Cat. No. W253-E1-1

生産終了
DISCONTINUED

SYSMAC C-series/CVM1/CV-series
C500-CT021

High-speed Counter Unit

OPERATION MANUAL

OMRON

No. 6182
OMRON Corporation

Read and Understand this Manual

Please read and understand this manual before using the product. Please consult your OMRON representative if you have any questions or comments.

Warranty and Limitations of Liability

WARRANTY

OMRON's exclusive warranty is that the products are free from defects in materials and workmanship for a period of one year (or other period if specified) from date of sale by OMRON.

OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, REGARDING NON-INFRINGEMENT, MERCHANTABILITY, OR FITNESS FOR PARTICULAR PURPOSE OF THE PRODUCTS. ANY BUYER OR USER ACKNOWLEDGES THAT THE BUYER OR USER ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE. OMRON DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED.

LIMITATIONS OF LIABILITY

OMRON SHALL NOT BE RESPONSIBLE FOR SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR COMMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED ON CONTRACT, WARRANTY, NEGLIGENCE, OR STRICT LIABILITY.

In no event shall the responsibility of OMRON for any act exceed the individual price of the product on which liability is asserted.

IN NO EVENT SHALL OMRON BE RESPONSIBLE FOR WARRANTY, REPAIR, OR OTHER CLAIMS REGARDING THE PRODUCTS UNLESS OMRON'S ANALYSIS CONFIRMS THAT THE PRODUCTS WERE PROPERLY HANDLED, STORED, INSTALLED, AND MAINTAINED AND NOT SUBJECT TO CONTAMINATION, ABUSE, MISUSE, OR INAPPROPRIATE MODIFICATION OR REPAIR.

Application Considerations

SUITABILITY FOR USE

OMRON shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the products.

At the customer's request, OMRON will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system, or other application or use.

The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses listed may be suitable for the products:

- Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this manual.
- Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.
- Systems, machines, and equipment that could present a risk to life or property.

Please know and observe all prohibitions of use applicable to the products.

NEVER USE THE PRODUCTS FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCTS ARE PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

PROGRAMMABLE PRODUCTS

OMRON shall not be responsible for the user's programming of a programmable product, or any consequence thereof.

Disclaimers

CHANGE IN SPECIFICATIONS

Product specifications and accessories may be changed at any time based on improvements and other reasons.

It is our practice to change model numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the products may be changed without any notice. When in doubt, special model numbers may be assigned to fix or establish key specifications for your application on your request. Please consult with your OMRON representative at any time to confirm actual specifications of purchased products.

DIMENSIONS AND WEIGHTS

Dimensions and weights are nominal and are not to be used for manufacturing purposes, even when tolerances are shown.

PERFORMANCE DATA

Performance data given in this manual is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of OMRON's test conditions, and the users must correlate it to actual application requirements. Actual performance is subject to the OMRON Warranty and Limitations of Liability.

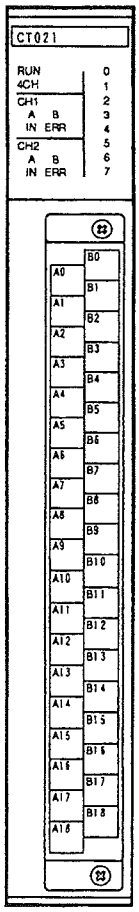
ERRORS AND OMISSIONS

The information in this manual has been carefully checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical, or proofreading errors, or omissions.

C-series/CVM1/CV-series
C500-CT021 High-speed Counter Unit

Operation Manual

Produced March 1995



Notice:

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

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

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

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

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

OMRON Product References

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

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

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

Visual Aids

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

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

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

TABLE OF CONTENTS

TABLE OF CONTENTS

About this Manual:

This manual describes the installation and operation of the C-series/CVM1/CV-series C500-CT021 High-speed Counter Unit and includes the sections described below.

Please read this manual carefully and be sure you understand the information provided before attempting to install and operate the C500-CT021 High-speed Counter Unit.

Section 1 describes the basic operation of the C500-CT021 High-speed Counter Unit, and shows how it can be installed in a basic system configuration. It also explains the operating and control modes and outlines the basic procedure for setting up the High-speed Counter Unit for operation.

Section 2 provides the Unit's basic specifications and describes its major components.

Section 3 explains how to connect various input and output devices to the High-speed Counter Unit.

Section 4 provides the information necessary to operate the C500-CT021 High-speed Counter Unit, including modes, types of inputs, reset conditions, and data exchange with the PC.

Section 5 describes the data configuration of the High-speed Counter Unit and provides sample programs for transferring data between the PC and the High-speed Counter Unit.

Section 6 provides the information necessary for using the simple linear mode, including information on outputs, operating conditions, and performance specifications.

Section 7 provides the information necessary for using the linear mode, including information on operating conditions, data areas, settings, and performance specifications.

Section 8 provides the information necessary for using the circular mode, including information on operating conditions, data areas, settings, and performance specifications.

Section 9 provides the information necessary for using the preset mode, including information on operating conditions, data areas, settings, and performance specifications.

Section 10 provides the information necessary for using the gate mode, including information on operating conditions, data areas, settings, and performance specifications.

Section 11 provides the information necessary for using the latch mode, including information on operating conditions, data areas, settings, and performance specifications.

Section 12 provides the information necessary for using the sampling mode, including information on operating conditions, data areas, settings, and performance specifications.

Section 13 provides information to help identify and correct errors that might occur during operation.

> ⚠**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.

SECTION 1
Introduction

This section describes the basic operation of the C500-CT021 High-speed Counter Unit, and shows how it can be installed in a basic system configuration. It also explains the operating and control modes and outlines the basic procedure for setting up the High-speed Counter Unit for operation.

1-1 Basic Operation

The C500-CT021 is a Special I/O Unit for SYSMAC C-series, CVM1, and CV-series Programmable Controllers. It can be connected directly to devices such as sensors to function as a high-speed, reversible counter capable of counting at a maximum pulse input of 50 kcps. In this manual, the two data words for the high-speed counter are referred to as "axis-1" and "axis-2" to distinguish them from the regular memory areas.

1-1-1 Operating Modes

The High-speed Counter Unit can be operated in any of the following seven modes. These modes are described in more detail in subsequent sections of this manual.

Once the operating mode has been set, it cannot be readily changed. If it is necessary to make a change, first turn off the power to the High-speed Counter Unit and then reset the operating mode.

Simple Linear Mode

In simple linear mode, the counter value (i.e., the current count) is continually compared with a preset comparison value, and outputs are controlled according to the result (<, =, >).

Linear Mode

In linear mode, outputs are controlled according to a preset range (or ranges, up to a maximum of eight), and outputs are stopped when the upper or lower limit (i.e., the minimum or maximum count) of the range is reached.

Circular Mode

In circular mode, outputs are controlled according to a preset range (or ranges, up to a maximum of eight), and the counter value restarts from zero after reaching a preset maximum value, or returns to the preset maximum value when the counter value is decremented past zero.

Preset Mode

In preset mode, the counter value is decremented from a preset value to zero according to pulse inputs. During this decrement phase, outputs may be switched ON and OFF according to counter values, or turned ON for a fixed period (set by the preset timer) when the count reaches zero. The count stops when it reaches zero.

Gate Mode

In gate mode, the count continues only while control input signals from the encoder are ON. There are two types of gate mode operation: normal and cumulative. In normal gate mode, the count always begins from zero. It is reset at the rising edge of the control input signal. In cumulative gate mode, counting continues from the current counter value until it is reset to zero by the reset signal.

Latch Mode

In latch mode, the counter value is stored in the internal register at the rising edge of the control input signal, and is retained while the count continues. This value is always read as the current counter value. An external signal can be used as a trigger to obtain a precise reading of the current counter value while incrementing or decrementing.

Sampling Mode

In sampling mode, pulses are counted for a preset interval after the control input signal is turned ON.

1-1-2 Input Selection

Any one of three input types can be selected: offset phase inputs, individual up and down pulse inputs, and pulse and direction inputs. Depending on the input type, various kinds of sensors can be used and the counter value can be incremented or decremented.

Offset Phase Inputs

Offset phase inputs use the difference in phase between two inputs to determine whether the counter value will be incremented or decremented. The count is incremented or decremented at the rising or falling edge of the A-phase input when there is a 90° shift between the A-phase and B-phase inputs from the encoder. A ×4 input multiplier is available to increase accuracy using the same encoder pulses.

Up and Down Pulse Inputs

With individual up and down pulse inputs, up and down encoders or sensors (counter clocks) are connected and the counter value is incremented or decremented on the rising edge of each input. The counter value will not be changed if both signals are input simultaneously.

Pulse and Direction Inputs

With pulse and direction inputs, the counter value is incremented or decremented on the rising edge of the pulse input from the encoder or sensor (counter clock).

Note

1. Once the operational settings (operating mode, reset conditions, preset function, input mode) have been, they cannot be readily changed. If it is necessary to make a change, first turn off the power to the Counter Unit and then reset the operating mode.
2. When the Counter Unit is connected to a SYSMAC BUS/2 Slave Unit, it will be reset whenever a restart (word A001) is executed for the SYSMAC BUS/2 Master Unit. The settings will be cleared at that time, so they will have to be made again.
3. Comparison set values, preset values, and so on, can be changed during operation.

1-1-3 Encoders and Sensors

Open collector output-type incremental encoders or line driver output-type encoders or sensors can be connected. When line driver inputs (differential inputs) are used, an external device with an Am26LS31 or equivalent output interface (5 V ± 5% power supply) can be connected.

1-1-4 Control Modes

The High-speed Counter Unit has two control modes: 2-word and 4-word. The control mode will depend on the PC and the system configuration. For more detailed information regarding control modes, refer to *Section 5 Data Configuration and Program Development.*

2-word Mode

In 2-word mode, one input word and one output word are allocated to the High-speed Counter Unit, for a total of two words. The High-speed Counter Unit is controlled through these two words, using the READ and WRIT instructions. Control data can be read and written as a block.

4-word Mode

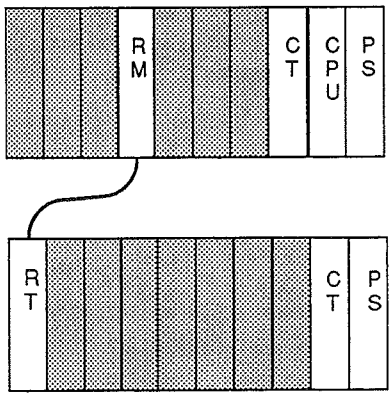
In 4-word mode, two input words and two output words are allocated to the High-speed Counter Unit, for a total of four words. The High-speed Counter Unit is controlled through these four words, using the MOV instruction. Control data is read and written one word at a time while commands are specified.

When a CVM1 CPU with an "-EV2" suffix is used, RD2(280) and WR2(281) can be used to read and write control data as a block.

1-2 Basic System Configuration

The High-speed Counter Unit can be mounted to C500, C1000H, C2000H, CVM1, or CV-series CPU Racks or to Remote I/O Slave Racks. The High-speed Counter Unit's control mode will be changed according to the mounting position.

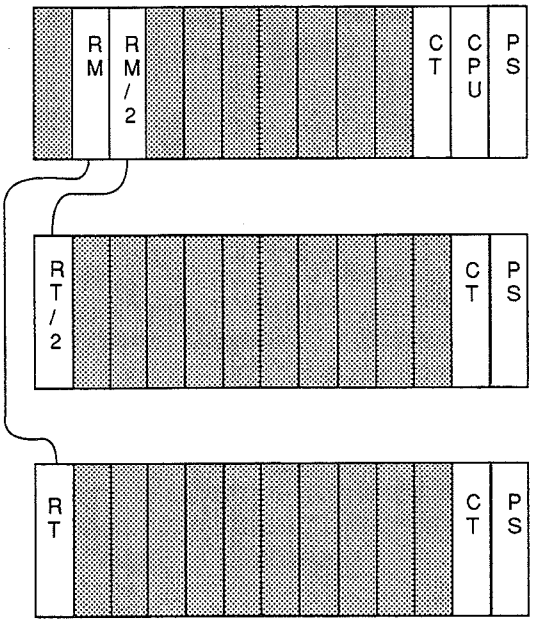
C500, C1000H, C2000H



Mounted on CPU Rack or Expansion I/O Rack.
Controlled by READ and WRIT instructions (2-word mode).

Mounted on Slave Rack (SYSMAC BUS).
Controlled by commands (4-word mode).

CVM1, CV-series



Mounted on CPU Rack, Expansion CPU Rack, or Expansion I/O Rack.
Controlled by READ and WRIT instructions (2-word mode).

Mounted on Slave Rack (SYSMAC BUS/2).
Controlled by READ and WRIT instructions (2-word mode).

Mounted on Slave Rack (SYSMAC BUS).
Control method depends on CPU model.
Models with "-EV2" suffix:
Controlled by RD2 and WR2 instructions (4-word mode).
Models with "-EV1" or no suffix:
Controlled by commands (4-word mode).

PS: Power Supply Unit
CPU: CPU Unit
CT: High-speed Counter Unit
RM/2: SYSMAC BUS/2 Master Unit
RT/2: SYSMAC BUS/2 Slave Unit
RM: SYSMAC BUS Master Unit
RT: SYSMAC BUS Slave Unit

Note The number of High-speed Counter Units that can be mounted depends on the power supply capacity.

1-3 Setup Procedure

Follow the procedure outlined below for setting up the High-speed Counter Unit.

1, 2, 3...

1. Make the DIP switch settings. The settings will differ according to the system configuration in which the High-speed Counter Unit is used. Refer to *2-2-2 Setting Switches and Fuse*.
2. Select the operating mode according to the application. Refer to *4-1 Operating Modes*.
3. Refer to relevant section (*Sections 6* to *12*) for the operating mode, and create the data table.
4. Select the control mode. The method for writing the data table to the High-speed Counter Unit differs depending on the CPU model and the system configuration. Refer to *1-1-4 Control Modes* and *1-2 Basic System Configuration*.
5. Create the ladder program. The method for creating the program differs depending on the control mode and the instructions that are used. Refer to *Section 5 Data Configuration and Program Development*.

SECTION 2
Specifications and Components

This section provides the Unit's basic specifications and describes its major components.

2-1 Specifications

2-1-1 General Specifications

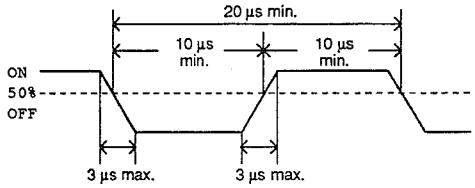
The general specifications conform to the C-series and CV-series specifications.

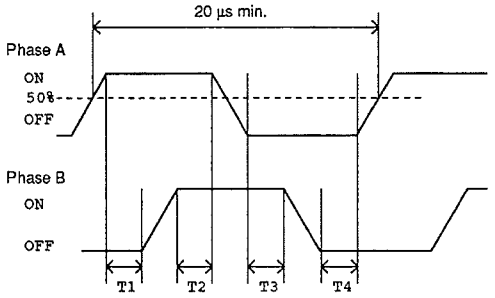
2-1-2 Characteristics

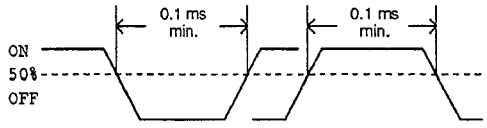
Item		Specification
Number of axes		2 axes/Unit
Operating modes		The 7 operating modes are listed below. A different mode can be set for each axis on each Unit. Simple linear mode Linear mode Circular mode Preset mode Gate mode Latch mode Sampling mode
Count inputs	Input signals	Encoder input A, encoder input B
	Signal levels	5 VDC, 12 VDC, and 24 VDC (open collector/line driver)
	Input modes	Offset phase inputs (×1/×4) Up and down pulse inputs Pulse + direction inputs
	Counting rate	50K cps max. (The offset phase input has a ×4 input multiplier function.)
External inputs	Input signal	Pulse input Z
	Signal levels	5 VDC, 12 VDC, and 24 VDC (open collector/line driver)
	Input signal	One control input (Used with the preset function, reset function, gate counter, sampling counter, preset counter, and latch counter.)
	Signal levels	12 VDC and 24 VDC
External outputs	Outputs	External outputs 0 to 7, 8 points/Unit (Can be allocated freely to each comparison set value.)
	Switching capacity	50 mA at 5 VDC to 300 mA at 24 VDC
Internal current consumption		350 mA max. at 5 VDC (Supplied from Backplane.)
Dimensions		250 × 34.5 × 115 mm (H × W × D) including the terminal block's height.
Weight		500 g max.

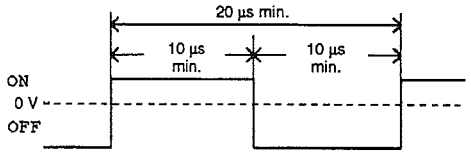
2-1-3 Electrical Characteristics of I/O Signals

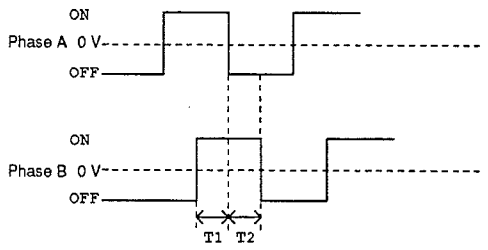
Input Characteristics (Open Collector/Line Driver Inputs)

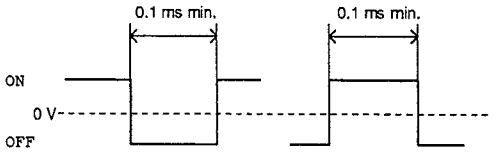
<table>
<tr><th>Item</th><th colspan="3">Encoder Input A, Encoder B, Pulse Input Z</th><th>Encoder Input A, Encoder B, Pulse Input Z</th></tr>
<tr><td>Input voltage</td><td>5 VDC ±5%</td><td>12 VDC ±10%</td><td>24 VDC ±10%</td><td rowspan="4">Conform to RS-422 line driver (Am26LS31 or equivalent) specifications.
(The power supply voltage of the connecting side is 5 VDC ±5%.)</td></tr>
<tr><td>Input current</td><td>14 mA TYP.</td><td colspan="2">8 mA TYP.</td></tr>
<tr><td>ON voltage (min.)</td><td>4.5 VDC</td><td>10.2 VDC</td><td>20.4 VDC</td></tr>
<tr><td>OFF voltage (max.)</td><td>1.5 VDC</td><td>3.0 VDC</td><td>4.0 VDC</td></tr>
<tr><td>Minimum response pulse</td><td colspan="3">Encoder Input A/Encoder B waveform:
The input's rise/fall time is 3 µs max. (Equivalent to a 50-Khz signal with a 50% duty ratio.)
 

A and B phases in offset phase inputs:
The variation between phases A and B (T1/T2/T3/T4) is 2.5 µs min.
 

Pulse input Z:
The pulse width is 0.1 ms min.
 

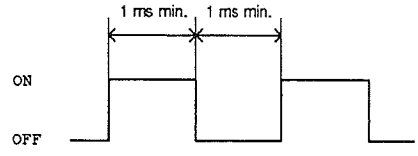
Be sure to leave an input interval of at least 1.5 ms between Z input pulses.</td><td>Encoder Input A/Encoder B (+) terminal waveform:
Equivalent to a 50-Khz signal with a 50% duty ratio.
 

A and B phases in offset phase inputs:
The variation between phases A and B is 2.5 µs min.
 

Pulse input Z:
A pulse width of at least 0.1 ms min. is required.
 

Be sure to leave an input interval of at least 1.5 ms between Z input pulses.</td></tr>
</table>

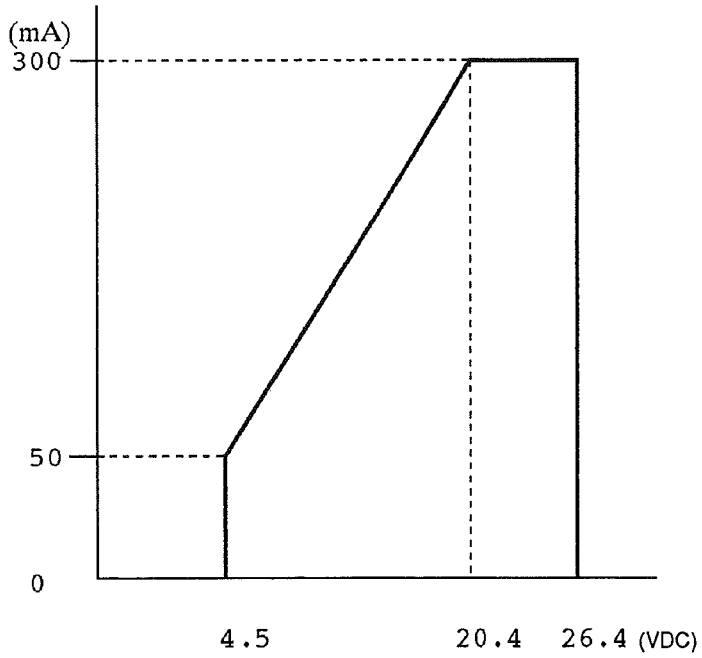
External Control Inputs

Item	External Control Input
Input voltage	12 to 24 VDC ±10%
Input current	4 to 11 mA
ON voltage (min.)	10.2 VDC
OFF voltage (max.)	3.0 VDC
ON/OFF delay	1 ms max.
Minimum response pulse	 When accessing these signals from the PC, the signals must be ON longer than the PC's cycle time.

Output Characteristics

Item	External Outputs 0 to 7
Number and type of outputs	8 transistor outputs/Unit
Max. switching capacity	50 mA at 4.5 VDC to 300 mA at 26.4 VDC (See the following graph.)
Leakage current	0.1 mA max.
Residual voltage	0.8 V max.
I/O response time (Count comparison to external output)	Simple linear mode: 1 ms max. Any other mode: 1.5 ms max.
External power supply	5 to 24 VDC ±10%

The maximum switching current depends upon the power supply voltage, as shown below.



⚠ Caution If the output current exceeds 3.2 A/common (8 points), the internal fuse will blow and the Unit will become inoperable.

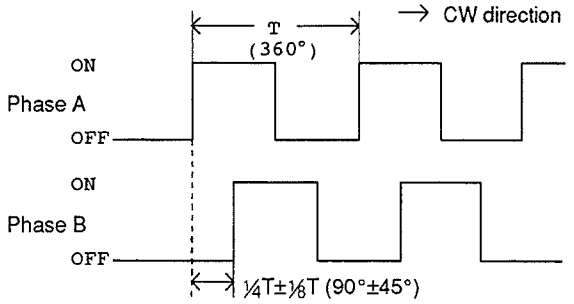
2-1-4 Precautions for the Counting Rate

The maximum response pulse frequency with offset phase inputs is determined by the specifications of the Incremental Encoder connected to the High-speed Counter Unit. An example calculation for OMRON's E6B2-CWZ6C Encoder is shown below.

Item	Specification
Power supply voltage	5 VDC–5% to 24 VDC+10%
Current consumption	80 mA max.
Resolution (P/R)	500 pulses/circuit
Output phases	Phase A, phase B, phase Z
Output type	Open collector output
Output capacity	Applied voltage: 30 VDC max.
	Sink current: 35 mA max.
	Residual voltage: 0.4 V max (when the sink current is 35 mA)
Max. response frequency	100 KHz
Output phase difference	A/B phase difference 90°±45° (¼±⅛T)
Output rise/fall time	1.0 μs max. (Control output voltage 5 V, load resistance 1 KΩ, cord length 50 cm)

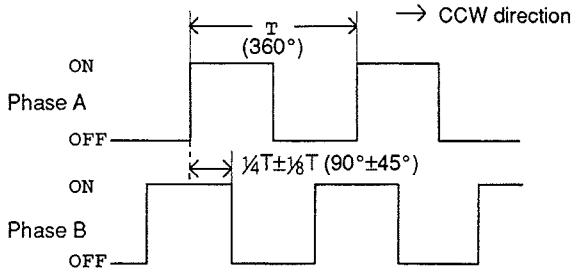
Clockwise (CW) Rotation

Phase A is advanced ¼±⅛T phase ahead of phase B.



Counterclockwise (CCW) Rotation

Phase A is delayed ¼±⅛T phase behind phase B.



The output phase difference is 90°±45°, so this Encoder's worst (smallest) phase difference is 90°–45° = 45°.

At least 2.5 μs is required even if the High-speed Counter Unit's phase difference is minimized. Thus:

$$\frac{2.5\ \mu s}{T} < \frac{45°}{360°}$$

(When the rise and fall of the Encoder's output are equivalent.)

$$T < 20\ \mu s$$

(T is the minimum pulse period that for responses.)

Inverting the period yields the maximum frequency of 50K cps.

$$\frac{1}{T} < \frac{1}{20\ \mu s} = 50K\ cps$$

(54 revolutions/s when there are 500 pulses/revolution)

Thus, the maximum frequency that can be used with this Encoder is 50K cps.

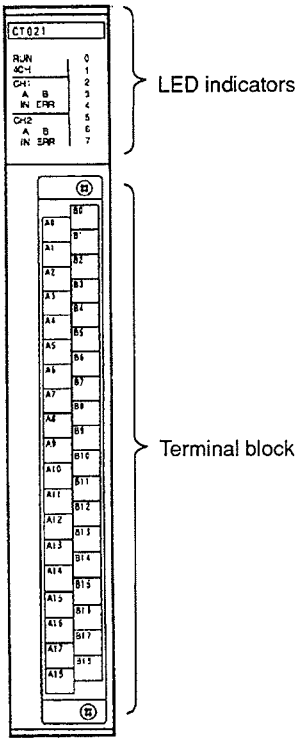
Note Be sure that the pulse input is longer than the minimum response pulse width when resetting the counter using pulse input Z. A pulse width of at least 0.1 ms is required for pulse input Z. Also, allow at least 1.5 ms spacing between pulse inputs.

2-2 High-speed Counter Unit Components

This section describes the main components of the C500-CT021 High-speed Counter Unit.

2-2-1 Indicators and Terminal Block

Front



Indicators

The following table explains the functions of the LED indicators.

Indicator		Name	Function
RUN		Operation	Lights when the Unit is operating. Goes off when a WDT error occurs.
4CH		4-word mode	Lights when the Unit is in 4-word mode.
CH1	A	Encoder Input A	Lights when Encoder Input A for axis-1 is ON.
	B	Encoder Input B	Lights when Encoder Input B for axis-1 is ON.
	IN	External control input	Lights when the external control input for axis-1 is ON.
	ERR	Error	Lights when an error has occurred with axis-1. Flashes when a WRIT instruction axis specification error has occurred.

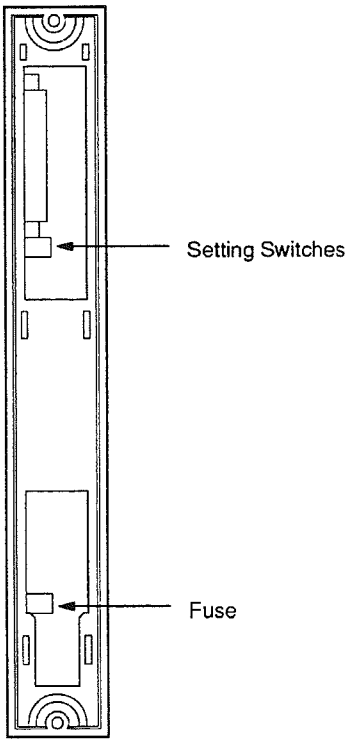
Indicator		Name	Function
CH2	A	Encoder Input A	Lights when Encoder Input A for axis-2 is ON.
	B	Encoder Input B	Lights when Encoder Input B for axis-2 is ON.
	IN	External control input	Lights when the external control input for axis-2 is ON.
	ERR	Error	Lights when an error has occurred with axis-2. Flashes when a WRIT instruction axis specification error has occurred.
01234567		External output	These indicators light when the corresponding external output (0 through 7) is ON.

Terminal Block

Connect output devices and input devices such as encoders to the terminal block. Refer to *3-2 Wiring to the Terminal Block* for details on wiring.

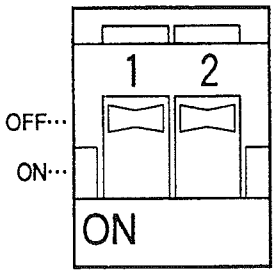
2-2-2 Setting Switches and Fuse

Back



Setting Switches

The setting switches are located on the back of the Unit and control basic operation of the Unit.



The following table explains the functions of these switches. Both switches are set to "OFF" when the Unit is shipped from the factory.

Refer to *1-2 Basic System Configuration* to determine the PC and Rack being used, and set the switches accordingly. All other settings are made from the PC with the ladder program.

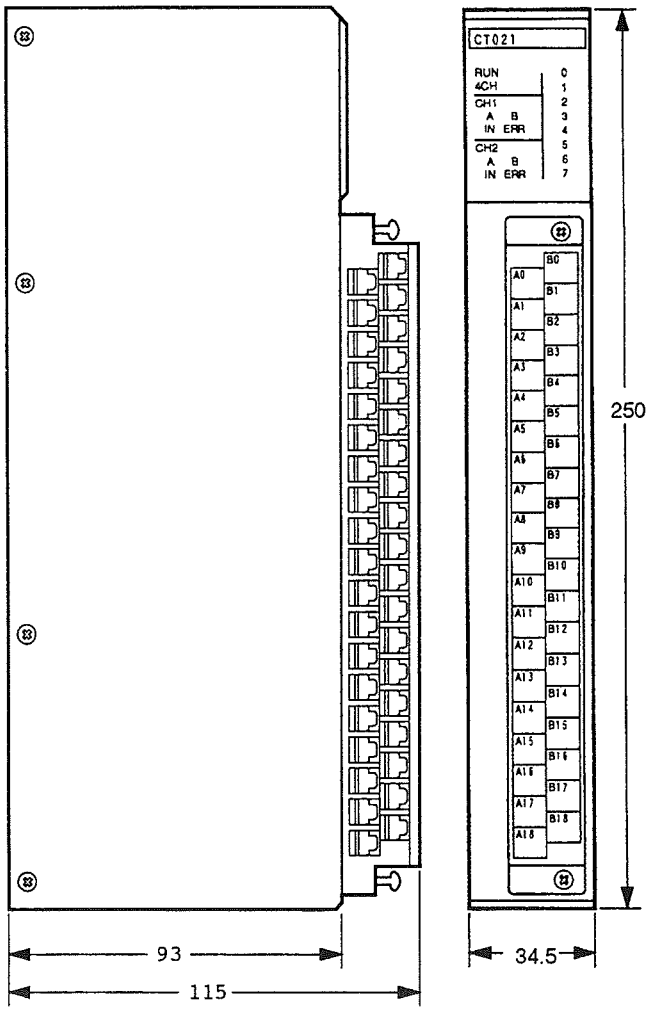
Switch	Status	Function
1	OFF	2-word mode: Leave switch 1 OFF when the Unit is mounted on a CPU Rack, Expansion I/O Rack, or SYSMAC BUS/2 Slave Rack.
	ON	4-word mode: Turn switch 1 ON when the Unit is mounted on a SYSMAC BUS Slave Rack.
2	OFF	Leave switch 2 OFF when using the Unit with a C1000H/C2000H PC.
	ON	Turn switch 2 ON when using the Unit with any other CPU.

Fuse

The fuse limits power to the external outputs. The fuse will blow if the output current exceeds 3.2 A/Common (8 points).

2-3 Dimensions

The following diagram shows the dimensions of the High-speed Counter Unit. All dimensions are in mm. The weight of the Unit is 500 g max.

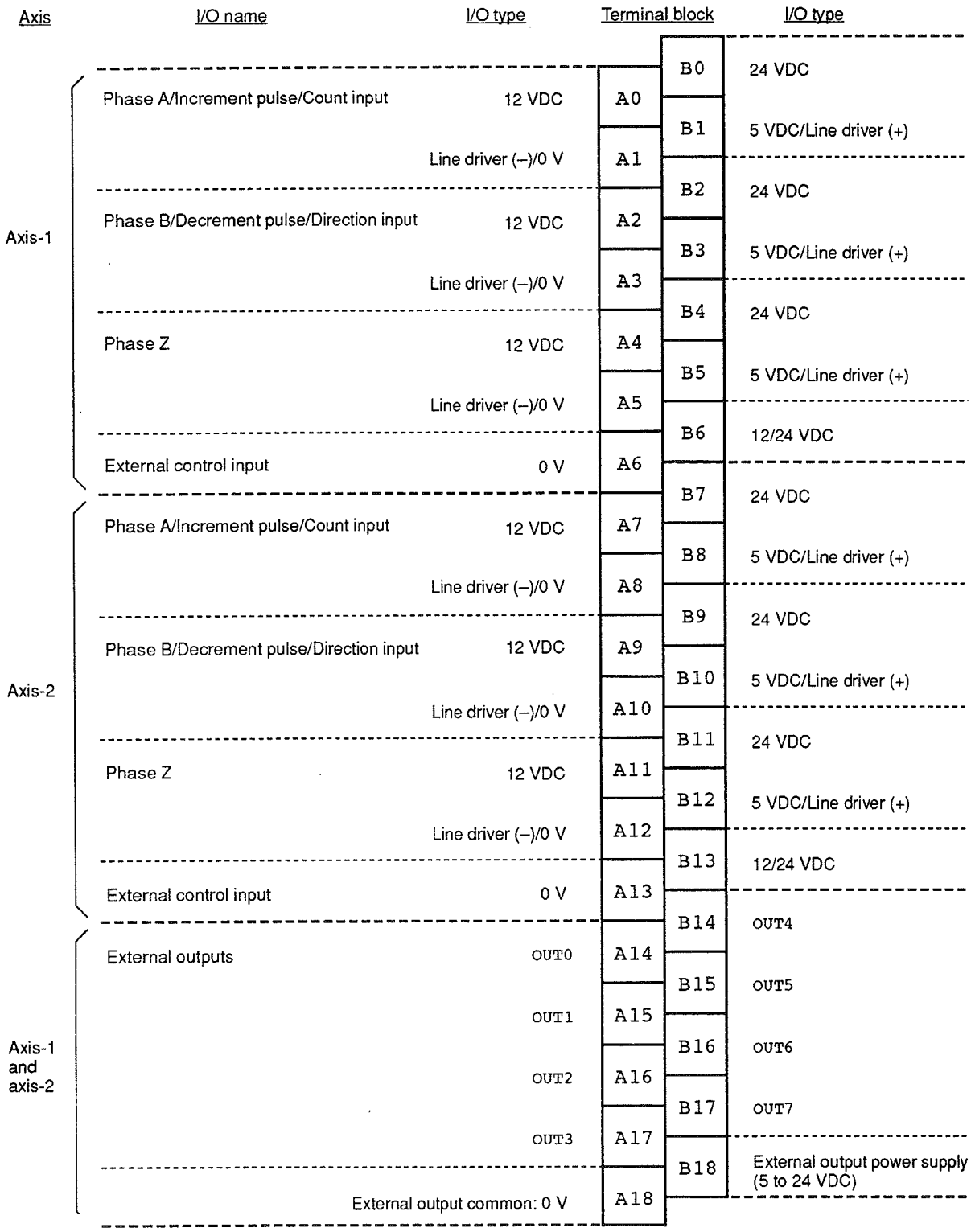


SECTION 3
Wiring

This section explains how to connect various input and output devices to the High-speed Counter Unit.

3-1 Terminal Allocation

The following diagram shows the names and pin allocation of the High-speed Counter Unit's terminals.



3-2 Wiring to the Terminal Block

3-2-1 Recommended Power Wires

Wire usage	Recommended wire
External outputs	AWG22 (0.3 mm^2)
A, B, or Z input signals	Shielded twisted-pair cable When used for line driver inputs, select a cable so that the entire (round-trip) resistance of the wire is 7 Ω max.

The rated current capacity of the power wires depends on factors such as the ambient temperature and insulation thickness, so be sure to check these factors when selecting power wires.

3-2-2 Terminal Screws and Crimp Connectors

The Unit is equipped with self-rising M3.5 terminal screws. Use M3.5 crimp connectors like the ones shown below when connecting to these terminals.

Tighten the terminal screws to 78 kgf•cm max.

3-2-3 Precautions when Wiring

Noise Reduction Measures

Take the following steps to reduce noise in encoder inputs and pulse inputs.

1, 2, 3...

1. Use shielded twisted-pair cable and ground the shield to a resistance of 100 Ω max.
2. Make the wiring as short as possible and avoid running the wires parallel to lines that produce a lot of noise, such as high-power lines.
3. Try to use a separate stabilized power supply for encoders and another power supply for other I/O.

Polarity

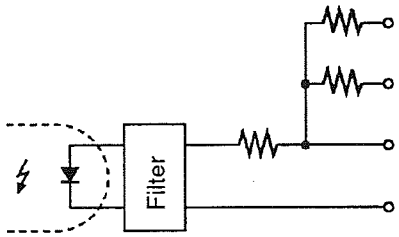
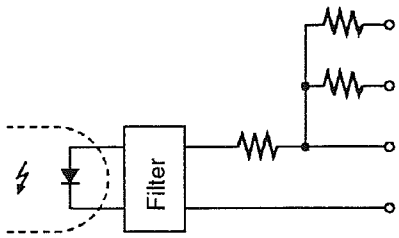
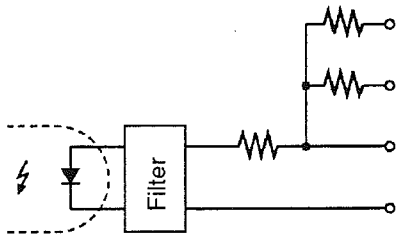
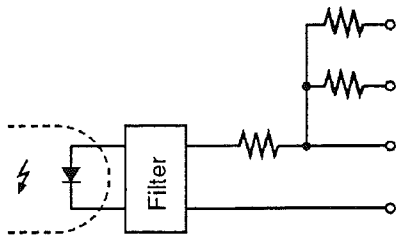
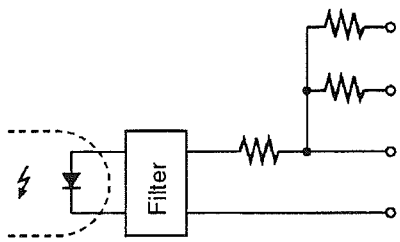
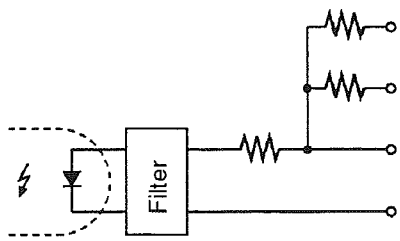
Be sure not to reverse the polarity when wiring a line driver encoder input and pulse input.

Signal Level

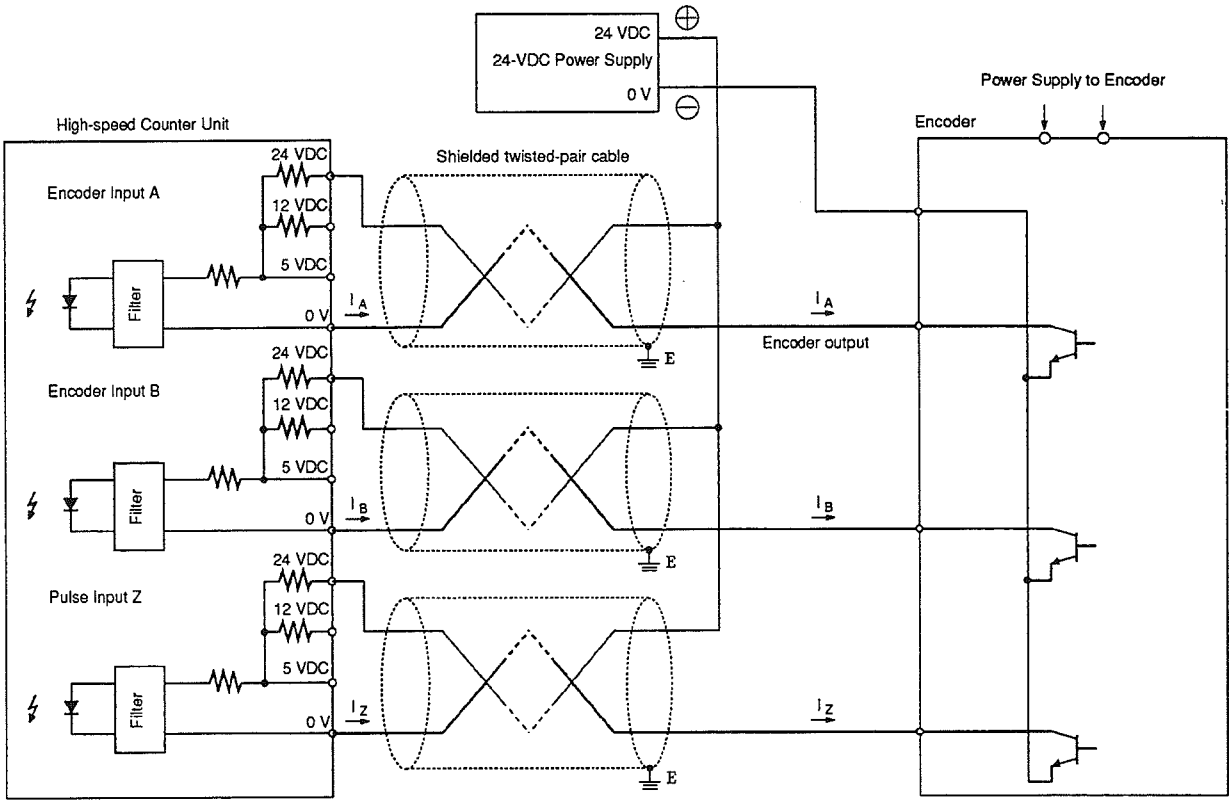
Different terminals are used to wire an open collector encoder input and pulse input for different signal levels (5 VDC, 12 VDC, or 24 VDC). Refer to *3-3 I/O Circuit Configurations* for details.

3-3 I/O Circuit Configurations

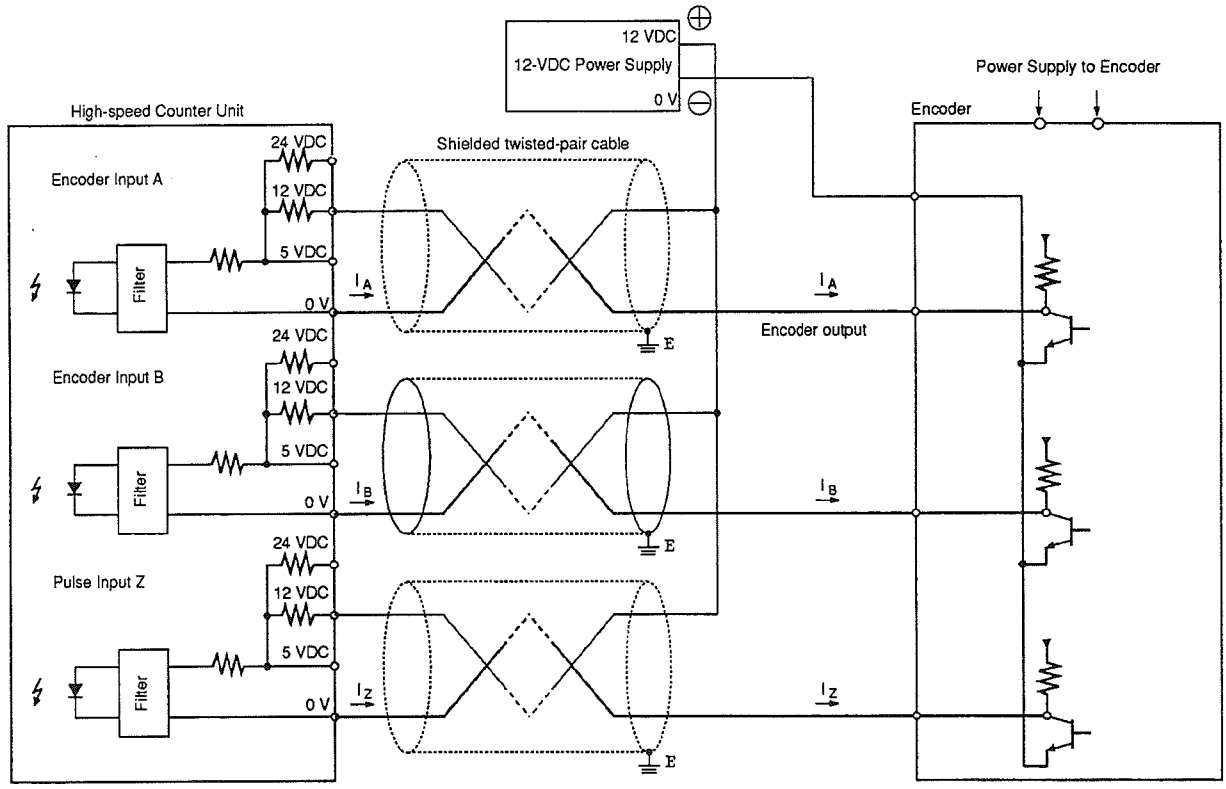
3-3-1 Encoder Input Circuit Configuration

Circuit	Pin	Name	Comments
	B0	Axis-1 Encoder Input A: 24 VDC	Supply power from B0, A0, or B1.
	A0	Axis-1 Encoder Input A: 12 VDC	
	B1	Axis-1 Encoder Input A: 5 VDC/Line driver (+)	
	A1	Axis-1 Encoder Input A: 0 V/Line driver (–)	---
	B2	Axis-1 Encoder Input B: 24 VDC	Supply power from B2, A2, or B3.
	A2	Axis-1 Encoder Input B: 12 VDC	
	B3	Axis-1 Encoder Input B: 5 VDC/Line driver (+)	
	A3	Axis-1 Encoder Input B: 0 V/Line driver (–)	---
	B4	Axis-1 Pulse Input Z: 24 VDC	Supply power from B4, A4, or B5.
	A4	Axis-1 Pulse Input Z: 12 VDC	
	B5	Axis-1 Pulse Input Z: 5 VDC/Line driver (+)	
	A5	Axis-1 Pulse Input Z: 0 V/Line driver (–)	---
	B7	Axis-2 Encoder Input A: 24 VDC	Supply power from B7, A7, or B8.
	A7	Axis-2 Encoder Input A: 12 VDC	
	B8	Axis-2 Encoder Input A: 5 VDC/Line driver (+)	
	A8	Axis-2 Encoder Input A: 0 V/Line driver (–)	---
	B9	Axis-2 Encoder Input B: 24 VDC	Supply power from B9, A9, or B10.
	A9	Axis-2 Encoder Input B: 12 VDC	
	B10	Axis-2 Encoder Input B: 5 VDC/Line driver (+)	
	A10	Axis-2 Encoder Input B: 0 V/Line driver (–)	---
	B11	Axis-2 Pulse Input Z: 24 VDC	Supply power from B11, A11, or B12.
	A11	Axis-2 Pulse Input Z: 12 VDC	
	B12	Axis-2 Pulse Input Z: 5 VDC/Line driver (+)	
	A12	Axis-2 Pulse Input Z: 0 V/Line driver (–)	---

Wiring Example 1: 24-VDC Open-collector Encoder

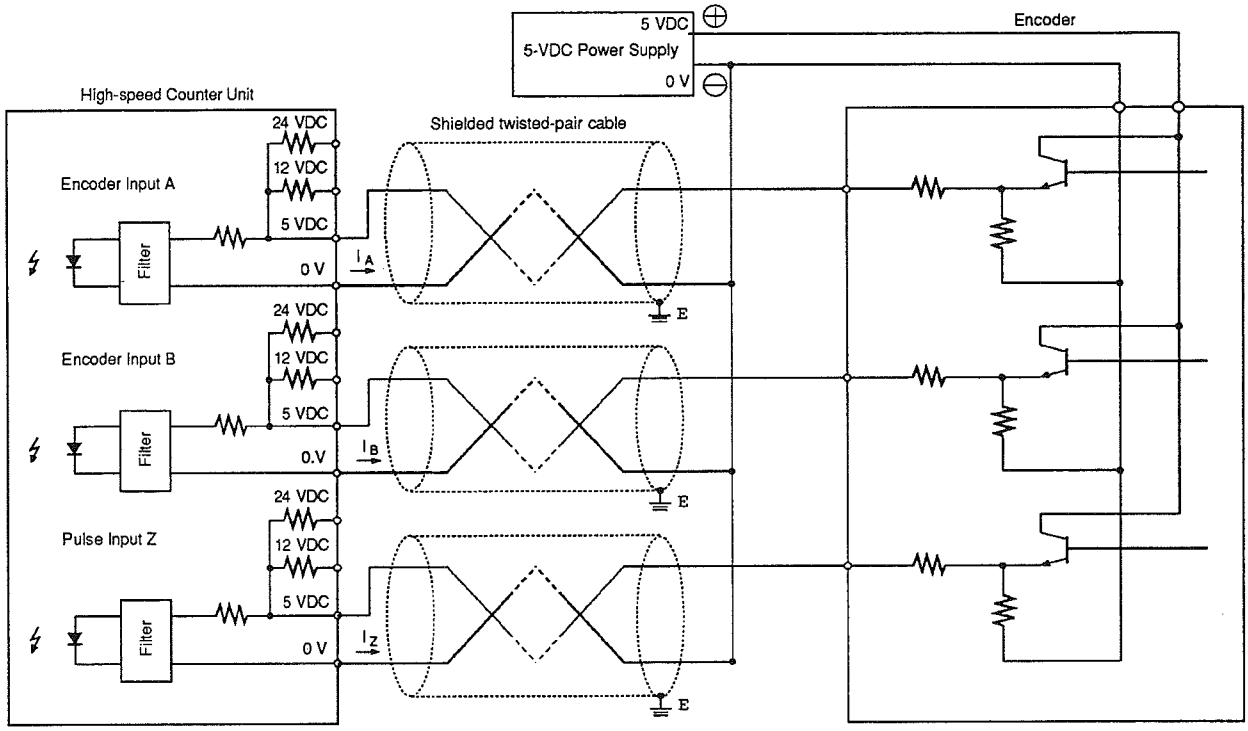


Wiring Example 2: 12-VDC Voltage-output (Sink-load) Encoder



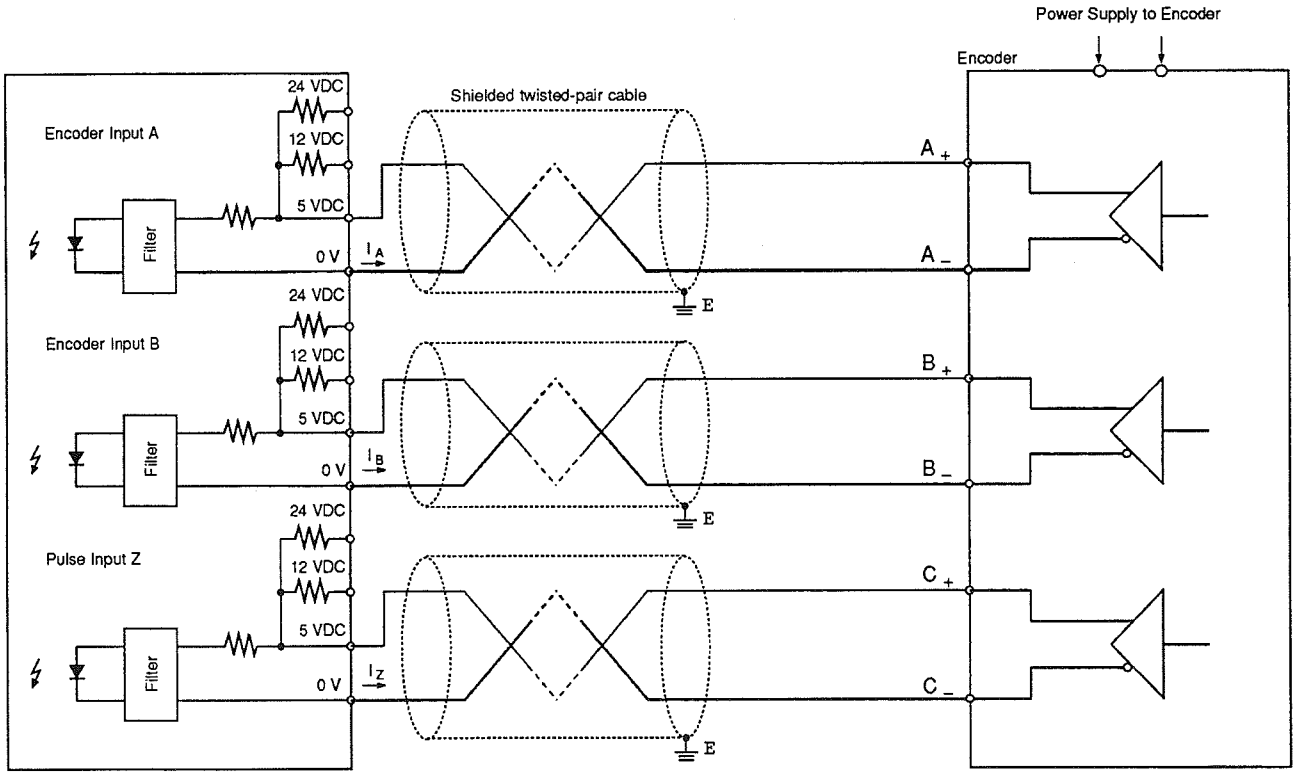
Note The input at the High-speed Counter Unit goes OFF when the encoder's output is "H" and goes ON when the encoder's output is "L."

Wiring Example 3: 5-VDC Voltage-output (Source-load) Encoder



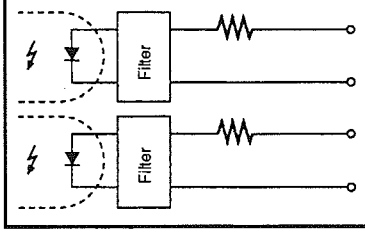
Note A current of 14 mA (rated) must flow when the encoder input is ON. Be sure that the ON voltage is correct when the input is ON.

Wiring Example 4: Line-driver Output (Am26LS31 or equivalent) Encoder

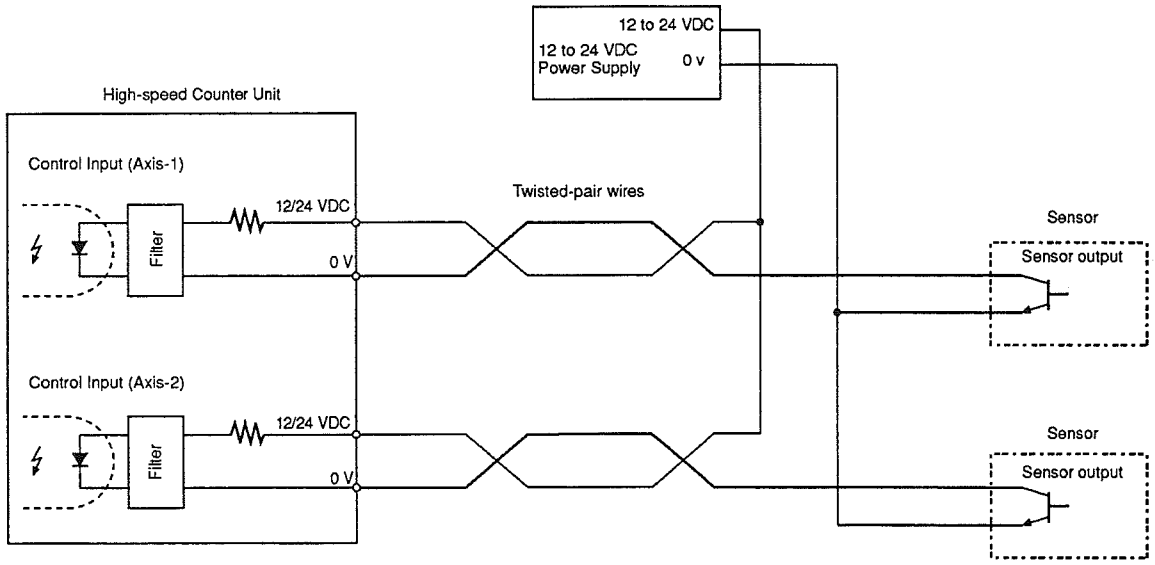


Note Wire the system so that the High-speed Counter Unit's pulse input goes ON when the encoder's output goes ON.

3-3-2 External Control Input Circuit Configuration

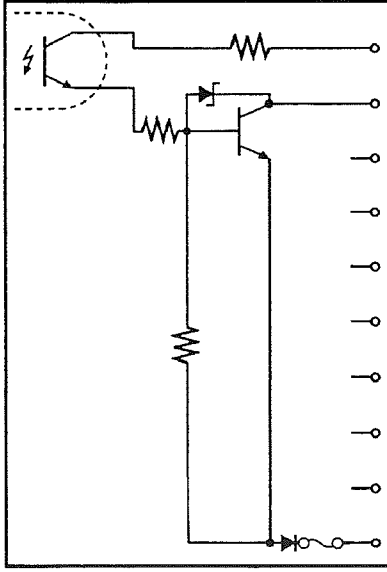
Circuit	Pin	Name
	B6	Axis-1 External control input: 12/24 VDC
	A6	Axis-1 External control input: 0 V
	B13	Axis-2 External control input: 12/24 VDC
	A13	Axis-2 External control input: 0 V

Wiring Example

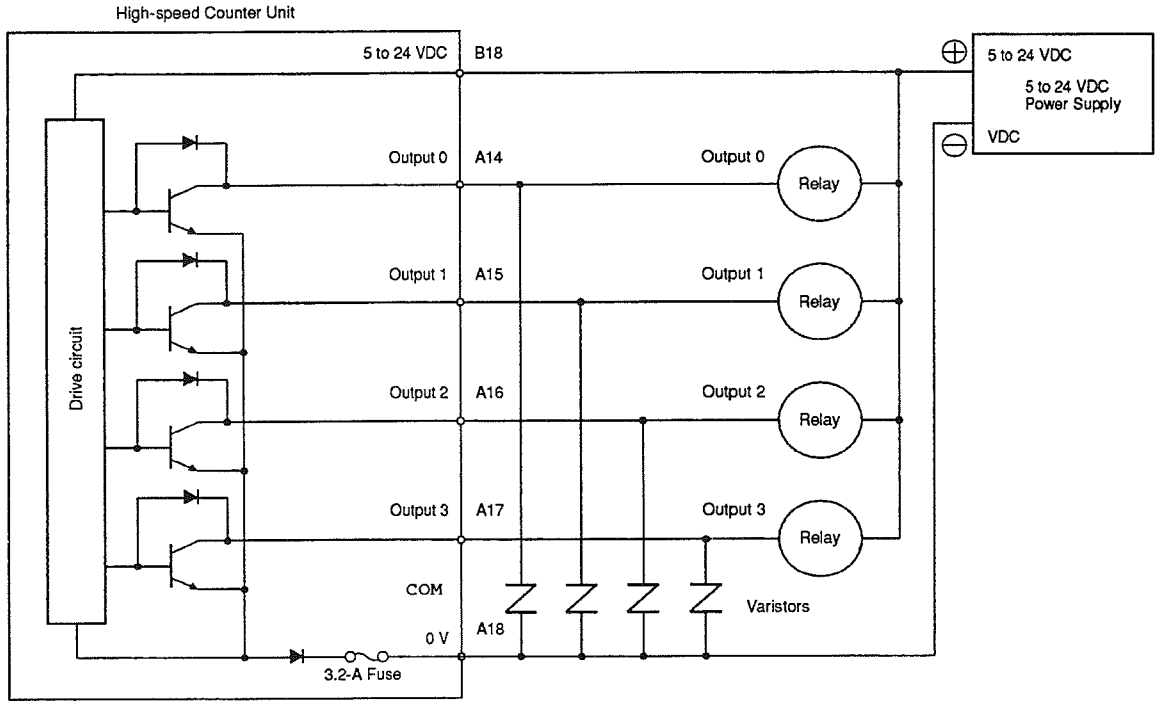


Note In order to prevent chatter at the input, use solid-state as much as possible.

3-3-3 External Output Circuit Configuration

Circuit	Pin	Name
	B18	Power supply for external outputs 0 to 7: 5 to 24 VDC ±10%
	A14	External output 0
	A15	External output 1
	A16	External output 2
	A17	External output 3
	B14	External output 4
	B15	External output 5
	B16	External output 6
	B17	External output 7
	A18	Common for external outputs 0 to 7: 0 V

Example: Connecting External Outputs 0 through 3 to Relays



The switching capacity varies with the voltage. Refer to *2-1-3 Electrical Characteristics of I/O Signals* for details.

If a load generates a surge voltage, connect a varistor to the load to protect the output transistor.

Use the same power supply for the external power supply and output load power supply. If different power supplies are used, be sure that a potential difference doesn't develop.

The output levels for external outputs 0 through 7 are as follows:

The external output is "L" when the High-speed Counter Unit's output is ON.
The external output is "H" when the Unit's output is OFF.

SECTION 4
Operation

This section provides the information necessary to operate the C500-CT021 High-speed Counter Unit, including modes, types of inputs, reset conditions, and data exchange with the PC.

4-1 Operating Modes

The High-speed Counter Unit can be used in any of the following seven modes.

Mode	Count range	Function	Reference
Simple linear	–8,388,608 to 8,388,607 (BCD) –2,147,483,648 to 2,147,483,647 (binary)	Compares the present counter value to the preset value (>, =, <) for each axis, and controls outputs according to the results.	*Section 6*
Linear	–8,388,608 to 8,388,607 (BCD) –2,147,483,648 to 2,147,483,647 (binary)	Up to eight ranges can be set for each axis, and outputs are continued while the counter value is within any of those ranges. Outputs are stopped when the counter value is not within any of the ranges.	*Section 7*
Circular	0 to 65,535 (BCD, binary)	Up to eight ranges can be set for each axis, and outputs are continued while the counter value is within any of those ranges. The counter value restarts from zero after reaching a preset maximum value, or returns to the preset maximum value when the counter value is decremented past zero.	*Section 8*
Preset	1 to 8,388,607 (BCD) 1 to 2,147,483,647 (binary)	Up to eight preset values can be set for each axis, and the counter value is decremented from one of these values when the start input is received. There are three outputs that turn ON and OFF according to the counter value, and one output that turns ON when the counter value reaches zero.	*Section 9*
Gate	–8,388,608 to 8,388,607 (BCD) –2,147,483,648 to 2,147,483,647 (binary)	The count continues only while the control input signal from the encoder is ON. When the signal turns OFF, the count stops. When the signal turns ON again, the count starts from zero (in normal gate mode) or from the present counter value (in cumulative gate mode).	*Section 10*
Latch	–8,388,608 to 8,388,607 (BCD) –2,147,483,648 to 2,147,483,647 (binary)	In latch mode, the counter value is stored in the internal register at the rising edge of the control input signal, and is retained while the count continues. This value is always read as the present counter value. An external signal can be used as a trigger to obtain a precise reading of the present counter value while incrementing or decrementing.	*Section 11*
Sampling	–8,388,608 to 8,388,607 (BCD) –2,147,483,648 to 2,147,483,647 (binary)	The count begins at the rising edge of the start input, and continues for a preset fixed interval. When the count stops, the value is retained. The count then starts over from zero at the rising edge of the next start input.	*Section 12*

When power is turned on, both axes operate in linear mode (with up and down pulse inputs), and the present counter value is read.

The operating mode is set for each axis by the ladder program at the PC. For details, refer to *Section 5 Data Configuration and Program Development.*

Note Once the operating mode has been set, it cannot be readily changed. If it is necessary to make a change, first turn off the power to the High-speed Counter Unit and then reset the operating mode.

4-2 BCD and Binary Modes

Preset values, maximum count values, and so on, can be set in either BCD or binary. When particularly fast response times are required, it is recommended that the settings be made in binary mode. This mode setting is made for each axis by the ladder program at the PC. For details, refer to *Section 5 Data Configuration and Program Development.*

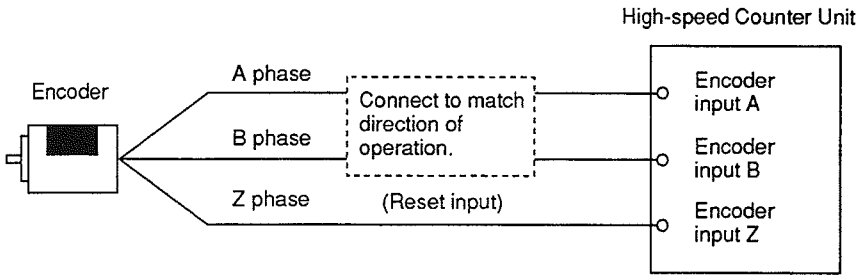
4-3 Input Modes

The input mode determines the timing and the method for incrementing and decrementing the counter. Any one of three types on inputs can be selected: offset phase inputs, individual up and down pulse inputs, and pulse and direction inputs.

When power is turned on, the startup mode is up and down pulse inputs (in linear mode). The modes for each axis can be set by the ladder program at the PC. For details, refer to *Section 5 Data Configuration and Program Development.*

4-3-1 Offset Phase Inputs

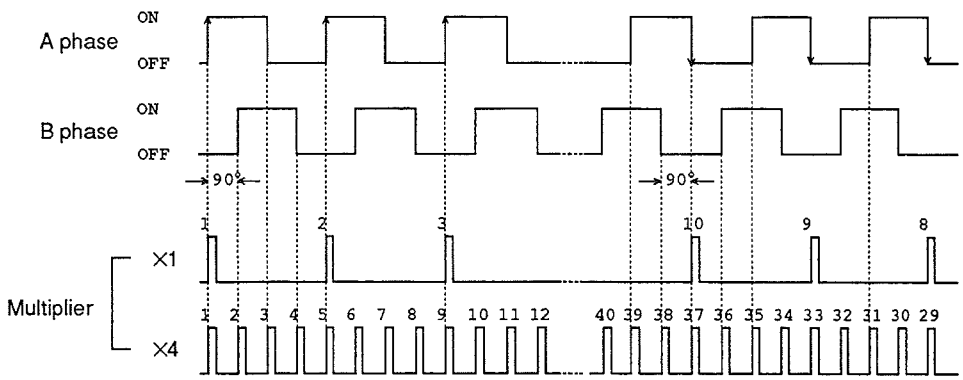
Offset phase inputs use the difference in phase between two inputs to determine whether the counter value will be incremented or decremented. An encoder with A-phase, B-phase, and Z-phase inputs is connected, and the count is incremented or decremented at the rising or falling edge of the A-phase input when there is a 90° shift between the A-phase and B-phase inputs from the encoder. For details, refer to *Section 5 Data Configuration and Program Development.*



Increment When the A-phase is 90° in advance of the B phase, the count is incremented at the rising edge of the A-phase input. (The encoder normally rotates forward.)

Decrement When the A-phase is 90° behind the B phase, the count is decremented at the falling edge of the A-phase input. (The encoder normally rotates in reverse.)

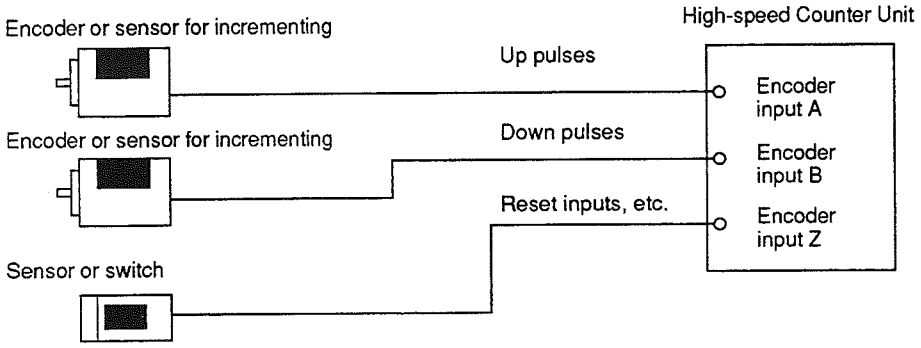
Reset Resets are made possible by connecting the encoder's Z phase to pulse input Z.



A ×4 input multiplier is available to increase accuracy using the same encoder pulses.

4-3-2 Up and Down Pulse Inputs

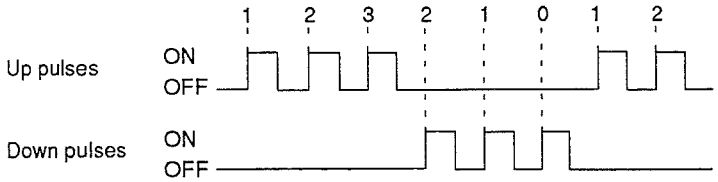
Up and down pulse inputs can be used by connecting separate encoders or sensors for incrementing and decrementing, and then counting up and down in response to these separate inputs. If up and down inputs are received simultaneously, the count remains unchanged. For details, refer to *Section 5 Data Configuration and Program Development.*



Increment The count is incremented at the rising edge of each pulse from the encoder for incrementing.

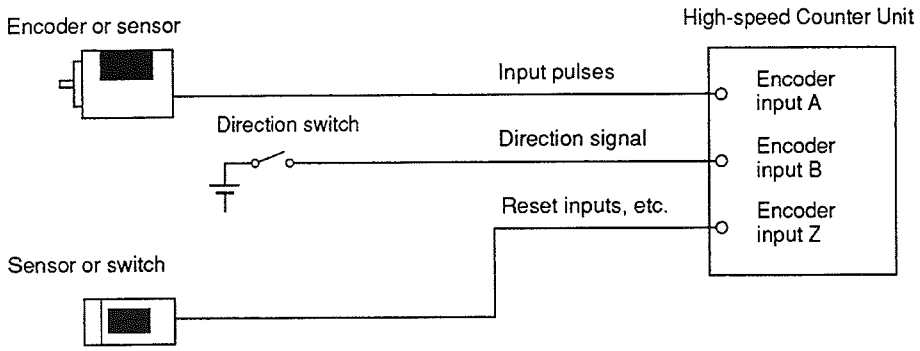
Decrement The count is decremented at the rising edge of each pulse from the encoder for decrementing.

Reset Resets are made possible by connecting the sensor or switch to pulse input Z. (For details, refer to *4-4 Counter Reset Conditions.*)



4-3-3 Pulse and Direction Inputs

Pulse and direction inputs can be used by connecting an encoder or sensor and then incrementing or decrementing according to a direction switch. For details, refer to *Section 5 Data Configuration and Program Development.*

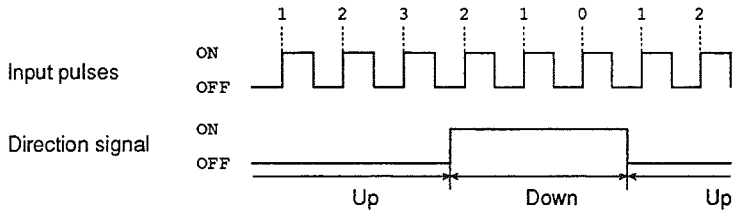


Increment The count is incremented at the rising edge of each pulse from the encoder when the direction signal is OFF.

Decrement The count is decremented at the rising edge of each pulse from the encoder when the direction signal is ON.

Reset

Resets are made possible by connecting the sensor or switch to pulse input Z. (For details, refer to *4-4 Counter Reset Conditions*.)

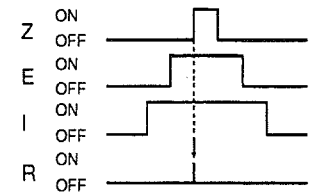
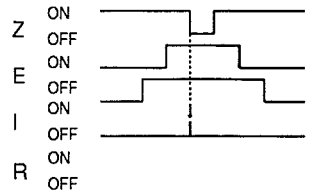
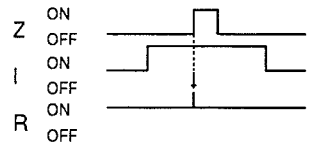
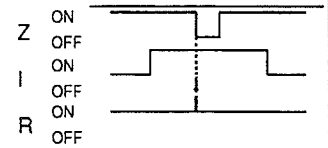
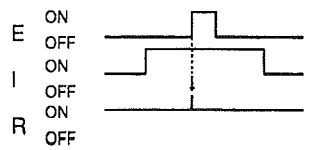


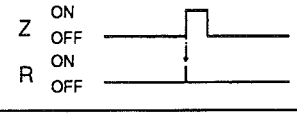
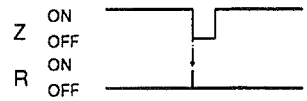
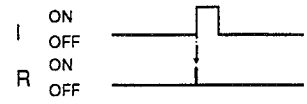
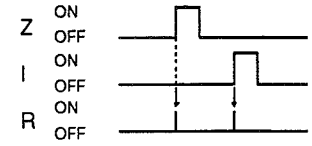
4-4 Counter Reset Conditions

There are eight types Counter reset conditions that can be set according to various combinations of Z pulse inputs, external control inputs, and the Internal Reset Bit. The actual settings are made by the PC's ladder program. For details, refer to *Section 5 Data Configuration and Program Development*.

The following abbreviations are used in this table:

Z: Pulse input Z
E: External control input
I: Internal Reset Bit
R: Reset

Combination	Reset no.	Reset condition	Counter reset condition and timing
Pulse input Z + external control input + Internal Reset Bit	0	Rising edge of Z when E and I are ON.	Z(↑), E, I 
	1	Falling edge of Z when E and I are ON.	Z(↓), E, I 
Pulse input Z + Internal Reset Bit	2	Rising edge of Z when I is ON.	Z(↑), I 
	3	Falling edge of Z when I is ON.	Z(↓), I 
External control input + Internal Reset Bit	4	Rising edge of Z when E is ON.	E(↑), I 

Combination	Reset no.	Reset condition	Counter reset condition and timing
Pulse input Z	5	Rising edge of Z.	Z(↑) 
	6	Falling edge of Z.	Z(↓) 
Internal Reset Bit	7	Rising edge of I.	I(↑) 
Power ON initial status	–	Rising edge of Z or rising edge of I.	Z(↑) or I(↑) 

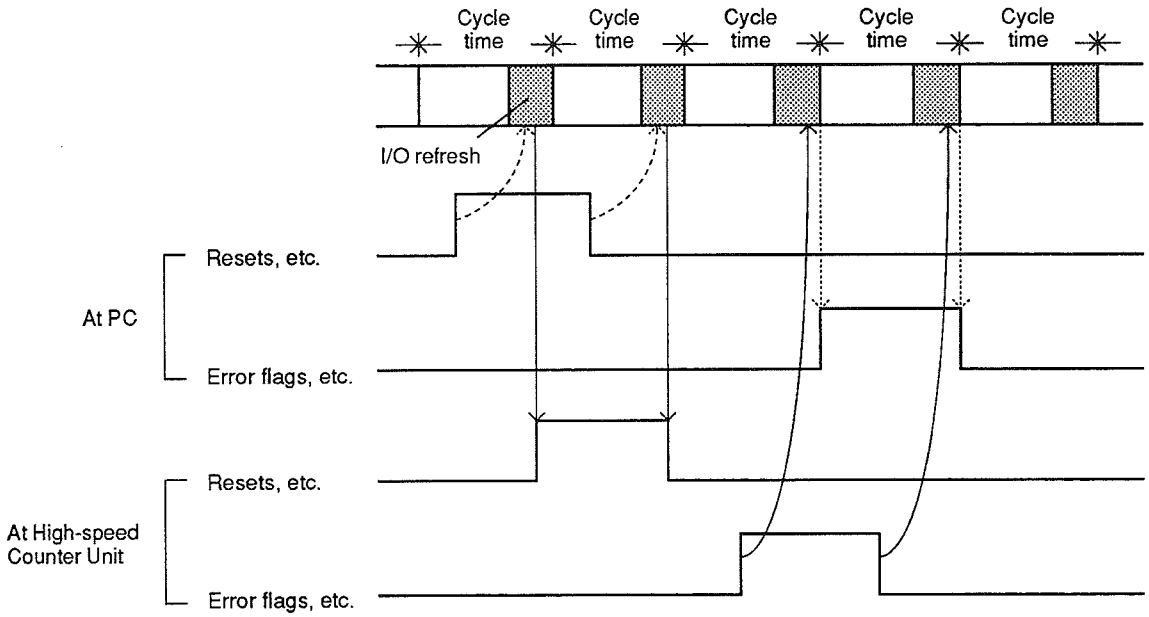
Note

1. Reset numbers 0, 1, and 4 cannot be used under the following circumstances:
   - In simple linear mode, linear mode, circular mode, or preset mode, when the external control input is set for the preset operation.
   - In gate mode or sampling mode, when the external control input is set for the start signal or the preset operation.
   - In latch mode under any circumstances.
2. The reset input interval must be at least 1.5 ms.
3. In the table above, when two or more conditions are combined they are treated as a logical AND in order for the reset operation to be carried out. For example, "Z(↑), E, I" means that the reset will be executed at the rising edge of the Z pulse input when both the external control input and the Internal Reset Bit are ON.

4-5 Data Exchange with PC

4-5-1 Memory Areas

The High-speed Counter Unit exchanges I/O Area information with the PC with every I/O refresh. This timing applies even when data is exchanged by means of the MOV instruction in 4-word mode. (For details, refer to *5-4 Programming in 4-word Mode*.)

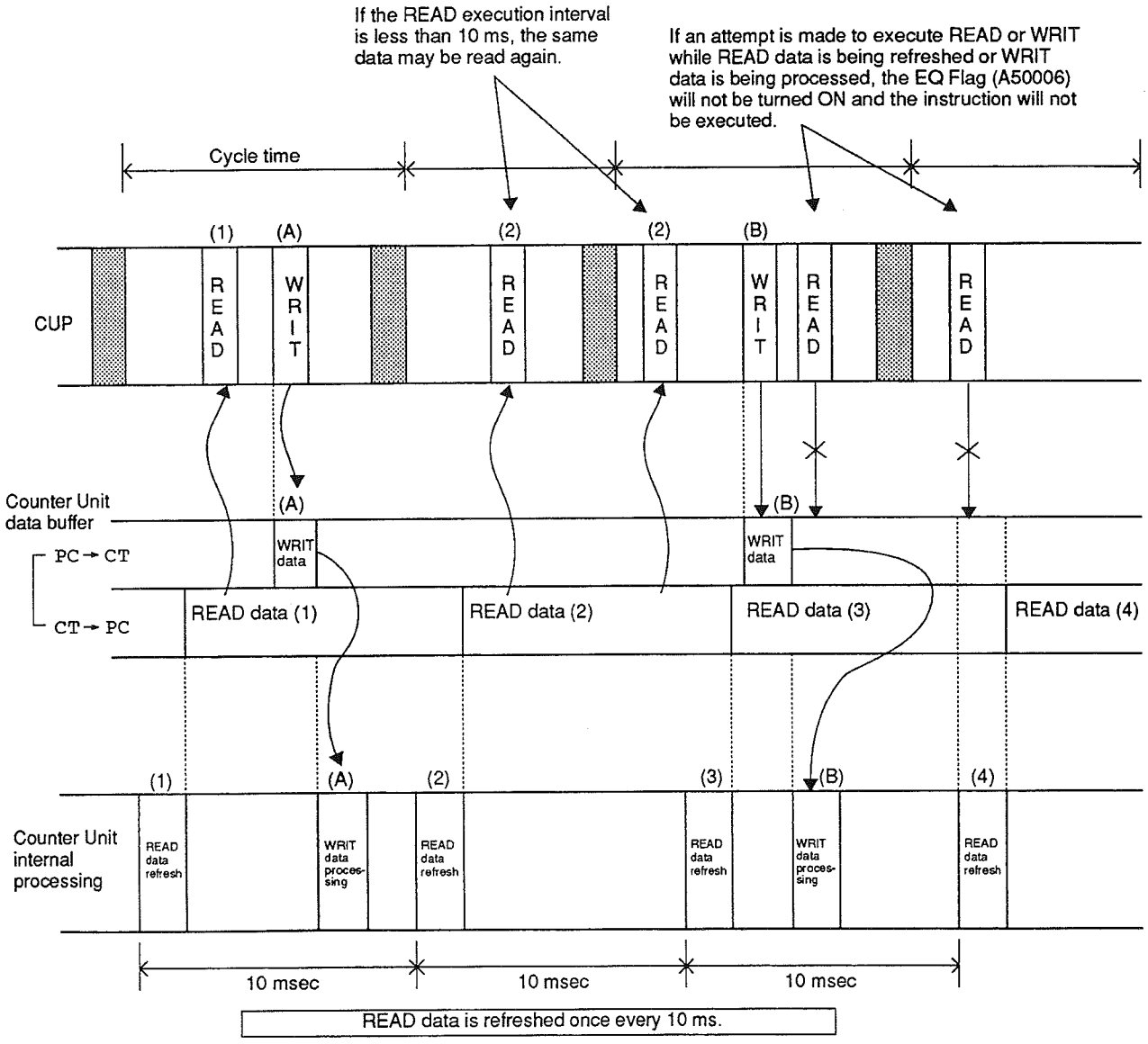


Note When the High-speed Counter Unit is mounted to a Slave Unit, there may be delays due to data transfers between the Master and the Slave. For details, refer to the relevant Remote I/O Unit documentation.

4-5-2 Reading and Writing Data

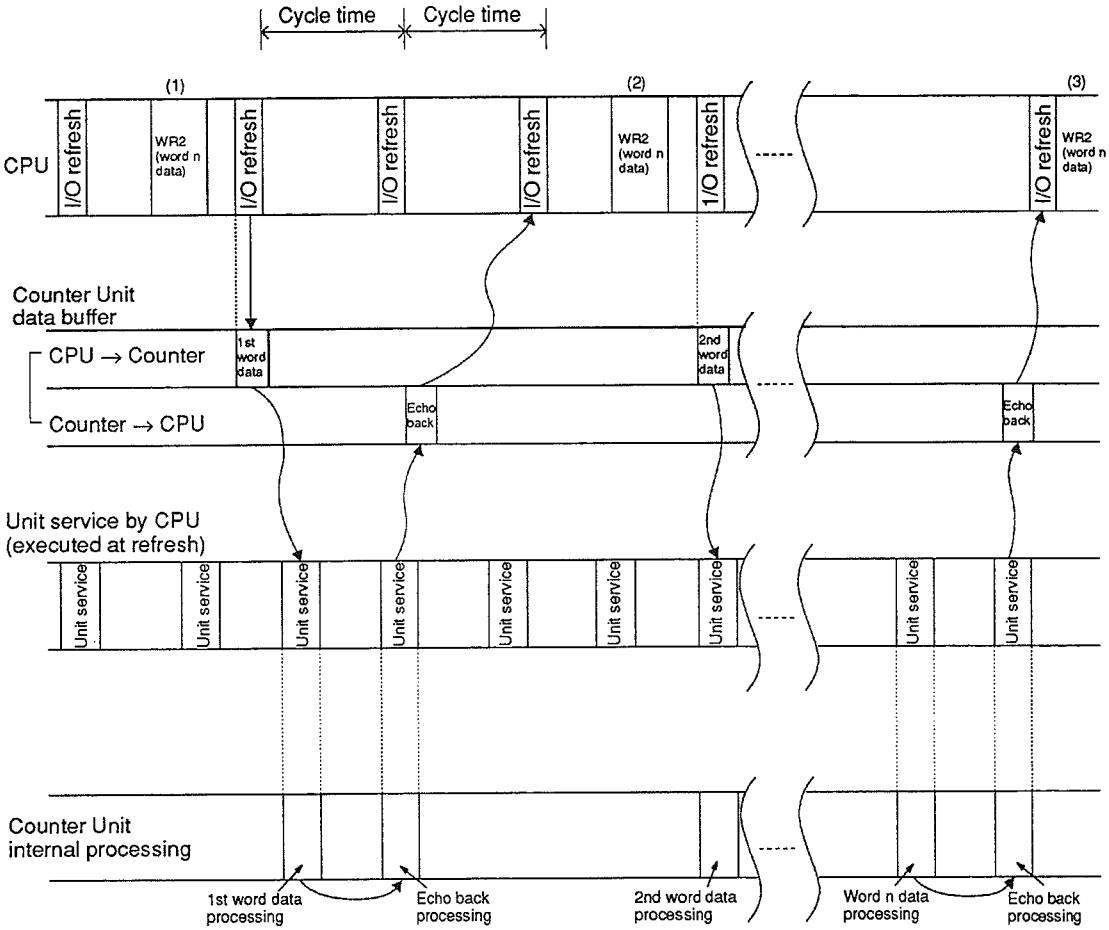
The following diagrams show how data is exchanged using the READ and WRIT instructions (in 2-word mode) and the RD2(280) and WR2(281) instructions (in 4-word mode).

READ/WRIT (2-word Mode)



READ/WRIT (4-word Mode)

The diagram below shows the timing for WR2(281) execution. When RD2(280) is executed, the data read during echo-back is transferred.



The operation is carried out as follows:

1, 2, 3...

1. WR2(281) transfers the data in the first word to the High-speed Counter Unit. (RD2(280) sends the read command to the High-speed Counter Unit.)
2. WR2(281) checks the echo-back from the data that was transferred in step no. 1 above, and transfers the data in the second word to the High-speed Counter Unit. ((RD2(280) receives the first word data and sends the read command for the second word data to the High-speed Counter Unit.)
3. WR2(281) checks the echo-back from the final data and completes the instruction execution. (RD2(280) reads the final data and completes the instruction execution.)

Note RD2(280) and WR2(281) can only be used with "-EV2" or later CVM1 CPUs.

SECTION 5
Data Configuration and Program Development

This section describes the data configuration of the High-speed Counter Unit and provides sample programs for transferring data between the PC and the High-speed Counter Unit.

5-1 I/O Allocation and Memory Configuration

I/O words are allocated to the High-speed Counter Unit automatically. Two or four words will be allocated, depending on the control mode setting:

2-word mode: 1 output word and 1 input word (2 words total)
4-word mode: 2 output words and 2 input words (4 words total)

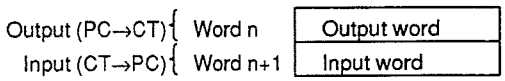
This section explains the relationship between the allocated words and the Unit's memory configuration.

5-1-1 2-word Mode

The READ and WRIT instructions can be used not only for reading from and writing to the input and output words, but also for reading and writing within the High-speed Counter Unit data areas.

Data Transfer to/from the IR Area

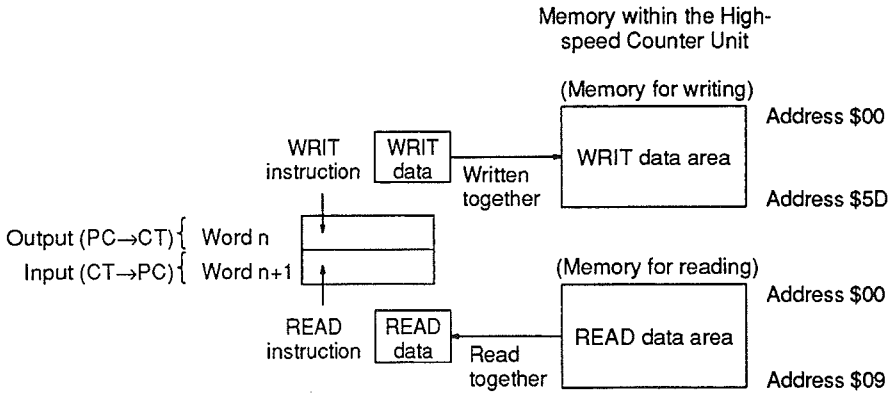
The contents of the input and output words depends on the High-speed Counter Unit's operating mode. For details, refer to the descriptions of the Unit's operating modes in *Sections 6* through *12*.



CT: High-Speed Counter Unit
n: First allocated word

Data Transfer using WRIT/READ Instructions

To write data to the High-speed Counter Unit's WRIT data area, specify the source word, destination word (word n), and number of words in the WRIT instruction. To read data from the High-speed Counter Unit's READ data area, specify the source word (word n+1), destination word, and number of words in the READ instruction. For details, refer to *5-3 Programming in 2-word Mode Using READ/WRIT.*

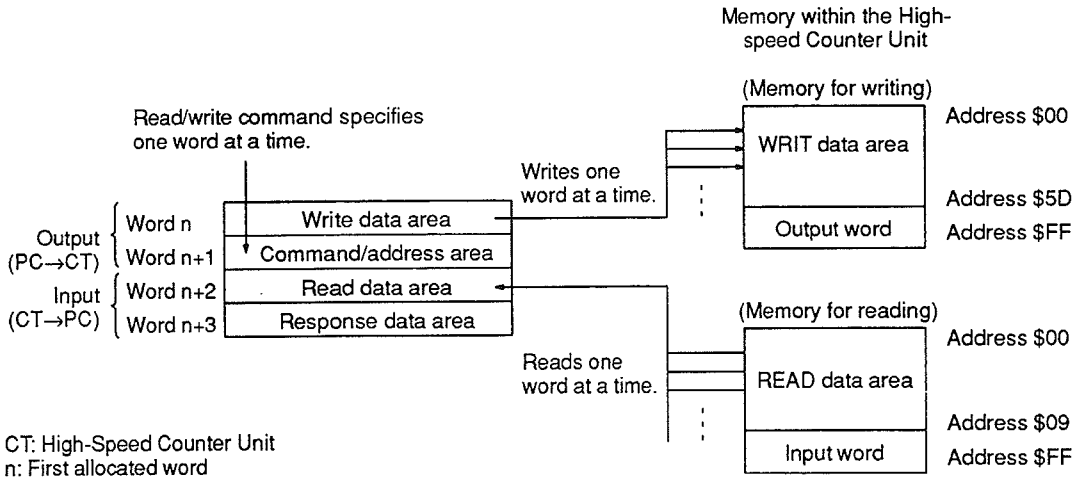


CT: High-Speed Counter Unit
n: First allocated word

Note Bit 01 of word n+1 (the Special I/O Read Completion Flag) is turned OFF after completion of the WRIT instruction. Check the status of this flag to confirm whether the WRIT instruction has been completed.

5-1-2 4-word Mode

In 4-word mode data cannot be transferred directly to or from the memory in the High-speed Counter Unit, so the command and address are specified in word n+1 and data is transferred one word at a time. (Write data is specified in word n and read data is stored in word n+2.) For details, refer to *5-4 Programming in 4-word Mode Using MOV.*



The output word and input word are located in address FF of the Unit's writing area and reading area, respectively. The output and input words can be used for data transfer just like the 2-word mode, by reading/writing data to address FF with read/write commands.

If the WR2/RD2 instructions are used, several read/write operations can be performed automatically in 4-word mode, too. For details, refer to *5-5 Programming in 4-word Mode Using WR2/RD2.*

5-2 Data Configuration

The High-speed Counter Unit controls the writing of data (WRIT data) according to a determined format. Also, the status of the High-speed Counter Unit can be learned from the data read from the Unit (READ data).

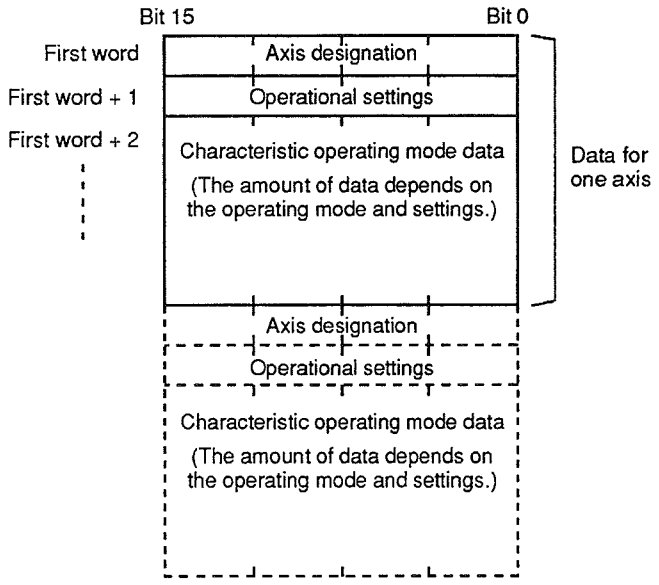
In 2-word mode, data is transferred all at once with the WRIT/READ instructions. In 4-word mode, data is transferred one word at a time with the MOV instruction while responses from the High-speed Counter Unit are checked. Normally the 2-word mode is used, but it cannot be used if the Unit is mounted on a SYSMAC BUS Slave Rack; in this case the 4-word mode is used.

If the PC uses a CVM1 CPU with "-EV2" in its model number, data can be transferred all at once even in 4-word mode by executing the WR2 and RD2 instructions.

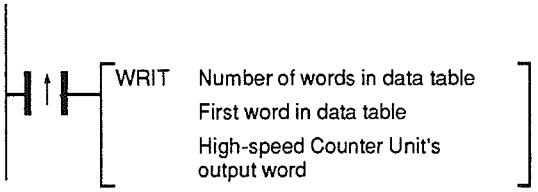
The WRIT and READ data have the same configuration in both 2-word and 4-word modes.

5-2-1 WRIT Data

The axis settings are made by creating the following data table in a CPU data area (such as DM) and writing the table to the High-speed Counter Unit's memory.



The following ladder diagram example shows the WRIT instruction used to write a data table.



Note When making settings for only one axis, write the data for only one axis.

Axis Designation

The axis designation indicates which axis (axes) the settings are for, as shown below:

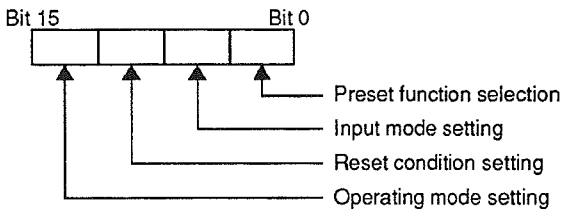
0000: Settings for axis-1 and axis-2
0001: Settings for axis-1 only
0002: Settings for axis-2 only

When "0001" or "0002" has been specified, the data will apply to that axis only.

When the first axis specifier is "0000," the data will apply to both axes. In this case, the second axis specifier (for axis-2) must be set to "0002." Be sure to set all of the data for axis-1.

Operational Settings

There are 4 digits in the operational settings, as shown below. Once the operational settings have been made for an axis, they can't be changed until the power is turned OFF.



Operating Mode Setting

The operating mode and BCD/Binary mode are set as shown in the following table.

Setting	Operating mode	BCD/Binary mode
0	Cannot be specified. (Initial status at startup)	BCD mode
1	Simple linear mode	
2	Linear mode	
3	Circular mode	
4	Preset mode	
5	Gate mode	
6	Latch mode	
7	Sampling mode	
8	Can't be specified.	Binary mode
9	Simple linear mode	
A	Linear mode	
B	Circular mode	
C	Preset mode	
D	Gate mode	
E	Latch mode	
F	Sampling mode	

Reset Condition Setting

The reset condition settings are shown below. The abbreviations Z, E, and I stand for pulse input Z, external control input, and Internal Reset Flag respectively. See *4-4 Counter Reset Conditions* for details on reset conditions.

0: Z (↑), E, I
1: Z (↓), E, I
2: Z (↑), I
3: Z (↓), I
4: E (↑), I
5: Z (↑)
6: Z (↓)
7: I (↑)

Input Mode Setting

The input mode settings are shown below. See *4-3 Input Modes* for details.

0: Offset Phase Inputs (×4 multiplier)
1: Offset Phase Inputs (×1 multiplier)
2: Up and Down Pulse Inputs
3: Pulse and Direction Inputs

See *4-4 Counter Reset Conditions* for details regarding the meaning of the settings.

Preset Function Selection

When the operating mode is set to simple linear mode, linear mode, or circular mode, the preset operation will be executed on the rising edge of the Preset Flag or external control input. A "0" specifies the Preset Flag and a "4" specifies the external control input.

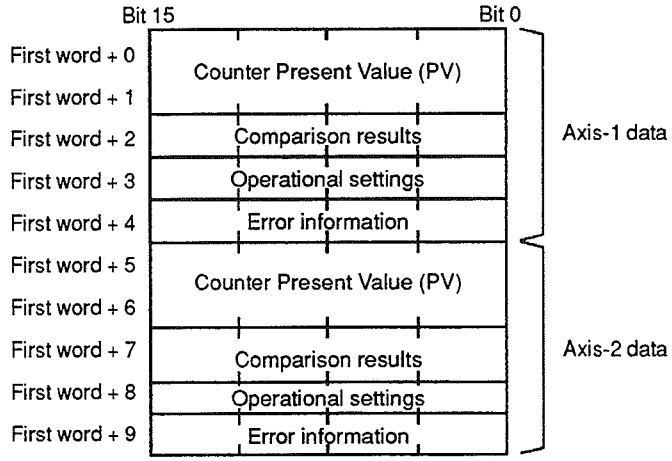
0: The counter PV is changed to the preset value when the Preset Flag in the output word goes from OFF to ON.

4: The counter PV is changed to the preset value when the external control input goes from OFF to ON.

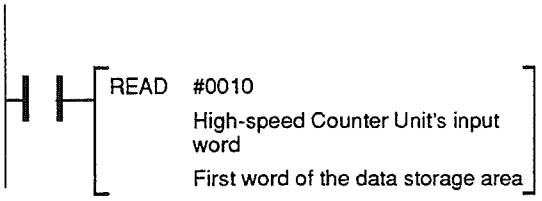
When "4" has been specified, the external control input cannot be used as a reset.

5-2-2 READ Data

The following data can be read from the High-speed Counter Unit.



The following ladder diagram example shows the READ instruction used to read all of the data for 2 axes.



Counter Present Value

The counter PV is stored in the first two words, as shown below:

	Bit 15			Bit 0
Word n	4th digit	3rd digit	2nd digit	1st digit
Word n+1	8th digit	7th digit	6th digit	5th digit

The numerical value of words n and n+1 is different for BCD and binary modes:

BCD Mode

Digits 1 through 7 contain the PV in BCD and digit 8 indicates the sign. (F is negative and 0 is positive.)

The PV range is F8388608 to 08388607 (–8,388,608 to 8,388,607).

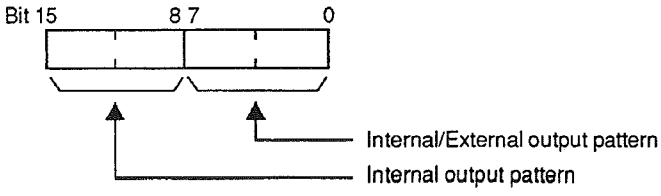
Binary Mode

Digits 1 through 8 contain the PV in hexadecimal, and negative values are indicated by the two's complement.

The PV range is 80000000 to 7FFFFFFF (–2,147,483,648 to 2,147,483,647).

Comparison Results

The results of the comparison between the counter present value and the comparison set value for each axis (the output pattern) is stored in the third word, as shown below:



Bits 0 through 15 of the comparison results correspond to internal output patterns 0 through 15. When the External Output Enable Flag in the output word is ON, bits 0 through 7 correspond to external output patterns 0 through 7, too. The outputs on the status of the output pattern bits as follows:

0: Output OFF
1: Output ON

The status of each external output (OUT0 to OUT7) is determined by logical OR between the output of each axis and each comparison set value.

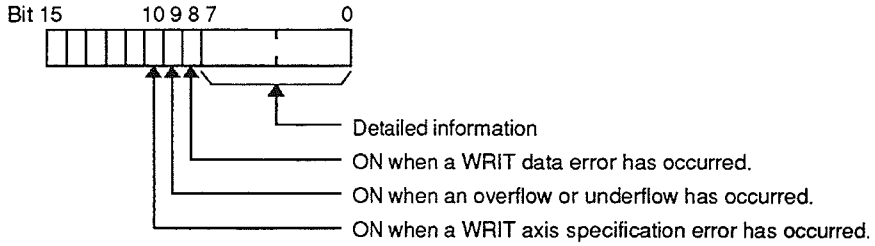
Operational Settings

The "operational settings" set in the WRIT data are stored in the fourth word.

The Unit will operate in linear mode with the default startup settings, but the operational settings will be 0000.

Error Information

The following error information is provided for each axis:



Refer to *Section 13 Error Processing and Troubleshooting* for more details.

5-3 Programming in 2-word Mode Using READ/WRIT

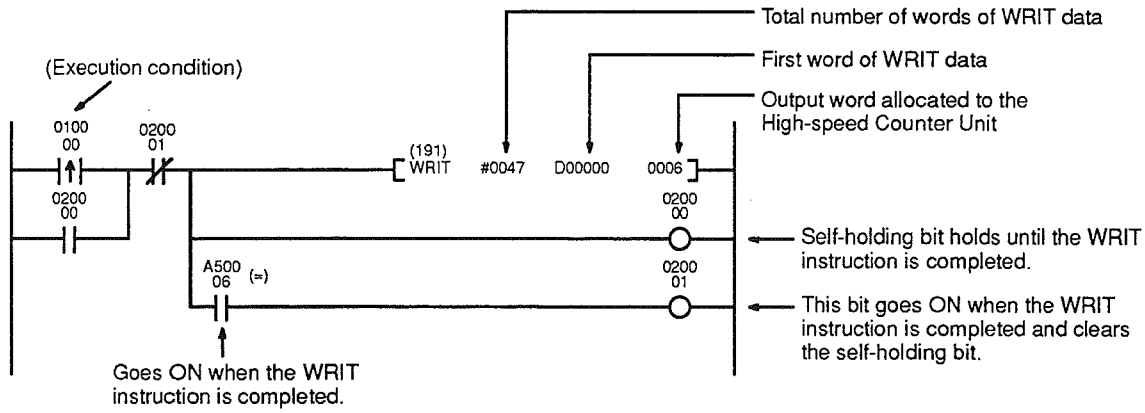
This section explains how to make programs to control the High-speed Counter Unit in 2-word mode. The sample programs are for CVM1/CV-series PCs.

5-3-1 Writing Operating Settings

The following procedure is used to write the WRIT data to the High-speed Counter Unit. In this case, CIO 0006 has been allocated to the Unit as the output word and CIO 0007 has been allocated as the input word.

1, 2, 3...

1. Prepare the WRIT data. For details, refer to the descriptions of the Unit's operating modes in Sections 6 through 12.
2. Use the WRIT instruction to write the WRIT data to the High-speed Counter Unit. A self-holding bit is used to ensure that the WRIT instruction is executed completely.



⚠WARNING The WRIT instruction won't be executed when the High-speed Counter Unit is busy. Be sure to incorporate a self-holding circuit, check the status of A50006 (the Equals Flag), and repeat execution until execution is completed.

The WRIT instruction will influence the High-speed Counter Unit's I/O response time, so be sure to use the differentiated version.

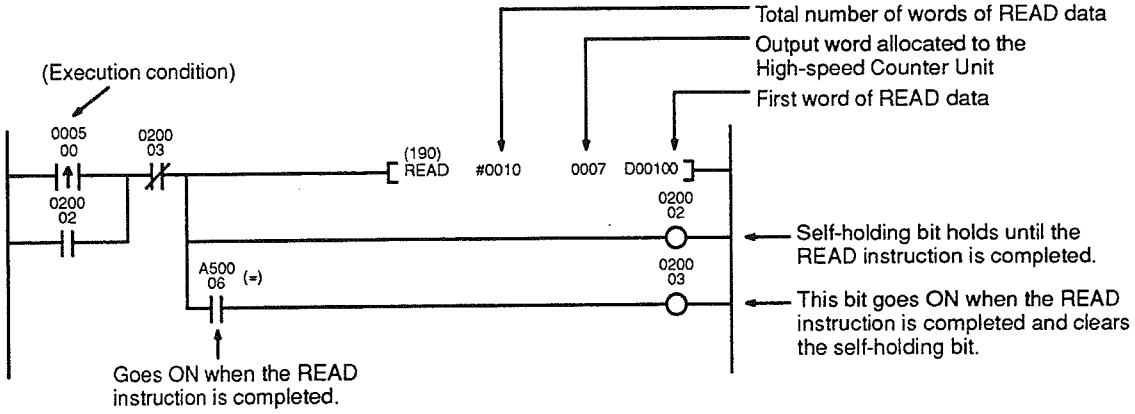
Check the status of bit 01 of the input word (the Special I/O Read Completed Flag) to verify that the WRIT instruction has been completed. This flag is turned OFF the cycle after the WRIT instruction is completed.

5-3-2 Reading Unit Status

The following procedure is used to read the READ data from the High-speed Counter Unit. In this case, CIO 0006 has been allocated to the Unit as the output word and CIO 0007 has been allocated as the input word.

1, 2, 3...

1. Select a region of memory where the READ data will be stored.
2. Use the READ instruction to read the READ data from the High-speed Counter Unit and store it in the selected region. A self-holding bit is used to ensure that the READ instruction is executed completely.



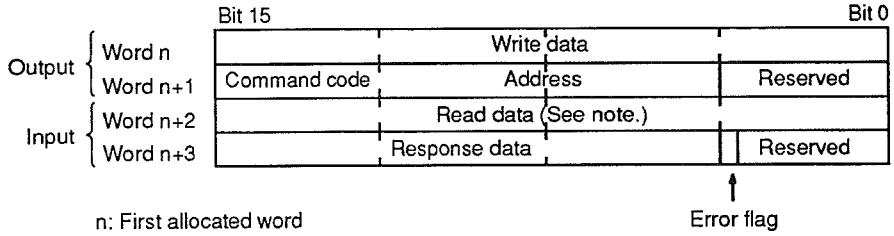
⚠WARNING The READ instruction won't be executed when the High-speed Counter Unit is busy. Be sure to incorporate a self-holding circuit, check the status of A50006 (the Equals Flag), and repeat execution until execution is completed.

5-4 Programming in 4-word Mode Using MOV

This section explains how to make programs to control the High-speed Counter Unit in 4-word mode when the WR2 and RD2 instructions can't be used. Refer to *5-5 Programming in 4-word Mode (Using WR2/RD2)* if a version -EV2 or later CVM1/CV-series PC is being used.

5-4-1 4-word Mode Word Allocation

In 4-word mode, 2 words are allocated as output words and 2 words are allocated as input words. The function of these words is shown below.



Note The address specifies the WRIT/READ instruction's data address in hexadecimal. Allocate address FF for a function equivalent to the 2-word mode's input/output words. The function is used by reading/writing address FF with random

READ/WRITE commands. Refer to *5-1 I/O Allocation and Memory Configuration* for details on the memory configuration.

5-4-2 4-word Mode Commands

The following 4 commands can be used to make settings and control operation of the Unit in 4-word mode. Write the command code (1 hexadecimal digit) in word n+1 and write "0" in the reserved digit.

Except for the "end" command, the command code and address are returned unchanged as response data. The response data can be checked to verify that the command was read by the High-speed Counter Unit.

The command code and address will be returned unchanged even when there is an error in the command or an invalid command has been issued. If there is an error in the command, it can be checked when the "end" command is executed. Specify the command's data in the following order: first the write data and then the command code and address.

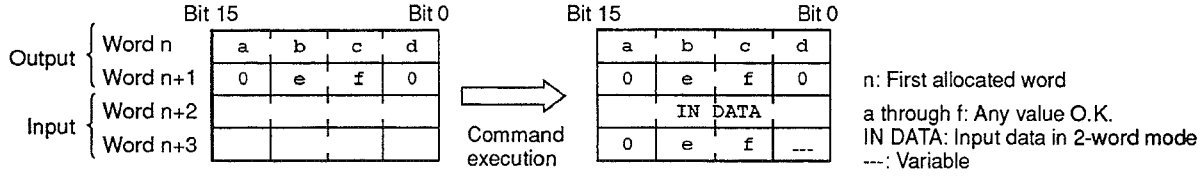
Command	Function	Usage
Initialize (0)	Turns the external outputs OFF. Reads the input word contents.	Use this command when you want to turn off all external outputs. (This is the same status that occurs at startup or when operation is stopped.)
Random write (1)	Transfers 1 word of settings data to the Unit.	Use this command to set data in the Unit. Use this command to output to the output word in 2-word mode.
Random read (2)	Transfers 1 word from the Unit.	Use this command to read data from the Unit. Use this command to read the input word in 2-word mode.
Monitoring (3)	Reads the specified word every cycle.	Use this command to read the selected data area contents continuously.
End (F)	Notifies of the end of a random write and reflects the data to be set in the the Unit. Notifies of the end of a random read and performs a command error check.	Use this command to end a random write or random read.

Initialize (Command Code: 0)

Turns OFF all external outputs and reflects the contents of the 2-word mode input word in the read data. (The contents depend on the operating mode being used. For details, refer to the descriptions of the Unit's operating modes in *Sections 6* through *12*.)

This status will occur when power is turned on, the PC is switched to PROGRAM mode, a PC stop error occurs, or the Output OFF bit is on.

Only the command code needs to be specified. Any values can be entered for the write data and address.

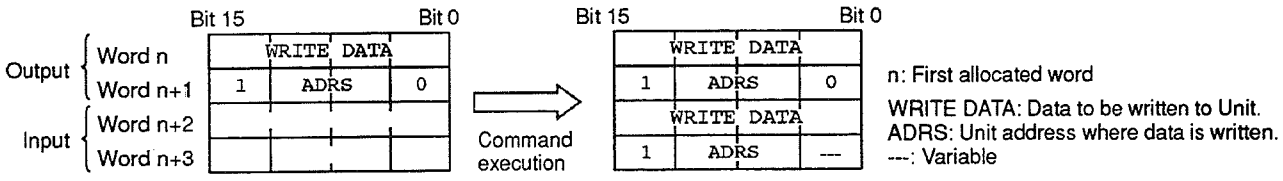


Random Write (Command Code: 1)

Writes the 4-digit hexadecimal "write data" to the specified address in the High-speed Counter Unit. The specified address is 2-digit hexadecimal: 00 to 5D, or

FF. Data written to the Unit is valid after execution of the end command (command code: F).

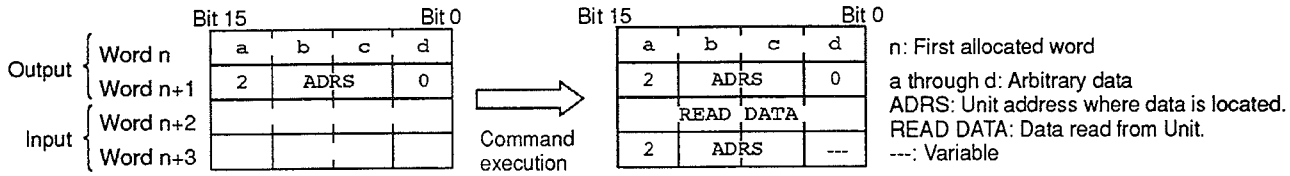
The command is executed just once whenever the command and address in word n+1 are changed. When the command is completed, the contents of word n are returned to word n+2 unchanged as a response.



Random Read (Command Code: 2)

Reads the 4-digit hexadecimal "read data" from the specified address in the High-speed Counter Unit.

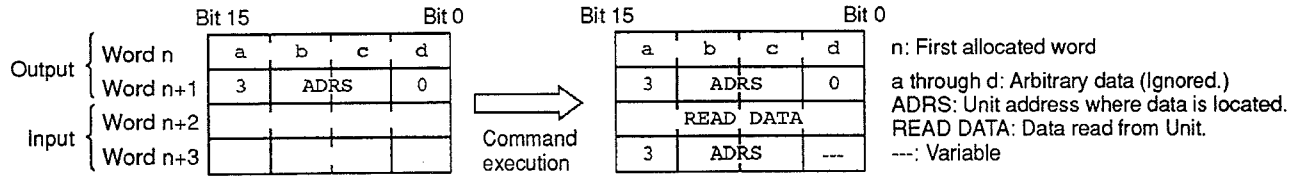
The command is executed just once whenever the command and address in word n+1 are changed.



Monitoring (Command Code: 3)

Reads the 4-digit hexadecimal "read data" from the specified address in the High-speed Counter Unit. The specified address is 2-digit hexadecimal: 00 to 5D, or FF. This command is executed continuously.

The monitoring command can be used to monitor the input and output words when the Unit is in 2-word mode.



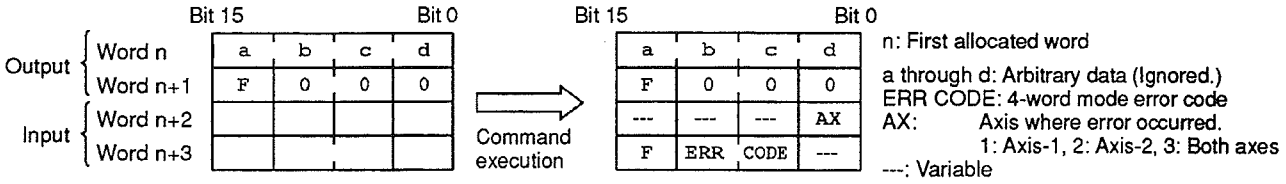
End (Command Code: F)

Notifies that the data transfer to or from the High-speed Counter Unit by a random write or random read command has been completed. A random write command will become invalid if there isn't an end command in the write command's display. The "write data" written with a random write command will be reflected in High-speed Counter Unit operation when the data is returned as a response.

If an error has occurred in the High-speed Counter Unit, an 2-digit hexadecimal error code will be stored in bits 4 through 11 of word n+3. The error codes are listed in the following table.

Error code	Meaning
00	Normal completion
01	Command code error
02	Address overflow error
03	WRIT data error
04	Other error

Note Enter 00 for the address in the command.

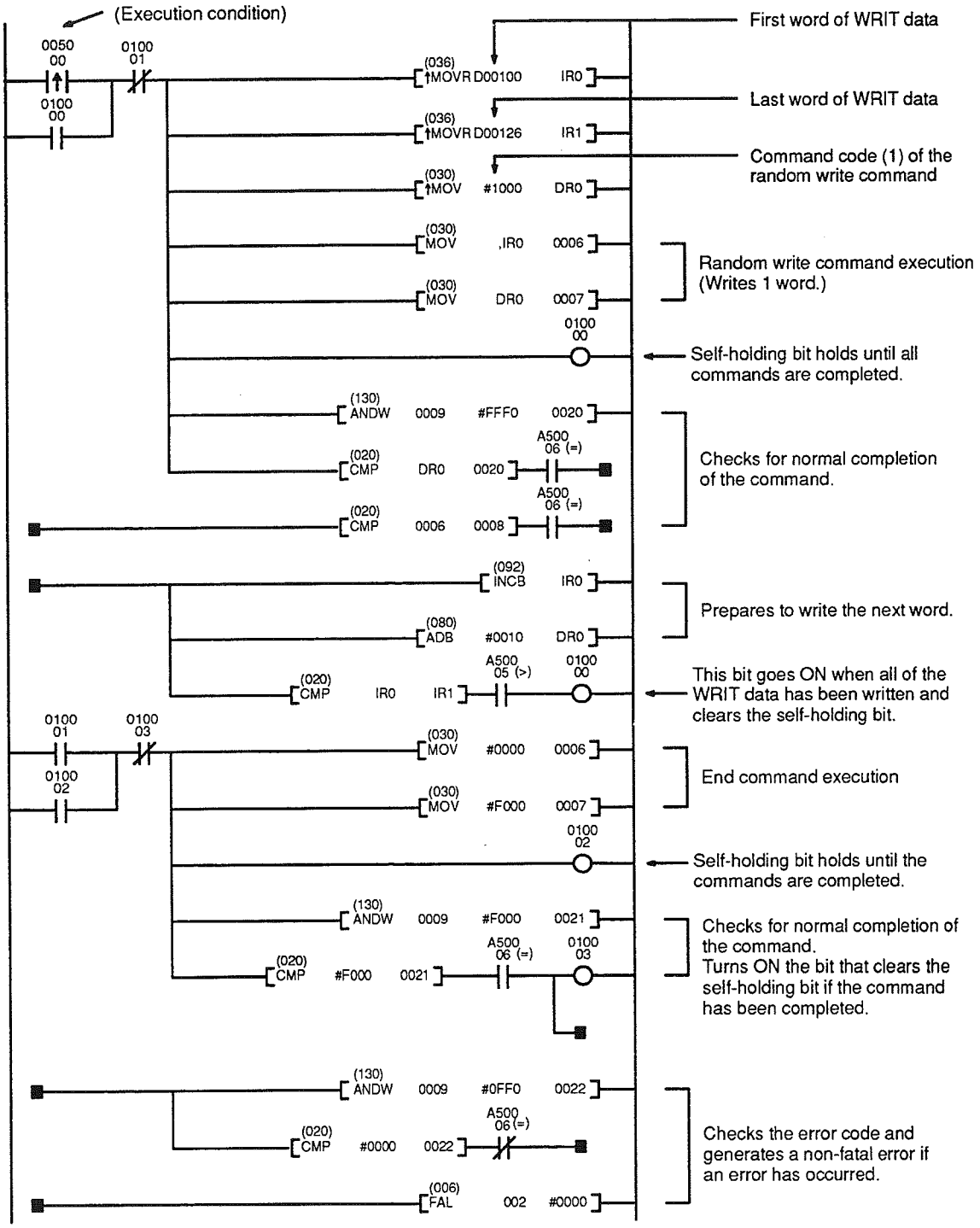


5-4-3 Writing Operating Settings

The following procedure is used to write the WRIT data to the High-speed Counter Unit. In this case, CIO 0006 and CIO 0007 have been allocated to the Unit as output words and CIO 0008 and CIO 0009 have been allocated as input words.

1, 2, 3... 1. Prepare the WRIT data. For details, refer to the descriptions of the Unit's operating modes in *Sections 6* through *12*.

2. Use MOV instructions to write the WRIT data to the High-speed Counter Unit.

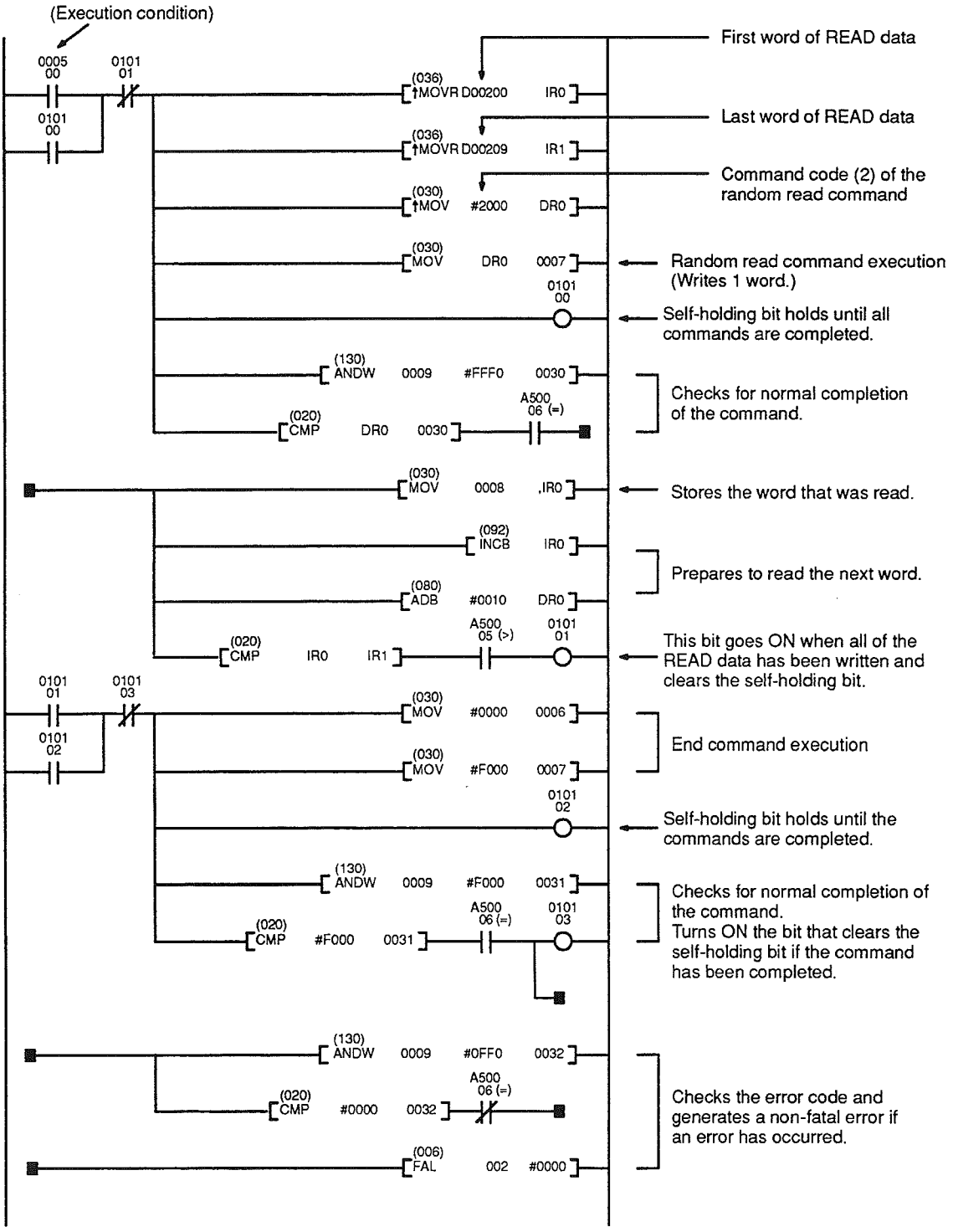


Note Index Registers or Data Registers are used in this example, but the same processing can be achieved using Indirect DM for C-series PCs.

5-4-4 Reading Unit Status

The following procedure is used to read the READ data from the High-speed Counter Unit. In this case, CIO 0006 and CIO 0007 have been allocated to the Unit as output words and CIO 0008 and CIO 0009 have been allocated as input words.

1, 2, 3... 1. Select a region of memory where the READ data will be stored.
2. Use the MOV instruction to read the READ data from the High-speed Counter Unit and store it in the selected region.



5-5 Programming in 4-word Mode Using WR2/RD2

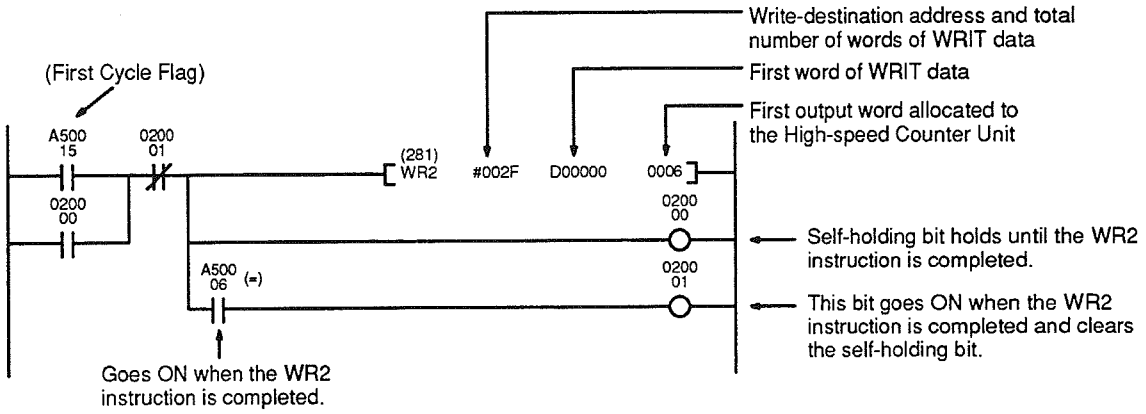
This section describes sample programs for a version -EV2 or later CVM1/CV-series PC. The WR2 and RD2 instructions can be used to make programs that control the High-speed Counter Unit in 4-word mode just like 2-word mode.

5-5-1 Writing Operating Settings

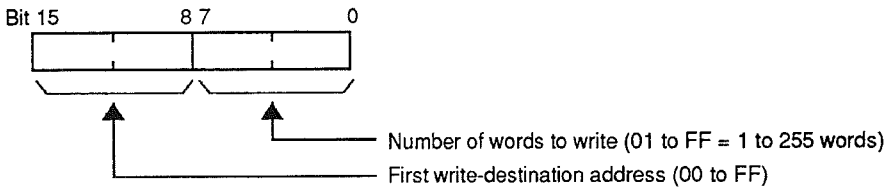
The following procedure is used to write the WRIT data to the High-speed Counter Unit. In this case, CIO 0006 and CIO 0007 have been allocated to the Unit as output words and CIO 0008 and CIO 0009 have been allocated as input words.

1, 2, 3...

1. Prepare the WRIT data. For details, refer to the descriptions of the Unit's operating modes in *Sections 6* through *12*.
2. Use the WR2 instruction to write the WRIT data to the High-speed Counter Unit. A self-holding bit is used to ensure that the WR2 instruction is executed completely.



The first operand of the WR2 instruction is different from the WRIT instruction. With WR2, the first operand specifies the write-destination address and total number of words to be written, as shown below.



Note The WR2 instructions are executed over several PC cycles. Set up a self-holding circuit during execution and repeat execution until completion of execution is verified by the status of A50006 (the Equals Flag).

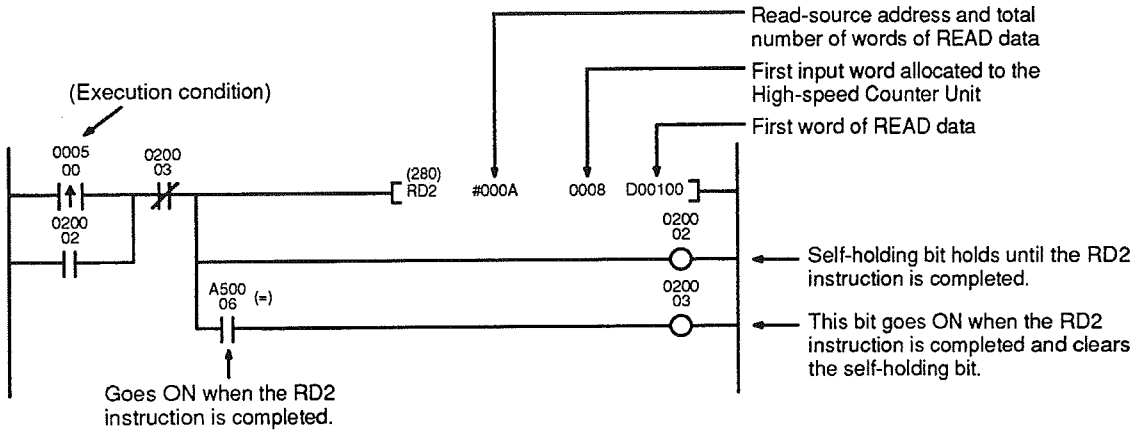
5-5-2 Reading Unit Status

The following procedure is used to read the READ data from the High-speed Counter Unit. In this case, CIO 0006 and CIO 0007 have been allocated to the Unit as output words and CIO 0008 and CIO 0009 have been allocated as input words.

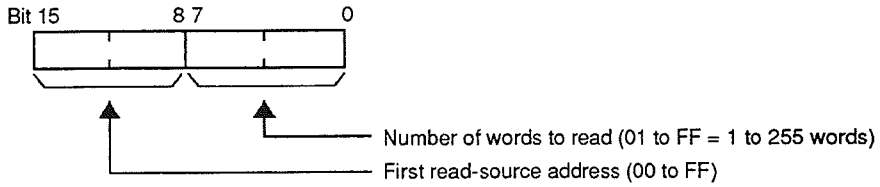
1, 2, 3...

1. Select a region of memory where the READ data will be stored.

2. Use the RD2 instruction to read the READ data from the High-speed Counter Unit and store it in the selected region. A self-holding bit is used to ensure that the RD2 instruction is executed completely.



The first operand of the RD2 instruction is different from the READ instruction. With RD2, the first operand specifies the read-source address and total number of words to be read, as shown below.



Note The RD2 instructions are executed over several PC cycles. Be sure to set up a self-holding circuit and repeat execution until completion of execution is verified by the status of A50006 (the Equals Flag).

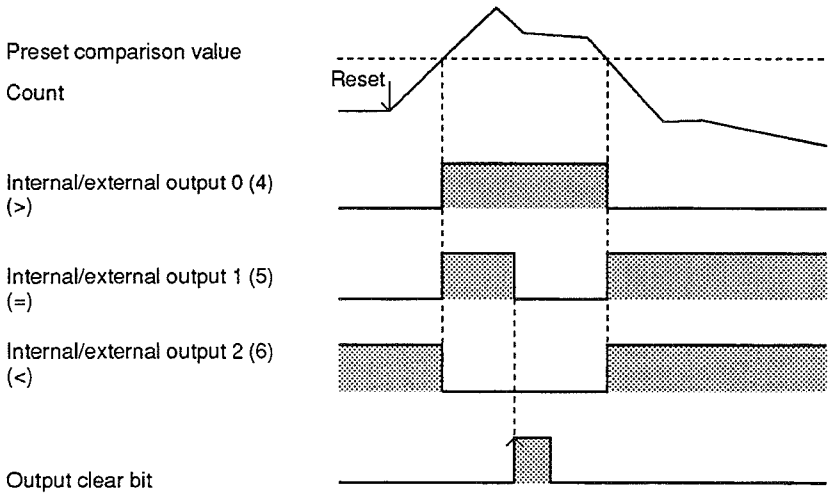
SECTION 6
Simple Linear Mode

This section provides the information necessary for using the simple linear mode, including information on outputs, operating conditions, and performance specifications.

6-1 Operation

In simple linear mode, the count from the encoder is compared with a preset value and outputs corresponding to the results (>, = <) are turned ON. Output numbers 0 to 2 and 4 to 6 correspond to external and internal outputs of the same numbers, and they are simultaneously reflected in the data areas and READ data bits. (External outputs are only output while the External Output Enable Bit is ON.)

In the following diagram, the output numbers in the parentheses are for two axes.



Outputs

In simple linear mode, the respective outputs are turned ON and OFF as follows, according to the results of the comparison between the encoder count and the comparison value. (The output numbers in the parentheses are for axis two.)

Internal/external output 0 (4): On when present count > comparison value

Internal/external output 1 (5): On when present count = comparison value

Internal/external output 2 (6): On when present count < comparison value

Note

1. Internal/external output 1 (5), which is used when the present count equals the comparison set value, is turned OFF at the rising edge of the Output Clear Bit. Once that output has been turned ON, that status is retained either until the rising edge of the Output Clear Bit or until the set or preset operation is executed. When the output is turned OFF by the Output Clear Bit, it will turn ON again the next time the result of the comparison is "equal." Be careful about cases where the count does not change after the output is originally turned ON.
2. Wire internal/external outputs 0 (4) and 2 (6) so that the ON/OFF interval is at least 1.5 ms. Suppose, for example, that the present count exceeds the comparison set value. If the comparison set value is lowered within 1.5 ms, those outputs may not be changed.

Operating Conditions

Counter initial value: 0

Count range: –8,388,608 to +8,388,607 (BCD)
80000000 to 7FFFFFFF (binary)
(–2,417,483,648 to +2,417,483,647 in decimal)

The count stops when it reaches the maximum or minimum value. Also, the present count can be changed to the preset value. The count can be either incremented or decremented.

In simple linear mode, the count always continues except when it is stopped as a result of an error. (There is no count start signal.)

The value set for comparison purposes can be changed even during counting. Reset and preset functions are also possible during counting. When "reset" is executed, the count is reset to zero; when "preset" is executed, the count is changed to the preset value. When either "reset" or "preset" is executed, internal/external output 1 (5) is cleared.

For details regarding reset conditions, refer to *4-4 Counter Reset Conditions.*

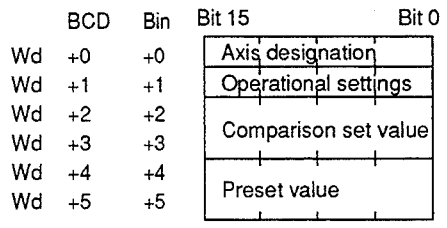
6-2 Performance Specifications

Item		Specifications	
Coefficient input signals:		Encoder input A:	Encoder input B:
Offset phase inputs		A phase	B phase
Up and down pulse inputs		Increment pulse	Decrement pulse
Pulse and direction inputs		Pulse	Direction
External input signals		Pulse input Z (reset signal), external control input (reset signal)	
External output signals		External outputs 0 to 2, 4 to 6	
Coefficient range		BCD mode: –8,388,608 to +8,388,607 Binary mode: –2,417,483,648 to +2,417,483,647	
Multiplier function		×1, ×4 (offset phase inputs only)	
Setting data	Data content	Comparison set value, preset value	
	Number of settings	One combination per axis	
Response speed (counter input → external output)		= output: 1.0 ms max. < or > output: 1.5 ms max.	
Reset interval		1.5 ms min.	
Preset interval		1.5 ms min.	

6-3 Data Areas and Settings

6-3-1 Operating Mode Data Settings

The following data is set for each axis in simple linear mode.



Axis Designation

Designate either or both axes by means of the following settings:

0000: Both axis-1 and axis-2.

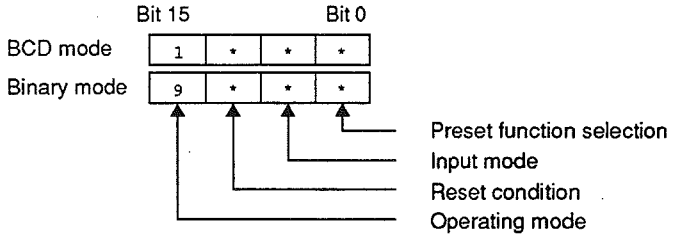
0001: Axis-1 only.

0002: Axis-2 only.

When either 0001 or 0002 is specified, the axis data will apply to that axis only. When 0000 is specified, the axis data for axis-1 and axis-2 is specified in that order. In that case, "0002" must be set at the beginning of the data for axis-2, and the data must be completely set for axis-1.

Operational Settings

Set the operational data for each digit as shown below. Once the settings have been made for an axis, they cannot be changed until the power is turned off.



Preset Function Selection

0: Count present value is changed to preset value at the rising edge of the Preset Flag in the data area.

4: Count present value is changed to preset value at the rising edge of the external control input signal.

Input Mode

0: Offset phase inputs (x4 multiplier)

1: Offset phase inputs (x1 multiplier)

2: Up and down pulse inputs

3: Pulse and direction inputs

Reset Condition

0: Z(↑), E, I

1: Z(↓), E, I

2: Z(↑), I

3: Z(↓), I

4: E(↑), I

5: Z(↑)

6: Z(↓)

7: I(↑)

When the preset function setting is "4," reset condition settings "0," "1," and "4" are not possible. The abbreviations Z, E, and I stand for pulse input Z, external control input, and internal reset flag respectively. For details regarding reset conditions, including refer to *4-4 Counter Reset Conditions*.

Comparison Value and Preset Value

	Bit 15			Bit 0
Wd n	Digit 4	Digit 3	Digit 2	Digit 1
Wd n+1	Digit 8	Digit 7	Digit 6	Digit 5

n: Rightmost word

Set the numbers for the eight digits as shown below, according to the mode.

BCD Mode

F8388608 to 8388607 (–8,388,608 to +8,388,607)

Set numbers for digits 1 through 7, and set the sign (0: positive; F: negative) for digit 8.

Binary Mode

80000000 to 7FFFFFFF (–2,417,483,648 to +2,417,483,647)

Set numbers (hexadecimal) for digits 1 through 8. Negative numbers are designated by 2's complement.

6-3-2 Data Areas

The following table shows the functions allocated to the High-speed Counter Unit data areas when in simple linear mode. The explanation here is in terms of the 2-word mode. For information concerning the 4-word mode, refer to *5-1 I/O Allocation and Memory Configuration.*

Word	Bit	Function	
Beginning word (output)	00 01 02	Reserved for system use. Write-protected.	
	03	Internal Reset Flag	Axis-1
	04	Preset Flag	
	05	Output Clear Bit	
	06 07 08	Not used.	
	09	Internal Reset Flag	Axis-2
	10	Preset Flag	
	11	Output Clear Bit	
	12 13 14	Not used.	
	15	External Output Enable Bit	Axis-1 and axis-2
Beginning word + 1 (input)	00	Reserved for system use.	
	01	Special I/O Read Completion Flag	
	02	Reserved for system use.	
	03 04	Not used.	
	05	Control input	Axis-1
	06	Control input	Axis-2
	07	Error Flag	Axis-1 and axis-2
	08	Internal/external output 0 (present value > set value)	Axis-1
	09	Internal/external output 1 (present value = set value)	
	10	Internal/external output 2 (present value < set value)	
	11	Not used.	
	12	Internal/external output 4 (present value > set value)	Axis-2
	13	Internal/external output 5 (present value = set value)	
	14	Internal/external output 6 (present value < set value)	
	15	Not used.	

Internal Reset Flag

This bit is used as an Internal Reset Flag, but whether or not it is actually used for resetting is determined by the reset condition setting. (Refer to *4-4 Counter Reset Conditions.*) When the reset operation is executed by means of the Internal Reset Flag alone, it is executed at the rising edge.

Preset Flag

This bit changes the present count to the preset value set by the WRIT data. The operation is carried out according to the preset function selection explained in *6-3-1 Operating Mode Data Settings.*

If the preset function selection is set so that the present value (PV) is changed by means of the Preset Flag, then the PV will be changed to the preset value at the rising edge of the Preset Flag (i.e. when the Preset Flag is turned ON). If the Preset Flag and the Internal Reset Flag turn ON simultaneously (in cases where the Internal Reset Flag is used for resetting), the reset operation will not be executed.

If the preset function selection is set so that the PV is changed by means of the external control input signal, then the PV will be changed to the preset value at the rising edge of the external control input signal.

Output Clear Bit

This bit turns OFF internal/external output 1 (5), the output which indicates that the present count equals the comparison set value.

External Output Enable Bit

This bit determines whether or not external outputs will actually be enabled. The status of this bit controls both axes together, and it is not possible to make the setting for just one axis or the other. When this bit is ON, outputs are enabled; when OFF, outputs are disabled.

Special I/O Read Completion Flag

This bit remains ON while the High-speed Counter Unit is processing WRIT instruction settings. The results will not be reflected in the data area until this bit turns OFF. After the WRIT instruction has been executed, this bit will not turn ON again until the next execution cycle.

Control Input Signals

These signals reflect the status of external control inputs.

Error Flag

This bit turns ON when an error occurs at either axis. For details, refer to *Section 13 Error Processing and Troubleshooting.*

Internal and External Outputs

Bits 8 to 10 and 12 to 14 reflect the status of internal/external outputs 0 to 2 and 4 to 6 respectively, even when actual external outputs are disabled by the External Output Enable Bit.

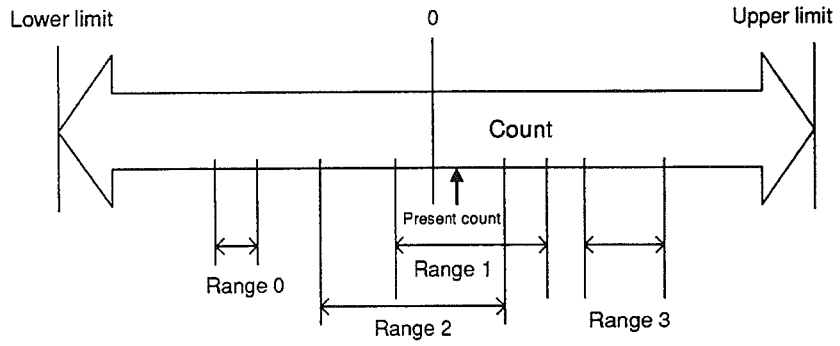
SECTION 7
Linear Mode

This section provides the information necessary for using the linear mode, including information on operating conditions, data areas, settings, and performance specifications. An application example is provided at the end of the section.

7-1 Operation

The linear mode is used when changing the count between the minimum and maximum values. The count is compared with eight ranges (i.e., comparison set values) with specified upper and lower limits, and specified outputs corresponding to the ranges are turned ON when it is within those ranges.

Output numbers 0 to 7 correspond to external and internal outputs of the same numbers, and they are simultaneously reflected in the memory areas and READ data bits. (External outputs are only output while enabled.) Output numbers 8 to 15 are reflected in input bits 8 to 15 and READ data bits (but not in external outputs and the memory areas.



Example

The following table provides an example of setting upper and lower limits for comparison ranges.

Axis	Range	Lower limit	Upper Limit	Outputs
Axis-1	Range 0	–7,000	–5,000	1, 3
	Range 1	–1,000	+4,500	6, 7
	Range 2	–4,000	+3,000	0, 5, 6
	Range 3	+6,000	+9,000	1, 2, 5, 7
Axis-2	Range 0	0	+2,000	0, 1
	Range 1	+10,000	+12,000	4
	Range 2	–10,000	–6,000	7, 10, 15

Suppose the comparison ranges are set as shown in this table, and the present count for both axes is +2,000. The count would thus be within ranges 1 and 2 for axis-1 and within range 0 for axis-2. Therefore outputs 0, 1, 5, 6, and 7 would be turned ON (i.e., the OR condition for outputs 6 and 7; 0, 5, and 6; and 0 and 1).

Operating Conditions

Counter initial value: 0
SV range: –8,388,608 to +8,388,607 (BCD)
80000000 to 7FFFFFFF (binary)
(–2,417,483,648 to +2,417,483,647 in decimal)

The count stops when it reaches the maximum or minimum value. Also, the present count can be changed to the set value. The count can be either incremented or decremented.

If the present count is within multiple comparison ranges, the OR condition for the respective outputs will be output.

Besides the eight internal/external outputs, eight internal outputs can also be specified to turn ON.

Up to a total of eight comparison ranges can be set for each axis, and they can be enabled or disabled according to requirements during counting. The comparison ranges can also be changed even while counting is in progress.

For details regarding reset conditions, refer to *4-4 Counter Reset Conditions*.

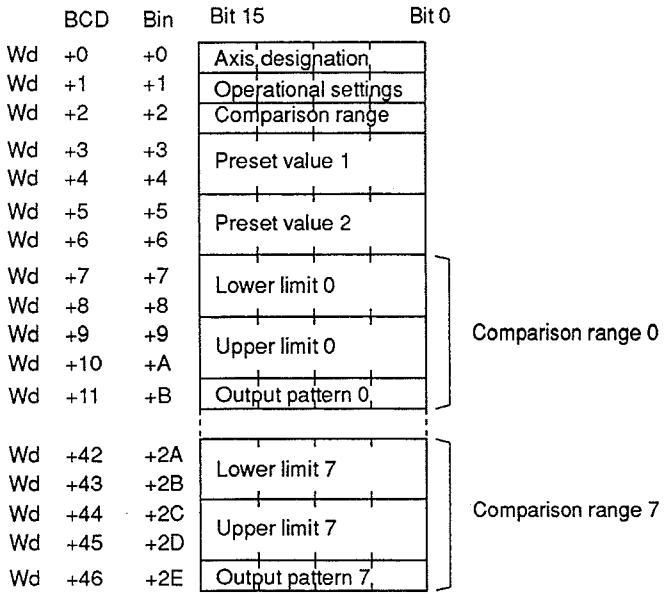
7-2 Performance Specifications

Item		Specifications	
Coefficient input signals: Offset phase inputs Up and down pulse inputs Pulse and direction inputs		Encoder input A: A phase Increment pulse Pulse	Encoder input B: B phase Decrement pulse Direction
External input signals		Pulse input Z, counter reset signal, external control input	
External output signals		External outputs 0 to 7	
Coefficient range		BCD mode: –8,388,608 to +8,388,607 Binary mode: –2,417,483,648 to +2,417,483,647	
Multiplier function		×1, ×4 (offset phase inputs only)	
Setting data	Data contents	Lower limit, upper limit, eight internal/external outputs, eight internal inputs	
	Number of settings	Eight combinations per axis	
Response speed (counter input → external output)		1.5 ms max.	
Reset interval		1.5 ms min.	
Preset interval		1.5 ms min.	

7-3 Data Settings and Memory Areas

7-3-1 Operating Mode Data Settings

The following data is set for each axis in linear mode.



Axis Designation

Designate either or both axes by means of the following settings:

0000: Both axis-1 and axis-2.

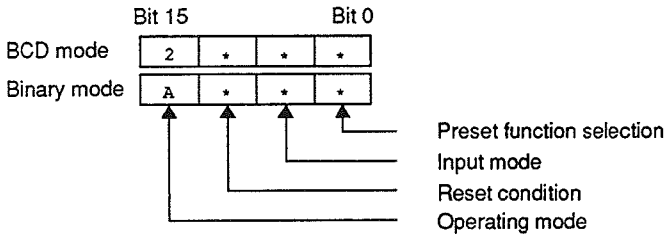
0001: Axis-1 only.

0002: Axis-2 only.

When either 0001 or 0002 is specified, the axis data will apply to that axis only. When 0000 is specified, the axis data for axis-1 and axis-2 is specified in that order. In that case, "0002" must be set at the beginning of the data for axis-2, and the data must be completely set for axis-1.

Operational Settings

Set the operational data for each digit as shown below. Once the settings have been made for an axis, they cannot be changed until the power is turned off.



Preset Function Selection

0: Count present value is changed to preset value at the rising edge of the Preset Flag in the memory area.

4: Count present value is changed to preset value at the rising edge of the external control input signal.

Input Mode

0: Offset phase inputs (×4 multiplier)

1: Offset phase inputs (×1 multiplier)

2: Up and down pulse inputs

3: Pulse and direction inputs

The initial setting from the time power is turned on until the operation data settings are made will be "2: Up and down pulse inputs."

Reset Condition

0: Z(↑), E, I

1: Z(↓), E, I

2: Z(↑), I

3: Z(↓), I

4: E(↑), I

5: Z(↑)

6: Z(↓)

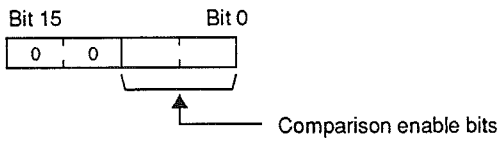
7: I(↑)

The initial setting from the time power is turned on until the operation data settings are made will be either "E(↑)" or "I(↑)."

When the preset function setting is "4," reset condition settings "0," "1," and "4" are not possible. The abbreviations Z, E, and I stand for pulse input Z, external control input, and Internal Reset Flag respectively. For details regarding reset conditions, refer to *4-4 Counter Reset Conditions.*

Comparison Range Setting

Bits 0 to 7 correspond to the eight comparison ranges, and each of those ranges is enabled or disabled according to the setting of its respective bit. When the bit status for a given comparison range is 0 (OFF), that range will be disabled and will not be used for comparison with the count. When the status of that bit is 1 (ON), the range will be enabled and will be used for comparison with the count.



Preset Value, Lower Limit, and Upper Limit

	Bit 15			Bit 0
Wd n	Digit 4	Digit 3	Digit 2	Digit 1
Wd n+1	Digit 8	Digit 7	Digit 6	Digit 5

n: Rightmost word

Set the numbers for the eight digits as shown below, according to the mode.

BCD Mode

F8388608 to 8388607 (–8,388,608 to +8,388,607)

Set numbers for digits 1 through 7, and set the sign (0: positive; F: negative) for digit 8.

Binary Mode

80000000 to 7FFFFFFF (–2,417,483,648 to +2,417,483,647)

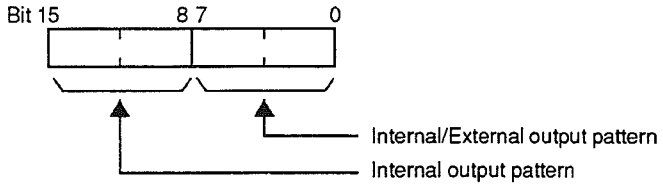
Set numbers (hexadecimal) for digits 1 through 8. Negative numbers are designated by 2's complement.

Note

1. The lower limit of any range must always be less than or equal to the upper limit of that range.
2. If the count is within a given range for no more than 1.5 ms, the outputs may not respond. For example, at 50 kcps the interval between the lower and upper limits should be at least 75 counts.

Output Pattern

The results of the comparison between the counter present value and the comparison set value for each axis (the output pattern) is stored in the third word, as shown below:



Bits 0 through 15 of the comparison results correspond to internal output patterns 0 through 15. When the External Output Enable Flag in the output word is ON, bits 0 through 7 correspond to external output patterns 0 through 7, too. The outputs on the status of the output pattern bits as follows:

0: Output OFF
1: Output ON

The status of each external output (OUT0 to OUT7) is determined by logical OR between the output of each axis and each comparison set value.

7-3-2 Data Areas

The following table shows the functions allocated to the High-speed Counter Unit data areas when in linear mode. The explanation here is in terms of the 2-word mode. For information concerning the 4-word mode, refer to *5-1 I/O Allocation and Memory Configuration*.

Word	Bit	Function	
Beginning word (output)	00 01 02	Reserved for system use. Write-protected.	
	03	Internal Reset Flag	Axis-1
	04	Preset Flag 1	
	05	Preset Flag 2	
	06 07 08	Not used.	
	09	Internal Reset Flag	Axis-2
	10	Preset Flag 1	
	11	Preset Flag 2	
	12 13 14		
	15	External Output Enable Bit	Axis-1 and axis-2
Beginning word + 1 (input)	00	Reserved for system use.	
	01	Special I/O Read Completion Flag	
	02	Reserved for system use.	
	03 04	Not used.	
	05	Control input	Axis-1
	06	Control input	Axis-2
	07	Error Flag	Axis-1 and axis-2
	08	Internal/external output 0	
	09	Internal/external output 1	
	10	Internal/external output 2	
	11	Internal/external output 3	
	12	Internal/external output 4	
	13	Internal/external output 5	
	14	Internal/external output 6	
	15	Internal/external output 7	

Internal Reset Flag

This bit is used as an Internal Reset Flag, but whether or not it is actually used for resetting is determined by the reset condition setting. (Refer to *4-4 Counter Reset Conditions*.) When the reset operation is executed by means of the Internal Reset Flag alone, it is executed at the rising edge.

Preset Flags 1 and 2

These bits determine which of preset values 1 and 2 set by the WRIT data are to be used for the preset operation. The operation is carried out according to the preset function selection explained in *6-3-1 Operating Mode Data Settings*.

If the preset function selection is set so that the count's present value (PV) is changed by means of the Preset Flag, then the PV will be changed to preset value 1 when Preset Flag 1 turns ON, or to preset value 2 when Preset Flag 2 turns ON. If both turn ON simultaneously, then preset value 1 will be used. If the Preset Flag and the Internal Reset Flag turn ON simultaneously (in cases where the Internal Reset Flag is used for resetting), the reset operation will not be executed.

If the preset function selection is set so that the PV is changed by means of the external control input signal, then the PV will be changed to one of the preset values (if one of the flags is ON) at the rising edge of the external control input signal. If Preset Flag 1 is ON, then the PV will be changed to preset value 1; if Preset Flag 2 is ON, then the PV will be changed to preset value 2.

External Output Enable Bit This bit determines whether or not external outputs will actually be enabled when the count PV is within a given range. The status of this bit controls both axes together, and it is not possible to make the setting for just one axis or the other. When this bit is ON, outputs are enabled; when OFF, outputs are disabled.

Special I/O Read Completion Flag This bit remains ON while the High-speed Counter Unit is processing WRIT instruction settings. The results will not be reflected in the data area until this bit turns OFF. After the WRIT instruction has been executed, this bit will not turn ON again until the next execution cycle.

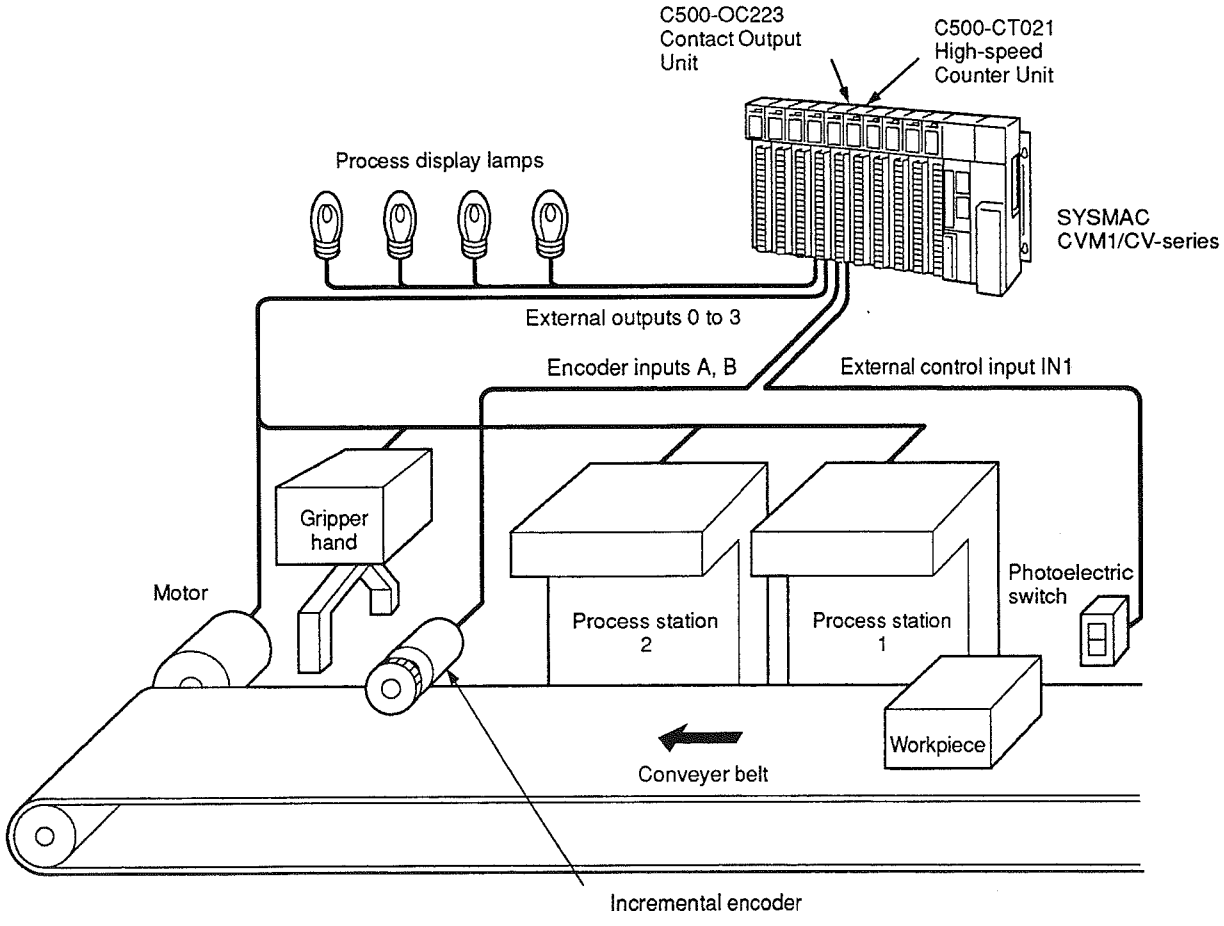
Control Input Signals These signals reflect the status of external control inputs.

Error Flag This bit turns ON when an error occurs at either axis. For details, refer to *Section 13 Error Processing and Troubleshooting.*

Internal and External Outputs Bits 8 to 15 reflect the status of internal/external outputs 0 to 7 respectively, even when actual external outputs are disabled by the External Output Enable Bit.

7-4 Application Example

This example shows how the High-speed Counter Unit can be used for process control on a conveyer belt. Assume that the High-speed Counter Unit has been assigned words 0006 and 0007. The following illustration shows the system configuration.



Operation

The positions of workpieces on a conveyer belt are detected by means of pulse inputs from an encoder, and processes are carried out at the required positions.

(1) A photoelectric switch detects that a workpiece has been placed on the conveyer belt, and the count is reset.

(2) Processes are carried out at each process station according to the count.

(3) The stopping and starting of the motor and the movement of the gripper hand are controlled at the PC.

Wiring

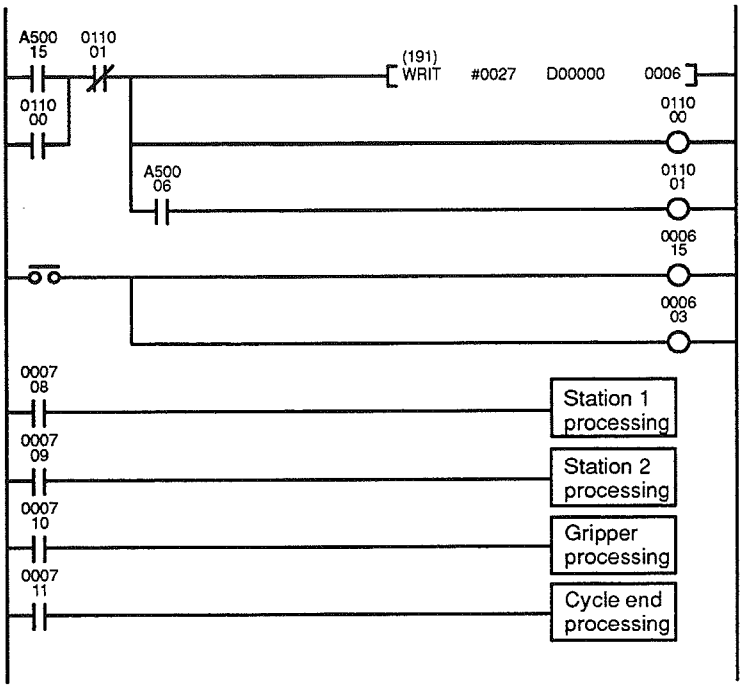
The photoelectric switch outputs are connected to the external control inputs. The incremental encoder outputs are connected to encoder inputs A and B. External outputs 0 to 3 are connected to the process display lamps. The C500-OC223 Output Unit outputs are connected to the motor, the gripper hand, and so on.

WRIT Data Settings

D00000	0001	Axis-1
D00001	2410	Linear mode (BCD mode); Reset: external control input (↑); Offset phase pulse inputs (x1 multiplier); Preset by Preset Flag in data area.
D00002	000F	Comparison ranges 0, 1, 2, and 3 enabled.
D00003	0000	Preset value 1: 0
D00004	0000	
D00005	0000	Preset value 2: 0
D00006	0000	
D00007	1000	Comparison range 0
D00008	0000	1,000 to 2,000 (when within process station 1)
D00009	1200	
D00010	0000	
D00011	0001	Internal/external output 0: ON
D00012	2500	Comparison range 1
D00013	0000	2,500 to 2,900 (when within process station 2)
D00014	2900	
D00015	0000	
D00016	0002	Internal/external output 1: ON
D00017	5000	Comparison range 2
D00018	0000	5,000 to 9,500 (when at conveyance position)
D00019	9500	
D00020	0000	
D00021	0004	Internal/external output 2: ON
D00022	9501	Comparison range 3
D00023	0000	9,501 to 8,388,607 (when ahead of conveyance position)
D00024	8607	
D00025	0838	
D00026	0008	Internal/external output 3: ON

Note Confirm that the processing of the settings has been completed by checking that the Special I/O Read Completion Flag (bit 01 of word n+1) is OFF in the next cycle after the WRIT instruction has been executed.

Program Example



Makes settings at PC startup.

While the switch is ON, external outputs are enabled and the Internal Reset Flag (000603) is ON.

Internal Reset Flag ON.

When the count PV is within comparison range 0, processing is carried out at station 1.

When the count PV is within comparison range 1, processing is carried out at station 2.

When the count PV is within comparison range 2, the gripper hand operations are carried out.

When the count PV is within comparison range 3, the processing at the end of the cycle is carried out.

The process display lamps are directly turned on and off by external outputs 0 to 3.

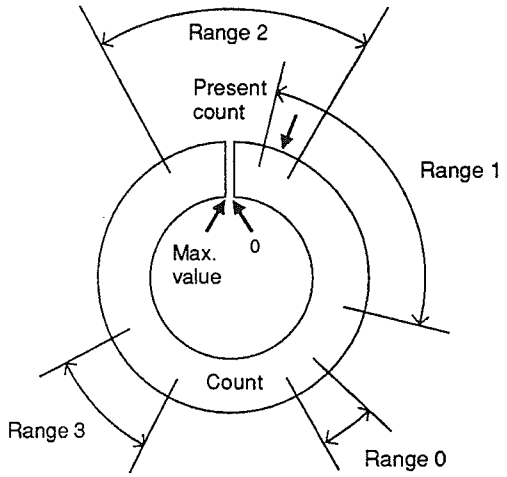
SECTION 8
Circular Mode

This section provides the information necessary for using the circular mode, including information on operating conditions, data areas, settings, and performance specifications. An application example is provided at the end of the section.

8-1 Operation

The circular mode is used when changing the count between 0 and a preset maximum value, based on encoder inputs. The count restarts from zero after reaching the preset maximum value, or returns to the preset maximum value when the count is decremented past zero. The count is compared with eight ranges (i.e., comparison set values) with specified upper and lower limits, and specified outputs corresponding to the ranges are turned ON when it is within those ranges.

Output numbers 0 to 7 correspond to external and internal outputs of the same numbers, and they are simultaneously reflected in the memory areas and READ data bits. (External outputs are only output while enabled.) Output numbers 8 to 15 are reflected in input bits 8 to 15 and READ data bits (but not in external outputs and the memory areas.



Example

The following table provides an example of setting upper and lower limits for comparison ranges.

Axis	Range	Lower limit	Upper Limit	Outputs
Axis-1	Range 0	4,000	4,500	0, 4
	Range 1	200	3,000	1, 2, 7
	Range 2	9,000	1,000	0, 2, 6
	Range 3	5,000	7,000	5, 8
Axis-2	Range 0	4,700	8,000	3, 10

Suppose the comparison ranges are set as shown in this table, and the present count for both axes is 600. The count would thus be within ranges 1 and 2 for axis-1, so outputs 0, 1, 2, 6, and 7 would be turned ON (i.e., the OR condition for outputs 1, 2, and 7, and outputs 0, 2 and 6). If, on the other hand, the present count is 7,000 for both axes, the count would be within range 3 for axis-1 and within range 0 for axis-2. This outputs 3, 5, 8, and 10 would be turned ON (i.e., the OR condition for outputs 5 and 8, and outputs 3 and 10).

Operating Conditions

Counter initial value: 0
Count range: 0 to +65,535 (BCD)
0000 to FFFF (binary)

The count restarts from zero after it reaches a preset maximum value, or returns to the preset maximum value when the counter value is decremented past zero. Also, the present count can be changed to the preset value. The count can be either incremented or decremented.

If the present count is within multiple comparison ranges, the OR condition for the respective outputs will be output.

Besides the eight internal/external outputs, eight internal outputs can also be specified to turn ON.

Up to a total of eight comparison ranges can be set for each axis, and they can be enabled or disabled according to requirements during counting. The comparison ranges can also be changed even while counting is in progress.

When the maximum value is changed, the change becomes effective after the next reset/preset.

For details regarding reset conditions, refer to *4-4 Counter Reset Conditions*.

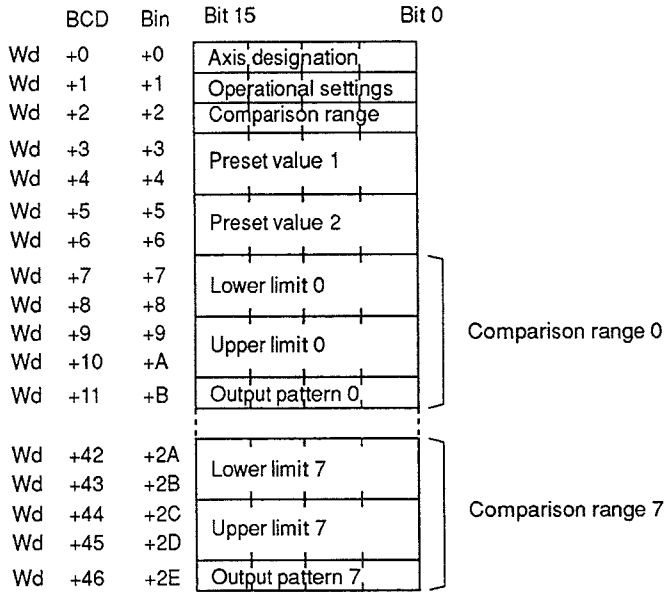
8-2 Performance Specifications

Item		Specifications	
Coefficient input signals:		Encoder input A:	Encoder input B:
Offset phase inputs		A phase	B phase
Up and down pulse inputs		Increment pulse	Decrement pulse
Pulse and direction inputs		Pulse	Direction
External input signals		Pulse input Z, counter reset signal, external control input	
External output signals		External outputs 0 to 7	
Coefficient range		0 to +65,535	
Multiplier function		×1, ×4 (offset phase inputs only)	
Setting data	Data content	Lower limit, upper limit, eight internal/external outputs, eight internal inputs	
	Number of settings	Eight combinations per axis	
Response speed (counter input → external output)		1.5 ms max.	
Reset interval		1.5 ms min.	
Preset interval		1.5 ms min.	

8-3 Data Settings and Memory Areas

8-3-1 Operating Mode Data Settings

The following data is set for each axis in circular mode.



Axis Designation

Designate either or both axes by means of the following settings:

0000: Both axis-1 and axis-2.

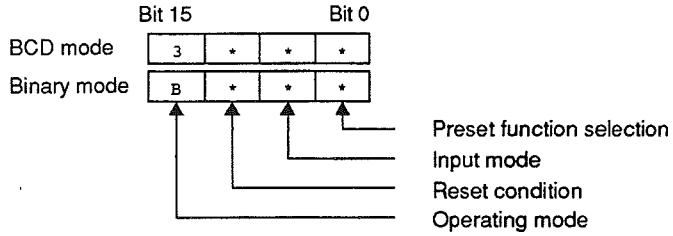
0001: Axis-1 only.

0002: Axis-2 only.

When either 0001 or 0002 is specified, the axis data will apply to that axis only. When 0000 is specified, the axis data for axis-1 and axis-2 is specified in that order. In that case, "0002" must be set at the beginning of the data for axis-2, and the data must be completely set for axis-1.

Operational Settings

Set the operational data for each digit as shown below. Once the settings have been made for an axis, they cannot be changed until the power is turned off.



Preset Function Selection

0: Count present value is changed to preset value at the rising edge of the Preset Flag in the memory area.

4: Count present value is changed to preset value at the rising edge of the external control input signal.

Input Mode

0: Offset phase inputs (x4 multiplier)

1: Offset phase inputs (x1 multiplier)

2: Up and down pulse inputs

3: Pulse and direction inputs

Reset Condition

0: Z(↑), E, I

1: Z(↓), E, I

2: Z(↑), I

3: Z(↓), I

4: E(↑), I

5: Z(↑)

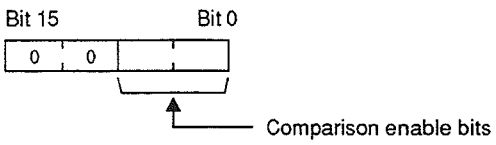
6: Z(↓)

7: I(↑)

When the preset function setting is "4," reset condition settings "0," "1," and "4" are not possible. The abbreviations Z, E, and I stand for pulse input Z, external control input, and Internal Reset Flag respectively. For details regarding reset conditions, refer to *4-4 Counter Reset Conditions*.

Comparison Range Setting

Bits 0 to 7 correspond to the eight comparison ranges, and each of those ranges is enabled or disabled according to the setting of its respective bit. When the bit status for a given comparison range is 0 (OFF), that range will be disabled and will not be used for comparison with the count. When the status of that bit is 1 (ON), the range will be enabled and will be used for comparison with the count.



Maximum Count Value, Preset Value, Lower Limit, and Upper Limit

	Bit 15			Bit 0
Wd n	Digit 4	Digit 3	Digit 2	Digit 1
Wd n+1	Digit 8	Digit 7	Digit 6	Digit 5

n: Rightmost word

Set the numbers for the eight digits as shown below, according to the mode.

BCD Mode
00000000 to 00065535 (0 to +65,535)

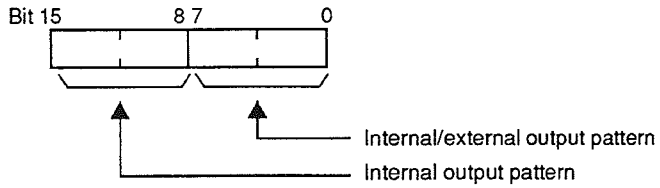
Binary Mode
00000000 to 0000FFFF (0 to +65,535)

Note

1. Set the preset value, lower limit, and upper limit from zero to the maximum count value.
2. If the count is within a given range for no more than 1.5 ms, the outputs may not respond. For example, at 50 kcps the interval between the lower and upper limits should be at least 75 counts.
3. If the lower limit is set to a value greater than the upper limit, it will not result not in the upper limit being less than or equal to the lower limit. Rather, the effective ranges will be from the lower limit to the maximum count value, and from zero to the upper limit.

Output Pattern

The results of the comparison between the counter present value and the comparison set value for each axis (the output pattern) is stored in the third word, as shown below:



Bits 0 through 15 of the comparison results correspond to internal output patterns 0 through 15. When the External Output Enable Flag in the output word is ON, bits 0 through 7 correspond to external output patterns 0 through 7, too. The outputs on the status of the output pattern bits as follows:

0: Output OFF
1: Output ON

The status of each external output (OUT0 to OUT7) is determined by logical OR between the output of each axis and each comparison set value.

8-3-2 Data Areas

The following table shows the functions allocated to the High-speed Counter Unit data areas when in circular mode. The explanation here is in terms of the 2-word mode. For information concerning the 4-word mode, refer to *5-1 I/O Allocation and Memory Configuration.*

Word	Bit	Function	
Beginning word (output)	00 01 02	Reserved for system use. Write-protected.	
	03	Internal Reset Flag	Axis-1
	04	Not used.	
	05	Preset Flag	
	06 07 08	Not used.	
	09	Internal Reset Flag	Axis-2
	10	Not used.	
	11	Preset Flag	
	12 13 14		
	15	External Output Enable Bit	Axis-1 and axis-2
Beginning word + 1 (input)	00	Reserved for system use.	
	01	Special I/O Read Completion Flag	
	02	Reserved for system use.	
	03 04	Not used.	
	05	Control input	Axis-1
	06	Control input	Axis-2
	07	Error Flag	Axis-1 and axis-2
	08	Internal/external output 0	
	09	Internal/external output 1	
	10	Internal/external output 2	
	11	Internal/external output 3	
	12	Internal/external output 4	
	13	Internal/external output 5	
	14	Internal/external output 6	
	15	Internal/external output 7	

Internal Reset Flag

This bit is used as an Internal Reset Flag, but whether or not it is actually used for resetting is determined by the reset condition setting. (Refer to *4-4 Counter Reset Conditions.*) When the reset operation is executed by means of the Internal Reset Flag alone, it is executed at the rising edge.

Preset Flag

This bit changes the present count to the preset value set by the WRIT data. The operation is carried out according to the preset function selection explained in *6-3-1 Operating Mode Data Settings.*

If the preset function selection is set so that the present value (PV) is changed by means of the Preset Flag, then the PV will be changed to the preset value at the rising edge of the Preset Flag (i.e. when the Preset Flag is turned ON). If the Preset Flag and the Internal Reset Flag turn ON simultaneously (in cases where the Internal Reset Flag is used for resetting), the reset operation will not be executed.

If the preset function selection is set so that the PV is changed by means of the external control input signal, then the PV will be changed to the preset value at the rising edge of the external control input signal.

External Output Enable Bit This bit determines whether or not external outputs will actually be enabled when the count PV is within a given range. The status of this bit controls both axes together, and it is not possible to make the setting for just one axis or the other. When this bit is ON, outputs are enabled; when OFF, outputs are disabled.

Special I/O Read Completion Flag This bit remains ON while the High-speed Counter Unit is processing WRIT instruction settings. The results will not be reflected in the data area until this bit turns OFF. After the WRIT instruction has been executed, this bit will not turn ON again until the next execution cycle.

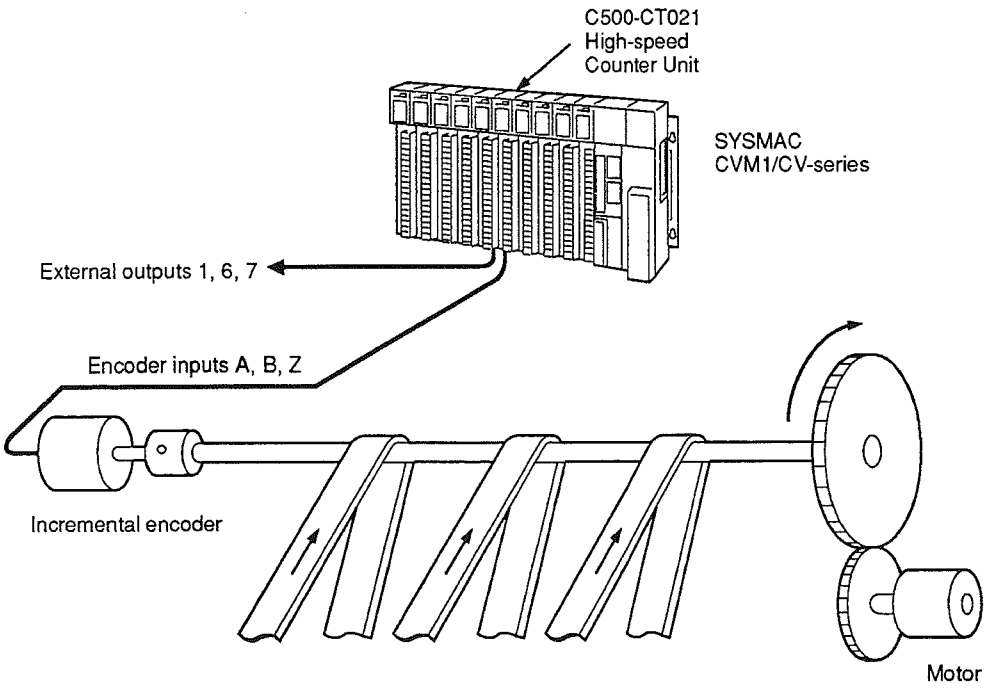
Control Input Signals These signals reflect the status of external control inputs.

Error Flag This bit turns ON when an error occurs at either axis. For details, refer to *Section 13 Error Processing and Troubleshooting*.

Internal and External Outputs Bits 8 to 15 reflect the status of internal/external outputs 0 to 7 respectively, even when actual external outputs are disabled by the External Output Enable Bit.

8-4 Application Example

This example shows how the High-speed Counter Unit can be used for cam timer control. Assume that the High-speed Counter Unit has been assigned words 0006 and 0007. The following illustration shows the system configuration.



Operation The control timing of a device connected to a shaft driven by a motor is detected by an incremental encoder, and outputs are controlled according to the angle of rotation.

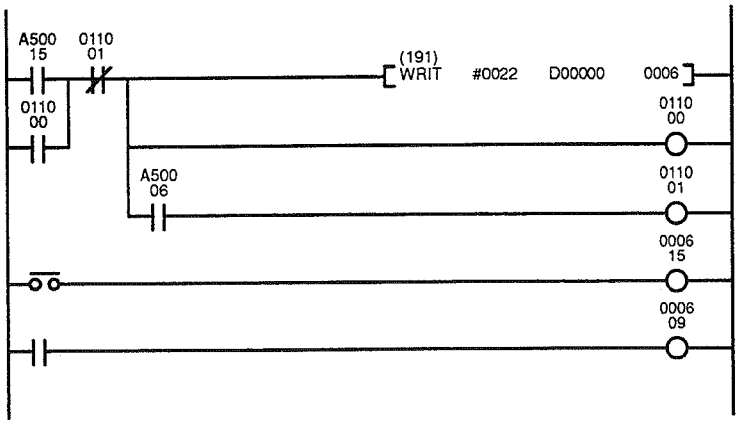
Wiring The incremental encoder outputs are connected to encoder inputs A, B, and Z of axis-2. The reset switch is connected to the external control inputs. External outputs 1, 6, and 7 are connected to the control unit of the device.

WRIT Data Settings

D00000	0002	Axis-2
D00001	3000	Circular mode (BCD mode); Reset: pulse input Z (↑), Internal Reset Flag, external control input; Offset phase pulse inputs (x4 multiplier); Preset by Preset Flag in data area.
D00002	0007	Comparison ranges 0, 1, 2, and 3 enabled.
D00003	4999	Maximum count value: 4,999 (i.e., count progresses as follows: 0, 1, 2,...4998, 4999, 0, 1,...)
D00004	0000	
D00005	0000	Preset value : 0
D00006	0000	
D00007	1000	Comparison range 0
D00008	0000	1,000 to 1,010
D00009	1010	
D00010	0000	
D00011	0080	Internal/external output 7: ON
D00012	4300	Comparison range 1
D00013	0000	4,300 to 200 (with 0 in between)
D00014	0200	
D00015	0000	
D00016	0042	Internal/external outputs 1, 6: ON
D00017	0600	Comparison range 2
D00018	0000	600 to 3,100
D00019	3100	
D00020	0000	
D00021	00C0	Internal/external outputs 6, 7: ON

Note Confirm that the processing of the settings has been completed by checking that the Special I/O Read Completion Flag (bit 01 of word n+1) is OFF in the next cycle after the WRIT instruction has been executed.

Program Example



Makes settings at PC startup.

While the switch is ON, external outputs are enabled.

While the Internal Reset Flag is ON, the count is reset by the rising edge of the pulse input Z directly after the counter reset switch is pressed (i.e., directly after the external control input turns ON).

External outputs 1, 6, and 7 are directly controlled from the High-speed Counter Unit.

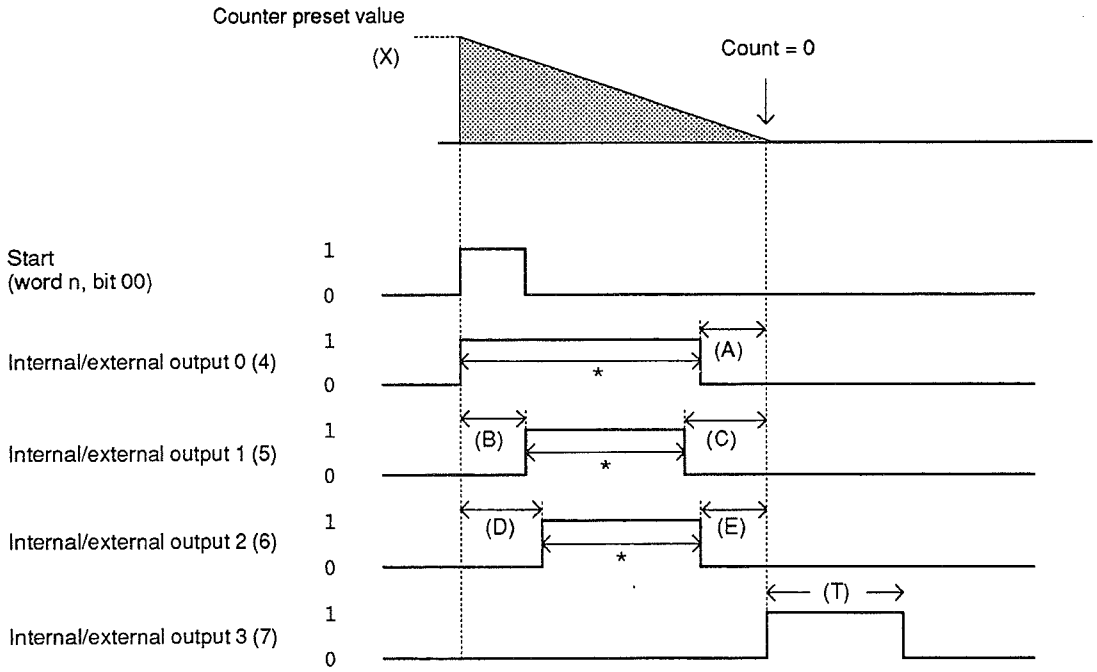
SECTION 9
Preset Mode

This section provides the information necessary for using the preset mode, including information on operating conditions, data areas, settings, and performance specifications. An application example is provided at the end of the section.

9-1 Operation

When the counter start bit turns ON in preset mode, one of the eight preset values is set for each axis and the count begins to be decremented according to encoder inputs. During this decrement phase, outputs may be switched ON and OFF according to counter values, or turned ON for a fixed period (set by the preset timer) when the count reaches zero.

Note External outputs are actually only turned ON and OFF when they are enabled by the External Output Flag.



Note

1. In preset mode, make sure that encoder inputs are applied in the decrement direction.
2. Be sure to allow intervals of at least 1.5 ms between ON and OFF values for outputs (i.e., for the intervals indicated by asterisks in the timing chart above). If the intervals are less than 1.5 ms, the output may not be executed correctly. B and D are relative values from the counter preset value.

Outputs

In preset mode, the patterns vary for turning outputs ON and OFF. (The output numbers in the parentheses are for axis-2.) If no outputs are desired, set the maximum value to an OFF value.

External Output 0 (4)
The output turns ON at the beginning of the count, and turns OFF at the preset OFF value (A).

External Outputs 1, 2 (5, 6)
After the count begins, outputs are turned ON at the "preset value – B" and the "preset value – D," and turned OFF at the OFF values (C and E).

External Output 3 (7)
The output turns ON when the count reaches zero, and turns OFF automatically after a fixed period has elapsed. The fixed period is represented in the diagram by (T).

Output Control Data Output control data can be set within the ranges shown in the following table.

Symbol	Contents	Range
A	Count value for turning OFF external output 0 (4). (OFF value)	0 to 8,388,607 (BCD); 00000000 to 7FFFFFFF (binary) (0 to 2,147,483,647 in decimal)
B and D	Value for turning ON external outputs 1 and 2 (5 and 6). (ON value)	
C and E	Count value for turning OFF external outputs 1 and 2 (5 and 6). (OFF value)	
T	Time period for external output 3 (7) to remain ON.	0 to 99.99 seconds, or remain ON (BCD); 0000 to FFFE (0 to 655.34 seconds) or remain ON (binary)

Operating Conditions

Preset value: 1 to 8,388,607 (BCD)
00000001 to 7FFFFFFF (binary)
(0 to 2,147,483,647 in decimal)

Count range: 0 to 8,388,607 (BCD)
00000000 to 7FFFFFFF (binary)

A total of up to eight preset values can be set for each axis, and the ones that are to be used can be specified. These preset values can be changed even after they have been set.

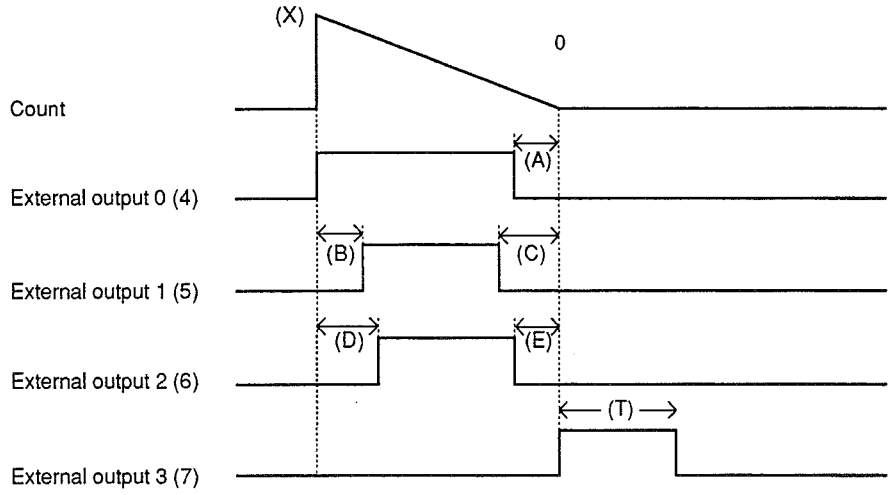
The output control data (i.e., the values at which the internal/external outputs are to be turned ON and OFF) must be set in advance before the count begins. Except for the retention time (T), these values cannot be changed while the count is in progress. Likewise, the retention time (T) cannot be changed once the output status is actually being retained (i.e., once the time period is actually in effect).

The count can only be decremented, and not incremented.

Note If a reset is executed during the count, all outputs and the count value will be cleared. For details regarding reset conditions, refer to *4-4 Counter Reset Conditions*.

9-2 Performance Specifications

Item	Specifications	
Coefficient input signals: Offset phase inputs Up and down pulse inputs Pulse and direction inputs	Encoder input A: A phase Increment pulse Pulse	Encoder input B: B phase Decrement pulse Direction
External input signals	Pulse input Z, external control input	
External output signals	External output 0 (4): ON after beginning of count; OFF at (A).	
	External outputs 1, 2 (5, 6): ON at (B)/(D) after beginning of count; OFF at (C)/(E).	
	External output 3 (7): OFF when the count is up and the retention time (T) has elapsed; The ON status can also be retained until the beginning of the next count.	
Coefficient range	BCD mode: 0 to 8,388,607 Binary mode: 0 to 2,147,483,647	
Multiplier function	×1, ×4 (offset phase inputs only)	
Counter preset values	Eight ranges can be set, within the following limits: 1 to 8,388,607 (BCD) 1 to 2,147,483,647 (binary)	
Holding time for external output 3 (7) (time ON status is held)	BCD mode: 0 to 99.99 s or continuously ON Binary mode: 0 to 655.34 s or continuously ON	
Response speed (counter input → external output)	1.5 ms max.	
Reset interval	1.5 ms min.	
Preset interval	1.5 ms min.	

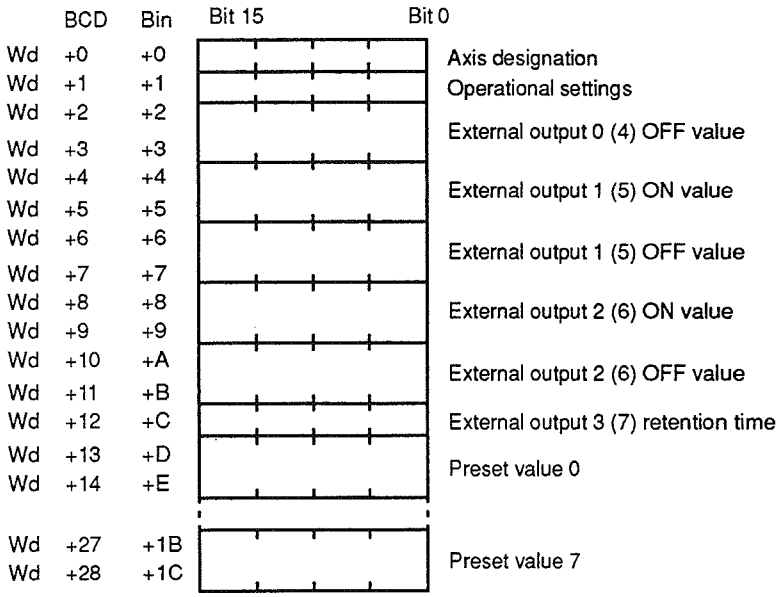


⚠ **Caution** The ON/OFF interval for outputs (i.e., the time period for a given output), must be at least 1.5 ms. If the interval is less than that, the output may not be correctly executed.

9-3 Data Settings and Memory Areas

9-3-1 Operating Mode Data Settings

The following data is set for each axis in preset mode.



Axis Designation

Designate either or both axes by means of the following settings:

0000: Both axis-1 and axis-2.

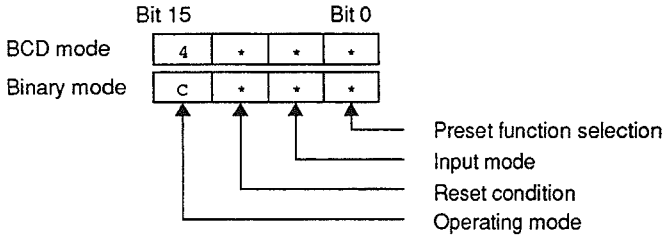
0001: Axis-1 only.

0002: Axis-2 only.

When either 0001 or 0002 is specified, the axis data will apply to that axis only. When 0000 is specified, the axis data for axis-1 and axis-2 is specified in that order. In that case, "0002" must be set at the beginning of the data for axis-2, and the data must be completely set for axis-1.

Operational Settings

Set the operational data for each digit as shown below. Once the settings have been made for an axis, they cannot be changed until the power is turned off.



Preset Function Selection

0: Preset is executed and the count begins at the rising edge of the Start Count Flag in the memory area.

4: Preset is executed and the count begins at the rising edge of the external control input signal.

Input Mode

0: Offset phase inputs (x4 multiplier)

1: Offset phase inputs (x1 multiplier)

2: Up and down pulse inputs

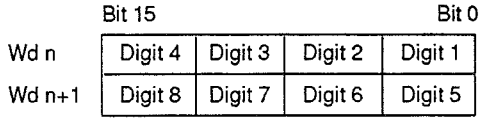
3: Pulse and direction inputs

Reset Condition

0: Z(↑), E, I
1: Z(↓), E, I
2: Z(↑), I
3: Z(↓), I
4: E(↑), I
5: Z(↑)
6: Z(↓)
7: I(↑)

When the preset function setting is "4," reset condition settings "0," "1," and "4" are not possible. The abbreviations Z, E, and I stand for pulse input Z, external control input, and Internal Reset Flag respectively. For details regarding reset conditions, refer to *4-4 Counter Reset Conditions*.

External Output OFF and ON Values



n: Rightmost word

Set the numbers for the eight digits as shown below, according to the mode.

BCD Mode

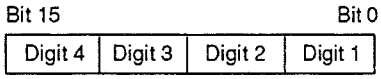
00000000 to 08388607 (0 to +8,388,607)

Binary Mode

00000000 to 7FFFFFFF (0 to +2,147,483,647)

Note Be sure to set all three output external OFF values and both external output ON values.

External Output Retention Time



Set the numbers for the four digits (unit: 10 ms) as shown below, according to the mode.

BCD Mode

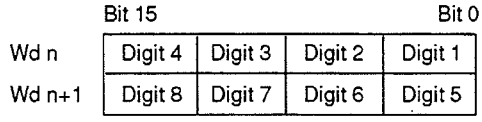
0000 to 9999 (0 to 99.99 seconds)
or FFFF (remain ON)

Binary Mode

0000 to FFFF (0 to 655.34 seconds)
or FFFF (remain ON)

Note This setting must be made.

Preset Values



n: Rightmost word

Set the numbers for the eight digits as shown below, according to the mode.

BCD Mode

00000000 to 08388607 (0 to 8,388,607)
If 0 is set, nothing will be output.

Binary Mode

00000000 to 7FFFFFFF (0 to 2,147,483,647)
If 0 is set, nothing will be output.

9-3-2 Data Areas

The following table shows the functions allocated to the High-speed Counter Unit data areas when in preset mode. The explanation here is in terms of the 2-word mode. For information concerning the 4-word mode, refer to *5-1 I/O Allocation and Memory Configuration.*

Word	Bit	Function	
Beginning word (output)	00 01 02	Reserved for system use. Write-protected.	
	03	Internal Reset Flag	Axis-1
	04	Start Count Flag	
	05	Not used.	
	06 07 08	Preset value no.	
	09	Internal Reset Flag	Axis-2
	10	Start Count Flag	
	11	Not used.	
	12 13 14	Preset value no.	
	15	External Output Enable Bit	Axis-1 and axis-2
Beginning word + 1 (input)	00	Reserved for system use.	
	01	Special I/O Read Completion Flag	
	02	Reserved for system use.	
	03 04	Not used.	
	05	Control input	Axis-1
	06	Control input	Axis-2
	07	Error Flag	Axis-1 and axis-2
	08	Internal/external output 0	
	09	Internal/external output 1	
	10	Internal/external output 2	
	11	Internal/external output 3	
	12	Internal/external output 4	
	13	Internal/external output 5	
	14	Internal/external output 6	
	15	Internal/external output 7	

Internal Reset Flag

This bit is used as an Internal Reset Flag, but whether or not it is actually used for resetting is determined by the reset condition setting. (Refer to *4-4 Counter Reset Conditions.*) When the reset operation is executed by means of the Internal Reset Flag alone, it is executed at the rising edge.

Start Count Flag

This bit specifies the start of the count. The operation is carried out according to the preset function selection explained in *9-3-1 Operating Mode Data Settings.*

If the preset function selection is set so that the count is started by means of the Start Count Flag, then the preset will be executed and the count started at the rising edge of the Start Count Flag (i.e. when the Start Count Flag is turned ON). If the Start Count Flag and the Internal Reset Flag turn ON simultaneously (in cases where the Internal Reset Flag is used for resetting), the count will not be started.

If the preset function selection is set so that the count is started by means of the external control input signal, then the preset will be executed and the count started at the rising edge of the external control input signal.

Preset Value Number

These bits specify the preset values to be used when the count is begun.

Axis-1	08	07	06	Preset value used
Axis-2	14	13	12	
Designation	0	0	0	Preset value 0
	0	0	1	Preset value 1
	0	1	0	Preset value 2
	0	1	1	Preset value 3
	1	0	0	Preset value 4
	1	0	1	Preset value 5
	1	1	0	Preset value 6
	1	1	1	Preset value 7

External Output Enable Bit

This bit determines whether or not external outputs will actually be enabled. The status of this bit controls both axes together, and it is not possible to make the setting for just one axis or the other. When this bit is ON, outputs are enabled; when OFF, outputs are disabled.

Special I/O Read Completion Flag

This bit remains ON while the High-speed Counter Unit is processing WRIT instruction settings. The results will not be reflected in the data area until this bit turns OFF. After the WRIT instruction has been executed, this bit will not turn ON again until the next execution cycle.

Control Input Signals

These signals reflect the status of external control inputs.

Error Flag

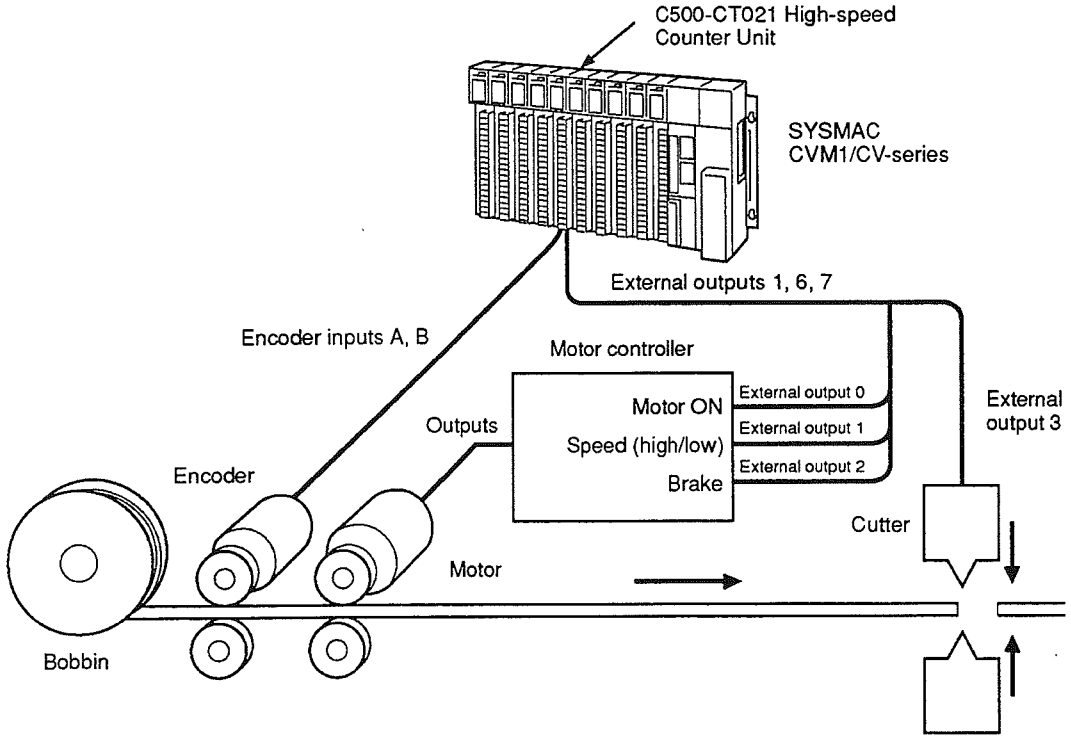
This bit turns ON when an error occurs at either axis. For details, refer to *Section 13 Error Processing and Troubleshooting*.

Internal and External Outputs

Bits 8 to 15 reflect the status of internal/external outputs 0 to 7 respectively, even when actual external outputs are disabled by the External Output Enable Bit.

9-4 Application Example

This example shows how the High-speed Counter Unit can be used for cutting measured lengths of material. Assume that the High-speed Counter Unit has been assigned words 0007 and 0008. The following illustration shows the system configuration.



Operation

In this operation, only the prescribed length of cable is fed, and a cutter is activated to cut the cable at the target position.

Control Procedure

(1) The brake is released and the motor is started at low speed.

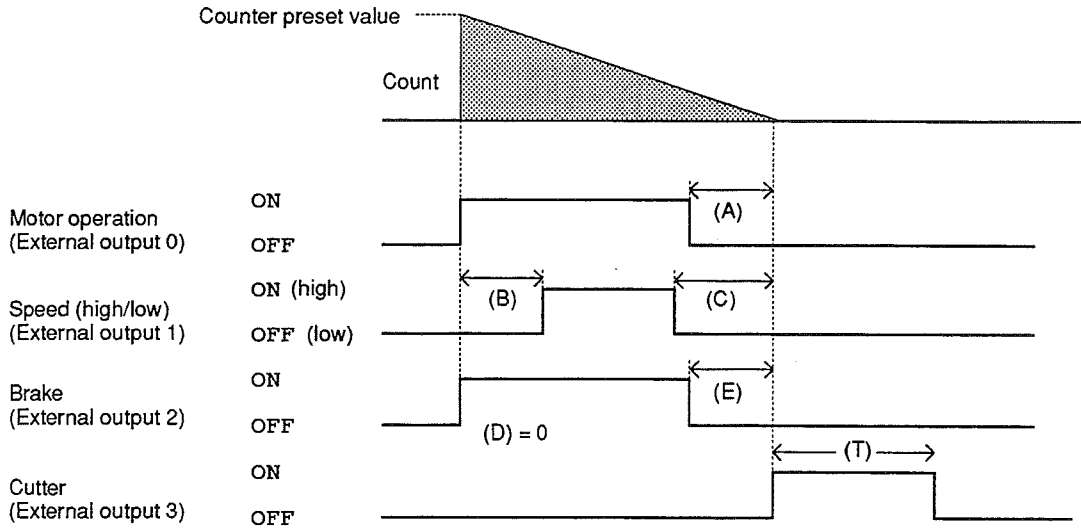
(2) The motor speed is increased.

(3) Before reaching the target position, the motor is slowed back to low speed.

(4) The motor is stopped ahead of the target position, taking into account the travel distance due to momentum.

(5) The brake is turned on just before the target position.

(6) When the target position is reached, the cutter is activated.



Example Settings

Item	Set value (SV)
Counter preset value	10,000
External output 0 OFF value (A)	100
External output 1 ON value (B)	150
External output 1 OFF value (C)	200
External output 2 ON value (D)	0
External output 2 OFF value (E)	50
External output 3 OFF value (T)	500 ms

Wiring

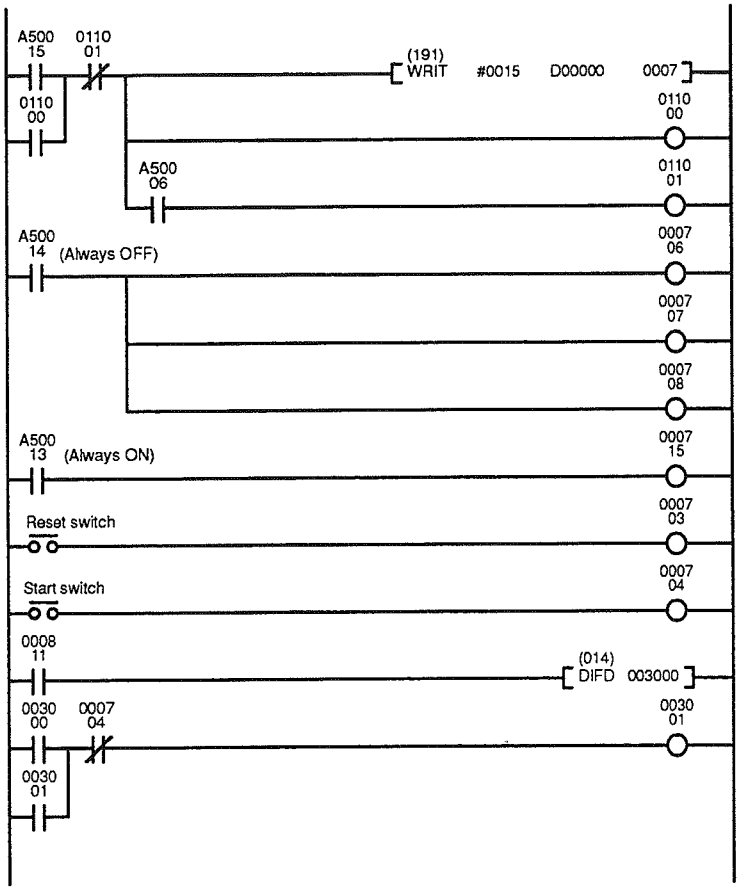
The incremental encoder outputs are connected to encoder inputs A and B.
External output 0 is connected to the motor ON terminal at the motor controller.
External output 1 is connected to the speed switch at the motor controller.
External output 2 is connected to the brake signal input at the motor controller.
External output 3 is connected to the input for the cutter drive device.

WRIT Data Settings

D00000	0001	Axis-1
D00001	4700	Preset mode (BCD mode); Reset: Internal Reset Flag (↑); Offset phase pulse inputs (x4 multiplier); Preset by Preset Flag in data area.
D00002	0100	External output 0 OFF value: 100
D00003	0000	
D00004	0150	External output 1 ON value: 150
D00005	0000	
D00006	0200	External output 1 OFF value: 200
D00007	0000	
D00008	0000	External output 2 ON value: 0
D00009	0000	
D00010	0050	External output 2 OFF value: 50
D00011	0000	
D00012	0050	External output 3 retention time: 50 (500 ms)
D00013	0000	Preset value 0: 10,000
D00014	0001	

Note Confirm that the processing of the settings has been completed by checking that the Special I/O Read Completion Flag (bit 01 of word n+1) is OFF in the next cycle after the WRIT instruction has been executed.

Program Example



Makes settings at PC startup.

Specifies preset value 0.

External outputs always enabled.

Internal Reset Flag ON.

Start Count Flag ON.

Cutter operation completion (falling edge) detected.

Cut completed indicator output

SECTION 10
Gate Mode

This section provides the information necessary for using the gate mode, including information on operating conditions, data areas, settings, and performance specifications. An application example is provided at the end of the section.

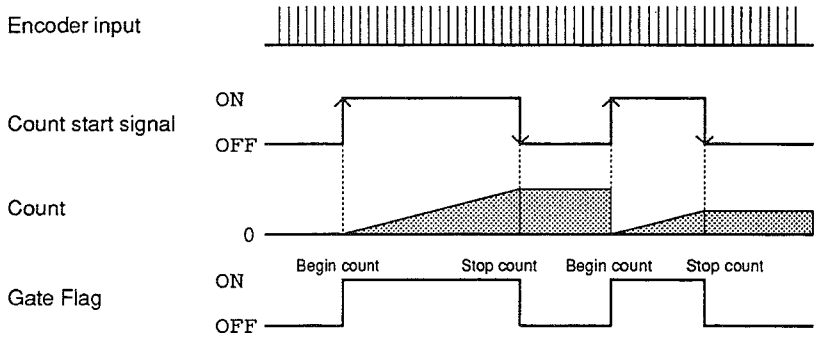
10-1 Operation

In gate mode, the count continues only while the start count signal (either an external control input or the Internal Input Flag) is ON. When the signal turns OFF, the count stops. When the signal turns ON again, the count restarts from zero (in normal gate mode) or from the present counter value (in cumulative gate mode). In cumulative gate mode, the count is reset by means of reset inputs.

For details regarding reset conditions, refer to *4-4 Counter Reset Conditions*.

10-1-1 Normal Count Operation

Encoder inputs are counted while the start count signal is ON. When the signal turns OFF, the count at that point is retained. When the signal next turns ON again (at the rising edge), the count is reset and begins again from zero.



Operating Conditions

Counter initial value: 0
Count range: –8,388,608 to +8,388,607 (BCD)
80000000 to 7FFFFFFF (binary)
(–2,147,483,648 to +2,147,483,647 in decimal)

If the count exceeds either the minimum or maximum value, underflow or overflow error will be generated and the count will be stopped.

The count can be incremented and decremented.

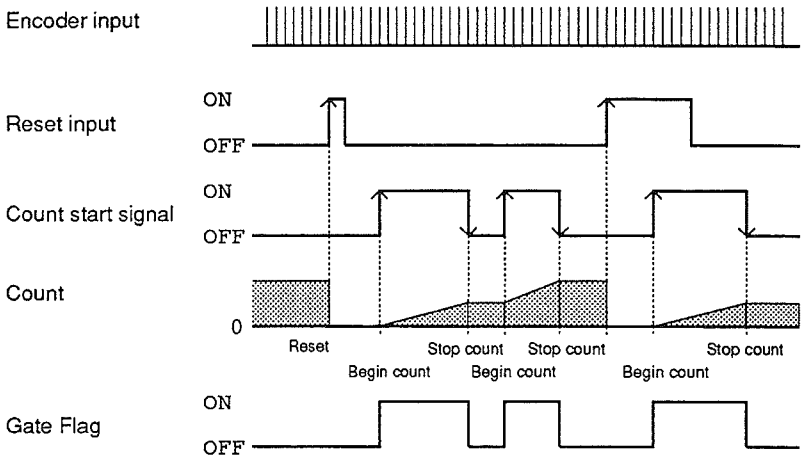
Either an external control signal or the Internal Input Flag can be selected for use as the start count signal.

External outputs are not performed.

The count is reset according to the reset conditions.

10-1-2 Cumulative Count Operation

Encoder inputs are counted while the start count signal is ON. When the signal turns OFF, the count at that point is retained. When the signal next turns ON again (at the rising edge), the count is begins again from the present value. The count can be returned to zero by executing a reset according to the reset conditions.



Operating Conditions

Counter initial value: 0
Count range: –8,388,608 to +8,388,607 (BCD)
80000000 to 7FFFFFFF (binary)
(–2,147,483,648 to +2,147,483,647 in decimal)

If the count exceeds either the minimum or maximum value, underflow or overflow error will be generated and the count will be stopped.

The count can be incremented and decremented.

Either an external control signal or the Internal Input Flag can be selected for use as the start count signal.

External outputs are not possible.

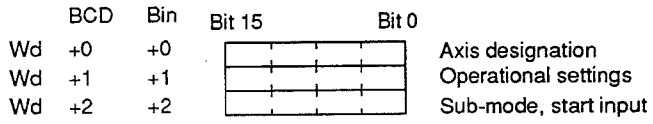
10-2 Performance Specifications

Item	Specifications	
Coefficient input signals:	Encoder input A:	Encoder input B:
Offset phase inputs	A phase	B phase
Up and down pulse inputs	Increment pulse	Decrement pulse
Pulse and direction inputs	Pulse	Direction
External input signals	External control inputs: Start count signal, reset signal (cumulative mode only) Pulse input Z: Reset signal	
External output signals	None	
Coefficient range	BCD mode: –8,388,608 to +8,388,607 Binary mode: –2,147,483,648 to +2,147,483,647	
Multiplier function	×1, ×4 (offset phase inputs only)	
Reset interval	1.5 ms min.	

10-3 Data Settings and Memory Areas

10-3-1 Operating Mode Data Settings

The following data is set for each axis in gate mode.



Axis Designation

Designate either or both axes by means of the following settings:

0000: Both axis-1 and axis-2.

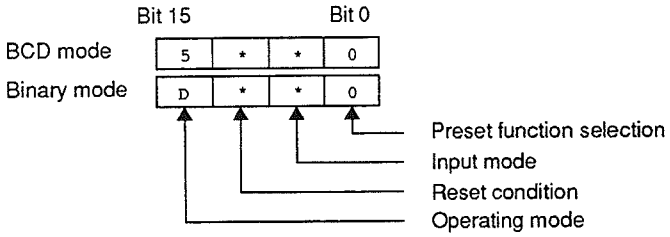
0001: Axis-1 only.

0002: Axis-2 only.

When either 0001 or 0002 is specified, the axis data will apply to that axis only. When 0000 is specified, the axis data for axis-1 and axis-2 is specified in that order. In that case, "0002" must be set at the beginning of the data for axis-2, and the data must be completely set for axis-1.

Operational Settings

Set the operational data for each digit as shown below. Once the settings have been made for an axis, they cannot be changed until the power is turned off.



Preset Function Selection

The preset function cannot be used in gate mode, so set this to "0."

Input Mode

0: Offset phase inputs (x4 multiplier)

1: Offset phase inputs (x1 multiplier)

2: Up and down pulse inputs

3: Pulse and direction inputs

Reset Condition

0: Z(↑), E, I

1: Z(↓), E, I

2: Z(↑), I

3: Z(↓), I

4: E(↑), I

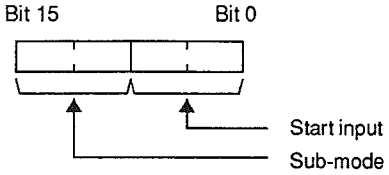
5: Z(↑)

6: Z(↓)

7: I(↑)

When the start input designation is "00," reset condition settings "0," "1," and "4" are not possible. The abbreviations Z, E, and I stand for pulse input Z, external control input, and Internal Reset Flag respectively. For details regarding reset conditions, refer to *4-4 Counter Reset Conditions*.

Sub-mode, Start Input



Sub-mode
Designate the sub-mode by means of the following settings:

00: Normal count mode

01: Cumulative count mode

Start Input
Designate the start input by means of the following settings:

00: External control input

01: Internal Input Flag

10-3-2 Data Areas

The following table shows the functions allocated to the High-speed Counter Unit data areas when in gate mode. The explanation here is in terms of the 2-word mode. For information concerning the 4-word mode, refer to *5-1 I/O Allocation and Memory Configuration.*

Word	Bit	Function	
Beginning word (output)	00 01 02	Reserved for system use. Write-protected.	
	03	Internal Reset Flag	Axis-1
	04	Internal Input Flag	
	05 06 07 08	Not used.	
	09	Internal Reset Flag	Axis-2
	10	Internal Input Flag	
	11 12 13 14 15	Not used.	
Beginning word + 1 (input)	00	Reserved for system use.	
	01	Special I/O Read Completion Flag	
	02	Reserved for system use.	
	03	Gate Flag	Axis-1
	04	Gate Flag	Axis-2
	05	Control input	Axis-1
	06	Control input	Axis-2
	07	Error Flag	Axis-1 and axis-2
	08 09 10 11 12 13 14 15	Not used.	

Internal Reset Flag

This bit is used as an Internal Reset Flag, but whether or not it is actually used for resetting is determined by the reset condition setting. (Refer to *4-4 Counter Reset Conditions.*) When the reset operation is executed by means of the Internal Reset Flag alone, it is executed at the rising edge.

Internal Input Flag

This bit executes the count when Internal Input Flag is specified as the start count signal. It has no function when "external control input" is specified. (Refer to "Start Input" under *10-3-1 Operating Mode Data Settings.*)

Special I/O Read Completion Flag

This bit remains ON while the High-speed Counter Unit is processing WRIT instruction settings. The results will not be reflected in the data area until this bit turns OFF. After the WRIT instruction has been executed, this bit will not turn ON again until the next execution cycle.

Gate Flag

This bit turns ON during gate processing.

Control Input Signals

These signals reflect the status of external control inputs.

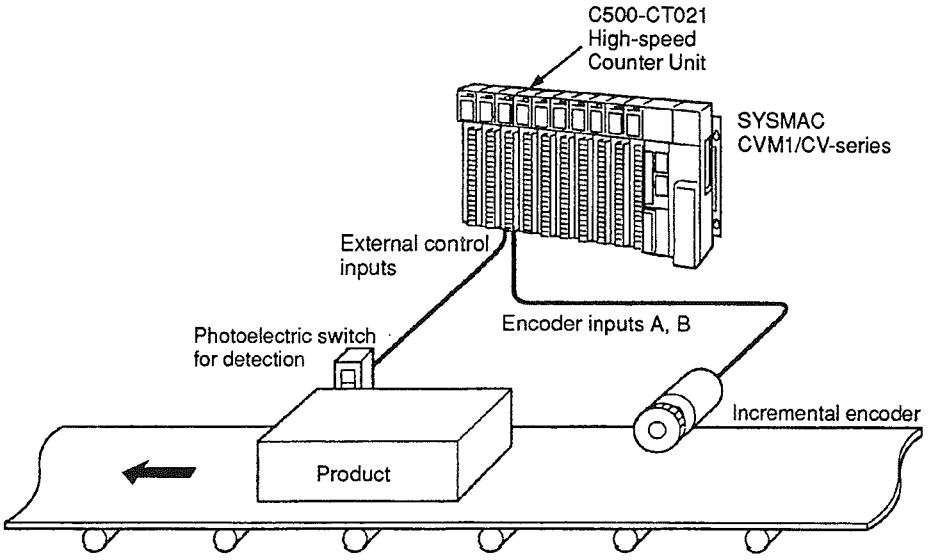
Error Flag

This bit turns ON when an error occurs at either axis. For details, refer to *Section 13 Error Processing and Troubleshooting.*

Note When the count is stopped due to an error, it cannot be restarted simply by clearing the error. After the error has been cleared, the start count signal must be turned ON again.

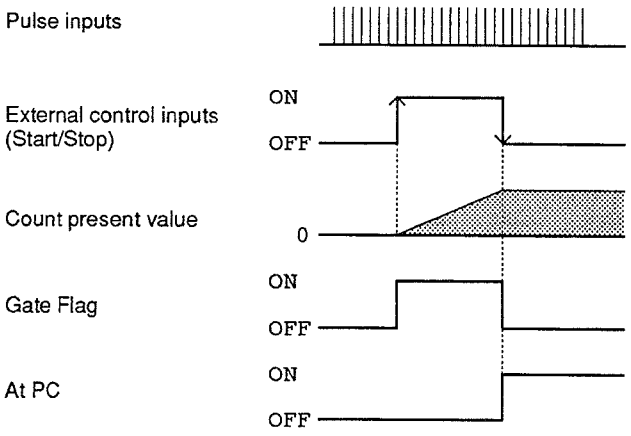
10-4 Application Example

This example shows how the High-speed Counter Unit can be used for measuring product dimensions. Assume that the High-speed Counter Unit has been assigned words 0002 and 0003. The following illustration shows the system configuration.



Operation

Encoder inputs are counted while the photoelectric switch is ON, and the dimensions of products moving along the conveyer belt are measured. The PC determines whether or not those dimensions are acceptable.



Wiring

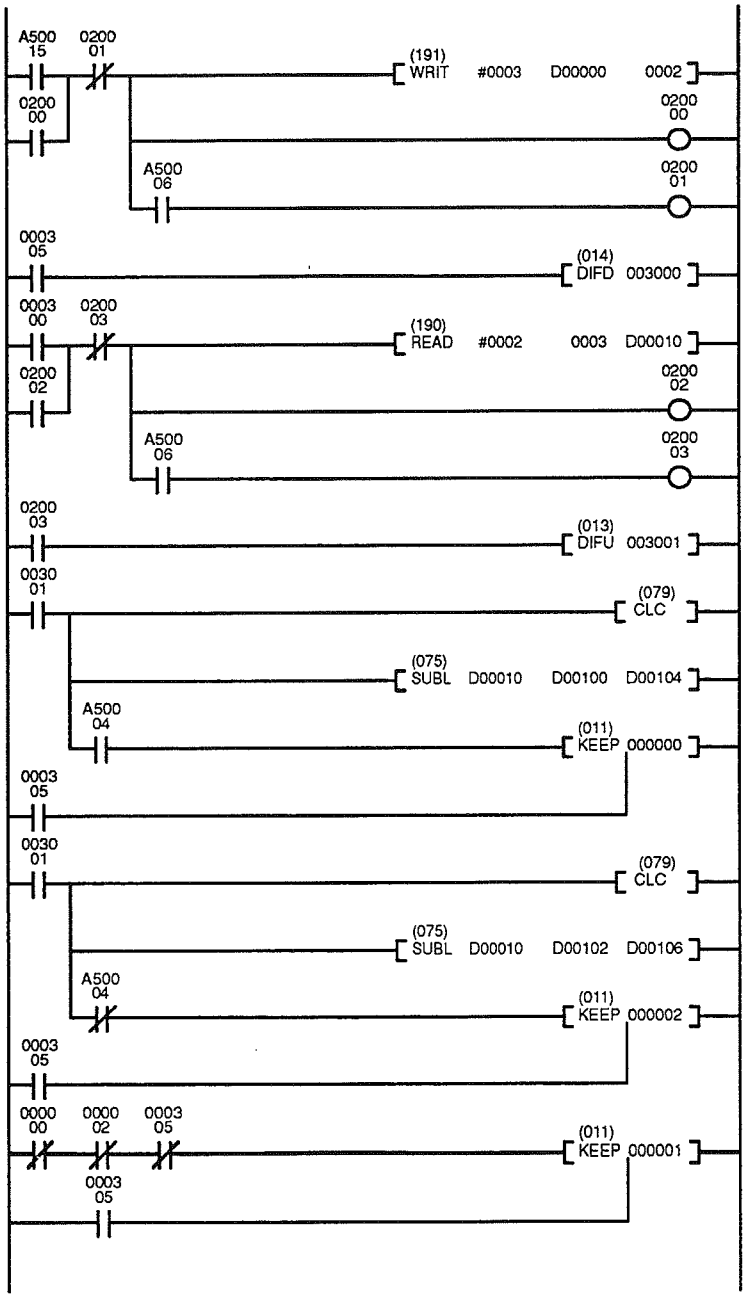
The incremental encoder outputs are connected to encoder inputs A and B. The photoelectric switch output is connected to the external control input.

WRIT Data Settings

D00000	0001	Axis-1
D00001	5700	Gate mode (BCD mode); Reset: Internal Reset Flag (↑); Offset phase pulse inputs (x4 multiplier); Preset operation cannot be used.
D00002	0000	Normal count mode; Start count signal: External control input

Note Confirm that the processing of the settings has been completed by checking that the Special I/O Read Completion Flag (bit 01 of word n+1) is OFF in the next cycle after the WRIT instruction has been executed.

Program Example



Makes settings at PC startup.

Reads count value when photoelectric switch turns OFF.

Checks count value when the read is complete.

Checks whether count value is ≧ lower limit.

Outputs if dimensions are too small.

Checks whether count value is ≦ upper limit.

Outputs if dimensions are too large.

Outputs if dimensions are within standards.

Comparison Data Areas

The following data areas are used for comparison of values.

D00100 to D00101:	Lower limit
D00102 to D00103:	Upper limit
D00104 to D00105:	Difference with lower limit
D00106 to D00107:	Difference with upper limit

Output Results

Dimensions too small:	00000 ON
Dimensions correct:	00001 ON
Dimensions too large:	00002 ON

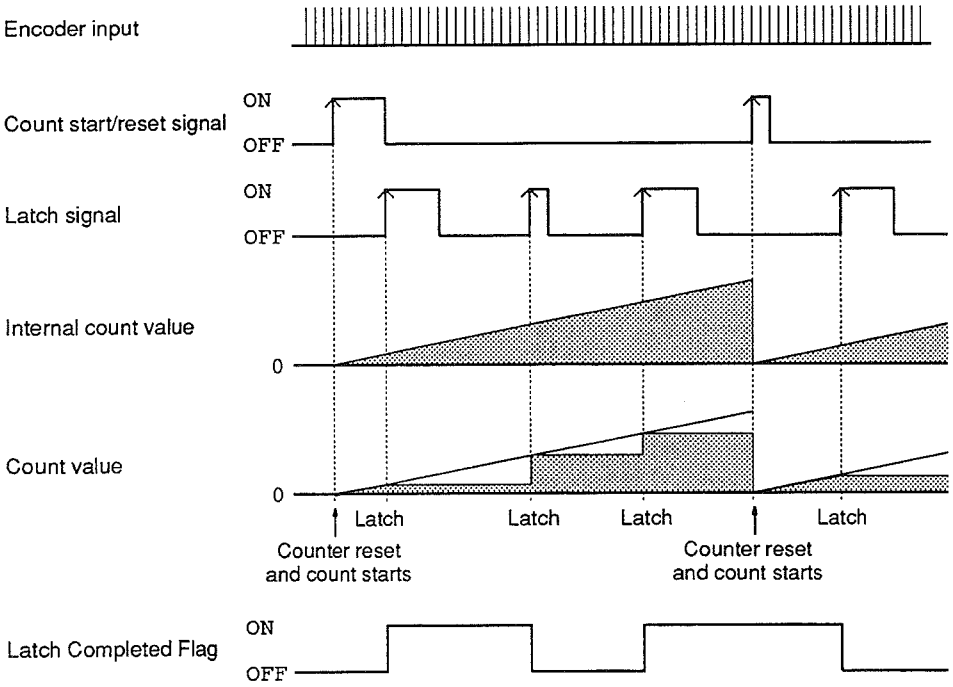
SECTION 11
Latch Mode

This section provides the information necessary for using the latch mode, including information on operating conditions, data areas, settings, and performance specifications.

11-1 Operation

In latch mode, the High-speed Counter Unit begins counting encoder inputs when the High-speed Counter Unit is reset after the mode setting is made. This internal count continues until the High-speed Counter Unit is reset again, but the count doesn't change until the latch signal is received.

The count is set to the internal count value when the latch signal goes from OFF to ON (the latch signal's rising edge) and the new count value is maintained until the next time the latch signal goes ON.



Operating Conditions

Counter initial value: 0
Count range: –8,388,608 to +8,388,607 (BCD)
80000000 to 7FFFFFFF (binary)
(–2,417,483,648 to +2,417,483,647 in decimal)

The count stops when it reaches the maximum/minimum value and an overflow/underflow error occurs.

The count can be incremented and decremented.

External outputs are not performed.

The count present value is refreshed with the internal count value when the latch signal goes ON (the rising edge). Both the external control input and Internal Latch Bit can be used for the latch signal.

A reset can be performed with the reset condition while the Unit is counting.

For details regarding reset conditions, refer to *4-4 Counter Reset Conditions*.

Note The count present value is refreshed every 10 ms from the start of counting until the first time the latch signal goes ON.

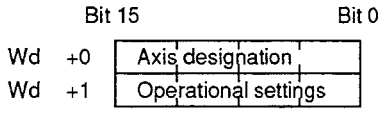
11-2 Performance Specifications

Item	Specifications	
Coefficient input signals:	Encoder input A:	Encoder input B:
Offset phase inputs	A phase	B phase
Up and down pulse inputs	Increment pulse	Decrement pulse
Pulse and direction inputs	Pulse	Direction
External input signals	Pulse input Z (count start signal) External control input (latch signal)	
External output signals	None	
Coefficient range	BCD mode: –8,388,608 to +8,388,607 Binary mode: –2,417,483,648 to +2,417,483,647	
Multiplier function	×1, ×4 (offset phase inputs only)	
Reset interval	1.5 ms min.	

11-3 Data Areas and Settings

11-3-1 Operating Mode Data Settings

The following data is set for each axis in latch mode.



Both the external control input and Internal Latch Bit can be used for the latch signal. The count is started by resetting the counter after the mode has been set.

Axis Designation

Designate either or both axes by means of the following settings:

0000: Both axis-1 and axis-2.

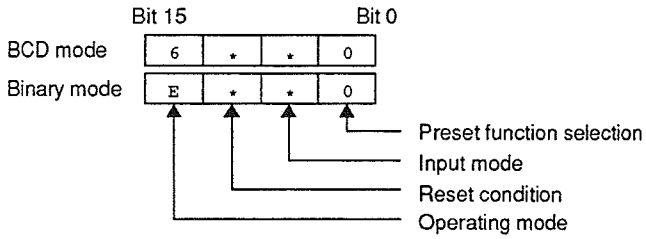
0001: Axis-1 only.

0002: Axis-2 only.

When either 0001 or 0002 is specified, the axis data will apply to that axis only. When 0000 is specified, the axis data for axis-1 and axis-2 is specified in that order. In that case, "0002" must be set at the beginning of the data for axis-2, and the data must be completely set for axis-1.

Operational Settings

Set the operational data for each digit as shown below. Once the settings have been made for an axis, they cannot be changed until the power is turned off.



Preset Function Selection

The preset function can't be used in latch mode. Set this digit to "0."

Input Mode

0: Offset phase inputs (×4 multiplier)

1: Offset phase inputs (×1 multiplier)

2: Up and down pulse inputs

3: Pulse and direction inputs

Reset Condition

2: Z(↑), I

3: Z(↓), I

5: Z(↑)

6: Z(↓)

7: I(↑)

The abbreviations Z, E, and I stand for pulse input Z, external control input, and internal reset flag respectively. Refer to *4-4 Counter Reset Conditions* for details regarding reset conditions.

11-3-2 Data Areas

The following table shows the functions allocated to the High-speed Counter Unit data areas when in latch mode. The explanation here is in terms of the 2-word mode. For information concerning the 4-word mode, refer to *5-1 I/O Allocation and Memory Configuration.*

Word	Bit	Function	
Beginning word (output)	00 01 02	Reserved for system use. Write-protected.	
	03	Internal Reset Flag	Axis-1
	04	Internal Latch Bit	
	05 06 07 08	Not used.	
	09	Internal Reset Flag	Axis-2
	10	Internal Latch Bit	
	11 12 13 14 15	Not used.	
Beginning word + 1 (input)	00	Reserved for system use.	
	01	Special I/O Read Completion Flag	
	02	Reserved for system use.	
	03	Latch Completed Flag	Axis-1
	04	Latch Completed Flag	Axis-2
	05	Control input	Axis-1
	06	Control input	Axis-2
	07	Error Flag	Axis-1 and axis-2
	08 09 10 11 12 13 14 15	Not used.	

Internal Reset Flag

This bit is used as an Internal Reset Flag, but whether or not it is actually used for resetting is determined by the reset condition setting. (Refer to *4-4 Counter Reset Conditions.*)

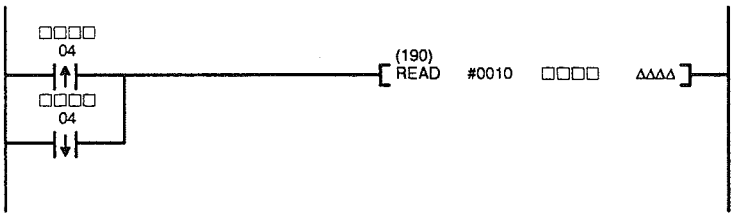
Internal Latch Bit

The count value is set to the internal count on the rising edge of the Internal Latch Bit or external control input.

Latch Completed Flag

The status of the Latch Completed Flag is toggled (OFF → ON or ON → OFF) each time the latch signal is input and the count value is reflected in the READ data area. The latched count value is reflected in the READ data area once every 10 ms. The Latch Completed Flag will be toggled only once if more than one latch signal is input in 10 ms.

If the CPU's cycle time is longer than 10 ms, it might not be possible to detect changes in the Latch Completed Flag from the program. The following program section can be used to determine latch timing (for axis-2 in this case).



Special I/O Read Completion Flag

This bit remains ON while the High-speed Counter Unit is processing WRIT instruction settings. The results will not be reflected in the data area until this bit turns OFF. After the WRIT instruction has been executed, this bit will not turn ON again until the next execution cycle.

Control Input Signals

These signals reflect the status of external control inputs.

Error Flag

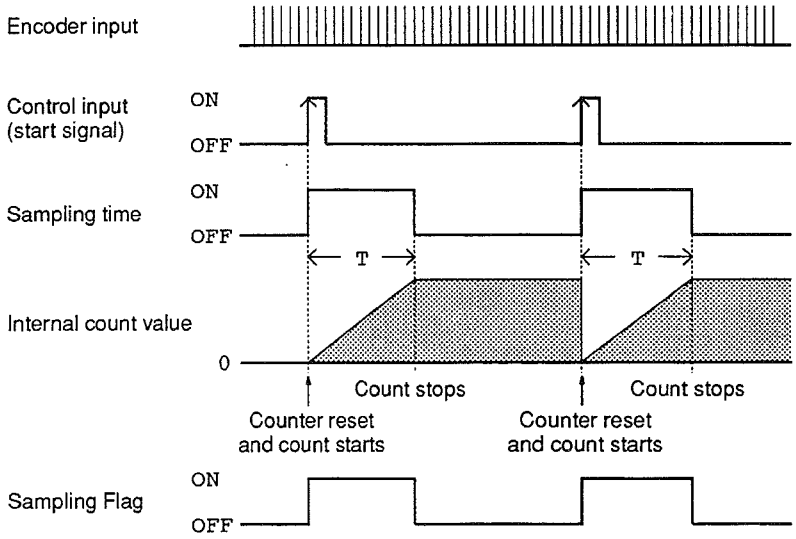
This bit turns ON when an error occurs at either axis. For details, refer to *Section 13 Error Processing and Troubleshooting.*

SECTION 12
Sampling Mode

This section provides the information necessary for using the sampling mode, including information on operating conditions, data areas, settings, and performance specifications. Two application examples are provided at the end of the section.

12-1 Operation

In sampling mode, the High-speed Counter Unit begins counting encoder inputs when the start count signal goes ON (the signal's rising edge). Counting stops after the preset sampling time has elapsed. If the start count signal goes from OFF to ON again while the Unit is counting, the counter will be reset and resume counting from 0.



Operating Conditions

Counter initial value: 0
Count range: –8,388,608 to +8,388,607 (BCD)
80000000 to 7FFFFFFF (binary)
(–2,147,483,648 to +2,147,483,647 in decimal)

The count stops when it reaches the maximum or minimum value.

Sampling time settings: 10 to 9,999 ms (BCD)
10 to 65,535 ms (binary)

The count can be incremented and decremented.

After the sampling time elapses, the counter value will be maintained until the start count signal goes ON again or the reset condition is met.

The type of start count signal and the sampling time can be changed even after the operating mode has been set. When the sampling time is changed while the Unit is counting, the new sampling time will be valid the next time that the count starts.

Either the external control input or a bit can be selected as the start count signal.

External outputs are not performed.

A reset can be performed with the reset condition while the Unit is counting.

For details regarding reset conditions, refer to *4-4 Counter Reset Conditions*.

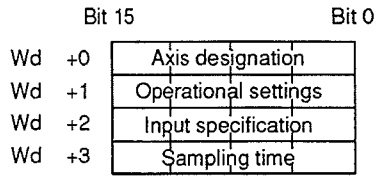
12-2 Performance Specifications

Item	Specifications	
Coefficient input signals:	Encoder input A:	Encoder input B:
Offset phase inputs	A phase	B phase
Up and down pulse inputs	Increment pulse	Decrement pulse
Pulse and direction inputs	Pulse	Direction
External input signals	Pulse input Z (reset signal) External control input (reset/start count signal)	
External output signals	None	
Coefficient range	BCD mode: –8,388,608 to +8,388,607 Binary mode: –2,147,483,648 to +2,147,483,647	
Multiplier function	×1, ×4 (offset phase inputs only)	
Settings	Sampling time (1-ms units) 10 to 9,999 ms (BCD) 10 to 65,535 ms (binary)	
Accuracy	Sampling time $^{+0}/_{-1}$ ms	
Reset interval	1.5 ms min.	

12-3 Data Areas and Settings

12-3-1 Operating Mode Data Settings

The following data is set for each axis in sampling mode.



Axis Designation

Designate either or both axes by means of the following settings:

0000: Both axis-1 and axis-2.

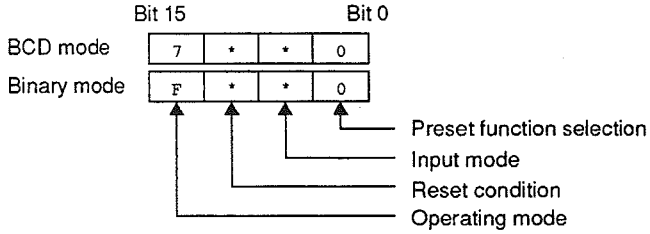
0001: Axis-1 only.

0002: Axis-2 only.

When either 0001 or 0002 is specified, the axis data will apply to that axis only. When 0000 is specified, the axis data for axis-1 and axis-2 is specified in that order. In that case, "0002" must be set at the beginning of the data for axis-2, and the data must be completely set for axis-1.

Operational Settings

Set the operational data for each digit as shown below. Once the settings have been made for an axis, they cannot be changed until the power is turned off.



Preset Function Selection

The preset function can't be used in sampling mode. Set this digit to "0."

Input Mode

0: Offset phase inputs (×4 multiplier)

1: Offset phase inputs (×1 multiplier)

2: Up and down pulse inputs

3: Pulse and direction inputs

Reset Condition

0: Z(↑), E, I

1: Z(↓), E, I

2: Z(↑), I

3: Z(↓), I

4: E(↑), I

5: Z(↑)

6: Z(↓)

7: I(↑)

When the preset function setting is "4," reset condition settings "0," "1," and "4" are not possible. The abbreviations Z, E, and I stand for pulse input Z, external control input, and Internal Reset Flag respectively. Refer to *4-4 Counter Reset Conditions* for details regarding reset conditions.

Input Specification

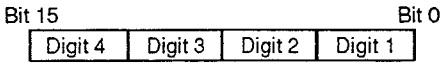
Specify the bit that will be used as the start count signal by means of the following settings:

0000: External control input

0001: Internal input bit

Sampling Time

Specify the 4-digit sampling time, as shown below.



The following ranges are possible:

BCD mode: 0010 to 9999 (10 to 9,999 ms)
Binary mode: 000A to FFFF (10 to 65,535 ms)

12-3-2 Data Areas

The following table shows the functions allocated to the High-speed Counter Unit data areas when in sampling mode. The explanation here is in terms of the 2-word mode. For information concerning the 4-word mode, refer to *5-1 I/O Allocation and Memory Configuration*.

Word	Bit	Function	
Beginning word (output)	00 01 02	Reserved for system use. Write-protected.	
	03	Internal Reset Flag	Axis-1
	04	Count Start Flag	
	05 06 07 08	Not used.	
	09	Internal Reset Flag	Axis-2
	10	Start Count Bit	
	11 12 13 14 15	Not used.	
Beginning word + 1 (input)	00	Reserved for system use.	
	01	Special I/O Read Completion Flag	
	02	Reserved for system use.	
	03	Sampling Flag	Axis-1
	04	Sampling Flag	Axis-2
	05	Control input	Axis-1
	06	Control input	Axis-2
	07	Error Flag	Axis-1 and axis-2
	08 09 10 11 12 13 14 15	Not used.	

Internal Reset Flag

This bit is used as an Internal Reset Flag, but whether or not it is actually used for resetting is determined by the reset condition setting. (Refer to *4-4 Counter Reset Conditions*.) When the reset operation is executed by means of the Internal Reset Flag alone, it is executed at the rising edge.

Count Start Flag

Depending on the input specification in the WRIT data, this bit can be used as the count start signal.

Special I/O Read Completion Flag

This bit remains ON while the High-speed Counter Unit is processing WRIT instruction settings. The results will not be reflected in the data area until this bit turns OFF. After the WRIT instruction has been executed, this bit will not turn ON again until the next execution cycle.

Sampling Flag

This flag is turned ON when the Unit is counting (sampling).

Control Input Signals

These signals reflect the status of external control inputs.

Error Flag

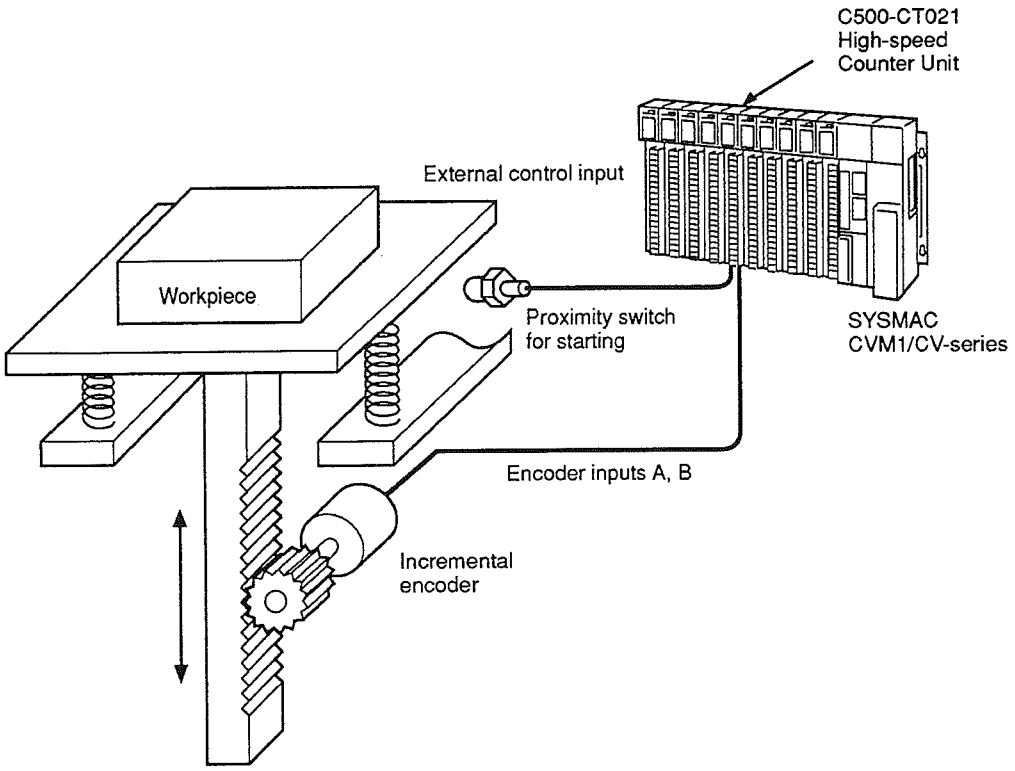
This bit turns ON when an error occurs at either axis. For details, refer to *Section 13 Error Processing and Troubleshooting*.

Note When the count is stopped due to an error, it cannot be restarted simply by clearing the error. After the error has been cleared, the start count signal must be turned ON again.

12-4 Application Examples

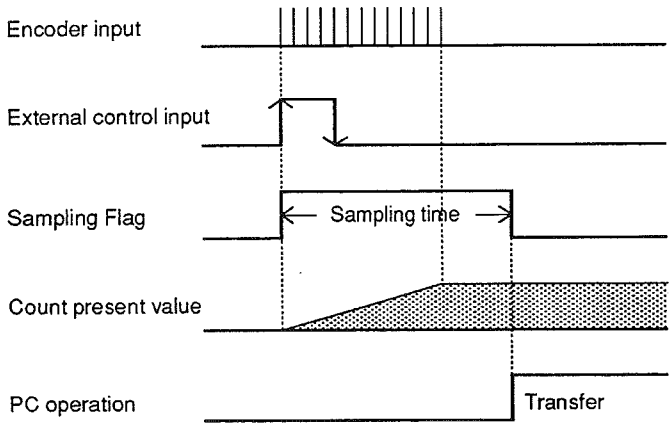
12-4-1 Example 1: Weight Measurement

This example shows how the High-speed Counter Unit can be used to weigh a workpiece. Assume that the High-speed Counter Unit has been assigned words 0004 and 0005. The following illustration shows the system configuration.



Operation

After loading the workpiece on the scale, wait a short time and read the count value. By waiting a short time, the oscillations from the scale's springs will die out and an accurate count value can be obtained.



Wiring

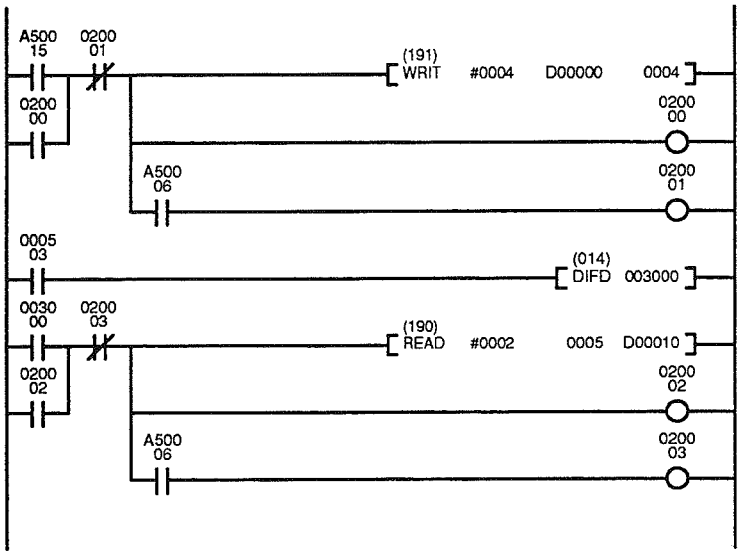
The incremental encoder outputs are connected to encoder inputs A and B. The proximity switch's output is connected to the external control input.

WRIT Data Settings

D00000	0001	Axis-1
D00001	F700	Sampling mode (binary mode); Reset: Internal Reset Flag (↑); Offset phase pulse inputs (×4 multiplier); Preset function can't be used.
D00002	0000	Count start signal: External control input
D00003	0BB8	Sampling time: 3,000 ms

Note Confirm that the processing of the settings has been completed by checking that the Special I/O Read Completion Flag (bit 01 of word n+1) is OFF in the next cycle after the WRIT instruction has been executed.

Program Example



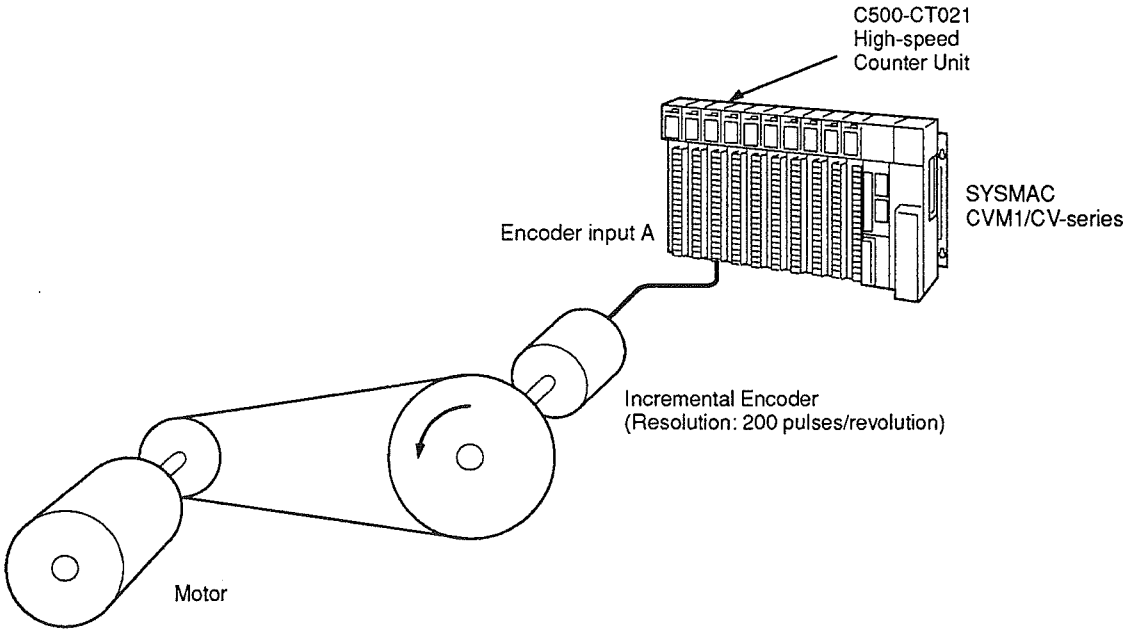
Makes settings at PC startup.

Detects completion of the measurement when the sampling flag goes OFF.

The count present value is stored in D00010 and D00011 after the measurement is completed.

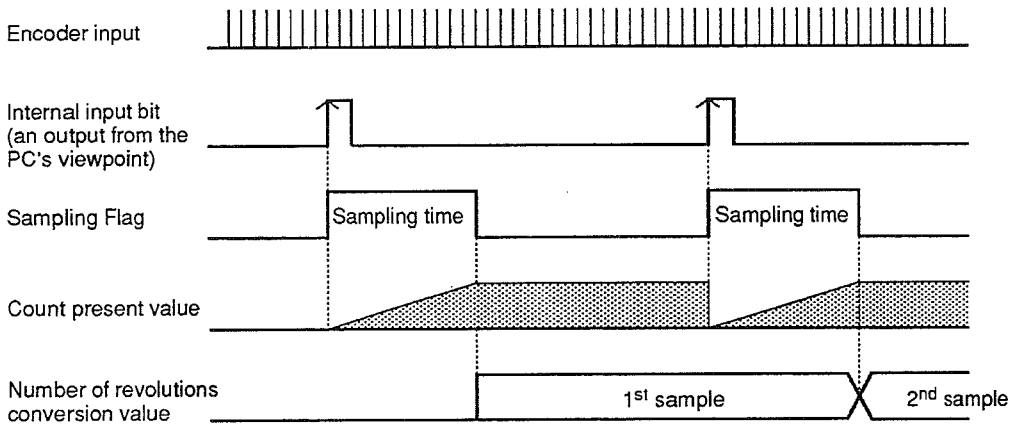
12-4-2 Example 2: Speed Measurement (Tachometer)

This example shows how the High-speed Counter Unit can be used to measure the speed of a motor. Assume that the High-speed Counter Unit has been assigned words 0004 and 0005. The following illustration shows the system configuration.



Operation

Pulses from the incremental encoder coupled to the rotating axis are measured at fixed intervals and the PC converts these measurements to rotational speed (RPMs).



Number of Revolutions Conversion

The incremental encoder's resolution is 200 pulses/revolution, so the revolutions per minute are:

$$\text{RPMs} = \frac{\text{Number of pulses/second (P)} \times 60}{\text{Number of pulses/revolution}} = P \times \frac{60}{200} = P \times \frac{3}{10} \text{ rpm}$$

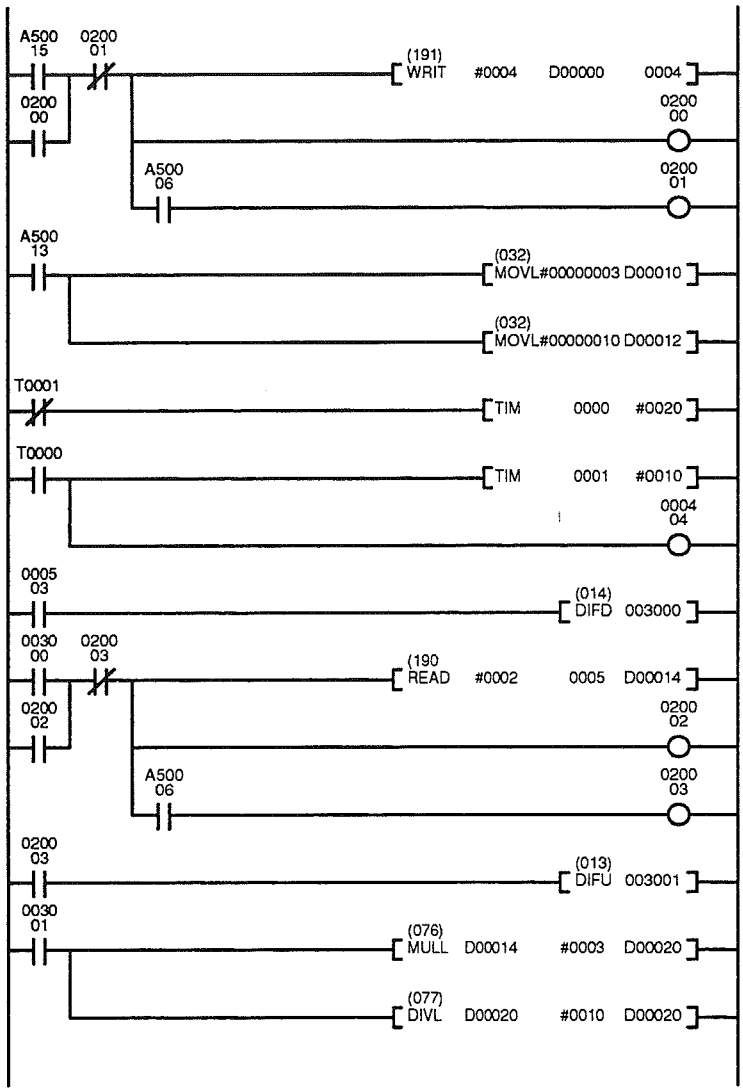
Wiring

The incremental encoder output is connected to encoder input A. Nothing is connected to encoder input B. Only the positive direction is used.

WRIT Data Settings

D00000	0002	Axis-2
D00001	7730	Sampling mode (BCD mode); Reset: Internal reset flag (↑); Pulse and direction inputs; Preset function can't be used.
D00002	0001	Count start signal: Internal input bit
D00003	1000	Sampling time: 1,000 ms

Program Example



Makes settings at PC startup.

Sets the values "0000" and "0003" in D00011 and D00010.

Sets the values "0000" and "0010" in D00013 and D00012.

Turns ON the internal input bit every 3 s. (Goes OFF again after 1 s.)

Detects completion of the measurement when the sampling flag goes OFF.

The count present value is stored in D00014 and D00015 after the measurement is completed.

After the value is stored, it is multiplied by 3/10 and stored in D00020 and D00021.

SECTION 13
Error Processing and Troubleshooting

This section provides information to help identify and correct errors that might occur during operation.

13-1 Error Processing

This section describes the error indicators and outputs that show when an error has occurred in the High-speed Counter Unit and explains how to correct those errors.

13-1-1 Error Indicators and Outputs

LED Indicators

The LED indicators will show when an error has occurred in the High-speed Counter Unit.

Error	Indicator status
WRIT instruction axis specification error	Both ERR indicators (axes 1 and 2) will flash.
Other errors	The affected axis' ERR indicator is lit.

Error Flag

The High-speed Counter Unit's Error Flag will be turned ON when an error occurs. The method for checking the Error Flag is different in 2-word mode and 4-word mode.

2-word Mode

The Error Flag is bit 07 of the input word (n+1) allocated to the Unit. Check the status of the flag normally (I/O refresh).

4-word Mode

A function corresponding to the 2-word mode's input word is allocated to address FF in the High-speed Counter Unit's read memory. Bit 07 of this word is the Error Flag. Read the status of this word from the High-speed Counter Unit with the random read command (when the MOV instruction is used) or the RD2 instruction. For details, refer to *Section 5 Data Configuration and Program Development.*

Error Codes

The cause of an error can be determined from the error code stored in the READ data (address 04 for axis-1, address 09 for axis-2). Refer to *Section 5 Data Configuration and Program Development* for details on reading the READ data. Refer to *13-1-2 Error Codes* for more details on error codes.

13-1-2 Error Codes

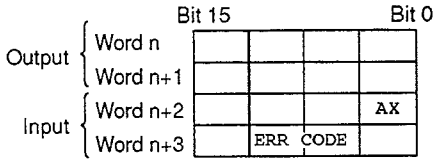
The following table lists the error codes and provides probable remedies to the causes of the errors. The "XX" at the end of an error code will contain the 2-digit hexadecimal address where the error occurred.

Error code	Meaning	Unit's status	Remedy
01XX	There was a mistake in the transmitted data. (WRIT instruction data error)	ERR indicator: Lit (affected axis only) External outputs: OFF (affected axis only) Count: Stopped (affected axis only)	Retransmit the instruction with correct data.
0201	The count exceeded the maximum for the operating mode. (Overflow error)	ERR indicator: Lit (affected axis only) External outputs: OFF (affected axis only) Count: Stopped (affected axis only)	Reset or preset.
0202	The count fell below the minimum for the operating mode. (Underflow error)	ERR indicator: Lit (affected axis only) External outputs: OFF (affected axis only) Count: Stopped (affected axis only)	Reset or preset.
03XX	A WRIT instruction data error and overflow/underflow error occurred.	ERR indicator: Lit (affected axes only) External outputs: OFF (affected axes only) Count: Stopped (affected axes only)	Retransmit the instruction with correct data, and reset or preset.
0400	There was a mistake in the transmitted axis specification data. (WRIT axis specification error)	ERR indicator: Flashing (Both axes) External outputs: O.K. (Both axes) Count: Continues (Both axes)	Retransmit the instruction with correct data, including the axis specifier.

Error code	Meaning	Unit's status	Remedy
05XX	A WRIT instruction data error and a WRIT axis specification error occurred.	ERR indicator: Lit (data error axis) Flashing (the other axis) External outputs: OFF (data error axis) O.K. (the other axis) Count: Stopped (data error axis) Continues (the other axis)	Retransmit the instruction with correct data.
0601	An overflow error and a WRIT axis specification error occurred.	ERR indicator: Lit (overflow axis) Flashing (the other axis) External outputs: OFF (overflow axis) O.K. (the other axis) Count: Stopped (overflow axis) Continues (the other axis)	Retransmit with correct data, including the axis specifier, and reset or preset.
0602	An underflow error and a WRIT axis specification error occurred.	ERR indicator: Lit (underflow axis) Flashing (the other axis) External outputs: OFF (underflow axis) O.K. (the other axis) Count: Stopped (underflow axis) Continues (the other axis)	Retransmit with correct data, including the axis specifier, and reset or preset.
07XX	A WRIT instruction data error, WRIT axis specification error, and overflow/underflow error occurred.	Some combination of the status given above.	Retransmit with correct data, and reset or preset.

13-1-3 Errors in 4-word Mode (Using MOV)

When the Unit is in 4-word mode and the MOV instruction has been used, an error is indicated by a 2-digit hexadecimal error code written to bits 4 through 11 of word n+3 when the "end command" is executed.



n: First allocated word
ERR CODE: Error code
AX: Axis where error occurred.

The 5 possible error codes are listed in the following table.

Error code	Name	Meaning
00	Normal completion	Normal completion
01	Command code error	The command code wasn't 0, 1, 2, or F.
02	Address overflow error	The specified address was greater than 5D for random write or greater than 09 for random read.
03	WRIT data error	There was a mistake in the settings data transmitted for a random write command.
04	Other error	The error caused by something other than the command.

The value "AX" in bits 0 to 3 of word n+2 indicates the axis in which the error occurred.

AX=1: Error occurred in axis-1.
AX=2: Error occurred in axis-2.
AX=3: Errors occurred in both axes.

Command code errors and Address overflow errors are checked regularly and bit 3 of word n+3 is turned ON if there is an error. Other errors are checked only when the end command is executed.

If the end command is executed and several errors have occurred since the last end command was executed, only the most recent error will be displayed. The previous error code will be cleared when the end command is executed.

13-2 Troubleshooting

Use the following troubleshooting table if the High-speed Counter Unit isn't operating normally or isn't operating as expected.

Symptom	Possible causes
The RUN indicator doesn't light.	Check whether the power supply voltage is wrong. Check whether the total current consumption of Units mounted to the backplane exceeds the current capacity of the Power Supply Unit. Check whether an error has occurred in the CPU. Check whether there is a source of noise near the Unit. There might be a malfunction in the hardware if none of the items above are causing the problem.
External outputs won't go ON. (indicators won't go ON, either.)	Check whether the External Output Enable Bit is ON. If the Unit is in linear mode or circular mode, check whether the output pattern has been set in the operating mode settings.
External outputs won't go ON. (indicators go ON, though.)	Check whether power is being supplied to the external outputs at terminal B18. Check whether the voltage supplied to terminal B18 is different from the output load voltage. Check whether the fuse in the back of the Unit has blown. Check whether the fuse in the back of the Unit is installed all the way into its holder. There might be a malfunction in the hardware if none of the items above are causing the problem.
The counter counts incorrectly.	Check whether there is a power line close to the signal wiring. Make sure that the twisted-pair cable's shield is grounded to 100 Ω or less. If the ground is bad, it might be best to disconnect the shield from the ground.

Index

Numbers

A

B

C

D

E

F–G

I

L

M–N

O

P

R

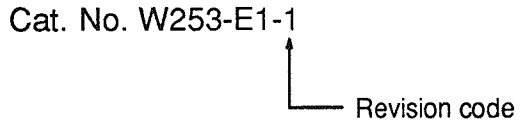
S

T–U

W

Revision History

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



The following table outlines the changes made to the manual during each revision. Page numbers refer to the previous version.

Revision code	Date	Revised content
1	March 1995	Original production

OMRON Corporation
FA Systems Division H.Q.
66 Matsumoto
Mishima-city, Shizuoka 411-8511
Japan
Tel: (81)559-77-9181/Fax: (81)559-77-9045

Regional Headquarters

OMRON EUROPE B.V.
Wegalaan 67-69, NL-2132 JD Hoofddorp
The Netherlands
Tel: (31)2356-81-300/Fax: (31)2356-81-388

OMRON ELECTRONICS LLC
1 East Commerce Drive, Schaumburg, IL 60173
U.S.A.
Tel: (1)847-843-7900/Fax: (1)847-843-8568

OMRON ASIA PACIFIC PTE. LTD.
83 Clemenceau Avenue,
#11-01, UE Square,
Singapore 239920
Tel: (65)835-3011/Fax: (65)835-2711

OMRON

Authorized Distributor:

Cat. No. W253-E1-1

Note: Specifications subject to change without notice.

Printed in Japan
1101—0.1M