in malfunction.
- Check the user program for proper execution before actually running it on the Unit. Not checking the program may result in an unexpected operation.
- Confirm that no adverse effect will occur in the system before attempting any of the following. Not doing so may result in an unexpected operation.
 - Changing the operating mode of the PC.
 - Force-setting/force-resetting any bit in memory.
 - Changing the present value of any word or any set value in memory.
- Resume operation only after transferring to the new CPU Unit the contents of the DM Area, HR Area, and other data required for resuming operation. Not doing so may result in an unexpected operation.
- Do not pull on the cables or bend the cables beyond their natural limit. Doing either of these may break the cables.
- Do not place objects on top of the cables or other wiring lines. Doing so may break the cables.
- Use crimp terminals for wiring. Do not connect bare stranded wires directly to terminals. Connection of bare stranded wires may result in burning.
- When replacing parts, be sure to confirm that the rating of a new part is correct. Not doing so may result in malfunction or burning.
- Before touching a Unit, be sure to first touch a grounded metallic object in order to discharge any static built-up. Not doing so may result in malfunction or damage.

SECTION 1

Introduction

The C200H-NC112 Position Control Unit is a Special I/O Unit that outputs pulse trains to control a stepping motor driver or a servomotor driver in accordance with a PC program or external inputs.

This section describes the basic features, components, and operation of the Position Control Unit, as well as the basic configuration and principles of positioning control systems. Reading this section first will give you a familiarity with the essential terminology used in this manual and an understanding of the fundamentals necessary for successful operation.

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1–1 Features

Applicable Motor Drivers	<p>The pulse train output can be easily connected to either of the following devices:</p> <ol style="list-style-type: none">1. Stepping motor driver2. Servomotor driver designed for pulse train input
Number of Control Axes and Controlling Capacity	<p>The Position Control Unit is designed to control a single axis and is capable of controlling speeds and positions in accordance with data recorded in the DM area of the C200H PC.</p>
Manual Operation	<p>Three commands enable manual positioning control: HIGH-SPEED JOG, LOW-SPEED JOG, and INCH.</p>
Data Transfer	<p>PCU positioning actions, speeds, and other data can be stored in the DM area or other areas of the PC and quickly transferred to the PCU via a TRANSFER DATA command. This effectively increases the amount of memory available to the PCU.</p>
Establishing Position	<p>The TRANSFER DATA command can also be used to change the present position to any desired value, including 0 (origin), any time the Position Control Unit is not outputting pulses.</p>
Teaching	<p>The present position can be written into the memory of the PC as positioning data whenever pulses are not being output.</p>
Operation in Four Modes	<p>The C200H-NC112 Position Control Unit can be operated in any of four modes, which are selected via the mode switch on the Unit. Mode 0 is equivalent to the C200H-NC111 Position Control Unit; the other three are for use with servomotor drivers. Mode 3 is designed especially for use with the OMRON R88D-EP/SR (marketed in Japan) servomotor driver.</p>
Choice of Origin Detection Method	<p>The method employed to detect the origin may be selected via the rear-panel DIP switch.</p>
Expanded Speed Range	<p>The speed range has been expanded to enable settings anywhere from 1 to 250,000 pps (compared with 1 to 99,990 for the NC111). In addition, acceleration and deceleration speeds between 2 and 2,000 pps/ms are now possible (compared with 1 to 999 pps/ms for the NC111).</p>
Greater Switching Capacity	<p>The minimum switching capacity has been increased from 2.5 mA (in the NC111) to 7 mA at 5 VDC.</p>
Optional Speed Numbers	<p>In the NC111, the speed number currently being executed is always incremented by one to obtain the subsequent target speed, but in the NC112, the next speed number can be set in the DM area of the C200H PC. If desired, speed numbers may be allowed to increment one by one as in the NC111.</p>
Smoother Acceleration and Deceleration	<p>Acceleration and deceleration have been made smoother by reducing each incremental step from the NC111's 10 ms to 4 ms.</p>
More Completion Codes	<p>In addition to the five completion codes possible with the NC111, the NC112 allows for a sixth, i.e., "extended with positioning".</p>

1-2 Components

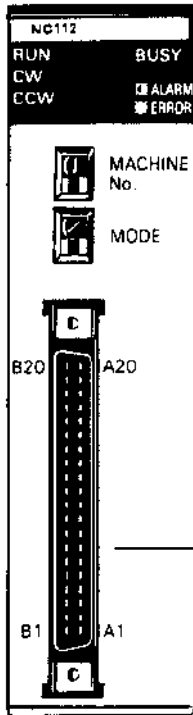
In addition to the front-panel components described below, there is a DIP switch located on the back panel. Pin settings for this switch, which are described in *Section 2-1*, determine certain aspects of Unit operation.

When setting the switches, use a screwdriver if necessary.

Do not apply 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

RUN: indicates operation is in progress	BUSY: indicates operation/transfer is in progress
CW: indicates motor is revolving clockwise	ALARM: flashes when an abnormality has occurred
CCW: indicates 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	Selects an operating mode (0 to 3).

Connector

Used to connect the Position Control Unit to a stepping motor driver or servomotor driver.

Attach the enclosed connector to the proper cable.

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 Unit operation.

Indicator	Color	Function
RUN	Green	Lit during normal operation. Goes out on 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 caused operation to stop.

1-3 Basic Operating Principles

The basic operation of the C200H-NC112 Position Control Unit is fairly simple. It controls either a stepping motor or a servomotor in accordance with

data stored in the DM area of the PC. This data includes directions, speeds, positions, and other information necessary for effective control. Before the Position Control Unit can be operated, you must first input the essential data. This is generally done via the Programming Console, although you can also input data with the TEACH command.

The way in which the Position Control Unit makes use of this data is determined by the program in the PC. The program does not control all of the Position Control Unit's operations directly, but rather, executes the Unit's commands by turning command bits ON and OFF. The commands control such functions as the starting and stopping of positioning, returning to the origin, and so on. (The origin is simply the point which is designated as 0 at any given time.) Thus, while the Position Control Unit functions as an integral part of your overall control system, it also exercises a good deal of autonomy. This capability is essential to the concept of distributed control, whereby control of each portion of an automated system is located near the devices actually being controlled.

The fundamental unit of positioning is the positioning action. A particular positioning action moves the workpiece along the positioning axis in a direction, at a speed, and to a position determined by the data which has previously been set. The positioning action begins when the appropriate command bit (START) is turned ON by the program.

A single positioning action may be executed by itself, or a bank of several positioning actions may be executed in sequence. A particular bank of actions may be repeated again and again. Before beginning execution of positioning actions, it is necessary to define the origin as a reference point by, for example, executing ORIGIN SEARCH.

1-4 I/O Configuration

The basic I/O configuration is shown on the following page. Position Control Unit outputs are connected to a motor driver, either for a stepping motor or for a servomotor (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 you choose to employ an open-loop or semiclosed-loop system. (See *Section 1-5*). The stepping motor or servomotor controls some type of positioning device (such as a feed screw). An independent power supply must be used for the motor driver. Some configurations also require an Input Unit on a C200H Rack 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 Slave Rack. No more than four of these can be mounted onto any one Slave Rack. Refer to the *Remote I/O System Operation Manuals* for further restrictions.

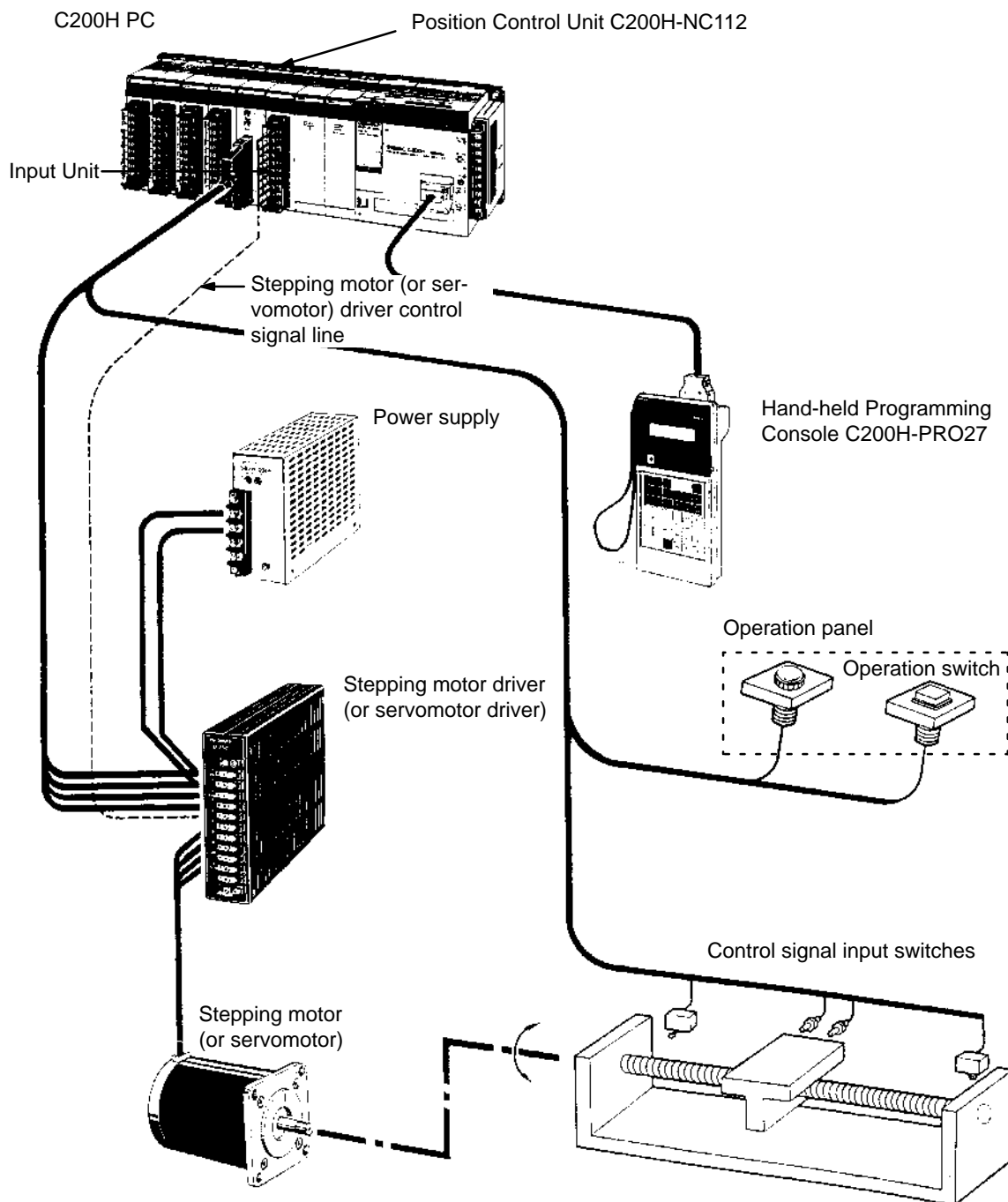
Mounting Location

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

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). (Lists of Position Control Unit inputs and outputs can be found under *I/O Circuits* in *Section 2-2*.) 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.



1-5 Positioning System Principles

Positioning 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 feedback is not provided for

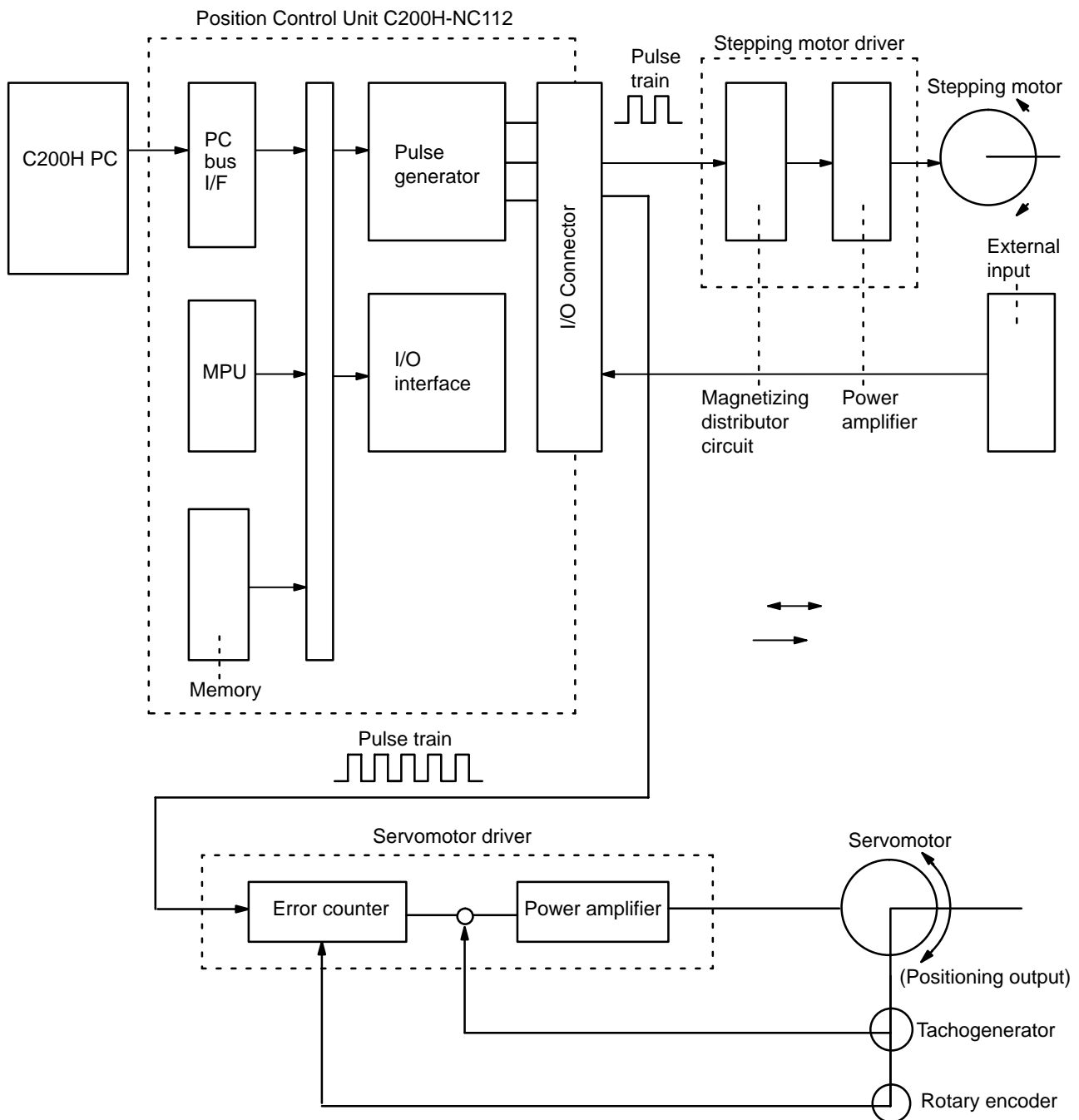
automatic adjustments. The C200H-NC112 Position Control Unit can be used in an open-loop system in conjunction with a stepping motor.

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-NC112 Position Control Unit is used with a servomotor, the servomotor driver must be able to handle digital signals. There is therefore no need for a D/A converter. Here, the servomotor is also connected to a tachogenerator and a rotary encoder.

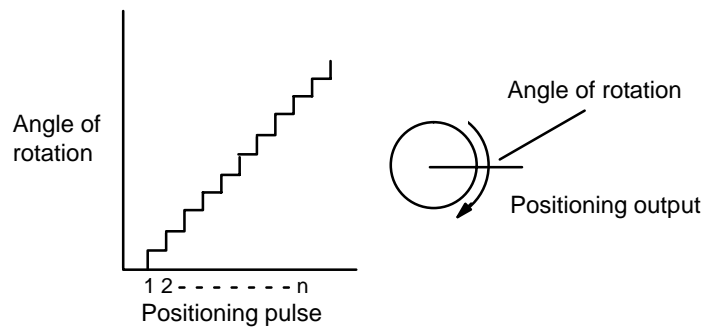
Both open-loop and semiclosed-loop systems are described in more detail on the following pages.

Data Flow



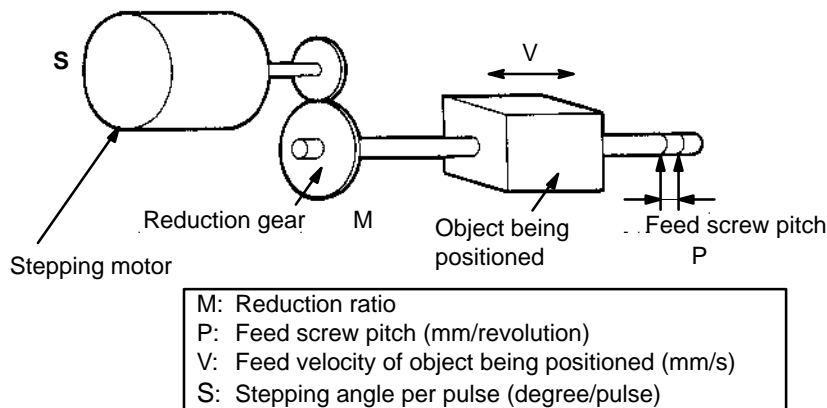
1-5-1 Open-loop System

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:

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

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

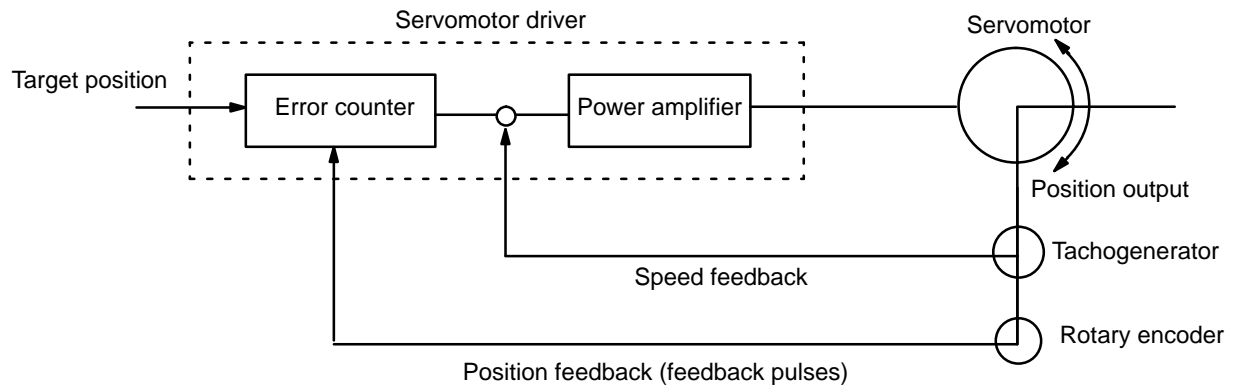
$$\begin{aligned}\text{Pulse frequency} &= V / \text{Positioning precision} \\ &= (360 \times M \times V) / (P \times S)\end{aligned}$$

The required number of pulses to feed an object by a distance L (in mm) is computed as follows:

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

1-5-2 Semiclosed-loop System

When the Position Control Unit is used in a semiclosed-loop system, the system supplies feedback which is used to compensate for any discrepancy between target values and actual values in position or speed. This system detects motor rotation 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, 2, 3...**
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 decrements the error counter.
 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 moves slightly, the error counter receives a feedback pulse from the rotary encoder, causing a rotation voltage to be emitted in the reverse direction from which the rotary encoder moved. This makes the motor 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 unmounted and mounted. Be sure that all settings and wiring match your positioning system specifications.

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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.

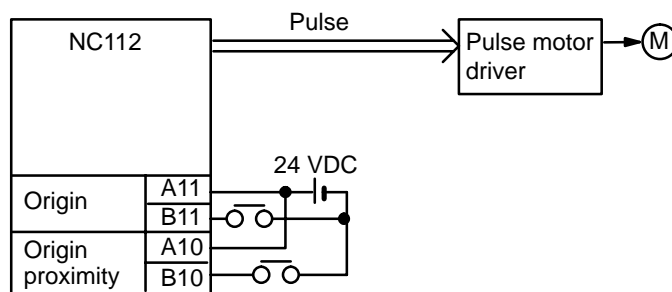
Switch	Function
Unit number (Machine no.)	Used to set the unit number (between 0 and 9). Do not set the same number for more than one Special I/O Unit. Doing so will cause an error and prevent operation.
Mode	Used to set the mode from 0 to 3.

Mode Switch

This switch sets one of operation modes 0 to 3. Select an appropriate operation mode in accordance with the motor driver or signal lines to be used.

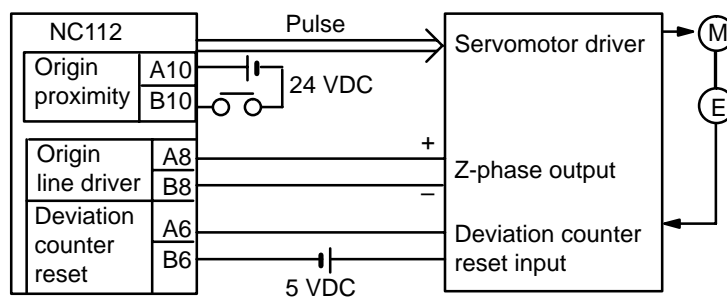
Mode 0

Set the Position Control Unit in this mode when it controls a stepping motor driver. In this mode, connect a sensor to the origin signal lines (connector pin nos. A11 and B11). The response time of the origin signal is 1 ms.



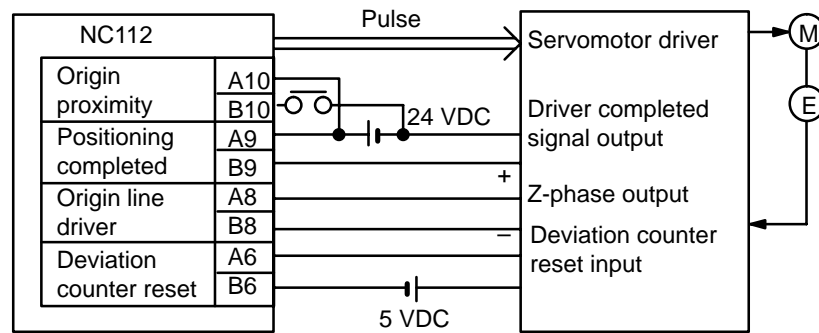
Mode 1

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

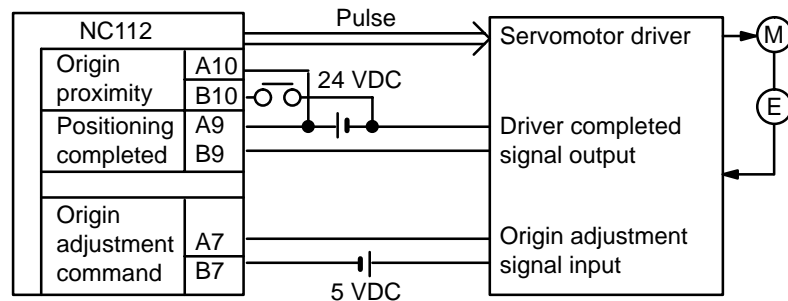


Mode 2

Use this mode when controlling a servomotor driver, and when the driver completed signal is necessary.

**Mode 3**

This mode is used when a servomotor driver having an origin adjustment signal (such as OMRON Model R88D) is used.



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

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

Back Panel DIP Switch

These pins must be set before the Unit is mounted.

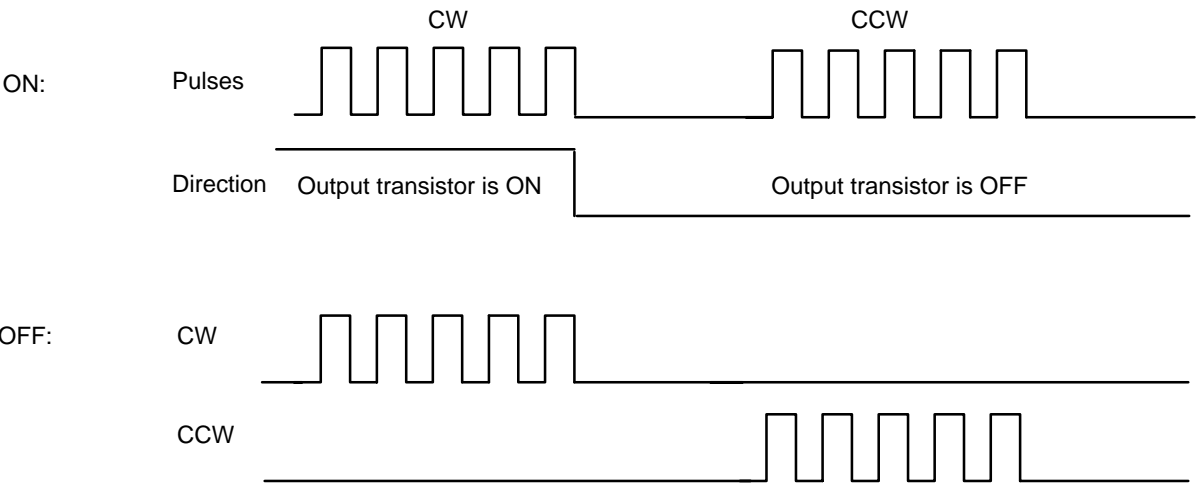
Pin no.	Name	ON	OFF
1	Output pulse selector	Nondirectional pulse and direction signal outputs.	Separate CW and CCW pulse outputs
2	Origin search direction	CCW	CW
3	Origin proximity present/absent	Present	Absent
4	Origin proximity signal type	NO input	NC input
5	Origin signal type	NO input	NC input
6	External interrupt signal type	Fixed via pin #7	Determined by IR word n, bit 06
7	External interrupt signal definition	CHANGE SPEED	STOP
8	Origin proximity reverse	Present	Absent

Note Setting origin proximity to absent is possible in mode 0, but in modes 1, 2, or 3, even if origin proximity is set to absent, operation is performed with origin proximity present.

Pin 1: Output Pulse Selector

When this pin is set to the ON position, the Position Control Unit outputs non-directional pulses and a direction signal; when it is set to the OFF position,

separate CW and CCW pulses are output. When nondirectional pulses are output, the direction signal determines the direction of positioning. Set this pin in accordance with the specifications of the motor and motor driver to be used.

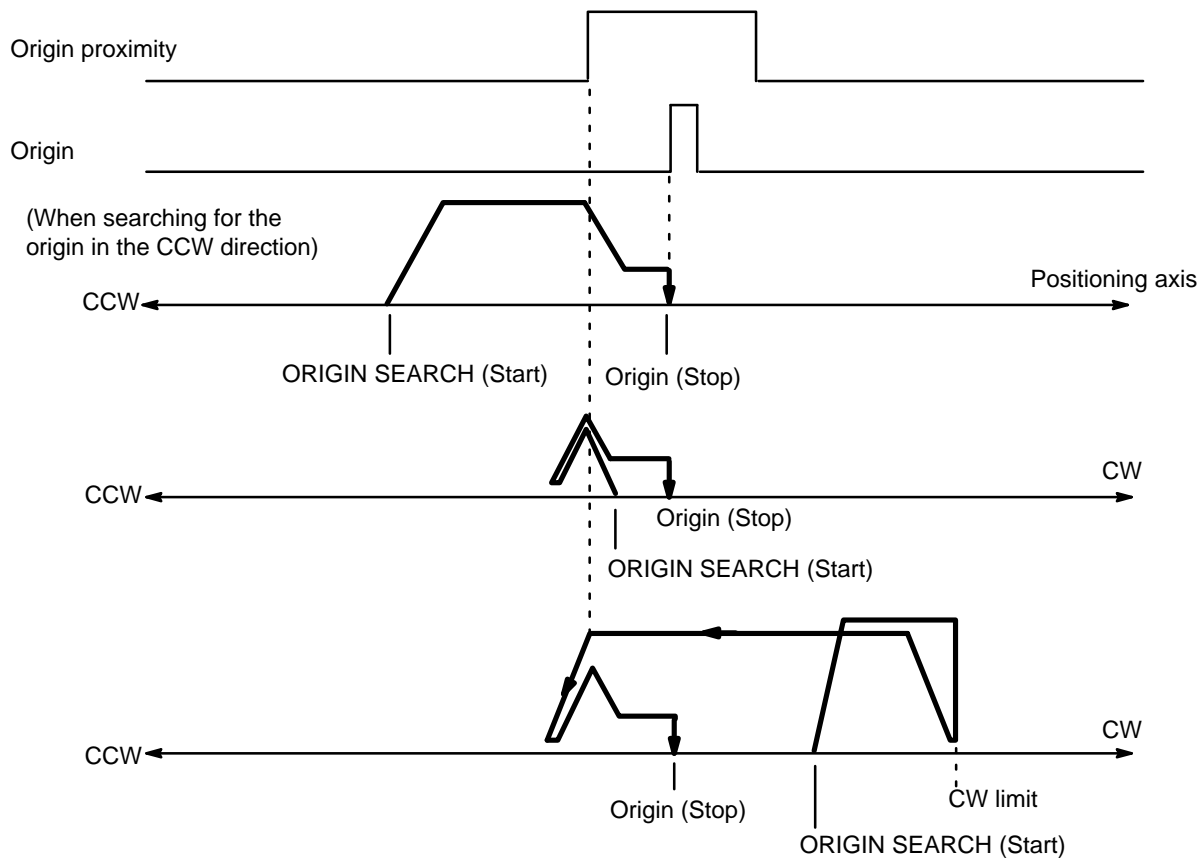


Pin 2: Origin Search Direction

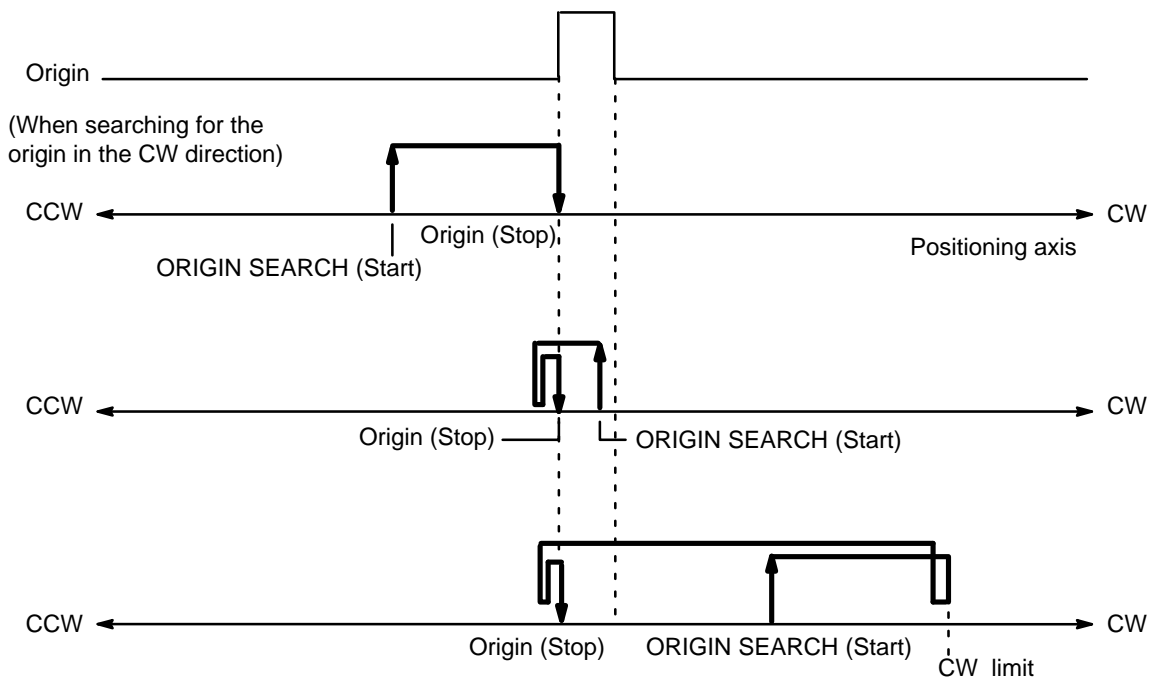
This pin selects the direction in which the origin is searched for and the direction from which the origin is reached. If the present position of the positioning system is near the origin, the origin is searched for in the direction opposite to that set by this pin.

Pin 3: Origin Proximity Signal Present/Absent

This pin enables or disables the origin proximity signal. When the pin is set to ON, ORIGIN SEARCH is executed using the origin and origin proximity signals. (Note that the origin proximity signal is necessary in modes 1, 2, and 3.)

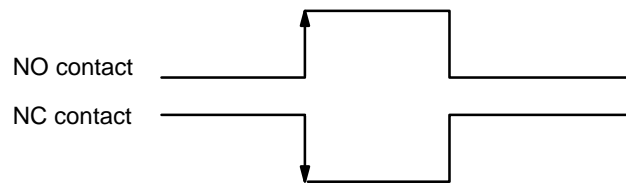


When the pin is set to OFF, ORIGIN SEARCH is executed completely at proximity speed (low speed).



**Pin 4: Origin Proximity
Signal Type and
Pin 5: Origin Signal Type**

These pins determine whether the origin proximity and origin signals are input from NO or NC contacts. When the pin is set to ON, the corresponding signal is input from an NO contact; when set to OFF, from an NC contact.



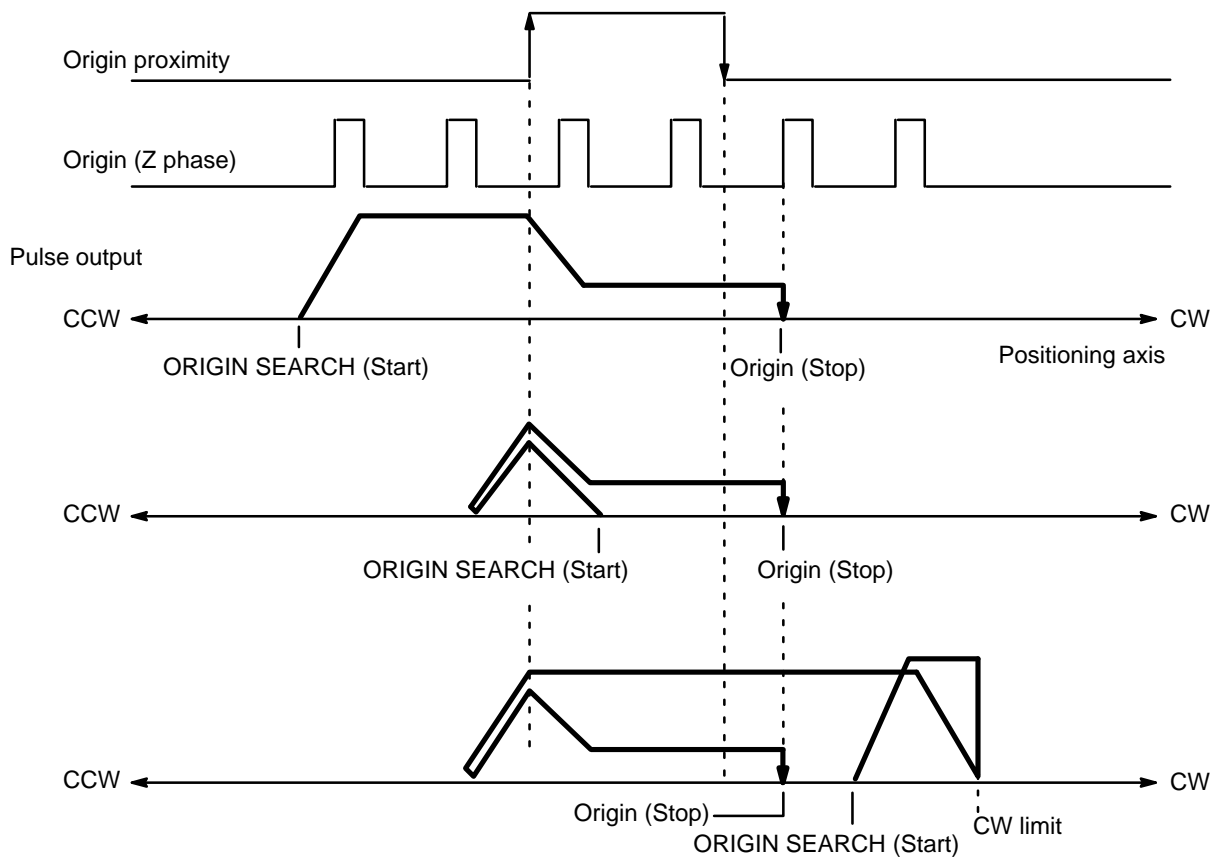
Pin 6: External Interrupt Signal Type and Pin 7: External Interrupt Signal Definition

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

Pin 8: Origin Proximity Reverse

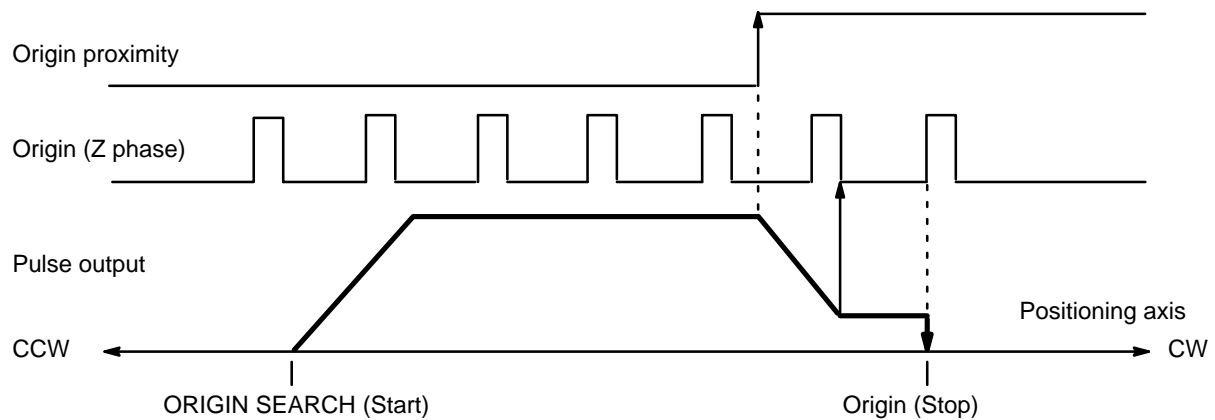
This pin selects whether the origin is detected after the origin proximity signal has turned ON or after it has turned ON once and then OFF.

When the pin is set to ON, origin proximity reverse is enabled. You can use this function to make sure that a sufficient deceleration period elapses when there are multiple origin signals. Set the origin proximity signal such that it remains on longer than the deceleration period. In the following example diagram, ORIGIN SEARCH is executed in the counterclockwise direction.



When the pin is set to OFF, origin proximity reverse is disabled and the origin signal is detected after the origin proximity signal has turned ON. Note, however, that the origin signal is not detected in modes 1, 2, and 3 during deceleration, and that the origin adjustment signal is not output in mode 3 during deceleration. Make sure, therefore, that deceleration is completed by the time the first origin signal is output after the origin proximity signal is turned on.

For details, refer to *Section 4-2*.



2-1-1 Switch Setting Examples

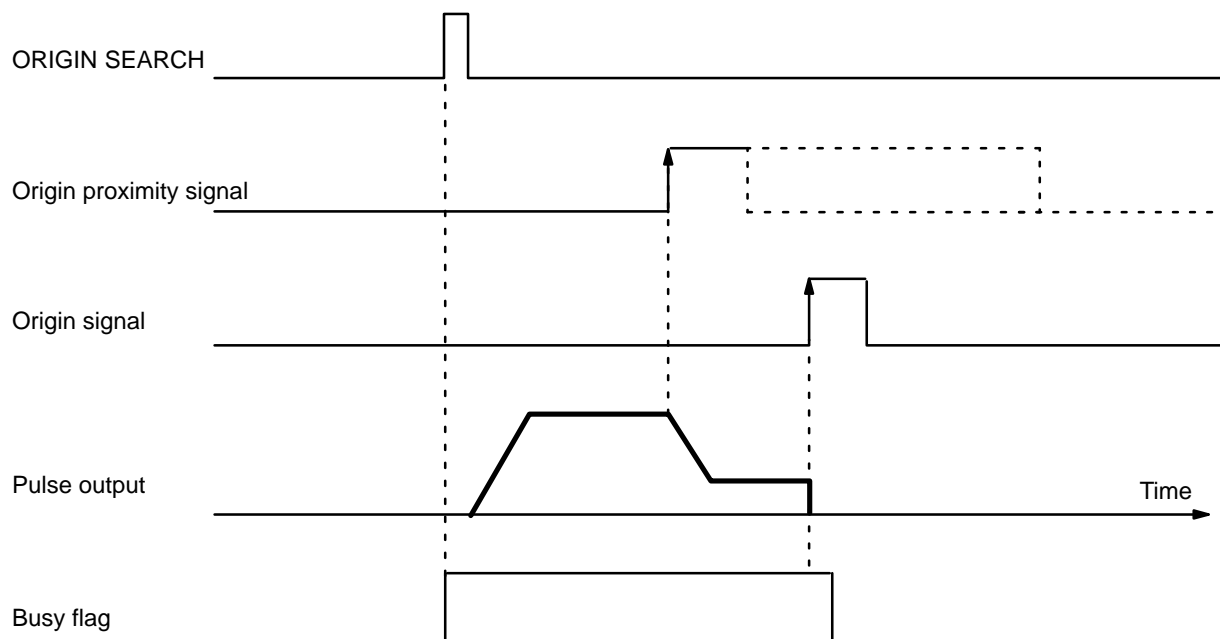
The examples in this section show switch settings for ORIGIN SEARCH in each of the four Position Control Unit modes. In every case, set the appropriate unit number and mode first, as described at the beginning of *Section 2-1*. See also *Section 4-2*.

Example 1: Settings in Mode 0

In this example, the mode switch is set to 0 and the DIP switch pins are set as follows:

1	OFF	CW/CCW output
2	ON	Origin search direction: CCW
3	ON	Origin proximity present
4	ON	Origin proximity signal from NO input (rising edge)
5	ON	Origin signal from NO input (rising edge)
6		Refer to <i>Section 4-10 External Interrupt Commands</i> .
7		
8	OFF	Origin proximity reverse absent (rising edge)

Origin search is started after the rising edge of the origin proximity signal and ends with the rising edge of the origin signal.

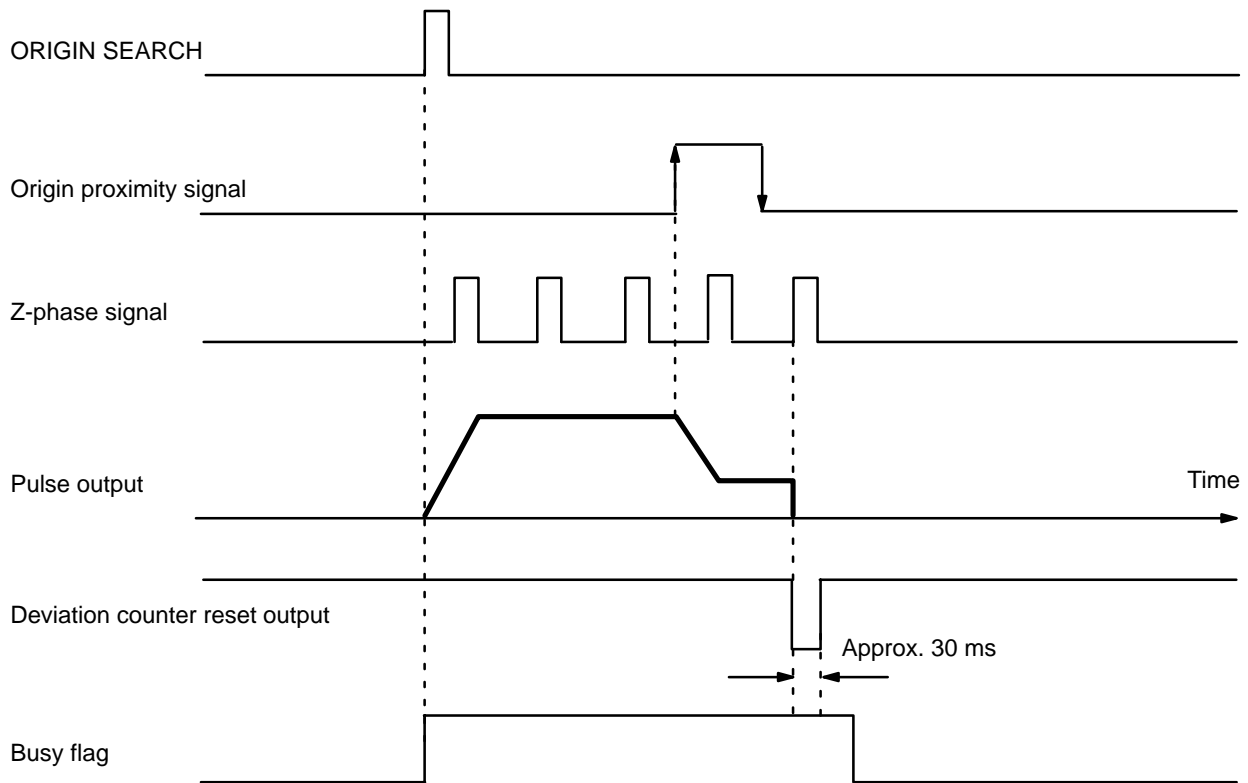


Example 2: Settings in Mode 1

In this example, the mode switch is set to 1 and the DIP switch pins are set as follows:

1	OFF	CW/CCW output
2	ON	Origin search direction: CCW
3	ON	Origin proximity present
4	ON	Origin proximity signal from NO input (rising edge)
5	ON	Origin signal from NO input (rising edge)
6		Refer to <i>Section 4-10 External Interrupt Commands</i> .
7		
8	ON	Origin proximity reverse present (rising, falling edge)

Origin search is started after the origin proximity signal has risen and fallen, and stops with completion of the first Z-phase signal after deceleration has stopped.

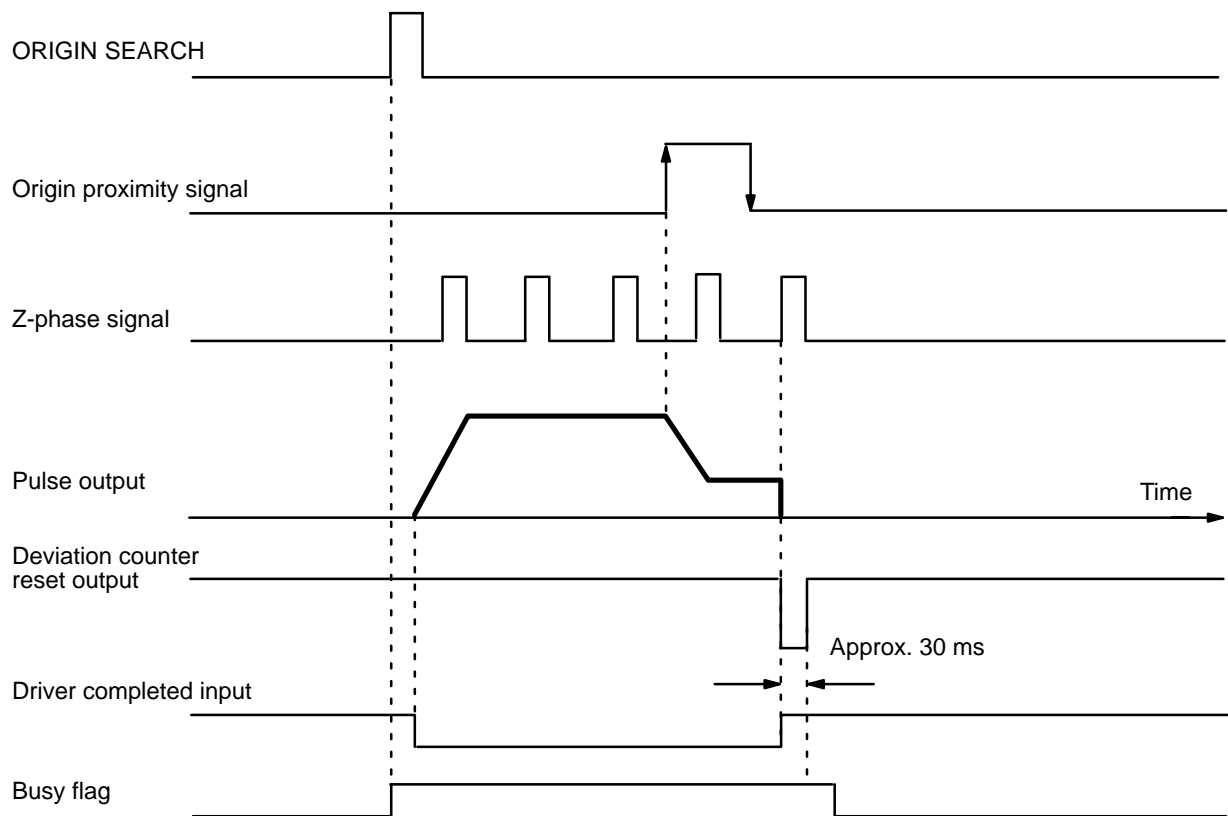


Example 3: Settings in Mode 2

In this example, the mode switch is set to 2 and the DIP switch pins are set as follows:

1	OFF	CW/CCW output
2	ON	Origin search direction: CCW
3	ON	Origin proximity present
4	ON	Origin proximity signal from NO input (rising edge)
5	ON	Origin signal from NO input (rising edge)
6		Refer to <i>Section 4-10 External Interrupt Commands</i> .
7		
8	ON	Origin proximity reverse present (rising, falling edge)

Origin search is started after the origin proximity signal has risen and fallen, and stops with completion of the first Z-phase signal after deceleration has stopped.

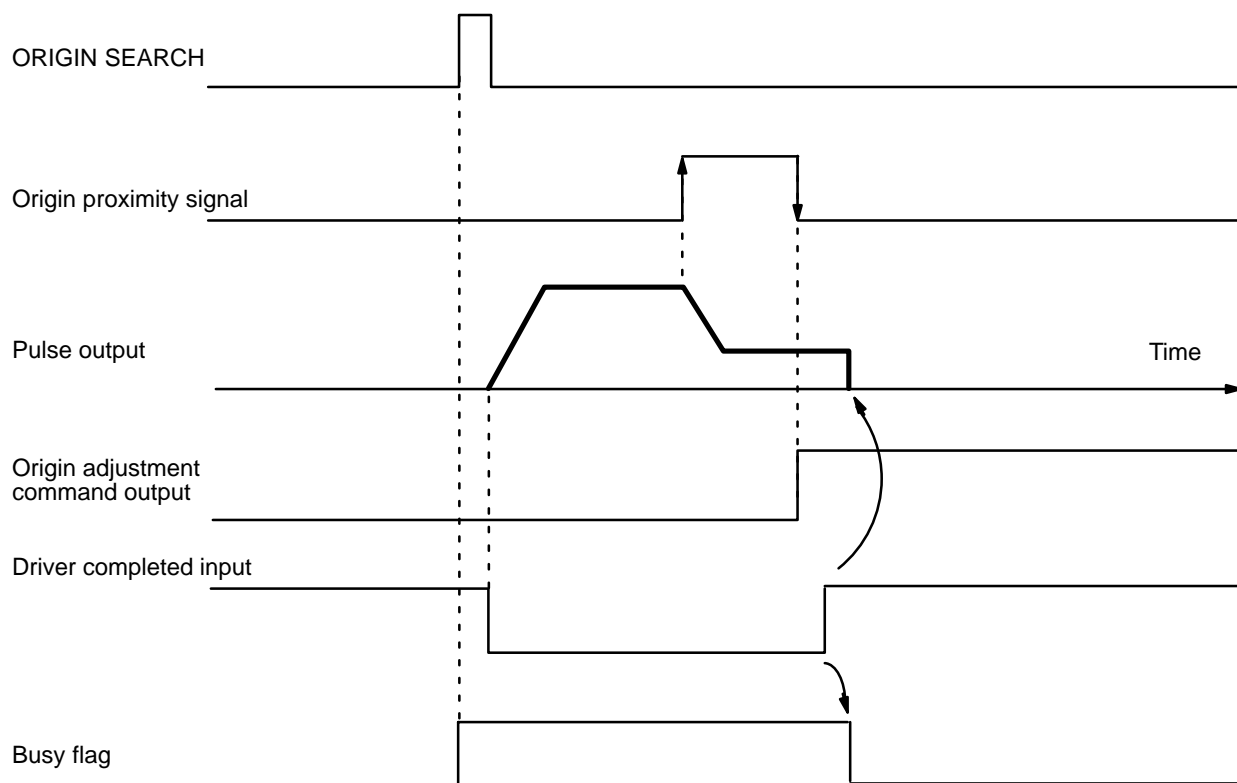


Example 4: Settings in Mode 3

In this example, the mode switch is set to 3 and the DIP switch pins are set as follows:

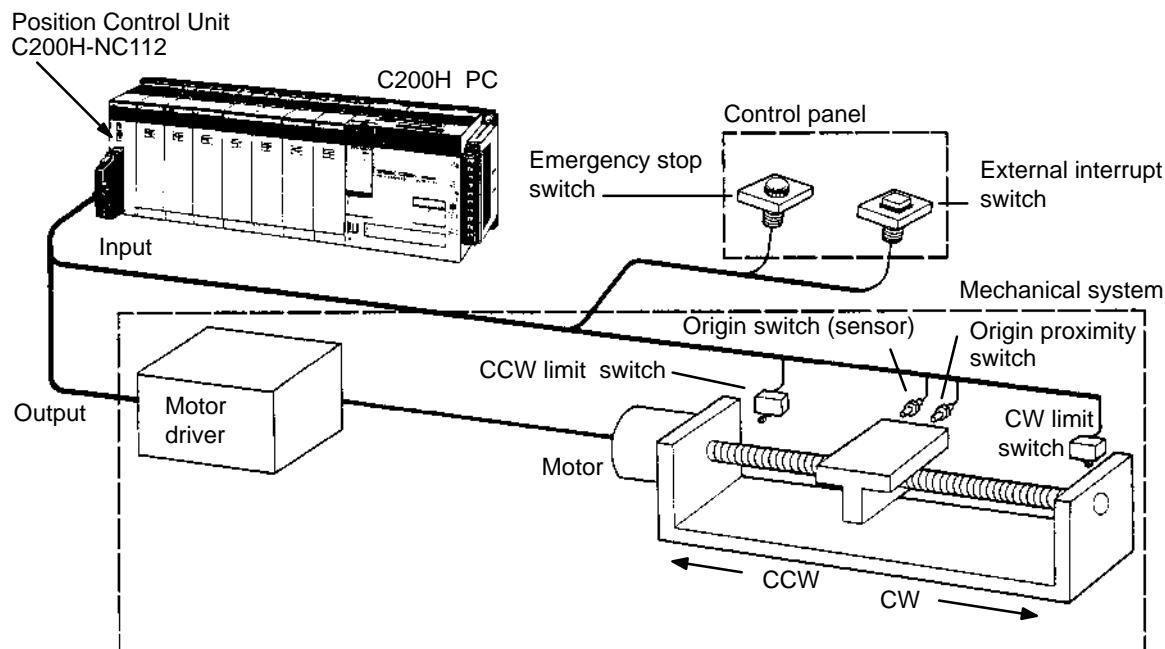
1	OFF	CW/CCW output
2	ON	Origin search direction: CCW
3	ON	Origin proximity present
4	ON	Origin proximity signal from NO input (rising edge)
5	ON	Origin signal from NO input (rising edge)
6		Refer to <i>Section 4-10 External Interrupt Commands</i> .
7		
8	ON	Origin proximity reverse present (rising, falling edge)

Origin search is started after the origin proximity signal has risen and fallen, and the origin adjustment signal is output to the servomotor driver after deceleration is completed. The positioning completed signal is then input from the servomotor driver and origin search ends. The servomotor driver stops automatically with the first Z-phase input after it has received the origin adjustment signal.



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.

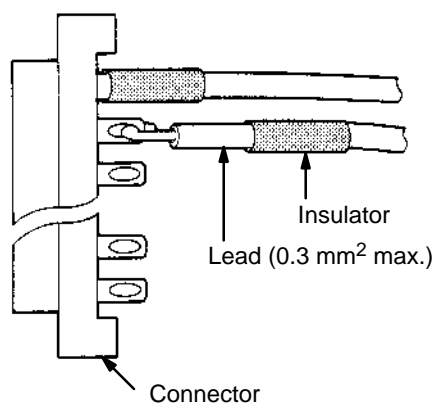
Row B	Pin no.	Row A
Emergency stop input (0V)	20	Emergency stop input (12 to 24 VDC)
External interrupt input (0V)	19	External interrupt input (12 to 24 VDC)
	18	
	17	
	16	
	15	
	14	
CW limit input (0V)	13	CW limit input (12 to 24 VDC)
CCW limit input (0V)	12	CCW limit input (12 to 24 VDC)
Origin input (0V)	11	Origin input (12 to 24 VDC)
Origin proximity input (0V)	10	Origin proximity input (12 to 24 VDC)
Driver completed input (0V)	9	Driver completed input (12 to 24 VDC)
Origin line driver input (-Z)	8	Origin line driver input (+Z)
Origin adjustment output (0V)	7	Origin adjustment output (open collector)
Decrement counter reset output (0V)	6	Decrement counter reset output (open collector)
Output power (0V)	5	Output power (0V)
CW pulse or nondirectional pulse output	4	CW pulse or nondirectional pulse output (1.6k Ω)
CW pulse or direction signal output	3	CCW pulse or direction signal output (1.6 k Ω)
5-VDC output power supply	2	
	1	24-VDC output power supply

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

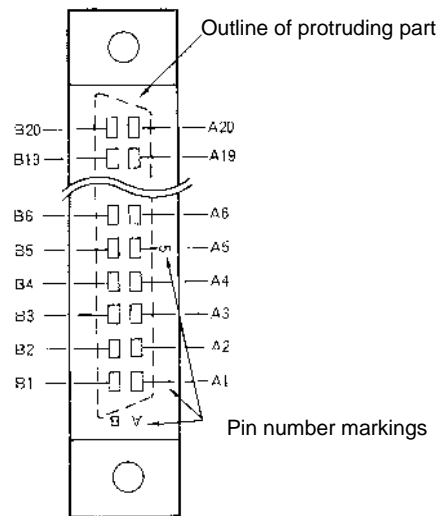
Caution Output power supply should be either 24 or 5 VDC. Never connect both 24 and 5 VDC supplies at the same time. Doing so may result in a fire.

Wiring to Connectors

- Solder-type connectors are included with the Unit.
- Use wire with a cross-sectional area of 0.3 mm² or less.
- When soldering, do not short-circuit an adjacent terminal. Cover the soldered section with an insulator.
- When using multi-core cable, wire output and input cables separately.

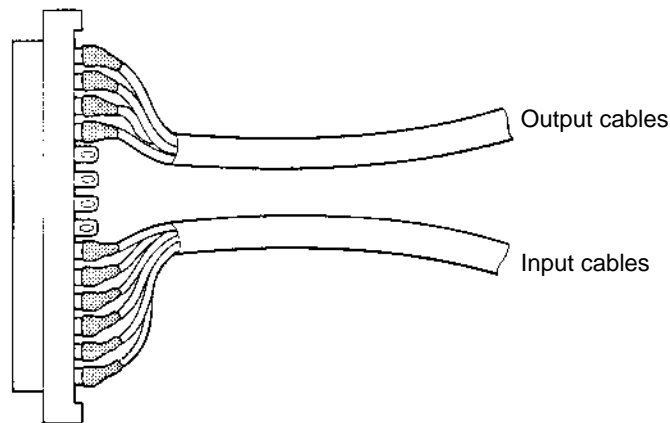


- The connector pin numbers are as shown below. Be sure to perform connection correctly.



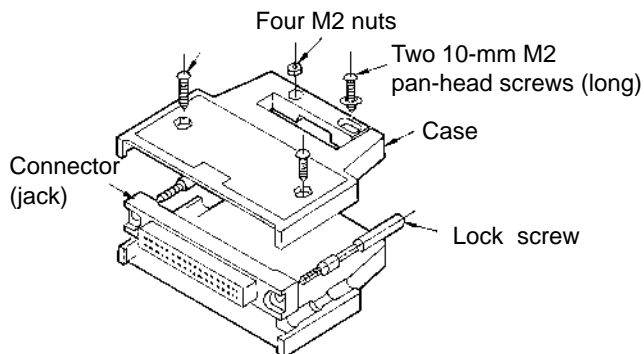
View from the Soldered Side

Differentiating Cables



Assembling Connectors

Two 8-mm M2 pan-head screws (short)



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)

Connector 1, above, is included as an accessory.
(Manufactured by Fujitsu)

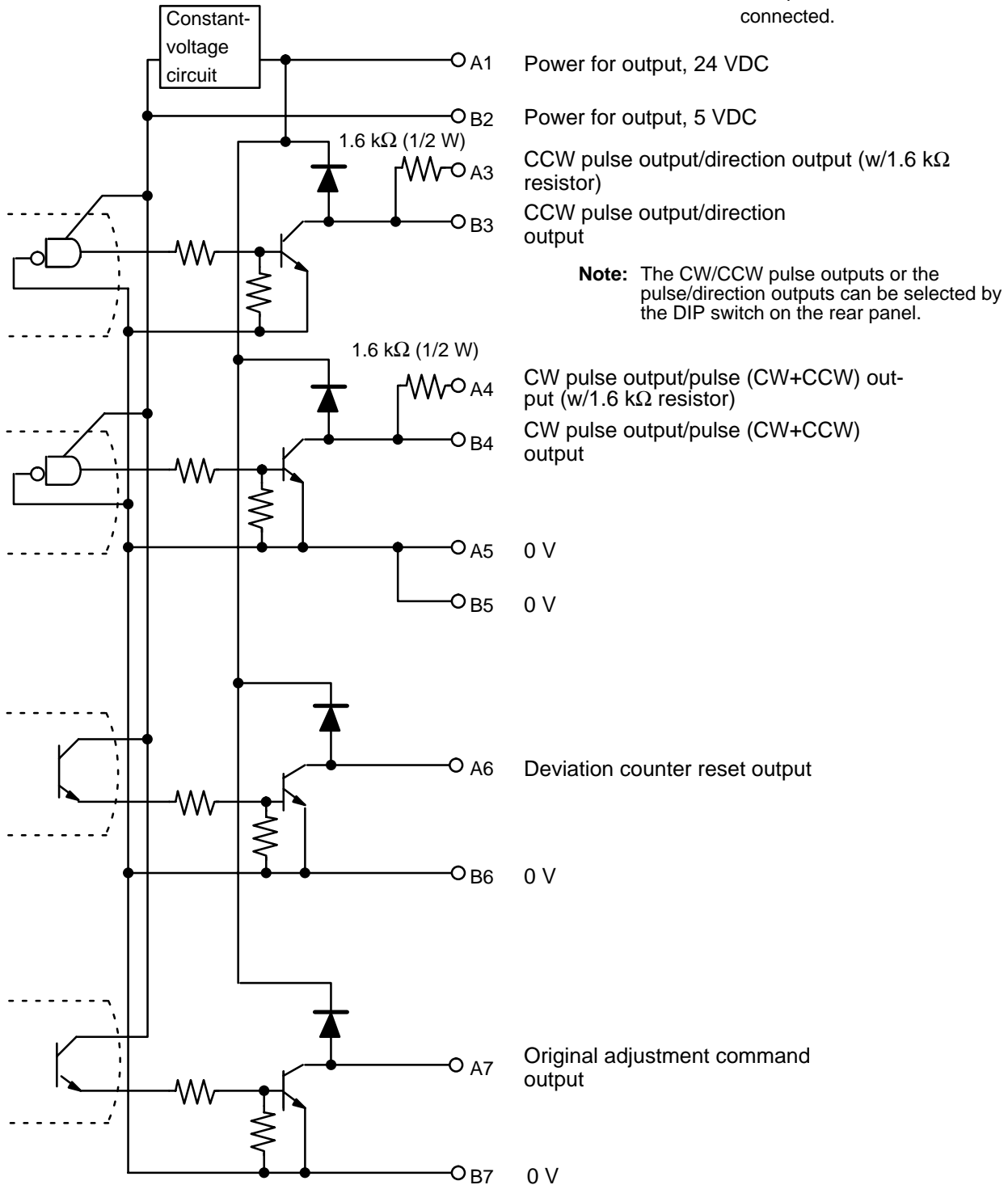
I/O Circuits

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.

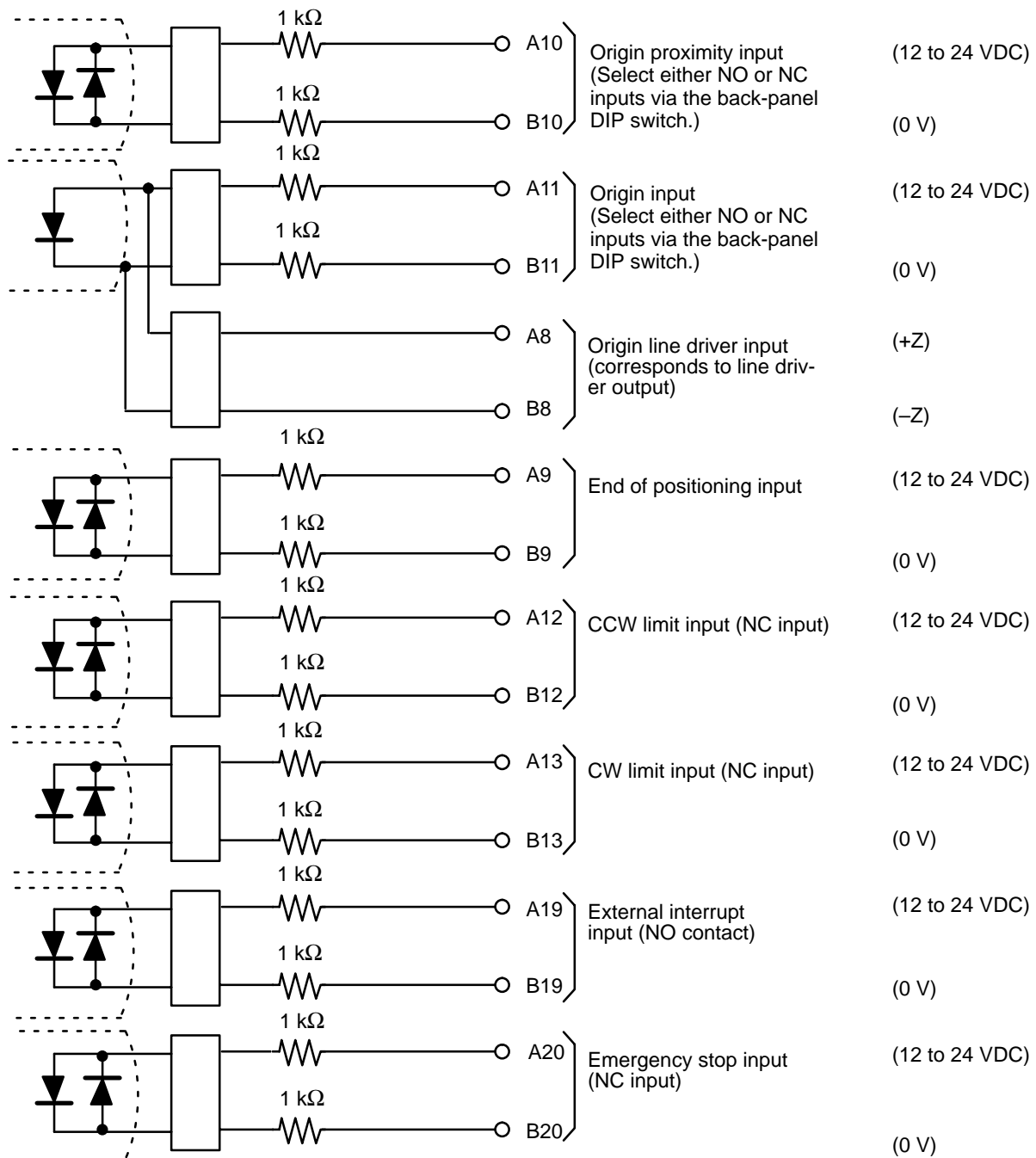
Outputs

Provide a power supply of either 5 or 24 VDC.

The internal circuit will be damaged if both the 5 and 24 VDC power sources are connected.



Inputs



All inputs except the origin line driver input have independent grounds (commons) and are bi-directional.

Origin Inputs (A11, B11), (A8, B8)

Mode 0 response time: 1.0 ms. Use origin input (A11, B11).

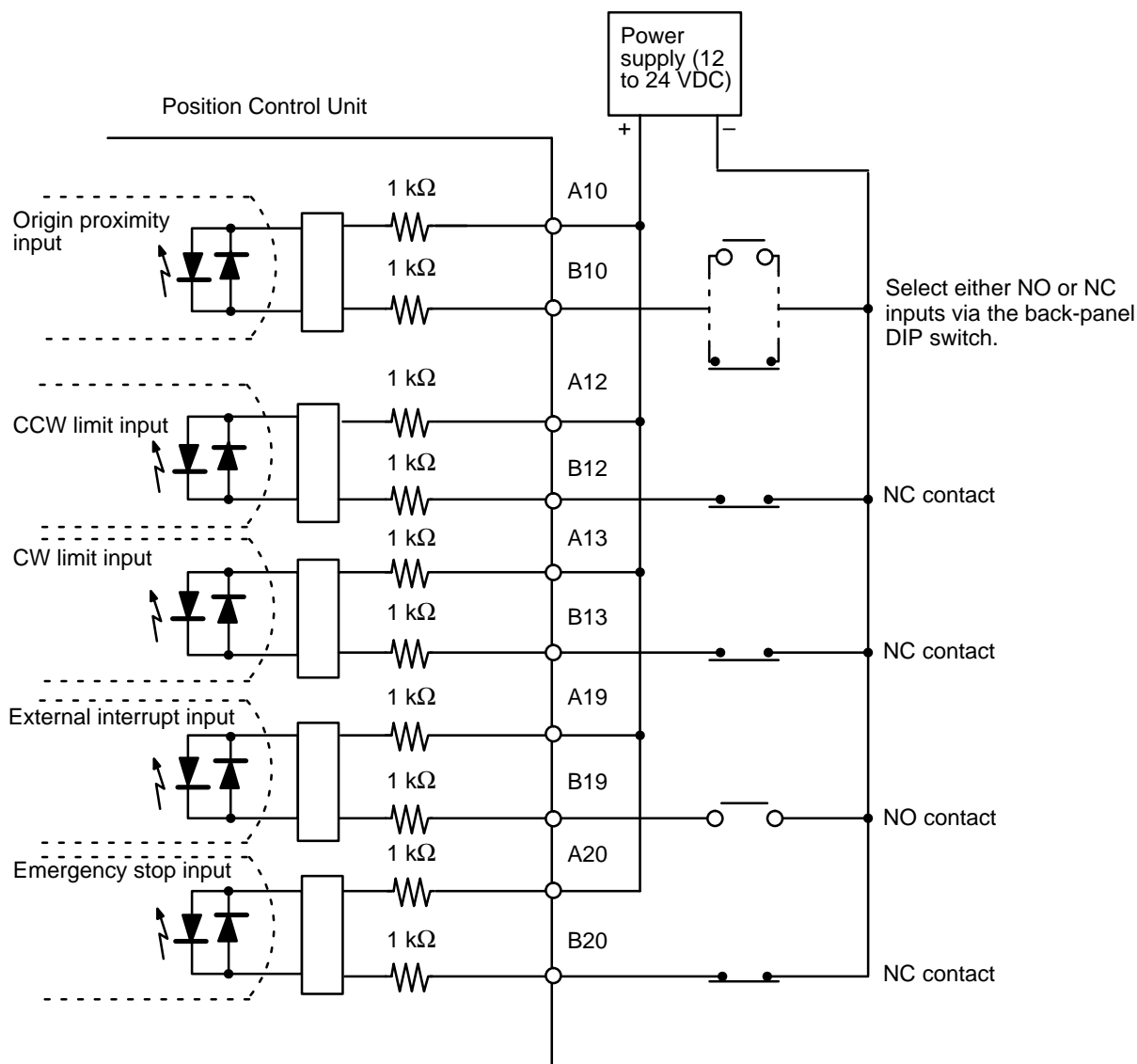
Modes 1,2 response time: 0.1 ms. Use origin line input (A8, B8).

Caution Origin input should be either (A11,B11) or (A8, B8). Never connect both at the same time; doing so may result in damage to the internal circuit.

2-2-1 Input Connection Examples

Each input is provided with both an NO (normally open) input and an NC (normally closed) input that can be used according to specifications.

Leave unused NO inputs open and connect unused NC inputs to the power supply.

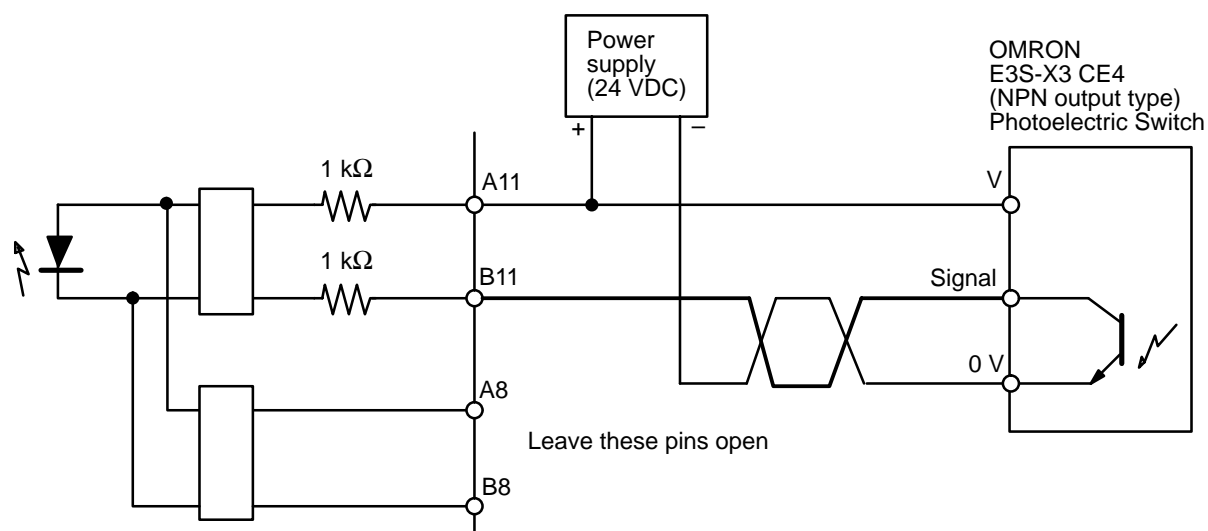


- All inputs have independent grounds (commons) and are bi-directional. Connect switches of at least 12-mA capacity.
- Use a non-contact sensor (such as a proximity sensor) for the origin input to reduce wear and deterioration.

Origin Input Connection Examples

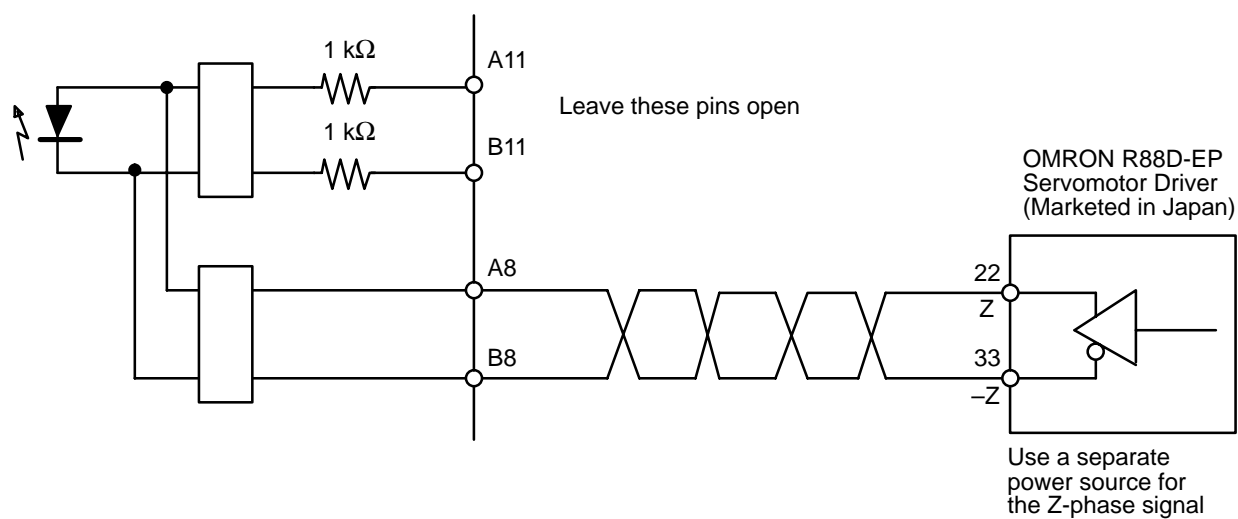
The Position Control Unit has two pairs of origin input pins: A11 and B11, and A8 and B8. Pins A11 and B11 are used with the open-collector output of a sensor, while pins A8 and B8 are used to connect the line driver output of a Z-phase encoder.

Origin Input (A11, B11)

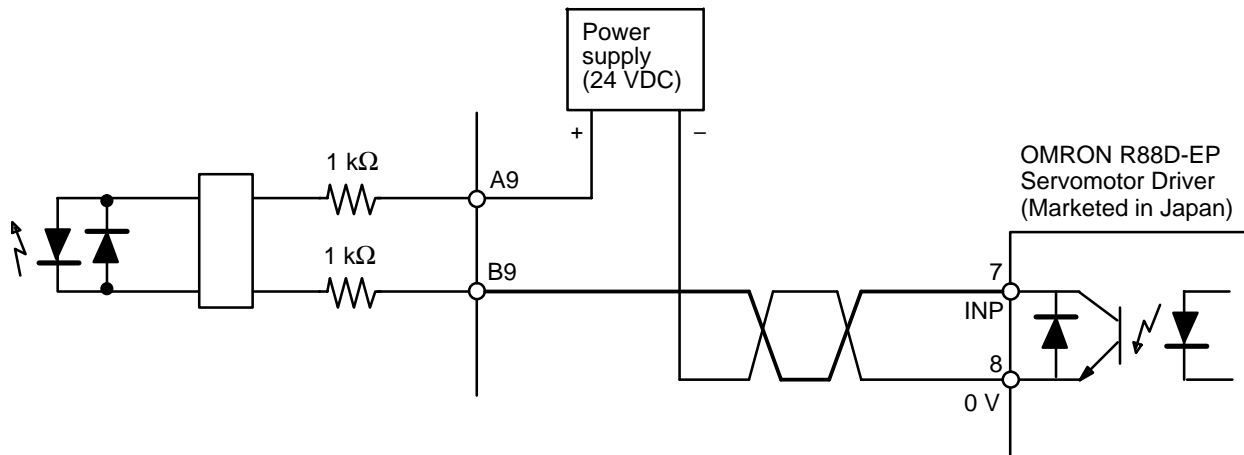


Pins A11 and B11 are internally rectified so that they can be used bi-directionally.

Origin Line Driver Input (A8, B8)



Driver Completed Input Example

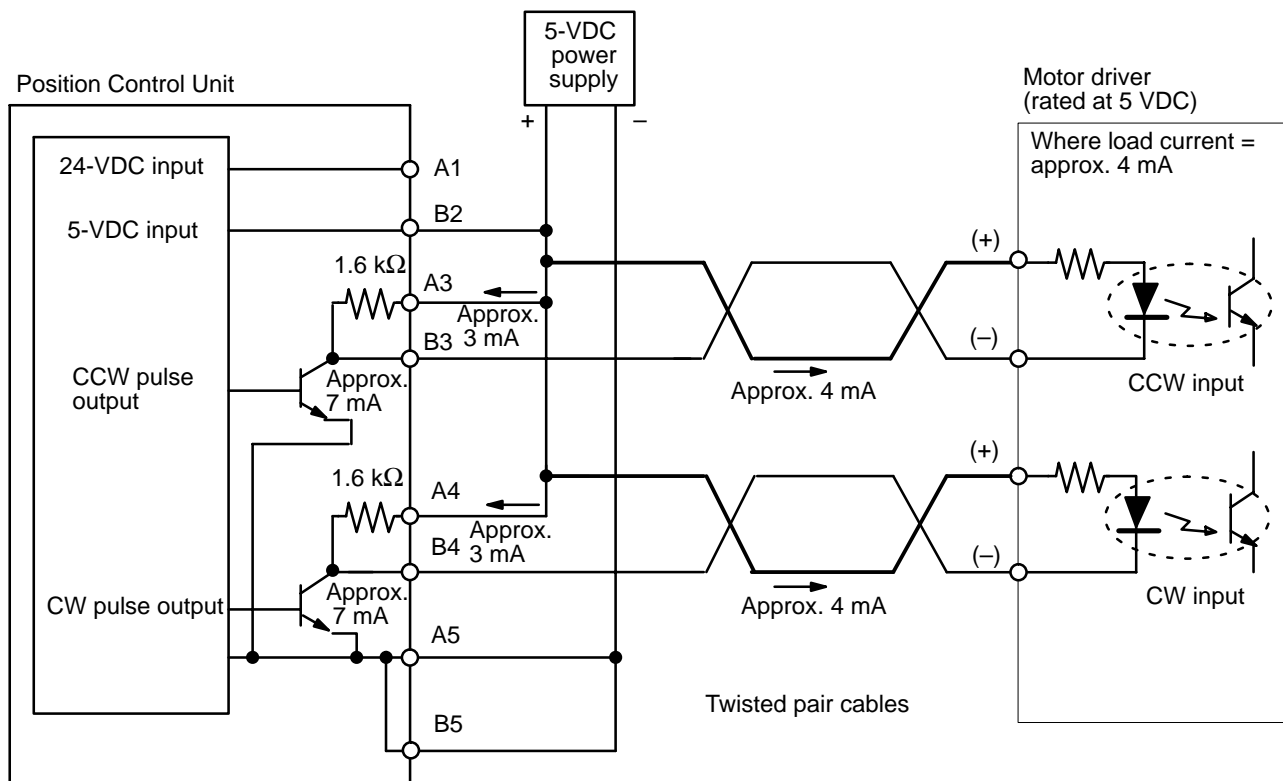


The driver completed input signal is also used as an origin search completed signal in modes 2 and 3. Adjust the setting of the servomotor driver so that this signal always turns OFF while the servomotor is operating, and ON when the motor stops.

2-2-2 Output Connection Examples

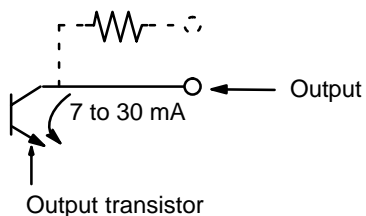
The figures on the following pages illustrate examples of connections to motor drivers. Always confirm motor driver specifications before making connections. Connect between 7 mA and 30 mA loads to the outputs of the Position Control Unit, or add bypass resistance for loads less than 7 mA.

The built-in 1.6 kΩ resistors can be used as bypass resistors. If, as in the following example diagram, the load current is 4 mA, then the output transistor current (7 mA) = load current (4 mA) + bypass current (3 mA).

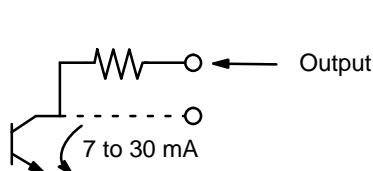


The output circuit of the Position Control Unit is provided with 1.6-kΩ (1/2 W) resistors. Use these resistors in accordance with the power requirements and the specifications of the motor driver to be used.

Open collector output



Open collector output with 1.6 kΩ series resistance

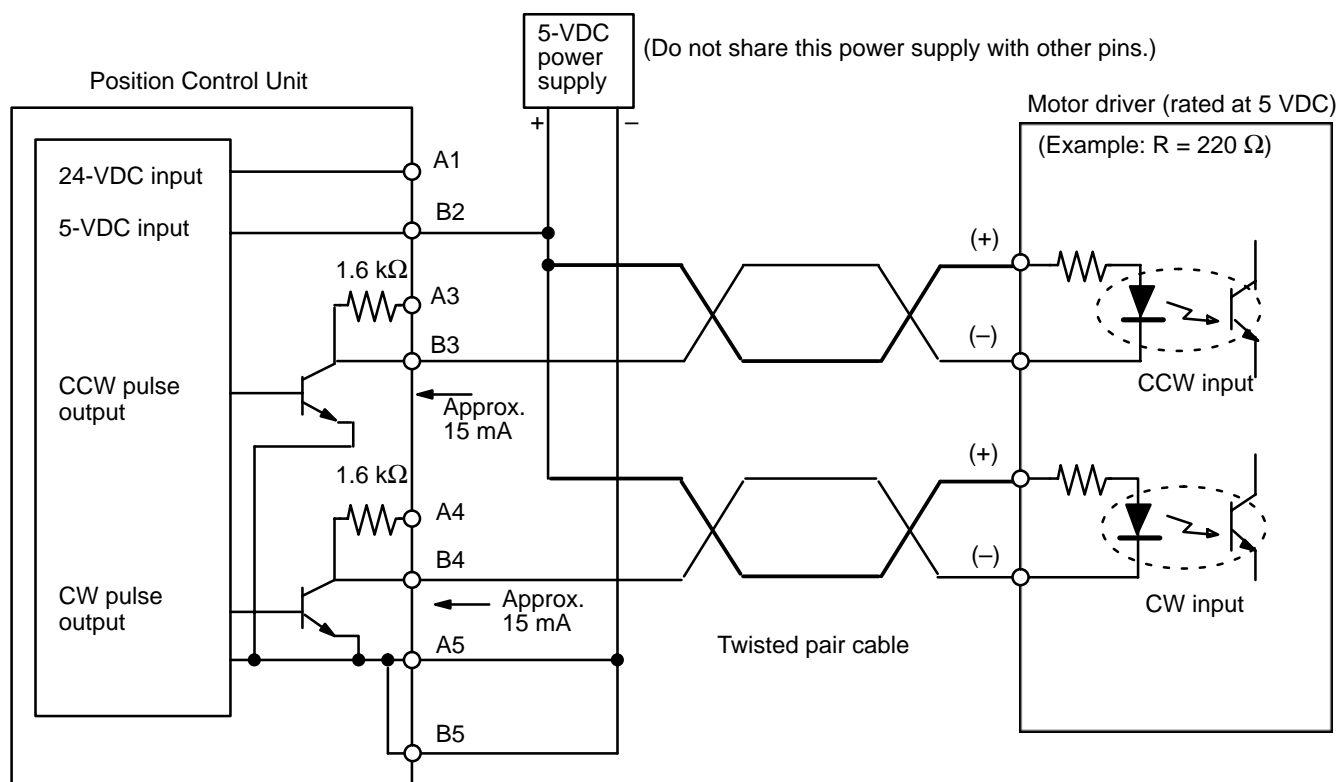


Pulses are not output when the output transistor in the pulse output section is OFF. (For direction output, OFF indicates CCW.)



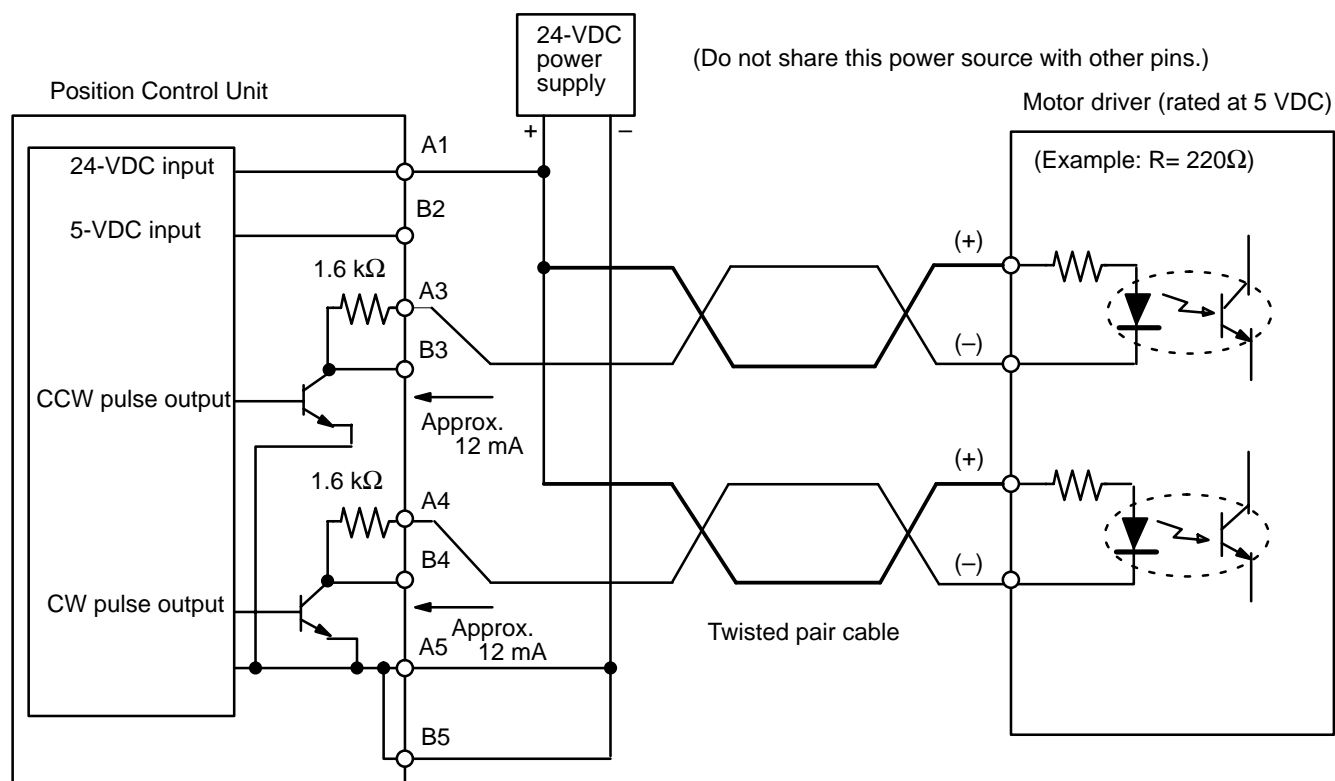
Caution Use either a 5 or 24-VDC power supply for the output section.

Example 1: Outputting CW and CCW Pulses with a 5 VDC Power Supply

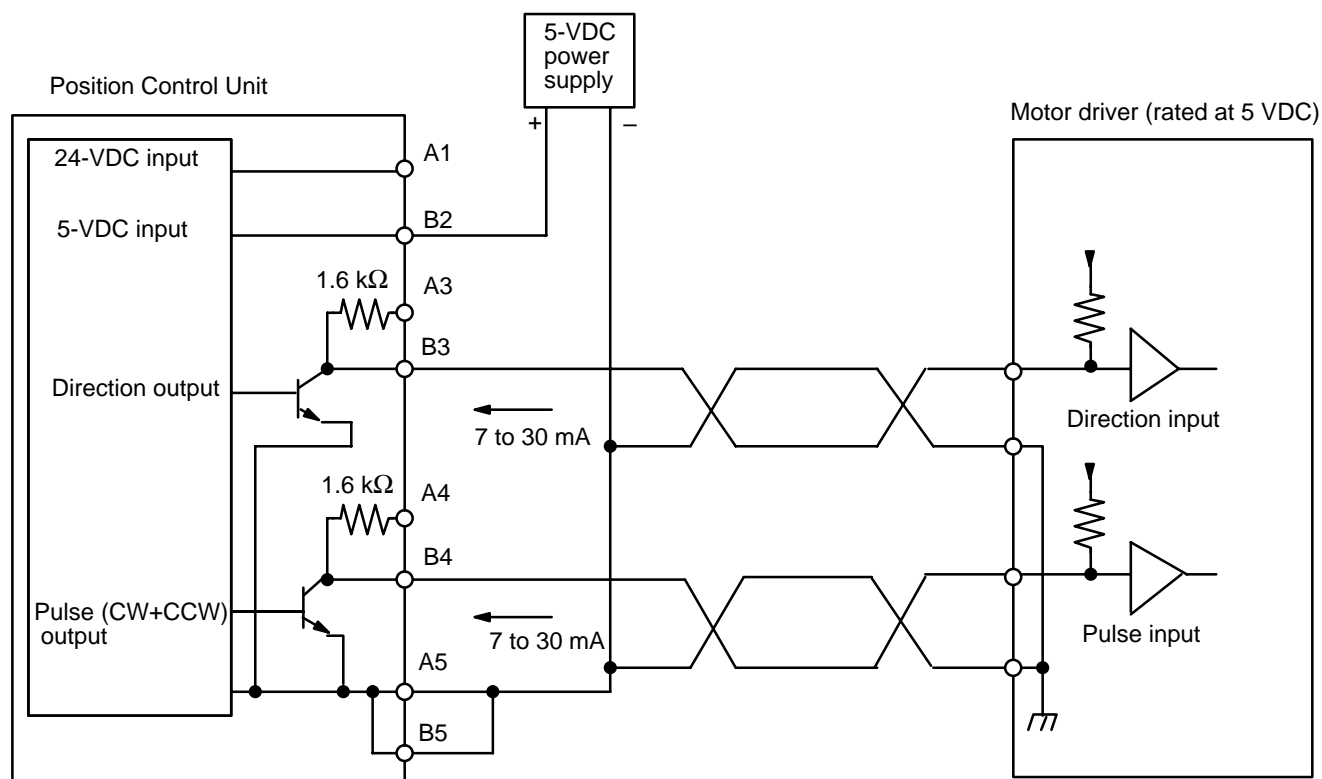


Example 2: Outputting CW and CCW Pulses with a 24-VDC Power Supply and a Motor Driver Rated at 5 VDC

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



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

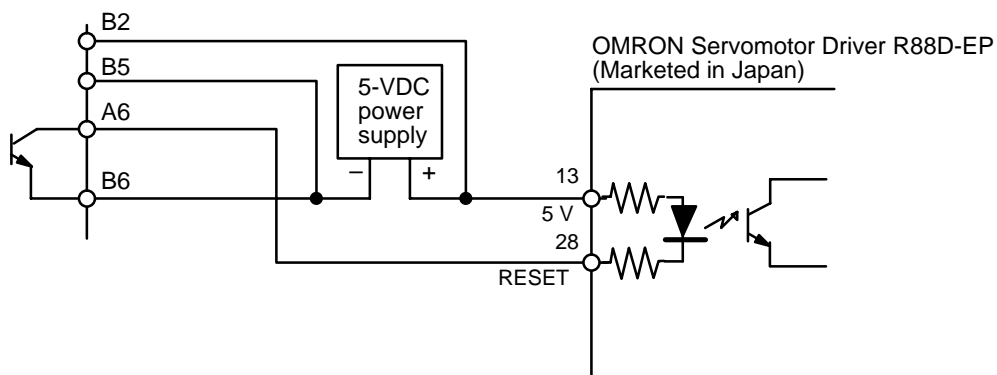


When the Position Control Unit is used to output voltage levels, the low level is obtained when the output transistor turns ON, while the level goes to high when the transistor turns OFF.

Example 4: Other Outputs with a 5-VDC Power Supply

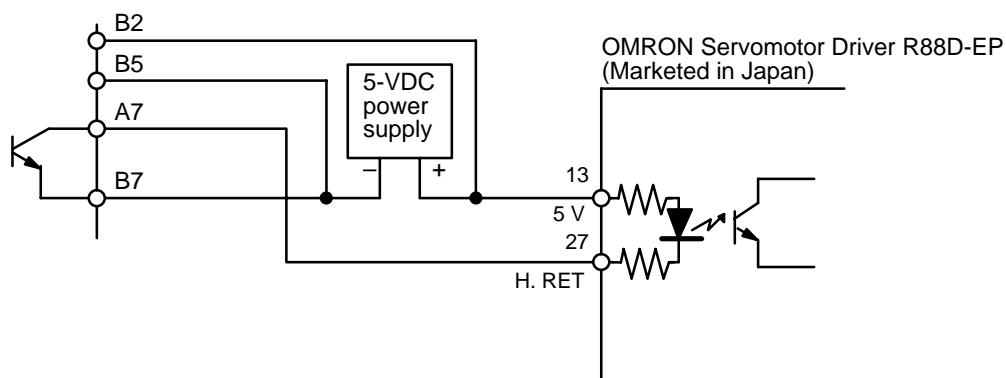
Deviation Counter Reset Output

When the Position Control Unit is set to modes 1 or 2, this signal is output for approximately 20 ms following completion of ORIGIN SEARCH.



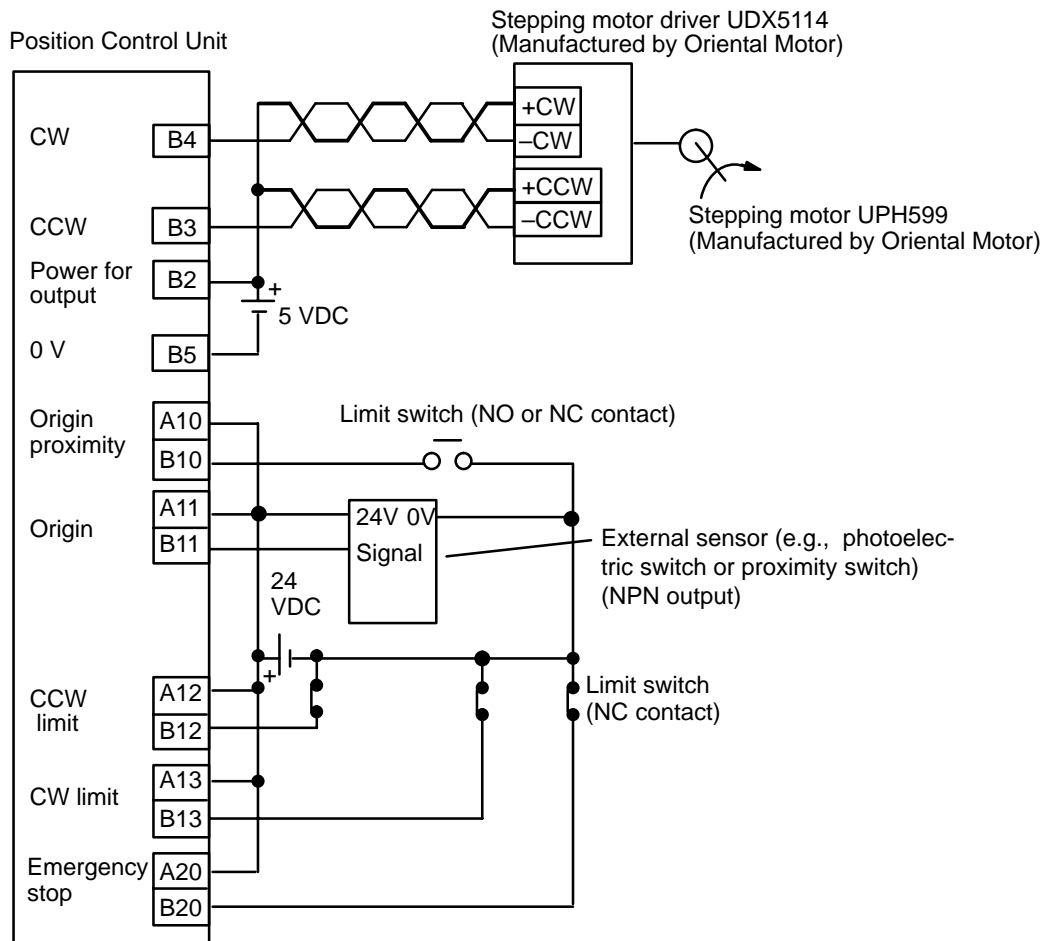
Origin adjustment signal Output

This signal is output in mode 3.



Note Use the same power supply for deviation counter reset output and/or origin adjustment signal output as for pulse output.

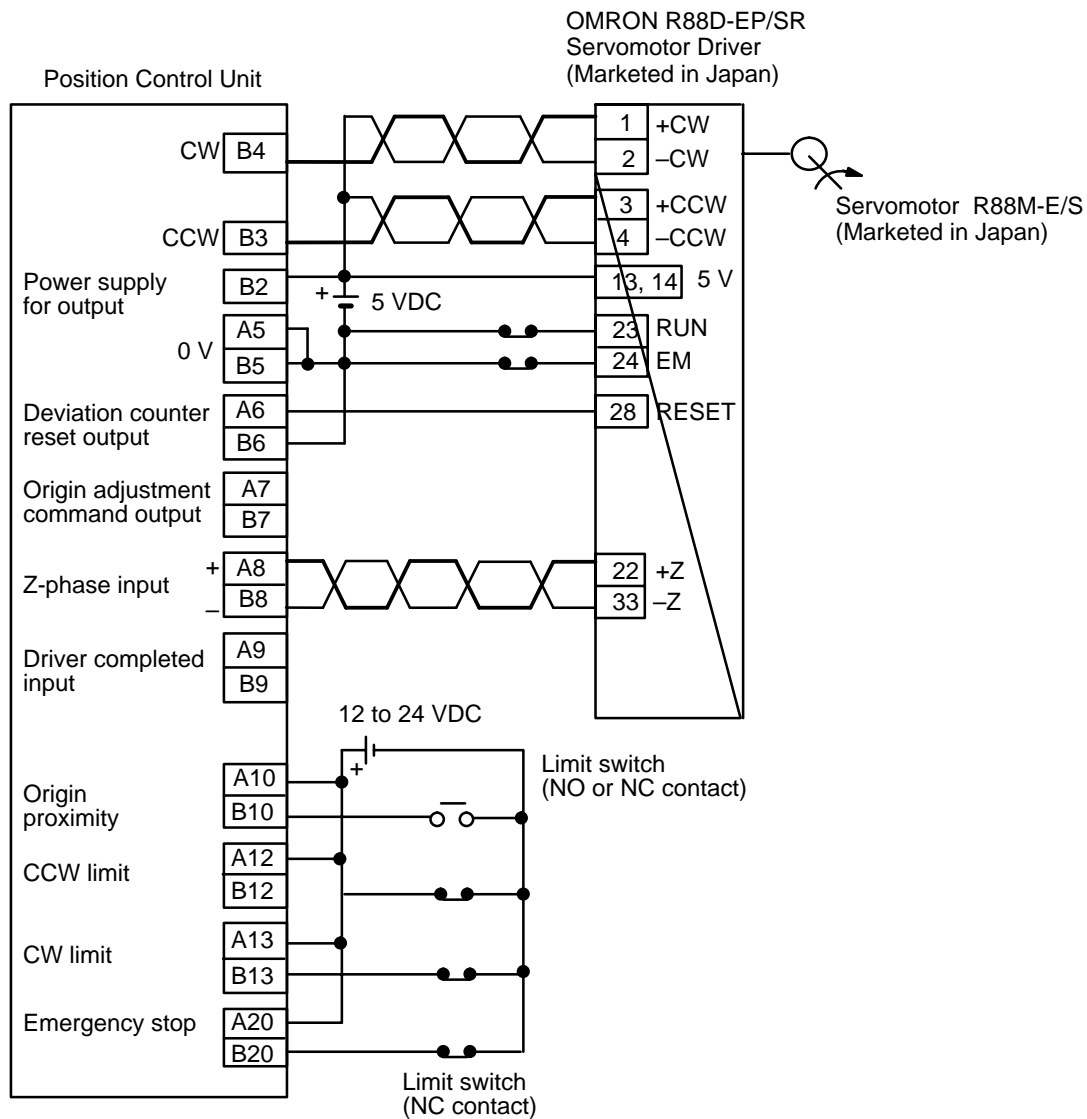
Example 5: Stepping-Motor Driver Connection



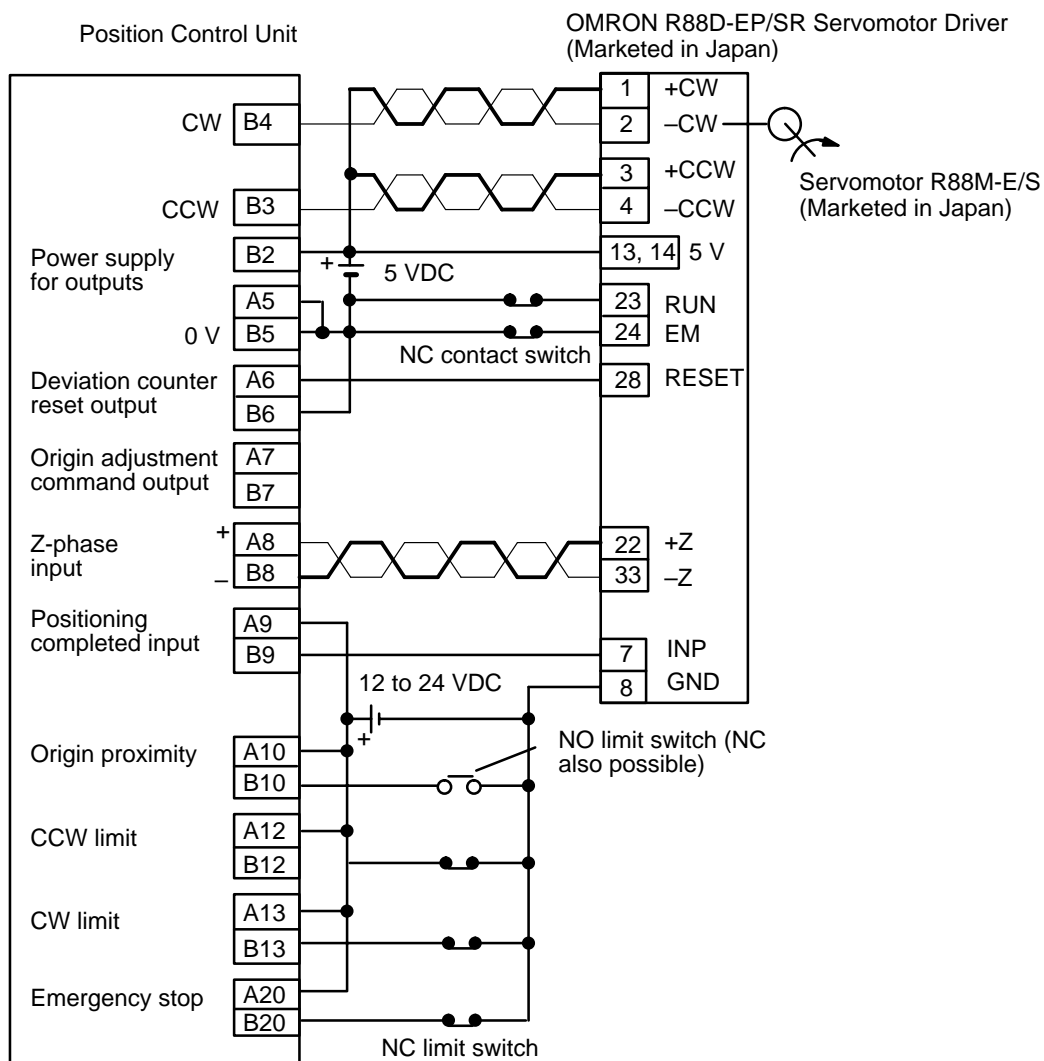
Example 6: Servomotor Driver Connection Examples

Mode 1

Connect a servomotor driver, using the Z-phase signal of the encoder as the origin signal. Do not connect anything to the origin signal pins (A11 and B11).

**Mode 2**

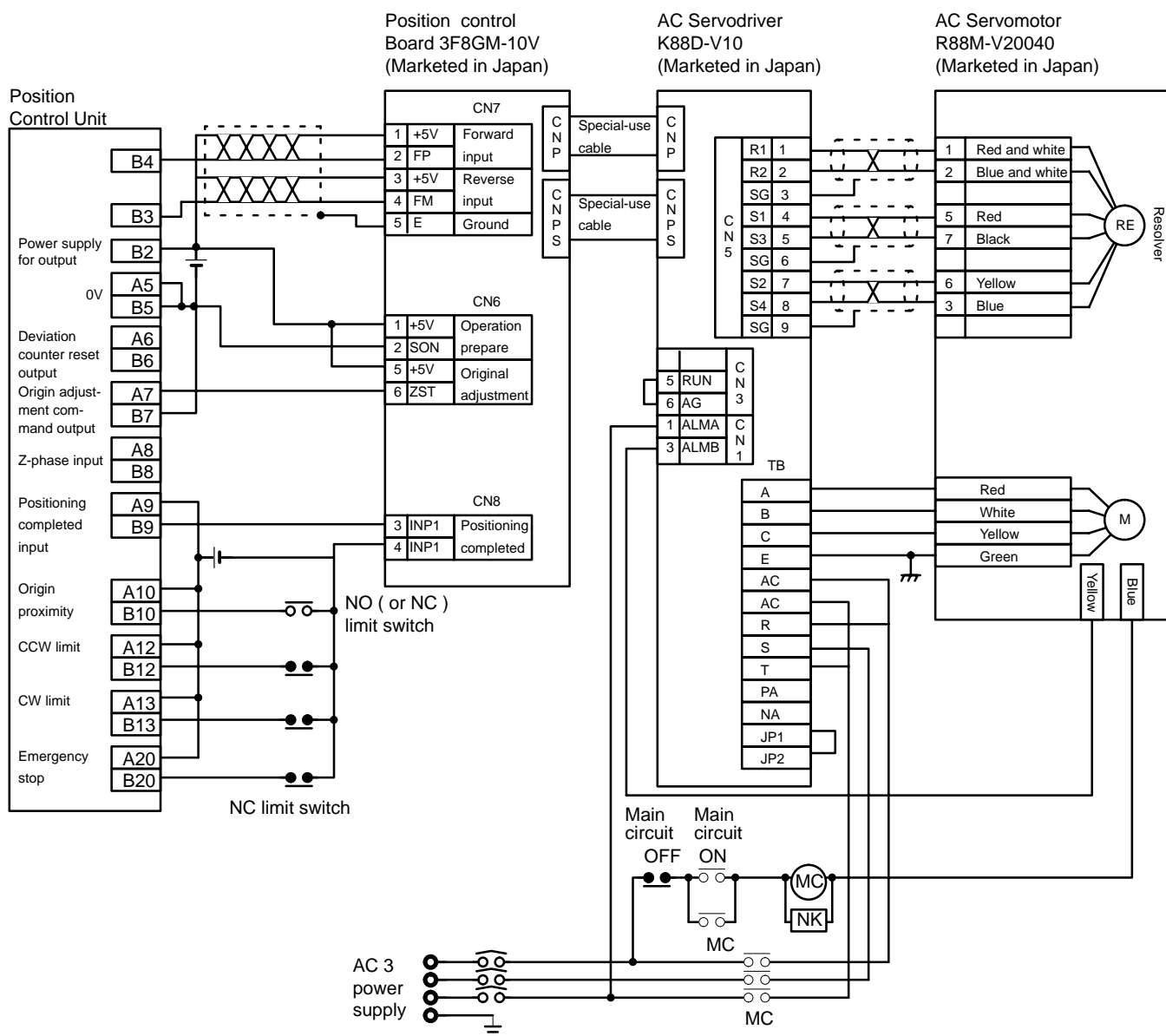
Connect a servomotor driver, using the Z-phase signal of the encoder as the origin signal. Do not connect anything to the origin signal pins (A11 and B11). The servomotor driver positioning completed signal is used as both the origin search completed and the positioning completed signals. Be sure to set the servomotor driver such that the driver completed signal is OFF during motor operation and ON while it is stopped.

**Mode 3**

This example diagram shows the use of the origin adjustment function of the OMRON R88D-EP/SR Servomotor Driver. The driver completed input (INP) is used as the origin search completed signal as well as the driver completed signal. Using this servomotor driver, it is possible to determine the origin quite accurately. Be sure to set the servomotor driver such that the driver completed signal is OFF during motor operation and ON while it is stopped.



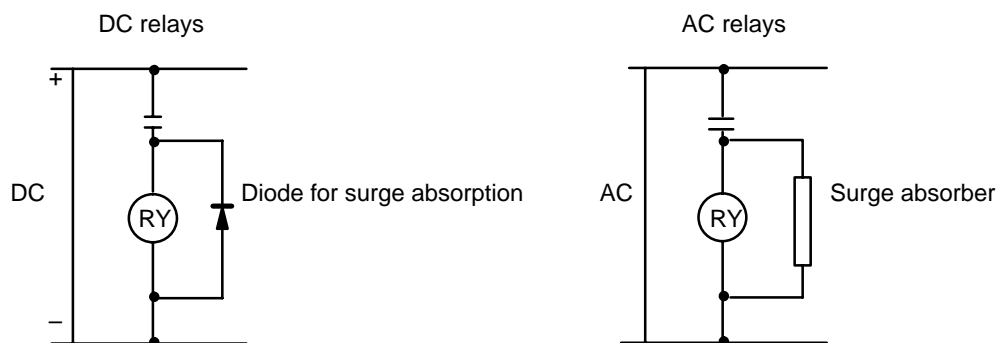
37



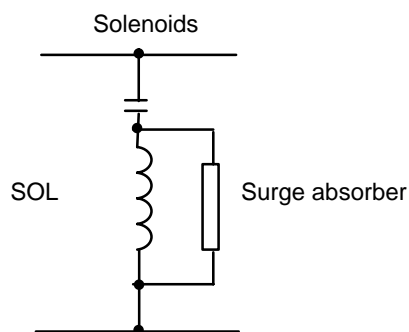
2-2-3 Wiring Precautions

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-induced 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.



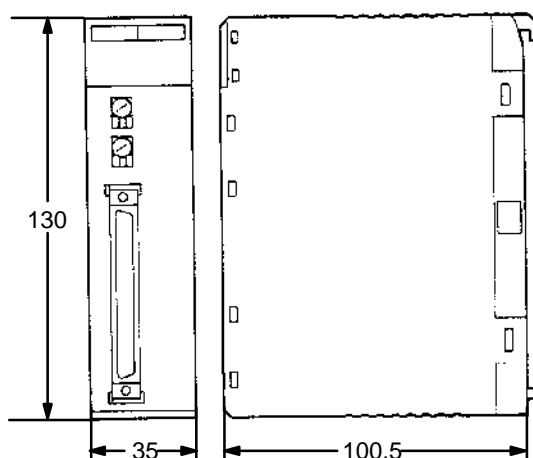
Note Connect the diode and surge absorber as close as possible to the relay. Use a diode capable of withstanding a voltage five times greater than the circuit voltage.



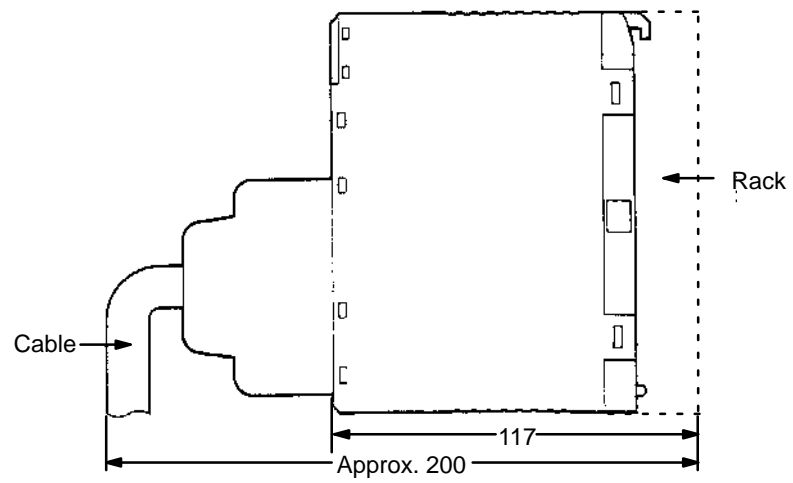
5. Insert a noise filter into the power supply line if it is noisy (e.g., when it is connected to the same power supply as an electric welder or an electric spark machine or when there is any source generating high frequency noise).
6. Twisted pair cable is recommended for power lines.
7. For grounds, use cable with a cross-sectional area of at least 1.25 mm².

2-3 Dimensions

Unit Dimensions (Unit: mm)



Mounted Dimensions (Unit: mm)



SECTION 3

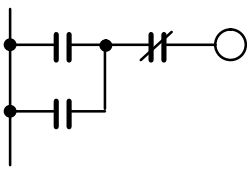
Operation

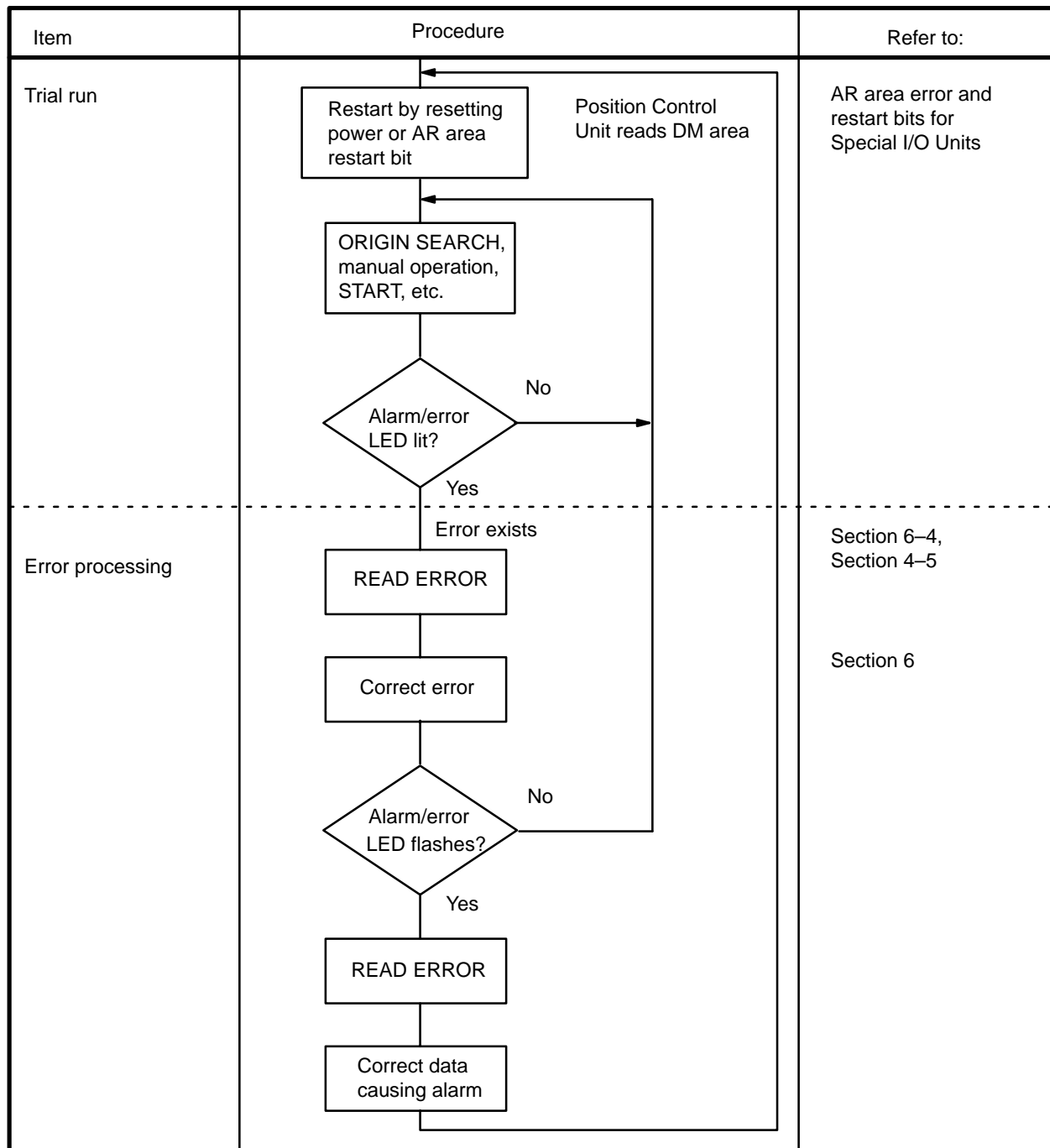
This section covers all aspects of Position Control Unit operation other than commands, which are covered in the following section. Included in this section are the basic operating procedure, the type of output pulses possible, the basic data format and configuration, some special features to aid operation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

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3-5	DM Area Data Format	48
3-6	Flags and Other Input Data	48
3-7	DM Area Allocation	48
3-7-1	Zones	50
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3-7-4	Data Calculations	53

3-1 Operational Flow

The basic procedure used to operate the Unit initially 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>Wiring motor to driver</p> <p>Wiring Position Control Unit to driver</p>	<p>Section 2-2</p>
	<p>Setting back-panel DIP switch</p> <p>Data setting</p> <p>Writing PC program</p>	<p>Section 3-4 Section 2-1</p> <p>Section 4 Section 3-7-4</p> <p>Section 5</p>
	<p>Origin, origin proximity, CW/CCW limits, emergency stop, external interrupt</p> <p>Follow motor and driver and instruction manuals for wiring details</p> <p>Output pulse selection Origin search direction Origin proximity signal type Origin signal type External interrupt signal type</p> <p>DM area (key input via Programming Console) Parameters Positioning actions Speeds</p> <p>Programming IR area (key input via Programming Console)</p> 	



Caution Before starting trial operation, disconnect the motor from the device it is driving and run the trial operation controlling the motor only. If it is not possible to disconnect the motor, check the system being controlled completely to ensure that no dangerous situations could occur during trial operation.

Final Wiring Check

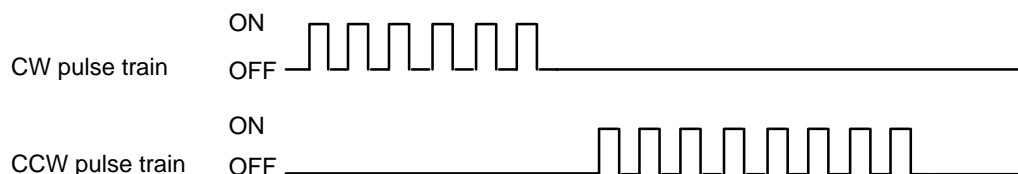
Before applying power to the PCU, check the following carefully.

- 1, 2, 3...**
1. Is the wiring correct?
 2. Are any clippings left from wiring causing shorts in the system?
 3. Are all terminals tight?
 4. Are all loads okay?

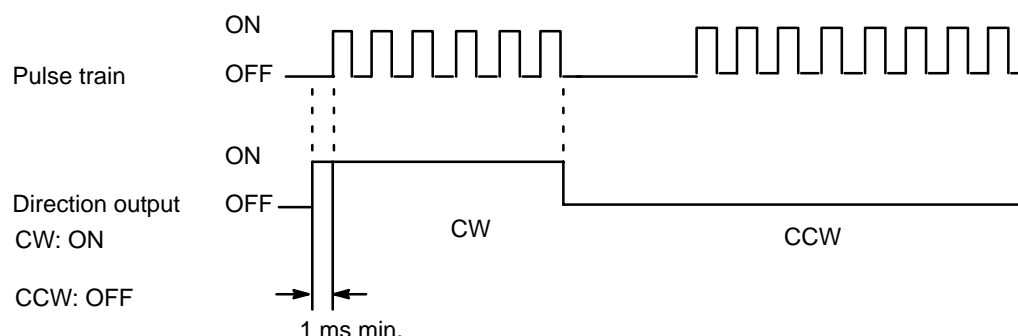
3-2 Output Pulses

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 desired type of output. (See *Section 2-1*.)

CW and CCW Pulse Outputs

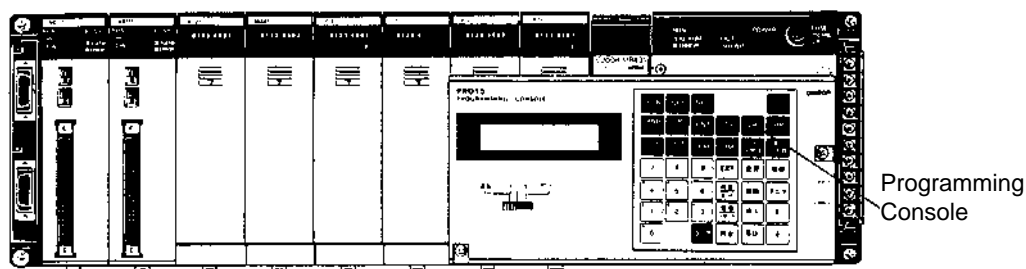


Nondirectional Pulse and Direction Signal Outputs



3-3 Writing Data

C200H PC



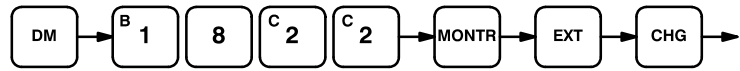
As explained in the Introduction, the Position Control Unit executes positioning actions and other operations in accordance with data (for speeds, positions, and so on) which you write into the DM area of the PC. You write this data, via the Programming Console, into the section of the DM area designated for Special I/O Units.

The specific words are DM 1000 through DM 1999, with 100 of these words allocated for each unit number assigned to a Special I/O 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

```
D1824D1823D1822
0012 5000 2000
```

Key Input Sequence



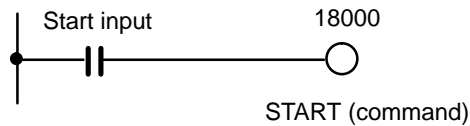
The above procedure prepares DM 1824 for change, and new data can be keyed in. Pressing the CHG key again moves the cursor to DM 1823. After inputting data, press the write key to execute the rewrite. In the above example, positioning action #0 of Unit #8 is shown.

Starting

When starting the Position Control Unit, the OUT refresh area is used. (The OUT refresh area is comprised of the first five of the ten IR words allocated to each Unit as refresh area. See *Section 3-4* for details.) The Busy flag and present position status can be read from the IN refresh area, the last five of these words.

To start the Unit, set (turn ON) the START command bit. This works 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 180 through IR 184 are allocated as the OUT refresh area; IR 185 through IR 190, as the IN refresh area.

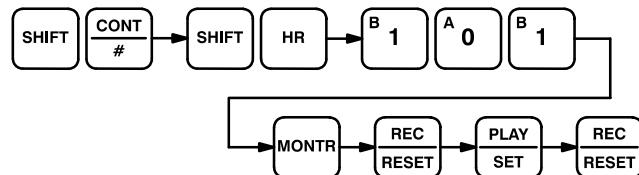
Special I/O Unit Restart Bits

Restart bits in AR 01 can be used to transfer altered DM area data to the Position Control Unit without turning power off and on. Refer to *Section 6-3* 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.

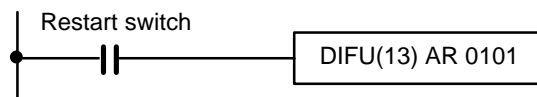
Programming Console Display

```
A0101
^ OFF
```

Key Input Sequence



Program example: Unit #1



3-4 Data Configuration and Allocation

IR 100 through IR 199 are allocated as I/O refresh areas. Each Position Control Unit is allocated ten consecutive words. The first word for each Unit, des-

ignated in this manual as n , can be computed from the unit number as follows:

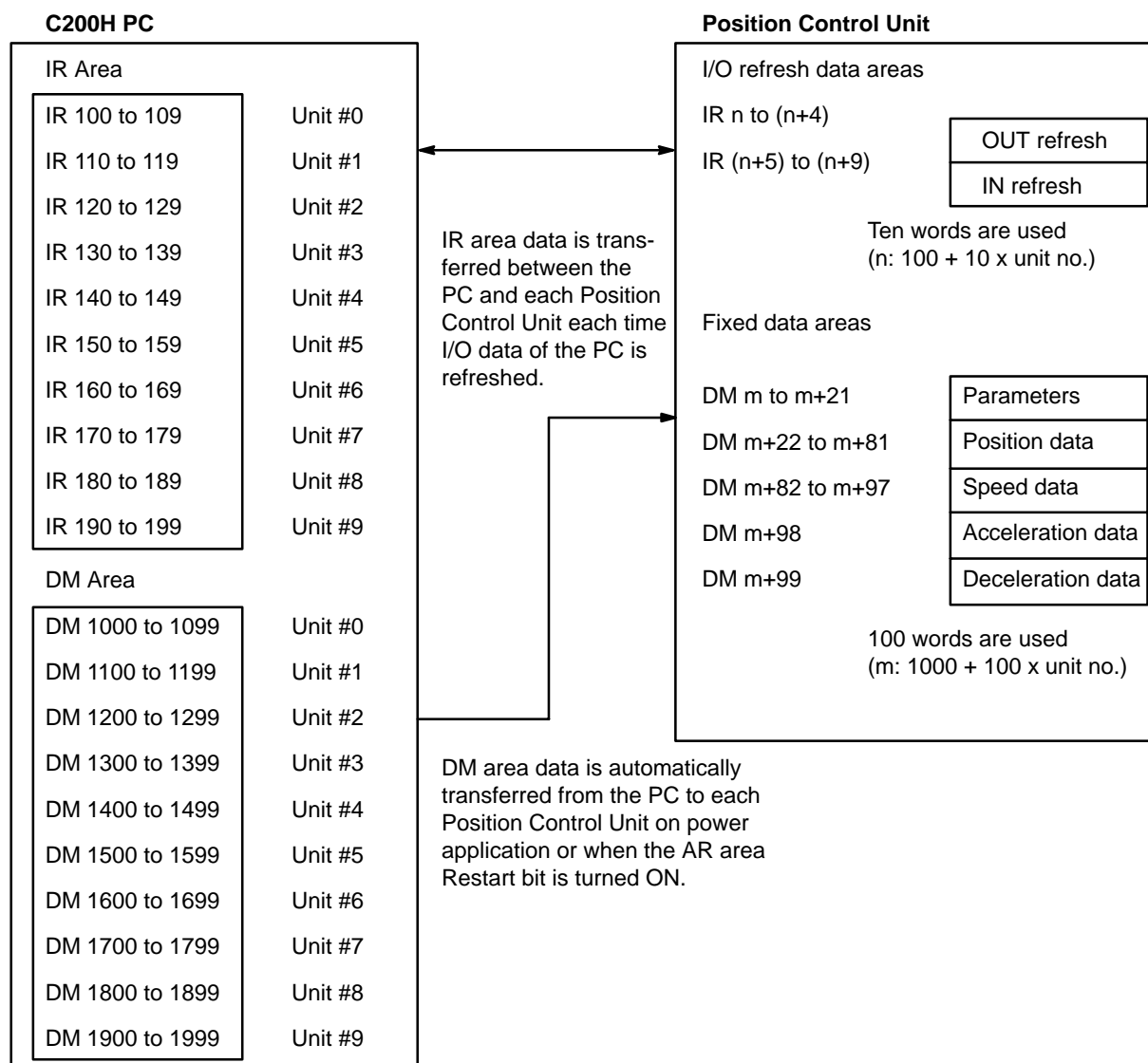
$$n = 100 + 10 \times \text{unit number.}$$

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* and *Appendix D*.

Data Configuration



IR Area Allocations

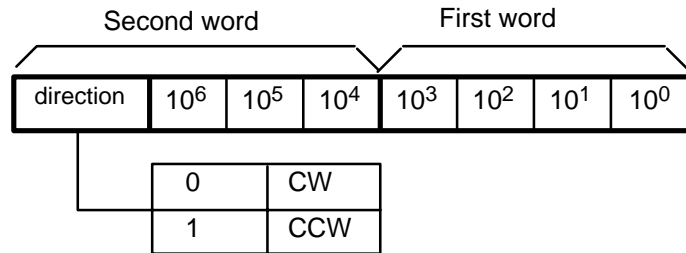
The command bits, flags, and signals you will employ when programming your control task are contained in the IR area of the PC. The following table gives an overview of the IR area allocations. “ n ” is the first IR word allocated to the Unit and equals 100 plus 10 times the unit number.

Word		n	n+1	n+2	n+3	n+4
Bit	00	START	Initial positioning action number	Speed coefficients	Beginning word TRANSFER DATA)	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		Deviation counter reset		
	07	Valid speed coefficient		Origin adjustment		
	08	RESET ORIGIN	TEACH positioning action no. 00 to 19	Beginning transfer no.		Number of transfers (for TRANSFER DATA)
	09	TEACH				
	10	TRANSFER DATA				
	11	HIGH-SPEED JOG				
	12	INCH/JOG direction				
	13	LOW SPEED JOG				
	14	INCH				
	15	STOP		TRANSFER DATA type		

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		Positioning completed input	Present position (leftmost 3 digits)	
	08	Zone 2 flag		Output code		
	09	Teaching completed flag				
	10	Transfer completed flag				
	11	No-origin flag		Emergency stop input		
	12	Busy flag				
	13	CW limit flag				
	14	CCW limit		External interrupt input		
	15	STOP flag		Origin input		
		Origin proximity input				

3–5 DM 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.

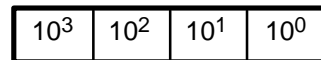


Note that the rightmost word is always the first word. If the two words were $m+8$ and $m+9$, for example, the rightmost word would be $m+8$ and the leftmost would be $m+9$. Furthermore, the rightmost digit in each word begins in the lowest bits. Thus, the digits $\times 10^4$ and $\times 10^0$ above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

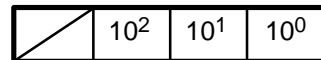
Speeds, Acceleration, and Deceleration

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

Speeds



Acceleration and Deceleration



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 first word and rightmost 12 bits of the second 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* 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 following table 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*.

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

3–7–1 Zones

A zone is a range of positions or values which can be defined so that flags in the IR area are turned ON whenever the present position is within the range. You can set up to three zones in the DM area. A zone flag is ON (1) when the

present position is within the zone; OFF (0) when it is not. You can set zones to cover a wide range of positions or only part of a single positioning action. Zones can also be set to overlap, if you wish. For an 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: DM m+9 and m+10, 7 digits with direction

Zone 0 CCW limit: DM m+11 and m+12, 7 digits with direction

Zone 1 CW limit: DM m+13 and m+14, 7 digits with direction

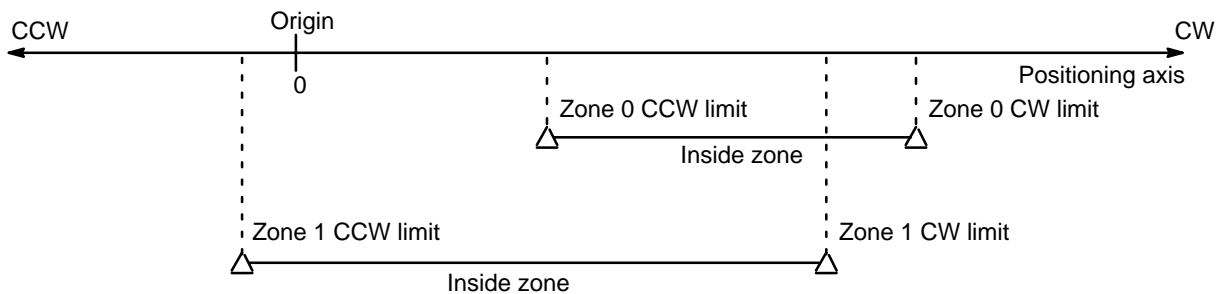
Zone 1 CCW limit: DM m+15 and m+16, 7 digits with direction

Zone 2 CW limit: DM m+17 and m+18, 7 digits with direction

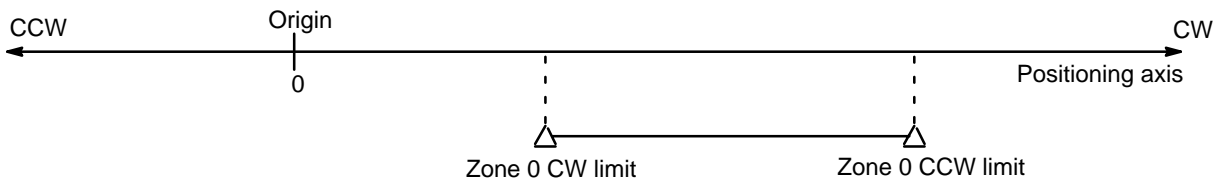
Zone 2 CCW limit: DM m+19 and m+20, 7 digits with direction

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

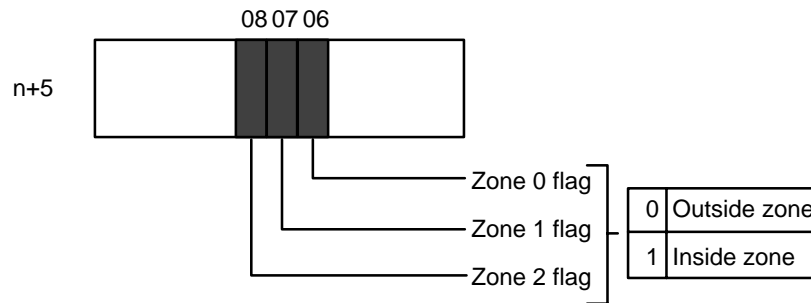


Example 2: Incorrect Setting



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

There may be a certain amount of mechanical play present in gears, that will affect positioning accuracy when the direction of positioning actions changes. You can compensate for this by using backlash compensation.

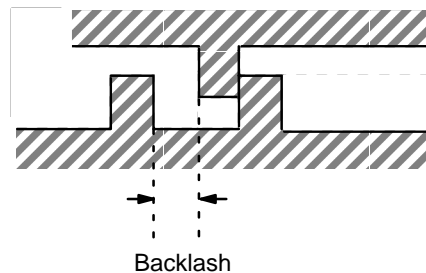
Setting Parameters

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

Backlash Compensation

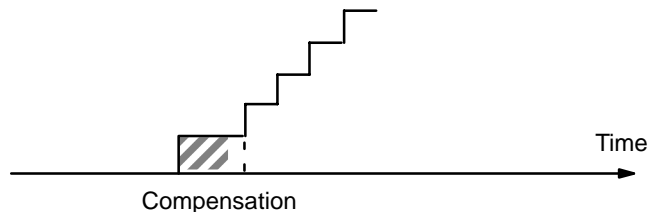
DM m+4

Set to between 0000 and 9999 pulses.

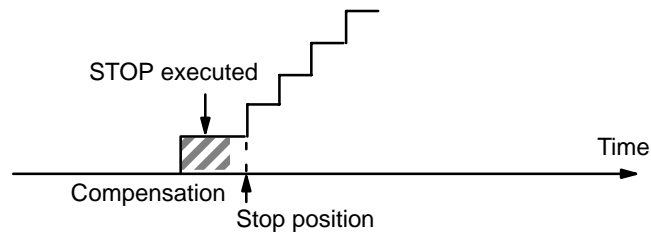


Using Backlash Compensation

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

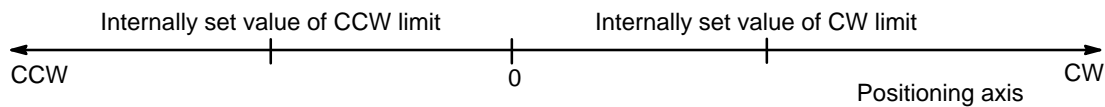


If STOP is executed during backlash compensation for any operations requiring acceleration or deceleration (HIGH-SPEED JOG, ORIGIN SEARCH, ORIGIN RETURN, and START), the Position Control Unit will stop feeding immediately after outputting the initial step of the acceleration or deceleration, which will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



3-7-3 Internal CW/CCW Limits

You can also make settings in the DM area to place internal limits on rotation of the axis on both the CW and CCW sides of the origin.



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

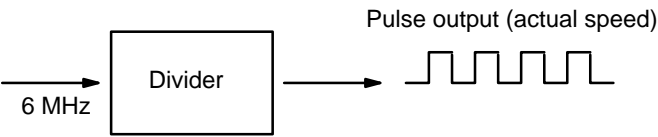
Speeds

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

Settings between 92 and 250,000 pps

Actual speed (pps) = $\frac{6,000,000}{\text{INT}(6,000,000/\text{set value})}$

where,
INT: Nearest integer
INT(6,000,000/set value): Divider ratio
pps: Pulses per second



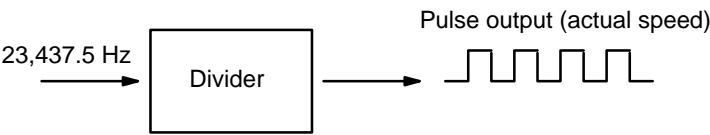
The slight difference occurs because a 6-MHz source clock is divided by the integral divider ratio.

Example Values

Set Value (pps)	Actual Speed (pps)
250,000	250,000.00
180,000	18,1818.18
140,000	142,857.14
95,000	95,238.10
3,500	3,500.58
92	92.00

Settings between 1 and 91 pps

Actual speed (pps) = $\frac{23,437.5}{\text{INT}(23,437.5/\text{set value})}$



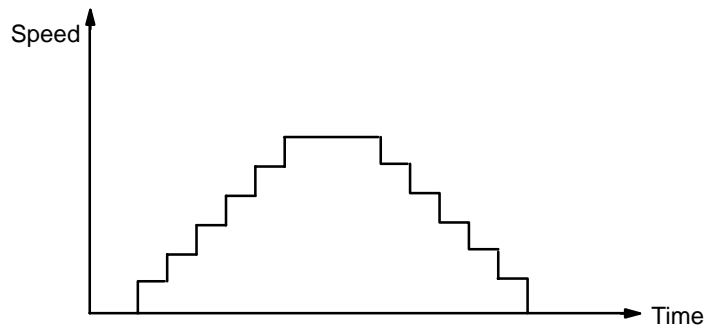
A 62.5-KHz source clock is divided by the integral divider ratio.

Example Values

Set Value (pps)	Actual Speed (pps)
91	91.20
60	60.10

**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 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, ΔV , 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 250,000).

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, ⁴

r: Acceleration or deceleration data, whichever smaller

R: Acceleration or deceleration data, whichever greater.

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

At this time, the time for one step of the smaller of the acceleration or deceleration data is obtained as follows:

$$T = \frac{(\Delta V/r)}{L}$$

3. Next, the speed difference (Δv) 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	Divider ratio
1	MIN	
2	MIN + Δv	
3	MIN + 2 Δv	
⋮	⋮	
L	MAX	

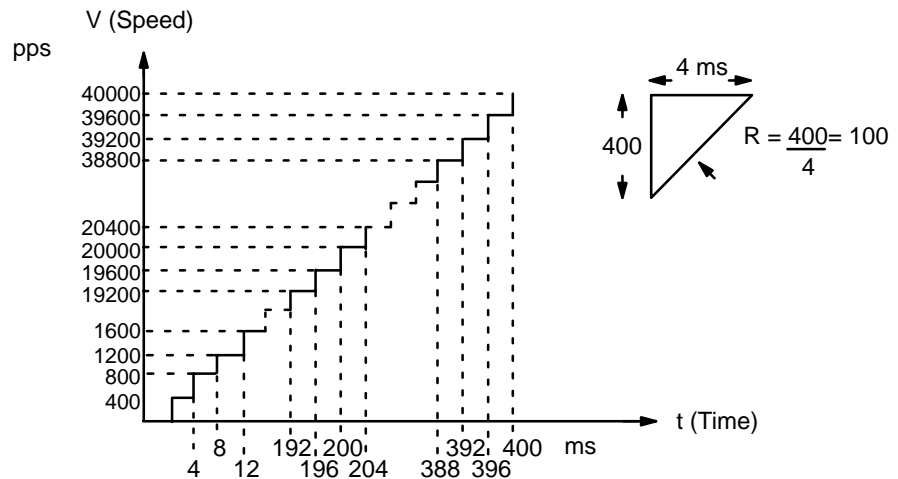
5. Example

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” completion codes.

External Interrupt Response Time

The time required between CHANGE SPEED or STOP command bit recognition and the beginning of execution is at least 4 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: $0.1 \text{ s} + k$ (scan time)

When Speed Data (Transfers #20 through #25) Is Included:

Maximum: $0.2 \text{ s} + k$ (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 Position Control Unit provides thirteen commands to execute automatic and manual positioning actions, define and establish position, transfer data, and handle interrupts and errors. Any given command is executed when the program in the PC turns ON the appropriate command bit in the IR area. In addition to the command bits themselves, the IR area contains certain other data which are necessary for executing commands.

In executing commands, the Position Control Unit makes use of data stored in the DM area. This data includes settings for speeds, positions, and so on. Although the data required for execution is listed under each command, much of this data is used by more than one command. Refer to *Section 3-4* for an outline of the structure of Position Control Unit data, and to *Section 3-5* for format specifications for particular types of data. *Appendix C* and *Appendix D* also provide convenient overviews of data allocation. Applications of most commands are presented in *Section 5*.

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4–1 **START**

Execution of positioning actions begins when the program turns ON the START command bit, bit 00 of IR word n (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, depending on another setting you make 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. (For an explanation of "single" and "bank end" positioning actions, see *Completion Codes* under *Section 4–1–1* below.)

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

4–1–1 **DM Area Settings**

Words 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. Before positioning actions can be executed, you must make all of the necessary data settings in the DM area. (For an explanation of data configuration, refer to *Section 3–4*.)

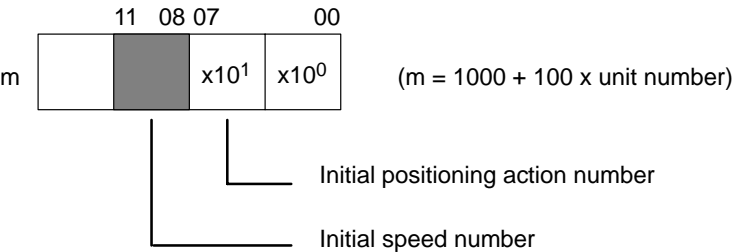
Initial Positioning Action Number

DM word m, bits 07 to 00

Set to a value between 00 and 19. This number is used for the following:

- 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

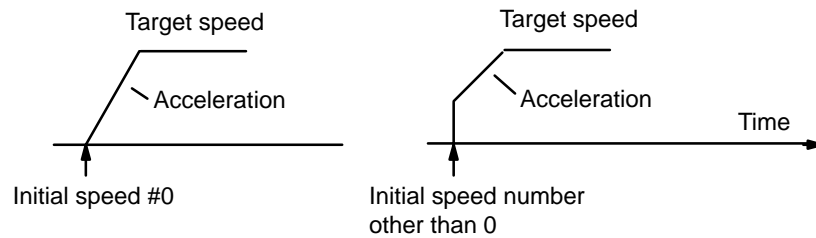
If bit 01 of IR word n is set to 1, the initial positioning action number designated in the IR area is used for the initial START after turning on the Unit, allowing for a different starting point for positioning system initialization.



Initial Speed Number

DM word m, bits 11 to 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.

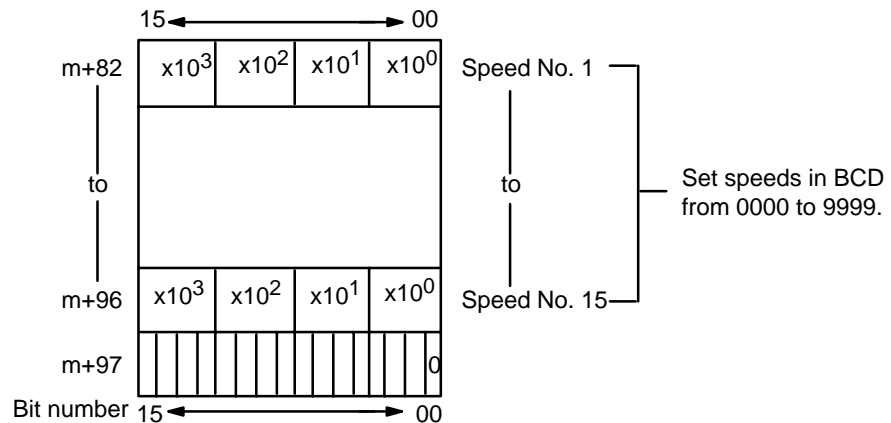


Speeds

DM words m+82 through m+96

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

You can set up to fifteen speeds in these DM words, numbered from one to fifteen. To each of these values, you assign a speed unit (in word m+97), which multiplies the corresponding speed by 1, 10, or 100. You can then refer to these settings by number to set speeds for START and several other commands.



Speed Units

DM word m+97

You assign each of the bits in this word to one of the speeds you previously set in words m+82 through m+96. Speed unit multiplication is affected by bit 04 of DM word m+3 as follows:

m + 97 bit*	M+3, bit 04	Condition
0	0	Speed multiplied by 1
	1	Speed multiplied by 10
1	0	Speed multiplied by 1
	1	Speed multiplied by 100

*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 15 to 00, 3 digits

Set from 2 to 2,000 (BCD). Acceleration is in pps per ms.

Deceleration

DM word m+99, bits 15 to 00, 3 digits

Set from 2 to 2,000 (BCD). Deceleration is in pps per ms.

4-2 Positioning Actions

DM words m+22 through m+81

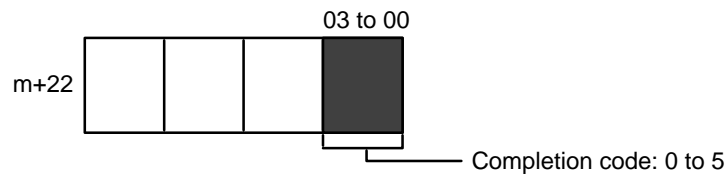
The fundamental unit of positioning is the positioning action. In C200H-NC112 Position Control Units, each positioning action is defined by its completion code, dwell time, output code, speed number, and target position, all of which are explained below.

Positioning 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* for detailed word and bit allocations.

Completion Code

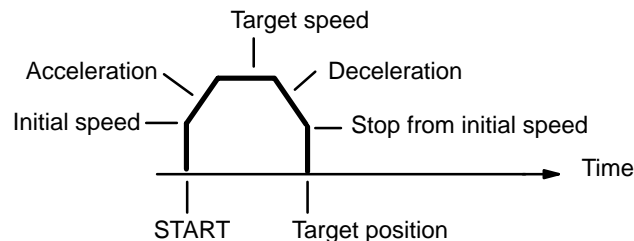
DM word m+22, bits 03 to 00

Each positioning action must be assigned a completion code. A completion code is a setting that specifies what is to happen when the positioning action has been completed. You can select any of six completion codes, all described in detail below, by setting these bits anywhere from 0 to 5. For further explanation, see also *Section 4-1-3*.



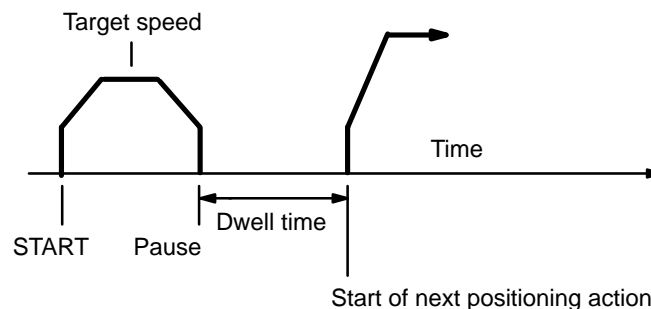
0: Single

If you designate a positioning action as “single”, then it will be executed in accordance with the data set for it and will not directly affect the subsequent positioning action (except, of course, for its initial position). The target position is reached and feeding stops. After completion of this action, START is necessary in order to execute the next positioning action(s).



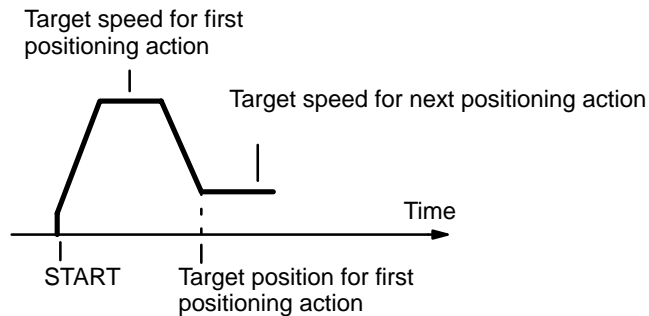
1: Pause

If you designate a positioning action as “pause”, it will execute in accordance with the data set for it, pause, and then automatically start the next positioning action. After the target position is reached, positioning will pause for the dwell time (see *following Dwell Time* diagram). The next positioning action is automatically started following the dwell time.

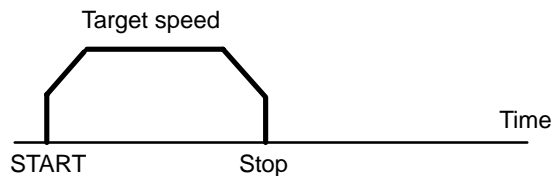


2: Continuous

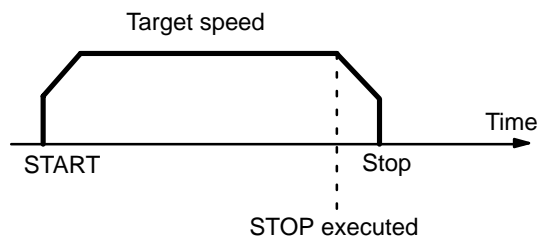
If you designate a positioning action as “continuous”, then as soon as the target position for that positioning action is reached, the next positioning action is started. The first target position is reached at the target speed set for the next positioning action, so that the next positioning action can be executed immediately.

**3: Bank end**

The term “bank” refers to a combination of several positioning actions or sequences. If you designate the positioning action as “bank end”, it will serve as the final positioning action in that bank. The target position is reached and feeding stops. The next positioning action to be executed will be the initial positioning action number in bits 07 to 00 of DM word m. START is required in order to resume execution of positioning actions.

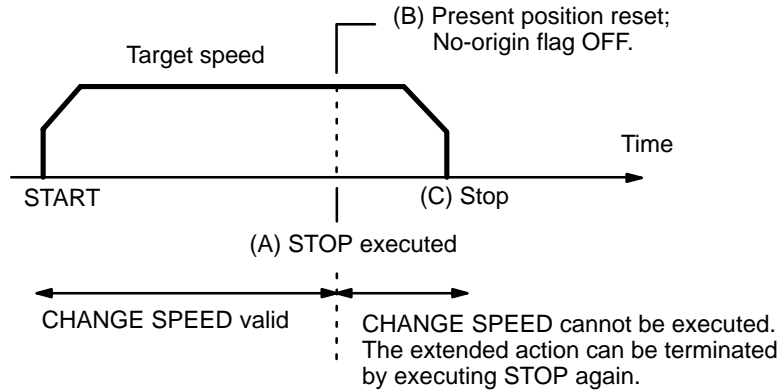
**4: Extended**

If you designate a positioning action as “extended”, the Position Control Unit will continually output pulses, at the speed set for the positioning action, until the action is terminated by STOP. The Unit will not calculate the present position, and the No-origin flag (bit 11 of IR 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*.) START is required in order to resume execution of positioning actions.

**5: Extended With Positioning**

If you designate a positioning action as “extended with positioning”, the Position Control Unit continually outputs pulses at the speed set for the positioning action. This is similar to “extended”, described above. When STOP is executed, however, the present position that was defined when the positioning

action was started is reset and positioning is executed according to the data set for the positioning action. The Unit will not calculate the present position, and the No-origin flag (bit 11 of IR n+5) will go ON during operation. The direction of pulse output is determined by the direction bit set for the positioning action. START is required in order to resume execution of positioning actions.

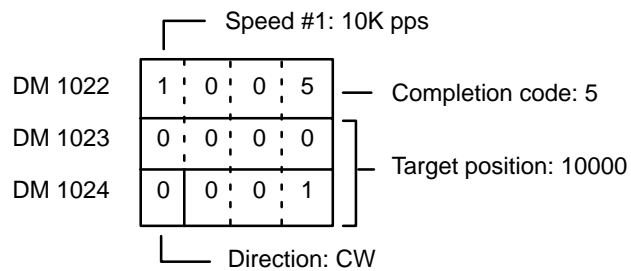


Note STOP can be executed by either an external input signal or by IR word n, bit 15. For details, refer to *Section 4-10-1*.

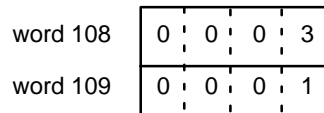
Delay Time

From position A to position B in the above diagram, there is a delay time of approximately 2 ms for internal processing (scan time). From position B to position C, there may be a maximum additional delay time of 2 ms. The delay time between points A and B does not affect the present position set in words n+8 and n+9. During the delay time between B and C, the present position in those words is reset to 0 and then updated. The delay time is also output in those words.

Example: Positioning Action #0 for Unit #0



After STOP, the present position is as follows:



In this example, the present position after operation has stopped is 10003. Since the target position was 10000, the actual position has exceeded the target position by 3 pulses. Since the speed was set to 10K pps, $3/10,000 = 0.0003 \text{ s} = 0.3 \text{ ms}$. Thus the delay time is 0.3 ms.

If the target position is near the position at which STOP is executed, pulse output will cease before deceleration is completed. However, no error code will be output.

Dwell Time

DM word m+22, bits 07 to 04

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

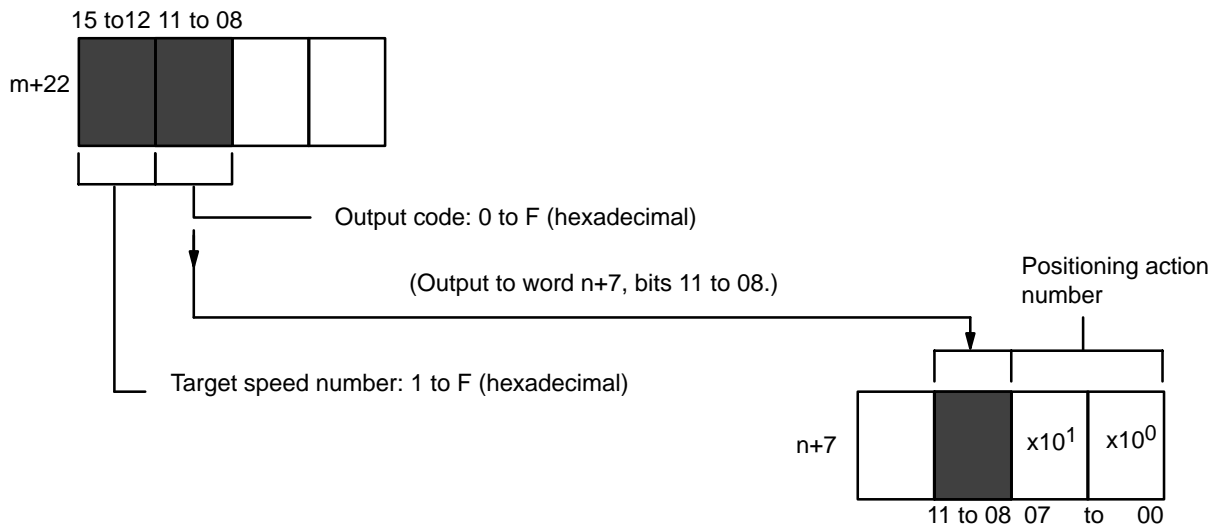
You can set a dwell time for however long you want positioning to pause. The next positioning action can be executed when the Busy flag turns OFF after the dwell time has expired. In other words, the Positioning Completed flag remains OFF and the Busy flag remains ON until the dwell time has expired. (See *Section 4-1-3*.)

Output Code

DM word m+22, bits 11 to 08

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

Output codes are user-defined codes output to IR word n+7, bits 11 to 08, of the OUT refresh area following completion of a positioning action.

**Target Speed Number**

DM word m+22, bits 15 to 12

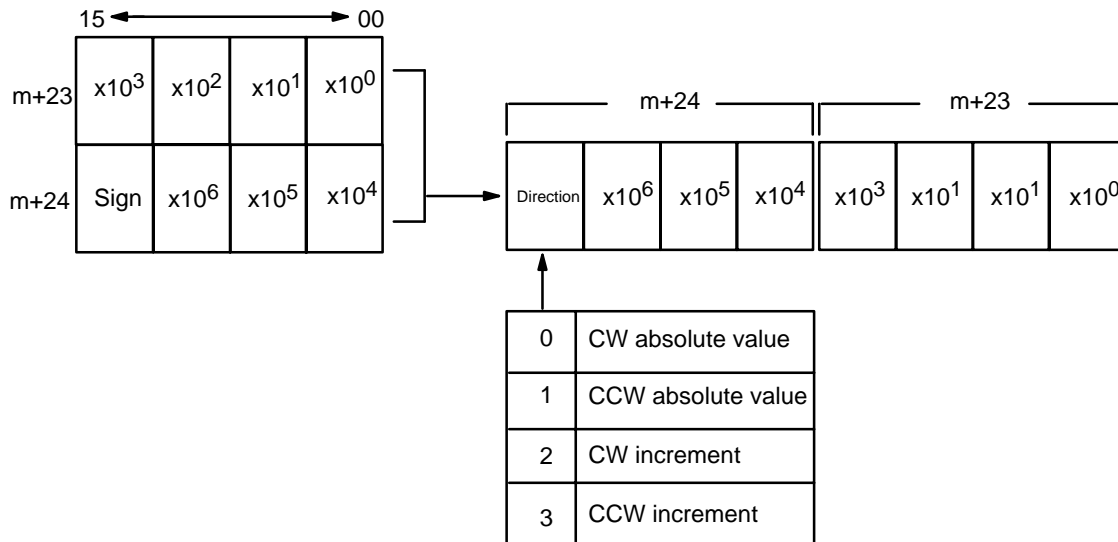
Set to a value between 1 and F (hex).

The speed number which you set here refers to the speeds which you previously set in DM words m+82 through m+96 (see *Speeds* above).

Target Position

DM words m+23 through m+24

The target position is set with the rightmost seven digits, i.e., all four digits of word 23 and the rightmost three digits of word 24. The remaining digit of word 24 is used as a direction digit. (See *Appendix C*.)

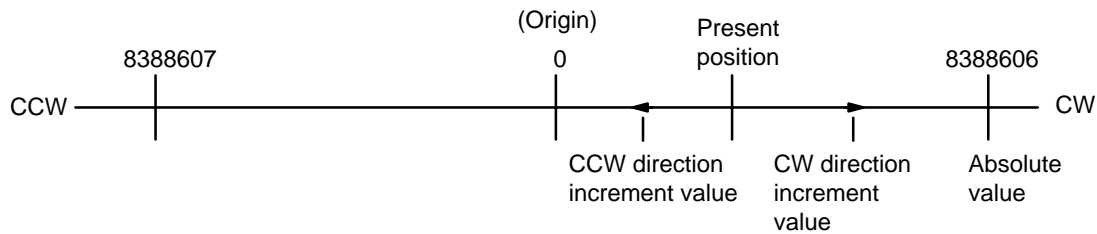


Maximum values are as follows:

CW: 8,388,606 pulses

CCW: 8,388,607 pulses

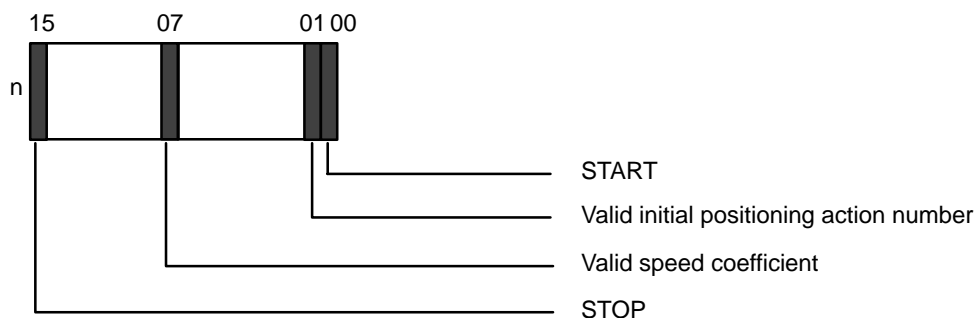
Absolute values are measured from the origin. Increment values are measured from the present position. Positions resulting from increments (i.e., present value plus the increment) must be between -8,388,607 and +8,388,606.



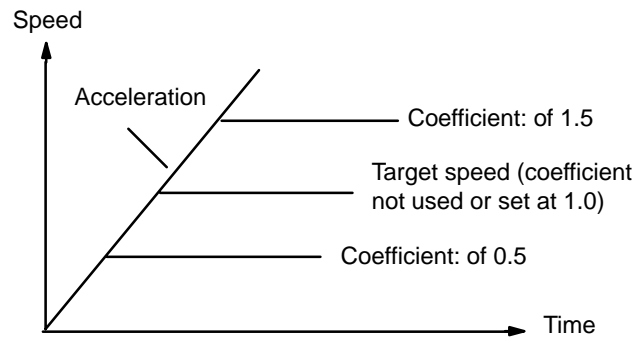
Note The TEACH command can be used to write target positions into the DM area. See *Section 4-7* for details.

4-2-1 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 *Section 3-4*. For a detailed table of words and bits in the IR area, see *Appendix D*.



START	<p>IR word n, bit 00</p> <p>When the program turns this bit ON (i.e., sets it to 1), bits 01 and 07 are referred to and positioning begins.</p>
Valid Initial Positioning Action Number	<p>IR word n, bit 01</p> <p>This is used when the initial positioning action number is designated in the I/O refresh areas. After the initial positioning action is set with bits 07 to 00 of IR word n+1, the START command is executed according to bit. These values are valid when set within the same scan.</p> <ul style="list-style-type: none"> 1: Initial position number set in bits 07 to 00 of IR word n+1 is valid. 0: Initial position number set in bits 07 to 00 of DM word m is valid.
Valid Speed Coefficient	<p>IR word n, bit 07</p> <p>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 IR word n+2, the START command is executed according to bit. These values are valid when set within the same scan. This bit can function simultaneously with bit 01 (described above).</p> <ul style="list-style-type: none"> 1: Coefficient in bits 07 to 00 of IR word n+2 is valid. 0: Coefficient is 1.0.
Deceleration/Stop Command (STOP)	<p>IR word n, bit 15</p> <p>The program turns this bit ON to execute STOP. Pulse output cannot be resumed as long as this bit remains ON. See <i>Section 4–10–1</i> for a more detailed explanation and several STOP execution examples.</p>
Initial Positioning Action Number	<p>IR word n+1, bits 07 to 00</p> <p>Set to an integer between 00 and 19.</p> <p>START will be executed from the positioning action specified here if bit 01 of IR word n is 1 when the START command bit (bit 00 of IR word n) is set.</p>
Speed Coefficient	<p>IR word n+2, bits 05 to 00</p> <p>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.</p> <p>This coefficient is valid if bit 07 of IR word n is 1 when the START command bit (bit 00 of word n) is turned ON (i.e., set to 1). It is valid only for START and cannot be changed during positioning, passes, or dwell time.</p> <p>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.</p> <p>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.</p>

**Deviation Counter Reset**

IR word n+2, bit 06

Bit 06 is only valid during STOP. The deviation counter reset output (A6, B6) is ON if this bit is set to 1, and OFF if it is set to 0.

Origin Adjustment

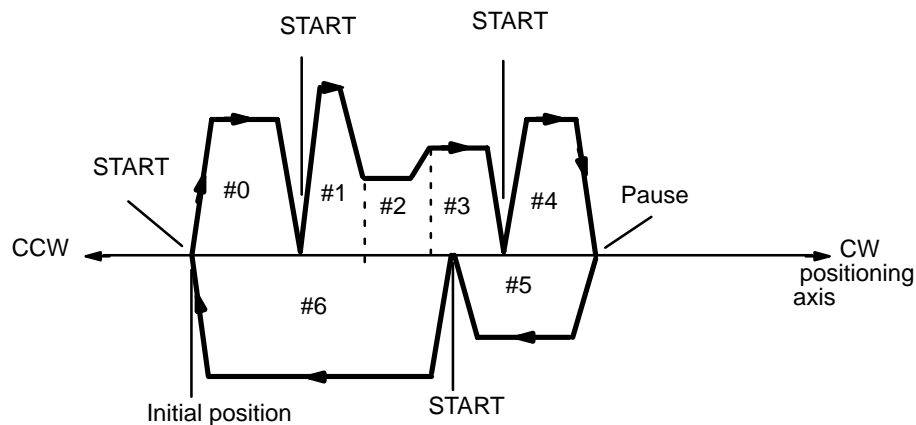
IR word n+2, bit 07

Bit 07 is only valid during STOP or manual operations (JOG or INCH). The origin adjustment signal is turned ON if this bit is set to 1, and remains OFF if it is set to 0.

4-2-2 Execution Examples

Example 1: Using Completion Codes

The example diagram on the following page illustrates the use of completion codes. 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 to 0, making it a single action. Positioning stops after completion of this action, and START is necessary for operation to begin again.

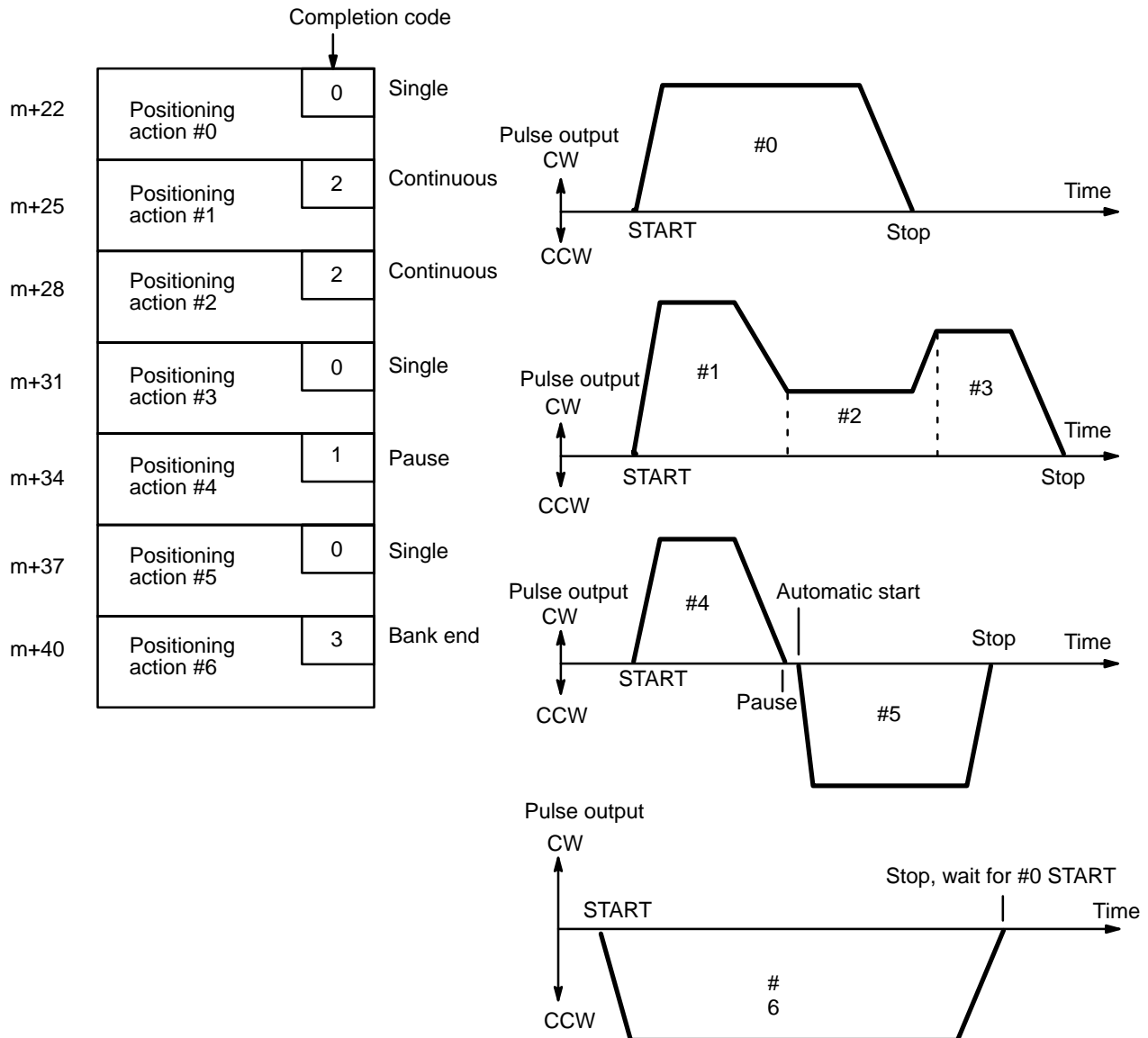
The completion codes for positioning actions #1 and #2 are set at 2, making them continuous actions. Positioning actions #1, #2, and #3 are thus executed consecutively, with each action reaching its target position at the target speed set for the subsequent action. The completion code for positioning 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.

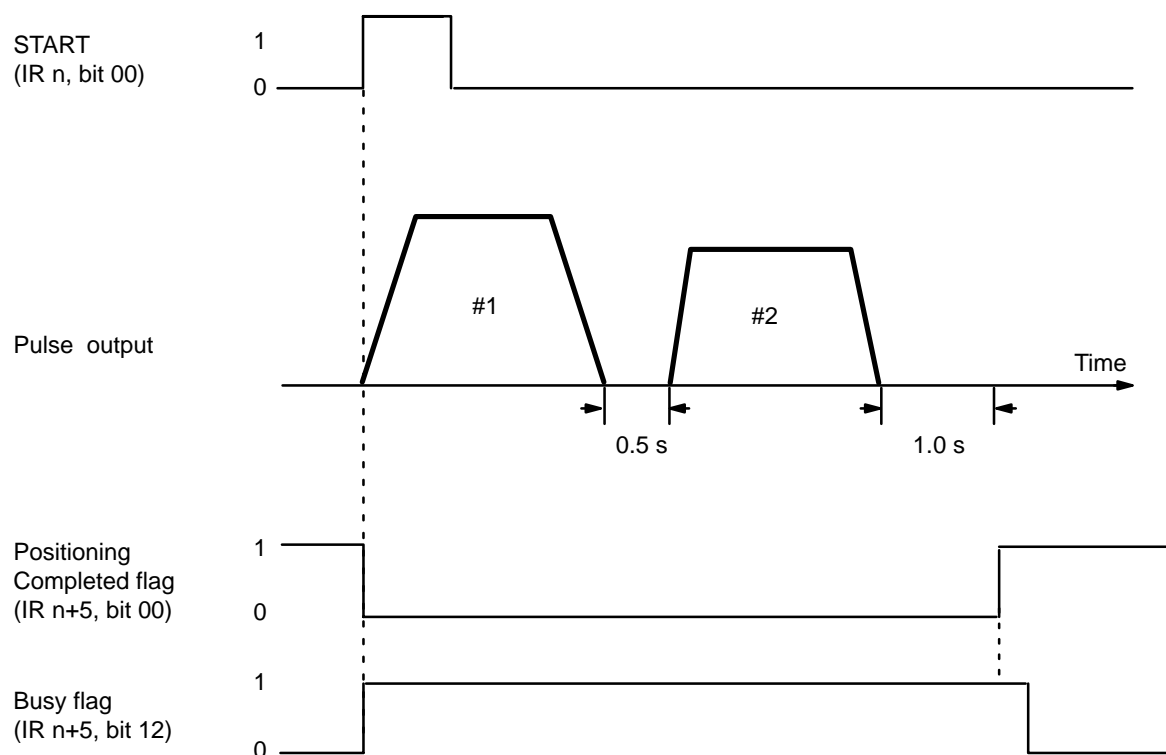
The completion code for positioning action #6 is set at 3, making it a bank end. Completion of this action will thereby signal completion of the entire bank of actions. Upon completion of this action, the Unit will be prepared to execute positioning action #0 but will wait for START before beginning.

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



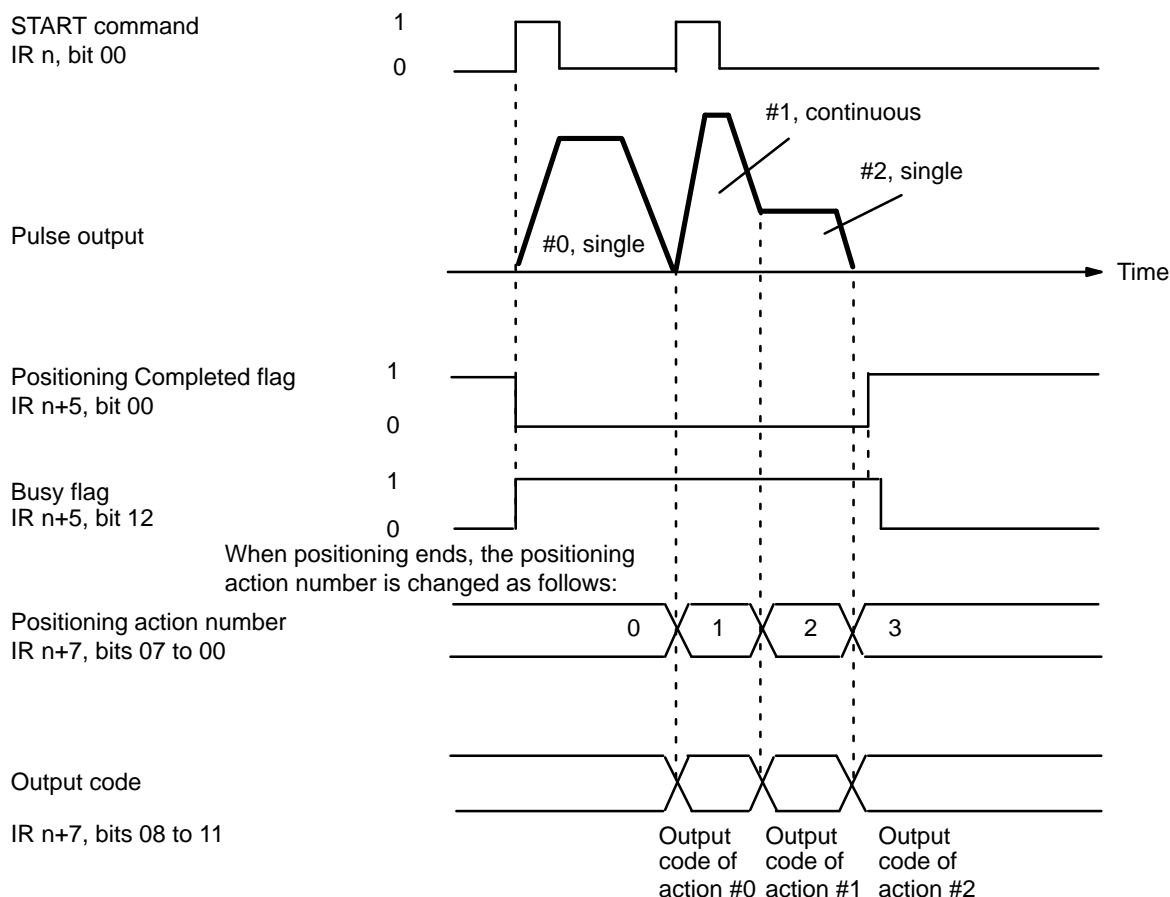
Example 2: Using Dwell Times

The following example diagram illustrates the use of dwell times. 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 *Section 4-10*.)



4-3 ORIGIN SEARCH

Before positioning actions can be executed, the origin must be defined as a reference point. The main method for this is ORIGIN SEARCH. The program executes ORIGIN SEARCH by turning ON the ORIGIN SEARCH command bit, bit 02 of IR word n. When this bit is turned ON, the Position Control Unit establishes 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 *Section 2-1* 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.

4-3-1 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 *Section 4-1*.

Initial Speed Number	Bits 11 to 08 of DM word m
Speeds	DM words m+82 through m+96
Speed Units	DM word m+97
Acceleration	Bits 15 to 00 of DM word m+98
Deceleration	Bits 15 to 00 of DM word m+99

ORIGIN SEARCH Proximity Speed Number (Low Speed)

DM word m+1, bits 03 to 00

Set to 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. 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 to 04

Set to 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. The speed designated here is used only if an origin proximity signal is present.

Origin Compensation

DM words m+2 and m+3

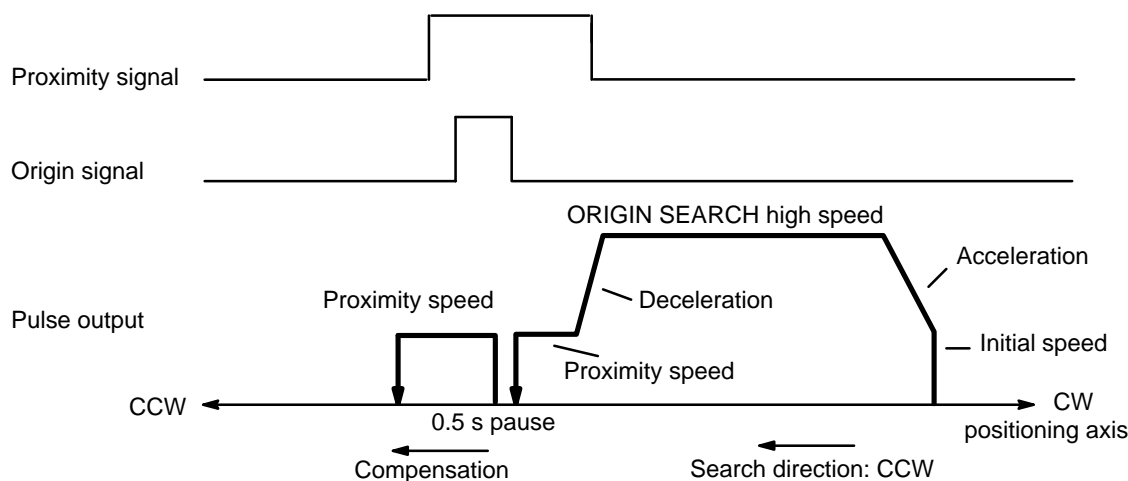
Set DM word m+2 to a value between 0000 and 9999 pulses.

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

- 0: CW
- 1: CCW

There may be cases where it is difficult to establish the mechanical origin with precision. In such cases you may want to compensate by establishing the origin a few pulses to either side of the origin signal input. If you want the position determined by origin signal input 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 *Section 4–2–3* for application.

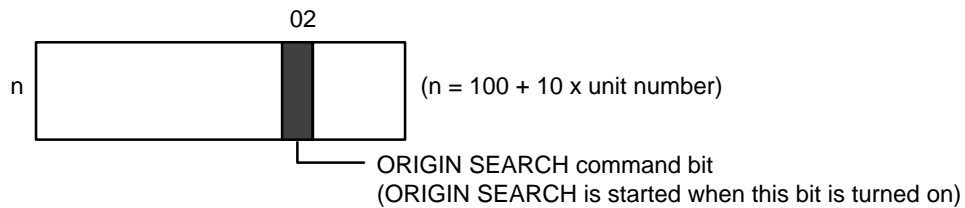
In the example diagram below, bit 00 of DM word m+3 is set at 1, so origin compensation is counterclockwise.



4–3–2 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 *Section 3–4*. For a detailed table of words and bits in the IR area, see *Appendix D*.

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



4-3-3 Execution Examples

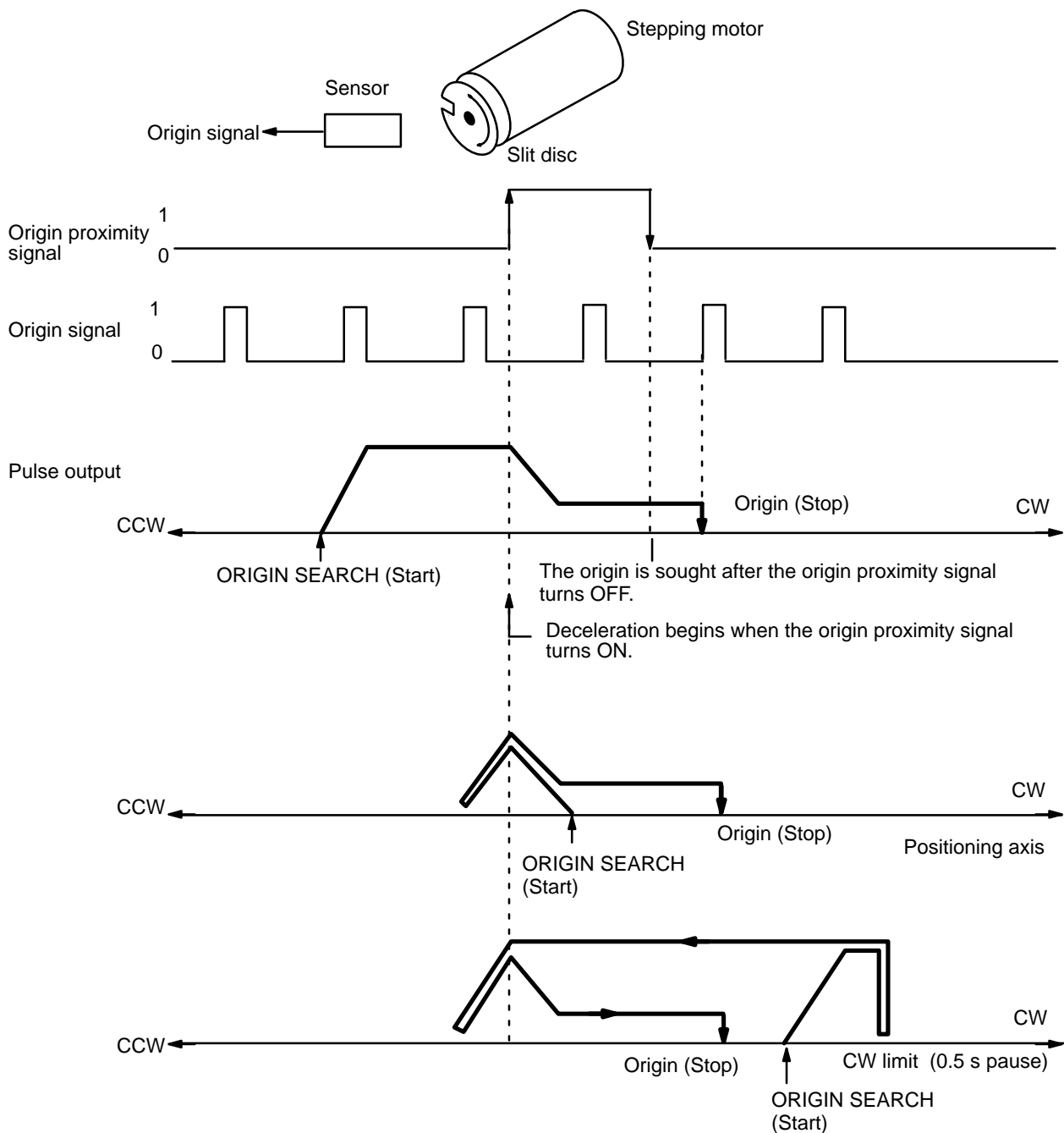
The following examples show the relationships among the mode number, DIP switch pin no. 3 (origin proximity present/absent), DIP switch pin no. 8 (origin proximity reverse present/absent) and operation. In the examples, the origin and origin proximity signals both use NC inputs (i.e., DIP switches 4 and 5 are ON).

Mode 0

Connect the open collector signals of the sensor, etc., to the origin line driver input (A11, B11) of the Position Control Unit. Origin response time is 1.0 ms. For wiring diagrams in each mode, refer to *Section 2-2*.

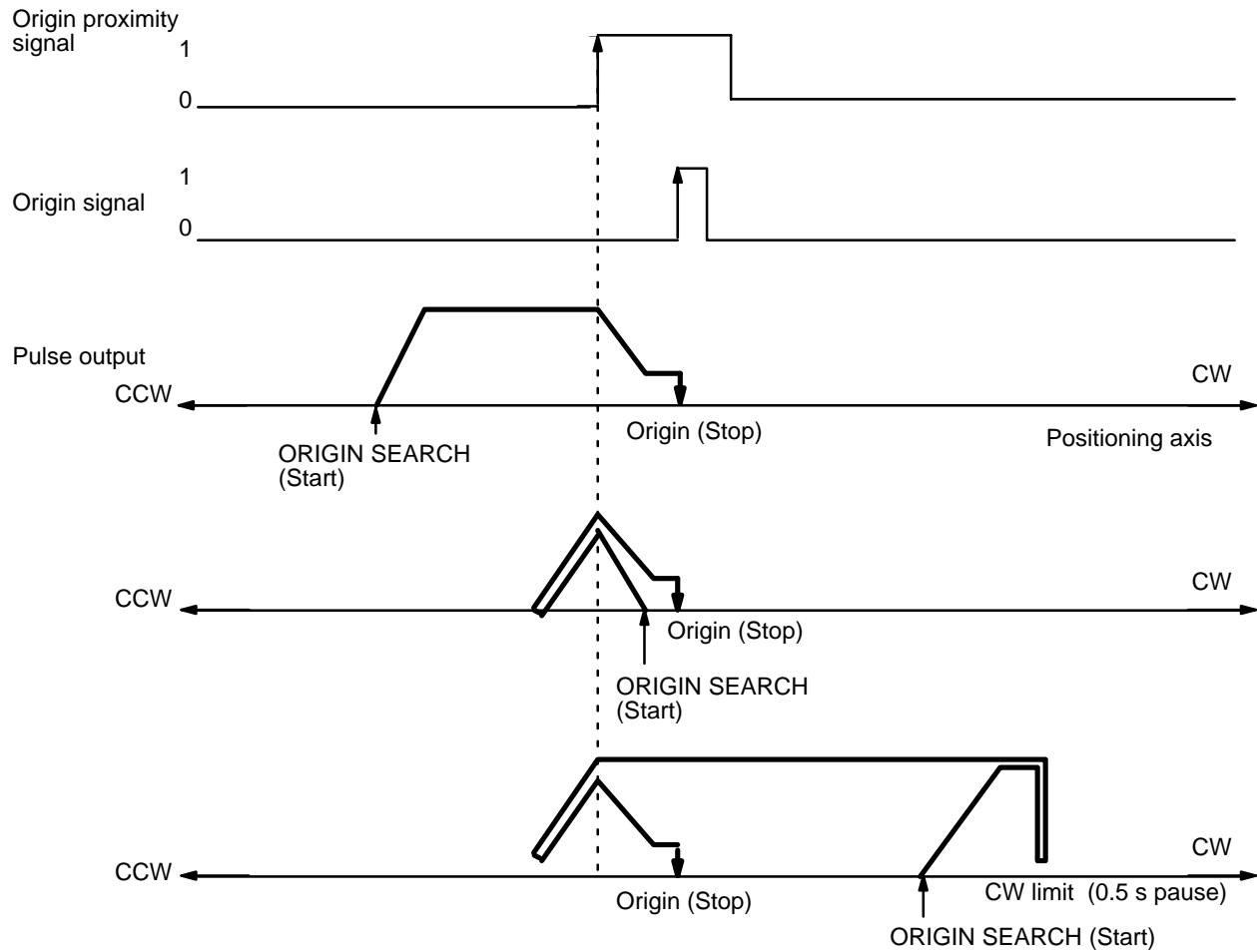
**Example 1:
When Origin Proximity
Reverse is Enabled**

As illustrated below, use the origin proximity signal to ensure sufficient deceleration time when using a slit disc for the origin signal. In this example, DIP switch pins 3 and 8 are ON. Refer to *Section 2-1*.



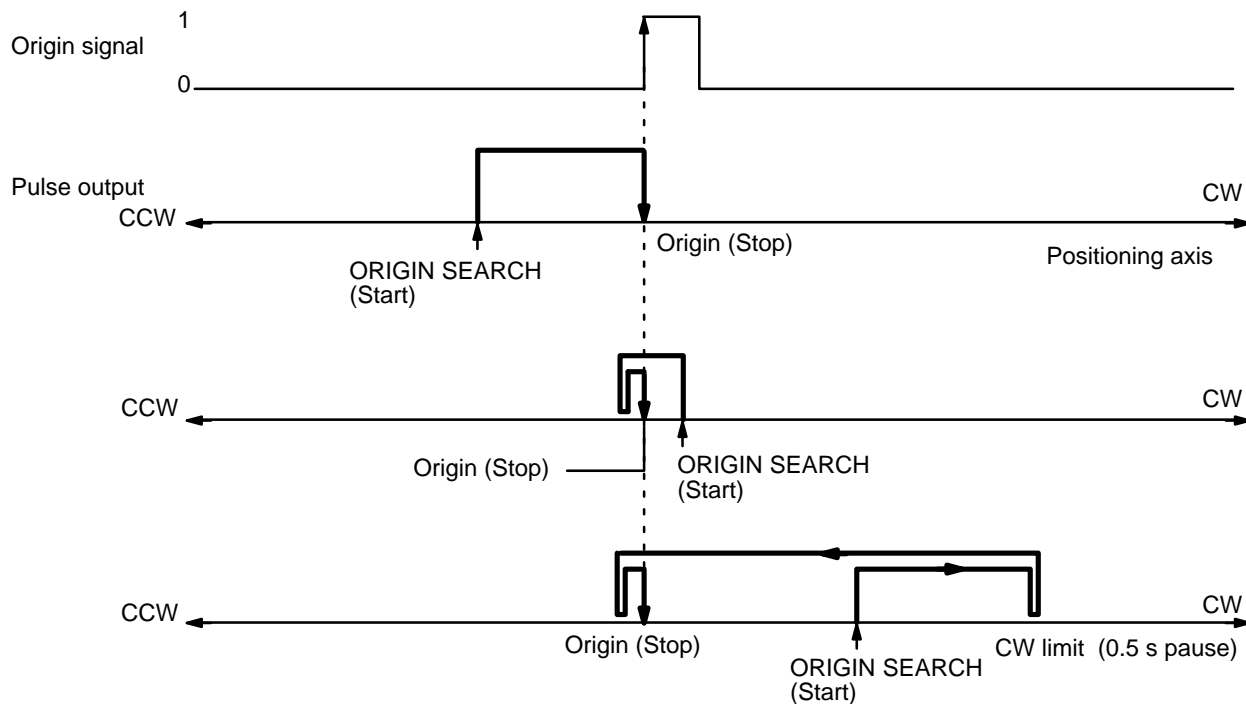
**Example 2:
When Origin Proximity
Reverse is Disabled**

In this example, DIP switch pin 3 is ON and 8 is OFF. (Refer to *Section 2-1*.)
The origin proximity signal and origin signal each occur once.



**Example 3:
No Origin Proximity Signal**

When the origin proximity signal is not needed, set DIP switch pin 3 to OFF and use only the origin signal. Positioning will be carried out completely at proximity speed (low speed).



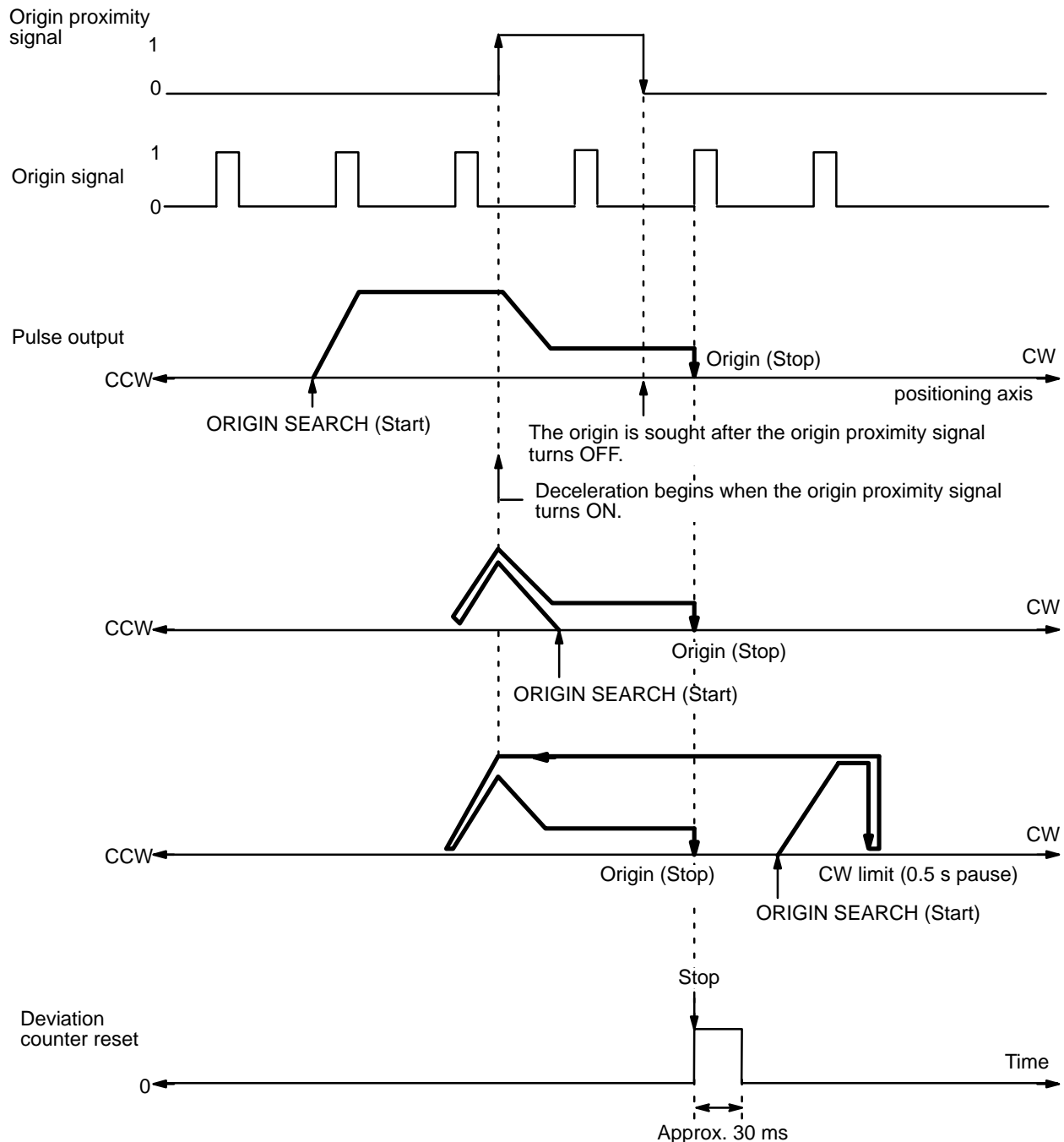
Mode 1

Origin response time is 0.1 ms. Connect to pins A8 and B8 the Z-phase signal from an encoder receiving output from the servomotor driver. For wiring diagrams in each mode, refer to *Section 2-2*.

Note In this mode, even if origin proximity is set to absent, operation is performed with origin proximity present.

**Example 1:
When Origin Proximity
Reverse is Enabled**

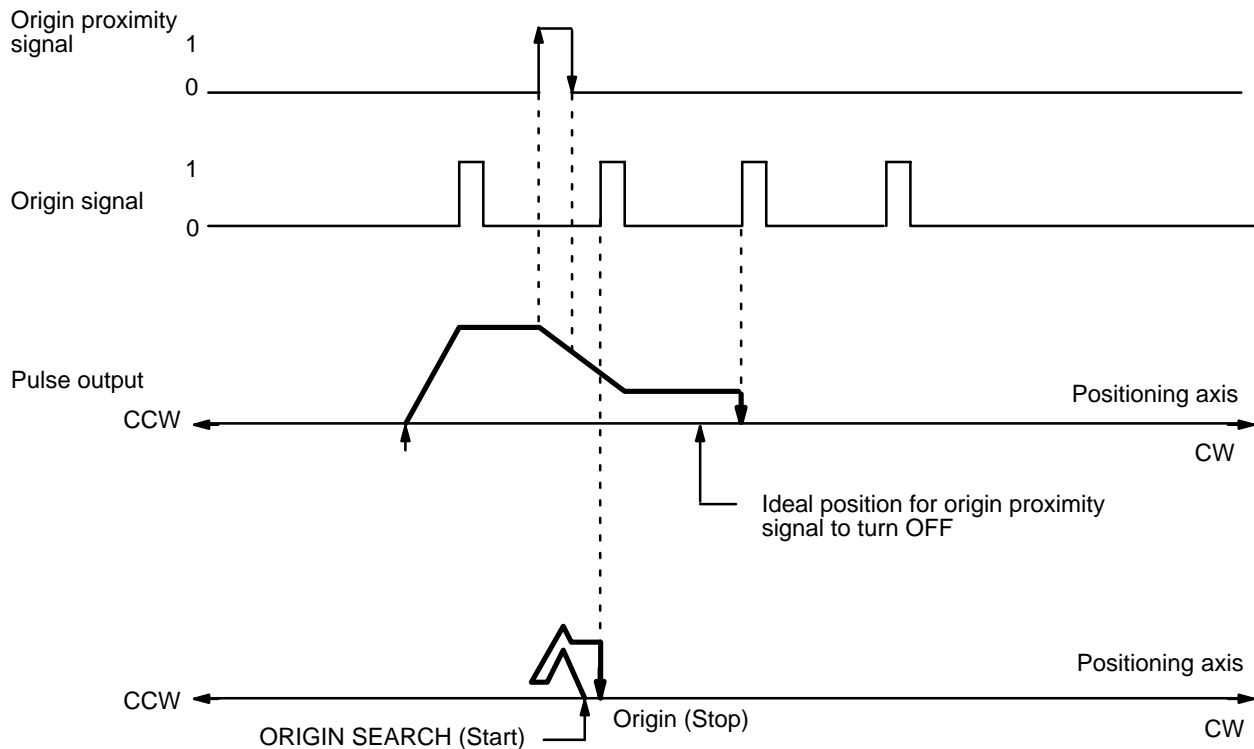
Use the origin proximity signal to ensure sufficient deceleration time when the origin proximity reverse is needed. In this example, DIP switch pins 3 and 8 are ON. For DIP switch settings, refer to *Section 2-1*.



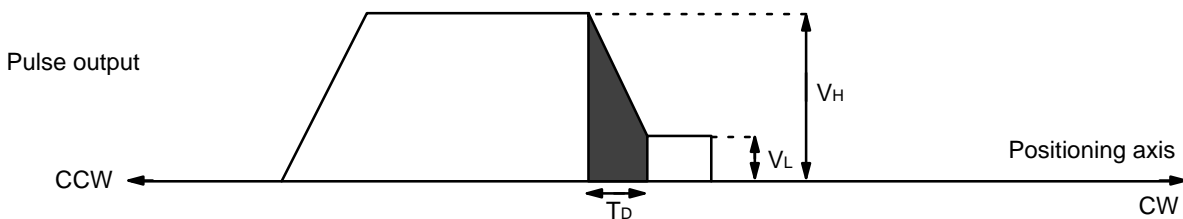
After positioning has been stopped, a deviation counter reset signal of about 30 ms is output.

In this mode, if deceleration has not ended when the origin proximity signal has turned OFF, positioning is stopped by the origin signal input after deceleration has ended. If the deceleration period is short for some reason (such as starting inside the origin proximity area), the Position Control Unit will de-

test a different origin signal. Therefore, be sure that the origin proximity signal period is long enough, i.e., at least as long as the deceleration period. The following diagram shows what can happen if this is not done.



Deceleration Time Calculations



Deceleration time:

$$T_D = \frac{V_H - V_L}{1000 \times R}$$

where R is deceleration data (pps/1 ms)

Number of pulses for deceleration period:

$$P_D = \frac{(V_H + V_L) \times T_D}{2}$$

$$= \frac{V_H^2 - V_L^2}{2000 \times R}$$

For example, where $V_H = 20000$ pps, $V_L = 1000$ pps, and $R = 1000$ pps/ms,

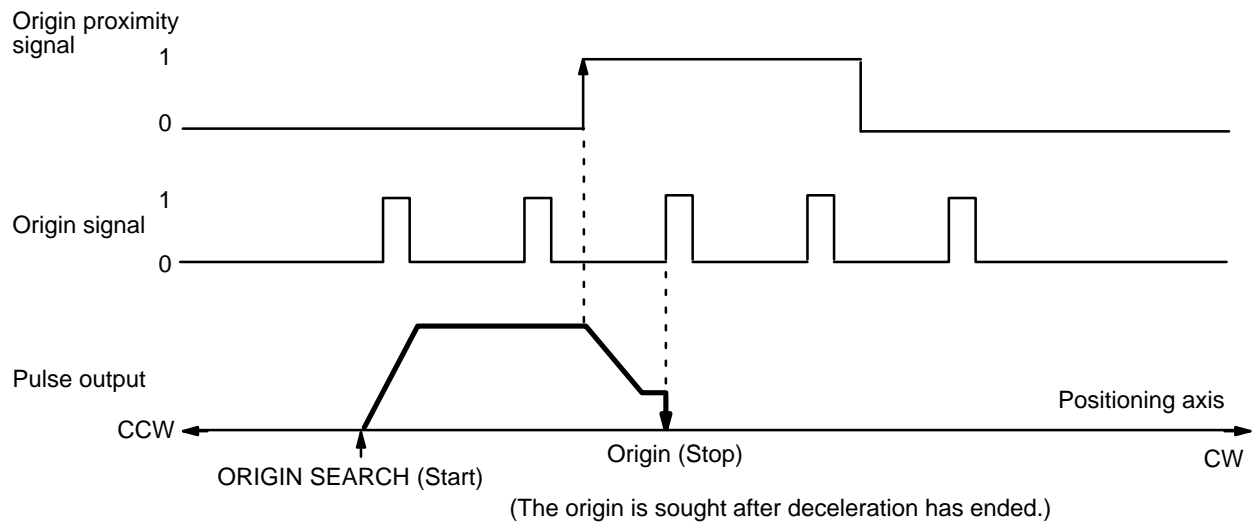
$$P_D = \frac{20000^2 - 1000^2}{2000 \times 100}$$

$$= 1995$$

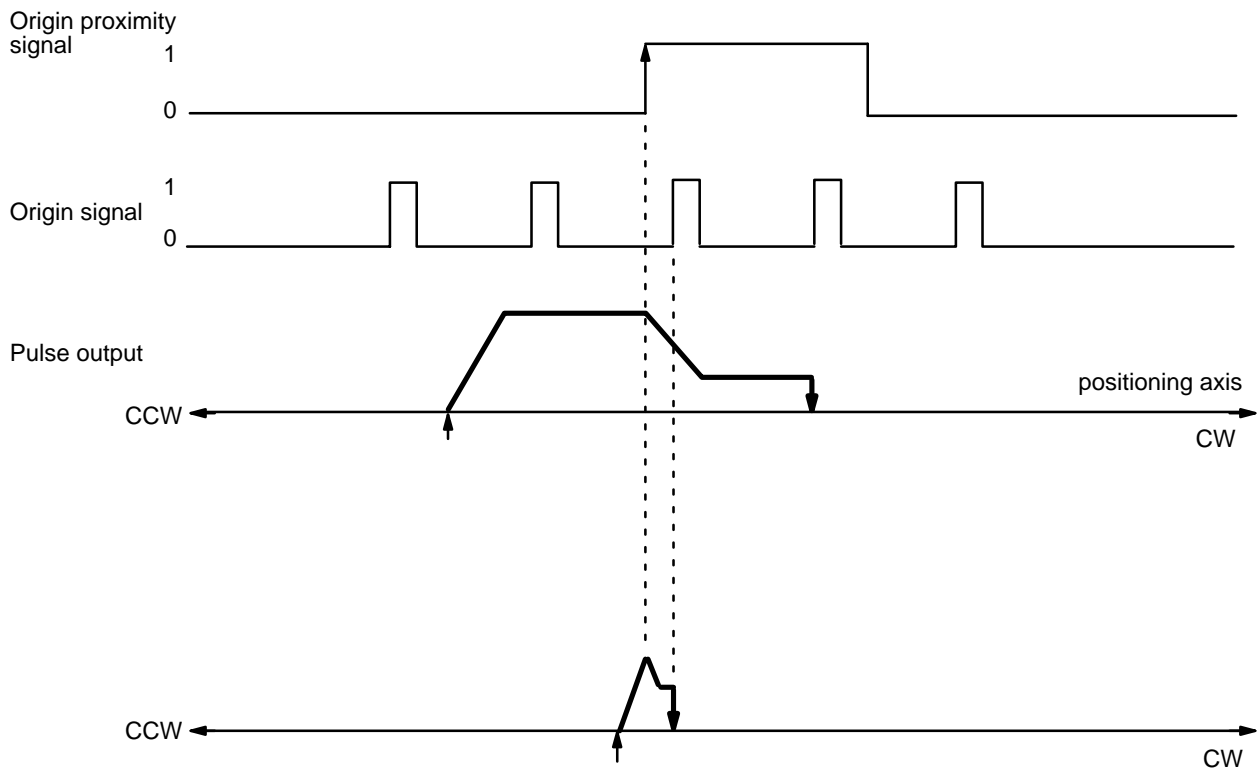
Therefore, approximately 2,000 pulses are required for deceleration.

Example 2: When Origin Proximity Reverse is Disabled

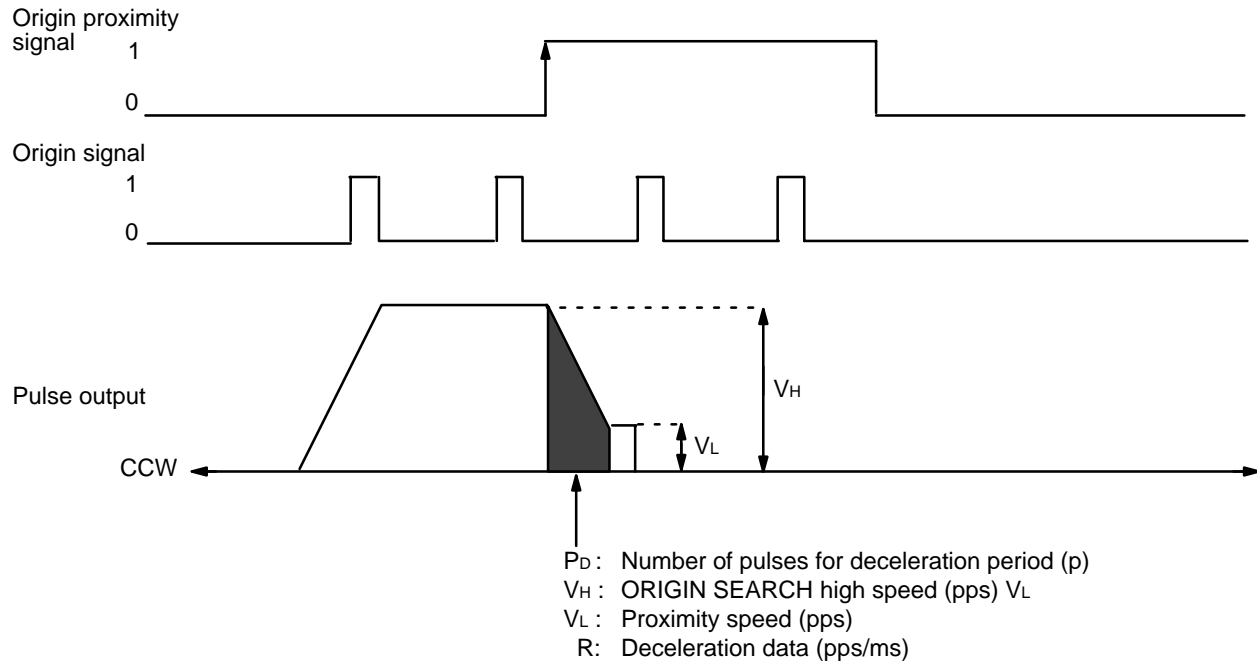
In this example, origin proximity reverse is not used. DIP switch pin 3 is ON and pin 8 is OFF. Positioning is stopped when the first origin signal has been input after deceleration has ended.



Note that if the origin signal is been input during deceleration, the stop position differs depending on the length of the deceleration period.



In this example diagram, deceleration from ORIGIN SEARCH high speed to proximity speed (low speed) is completed between the time of the origin proximity signal and the first origin signal.



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

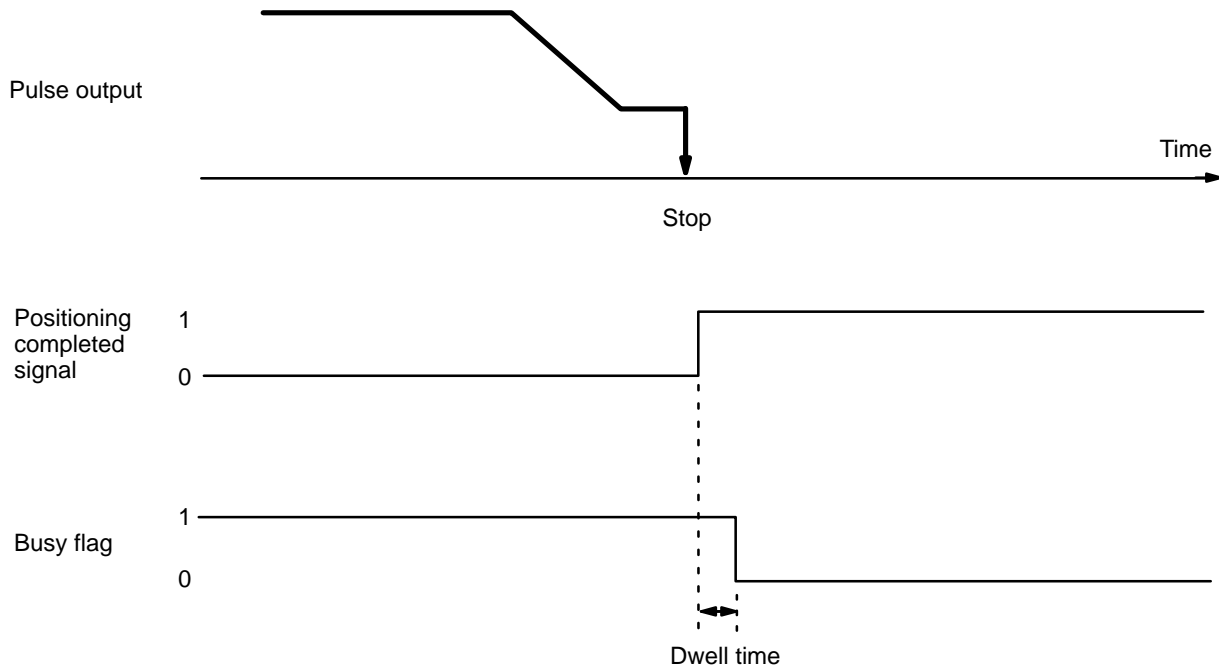
Set the values of V_H and R , using this expression, so that the value of P_D falls within the range shown in the above figure.

Mode 2

Mode 2 makes use of the servomotor driver's driver completed signal, in addition to the signals used in mode 1. For the connection of this signal, refer to *Section 2-2*.

The Busy flag turns OFF when the driver completed signal has been input. Keep the dwell time set to 0; for however long the dwell time is set, the Busy flag takes that much longer to turn OFF.

Note In this mode, even if origin proximity is set to absent, operation is performed with origin proximity present.



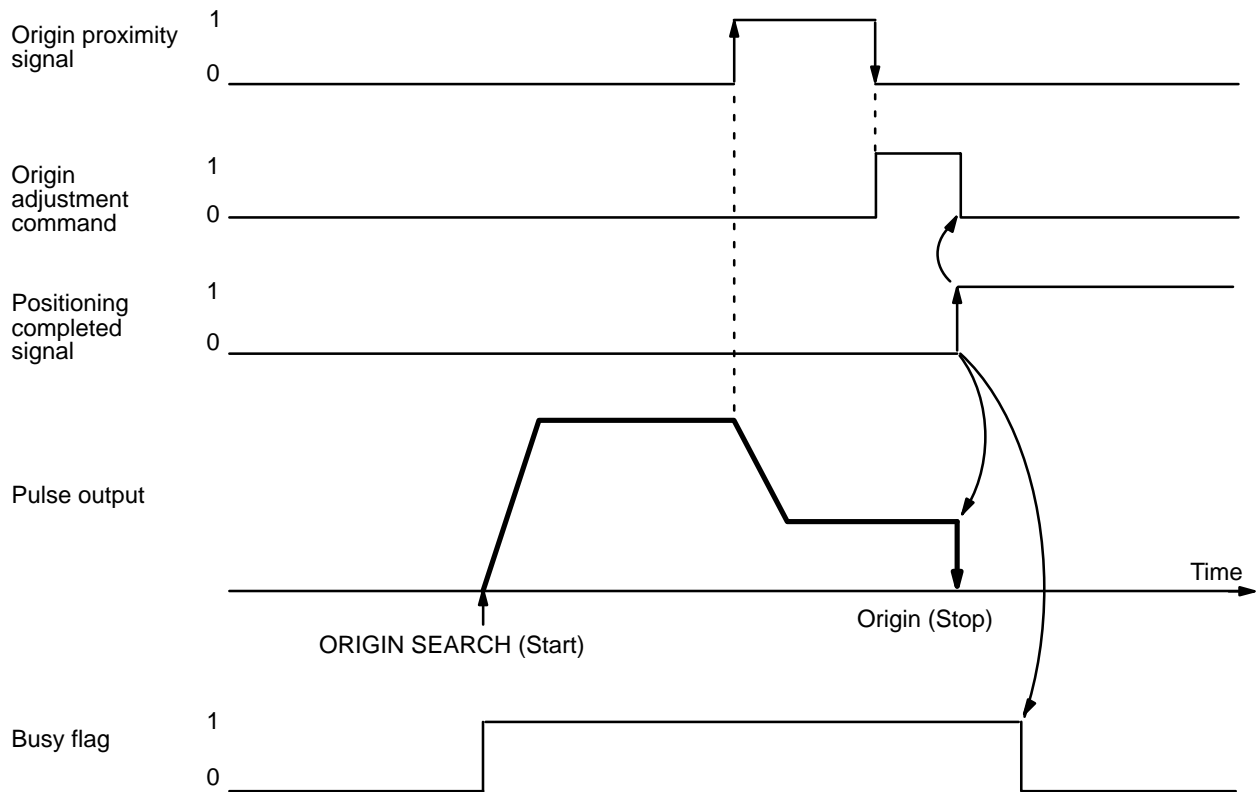
Mode 3

Mode 3 makes use of the origin adjustment functions of OMRON Servomotor Drivers R88D-EP and R88D-SR. The servomotor's driver completed signal (INP) is used as the origin search completion signal. Do not use an origin, Z-phase, or deviation counter reset signal. For wiring diagrams in each mode, refer to *Section 2-2*.

Note In this mode, even if origin proximity is set to absent, operation is performed with origin proximity present.

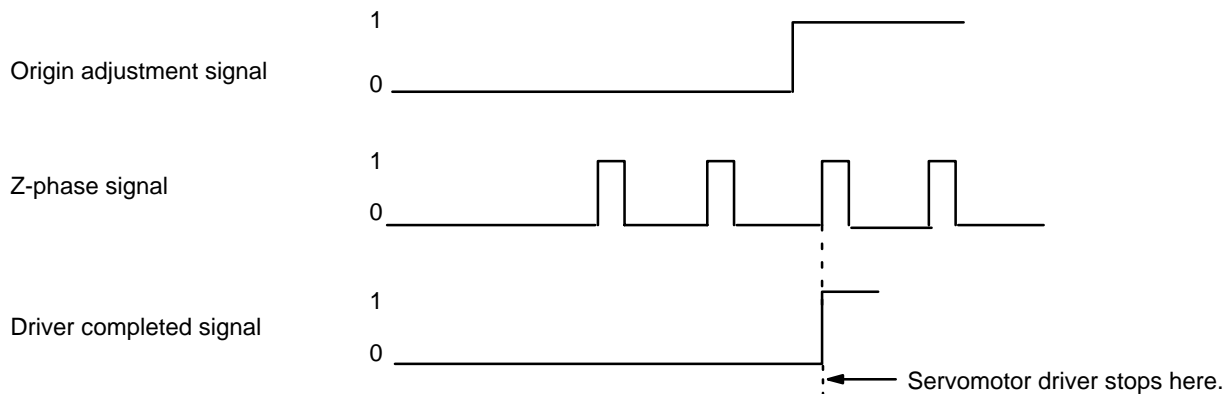
Example 1: When Origin Proximity Reverse is Enabled

Use the origin proximity signal to ensure sufficient deceleration time when the origin proximity reverse is needed. In this example, DIP switch pins 3 and 8 are ON. For DIP switch settings, refer to *Section 2-1*.



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

Processing by Servomotor Driver

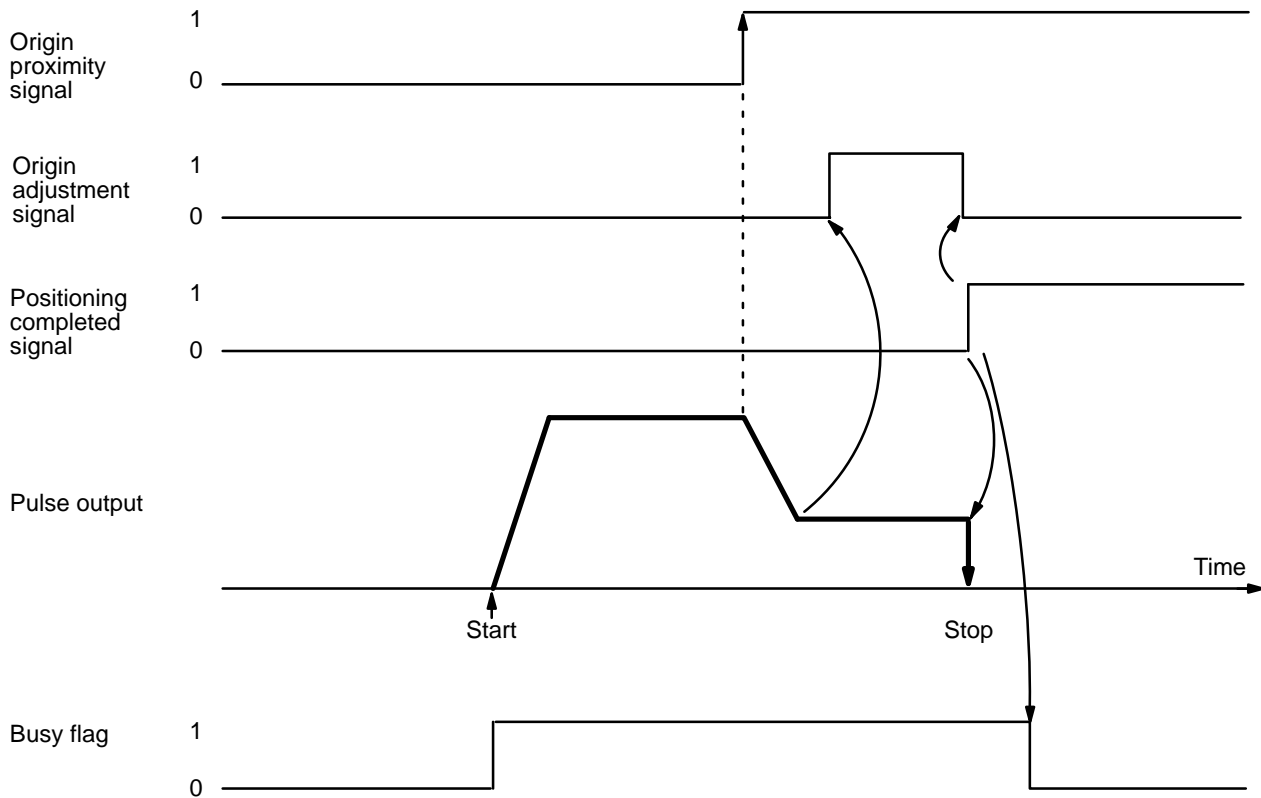


The point at which positioning stops is the same as in modes 1 and 2. There are some differences in operation depending on the starting position for ORIGIN SEARCH. For details, refer to the examples under *Mode 1*.

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

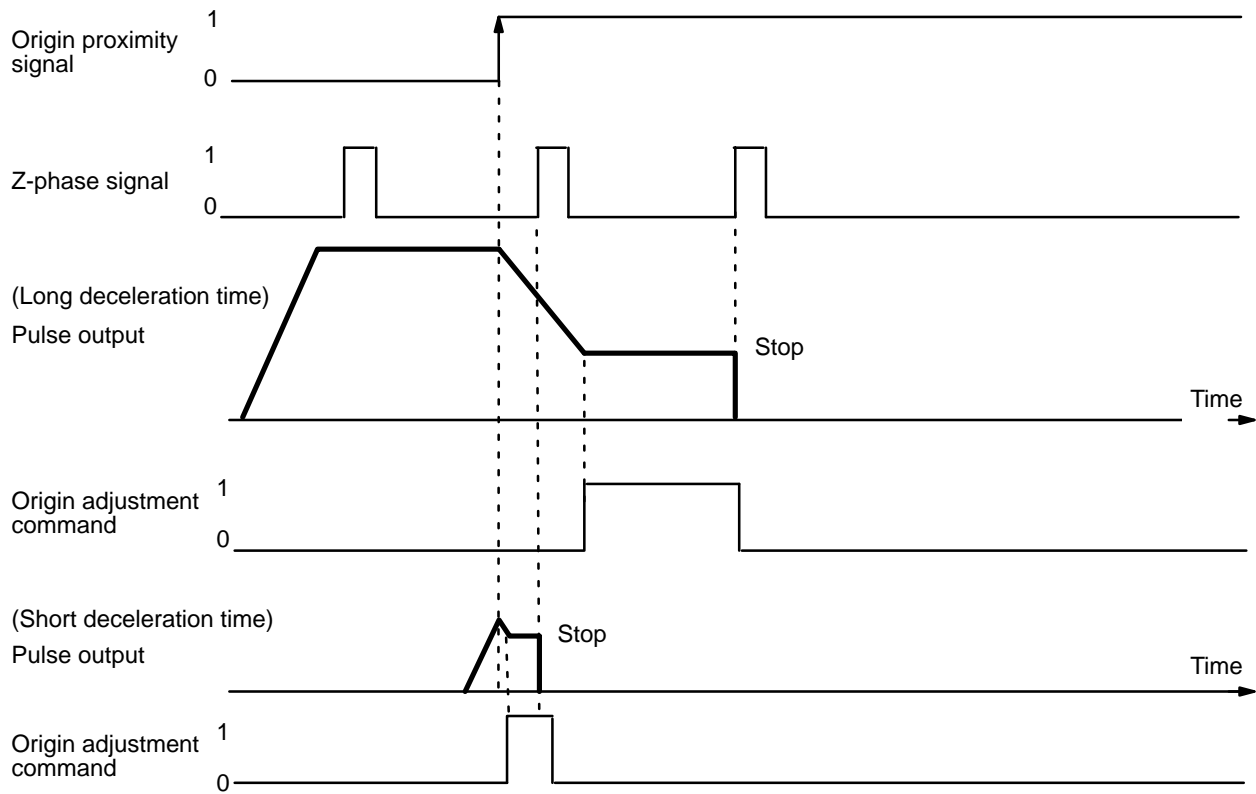
**Example 2:
When Origin Proximity
Reverse is Disabled**

In this example, origin proximity reverse is not used. DIP switch pin 3 is ON and pin 8 is OFF. The origin adjustment command is output after deceleration has ended.



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

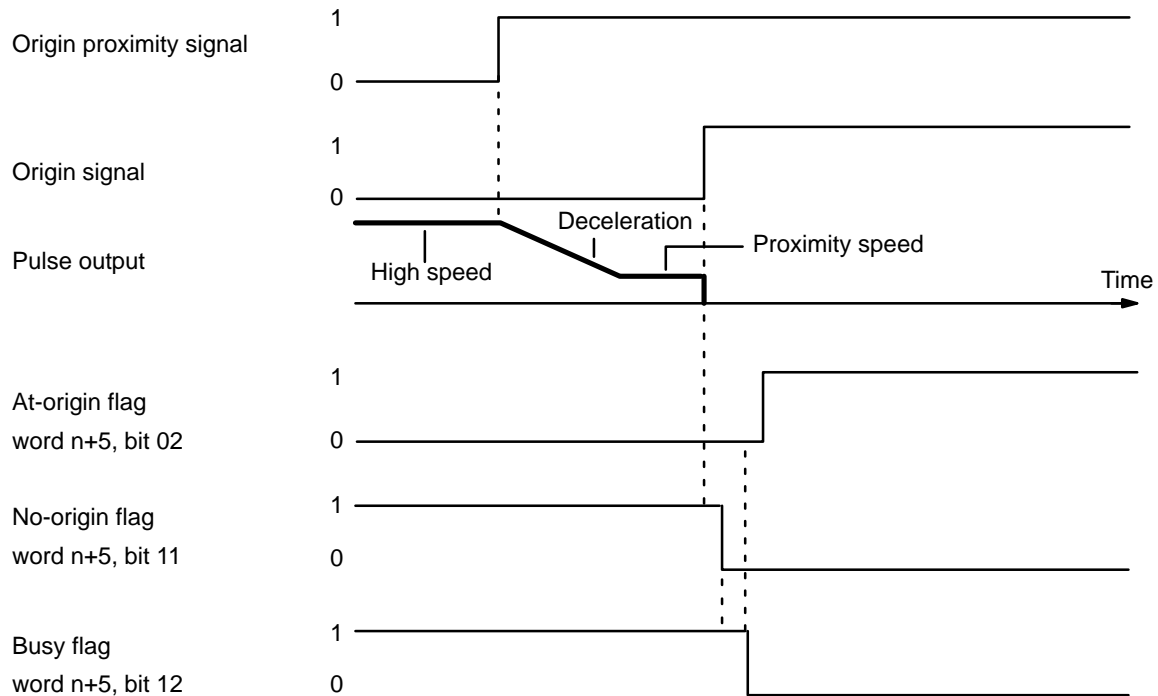
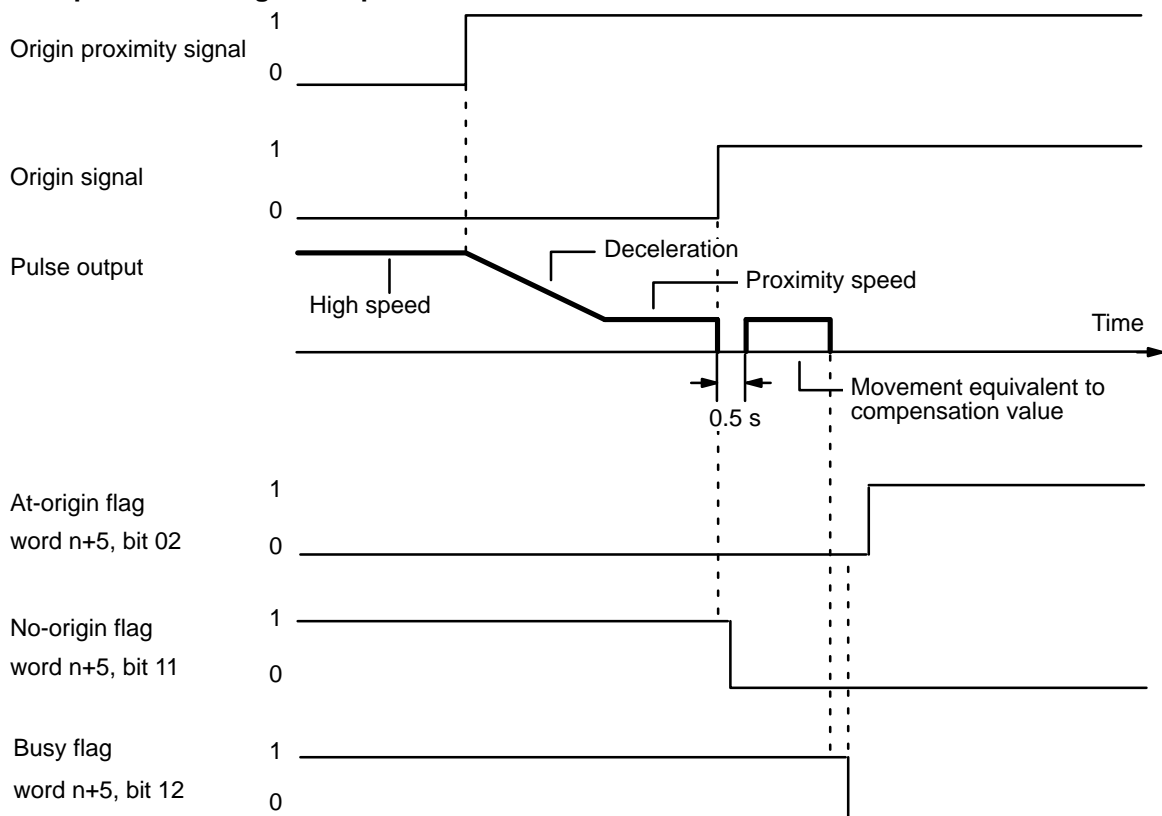
For details on calculating the number of pulses during deceleration, refer to *Mode 1, Example 2: When Origin Proximity Reverse is Disabled*.



4-3-4 Completion Examples

Completion Patterns With an Origin Proximity Signal

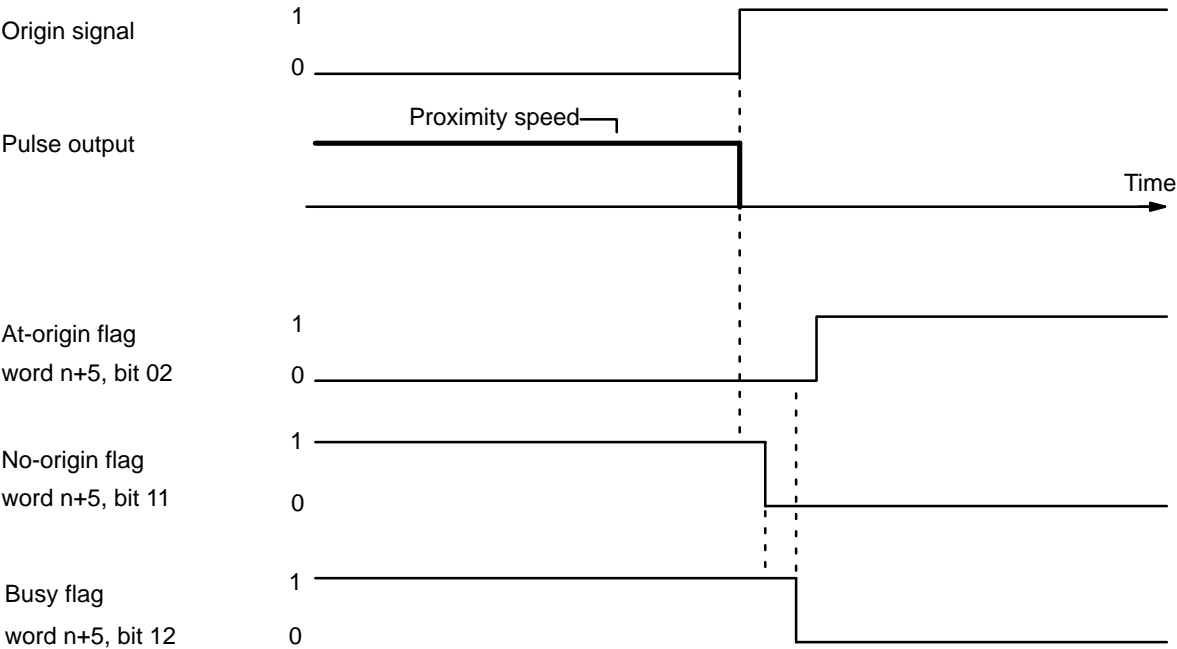
The following two example diagrams both illustrate completion of ORIGIN SEARCH when an origin proximity signal is present (i.e., when DIP switch no. 3 is ON). There is an origin compensation value set in the second example, but not in the first.

Example 1: Without Origin Compensation**Example 2: With Origin Compensation****Completion Patterns Without an Origin Proximity Signal**

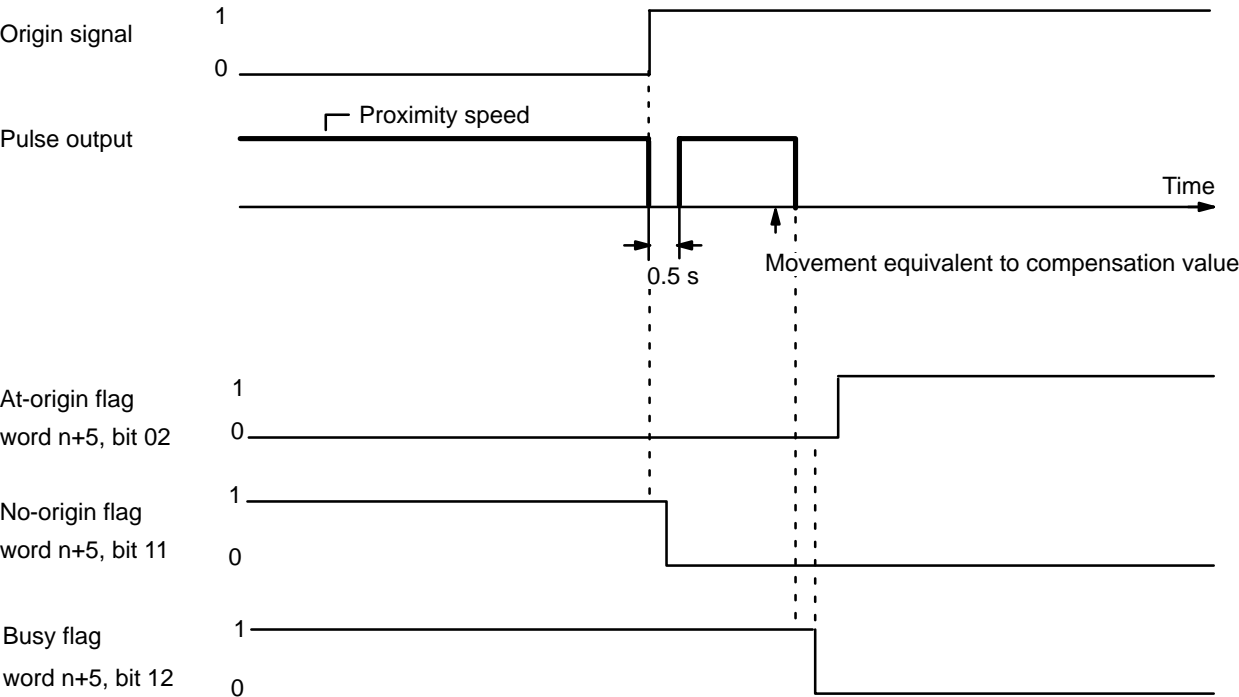
The following two example diagrams both illustrate completion of ORIGIN SEARCH when no origin proximity signal is present (i.e., when DIP switch

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



4-4 ORIGIN RETURN

Once the origin has been established, it is possible to return to the origin at any time by means of the ORIGIN RETURN command bit, bit 03 of IR word

n. When the program turns this bit ON (effective on signal's rising edge), the Position Control Unit outputs pulses until the origin is reached. As with ORIGIN SEARCH, the Position Control Unit uses data stored in the DM area when executing ORIGIN RETURN.

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. When the origin is reached, the At-origin flag turns ON and the Busy flag turns OFF.

4-4-1 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 for START, and can be set by following the instructions contained in *Section 4-1*.

Initial Speed Number Bits 11 to 08 of DM word m

Speeds DM words m+82 through m+96

Speed Units DM word m+97

Acceleration Bits 15 to 00 of DM word m+98

Deceleration Bits 15 to 00 of DM word m+99

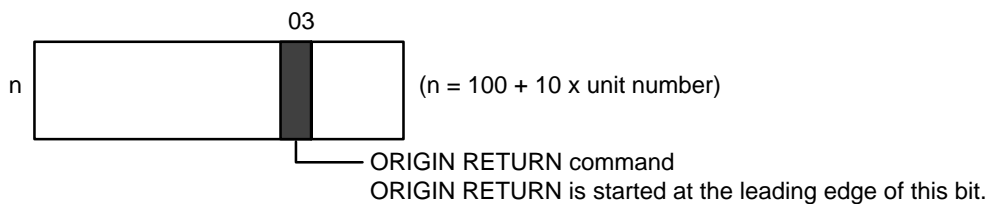
ORIGIN RETURN Speed Number

DM word m, bits 15 to 12

Set from 1 to F (hexadecimal). Refers to one of the speeds set in DM words m+82 through m+96.

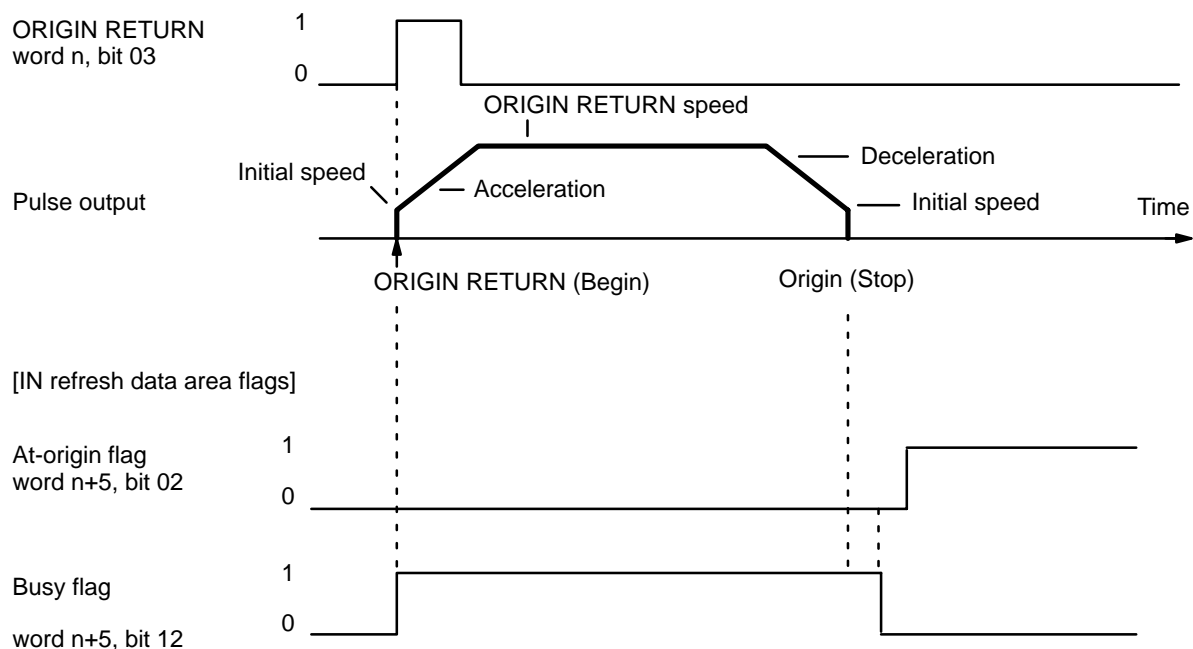
4-4-2 IR Area Settings

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



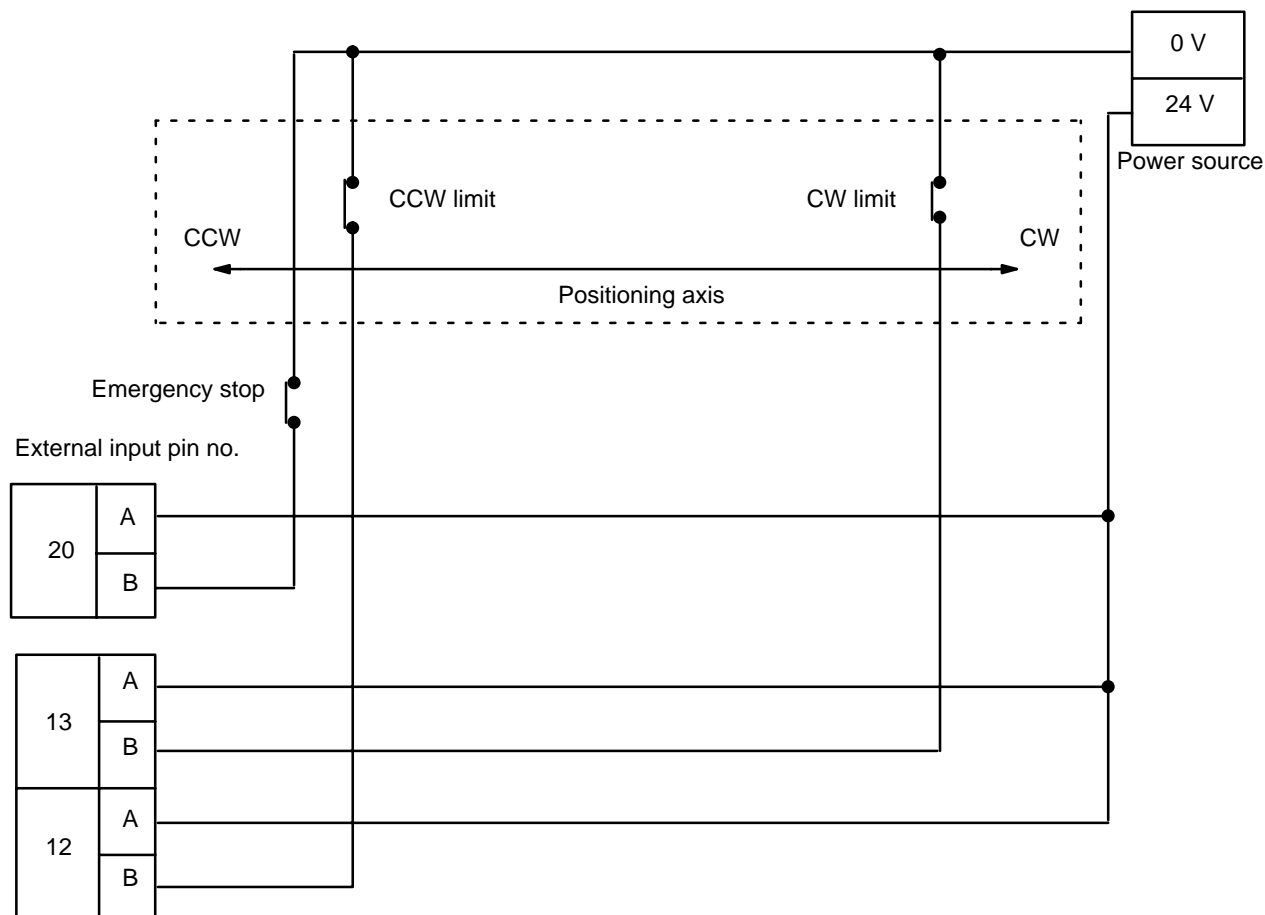
4-4-3 Execution Example

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.



4-5 RELEASE PROHIBIT

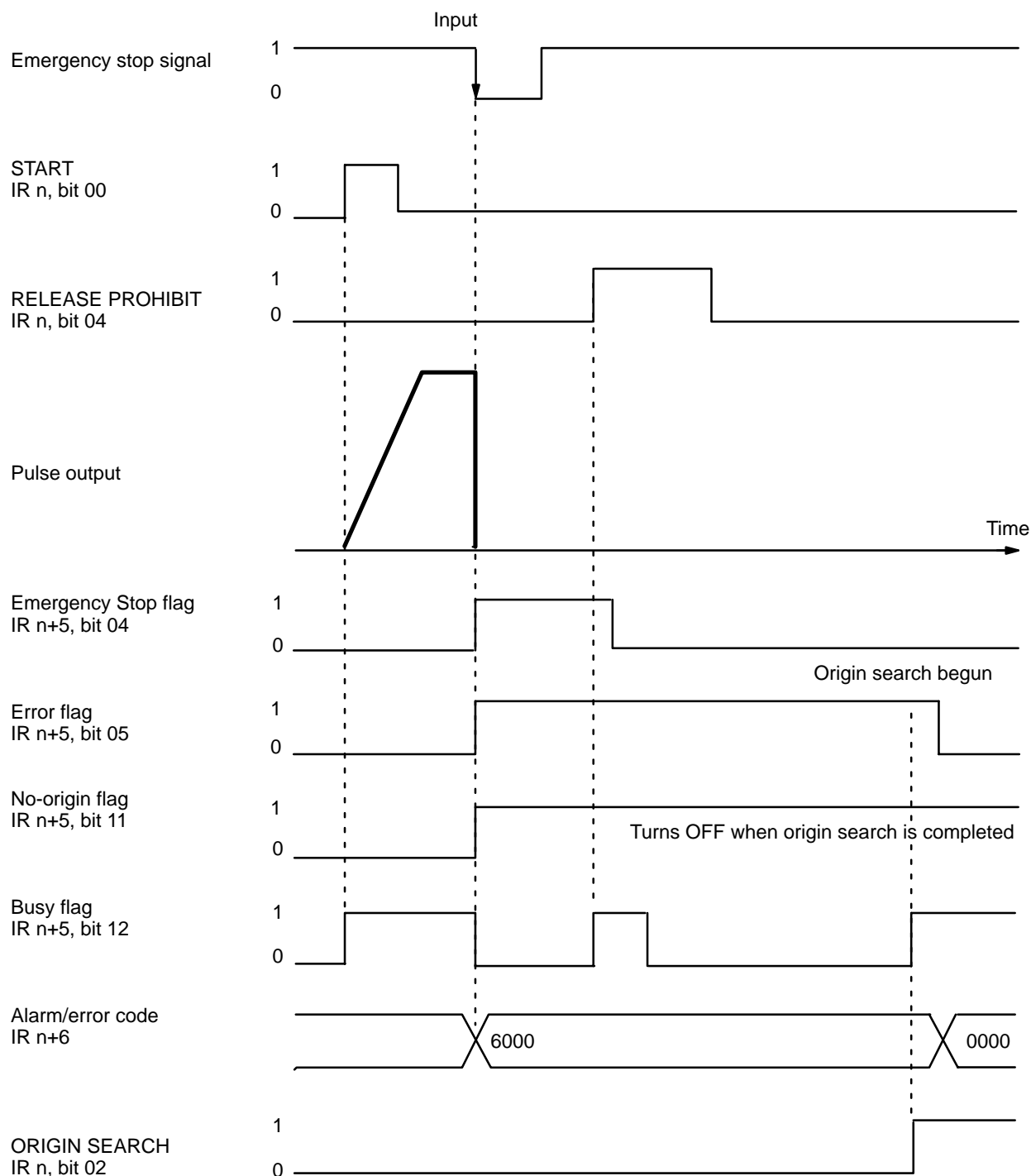
When Position Control Unit operation is stopped due to an emergency stop, CW limit, or CCW limit signal, (i.e., when the NC input of any of these turns ON), further pulse output is prohibited. In order to resume pulse output, it is necessary to cancel this prohibition by means of the RELEASE PROHIBIT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



Execution Examples

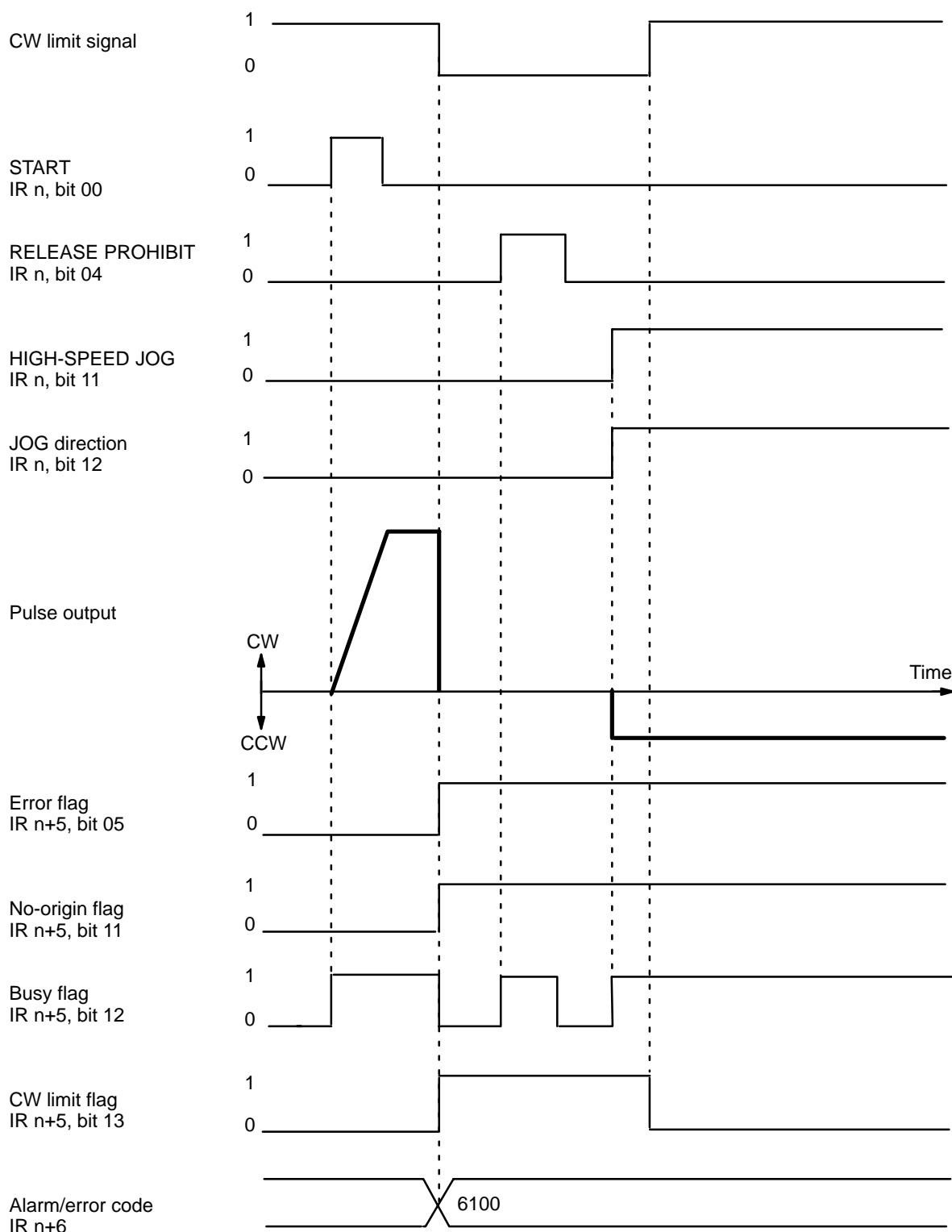
Example 1: Emergency Stop

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



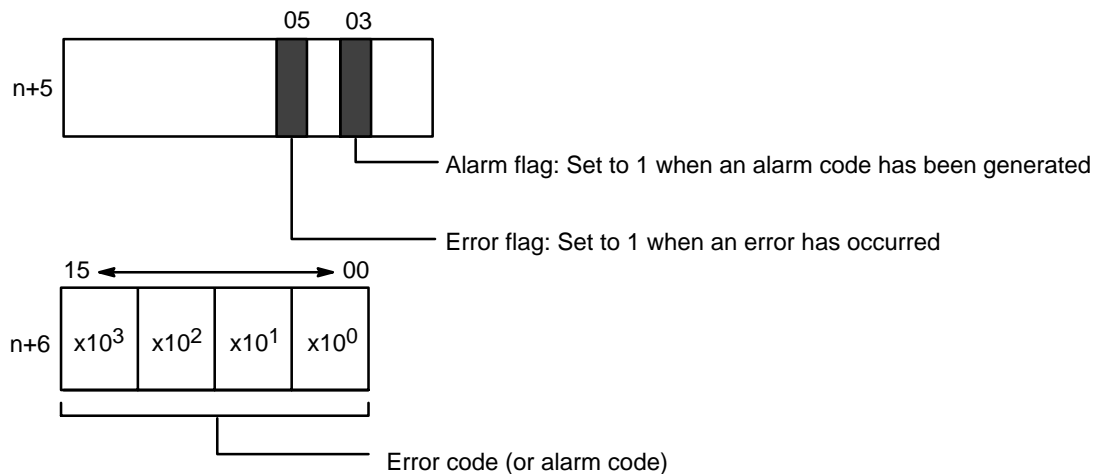
Example 2: Exceeding CW or CCW Limit

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.



4–6 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 IR word n+6. Errors and alarms have separate flags, as follows:



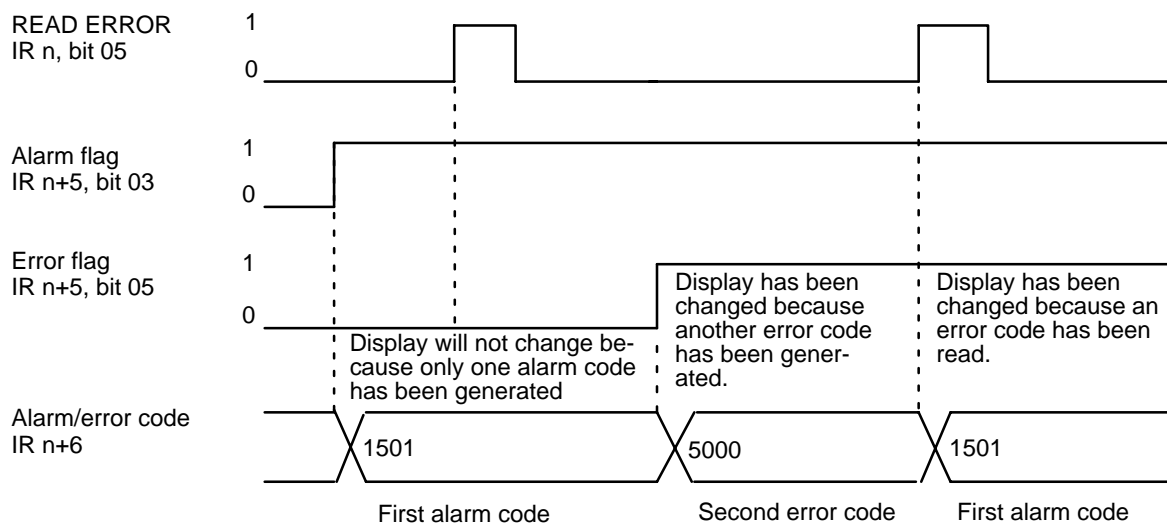
IR word n+6 shows four digits in BCD when displayed on the Programming Console. If there are no errors or alarms, 0000 will be displayed. If there are any errors or alarms, they will be displayed in code. The codes will be displayed in order as READ ERROR is executed. (If there is only one code, however, 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*. For a complete list of alarm codes, refer to *Appendix A*.

4–6–1 Execution Example

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



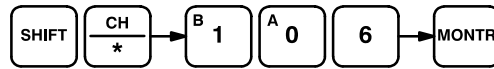
4–6–2 Reading from the Programming Console

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

Programming Console Display:

```
c106
1501
```

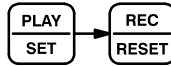
Key sequence:



```
10005 c106
^ OFF 1501
```



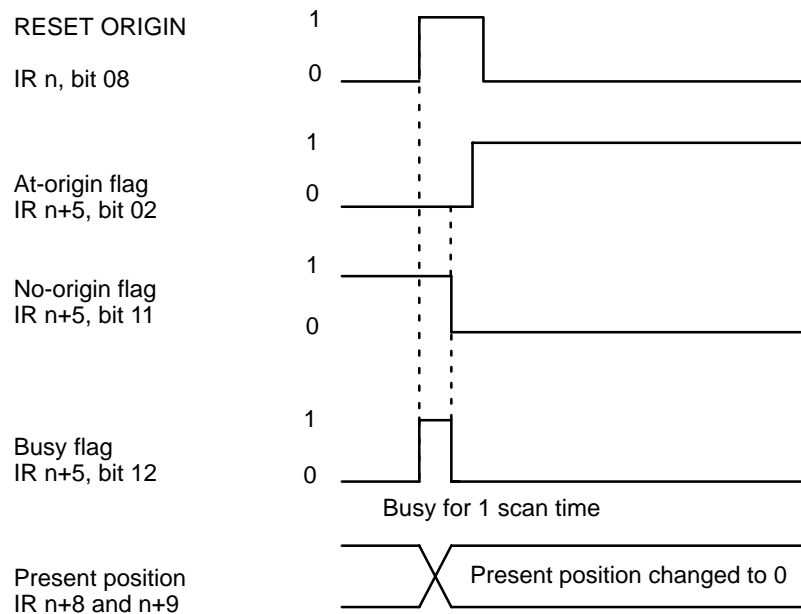
```
10005 c106
^ OFF 5000
```



4–7 RESET ORIGIN

The origin is simply the point which is designated as 0 at any given time. You can redefine it whenever you wish by using RESET ORIGIN. When the program turns ON the RESET ORIGIN command bit, bit 08 of word n (effective on signal's rising edge), it redefines the present position as the origin.

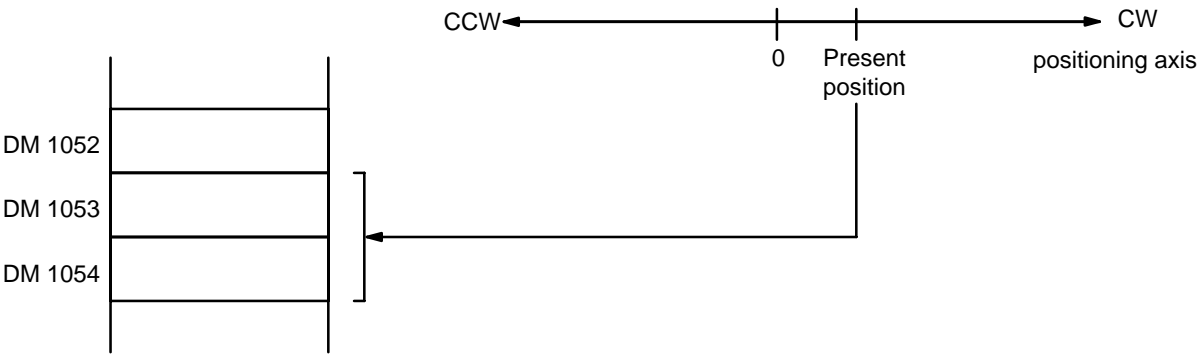
Execution Example



4–8 TEACH

There may be cases where you want to teach your control system a particular operation by leading it through the motions. In such cases, you can use TEACH to write the present position as the target position for a designated positioning action.

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. TEACH is executed by turning ON the TEACH command bit, bit 09 of IR word n. 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.



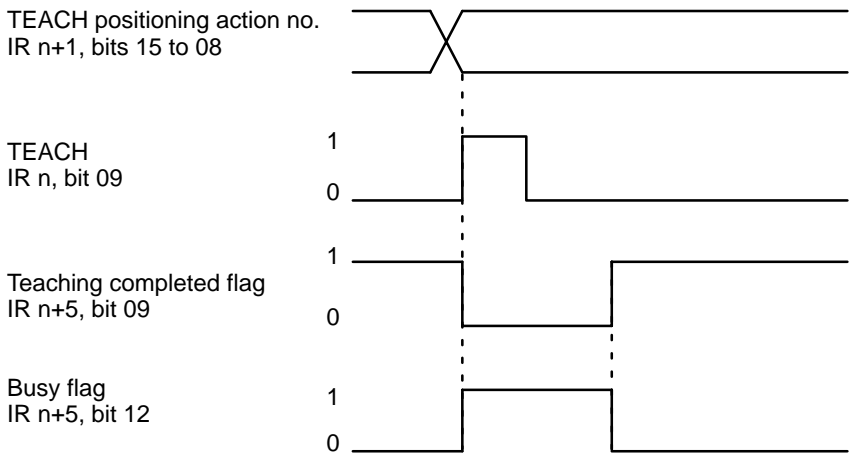
Data set using TEACH is valid immediately and can be used for positioning actions without turning off the power or transferring data. Note that data re-written using the Programming Console is not valid until data has been transferred again.

4–8–1 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 *Section 3–4*. For a detailed table of words and bits in the IR area, see *Appendix D*.

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 IR words n+8 and n+9.
TEACH Positioning Action Number	<p>IR word n+1, bits 15 to 08</p> <p>Set an integer between 00 and 19. The number set here indicates the positioning action for which the present position is to be set as the target position.</p>
TEACH Command Bit	<p>IR word n, bit 09</p> <p>TEACH is executed when this bit is ON.</p>

4–8–2 Execution Example



4–8–3 Teaching From the Programming Console

This example display 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

10013
^ OFF

10013
^ ON

c10110013
0000^ OFF

c10110013
1000^ OFF

10013 c101
^ OFF 1000

10009 c101
^ OFF 1000

10009 c101
^ OFF 1000

Key sequence

SHIFT

CONT
#

B 1

A 0

A 0

B 1

D 3

MONTR

PLAY
SET

Low-speed JOG

REC
RESET

SHIFT

CH
*

B 1

A 0

B 1

MONTR

CHG

B 1

A 0

A 0

A 0

WRITE

(Designated position for sequence #10)

MONTR

↑

↑

↑

↑

PLAY
SET

REC
RESET

Turns TEACH ON and OFF.

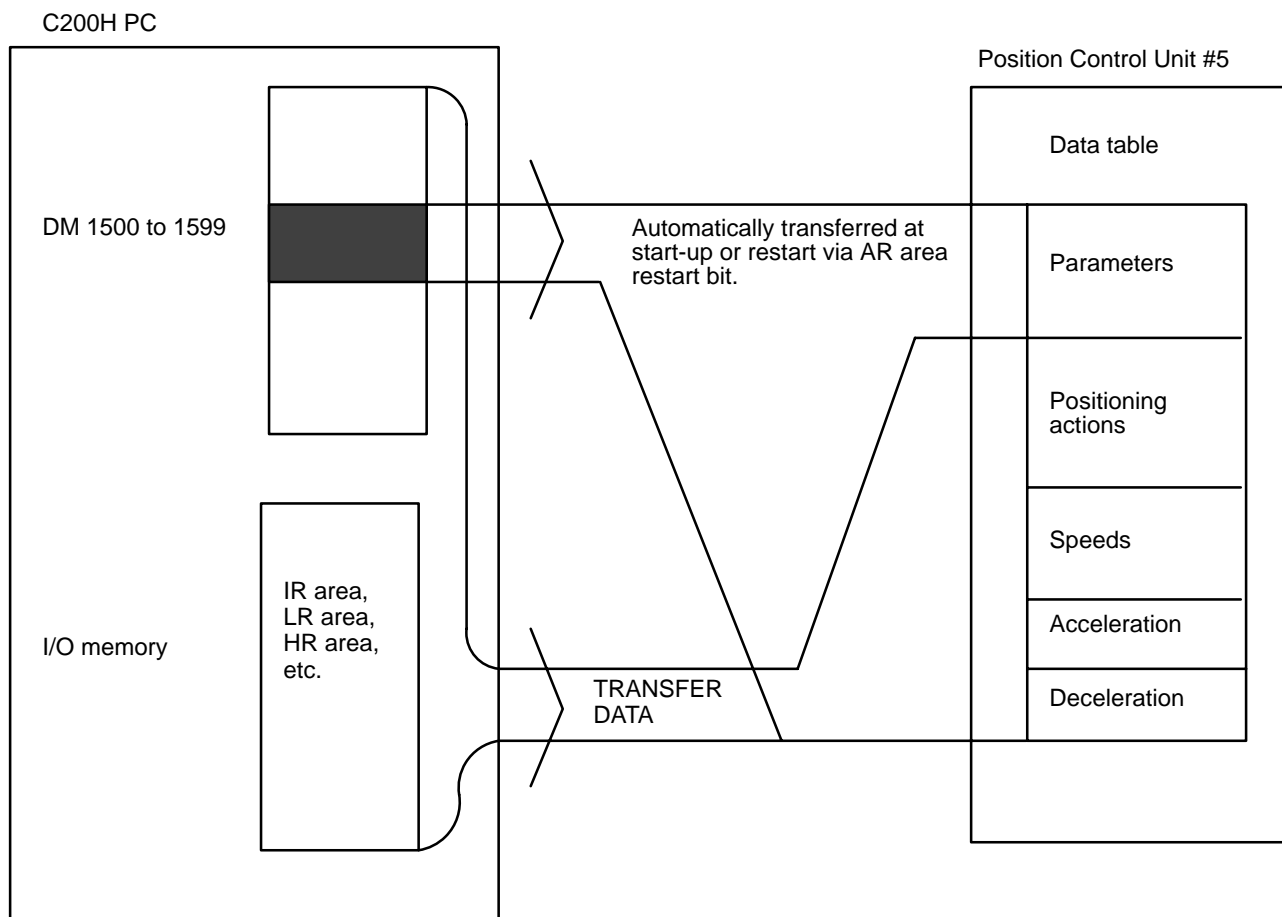
CLR

00001 T000
^ OFF 0100

4–9 TRANSFER DATA

The data which you write into the DM area (for positioning actions, speeds, and so on) is automatically transferred from the PC to the Position Control Unit. The data designated for any given Unit is transferred to that Unit when it is powered up or restarted by the AR area Restart bit. There may be times, however, when you want to control an operation requiring additional data. In those situations you can use TRANSFER DATA to access additional data, not only from other parts of the DM area but from any area in the PC.

As described in *Section 3–4*, 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. Position, speed, acceleration, and deceleration data are all transferable. TRANSFER DATA overwrites the RAM in the Position Control Unit, but does not affect the data set for that Unit in the DM area of the PC.



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.

4–9–1 Normal Transfer

If bit 15 of IR word $n+2$ is 0, the TRANSFER DATA command bit, bit 10 of IR 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 affected. Parameters set in DM words m through $m+21$ are not changed when TRANSFER DATA is executed.

Data Preparation

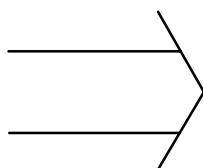
Before transferring data, you must prepare it in a PC data area in the required format and in consecutive words. (See *Appendix C* for the content of each word/bit.) When TRANSFER DATA is executed, the transfers are made

consecutively by number, starting with the beginning transfer number set in the IR area. 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.

As can be seen from the following tables, each transfer number corresponds to one particular positioning action, three of the 15 speeds, or other data. The data which is transferred overwrites the data for that positioning action (or other data) which had previously been automatically transferred to the Position Control Unit. The data to be newly transferred can be drawn from any of the PC data area words shown in the table on the left.

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



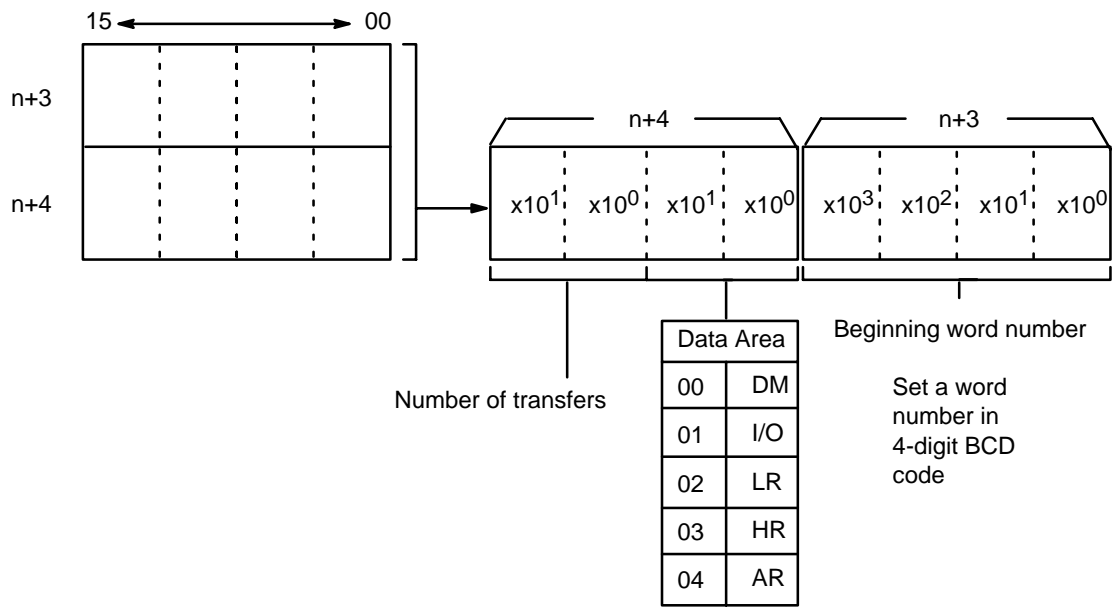
Position Control Unit's Rewritten Data

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

4–9–2 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 *Section 3–4*. For a detailed table of words and bits in the IR area, see *Appendix D IR Area Allocations*.

You use the IR area to designate the PC area from which you want to transfer data, the beginning word number to be transferred from that area, and the number of transfers (of three words each) which you want to execute. As shown in the diagram below, you make most of these settings in two IR words, n+3 and n+4. You write the beginning transfer number in IR word n+2.



Beginning Transfer Number IR word n+2, bits 15 to 08

Set an integer between 00 and 25.

This is the number of the first word to be transferred. The requested number of words will be transferred starting from this word.

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

Beginning Word Number IR word n+3, bits 15 to 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 specified by word n+2, bits 15 to 08. 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 Configuration and Allocation* in *Section 3-4*).

PC Data Area IR word n+4, bits 07 to 00

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

Number of Transfers IR word n+4, bits 15 to 08

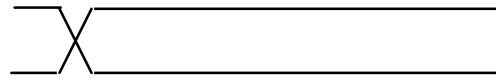
Set an integer between 01 and 26.

TRANSFER DATA Command Bit IR 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.

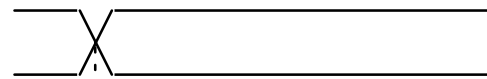
Execution Example (Normal Transfer) This example assumes that bit 15 of IR word n+2 is 0.

Preparation of data
in PC's data areas

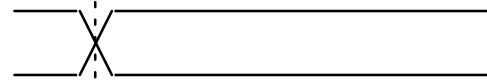


Set necessary information in IR area.

Beginning transfer number
IR n+2, bits 15 to 08



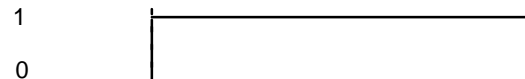
Beginning word number
IR n+3



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



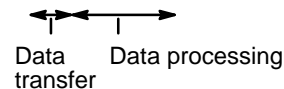
TRANSFER DATA
IR n, bit 10



Transfer Completed flag
IR n+5, bit 10



Busy flag
IR n+5, bit 12



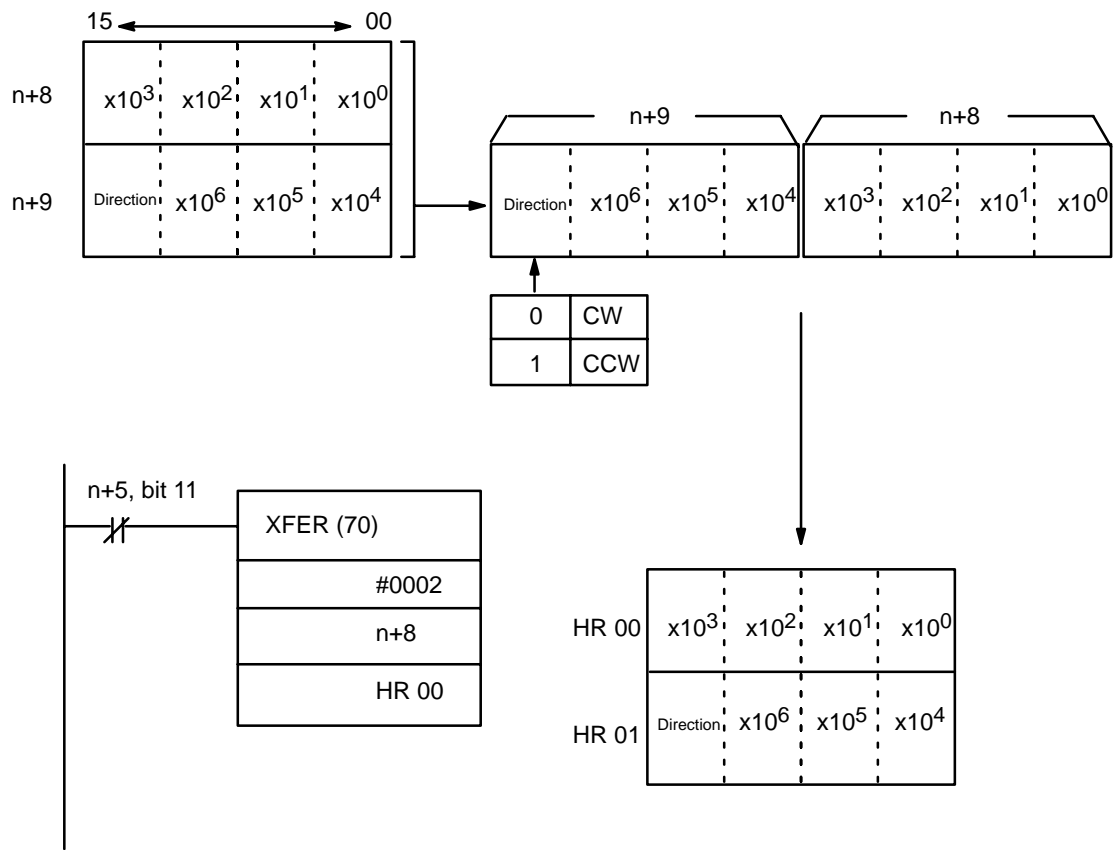
4–9–3 Present Position Preset

You can change the function of the TRANSFER DATA command bit with a setting in the IR area. If bit 15 of IR word n+2 is set to 1, the TRANSFER DATA command bit (bit 10 of IR 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 Position Control Unit is powered up, it is ordinarily necessary to execute ORIGIN SEARCH first. You can use the present position preset function instead, however, when it is sufficient to set a specific numerical value and use that position as a reference point. In such cases, the origin will be defined in relation to that position, and there is no need to search for the origin first.

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 it by using TRANSFER DATA the next time the Unit is powered up.

The following programming example shows IR n+8 data moving to HR 00 and IR n+9 data moving to HR 01. If there is no origin, bit 11 of IR 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

IR 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 to 08 as described in *Beginning Word Number* under *Section 4–9–2*.

Beginning Word Number

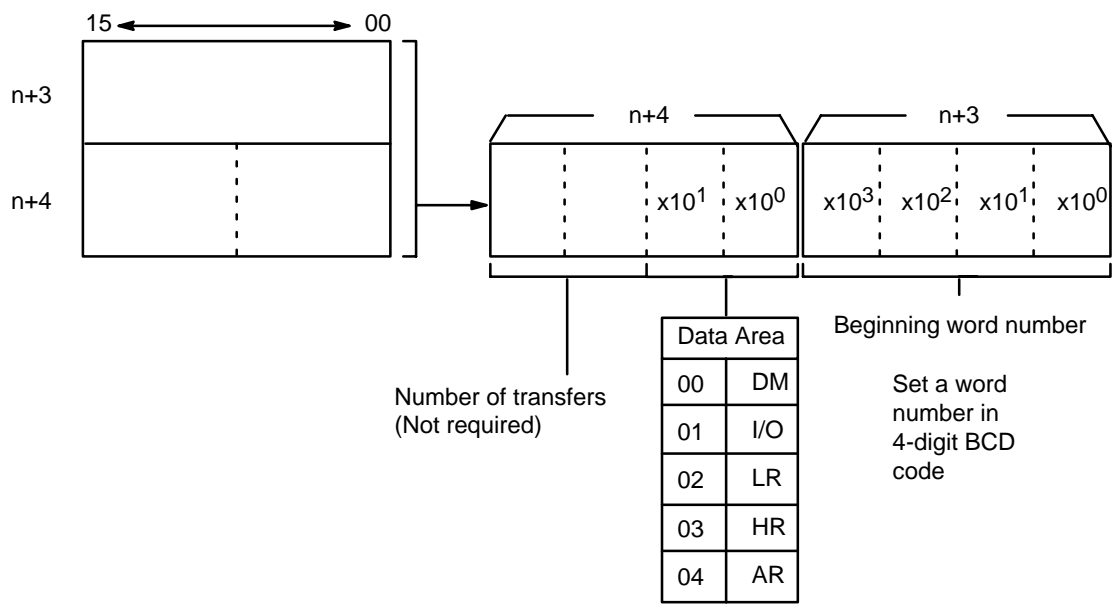
IR word n+3, bits 15 to 00

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 in *Data Preparation* toward the beginning of *Section 4–9–1*.

PC Data Area

IR word n+4, bits 07 to 00

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



TRANSFER DATA
Command Bit

IR word n, bit 10

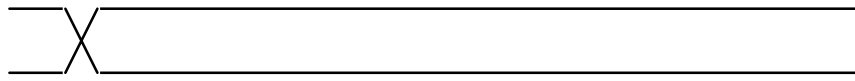
After the above settings are made, TRANSFER DATA is executed by turning ON this bit. This can all be done in one scan.

Execution Example (Preset)

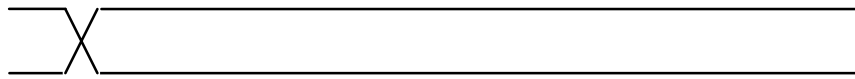
The following example assumes that bit 15 of IR word n+2 has been set to 1.

Set necessary information in IR area.

Present position preset
IR n+2, bit 15



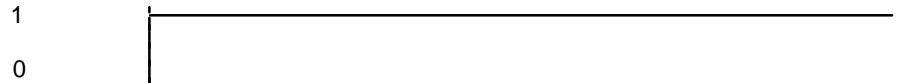
Beginning word number
IR n+3



PC data area
IR n+4 bits 07 to 00



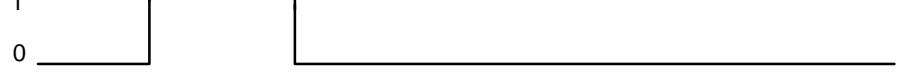
TRANSFER DATA
IR n, bit 10



Transfer completed flag
IR n+5, bit 10

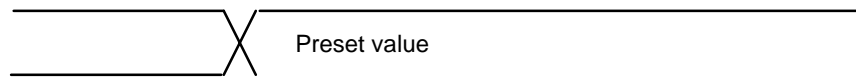


Busy flag
IR n+5, bit 12



Data transfer Present position determined
This position is reflected in the IN refresh area

Present position
IR n+8 and n+9



4–10 Manual Operations

Although positioning is generally carried out according to the program in the memory of the PC, the Position Control Unit also allows you to position manually when you need to. You can choose from three manual feeding commands, depending on how far and how fast you wish to change the position.

These three, HIGH-SPEED JOG, LOW-SPEED JOG, and INCH, are executed when their respective command bits turn ON in the IR area. As with other commands, the Position Control Unit makes use of the DM area data in carrying them out. You can use HIGH-SPEED JOG or LOW-SPEED JOG for rapid manual positioning. HIGH-SPEED JOG uses acceleration and deceleration as well as the target speed. You can use INCH for very fine adjustments, feeding one pulse at a time.

4–10–1 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 *Section 4–1*. Only the first three of these need be set for LOW-SPEED JOG.

Initial Speed Number Bits 11 to 08 of DM word m

Speeds DM words m+82 through m+96

Speed Units	DM word m+97
Acceleration	Bits 15 to 00 of DM word m+98
Deceleration	Bits 15 to 00 of DM word m+99

HIGH-SPEED JOG Speed Number DM word m+1, bits 15 to 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, and in DM word m+3, bit 04.

LOW-SPEED JOG Speed Number DM word m+1, bits 11 to 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, and in DM word m+3, bit 04.

4–10–2 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 *Section 3–4*. For a detailed table of words and bits in the IR area, see *Appendix D*.

HIGH-SPEED JOG Command IR word n, bit 11

0: Stop
1: Operate

INCH/JOG Direction IR word n, bit 12:

0: CW
1: CCW

LOW-SPEED JOG Command IR word n, bit 13

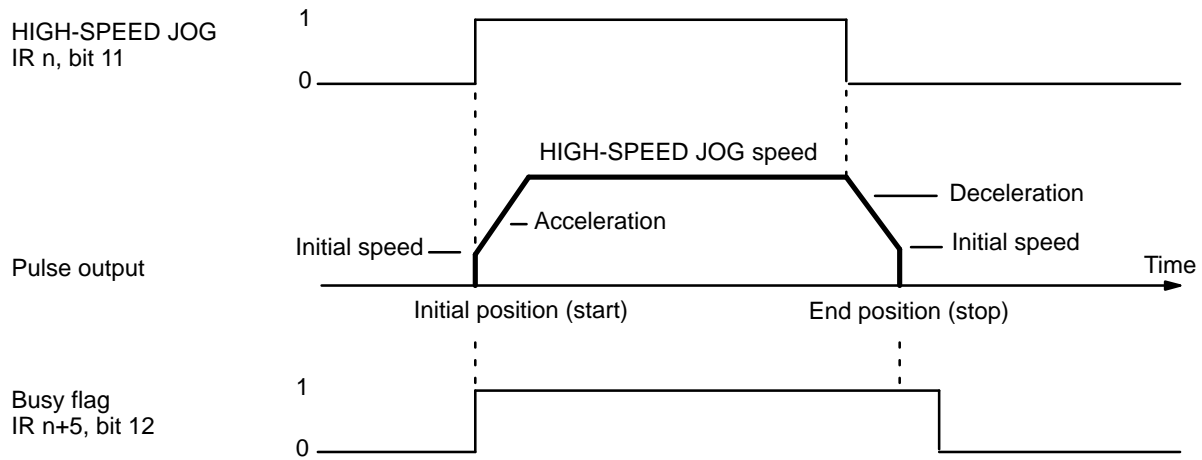
0: Stop
1: Operate

INCH Command IR word n, bit 14

0: Stop
1: Operate

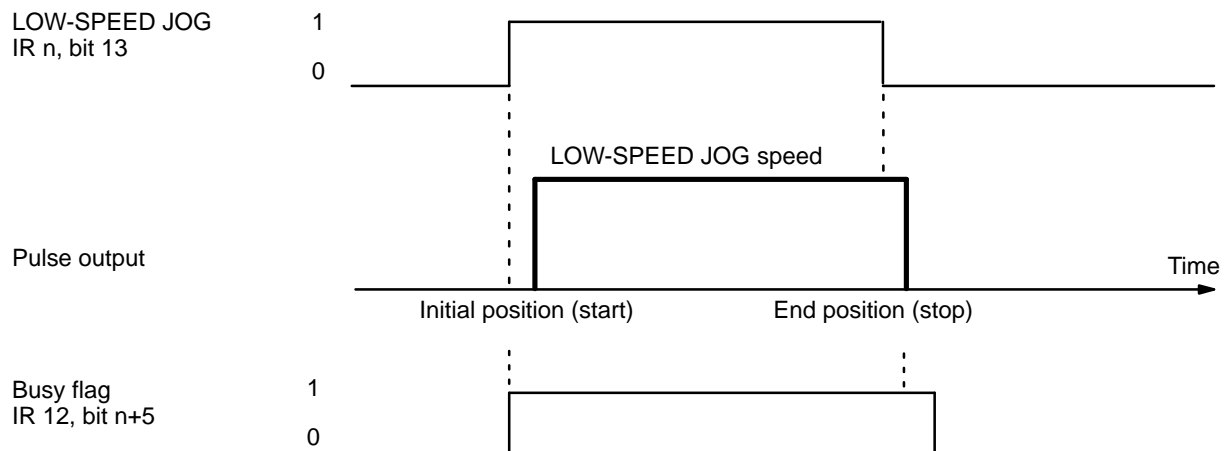
4–10–3 HIGH-SPEED JOG

Feeding starts at the designated speed when the HIGH-SPEED JOG command bit (IR word n, bit 11) turns ON (effective on signal's rising edge). Feeding continues until the command bit turns OFF.



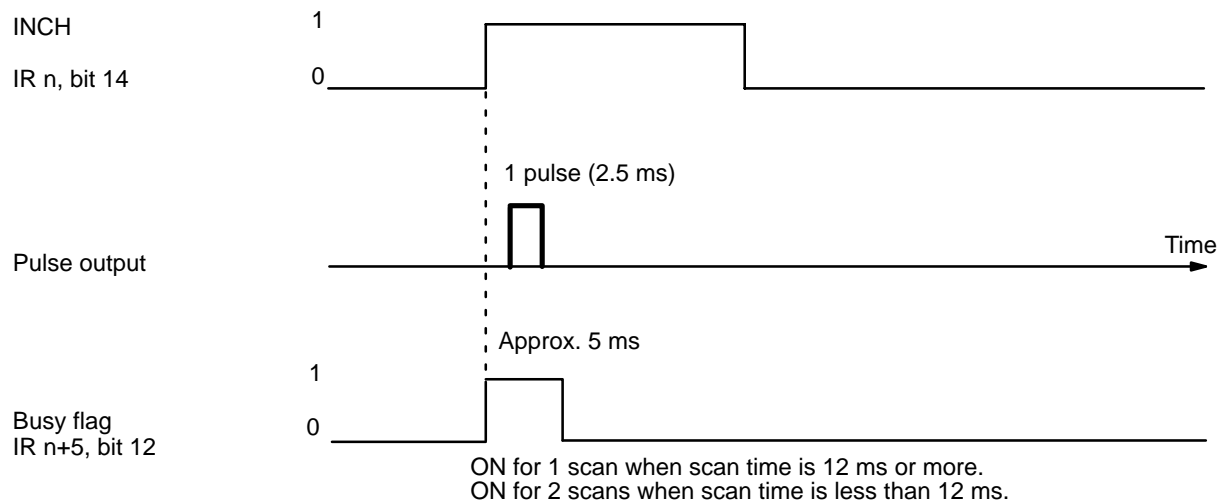
4-10-4 LOW-SPEED JOG

Feeding starts at the designated speed when the LOW-SPEED JOG command bit (IR word n, bit 13) turns ON (effective on signal's rising edge). Feeding continues until the command bit turns OFF.



4-10-5 INCH

You can use INCH to manually position one pulse at a time. One pulse is fed each time the INCH command bit, bit 14 of IR word n, is turned ON (effective on signal's rising edge).

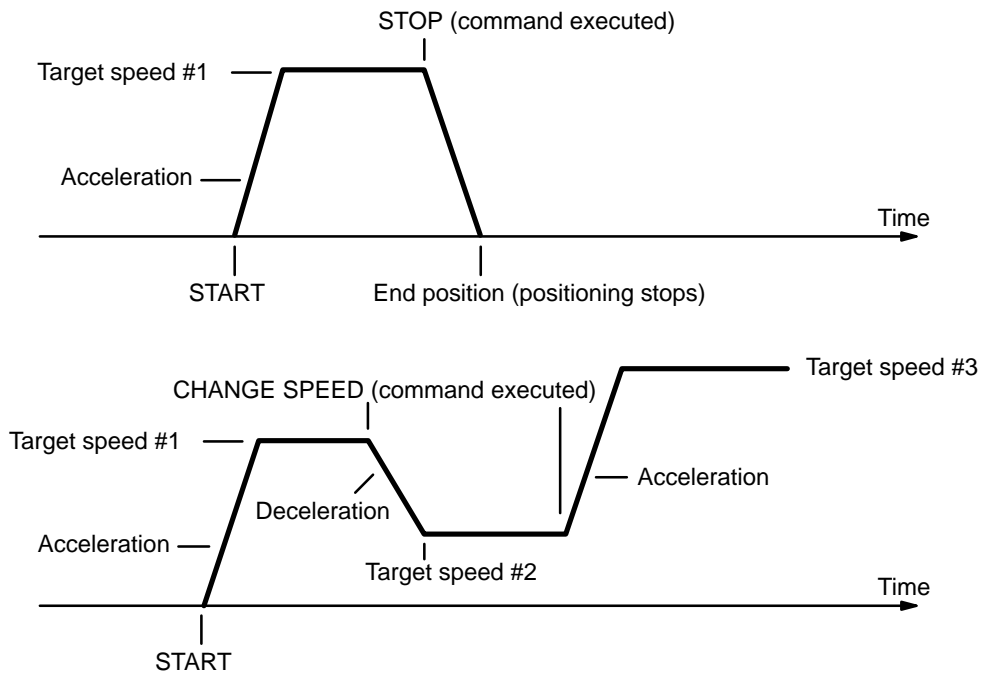


4-11 External Interrupt Commands

You can stop positioning or change speeds with either the bits set in the IR area or by external interrupt signal input, depending on your DIP switch settings. It is possible to set the pins so that both of these methods (command bits and external interrupts) are available at the same time for either STOP or CHANGE SPEED.

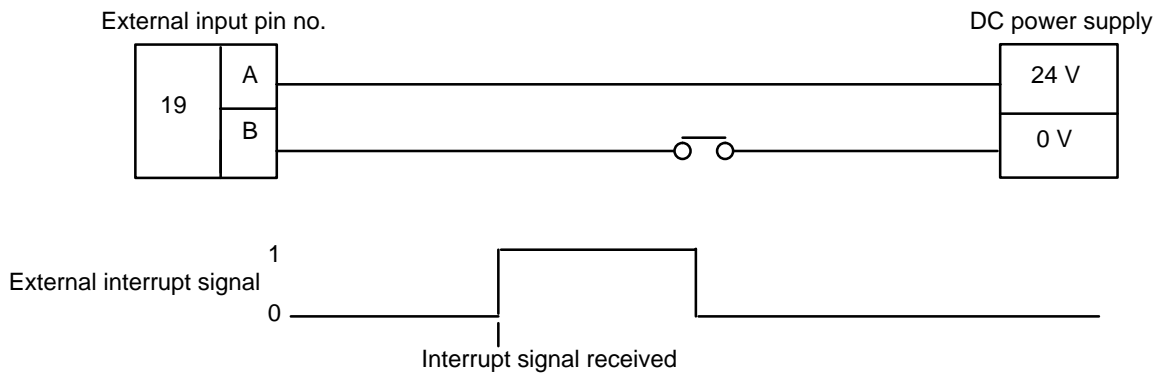
As illustrated in the following diagrams, positioning decelerates to a stop when STOP is executed. When CHANGE SPEED is executed, positioning accelerates or decelerates to the designated speed. Specify the target speed to be used for CHANGE SPEED by setting the speed numbers in bits 05 to 00 of IR word $n+2$. If those bits are set to 00, the next speed number after the one currently being executed will be taken as the target speed. The target speeds used during CHANGE SPEED are taken in order, beginning with the lowest speed number, from the DM area.

When executing CHANGE SPEED with an external input, designate the speed number from IR word $n+2$ at least one scan time in advance or it will not be effective. Otherwise, when designating the speed number, use an IR area work bit. (See *IR Area Settings* below).



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 IR 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 *Section 4–1* for details.

Acceleration Bits 15 to 00 of DM word $m+98$

Deceleration Bits 15 to 00 of DM word $m+99$

IR Area Settings

In addition to bits 15 and 06 of word n (described under *DIP Switch Settings* above), set bits 05 to 00 of IR word $n+2$. If these bits are set to 00, the next speed number after the one currently being executed will be taken as the target speed for CHANGE SPEED. If they are set to from 01 to 15, then they will specify the speed number to be taken as the target speed.

When executing CHANGE SPEED with an external interrupt signal, the data from this area must be written in at least one scan time before the interrupt signal. When executing CHANGE SPEED with a work bit (bit 06 of IR word n), it can be written in simultaneously with the rising edge of the work bit.

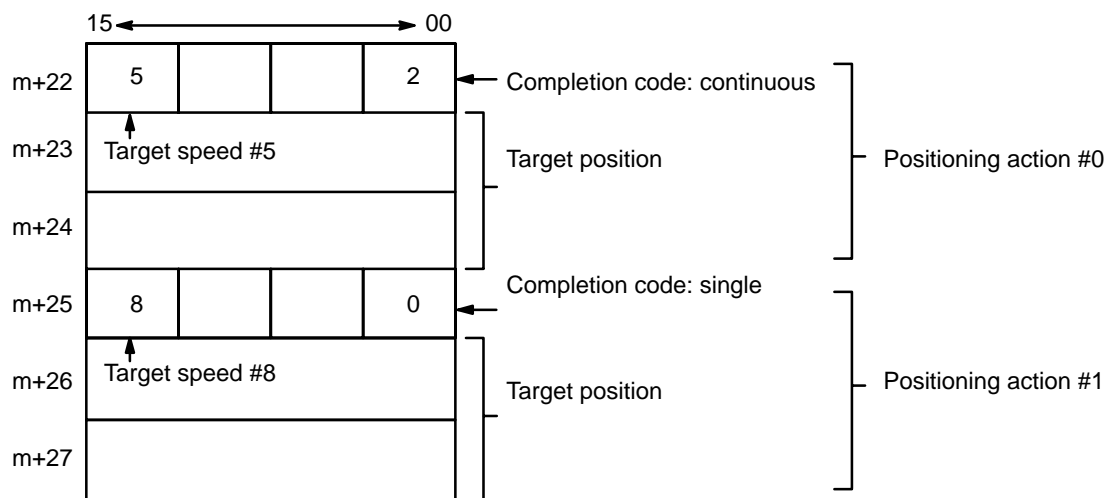
4–11–1 STOP

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 IR word n or from an external interrupt signal) is in effect.

STOP Executed During Positioning Actions

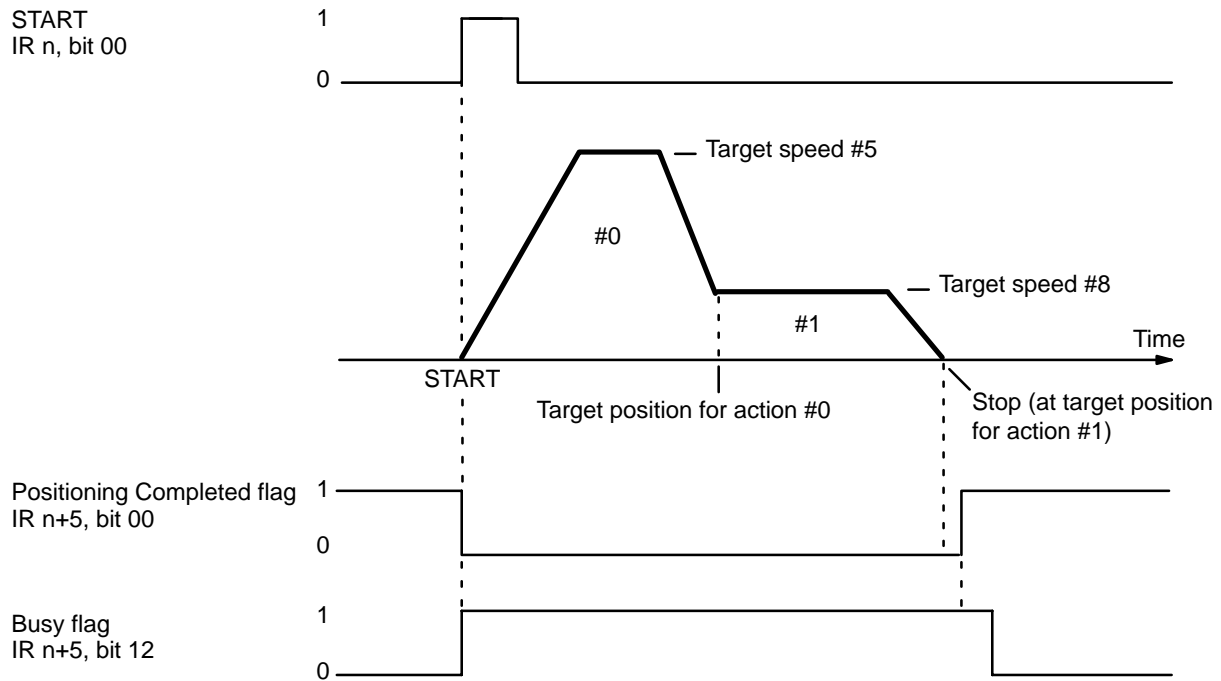
When the STOP command bit is set during execution of a positioning action under START, the Positioning Completed flag is not turned ON, and the positioning action number is not changed. When START is next executed, the target position and speed of that action will be used, as long as the target position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

Here is an example in which the following DM words and data are used.



Example 1

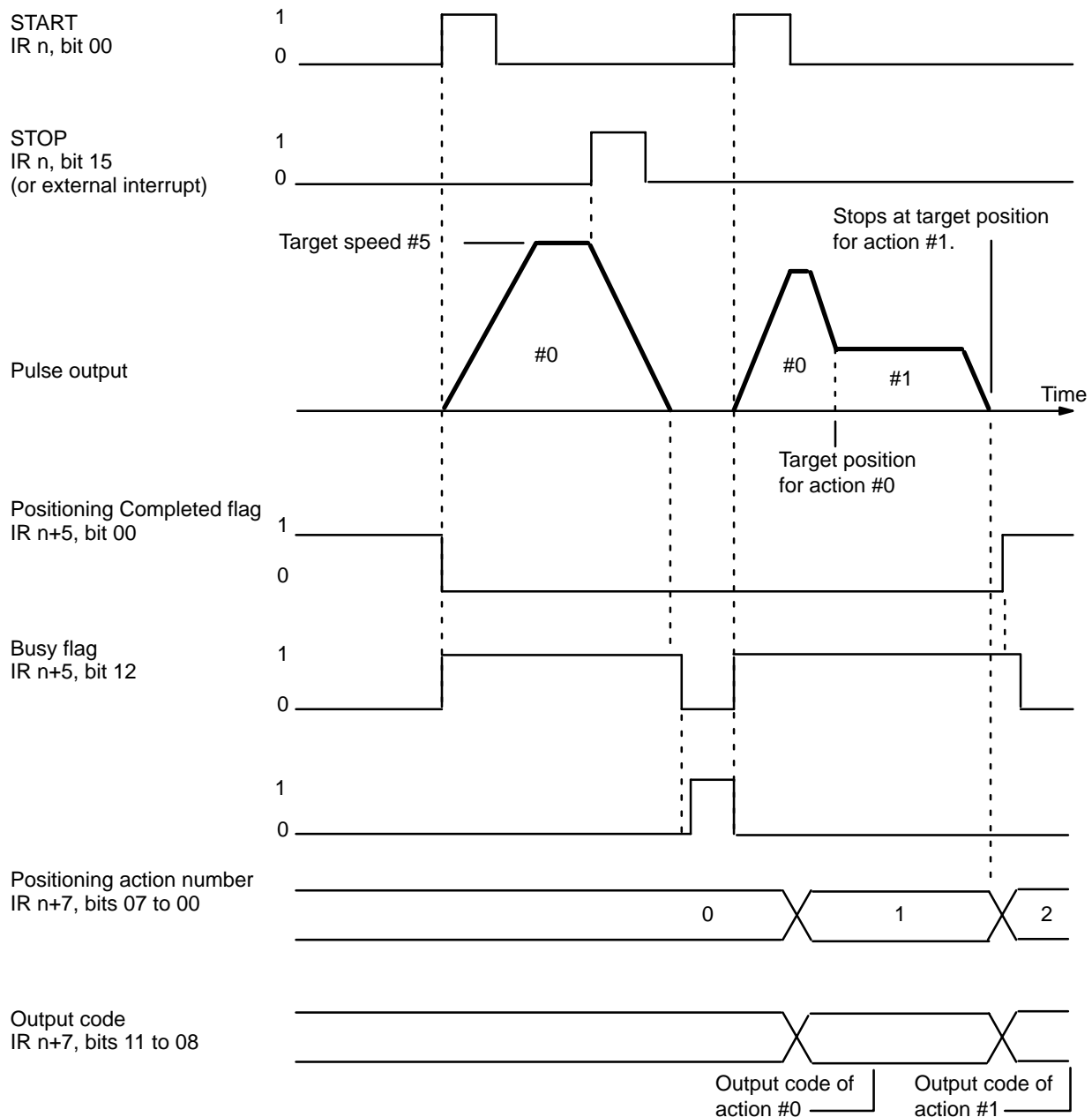
The following diagram shows the situation when STOP is not executed.



Example 2

The next diagram illustrates the case where STOP is executed before positioning is finished. In this example, START has initiated a sequence of two positioning actions, the first “continuous” and the second “single”. If STOP was not executed, positioning would reach the target speed (speed #5) for action #0, decelerate to the target speed (speed #8) for action #1, and finally stop at the target position for action #1.

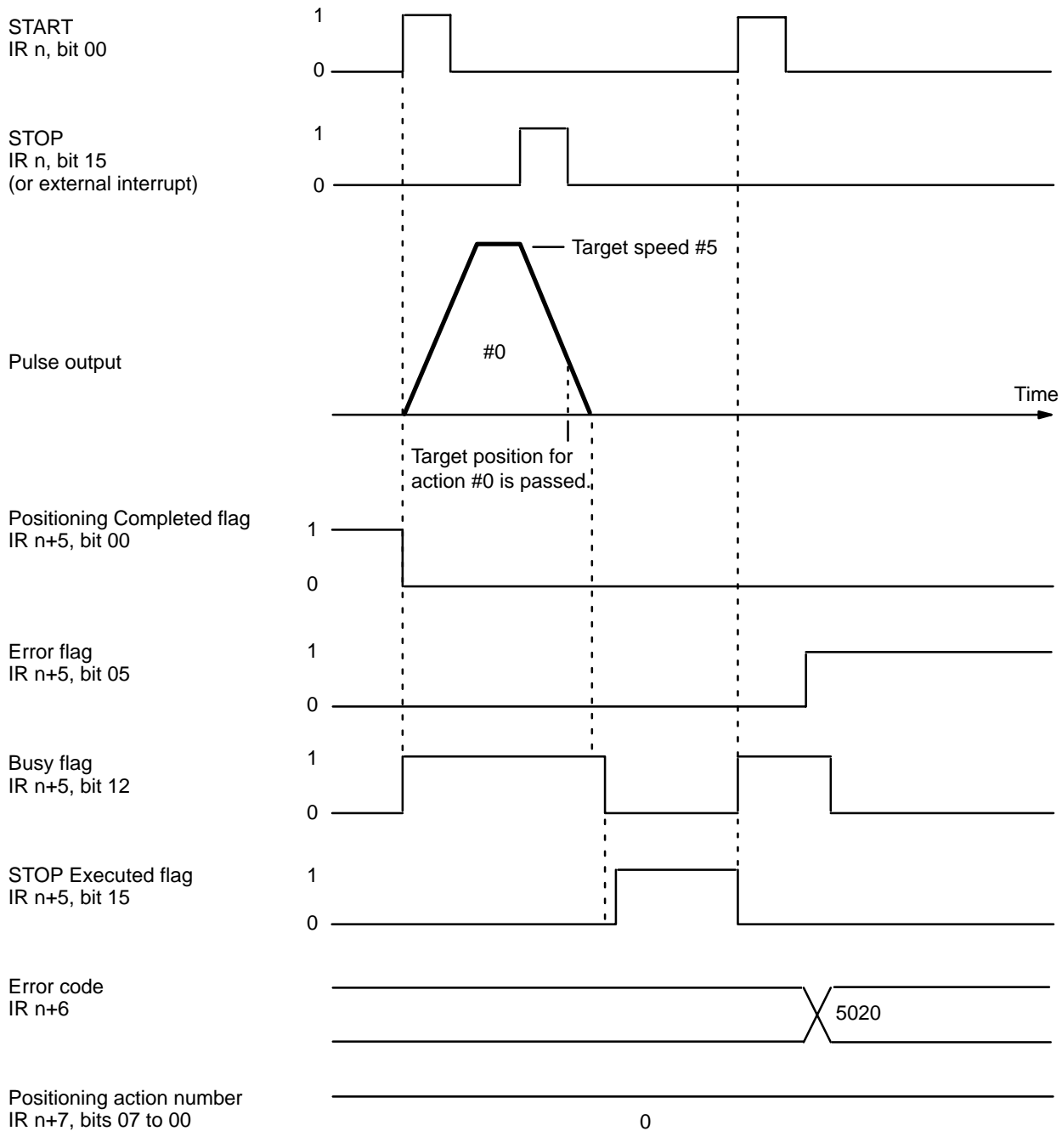
When STOP is executed during positioning action #0, however, positioning immediately decelerates to a stop. The STOP Executed flag turns ON and the Busy flag turns OFF (allowing manual operation). The Positioning Completed flag, however, remains OFF until both action #0 and action #1 have been fully implemented. The positioning action number remains the same, and the target speed and target position for that action are used the next time START is executed (as long as the target position has not already been exceeded).



Example 3

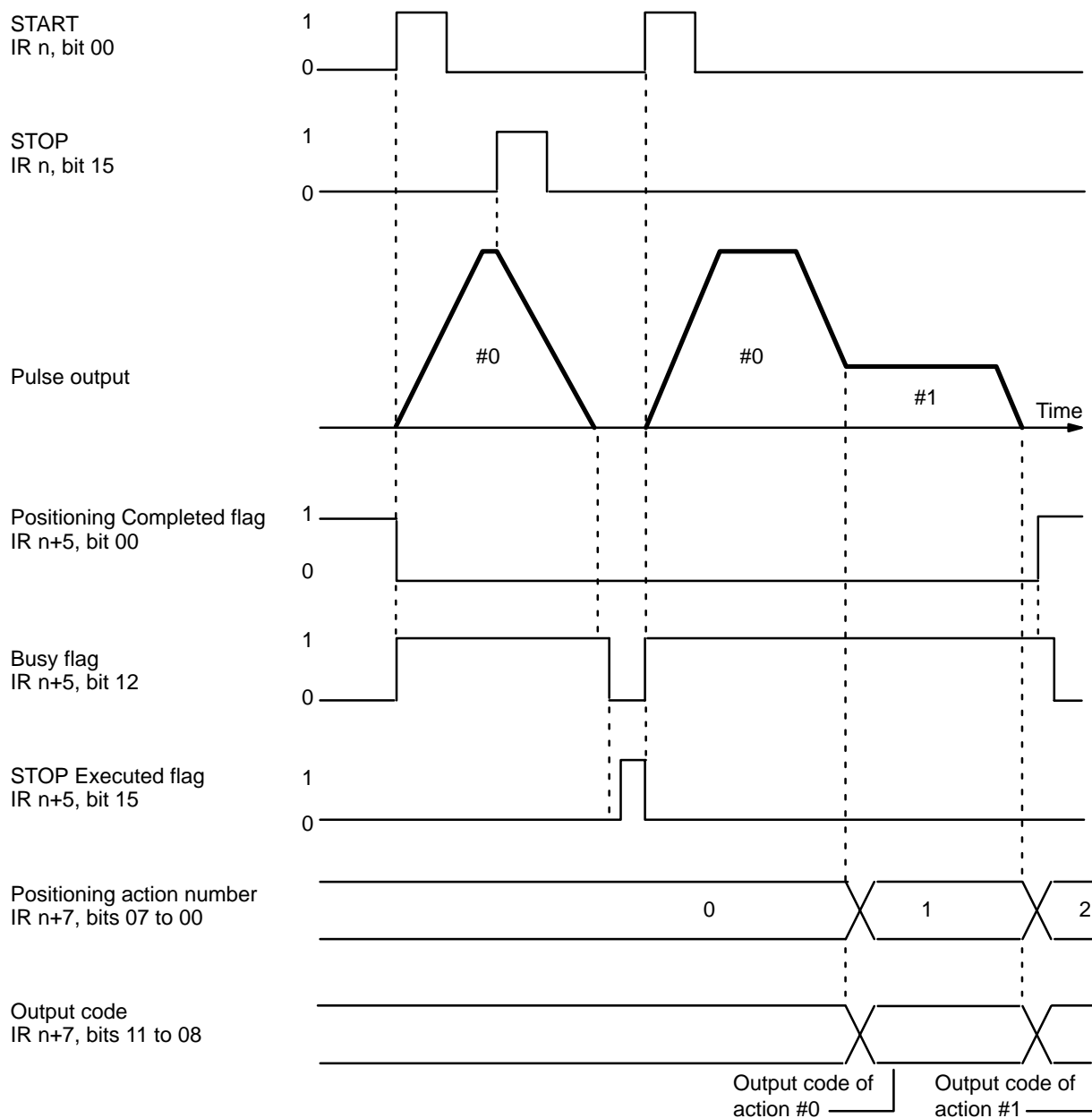
This diagram shows execution when a target position designated from the origin (i.e., not an increment) is exceeded during deceleration for STOP, as can happen when STOP is executed during the end of a continuous positioning action. If START is executed again before this situation is corrected, the feeding direction for the action will be wrong, and an error (code 5020) will be generated due to inability to begin the action. The Position Control 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

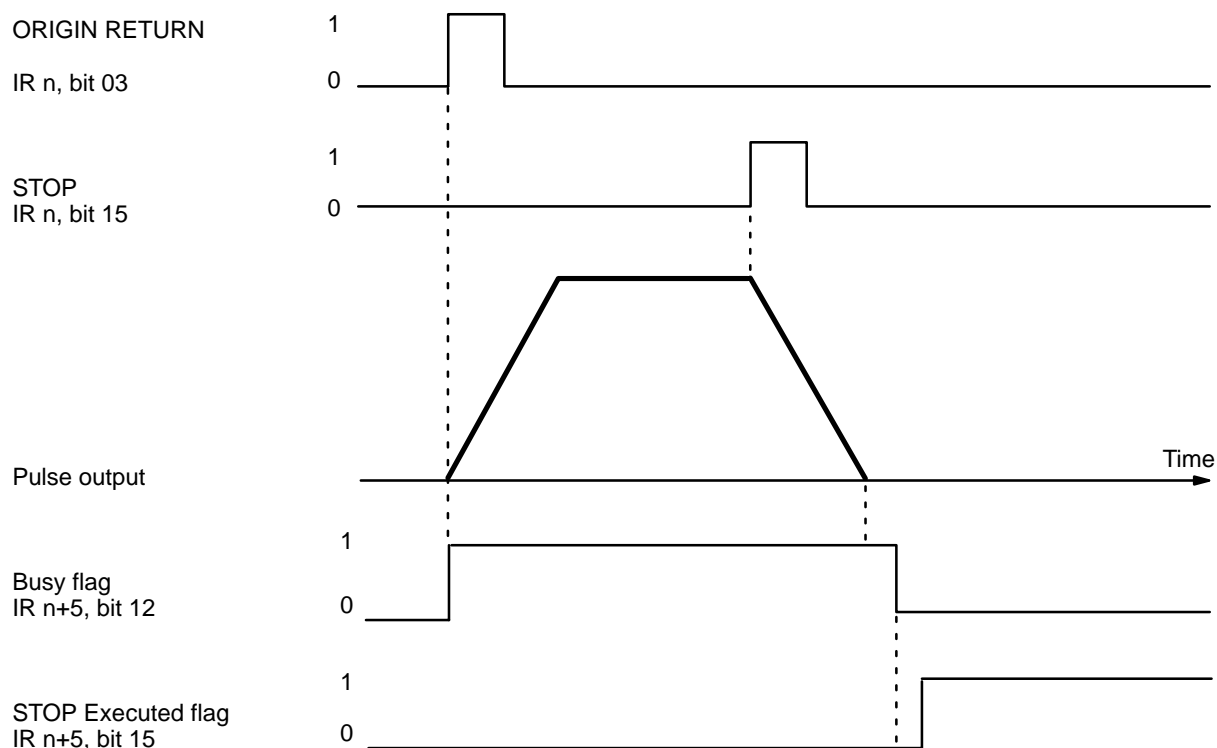
When the target position is expressed as an increment, the positioning action will be automatically started over from the position arrived at after STOP was executed.

**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.

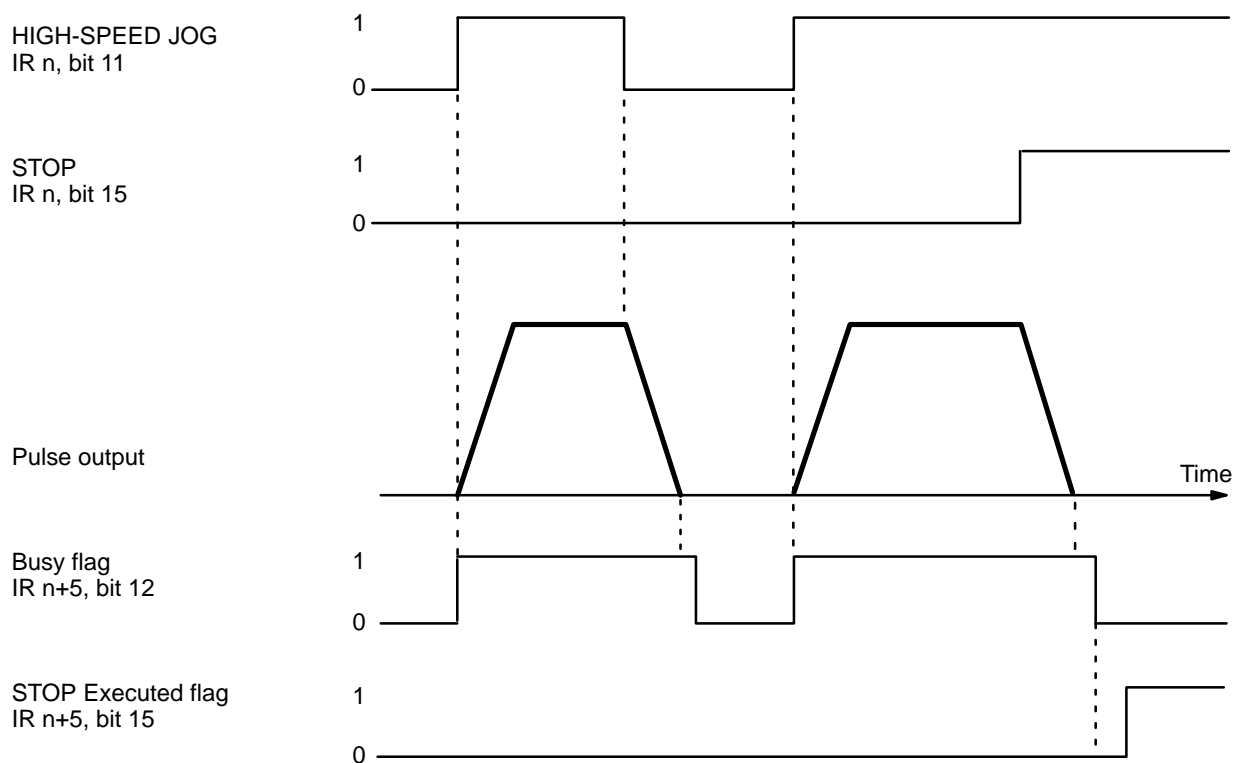
STOP During ORIGIN RETURN

Feeding stops according to the deceleration rate.



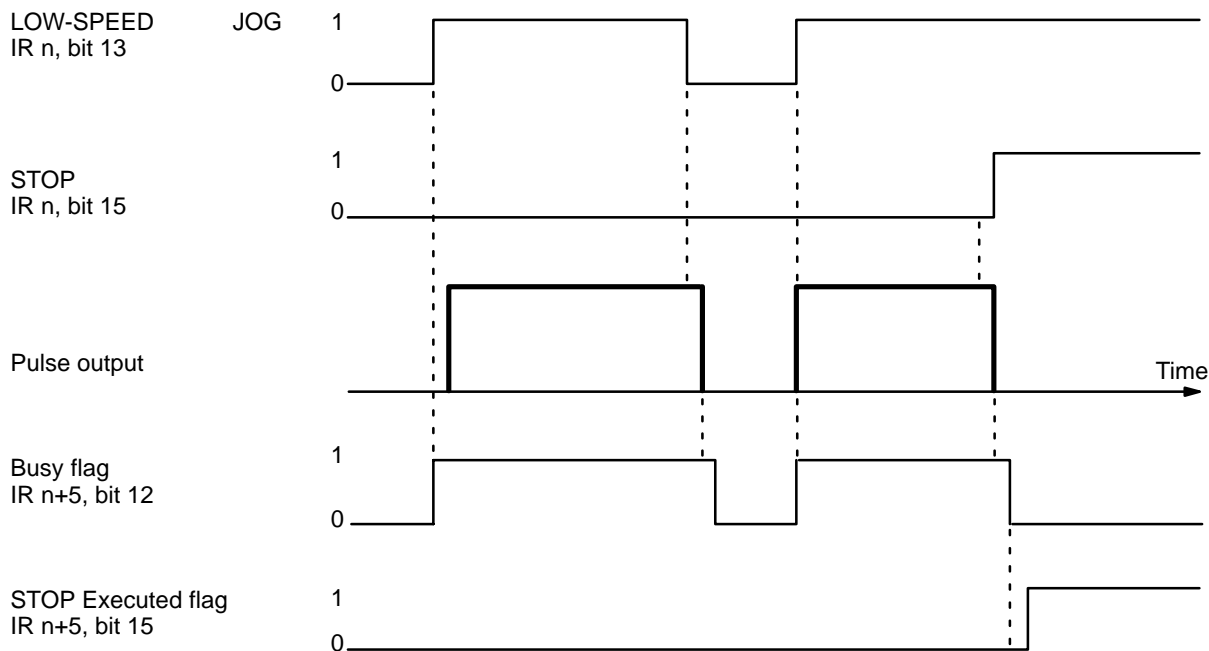
STOP During HIGH-SPEED JOG

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



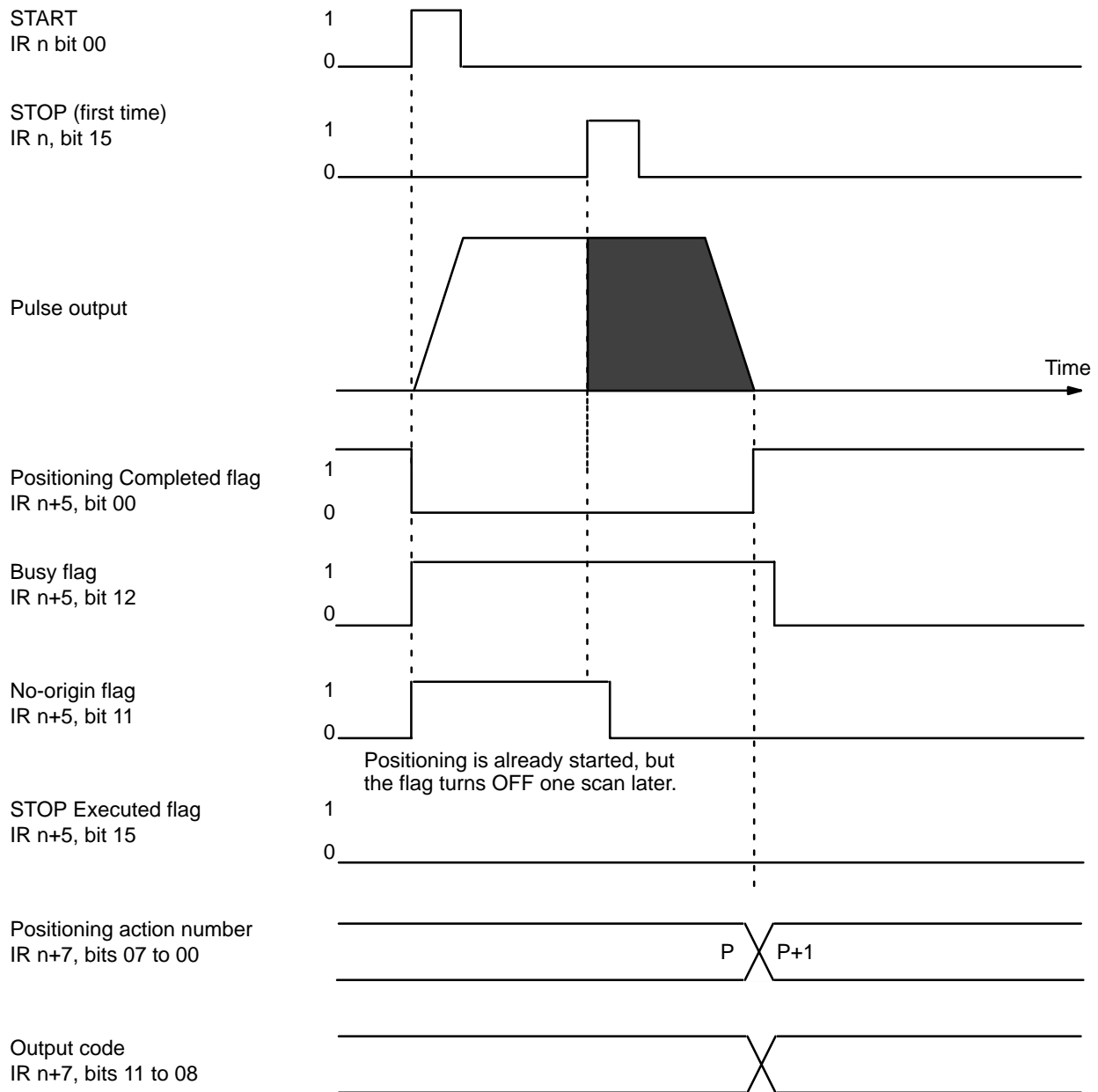
STOP During LOW-SPEED JOG

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

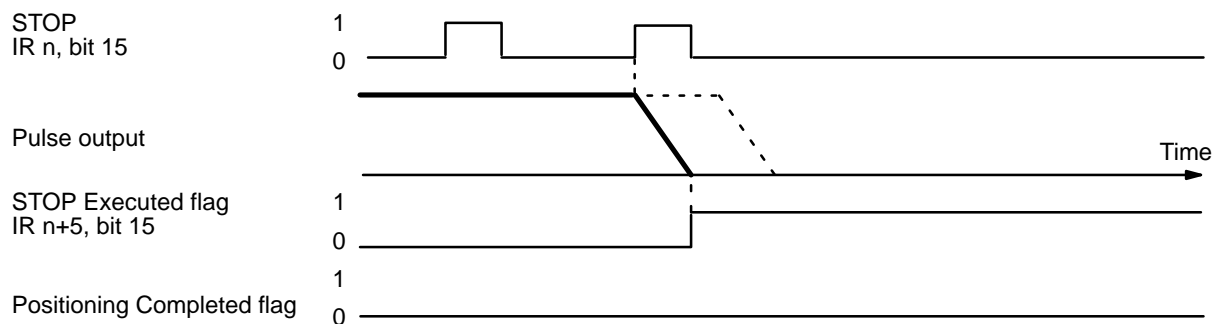
**STOP During a Completion Code 5 Positioning Action**

When STOP is executed for the first time during a positioning action with a completion code of 5, positioning will be executed according to whatever position data is set. When it is executed for a second time (see the following example diagram), positioning is interrupted and decelerates to a stop. See also *Completion Code* under *Section 4–1–1*.

Positioning cannot be restarted as long as the signal defined as the STOP command (either IR word n, bit 15 or an external interrupt signal) is ON. For details on defining either IR word n, bit 15 or an external interrupt signal as the STOP command, see *DIP Switch Settings* under *Section 4–10*.



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



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

4-11-2 CHANGE SPEED

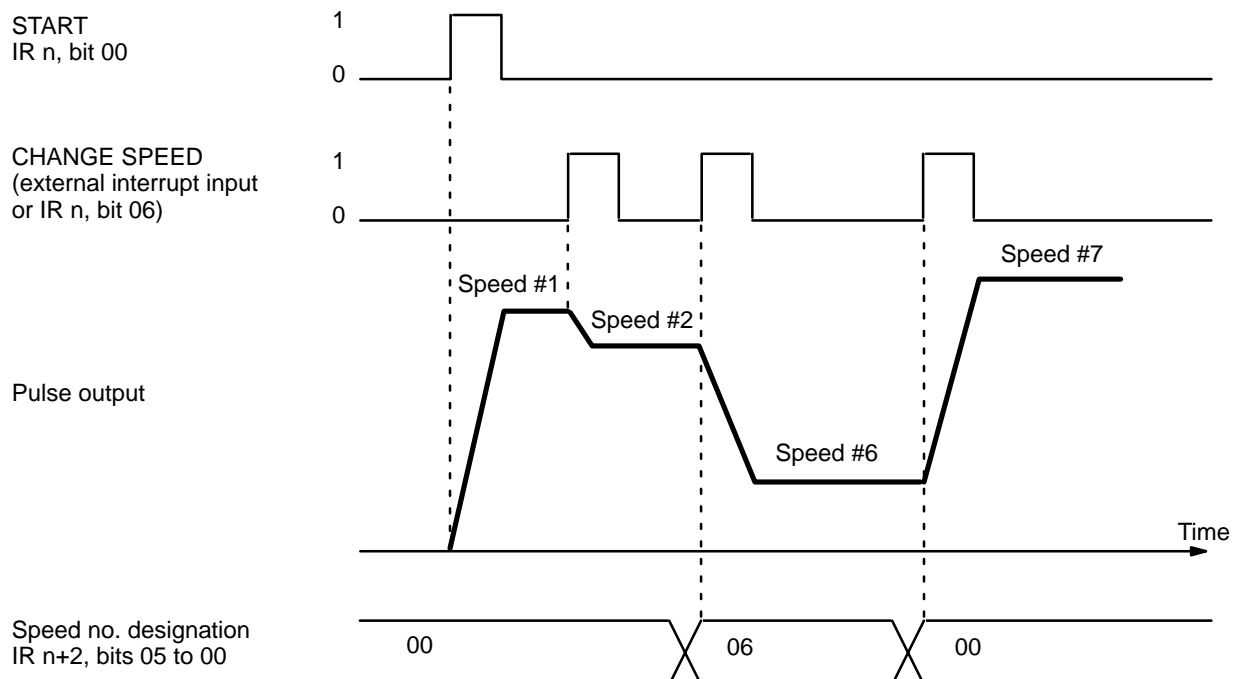
CHANGE SPEED can only be executed during positioning initiated with START. When executing CHANGE SPEED several times consecutively, you can either choose to have speed numbers incremented one by one, or select specific speed numbers to be executed in any order. Set the speed numbers in bits 05 to 00 of IR word $n+2$. (See *IR Area Settings* and *DIP Switch Settings* under *Section 4-10*). If you set these bits to 00, the speed numbers will be incremented in order from the one currently being executed. You can select specific speed numbers by setting the bits anywhere from 01 to 15.

It is also possible to execute CHANGE SPEED with bit 06 of IR word n , depending on the DIP switch settings. If bit 06 is used, the data will simultaneously be input to IR word $n+2$. If you use an external interrupt signal, however, be sure to input the data at least one scan time early or it will not be effective.

When the target position is being approached, CHANGE SPEED will not affect deceleration. In other words, normal deceleration to end at the target position will be carried out for single, pause, or bank end positioning actions, and the target speed for the next positioning action will take priority for a continuous positioning action.

Execution Example

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



SECTION 5

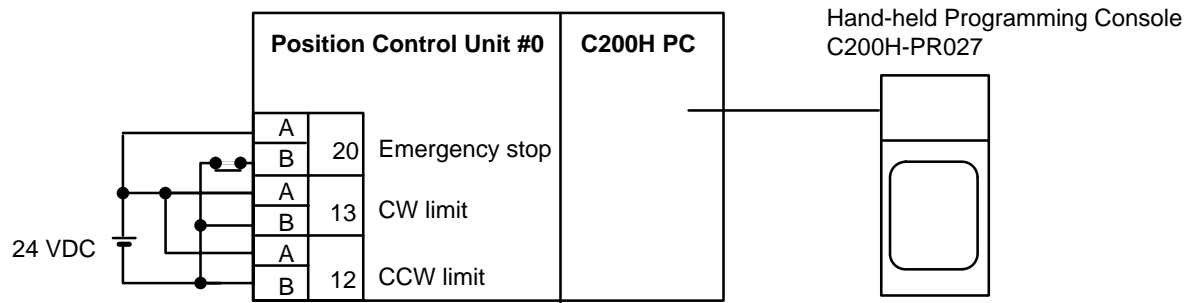
Programming Examples

This section contains examples of possible applications of Positioning Control Unit commands, inputs, and outputs. The first example (see *Section 5-1*) shows the minimum data required for operation. The second example (*Section 5-2*) shows the use of only one positioning action under START augmented by RESET ORIGIN. *Section 5-3* demonstrates the use of external switches to control positioning actions, while *Sections 5-4* and *5-5* show use of TRANSFER DATA: the example in *Section 5-4*, from the PC, and in *Section 5-5*, from external switches. *Section 5-6* shows a complex series of positioning actions under START. The example in *Section 5-7* illustrates possible search patterns under ORIGIN SEARCH, while that in *5-8* illustrates one possible use of zones: controlling manual feeding operations. *Section 5-9* shows how to set speeds by multiplying speed units, and *Section 5-10* shows a program with multiple banks. Refer to the *Appendixes* or individual operation or command descriptions for details.

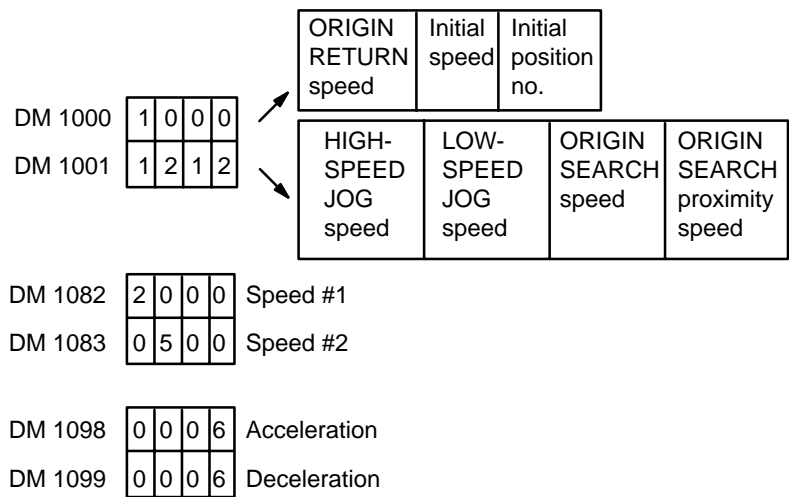
5-1	Operation with Minimum Data (Displaying JOG Positions)	118
5-2	Positioning at Intervals Using RESET ORIGIN	119
5-3	Feeding Selectively with START	121
5-4	TRANSFER DATA from Other PC Areas	123
5-5	TRANSFER DATA from External Switches	125
5-6	Using START to Carry Out Positioning Actions	128
5-7	Using Origin and Origin Proximity Signals	132
5-8	Using Zones to Control Jogging	132
5-9	Setting Speeds	134
5-10	Using a Multiple Bank Program	134

5-1 Operation with Minimum Data (Displaying JOG Positions)

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

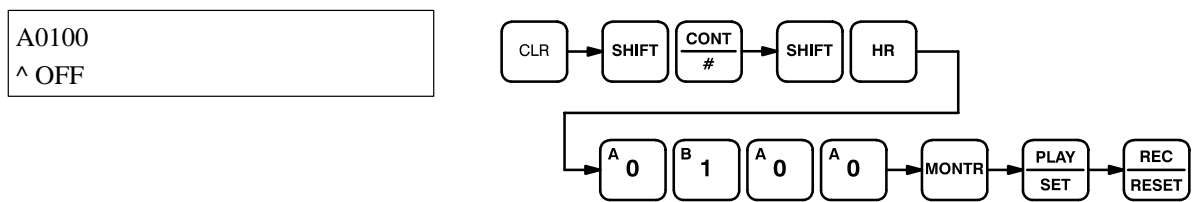


DM Area Settings The data settings shown below are the minimum required to prevent the alarm/error LED from flashing.

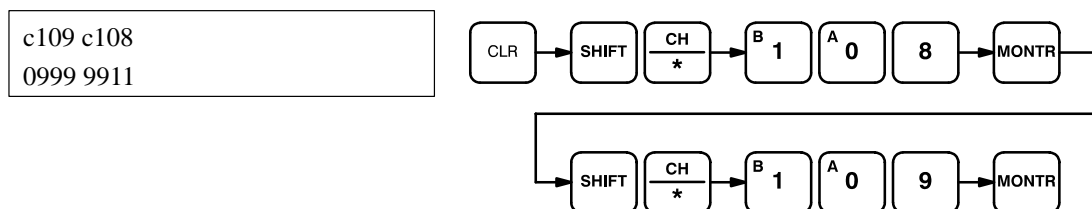


Procedure

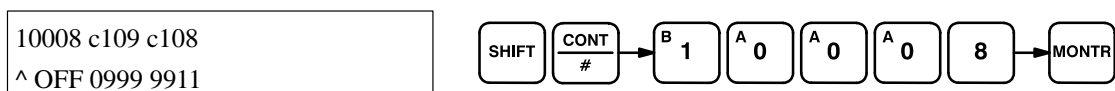
- 1, 2, 3... 1. Set the PC to PROGRAM mode, and then begin operation from the Programming Console.
2. Write data into the DM area and restart.



3. Monitor the present position words.



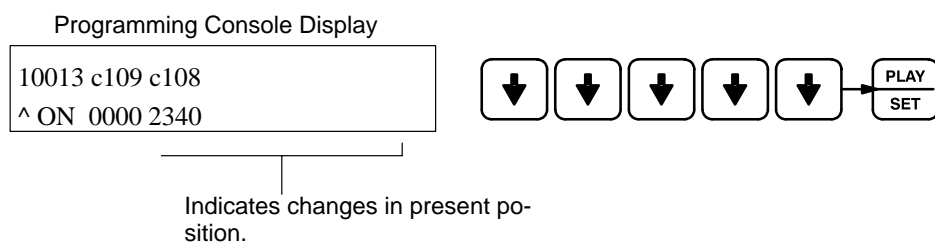
4. Monitor the RESET ORIGIN command bit.



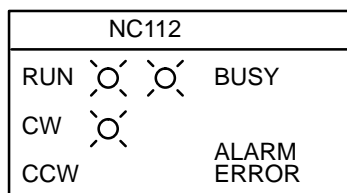
5. Reset the present position.



6. Set LOW-SPEED JOG command bit.



Indicators on Position Control Unit



CW and busy LEDs light when 10012 (direction) is OFF.

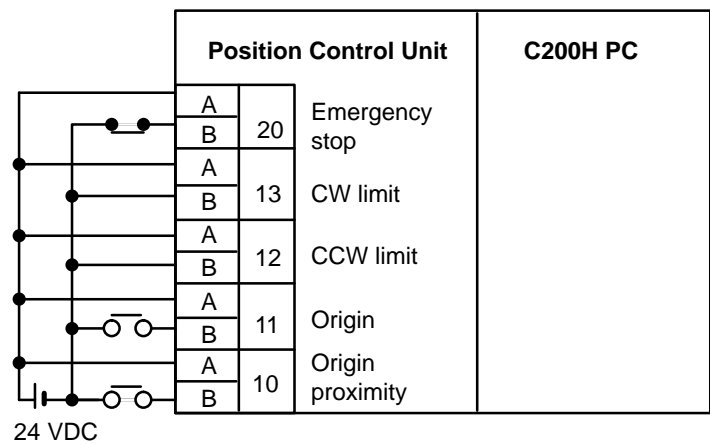
7. Stop LOW-SPEED JOG.



5–2 Positioning at Intervals Using **RESET ORIGIN**

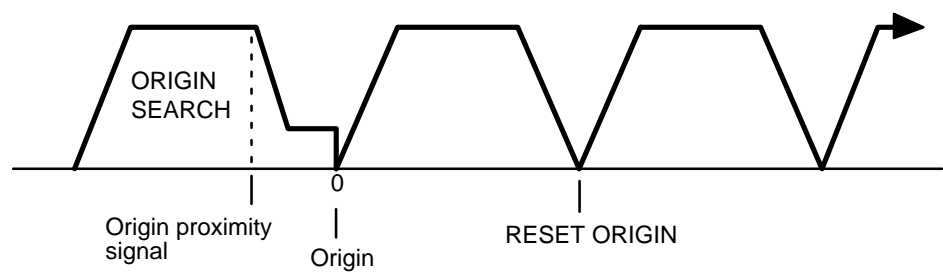
In this example, the Position Control Unit is assumed to be assigned unit number 0.

Configuration

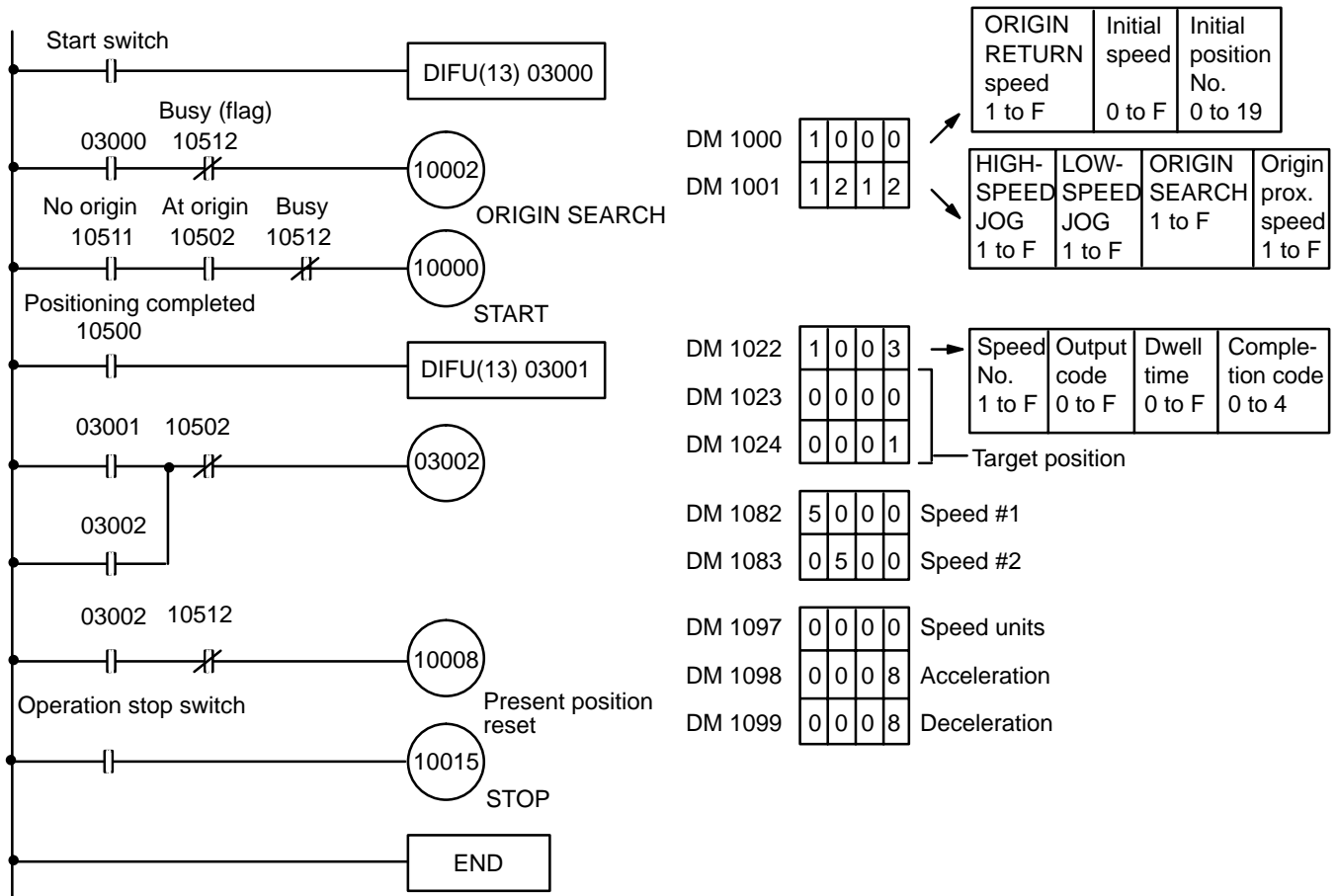


Operation

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.



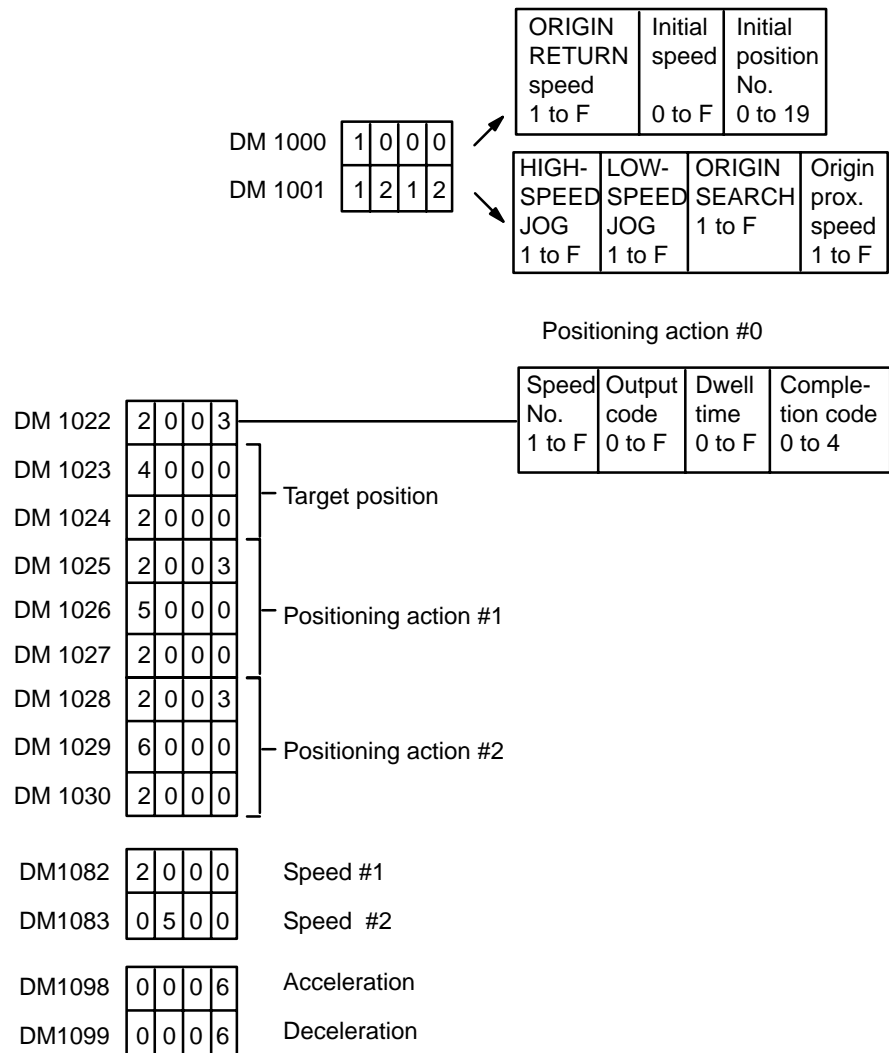
Programming



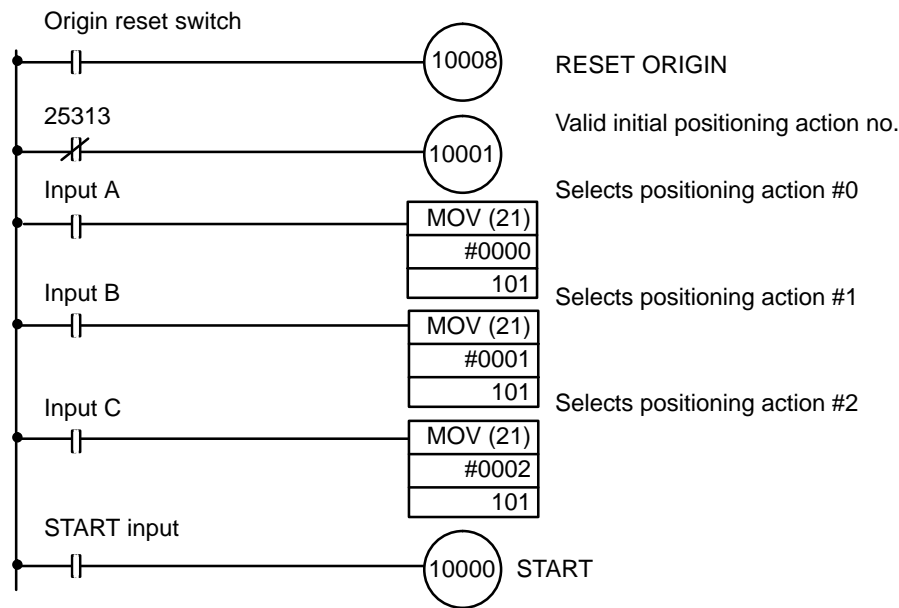
5-3 Feeding Selectively with START

Configuration

The configuration here is the same as that for Example 1. There is no origin or origin proximity signal used. With the following data and program, the user can select feeding 4,000, 5,000, or 6,000 pulses at a time at 1,000 pps. The data settings shown below are the minimum required to prevent the alarm/error LED from flashing. The positioning actions are all CW (incremental) bank completion actions.

**Ladder Diagram**

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

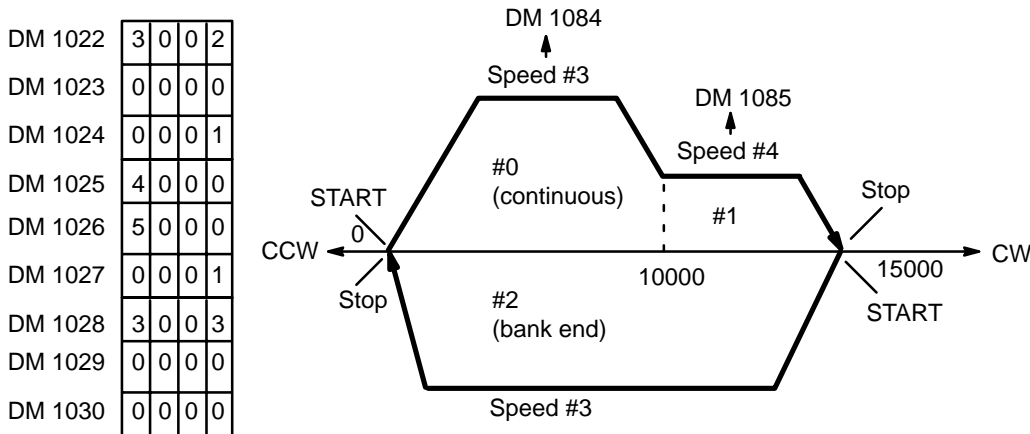


5-4 TRANSFER DATA from Other PC Areas

This example program shows data for three positioning actions transferred from DM 0010. 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 DM 1022, if the previous origin positioning action is to be repeated.

Initial Data

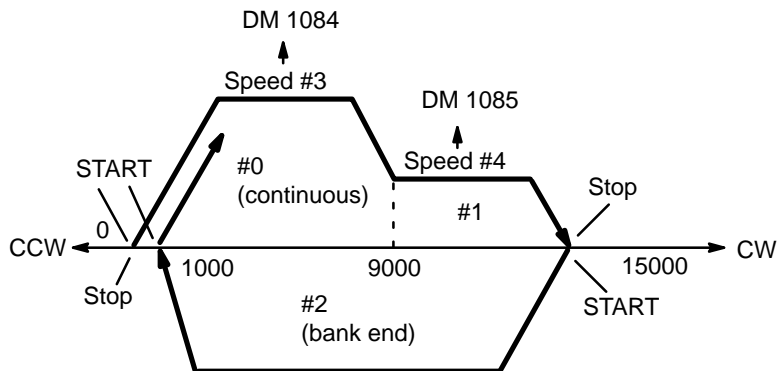
The initial data is entered in DM 1002 to 1030. The data and positioning actions are shown below.



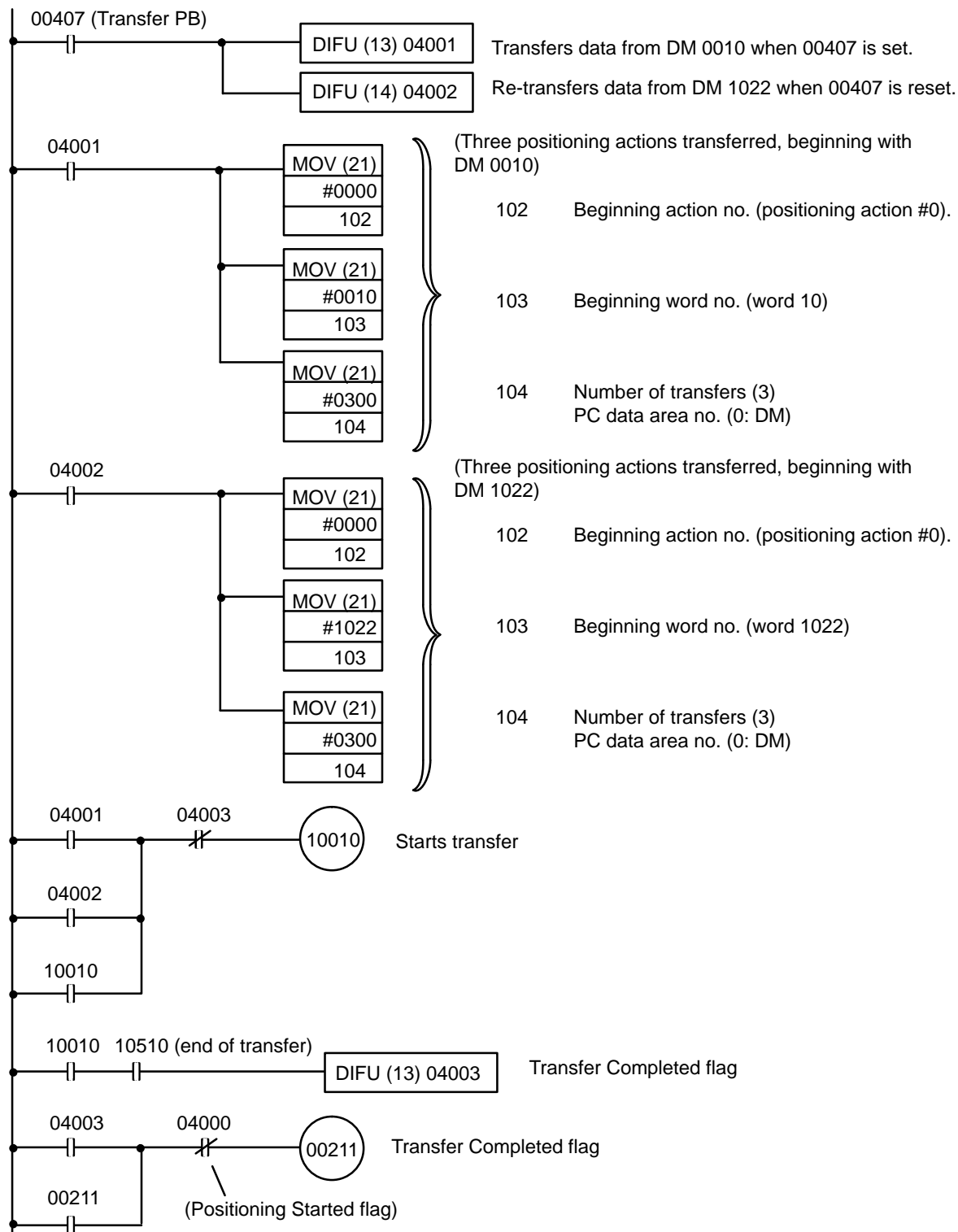
Data To Be Transferred

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	0	0



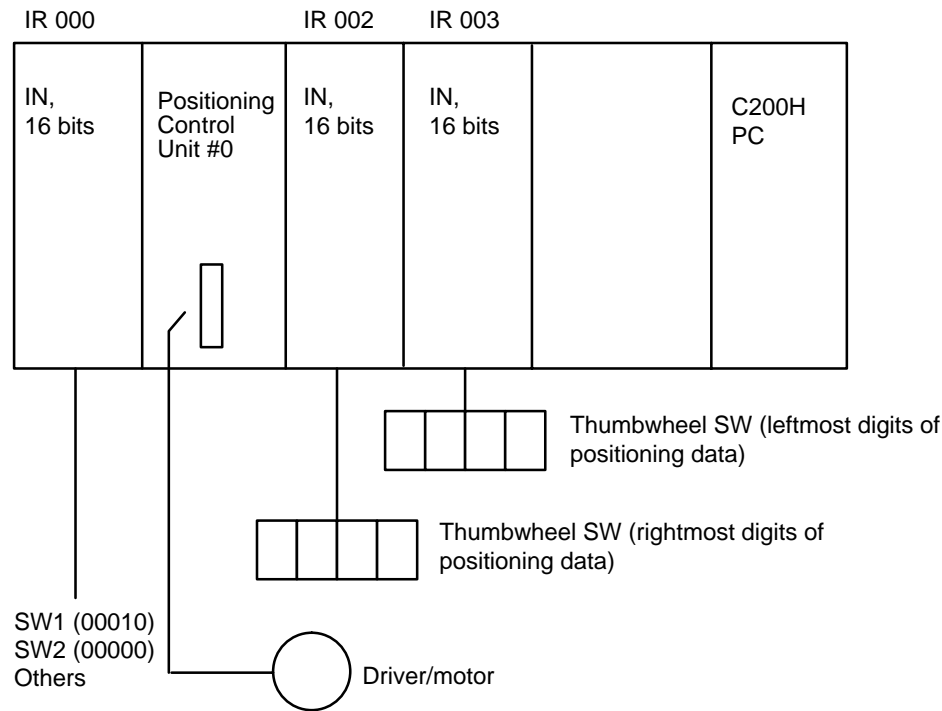
Program



5-5 TRANSFER DATA from External Switches

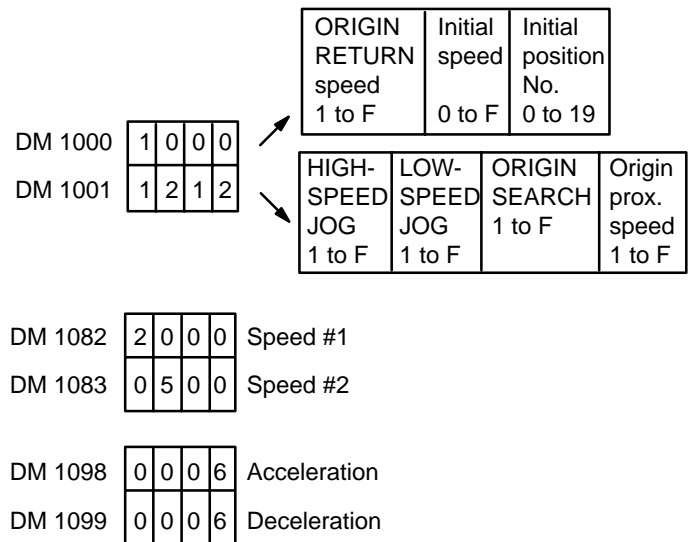
In this example, positioning is executed in accordance with the number of pulses set by external thumbwheel switches.

Configuration



Data Memory

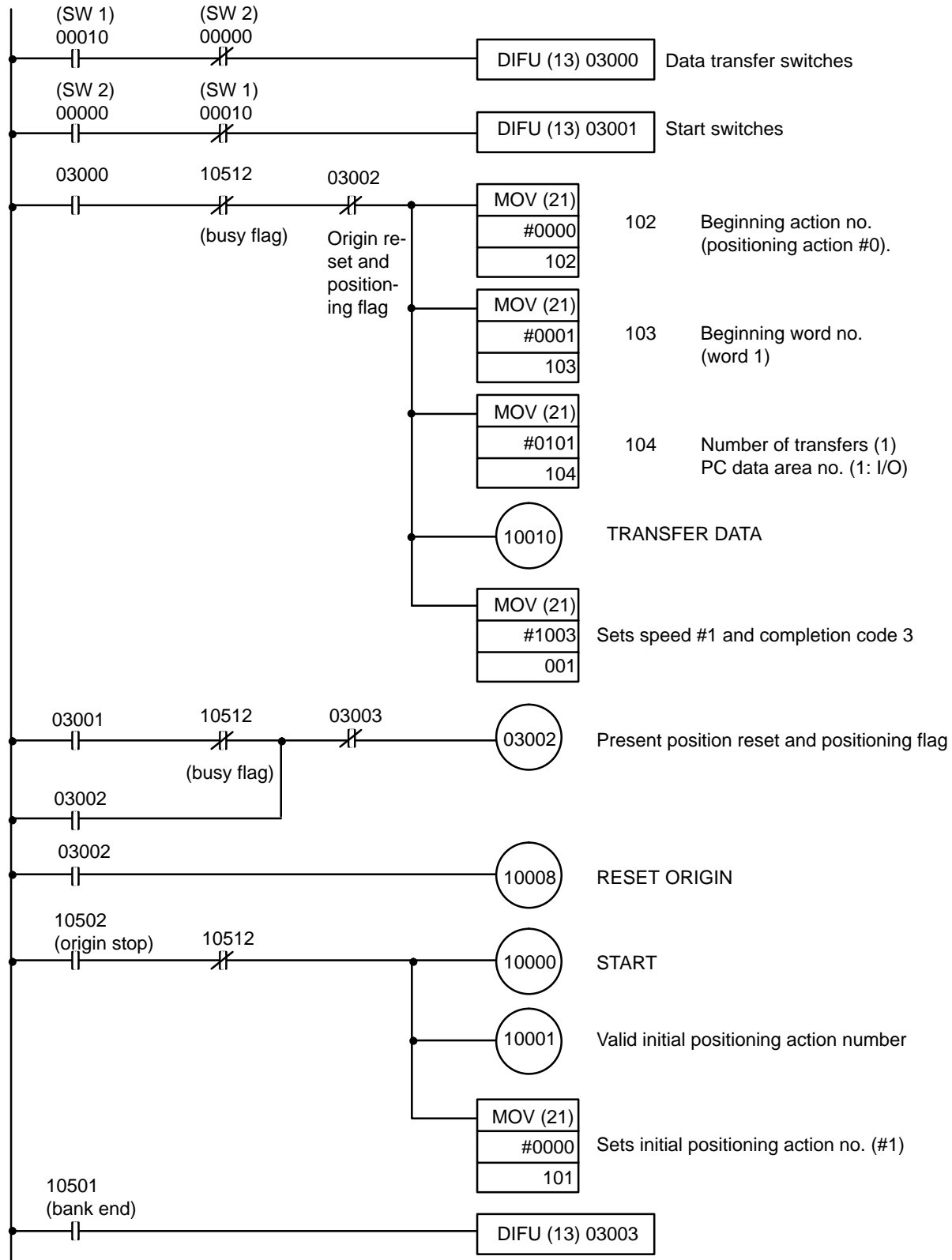
The following is the minimum data required so that an alarm will not be generated.



Data To Be Transferred

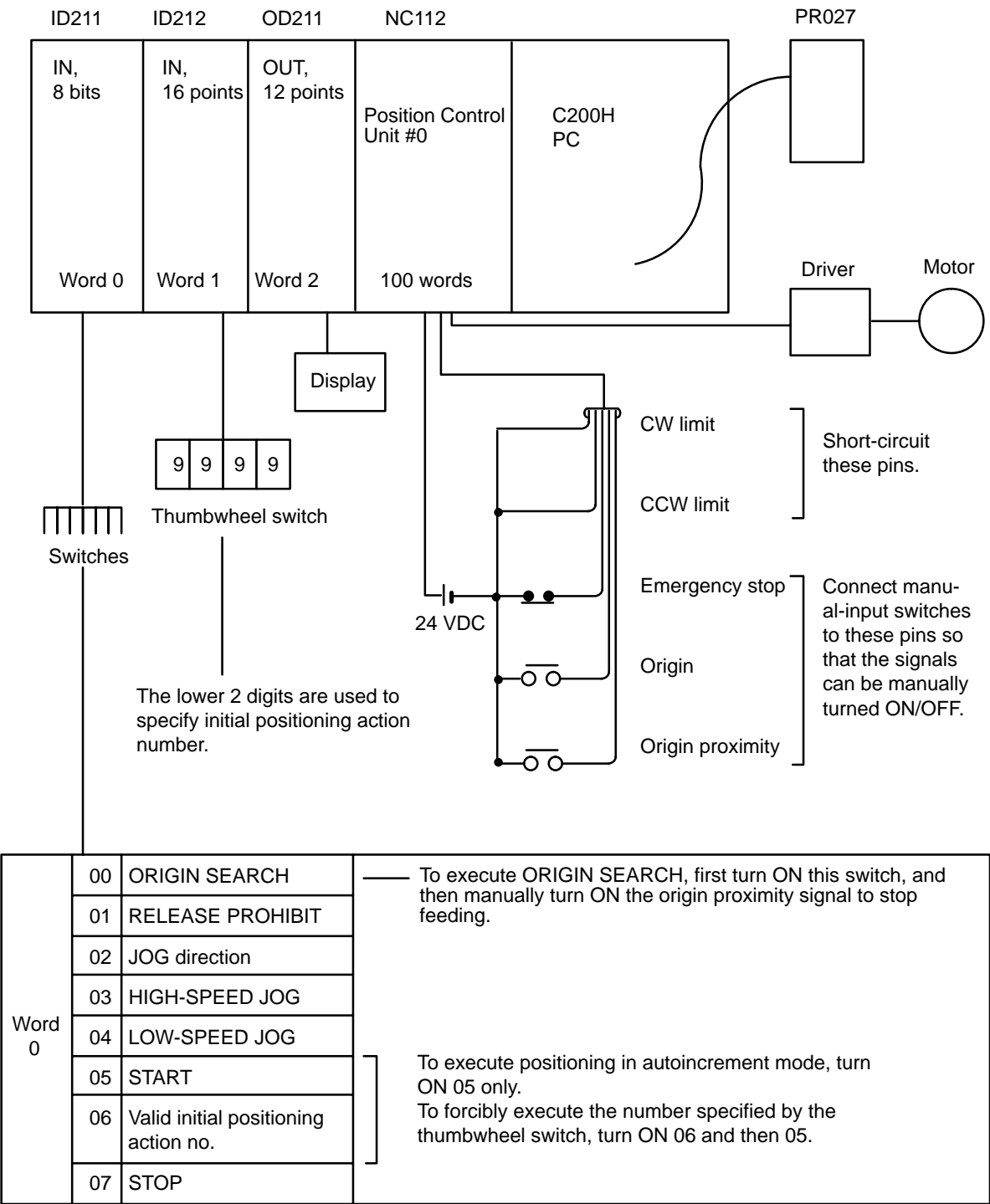
Three consecutive words are transferred for positioning action #0. The bits of IR 001, which is allocated to the Position Control Unit, are used as internal relays. The next two words are input from thumbwheel switches connected to Input Units allocated IR 002 and IR 003. Thus, when TRANSFER DATA is 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

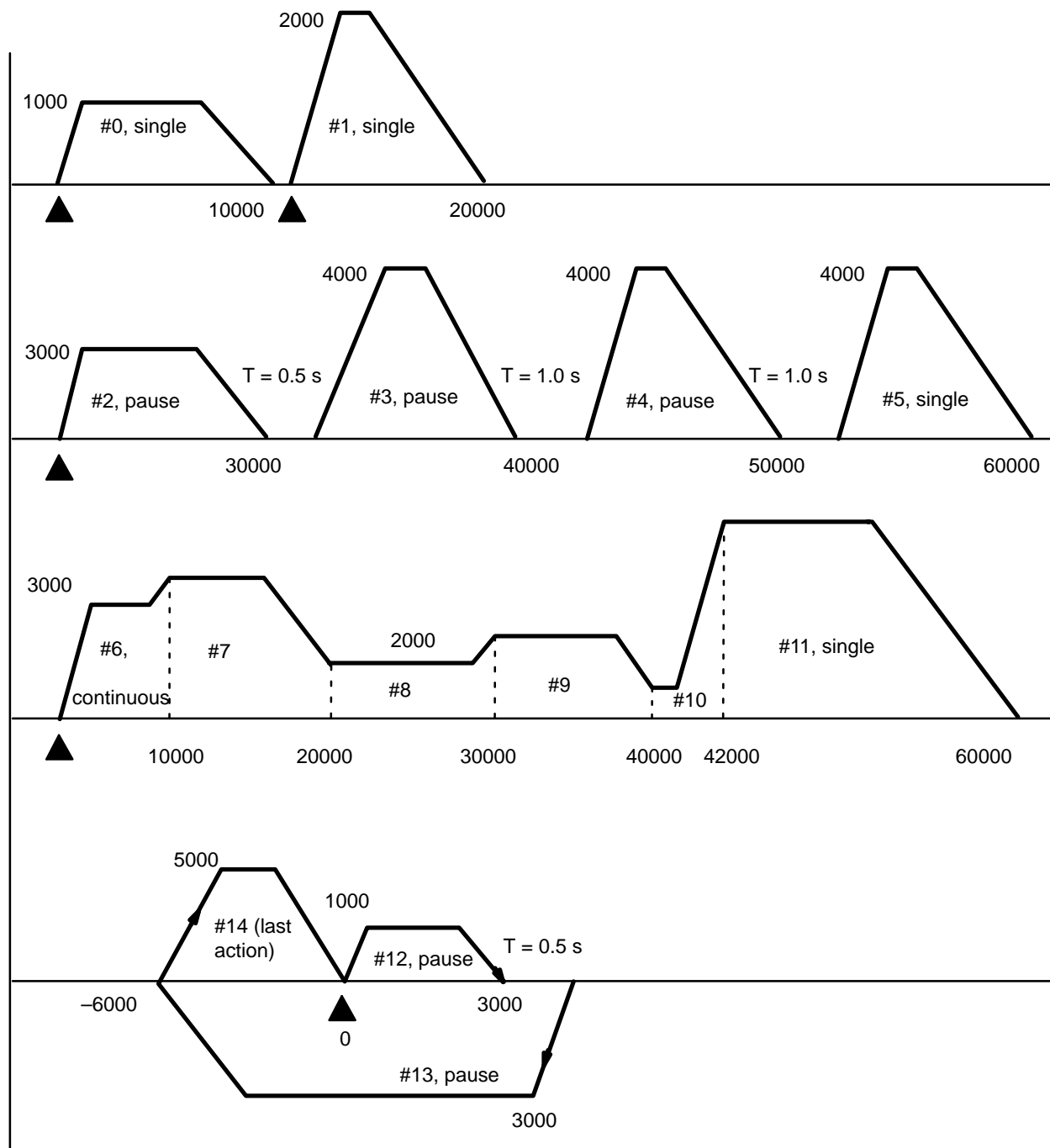


5–6 Using **START** to Carry Out Positioning Actions

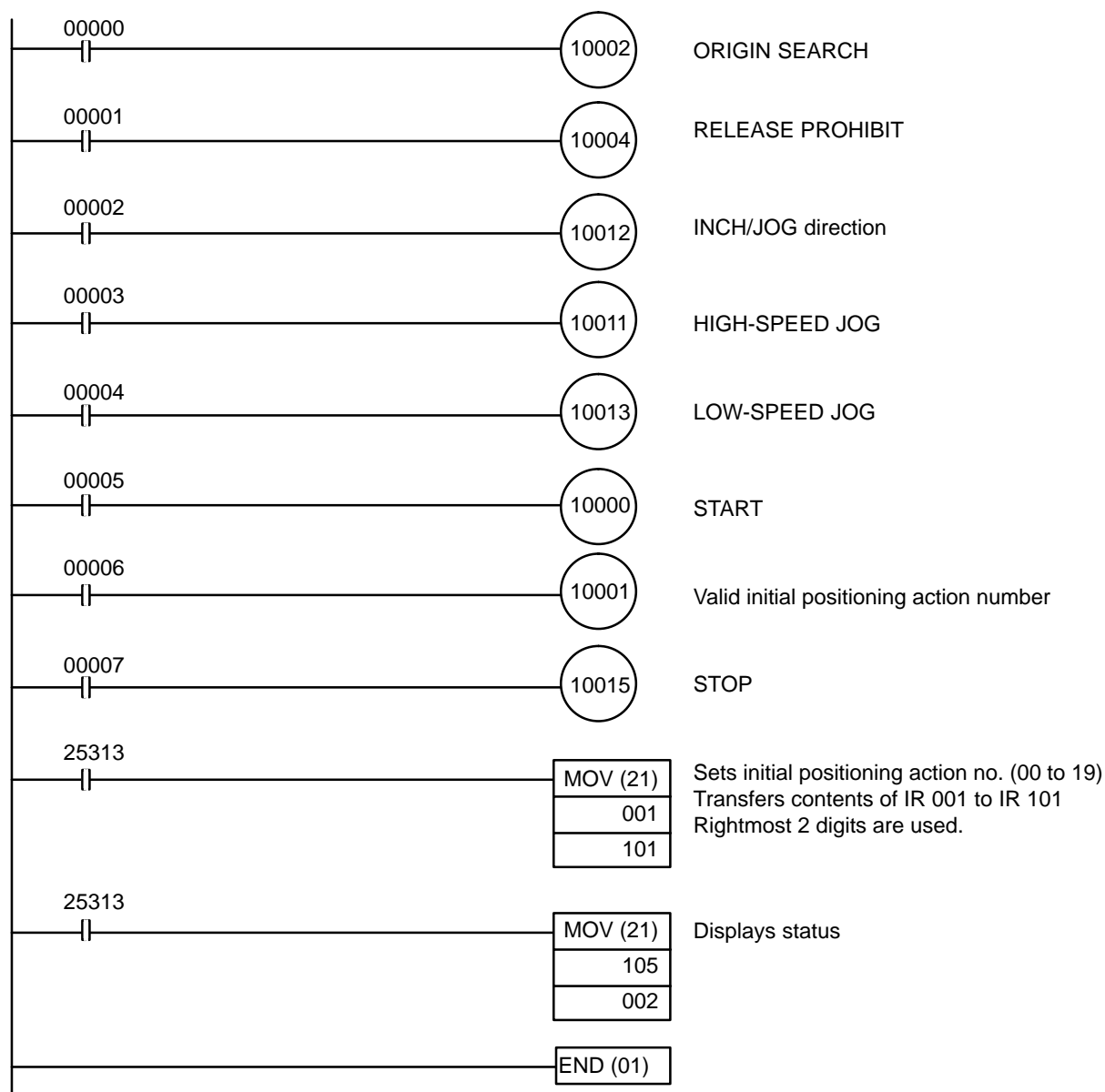
Wiring (Details Omitted)



Feeding Pattern



Program



DM Area Coding Sheet

Unit Number: 0

Allocated DM words:

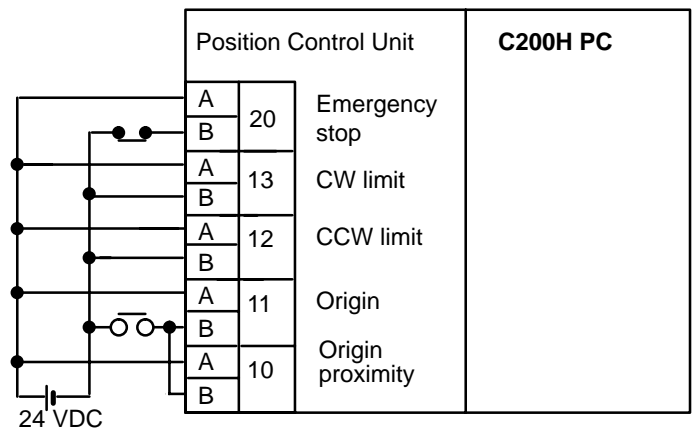
DM 1000 through DM 1099

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	1	1	2	Initial position nos.; speed nos.	Transfer no. →										Transfer no. →									
01	2	3	4	5		34	9	1	A	1	Positioning action #4	4	67					Positioning action #15	15						
02	2	0	0	0	Origin compensa- tion and direction	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		39	0	0	0	6			72												
07	0	0	0	0	CCW limit	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										
10	0	0	0	0		43	9	2	0	2	76							Positioning action #18	18						
11	0	5	0	0	Zone 0 CCW limit	44	0	0	0	0	77														
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 #8	8	79					Positioning action #19	19						
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			81												
16	0	0	0	0		49	7	4	0	2	Positioning action #9	9	82	5	0	0	0	Speed #1	20						
17	0	0	0	0	Zone 2 CW limit	50	0	0	0	0			83	5	0	0	0	Speed #2							
18	0	0	0	2		51	0	0	0	4			84	0	5	0	0	Speed #3							
19	5	0	0	0	Zone 2 CCW limit	52	3	5	0	2	Positioning action #10	10	85	4	0	0	0	Speed #4	21						
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			87	1	0	0	0	Speed #6							
22	6	0	0	0	Positioning action #0	0	55	A	6	0	0	Positioning action #11	11	88	2	0	0	0	Speed #7	22					
23	0	0	0	0			56	0	0	0	0			89	3	0	0	0	Speed #8						
24	0	0	0	1			57	0	0	0	6			90	4	0	0	0	Speed #9						
25	7	0	0	0	Positioning action #1	1	58	6	0	5	1	Positioning action #12	12	91	5	0	0	0	Speed #10	23					
26	0	0	0	0			59	3	0	0	0			92	6	0	0	0	Speed #11						
27	0	0	0	2			60	0	0	0	0			93	7	0	0	0	Speed #12						
28	8	1	5	1	Positioning action #2	2	61	8	0	0	1	Positioning action #13	13	94	8	0	0	0	Speed #13	24					
29	0	0	0	0			62	6	0	0	0			95	9	0	0	0	Speed #14						
30	0	0	0	3			63	1	0	0	0			96	1	0	0	0	Speed #15						
31	9	1	A	1	Positioning action #3	3	64	A	0	0	3	Positioning action #14	14	97	8	0	0	0	Speed units	25					
32	0	0	0	0			65	0	0	0	0			98	0	1	0	0	Acceleration						
33	0	0	0	4			66	0	0	0	0			99	0	0	5	0	Deceleration						

5–7 Using Origin and Origin Proximity Signals

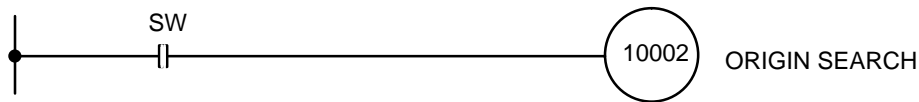
Configuration



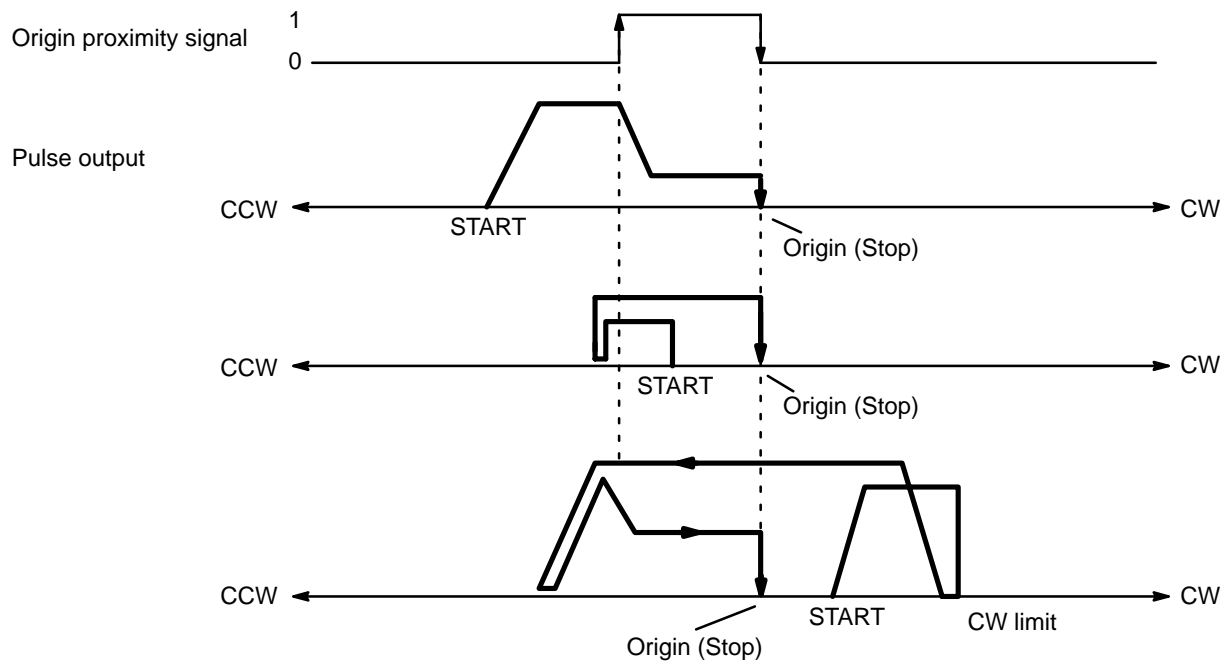
DIP Switch Settings

- 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.

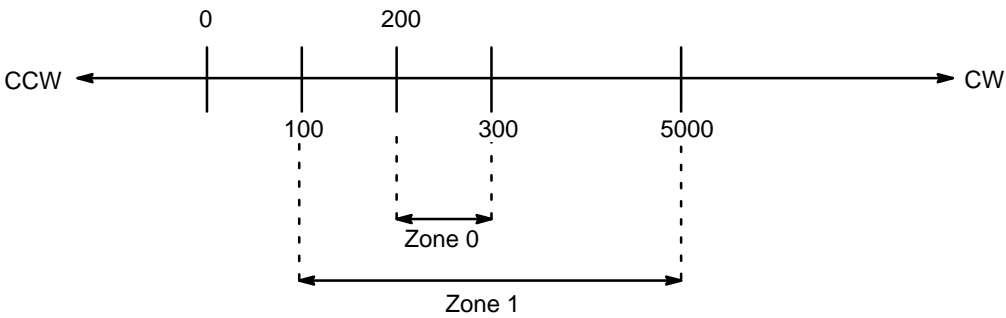


5–8 Using Zones to Control Jogging

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

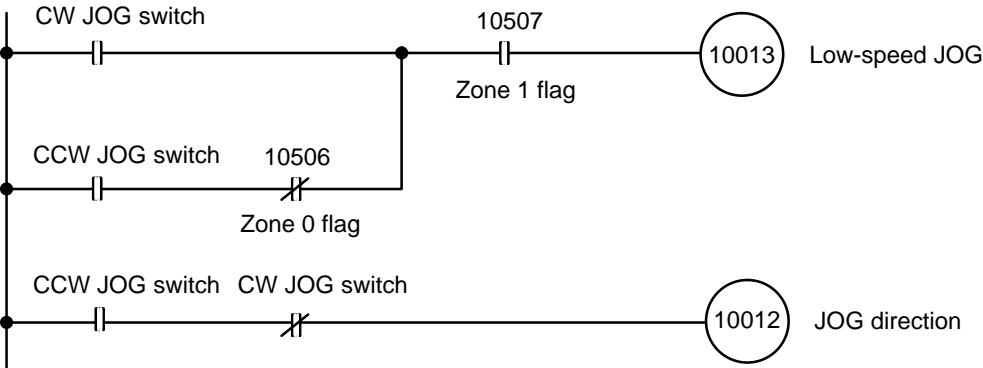
operations are possible in zone 1 except for the part of it occupied by zone 0. In zone 0, CCW manual feeding is prohibited.



DM Area Settings (Zone Data)

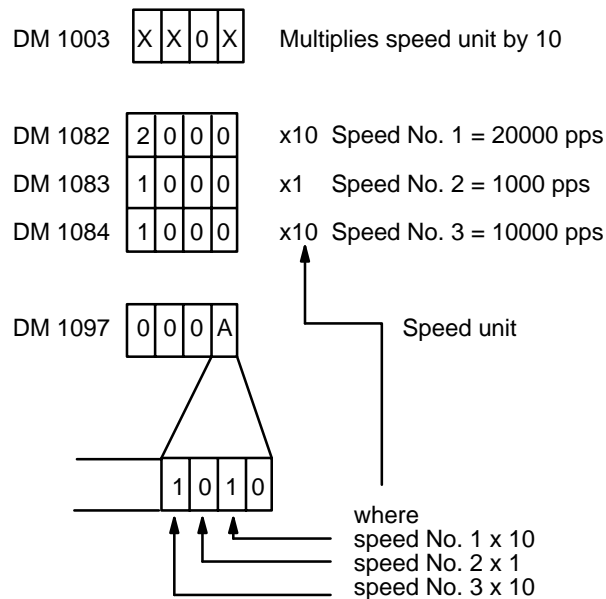
DM 1009	0	3	0	0	Zone 0 CW limit	Zone 0
DM 1010	0	0	0	0		
DM 1011	0	2	0	0		
DM 1012	0	0	0	0	Zone 0 CCW limit	Zone 0
DM 1013	5	0	0	0		
DM 1014	0	0	0	0		
DM 1015	0	1	0	0	Zone 1 CW limit	Zone 1
DM 1016	0	0	0	0		
					Zone 1 CCW limit	

Program

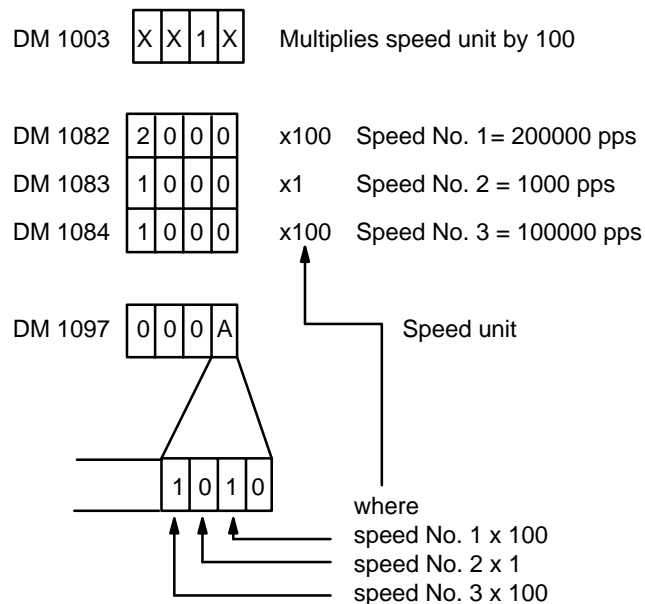


5–9 Setting Speeds

Multiplying the Speed Unit by 10



Multiplying the Speed Unit by 100



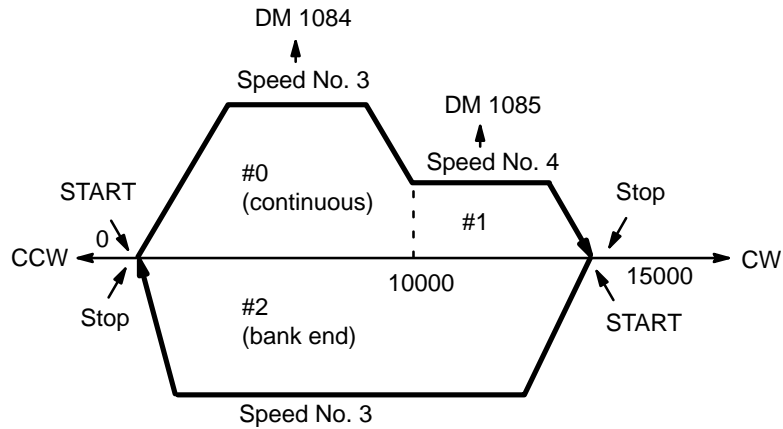
5–10 Using a Multiple Bank Program

In this example, it is assumed that the data from the example *Section 5–4* has already been input to Unit #0.

**First Bank
(Positioning Action
Numbers 0 to 2)**

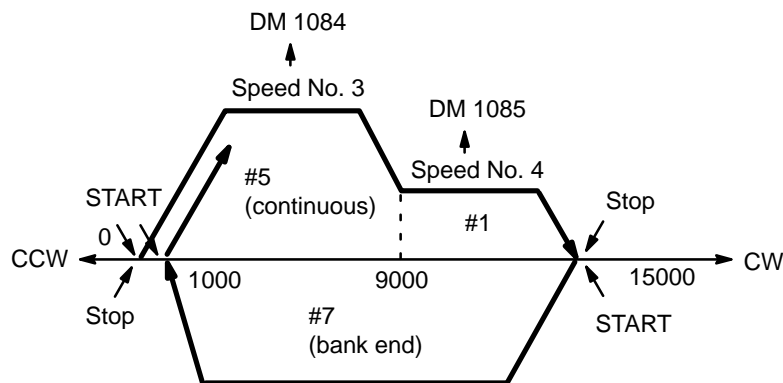
The data for one bank is entered into positioning action numbers 0, 1, and 2.

DM 1022	3	0	0	2
DM 1023	0	0	0	0
DM 1024	0	0	0	1
DM 1025	4	0	0	0
DM 1026	5	0	0	0
DM 1027	0	0	0	1
DM 1028	3	0	0	3
DM 1029	0	0	0	0
DM 1030	0	0	0	0

**Second Bank (Positioning
Action Numbers 5 to 7)**

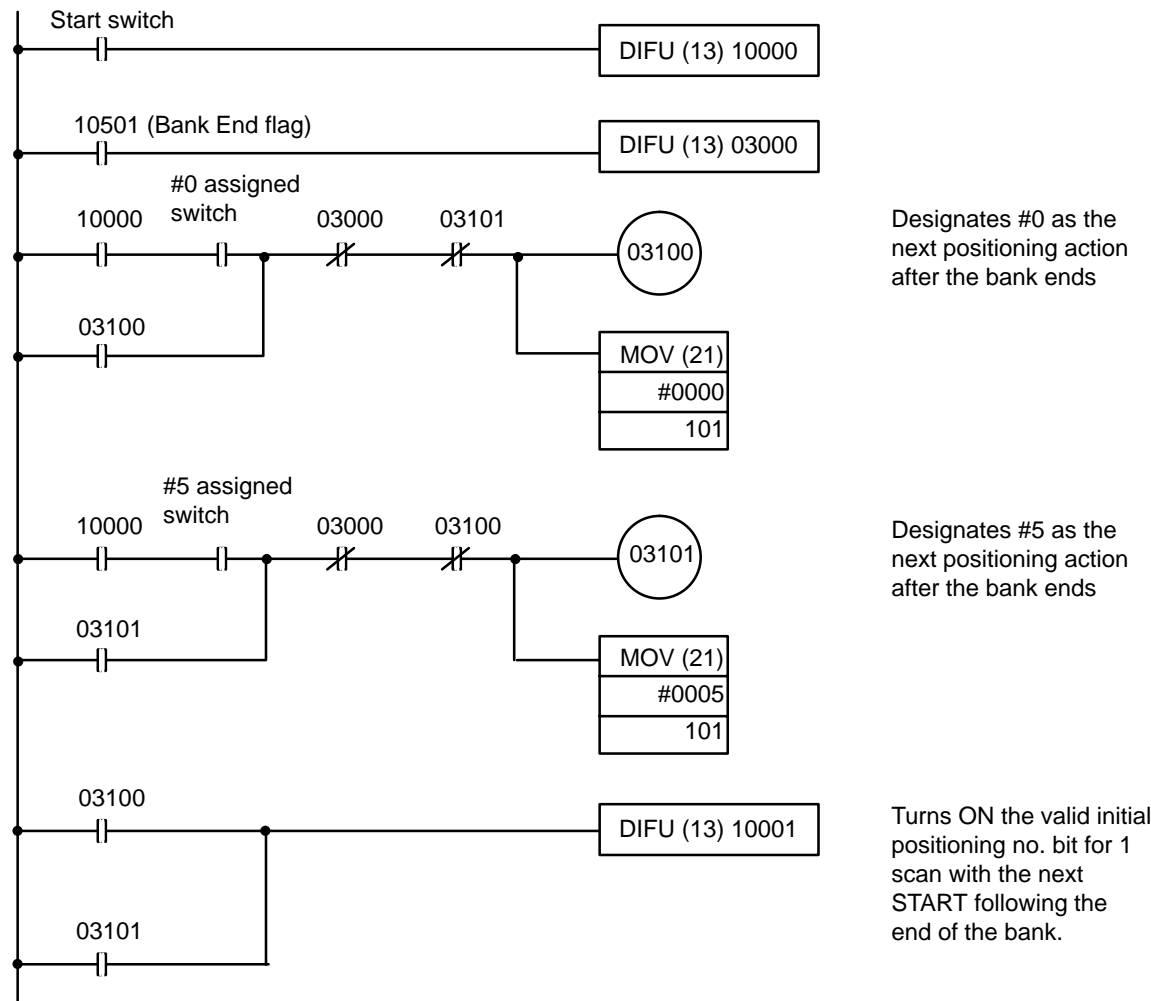
The data for another bank is entered into positioning action numbers 5, 6, and 7.

DM 1037	3	0	0	2
DM 1038	9	0	0	0
DM 1039	0	0	0	0
DM 1040	4	0	0	0
DM 1041	5	0	0	0
DM 1042	0	0	0	1
DM 1043	3	0	0	3
DM 1044	1	0	0	0
DM 1045	0	0	0	0

**Operation**

This program is used to distinguish between the two banks shown above (positioning action numbers 0 to 2 and 5 to 7). In order to select and execute either positioning action #0 or #5, it turns the valid bit (bit 01 of word n) of the initial positioning number ON, then immediately OFF. Leaving the initial positioning action valid bit ON forces execution of IR word n+1.

Program (Unit #0)



SECTION 6

Error Processing

This section covers the procedures for handling errors and alarms during Position Control Unit operation. It includes error codes, alarm codes, error and alarm indicators, troubleshooting from the PC, and AR area Restart bits. For a complete list of alarm codes, see *Appendix A*. For a list of error codes, see *Appendix B*.

6-1	Alarms and Errors	138
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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. An alarm code begins with a 1 or 2.

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. An error code begins with a 5 or 9.

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

6–2 Outputs to the IR Area

Alarm Flag

IR word n+5, bit 03

1: Alarm exists.

Error flag

IR word n+5, bit 5

1: Error exists.

Alarm/Error Codes

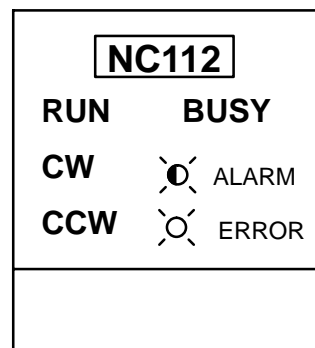
word n+6

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 IR word n). See *Section 4–5* 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



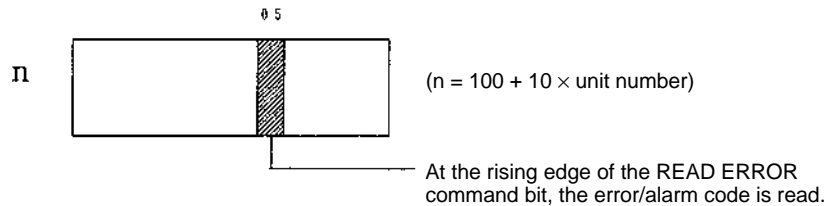
ALARM indicator flashes when an alarm code has been output and ERROR indicator lights when an error has occurred.

6–4 Error Code Output

When there is more than one error code or alarm code, use READ ERROR to read the codes in sequence.

If IR word n+6 is displayed on the Programming Console and there are no errors or alarms, the display will be "0000". If an error or an alarm is generated, the code will be displayed. If only one error or alarm has been generated, executing READ ERROR will have no effect. If there is more than one error or alarm, however, the codes can be displayed in order by executing READ ERROR.

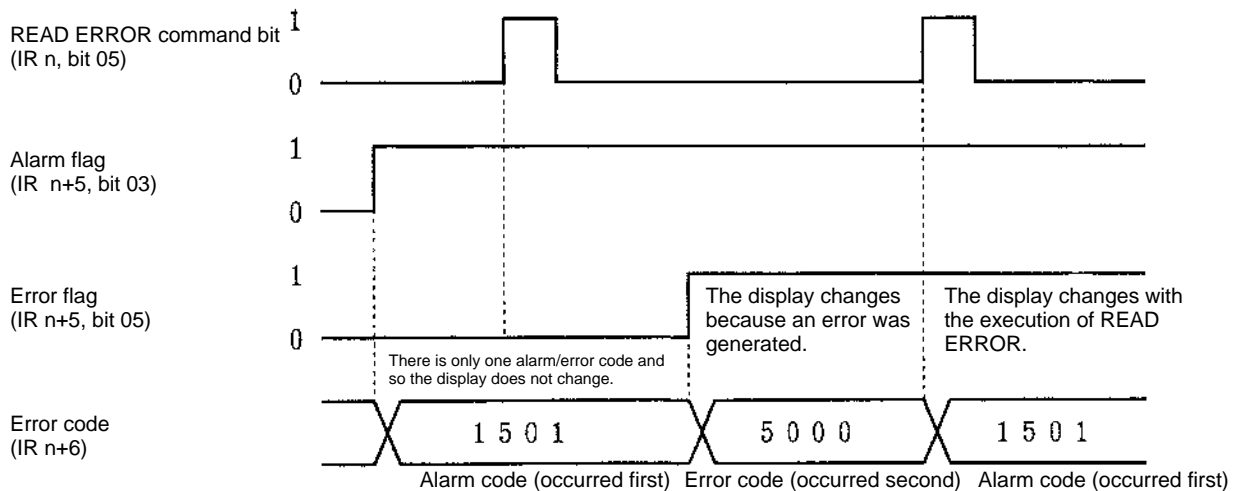
Setting for READ ERROR



READ ERROR Execution

The error code (word n+6) is updated with the first I/O refresh immediately after the READ ERROR command bit (word n, bit 5) is turned ON. The Busy flag does not turn ON.

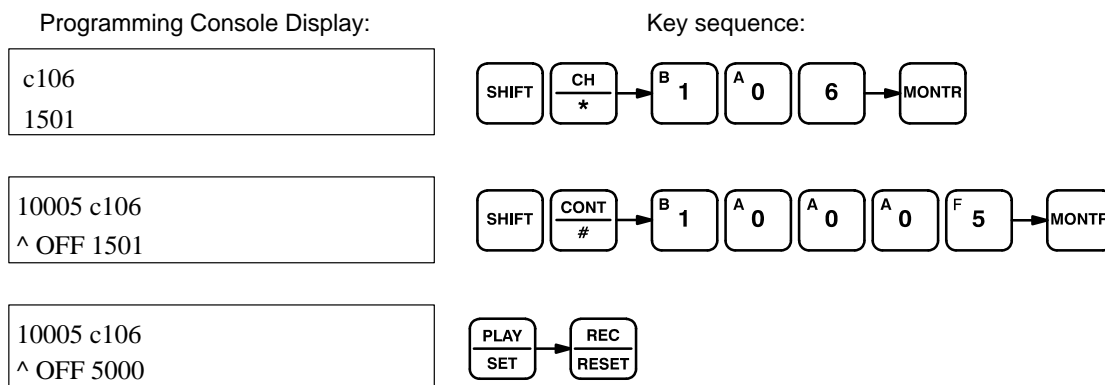
The case where alarm code 1501 and then error code 5000 are generated is given here as an example.



READ ERROR will still be executed even if the READ ERROR command bit is only ON for one scan.

Reading Error/Alarm Codes Using the Programming Console

Use the key operations shown below to read the error/alarm codes given in the example above. (Unit number = 0)



Clearing Errors

For details on clearing errors, refer to *Appendix E* and *Appendix F*. An outline is given below.

- **Alarms**
Correct DM area data → Restart (Refer to 6–5–2 *AR Area Error and Restart Bits for Special I/O Units* below.)
- **Emergency Stop**
Release the emergency stop input signal → Turn the RELEASE PROHIBIT command bit (unit number 0: word 100, bit 04) ON and OFF → Execute ORIGIN SEARCH

6–5 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.

6–5–1 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 malfunctioning Special I/O Unit with a new Unit. (The malfunctioning 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 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 0000 to 0009 and remove the cause of the error. Then, restart by turning the appropriate Restart bit (AR 0100 to 0109) on and then back off. If the Unit does not begin normal operation after restarting, replace it with a new one.

6–5–2 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.

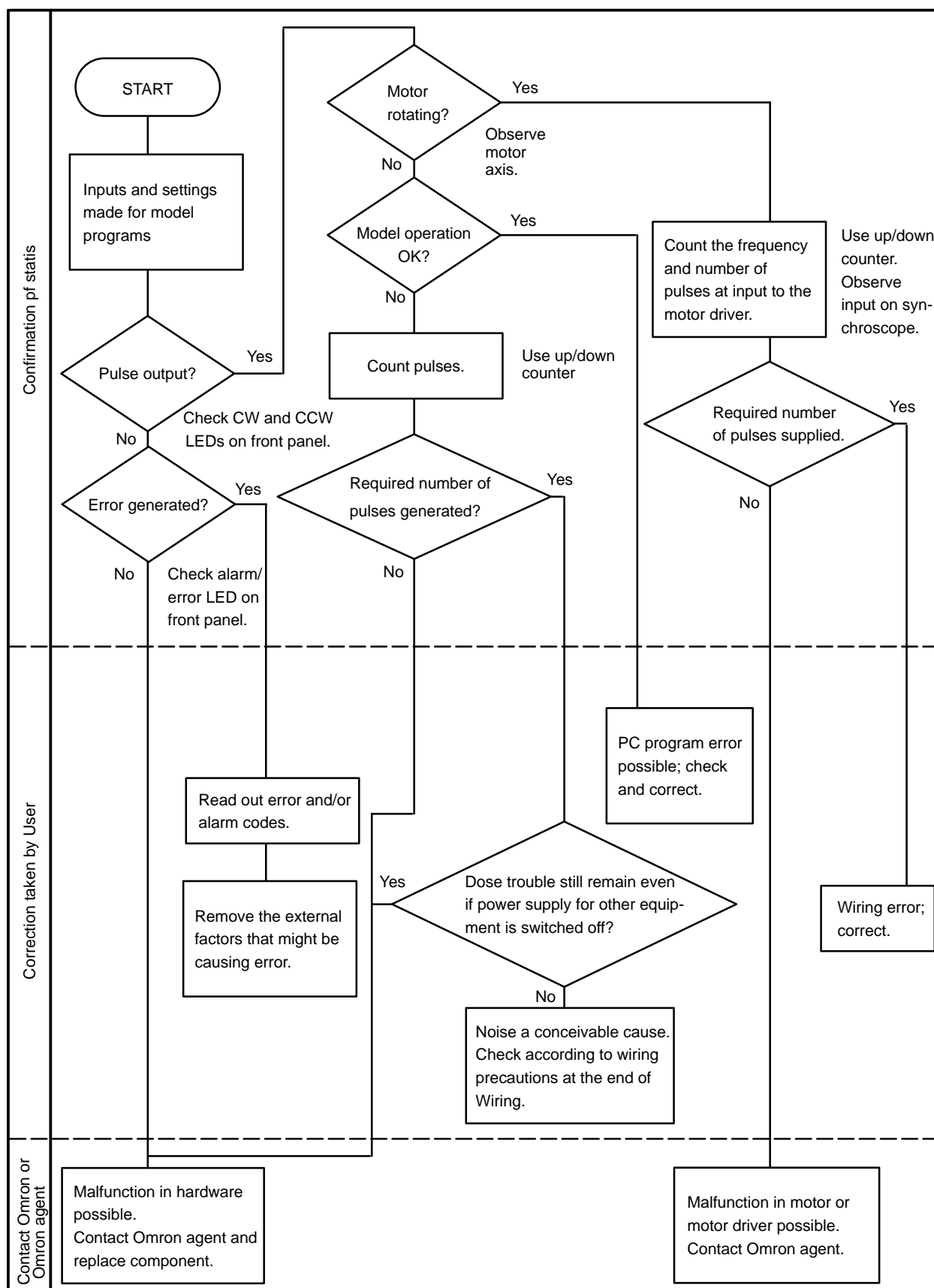
Bit	Unit number
AR 0000	0
AR 0001	1
AR 0002	2
AR 0003	3
AR 0004	4
AR 0005	5
AR 0006	6
AR 0007	7
AR 0008	8
AR 0009	9

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.

Bit	Unit number
AR 0100	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

6–6 Basic Troubleshooting Chart



6-7 Detection of Abnormal Pulse Outputs

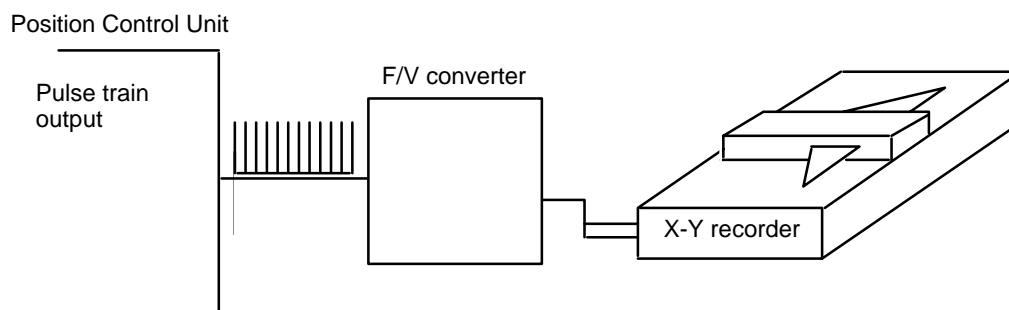
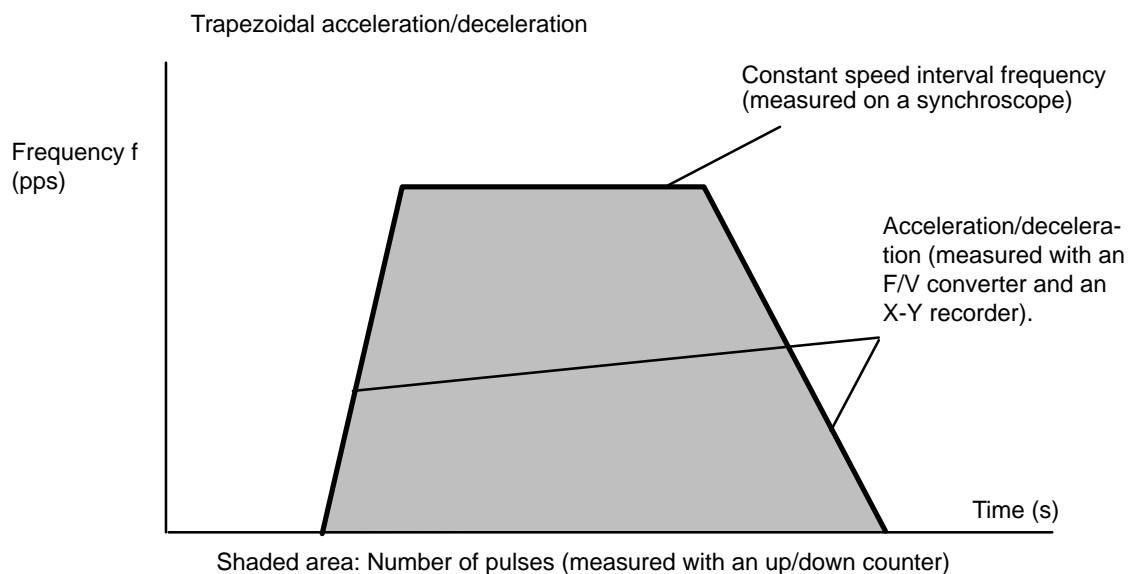
The Position Control Unit outputs pulse trains in accordance with the programmed data. When tracing an abnormality, the following should be taken into consideration.

Number of Pulses in Pulse Train

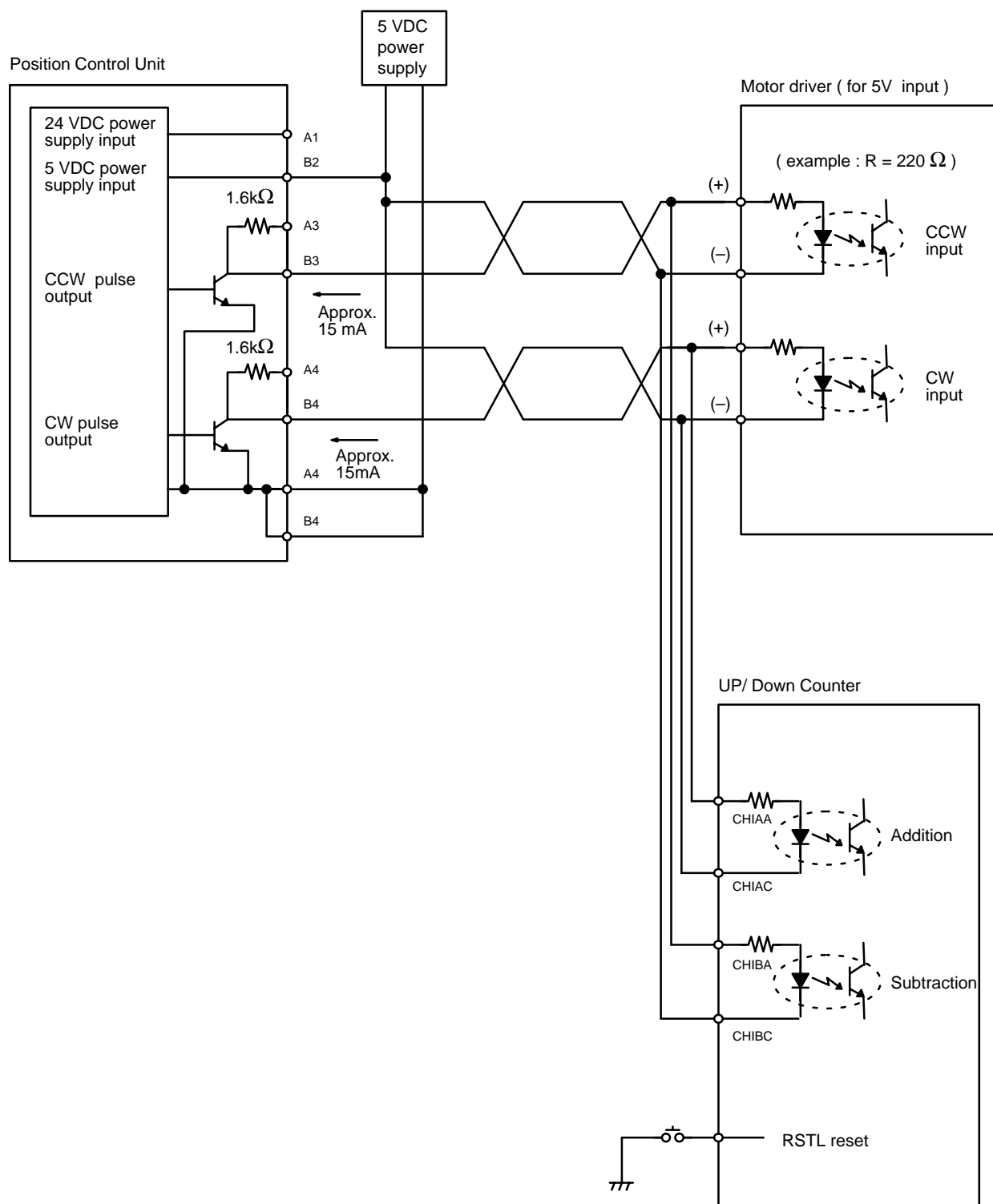
The Unit only outputs the number of pulses required to reach the target position. Count the number of pulses being output with an up/down counter and check to see if the proper number of pulses is being output.

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. For regular maintenance, observation of the frequency at stable speed intervals with a synchroscope is sufficient.



Connections to an Up/Down Counter



Appendix A

Standard Models

Name	Specifications		Model
CPU	100 to 120/200 to 240 VAC		C200H-CPU01-E
	24 VDC		C200H-CPU03-E
	100 to 120/200 to 240 VAC. Compatible with SYSMAC LINK and SYSMAC NET Link Units; Clock function provided; new instructions added.		C200H-CPU11-E
Position Control Unit	1 axis. Directly connectable to servomotor driver; compatible with line driver; speeds: 1 to 250,000 pps		C200H-NC112
Programming Console	Hand-held, with backlight. Except for C200H and C20, the Programming Console Adapter AP003 and connecting cable CN222/CN422 are necessary. They are sold separately.		C200H-PRO27-E
Programming Console Connecting Cable	For Hand-held Programming Console	2 m	C200H-CN222
		4 m	C200H-CN422

Appendix B

Specifications

General

Conforms to C-series specifications.

Performance

Item	Specifications
Number of axes	1 per Unit
Positioning system	Automatic trapezoidal acceleration/deceleration system
Positions	−8,388,607 pulses to +8,388,606 pulses
Number of positioning actions	20
Speeds	1 to 250,000 pps
Number of speeds	15
Acceleration/deceleration	2 to 2,000 pps
Origin search	Origin proximity: either absent, NO input, or NC input (selectable)
	Origin signal: either NO input or NC 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	12 to 24 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 5 to 24 VDC $\pm 10\%$, NPN open collector
Min. switching capacity	7 mA at 5 to 24 VDC $\pm 10\%$, 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.)

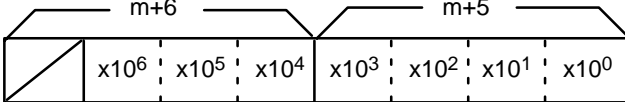
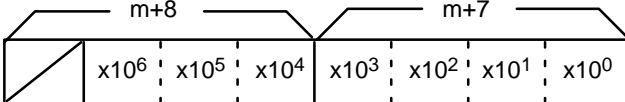
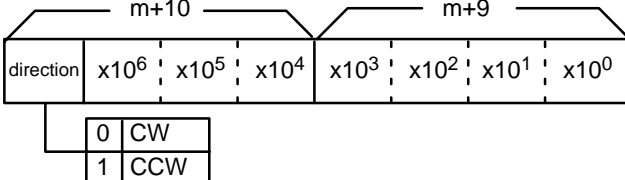
Origin Signal Input

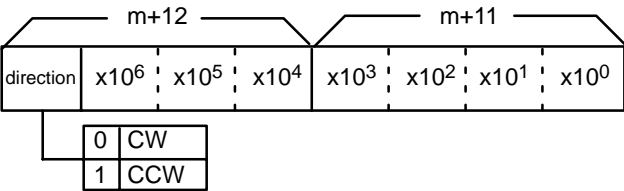
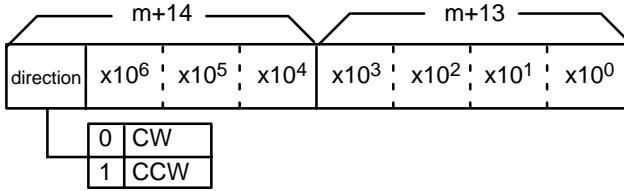
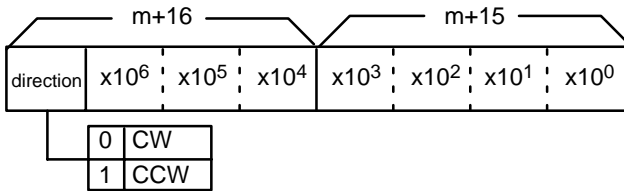
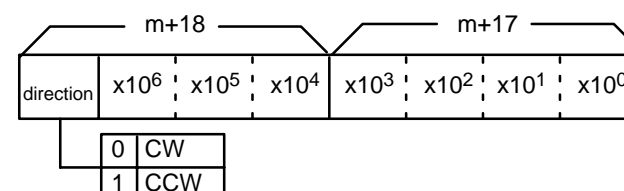
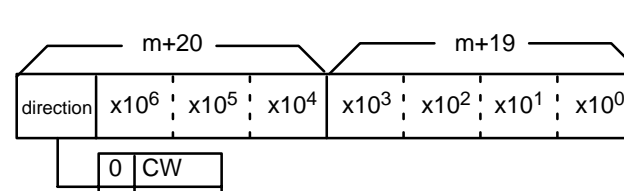
Item	Connector pins	Specifications	Response time
Open collector signal	A11, B11	All the above specifications apply, except that the input current is 6 mA (12 V) to 13 mA (24 V).	Mode 0: 1 ms max. Modes 1 and 2: 0.1 ms max. Mode 3: Not used
Line driver signal	A8, B8	Am26LS31 provides a suitable line driver signal.	

Appendix C

DM Area Allocations

In these tables, m = 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)
	03 to 01	Not used
	04	Speed unit multiplication 0: multiplies speed unit by 1 (if m+97: 0) or 10 (if m+97: 1) 1: multiplies speed unit by 1 (if m+97: 0) or 100 (if m+97: 1)
	07 to 05	Not used
	11 to 08	ORIGIN SEARCH dwell time, 0 to F (hexadecimal), in units of 0.1 s
	15 to 12	ORIGIN RETURN dwell time 0 to F (hexadecimal), in units of 0.1 s
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 5: Ext. w/ positioning
	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	Target speed no.	1 to F (hexadecimal)
m+23	15 to 00	Target position (pulses)	
m+24	15 to 00		
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)

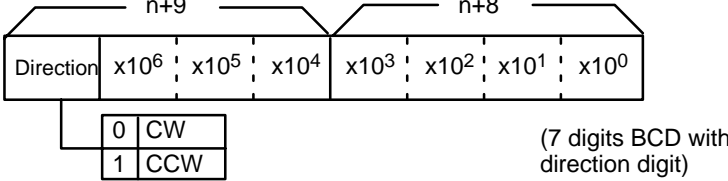
Word	Bit	Function	
m+52 m+53 m+54	→	Data format same as for positioning action #0	Positioning action #10 (Transfer data #10)
m+55 m+56 m+57	→	Data format same as for positioning action #0	Positioning action #11 (Transfer data #11)
m+58 m+59 m+60	→	Data format same as for positioning action #0	Positioning 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)	Transfer data #23
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)	Transfer data #24
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	Transfer data #25
	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	15 to 00	Acceleration data 2 to 2,000 (BCD) (speed incremented in ms)	
m+99	15 to 00	Deceleration data 2 to 2,000 (BCD) (speed decremented in ms)	

Appendix D

IR Area Allocations

	Word	Bit	Function (^ : leading edge; v : 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 IR n and begins positioning.
		01	Valid initial positioning no.: When set to 1, the initial positioning no. set in bits 07 to 00 of IR 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 05 to 00 of IR n+2 is valid. When set to 0, the speed coefficient of the target speed is set at 1.0.
		08	RESET ORIGIN: (^)
		09	TEACH: (^) References bits 15 to 08 of IR n+1 and registers the present position.
		10	TRANSFER DATA: (^) References IR 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 IR 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 IR n.
		14	INCH: (^) Outputs one pulse.
		15	STOP: (^) 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	05 to 00	Speed coefficient: 00 to 20 (BCD) in units of x 0.1 Speed numbers for CHANGE SPEED: 00 to 15 (00: current number + 1)
		06	Deviation counter reset (A6-B6) ON/OFF bit (1: ON)
		07	Origin adjustment (A7-B7) ON/OFF bit (1: ON)
		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)

	Word	Bit	Function (^ : leading edge; v : trailing edge)
Inputs (n = 100 x unit no.)	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)
		00	Positioning Completed flag: (^ : completed, v : starting)
		01	Bank Completed flag: (^ : bank completed, v : starting)
		02	At-origin flag: (1: stopped at origin)
		03	Alarm flag: (1: alarm)
		04	Emergency stop flag: (^ : Emergency stop, v : pulse output enabled)
		05	Error flag: (1: error)
	n+5	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: (^ : completed, v : starting)
		10	Transfer Completed flag: (^ : completed, v : starting)
		11	No-origin flag: (1: no origin)
		12	Busy flag: (1: busy) during transfer, pulse output, or dwell time
		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: (^ : STOP executed, v : operation begins)
	n+6	15 to 00	Error code: 4 digits (BCD)
	n+7	06 to 00	Positioning action number: 00 to 19 (BCD)
		07	Positioning Completed signal
		11 to 08	Output code: 0 to F (BCD)
		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.)
	n+8	15 to 00	Present position
	n+9	15 to 00	

Detailed IR Area Allocation Table

Word	Bit	Function
n+5	00	Positioning Completed flag 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 actions (including dwell time), but not when STOP is executed during operation. The Busy flag turns OFF within 1 scan after this flag turns ON.
	01	Bank Completed flag This bit turns OFF when positioning, ORIGIN SEARCH, or ORIGIN RETURN are started, and ON, along with the Positioning Completed flag, when positioning is completed for a bank.
	02	At-origin flag This bit turns ON when positioning stops at the origin, but not when the origin is passed during operation. It turns ON within 1 scan after the Busy flag turns OFF.
	03	Alarm flag This bit turns ON when an alarm code (1*** or 2***) is generated.
	04	Emergency Stop flag 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 IR n) is turned ON.
	05	Error flag This bit turns ON when error code (5*** or 9***) has been generated.
	00 07 08	Zone 0 flag Zone 1 flag Zone 2 flag These bits turn ON when the present position is within the zone ranges set in DM m+9 and m+20.
	09	Teaching Completed flag This bit turns OFF when TEACH is executed and ON when teaching is completed.
	10	Transfer Completed flag This bit turns OFF when TRANSFER DATA is executed and ON when data transfer is completed. The Busy flag turns OFF when this flag turns ON.
	11	No-origin flag 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"> • When positioning is stopped by an emergency stop or by a CW/CCW limit signal. • When an extended completion code is executed. • When positioning is stopped due to changing the PC's mode during pulse output. (i.e., changing RUN to PROGRAM). • When positioning is stopped during operation due to a hardware error. • When ORIGIN SEARCH is executed. The following conditions cause this bit to turn OFF: <ul style="list-style-type: none"> • When the origin signal is input during ORIGIN SEARCH. • When RESET ORIGIN is completed. • When the present position has been reset.
	12	Busy flag 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 status of this flag during the scan of the ladder program.

Word	Bit	Function																																				
n+5	13 14	CW Limit flag CCW Limit flag These bits turn ON while the respective external signals are being input.																																				
	15	STOP flag 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 (IR n, bit 15). It goes OFF when any of the above operations is started. Busy flag goes ON 1 scan later.																																				
n+6	15 to 00	Error code Only the most recent error code is output. Further codes can be accessed in order by executing READ ERROR (IR n, bit 05). Read-out does not erase error codes.																																				
n+7	06 to 00	Positioning action number 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 positioning action set in DM word m is used.																																				
	07	Driver completed signal This bit turns ON during input of the servomotor driver's driver completed signal (connected to A9 and B9). It is used to check external wiring.																																				
	11 to 08	Output code 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: <div><div>Normally ON</div><div><div></div><div>25313</div></div><div>MPLX (76)</div><div>107</div><div>#0002</div><div>HR 10</div></div>																																				
	12 13 14 15	Emergency stop signal External interrupt signal Origin signal Origin proximity signal 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 NC contact, and at the leading edge when input through an NO contact. Do not use use during programming.																																				
n+8 n+9	15 to 00 15 to 00	Present position The present position is always output as an absolute value (i.e., not as an increment) through these words. After powering up, output is as follows: <div><div><div>n+9</div><div>n+8</div></div><div><div>09xx</div><div>0xxx</div></div><div><div></div><div></div></div><div>Operating mode no.</div><div>DIP switch setting</div></div> <table><tr><td>Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr><tr><td>Switch no.</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr><tr><td>ON</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr><tr><td>OFF</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr></table>	Bit	7	6	5	4	3	2	1	0	Switch no.	8	7	6	5	4	3	2	1	ON	1	1	1	1	1	1	1	1	OFF	0	0	0	0	0	0	0	0
Bit	7	6	5	4	3	2	1	0																														
Switch no.	8	7	6	5	4	3	2	1																														
ON	1	1	1	1	1	1	1	1																														
OFF	0	0	0	0	0	0	0	0																														

Appendix E

Alarm Code List

Area	Item	Alarm Code	Problem	Position ^{*1}	Speed ^{*2}
Initial speed	BCD error	1000	There is a BCD error in the speed indicated by the initial speed number.		Yes
Initial positioning action	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.		Yes
	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.		Yes
	Speed contradiction	1202	The LOW-SPEED JOG is faster than the HIGH SPEED JOG.		Yes
Acceleration/	Acceleration error	1300	Acceleration is out-of-range or contains a BCD error.		Yes
Deceleration	Deceleration error	1301	Deceleration is out-of-range or contains a BCD error.		Yes
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.		Yes
Speeds	Speed contradiction	1500	Table for trapezoidal acceleration/deceleration cannot be created due to error in speed, acceleration, or deceleration.		Yes
	BCD error	1501	There is a BCD error in speed #1.		Yes
		1502 to 1515	There is a BCD error in the speed designated by the last two digits of the alarm code.		
ORIGIN SEARCH	Origin compensation BCD error	1600	Origin compensation contains a BCD error or exceeds the internal limit.		
	High speed error	1601	ORIGIN SEARCH high speed number is 0, or there is a BCD error in the speed designated by the number.		Yes
	Proximity speed error	1602	ORIGIN SEARCH proximity speed number is 0, or there is a BCD error in the speed designated by the number.		Yes
	Speed contradiction	1603	High speed is slower than proximity speed.		Yes
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 setting is not between 0 and 8,388,606.		
	CCW limit	1801	There is a BCD error in internal CCW limit setting or setting is not between 0 and 8,388,607.		

*1: Error cleared when new positioning data is set

*2: Error cleared when new speed data is set

Area	Item	Alarm Code	Problem	Position ^{*1}	Speed ^{*2}
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 1 CW error	1910	Problems are identical to those for zone 0.		
	Zone 1 CCW error	1911			
	Zone 1 contradiction	1912			
	Zone 2 CW error	1920	Problems are identical to those for zone 0.		
	Zone 2 CCW error	1921			
	Zone 2 contradiction	1922			
Positioning actions	Target position BCD error	2000	There is a BCD error in the target position for positioning action #0.	Yes	
		2001 to 2019	There is a BCD error in the target position for the positioning action designated by the last two digits of the alarm code		
	Speed BCD error	2100	There is a BCD error in the speed designated by the speed number for positioning action #0.	Yes	Yes
		2101 to 2119	There is a BCD error in the speed designated by the speed number for the positioning action designated by the last two digits of the alarm code		
	Position contradiction	2200	The completion codes for all positioning actions are 2 (continuous); the Unit cannot begin operation.	Yes	
	Completion code error	2300	Completion code for positioning action #0 is not between 0 and 5.	Yes	
		2301 to 2319	Completion code for the positioning action indicated by the last two digits of the alarm code is not between 0 and 5.		

*1: Error cleared when new positioning data is set

*2: Error cleared when new speed data is set

Appendix F

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 target position.	Read out alarm code and correct data accordingly. If there is no alarm, check data in IR n+7. 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 and correct data. After transferring data, the error code will be erased for the next START if data has been properly corrected
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.	Based on error code, read out alarm code and correct data accordingly.

Error	Error code	Problem	Correction
ORIGIN RETURN disabled	5200	ORIGIN RETURN cannot be executed because of data for ORIGIN RETURN speed or backlash compensation that generated alarm.	Based on error code, read out alarm code and correct and correct data accordingly. After transferring data, the error code will be erased for the next operation if data has been properly corrected. For data that cannot be transferred, restart after correcting DM.
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 counterclockwise using JOG, or INCH (or execute ORIGIN SEARCH, Present Position Reset, 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 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 (NC or NO).
No-origin flag	6201	The origin signal is not detected between CCW and CW limits.	Check wiring of origin signal and signal type (NC or NO)
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.

Error	Error code	Problem	Correction
CHANGE SPEED	6700	Feeding has been stopped following CHANGE SPEED due to the speed data of the next positioning action having an error or being set to 0.	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 has been set simultaneously in IR word n, bits 00, 02, 03, 04, 08, 09, 10, 11, 13, or 14.	Check program. This error code will be erased when every command bit in channel n goes to 0.
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.
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 <i>Section 4-8</i> 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 initial processing at start-up is not completed normally.	Hardware may be faulty.
	9100	Target position for a positioning action has been exceeded.	Hardware may be faulty or error may be caused by noise.
	9200	Speed for a positioning action has been exceeded.	

Appendix G

Using the C200H-NC112 with CS1-series PCs

Differences in Memory Allocation

Note the following differences in the memory areas when using the C200H-NC112 with a CS1-series PC.

IR (CIO) Area and DM Area Allocation

- The beginning word, n, of the IR Area allocated to the C200H-NC112 will change as follows:
 $n = \text{IR } 100 + \text{unit number} \times 10 \rightarrow n = \text{CIO } 2000 + \text{unit number} \times 10.$
- The beginning word of the DM Area allocated to the C200H-NC112 will change as follows:
 $m = \text{DM } 1000 + \text{unit number} \times 100 \rightarrow m = \text{D20000} + \text{unit number} \times 100.$

Transferring Data Using the CIO Area

Specifying addresses containing position and speed data using words n+3 and n+4 in the CIO Area is performed in the way illustrated in the table below.

(n = 2000 + unit number × 10)

Area	Address in CS1 PC (See note 1.)	Specifying address from CIO Area	
		Data area n+4, bits 00 to 07 (2 digits BCD)	Beginning word n+3, bits 00 to 15 (4 digits BCD)
General-purpose DM Area	D00000 to D00999	00	0000 to 0999
DM Area for Special I/O Units	D20000 to D20999	00	1000 to 1999 (See note 2.)
I/O Area	CIO 0000 to CIO 0255	01	0000 to 0255
Data Link Area	CIO 1000 to CIO 1063	02	0000 to 0063
Holding Area 1	H000 to H099	03	0000 to 0099
Holding Area 2	H100 to H127 Note: H101 cannot be specified.	04	0000 to 0027 Note: 0001 cannot be specified.

- Note**
1. Only the CS1-series PC addresses given in the above table can be specified.
 2. When specifying an address in the DM Area for Special I/O Units (D20000 to D20999), do not specify a number in the range 20000 to 20999. Use the range 1000 to 1999 (as if specifying an address for a C200HX/HG/HE, C200HS, or C200H PC).

Data Configuration

Allocated CIO Area

(n = 2000 + unit number × 10)

Bit	15	0	Contents	Direction
n to n+4	Commands from the CPU Unit		START, ORIGIN SEARCH, initial positioning action number, TRANSFER DATA, etc.	CPU Unit → PCU
n+5 to n+9	PCU status		Present position, zones, error flags, etc.	PCU → CPU Unit

Allocated DM Area

(m = D20000 + unit number × 100)

Bit	15	0	Contents	Direction
m to m+20	Parameters		Initial positioning action number, initial speed number, backlash compensation	CPU Unit → PCU
m+22 to m+81	Position data		Positioning actions #0 to #19	CPU Unit → PCU
m+82 to m+99	Speed and acceleration/deceleration data		Speeds #0 to #15, acceleration data, deceleration data	CPU Unit → PCU

Setup Procedure

Initial Hardware Settings

- 1, 2, 3... 1. Set the unit number and the operation mode using the rotary switches on the front of the PCU.
2. Mount to a CS1 CPU Rack, a C200H I/O Expansion Rack, a CS1 Expansion Rack, or a SYS-MAC BUS Remote I/O Slave Rack. For basic systems, up to 10 PCUs can be mounted. (There are no restrictions on the mounting position.)
3. Connect the external I/O connectors for each of the axes.
4. Connect the Programming Device.
5. Turn ON power to the PC.
6. Create the I/O table.

Initial Software Settings

- 1, 2, 3... 1. Make the settings for parameters and position, speed, acceleration, and deceleration data in the allocated DM Area.
2. Reset the power, or turn the Unit Restart flag from OFF to ON.

Transferring Data

Use the TRANSFER DATA command to send data in the case where the above settings for position, speed, acceleration, and deceleration data are insufficient, or to change initial settings for this data.

- 1, 2, 3... 1. When the TRANSFER DATA command bit (word n, bit 10) is turned from OFF to ON, the data at the address in I/O memory specified with words n+3 and n+4 in the CIO Area is transferred to the address (transfer number) in the PCU specified with bits 08 to 14 in word n+2 in the CIO Area.

Starting Operation

- 1, 2, 3... 1. Set the initial positioning action number (word n+1, bits 00 to 07) using MOV or another instruction.
2. Turn the START command bit (word n, bit 00) from OFF to ON using OUT or another instruction.

Programming

Set positioning data (initial data) in the allocated DM Area, and start operation. To do this, with the Busy flag (word n+5, bit 12) as an N. C. input condition, turn the START command bit and the valid initial positioning number bit from OFF to ON using OUT or another instruction.

Transferring Additional Data

- 1, 2, 3... 1. With the Busy flag (word n+5, bit 12) as an N. C. input condition, set the transfer data (words n+2 to n+4) using the MOV instruction.

2. With the same input condition as above, turn the TRANSFER DATA command bit (word n, bit 10) from OFF to ON using OUT or another instruction.

Programming Examples

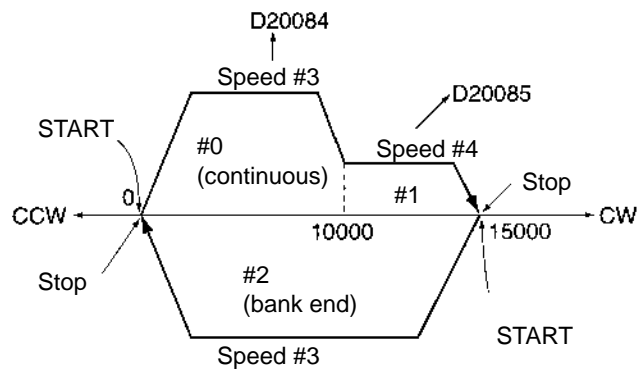
Transferring Data from Other PC Areas

This programming example shows how to transfer the data for three positioning actions starting from D00010.

Initial Data

The initial data is stored in D20022 to D20030. The data and positioning actions are shown below.

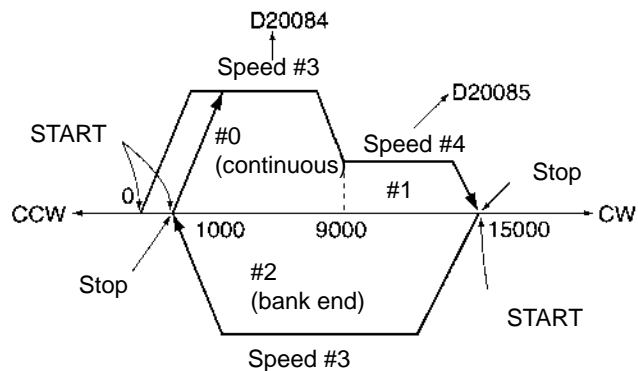
D20022	3	0	0	2
D20023	0	0	0	0
D20024	0	0	0	1
D20025	4	0	0	0
D20026	5	0	0	0
D20027	0	0	0	1
D20028	3	0	0	3
D20029	0	0	0	0
D20030	0	0	0	0



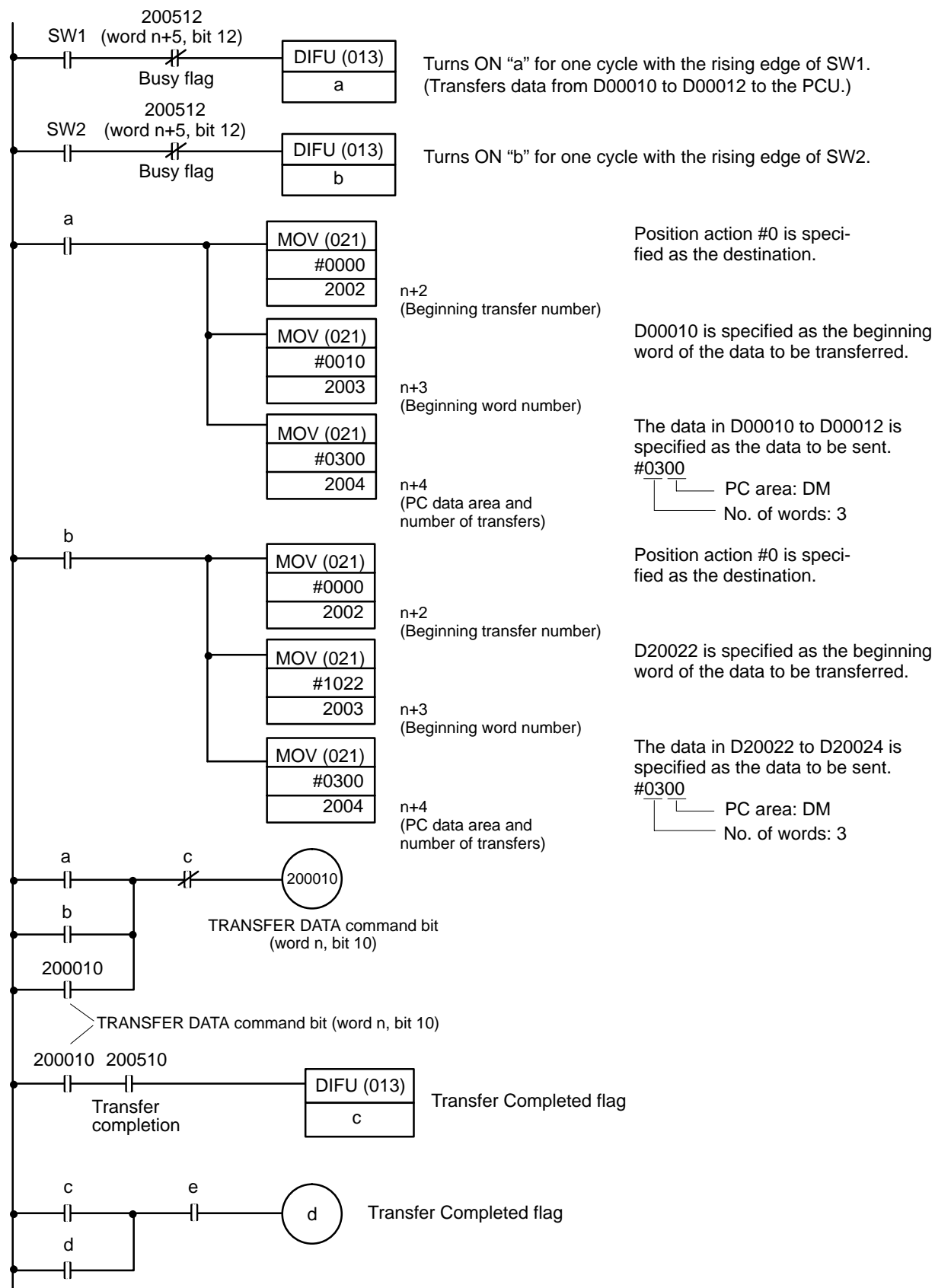
Data To Be Transferred

The transfer data is stored in D00010 to D00018. The data and positioning actions are shown below.

D00010	3	0	0	2
D00011	9	0	0	0
D00012	0	0	0	0
D00013	4	0	0	0
D00014	5	0	0	0
D00015	0	0	0	1
D00016	3	0	0	3
D00017	1	0	0	0
D00018	0	0	0	0



Program



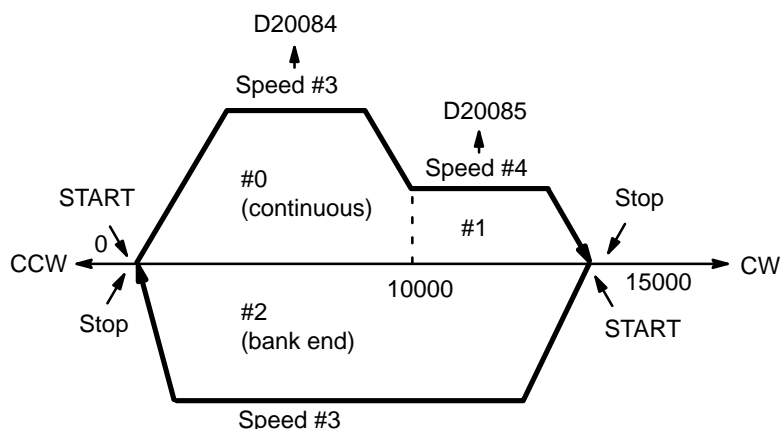
Using Multiple Banks

A program that distinguishes between two banks, the bank starting from positioning action #0 and the bank starting from positioning action #5, is given below. In order to select and execute either positioning action #0 or #5, it turns the valid initial positioning action number bit (bit 01 of word n) ON, then immediately OFF. Leaving the valid initial positioning action number bit ON forces execution of IR word n+1.

First Bank (Positioning Action Numbers 0 to 2)

The data for one bank is stored into positioning action numbers 0, 1, and 2.

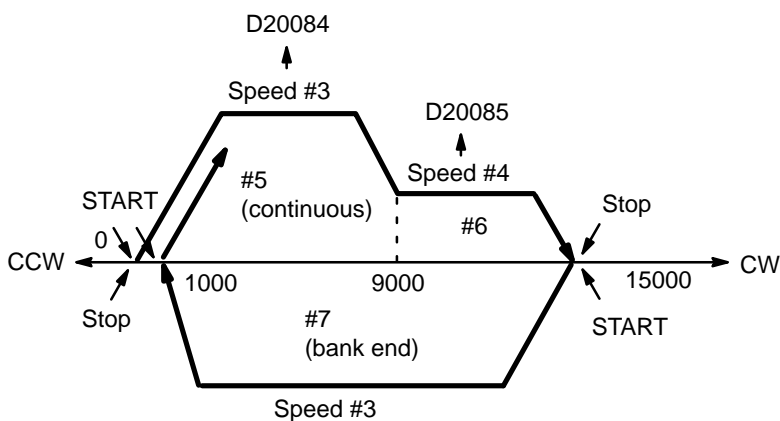
D20022	3	0	0	2
D20023	0	0	0	0
D20024	0	0	0	1
D20025	4	0	0	0
D20026	5	0	0	0
D20027	0	0	0	1
D20028	3	0	0	3
D20029	0	0	0	0
D20030	0	0	0	0



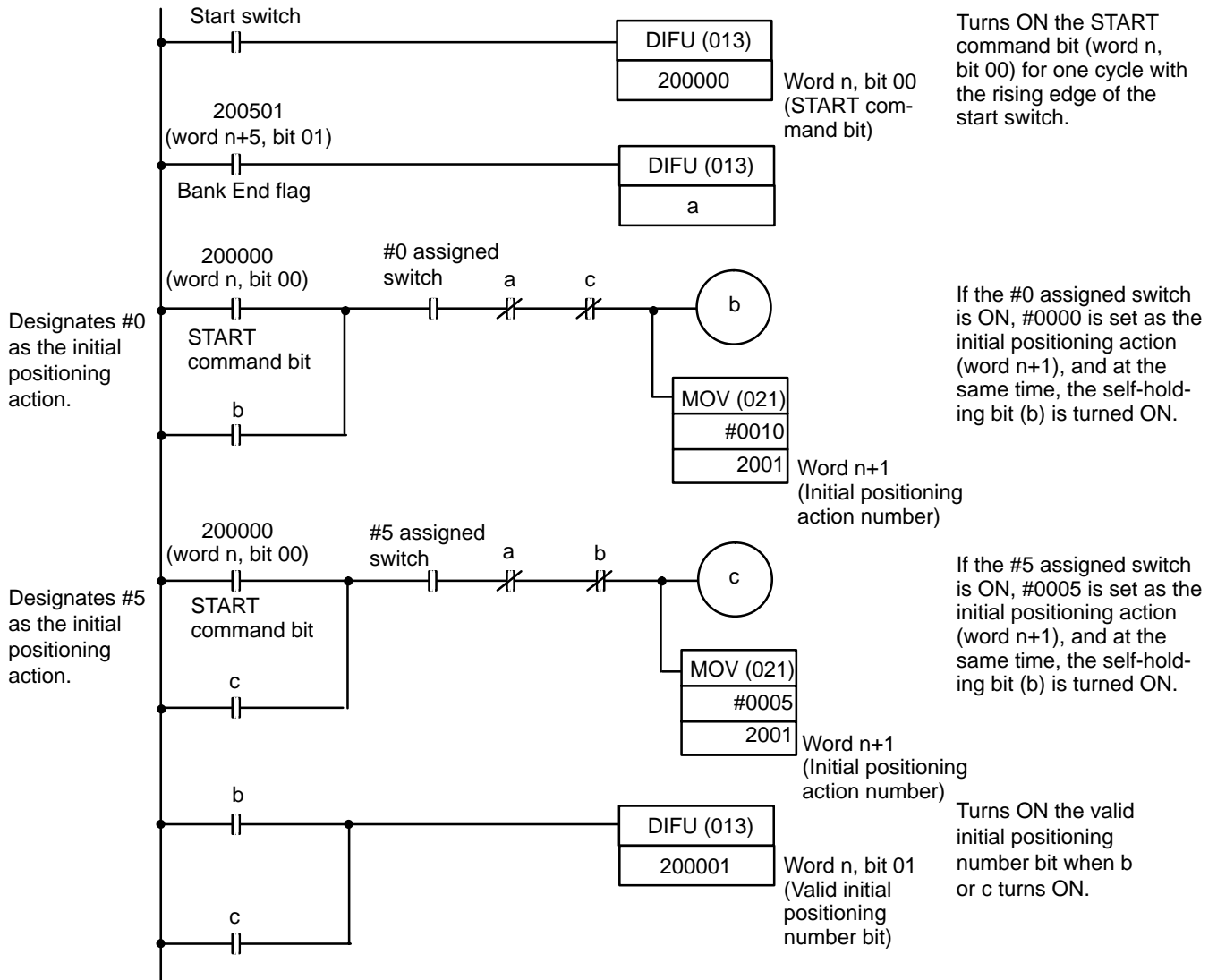
Second Bank (Positioning Action Numbers 5 to 7)

The data for the other bank is entered into positioning action numbers 5, 6, and 7.

D20037	3	0	0	2
D20038	9	0	0	0
D20039	0	0	0	0
D20040	4	0	0	0
D20041	5	0	0	0
D20042	0	0	0	1
D20043	3	0	0	3
D20044	1	0	0	0
D20045	0	0	0	0

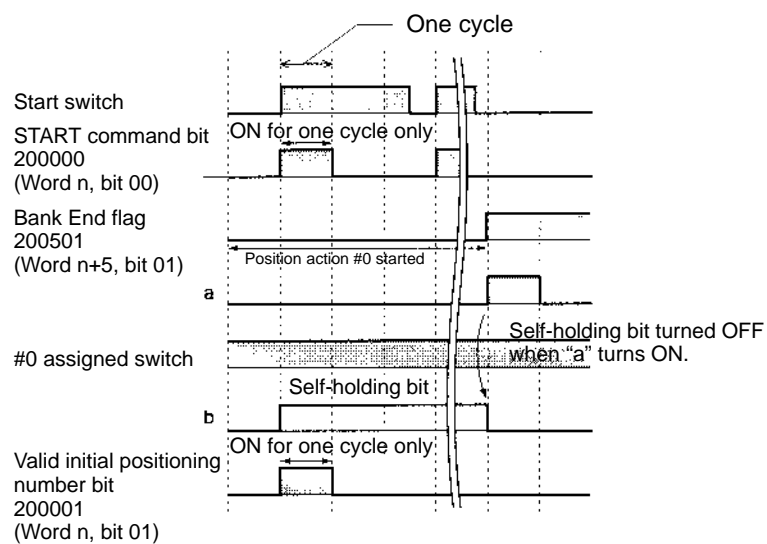


Program



Timing Chart

The following chart shows the timing in the case where initial position action #0 is selected.



Glossary

absolute 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.
DM area	A PC data area in which general operating parameters, speeds, and parameters for positioning actions are stored.
dwel time	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.

error code	A four-digit code which is output to a word in the IR area to identify the type of error which has occurred.
error counter	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.
extended (completion)	A positioning action completion code that causes pulses to be continually output until the positioning action is terminated with STOP.
extended with positioning (completion)	A positioning action completion code that causes pulses to be continually output until the positioning action is terminated with STOP. After STOP is executed, positioning does not stop immediately but is executed according to the data set for the positioning action.
external interrupt	A function whereby positioning may be stopped or speed may be changed, during operation, in response to an external command.
flag	A bit that is turned ON and OFF automatically by the system to provide status information.
host computer	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.
IN refresh area	The last five of the ten IR words allocated to each Position Control Unit as refresh areas.
inching	Manual feeding wherein positioning is executed one pulse at a time.
incremental target position	A target position given in respect to the present position, rather than in respect to the origin.
initial position	The present position when START is executed.
IR area	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.
mode	An internal circuitry which is selected, via a front-panel switch, based on the type of motor driver and signals which are to be used for a particular type of operation.
NC contacts	Normally-closed contacts. A pair of contacts on a relay that open when the relay is energized.
NO 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 fundamental unit of positioning. 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 Link 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, Remote Terminals, and I/O 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.
Slave Rack	A Backplane to which a Remote I/O Slave Unit is attached.
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.

Glossary

unit numbers	Numbers assigned to Special I/O 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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