

Machine Automation Controller

CJ-series

High-speed Counter Units

Operation Manual
for NJ-series CPU Unit

CJ1W-CT021

High-speed Counter Units



W492-E1-03

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Introduction

Thank you for purchasing a CJ-series CJ1W-CT021 High-speed Counter Unit.

This manual contains information that is necessary to use the CJ-series CJ1W-CT021 High-speed Counter Unit for an NJ-series CPU Unit. Please read this manual and make sure you understand the functionality and performance of the NJ-series CPU Unit before you attempt to use it in a control system.

Keep this manual in a safe place where it will be available for reference during operation.

Intended Audience

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

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

For programming, this manual is intended for personnel who understand the programming language specifications in international standard IEC 61131-3 or Japanese standard JIS B3503.

Applicable Products

This manual covers the following products.

- CJ-series CJ1W-CT021 High-speed Counter Unit

Relevant Manuals

There are three manuals that provide basic information on the NJ-series CPU Units: the *NJ-series CPU Unit Hardware User's Manual*, the *NJ-series CPU Unit Software User's Manual*, and the *NJ-series Instructions Reference Manual*.

Most operations are performed from the Sysmac Studio Automation Software. Refer to the *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504) for information on the Sysmac Studio.

Other manuals are necessary for specific system configurations and applications.

Read all of the manuals that are relevant to your system configuration and application to make the most of the NJ-series CPU Unit.

	NJ-series User's Manuals								CJ-series Special Unit Operation Manuals for NJ-series CPU Unit
	Basic information								
	NJ-series CPU Unit Hardware User's Manual	NJ-series CPU Unit Software User's Manual	NJ-series Instructions Reference Manual	NJ-series CPU Unit Motion Control User's Manual	NJ-series CPU Unit Built-in EtherCAT Port User's Manual	NJ-series Motion Control Instructions Reference Manual	NJ-series CPU Unit Built-in EtherNet/IP Port User's Manual	NJ-series Troubleshooting Manual	
Introduction to NJ-series Controllers	●								
Setting devices and hardware									
Using motion control				●					
Using EtherCAT	●				●				
Using EtherNet/IP							●		
Using CJ-series Units									●
Software settings									
Using motion control		●		●					
Using EtherCAT					●				
Using EtherNet/IP							●		
Programming		●	●						
Using motion control				●		●			
Using EtherCAT					●				
Using CJ-series Units									●
Programming error processing								●	
Testing operation and debugging									
Using motion control		●		●					
Using EtherCAT					●				
Using EtherNet/IP							●		
Troubleshooting and managing errors in an NJ-series Controller	△	△		△			△	●	
Use the relevant manuals for references according to any error that occurs.									
Maintenance									
Using EtherCAT	●				●				
Using EtherNet/IP							●		
Using CJ-series Units									●

Manual Configuration

NJ-series CPU Unit Hardware User's Manual (Cat. No. W500)

Section	Description
Section 1 Introduction	This section provides an introduction to the NJ-series Controllers and their features, and gives the NJ-series Controller specifications.
Section 2 System Configuration	This section describes the system configuration used for NJ-series Controllers.
Section 3 Configuration Units	This section describes the parts and functions of the configuration devices in the NJ-series Controller configuration, including the CPU Unit and Configuration Units.
Section 4 Installation and Wiring	This section describes where and how to install the CPU Unit and Configuration Units and how to wire them.
Section 5 Troubleshooting	This section describes the event codes, error confirmation methods, and corrections for errors that can occur.
Section 6 Inspection and Maintenance	This section describes the contents of periodic inspections, the service life of the Battery and Power Supply Units, and replacement methods for the Battery and Power Supply Units.
Appendices	The appendices provide the specifications of the Basic I/O Units, Unit dimensions, load short-circuit protection detection, line disconnection detection, and measures for EMC Directives.

NJ-series CPU Unit Software User's Manual (Cat. No. W501)

Section	Description
Section 1 Introduction	This section provides an introduction to the NJ-series Controllers and their features, and gives the NJ-series Controller specifications.
Section 2 CPU Unit Operation	This section provides information that is necessary to use the CPU Unit, including how the CPU Unit works and the operations that it performs depending on the status of the CPU Unit.
Section 3 I/O Ports, Slave Configuration, and Unit Configuration	This section describes how to use I/O ports, how to create the slave configuration and unit configuration and how to assign functions.
Section 4 Controller Setup	This section describes the initial settings of the function modules.
Section 5 Designing Tasks	This section describes the task system and types of tasks.
Section 6 Programming	This section describes programming, including the programming languages and the variables and instructions that are used in programming.
Section 7 Checking Operation and Actual Operation	This section describes the items and procedures for checking the operation of an NJ-series Controller, including offline debugging procedures.
Section 8 CPU Unit Functions	This section describes the functionality provided by the CPU Unit.
Section 9 Communications Setup	This section describes how to go online with the CPU Unit and how to connect to other devices.
Section 10 Example of Actual Application Procedures	This section describes the procedures that are used to actually operate an NJ-series Controller.
Section 11 Troubleshooting	This section describes the event codes, error confirmation methods, and corrections for errors that can occur.
Appendices	The appendices provide the CPU Unit specifications, task execution times, specifications of individual system-defined variables, data attribute lists, CJ-series Unit memory information, CJ-series Unit memory allocation methods, and version information.

Sysmac Studio Version 1 Operation Manual (Cat. No. W504)

Section	Description
Section 1 Introduction	This section provides an overview and lists the specifications of the Sysmac Studio and describes its features and components.
Section 2 Installation and Uninstallation	This section describes how to install and uninstall the Sysmac Studio.
Section 3 System Design	This section describes the basic concepts for designing an NJ-series System with the Sysmac Studio and the basic operating procedures.
Section 4 Programming	This section describes how to create programs with the Sysmac Studio.
Section 5 Online Connections to a Controller	This section describes how to go online with a Controller.
Section 6 Debugging	This section describes how to debug the programs online on the Controller or debug it offline with the Simulator.
Section 7 Other Functions	This section describes other functions that are supported by the Sysmac Studio, including security functions and troubleshooting functions.
Section 8 Reusing Programming	This section describes how to reuse the programs that you create with the Sysmac Studio.
Section 9 Support Software Provided with the Sysmac Studio	This section describes the Support Software that is provided with the Sysmac Studio.
Section 10 Troubleshooting	This section describes the error messages that are displayed when you check a program on the Sysmac Studio and how to correct those errors.
Appendices	The appendices describe the following: Driver Installation for Direct USB Cable Connection Specifying One of Multiple Ethernet Interface Cards Online Help Simulation Instructions

CJ-series High-speed Counter Units Operation Manual for NJ-series CPU Unit (Cat. No. W492) (This Manual)

Section	Description
Section 1 Introduction	This section describes the functionality and the specifications of the High-speed Counter Unit, and the operating procedure.
Section 2 Components, Installation and Wiring	This section describes the details of the components and where and how to install and wire the High-speed Counter Unit.
Section 3 Operation and Configuration	This section describes the functionality of the High-speed Counter Unit and how to configure the Unit.
Section 4 Exchanging Data with CPU	This section describes the data exchange between the CPU Unit and High-speed Counter Unit and the definitions of the device variables for CJ-series Unit.
Section 5 Error Processing, Maintenance and Inspection	This section describes the troubleshooting procedure, event logs and maintenance procedure for the High-speed Counter Unit.
Section 6 Application Examples	This section provides an application example of the High-speed Counter Unit using a sample program.
Appendices	---

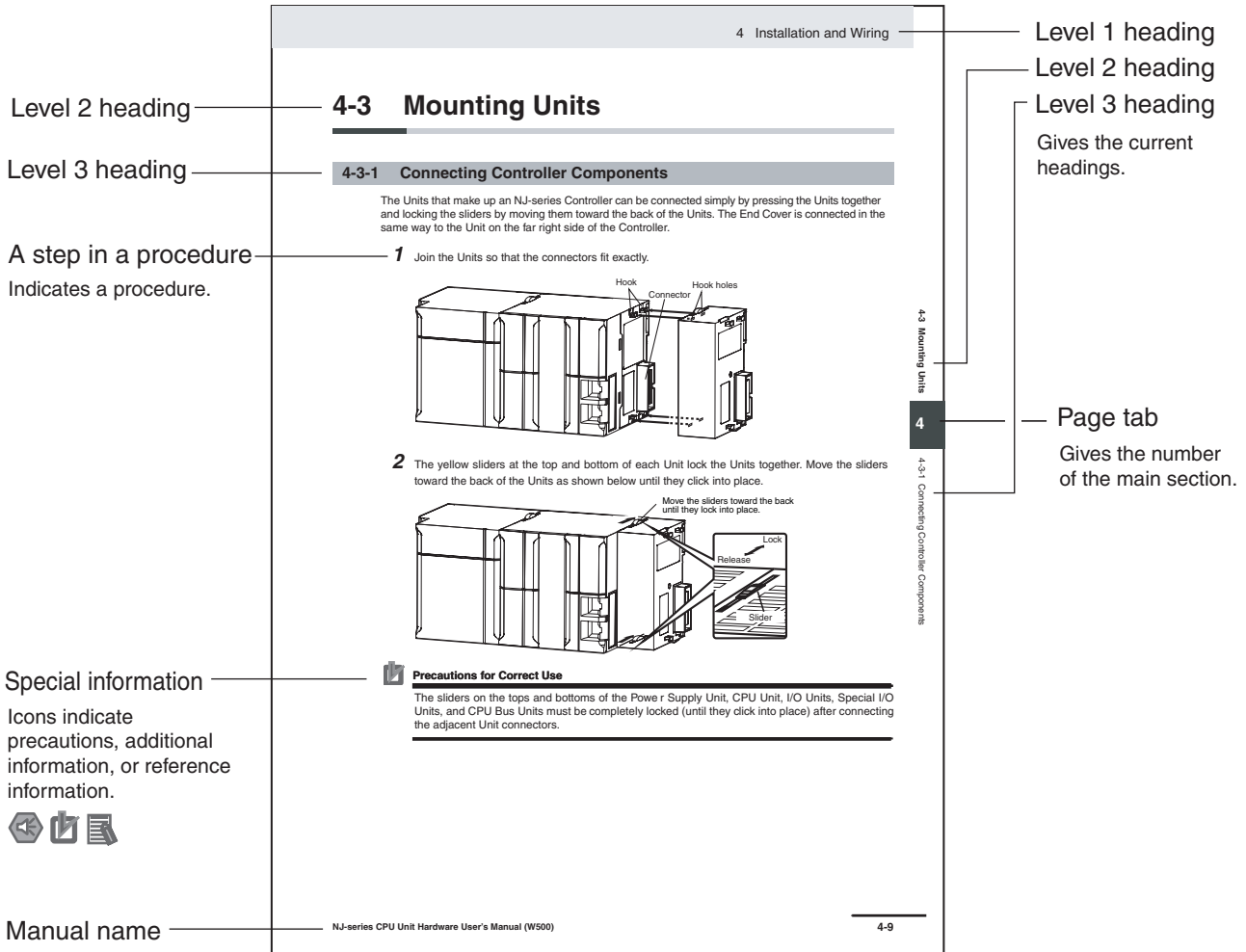
CJ-series High-speed Counter Units Operation Manual (Cat. No. W401)

Section	Description
Section 1 Introduction	This section describes the functionality and the specifications of the High-speed Counter Unit, and the operating procedure.
Section 2 Components, Installation and Wiring	This section describes the details of the components and where and how to install and wire the High-speed Counter Unit.
Section 3 Operation and Configuration	This section describes the functionality of the High-speed Counter Unit and how to configure the Unit.
Section 4 Exchanging Data with CPU	This section describes the data exchange between the CPU Unit and High-speed Counter Unit and data definitions.
Section 5 Error Processing, Maintenance and Inspection	This section describes the troubleshooting and maintenance procedures for the High-speed Counter Unit.
Section 6 Application Examples	This section provides application examples of the High-speed Counter Unit using program samples.
Appendices	---

Manual Structure

Page Structure

The following page structure is used in this manual.



This illustration is provided only as a sample. It may not literally appear in this manual.

Special Information

Special information in this manual is classified as follows:



Precautions for Safe Use

Precautions on what to do and what not to do to ensure safe usage of the product.



Precautions for Correct Use

Precautions on what to do and what not to do to ensure proper operation and performance.



Additional Information

Additional information to read as required.

This information is provided to increase understanding or make operation easier.

Note References are provided to more detailed or related information.

Precaution on Terminology

In this manual, “download” refers to transferring data from the Sysmac Studio to the physical Controller and “upload” refers to transferring data from the physical Controller to the Sysmac Studio.

For the Sysmac Studio, synchronization is used to both upload and download data. Here, “synchronize” means to automatically compare the data for the Sysmac Studio on the computer with the data in the physical Controller and transfer the data in the direction that is specified by the user.

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Read and Understand this Manual

Please read and understand this manual before using the products. 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.

Safety Precautions

Definition of Precautionary Information

The following notation is used in this manual to provide precautions required to ensure safe usage of a CJ-series High-speed Counter Unit. The safety precautions that are provided are extremely important to safety. Always read and heed the information provided in all safety precautions. The following notation is used.



WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. Additionally, there may be severe property damage.



Caution

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



Precautions for Safe Use

Indicates precautions on what to do and what not to do to ensure safe usage of the product.



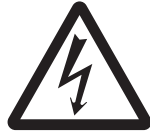
Precautions for Correct Use

Indicates precautions on what to do and what not to do to ensure proper operation and performance.

Symbols



The circle and slash symbol indicates operations that you must not do. The specific operation is shown in the circle and explained in text. This example indicates prohibiting disassembly.



The triangle symbol indicates precautions (including warnings). The specific operation is shown in the triangle and explained in text. This example indicates a precaution for electric shock.



The triangle symbol indicates precautions (including warnings). The specific operation is shown in the triangle and explained in text. This example indicates a general precaution.



The filled circle symbol indicates operations that you must do. The specific operation is shown in the circle and explained in text. This example shows a general precaution for something that you must do.

WARNING

During Power Supply

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



Do not attempt to take any Unit apart. In particular, high-voltage parts are present in the Power Supply Unit while power is supplied or immediately after power is turned OFF. Touching any of these parts may result in electric shock. There are sharp parts inside the Unit that may cause injury.



Fail-safe Measures

Provide safety measures in external circuits to ensure safety in the system if an abnormality occurs due to malfunction of the CPU Unit, other Units, or slaves or due to other external factors affecting operation. Not doing so may result in serious accidents due to incorrect operation.



Emergency stop circuits, interlock circuits, limit circuits, and similar safety measures must be provided in external control circuits.



The Controller outputs may remain ON or OFF due to deposition or burning of the output relays or destruction of the output transistors. As a countermeasure for such problems, external safety measures must be provided to ensure safe operation of the system.



The CPU Unit will turn OFF all outputs from Basic Output Units in the following cases. The remote I/O slaves will operate according to the settings in the slaves.

- If an error occurs in the power supply
- If the power supply connection becomes faulty
- If a CPU watchdog timer error or CPU reset occurs
- If a major fault level Controller error occurs
- While the CPU Unit is on standby until RUN mode is entered after the power is turned ON



External safety measures must be provided to ensure safe operation of the system in such cases.

If external power supplies for slaves or other devices are overloaded or short-circuited, the voltage will drop, outputs will turn OFF, and the system may be unable to read inputs. Provide external safety measures in controls with monitoring of external power supply voltage as required so that the system operates safely in such a case.



WARNING

Fail-safe Measures

Unintended outputs may occur when an error occurs in variable memory or in memory used for CJ-series Units. As a countermeasure for such problems, external safety measures must be provided to ensure safe operation of the system.



Provide measures in the communications system and user program to ensure safety in the overall system even if errors or malfunctions occur in data link communications or remote I/O communications.



If there is interference in remote I/O communications or if a major fault level error occurs, output status will depend on the products that are used. Confirm the operation that will occur when there is interference in communications or a major fault level error, and implement safety measures. Correctly set all of the EtherCAT slaves.



The NJ-series Controller continues normal operation for a certain period of time when a momentary power interruption occurs. This means that the NJ-series Controller may receive incorrect signals from external devices that are also affected by the power interruption. Accordingly, take suitable actions, such as external fail-safe measures and interlock conditions, to monitor the power supply voltage of the external device as required.



You must take fail-safe measures to ensure safety in the event of incorrect, missing, or abnormal signals caused by broken signal lines, momentary power interruptions, or other causes. Not doing so may result in serious accidents due to incorrect operation.



Voltage and Current Inputs

Make sure that the voltages and currents that are input to the Units and slaves are within the specified ranges. Inputting voltages or currents that are outside of the specified ranges may cause accidents or fire.



Downloading

Always confirm safety at the destination before you transfer a user program, configuration data, setup data, device variables, or values in memory used for CJ-series Units from the Sysmac Studio. The devices or machines may perform unexpected operation regardless of the operating mode of the CPU Unit.





Caution

Application

Do not touch any Unit when power is being supplied or immediately after the power supply is turned OFF. Doing so may result in burn injury.



Wiring

Be sure that all terminal screws and cable connector screws are tightened to the torque specified in the relevant manuals. The loose screws may result in fire or malfunction.



Online Editing

Execute online editing only after confirming that no adverse effects will be caused by deviations in the timing of I/O. If you perform online editing, the task execution time may exceed the task period, I/O may not be refreshed with external devices, input signals may not be read, and output timing may change.



Precautions for Safe Use

Disassembly and Dropping

- Do not attempt to disassemble, repair, or modify any Units. Doing so may result in malfunction or fire.
- Do not drop any Unit or subject it to abnormal vibration or shock. Doing so may result in Unit malfunction or burning.

Mounting

- The sliders on the tops and bottoms of the Power Supply Unit, CPU Unit, I/O Units, and other Units must be completely locked (until they click into place) after connecting the adjacent Unit connectors.

Installation

- Always connect to a ground of 100 Ω or less when installing the Units. A ground of 100 Ω or less must be installed when shorting the GR and LG terminals on the Power Supply Unit.

Wiring

- Follow the instructions in this manual to correctly perform wiring.
Double-check all wiring and switch settings before turning ON the power supply.
- Use crimp terminals for wiring.
Do not connect bare stranded wires directly to terminals.
- Do not pull on the cables or bend the cables beyond their natural limit.
Do not place heavy objects on top of the cables or other wiring lines. Doing so may break the cables.
- Mount terminal blocks and connectors only after checking the mounting location carefully.
- Be sure that the terminal blocks, expansion cables, and other items with locking devices are properly locked into place.
- Always remove any dustproof labels that are on the top of the Units when they are shipped before you turn ON the power supply. If the labels are not removed, heat will accumulate and malfunctions may occur.
- Before you connect a computer to the CPU Unit, disconnect the power supply plug of the computer from the AC outlet. Also, if the computer has an FG terminal, make the connections so that the FG terminal has the same electrical potential as the GR terminal on the Power Supply Unit. A difference in electric potential between the computer and Controller may cause failure or malfunction.
- If the external power supply to an Output Unit or slave has polarity, connect it with the correct polarity. If the polarity is reversed, current may flow in the reverse direction and damage the connected devices regardless of the operation of the Controller.

Power Supply Design

- Do not exceed the rated supply capacity of the Power Supply Units in the NJ-series Controller. The rated supply capacities are given in the *NJ-series CPU Unit Hardware User's Manual* (Cat. No. W500).
If the capacity is exceeded, operation may stop, malfunctions may occur, or data may not be backed up normally for power interruptions.
Use NJ-series Power Supply Units for both the NJ-series CPU Rack and Expansion Racks.
Operation is not possible if a CJ-series Power Supply Unit is used with an NJ-series CPU Unit or an NJ-series Power Supply Unit is used with a CJ-series CPU Unit.

- Do not apply voltages or connect loads to the Output Units or slaves in excess of the maximum ratings.
- Surge current occurs when the power supply is turned ON. When selecting fuses or breakers for external circuits, consider the above precaution and allow sufficient margin in shut-off performance. Refer to the relevant manuals for surge current specifications. Refer to the *NJ-series CPU Unit Hardware User's Manual* (Cat. No. W500) for surge current specifications.
- If the full dielectric strength voltage is applied or turned OFF using the switch on the tester, the generated impulse voltage may damage the Power Supply Unit. Use the adjustment on the tester to gradually increase and decrease the voltage.
- Apply the voltage between the Power Supply Unit's L1 or L2 terminal and the GR terminal when testing insulation and dielectric strength.
- Do not supply AC power from an inverter or other device with a square-wave output. Internal temperature rise may result in smoking or burning. Always input a sinusoidal wave with the frequency that is given in the *NJ-series CPU Unit Hardware User's Manual* (Cat. No. W500).
- Install external breakers and take other safety measures against short-circuiting in external wiring.

Turning ON the Power Supply

- It takes up to approximately 10 to 20 s to enter RUN mode after the power is turned ON. During that time, outputs will be OFF or will be the values specified in the Unit or slave settings, and external communications cannot be performed. Use the RUN output on the Power Supply Unit, for example, to implement fail-safe circuits so that external devices do not operate incorrectly.
- Configure the external circuits so that the power supply to the control system turns ON only after the power supply to the Controller has turned ON. If the power supply to the Controller is turned ON after the control power supply, temporary errors may result in incorrect control system signals because the output terminals on Output Units may momentarily turn ON when power supply is turned ON to the Controller.
- If you transfer data from a backup file on an SD Memory Card to the Controller when the power supply is turned ON, properly select the data groups to transfer. If the data for an unintended data group is transferred to the Controller, it may cause the equipment to operate unpredictably.

Actual Operation

- Check the user program, data, and parameter settings for proper execution before you use them for actual operation.

Turning OFF the Power Supply

- Never turn OFF the power supply to the Controller when the BUSY indicator is flashing. While the BUSY indicator is lit, the user program and settings in the CPU Unit are being backed up in the built-in non-volatile memory. This data will not be backed up correctly if the power supply is turned OFF. Also, a major fault level Controller error will occur the next time you start operation, and operation will stop.
- Do not turn OFF the power supply or remove the SD Memory Card while SD Memory Card access is in progress (i.e., while the SD BUSY indicator flashes). Data may become corrupted, and the Controller will not operate correctly if it uses corrupted data. To remove the SD Memory Card from the CPU Unit while the power supply is ON, press the SD Memory Card power supply switch and wait for the SD BUSY indicator to turn OFF before you remove the SD Memory Card.
- Do not disconnect the cable or turn OFF the power supply to the Controller when downloading data or the user program from Support Software.
- Always turn OFF the power supply to the Controller before you attempt any of the following.
 - Mounting or removing I/O Units or the CPU Unit
 - Assembling the Units
 - Setting DIP switches or rotary switches

- Connecting cables or wiring the system
- Connecting or disconnecting the connectors

The Power Supply Unit may continue to supply power to the rest of the Controller for a few seconds after the power supply turns OFF. The PWR indicator is lit during this time. Confirm that the PWR indicator is not lit before you perform any of the above.

Operation

- Confirm that no adverse effect will occur in the system before you attempt any of the following.
 - Changing the operating mode of the CPU Unit (including changing the setting of the Operating Mode at Startup)
 - Changing the user program or settings
 - Changing set values or present values
 - Forced refreshing
- Always sufficiently check the safety at the connected devices before you change the settings of an EtherCAT slave or Special Unit.
- If two different function modules are used together, such as when you use CJ-series Basic Output Units and EtherCAT slave outputs, take suitable measures in the user program and external controls to ensure that safety is maintained in the controlled system if one of the function modules stops. The relevant outputs will stop if a partial fault level error occurs in one of the function modules.
- Always confirm safety at the connected equipment before you reset Controller errors with an event level of partial fault or higher for the EtherCAT Master Function Module.
When the error is reset, all slaves that were in any state other than Operational state due to a Controller error with an event level of partial fault or higher (in which outputs are disabled) will go to Operational state and the outputs will be enabled.
Before you reset all errors, confirm that no Controller errors with an event level of partial fault have occurred for the EtherCAT Master Function Module.
- Always confirm safety at the connected equipment before you reset Controller errors for a CJ-series Special Unit. When a Controller error is reset, the Unit where the Controller error with an event level of observation or higher will be restarted.
Before you reset all errors, confirm that no Controller errors with an event level of observation or higher have occurred for the CJ-series Special Unit. Observation level events do not appear on the Controller Error Tab Page, so it is possible that you may restart the CJ-series Special Unit without intending to do so.
You can check the status of the `_CJB_UnitErrSta[0,0]` to `_CJB_UnitErrSta[3,9]` error status variables on a Watch Tab Page to see if an observation level Controller error has occurred.

Battery Backup

- The user program and initial values for the variables are stored in non-volatile memory in the CPU Unit. The present values of variables with the Retain attribute and the values of the Holding, DM, and EM Areas in the memory used for CJ-series Units are backed up by a Battery. If the Battery is not connected or the Battery is exhausted, the CPU Unit detects a Battery-backup Memory Check Error. If that error is detected, variables with a Retain attribute are set to their initial values and the Holding, DM, and EM Areas in memory used for CJ-series Units are cleared to all zeros. Perform thorough verifications and provide sufficient measures to ensure that the devices perform safe operation for the initial values of the variables with Retain attributes and the resulting operation.

Debugging

- Forced refreshing ignores the results of user program execution and refreshes I/O with the specified values. If forced refreshing is used for inputs for which I/O refreshing is not supported, the inputs will first take the specified values, but they will then be overwritten by the user program. This operation differs from the force-set/reset functionality of the CJ-series PLCs.

- You cannot upload or download information for forced refreshing with the Sysmac Studio. After downloading data that contains forced refreshing, change to RUN mode and then use the Sysmac Studio to perform the operation for forced refreshing. Depending on the difference in the forced status, the control system may operate unexpectedly.
- Do not specify the same address for the AT specification for more than one variable. Doing so would allow the same entity to be accessed with different variable names, which would make the user program more difficult to understand and possibly cause programming mistakes.

General Communications

- When you use data link communications, check the error information that is given in *ErrSta* (Controller Error Status) to make sure that no error has occurred in the source device. Write the user program to use the received data only if there is no error. If there is an error in the source device, the data for the data link may contain incorrect values.
- Unexpected operation may result if inappropriate data link tables are set. Even if appropriate data link tables have been set, confirm that the controlled system will not be adversely affected before you transfer the data link tables. The data links start automatically after the data link tables are transferred.
- All CPU Bus Units are restarted when routing tables are transferred from Support Software to the CPU Unit. Confirm that the system will not be adversely affected by restarting before you transfer the routing tables.
- Tag data links will stop between related nodes while tag data link parameters are transferred during Controller operation. Confirm that the system will not be adversely affected before you transfer the tag data link parameters.

EtherNet/IP Communications

- All related EtherNet/IP nodes are reset when you transfer settings for the built-in EtherNet/IP port (including IP addresses and tag data links settings). Confirm that the system will not be adversely affected by resetting nodes before you transfer the settings.
- If EtherNet/IP tag data links (cyclic communications) are used with a repeating hub, the communications load on the network will increase. This will increase collisions and may prevent stable communications. Do not use repeating hubs on networks where tag data links are used. Use an Ethernet switch instead.

EtherCAT Communications

- Make sure that the communications distance, number of nodes connected, and method of connection for EtherCAT are within specifications. Do not connect EtherCAT communications to EtherNet/IP, a standard in-house LAN, or other networks. An overload may cause the network to fail or malfunction.
- Malfunctions or unexpected operation may occur for some combinations of EtherCAT revisions of the master and slaves. If you disable the revision check in the network settings, use the Sysmac Studio to check the slave revision settings in the master and the actual slave revisions, and then make sure that functionality is compatible in the slave manuals or other references. You can check the actual slave revisions from the Sysmac Studio or on slave nameplates.
- After you transfer the user program, the CPU Unit is restarted and communications with the EtherCAT slaves are cut off. During that period, the slave outputs behave according to the slave settings. The time that communications are cut off depends on the EtherCAT network configuration. If the EtherCAT network configuration contains only OMRON EtherCAT slaves, communications are cut off for a maximum of 45 seconds. Before you transfer the user program, confirm that the system will not be adversely affected.

- If the Fail-soft Operation parameter is set to stop operation, process data communications will stop for all slaves when an EtherCAT communications error is detected in a slave. For this reason, if Servo Drives are connected, the Servos for all axes will be turned OFF. Make sure that the Fail-soft Operation parameter setting results in safe operation when a device error occurs.
- EtherCAT communications are not always established immediately after the power supply is turned ON. Use the system-defined variables in the user program to confirm that communications are established before attempting control operations.
- If frames sent to EtherCAT slaves are lost due to noise or other causes, slave I/O data is not communicated, and the intended operation is sometimes not achieved. If noise countermeasures are required, use the `_EC_InDataInvalid` (Input Data Disable) system-defined variable as an interlock condition in the user program.
Refer to the *NJ-series CPU Unit Built-in EtherCAT Port User's Manual* (Cat. No. W505) for details.
The slave outputs behave according to the slave settings. Refer to the manuals for the slaves for details.
- When an EtherCAT slave is disconnected, communications will stop and control of the outputs will be lost not only for the disconnected slave, but for all slaves connected after it. Confirm that the system will not be adversely affected before you disconnect a slave.
- If you disconnect the cable from an EtherCAT slave to disconnect it from the network, any current communications frames may be lost. If frames are lost, slave I/O data is not communicated, and the intended operation is sometimes not achieved. Perform the following processing for a slave that needs to be replaced.
 - Program the `_EC_InDataInvalid` (Input Data Disable) system-defined variable as an interlock condition.
 - Set the Impermissible Number of Continuous Timeouts setting in the EtherCAT master to at least 2.
 Refer to the *NJ-series CPU Unit Built-in EtherCAT Port User's Manual* (Cat. No. W505) for details.

Motion Control

- Confirm the axis number carefully before you perform an MC Test Run.
- The motor is stopped if communications are interrupted between the Sysmac Studio and the CPU Unit during an MC Test Run. Connect the communications cable between the computer and CPU Unit securely and confirm that the system will not be adversely affected before you perform an MC Test Run.
- Always execute the Save Cam Table instruction if you change any of the cam data from the user program in the CPU Unit or from the Sysmac Studio. If the cam data is not saved, the previous condition will be restored when the power is turned ON again, possibly causing unexpected machine operation.
- The positive drive prohibit input (POT), negative drive prohibit input (NOT), and home proximity input (DEC) of the Servo Drive are used by the MC Function Module as the positive limit input, negative limit input, and home proximity input. Make sure that the signal widths for all of these input signals are longer than the control period of the MC Function Module. If the input signal widths are shorter than the control period, the MC Function Module may not be able to detect the input signals, resulting in incorrect operation.

Battery Replacement

- The Battery may leak, rupture, heat, or ignite. Never short-circuit, charge, disassemble, heat, or incinerate the Battery or subject it to strong shock.
- Dispose of any Battery that has been dropped on the floor or otherwise subjected to excessive shock. Batteries that have been subjected to shock may leak if they are used.
- UL standards require that only an experienced engineer replace the Battery. Make sure that an experienced engineer is in charge of Battery replacement.

- Apply power for at least five minutes before changing the Battery. Install a new Battery within five minutes (at 25°C) of turning OFF the power supply. If power is not supplied for at least 5 minutes, the saved data may be lost.

Unit Replacement

- We recommend replacing the Battery with the power turned OFF to prevent the CPU Unit's sensitive internal components from being damaged by static electricity and to prevent malfunctions. The Battery can be replaced without turning OFF the power supply. To do so, always touch a grounded piece of metal to discharge static electricity from your body before you start the procedure. After you replace the Battery, connect the Sysmac Studio and clear the Low Battery Voltage error.
- Make sure that the required data, including the user program, configurations, settings, variables, and memory used for CJ-series Units, is transferred to a CPU Unit that was replaced and to externally connected devices before restarting operation. Be sure to include the routing tables, network parameters, and other CPU Bus Unit data, which are stored in the CPU Unit.

Disposal

- Dispose of the product and Batteries according to local ordinances as they apply.



廢電池請回收

- The following information must be displayed for all products that contain primary lithium batteries with a perchlorate content of 6 ppb or higher when shipped to or transported through the State of California, USA.
Perchlorate Material - special handling may apply.
See www.dtsc.ca.gov/hazardouswaste/perchlorate.
- The CPU Unit contains a primary lithium battery with a perchlorate content of 6 ppb or higher. Place the above information on the individual boxes and shipping boxes when shipping finished products that contain a CPU Unit to the State of California, USA.

Precautions for Correct Use

Storage, Mounting, and Wiring

- Do not operate or store the Controller in the following locations. Operation may stop or malfunctions may occur.
 - Locations subject to direct sunlight
 - Locations subject to temperatures or humidity outside the range specified in the specifications
 - Locations subject to condensation as the result of severe changes in temperature
 - Locations subject to corrosive or flammable gases
 - Locations subject to dust (especially iron dust) or salts
 - Locations subject to exposure to water, oil, or chemicals
 - Locations subject to shock or vibration
- Take appropriate and sufficient countermeasures when installing the Controller in the following locations.
 - Locations subject to strong, high-frequency noise
 - Locations subject to static electricity or other forms of noise
 - Locations subject to strong electromagnetic fields
 - Locations subject to possible exposure to radioactivity
 - Locations close to power lines
- Before touching a Unit, be sure to first touch a grounded metallic object in order to discharge any static build-up.
- Install the Controller away from sources of heat and ensure proper ventilation. Not doing so may result in malfunction, in operation stopping, or in burning.
- An I/O bus check error will occur and the Controller will stop if an I/O Connecting Cable's connector is disconnected from the Rack. Be sure that the connectors are secure.
- Do not allow foreign matter to enter the openings in the Unit. Doing so may result in Unit burning, electric shock, or failure.
- Do not allow wire clippings, shavings, or other foreign material to enter any Unit. Otherwise, Unit burning, failure, or malfunction may occur. Cover the Units or take other suitable countermeasures, especially during wiring work.
- For EtherCAT and EtherNet/IP, use the connection methods and cables that are specified in the *NJ-series CPU Unit Built-in EtherCAT Port User's Manual* (Cat. No. W505) and the *NJ-series CPU Unit Built-in EtherNet/IP Port User's Manual* (Cat. No. W506). Otherwise, communications may be faulty.
- Use the rated power supply voltage for the Power Supply Units. Take appropriate measures to ensure that the specified power with the rated voltage and frequency is supplied in places where the power supply is unstable.
- Make sure that the current capacity of the wire is sufficient. Otherwise, excessive heat may be generated. When cross-wiring terminals, the total current for all the terminals will flow in the wire. When wiring cross-overs, make sure that the current capacity of each of the wires is not exceeded.
- Do not touch the terminals on the Power Supply Unit immediately after turning OFF the power supply. Residual voltage may cause electrical shock.
- If you use reed switches for the input contacts for AC Input Units, use switches with a current capacity of 1 A or greater.
If the capacity of the reed switches is too low, surge current may fuse the contacts.

Error Processing

- In applications that use the results of instructions that read the error status, consider the affect on the system when errors are detected and program error processing accordingly. For example, even the detection of a minor error, such as Battery replacement during operation, can affect the system depending on how the user program is written.
- If you change the event level of a Controller error, the output status when the error occurs may also change. Confirm safety before you change an event level.

Restoring and Automatically Transferring Data

- When you edit the restore command file or the automatic transfer command file, do not change anything in the file except for the “yes” and “no” specifications for the selectable data groups. If you change anything else in the file, the Controller may perform unexpected operation when you restore or automatically transfer the data.

Unit Replacement

- If you replace a CPU Bus Unit or Special I/O Unit, refer to operation manual for the Unit for information on the data required for individual Units and redo the necessary settings.
- The absolute encoder home offset is backed up with a Battery in the CPU Unit.
When you change the combination of the CPU Unit and Servomotor, e.g., when you add or replace a Servomotor, define home again.
To restore the information without changing the CPU Unit-Servomotor combination, remove the absolute encoder home offset from the data to restore.

Task Settings

- If a Task Period Exceeded error occurs, shorten the programs to fit in the task period or increase the setting of the task period.

Motion Control

- Use the system-defined variable in the user program to confirm that EtherCAT communications are established before you attempt to execute motion control instructions. Motion control instructions are not executed normally if EtherCAT communications are not established.
- Use the system-defined variables to monitor for errors in communications with the slaves that are controlled by the motion control function module. Motion control instructions are not executed normally if an error occur in slave communications.
- Before you start an MC Test Run, make sure that the operation parameters are set correctly.
- Do not download motion control settings during an MC Test Run.

EtherCAT Communications

- Do not disconnect the EtherCAT slave cables during operation. The outputs will become unstable.
- Set the Servo Drives to stop operation if an error occurs in EtherCAT communications between the Controller and a Servo Drive.
- Make sure that all of the slaves to be restored are participating in the network before you reset a Network Configuration Verification Error, Process Data Communications Error, or Link OFF Error in the EtherCAT Master Function Module. If any slave is not participating when any of these errors is reset, the EtherCAT Master Function Module may access slave with a different node address than the specified node address or the error may not be reset correctly.

Battery Replacement

- Be sure to install a replacement Battery within two years of the production date shown on the Battery label.
- Turn ON the power after replacing the Battery for a CPU Unit that has been unused for a long time. Leaving the CPU Unit unused again without turning ON the power even once after the Battery is replaced may result in a shorter Battery life.
- When you replace the Battery, use the CJ1W-BAT01 Battery Set.

SD Memory Cards

- Insert the SD Memory Card all the way.
- Do not turn OFF the power supply to the Controller during SD Memory Card access. The files may be corrupted.
If there is a corrupted file in the SD Memory Card, the file is automatically deleted by the restoration function when the power supply is turned ON.

Regulations and Standards

Conformance to EC Directives

Applicable Directives

- EMC Directives
- Low Voltage Directive

Concepts

● EMC Directive

OMRON devices that comply with EC Directives also conform to the related EMC standards so that they can be more easily built into other devices or the overall machine. The actual products have been checked for conformity to EMC standards.*

Whether the products conform to the standards in the system used by the customer, however, must be checked by the customer. EMC-related performance of the OMRON devices that comply with EC Directives will vary depending on the configuration, wiring, and other conditions of the equipment or control panel on which the OMRON devices are installed. The customer must, therefore, perform the final check to confirm that devices and the overall machine conform to EMC standards.

* Applicable EMC (Electromagnetic Compatibility) standards are as follows:

EMS (Electromagnetic Susceptibility): EN 61131-2 and EN 61000-6-2

EMI (Electromagnetic Interference): EN 61131-2 and EN 61000-6-4 (Radiated emission: 10-m regulations)

● Low Voltage Directive

Always ensure that devices operating at voltages of 50 to 1,000 VAC and 75 to 1,500 VDC meet the required safety standards. The applicable directive is EN 61131-2.

● Conformance to EC Directives

The NJ-series Controllers comply with EC Directives. To ensure that the machine or device in which the NJ-series Controller is used complies with EC Directives, the Controller must be installed as follows:

- The NJ-series Controller must be installed within a control panel.
- You must use reinforced insulation or double insulation for the DC power supplies connected to DC Power Supply Units and I/O Units.
- NJ-series Controllers that comply with EC Directives also conform to the Common Emission Standard (EN 61000-6-4). Radiated emission characteristics (10-m regulations) may vary depending on the configuration of the control panel used, other devices connected to the control panel, wiring, and other conditions.

You must therefore confirm that the overall machine or equipment complies with EC Directives.

Conformance to Shipbuilding Standards

The NJ-series Controllers comply with the following shipbuilding standards. Applicability to the shipbuilding standards is based on certain usage conditions. It may not be possible to use the product in some locations. Contact your OMRON representative before attempting to use a Controller on a ship.

Usage Conditions for NK and LR Shipbuilding Standards

- The NJ-series Controller must be installed within a control panel.
- Gaps in the door to the control panel must be completely filled or covered with gaskets or other material.
- The following noise filter must be connected to the power supply line.

Noise Filter

Manufacturer	Model
Cosel Co., Ltd.	TAH-06-683

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Unit Versions

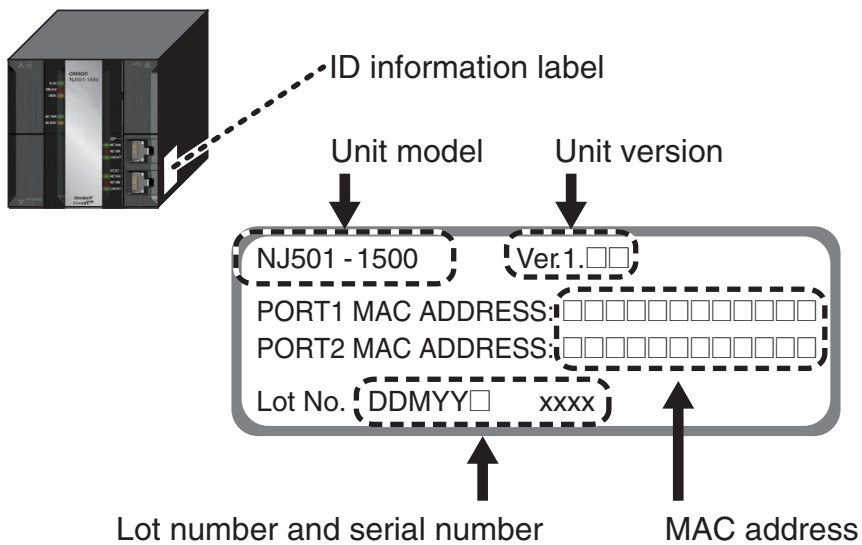
Unit Versions

A “unit version” has been introduced to manage CPU Units in the NJ Series according to differences in functionality accompanying Unit upgrades.

Notation of Unit Versions on Products

The unit version is given on the ID information label of the products for which unit versions are managed, as shown below.

Example for NJ-series NJ501-□□□□ CPU Unit:



The following information is provided on the ID information label.

Item	Description
Unit model	Gives the model of the Unit.
Unit version	Gives the unit version of the Unit.
Lot number and serial number	Gives the lot number and serial number of the Unit. DDMY: Lot number, □: For use by OMRON, xxxx: Serial number “M” gives the month (1 to 9: January to September, X: October, Y: November, Z: December)
MAC address	Gives the MAC address of the built-in port on the Unit.

Confirming Unit Versions with Sysmac Studio

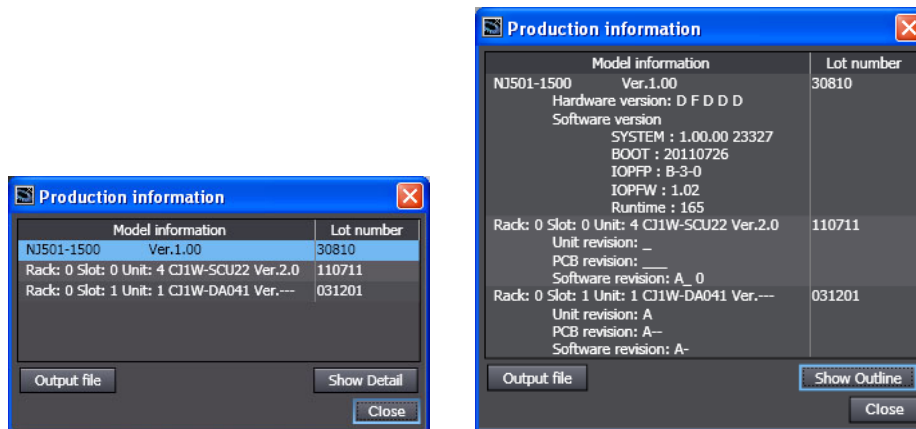
You can use the Unit Production Information on the Sysmac Studio to check the unit version of the CPU Unit, CJ-series Special I/O Units, CJ-series CPU Bus Units, and EtherCAT slaves. The unit versions of CJ-series Basic I/O Units cannot be checked from the Sysmac Studio.

● CPU Unit and CJ-series Units

- 1 Double-click **CPU/Expansion Racks** under **Configurations and Setup** in the Multiview Explorer. Or, right-click **CPU/Expansion Racks** under **Configurations and Setup** and select **Edit** from the menu.

The Unit Editor is displayed for the Controller Configurations and Setup layer.

- 2** Right-click any open space in the Unit Editor and select **Production Information**.
The Production Information Dialog Box is displayed.



Simple Display

Detailed Display

In this example, “Ver.1.00” is displayed next to the unit model.

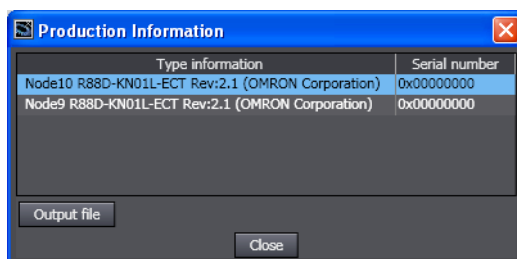
The following items are displayed.

CPU Unit	CJ-series Units
Unit model	Unit model
Unit version	Unit version
Lot number	Lot number
	Rack number, slot number, and unit number

● EtherCAT Slaves

- 1** Double-click **EtherCAT** under **Configurations and Setup** in the Multiview Explorer. Or, right-click **EtherCAT** under **Configurations and Setup** and select **Edit** from the menu.
The EtherCAT Configuration Tab Page is displayed for the Controller Configurations and Setup layer.
- 2** Right-click the master in the EtherCAT Configurations Editing Pane and select **Display Production Information**.

The Production Information Dialog Box is displayed.



The following items are displayed.

Node address
Type information*
Serial number

* If the model number cannot be determined (such as when there is no ESI file), the vendor ID, product code, and revision number are displayed.

Related Manuals

The following manuals are related to the NJ-series Controllers. Use these manuals for reference.

Manual name	Cat. No.	Model numbers	Application	Description
NJ-series CPU Unit Hardware User's Manual	W500	NJ501-□□□□ NJ301-□□□□	Learning the basic specifications of the NJ-series CPU Units, including introductory information, designing, installation, and maintenance. Mainly hardware information is provided.	An introduction to the entire NJ-series system is provided along with the following information on the CPU Unit. <ul style="list-style-type: none"> • Features and system configuration • Introduction • Part names and functions • General specifications • Installation and wiring • Maintenance and inspection Use this manual together with the <i>NJ-series CPU Unit Software User's Manual</i> (Cat. No. W501).
NJ-series CPU Unit Software User's Manual	W501	NJ501-□□□□ NJ301-□□□□	Learning how to program and set up an NJ-series CPU Unit. Mainly software information is provided.	The following information is provided on a Controller built with an NJ501 CPU Unit. <ul style="list-style-type: none"> • CPU Unit operation • CPU Unit features • Initial settings • Programming based on IEC 61131-3 language specifications Use this manual together with the <i>NJ-series CPU Unit Hardware User's Manual</i> (Cat. No. W500).
Sysmac Studio Version 1 Operation Manual	W504	SYSMAC-SE2□□□	Learning about the operating procedures and functions of the Sysmac Studio.	Describes the operating procedures of the Sysmac Studio.
CJ-series High-speed Counter Units Operation Manual for NJ-series CPU Unit (This Manual)	W492	CJ1W-CT021	Learning about the functions and usage of CJ-series High-speed Counter Units for using it in an NJ-series configuration.	The functions and usage of the CJ-series High-speed Counter Unit for using it in an NJ-series configuration are described.
CJ-series High-speed Counter Units Operation Manual	W401	CJ1W-CT021	Learning about the functions and usage of CJ-series High-speed Counter Units.	The functions and usage of the CJ-series High-speed Counter Unit for using it in a CJ-series configuration are described.

Revision History

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

Cat. No. W492-E1-03

↑
Revision code

Revision code	Date	Revised content
01	July 2011	Original production
02	March 2012	Corrected errors.
03	August 2012	Made changes accompanying release of unit version 1.03 of the CPU Unit.

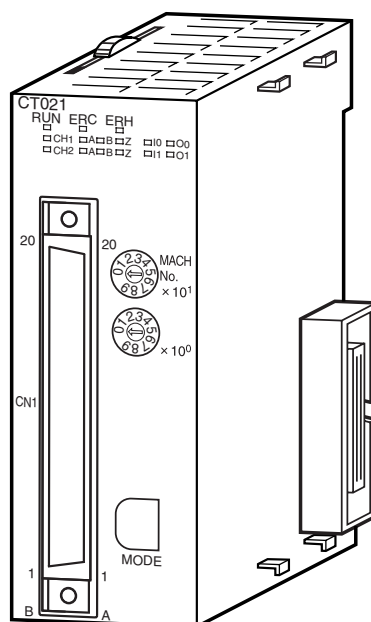
1

Introduction

This section gives specifications of the CJ1W-CT021 and a brief description of the functions and features of the Unit and the areas of application.

1-1	Features and Functions	1-2
1-2	Basic Configuration	1-5
1-3	Specifications and Characteristics	1-7
1-3-1	General Specifications	1-7
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1-4-1	Configuring the High-speed Counter Unit	1-17
1-5	Operating Procedure Guidelines	1-19
1-6	Application Areas	1-22

1-1 Features and Functions



The CJ1W-CT021 High-speed Counter Unit is equipped with 2 Counters and counts over a maximum binary range of 32-bits. Accepting input pulse frequencies of up to 500 kHz allows precise control of fast motions. The Unit's bi-directional counting ability enables detecting movement in either direction. Each Counter of the Unit can be configured independently. The Unit is equipped with 2 Digital Inputs, 2 Digital Outputs and 30 Soft Outputs. A maximum response time of 0.5 ms guarantees high-speed closed loop control of applications.

● Freely Configurable

You can make a flexible setting on this High-speed Counter Unit to suit the user application.

● Counter Type

Configuring the Unit starts with choosing one out of 3 Counter Types:

- Simple Counter (refer to 3-2-1 Simple Counter)
- Circular Counter (refer to 3-2-2 Circular Counter)
- Linear Counter (refer to 3-2-3 Linear Counter)

By default all Counters are set to Simple Counter for which no configuration settings have to be made, enabling every Counter to count pulses directly after the Unit has been powered up. For all Counter Types the full counting range is available. Circular and Linear Counters can be configured with Special Unit settings according to the application to control.

● Input Signal Type

Depending on the type of input signal that your application requires, for every Counter a choice can be made out of three input signal types:

- Phase Differential Inputs (multiplication by either 1, 2 or 4)
(refer to 3-3-1 Phase Differential)
- Up/Down Pulse Inputs (refer to 3-3-2 Up & Down Pulse)
- Pulse & Direction Inputs (refer to 3-3-3 Pulse & Direction)

● Digital Input Function

This Unit supports two Digital Inputs (I0 and I1) which can be allocated freely for each Counter. A function can be selected from among eight types of functions and allocated for each Digital Input according to the user application.

Function allocation makes it possible to use the Digital Inputs together with gates, presets, resets, etc. (Refer to *3-4 Digital Input Functions*).

● Digital Output Control

To control the Outputs, the Unit can be configured in one of the two following Output Control Modes:

- Range Mode (refer to *3-5-1 Range Mode*)
- Comparison Mode (refer to *3-5-2 Comparison Mode*)

In Range Mode, up to 32 Ranges can be applied to individual Counters. Every Range can control a maximum of 32 Outputs. An Output is turned ON when the Counter is in the corresponding Range. In Comparison Mode, up to 32 comparison data can be applied to individual Counters. Depending on the direction of counting, an Output can be set or reset (configurable) on reaching the Comparison Value. Every Comparison Value can control up to 32 Outputs.

Furthermore, by setting and resetting I/O ports for output data in the CPU Unit, Digital Output can be controlled manually (refer to *3-5-3 Manual Output Control*).

You can set to hold the output in the previous status or to put it into the defined status for when the CPU Unit Operating Mode is changed from RUN Mode to PROGRAM Mode, when an I/O bus check error occurs or when an overflow/underflow error occurs (refer to *3-5-4 Output Control Configuration*).

● Resetting Counter Value

Resetting of the Counter Value can be freely configured depending on the application needs. The following sources can trigger a reset:

- Software bit in the PLC
- Z-Input
- Digital Input (that is configured as a Reset Input)

To enable resetting a Counter Value, an Digital Input must be configured as Enable Reset Input and/or the Software Enable Reset bit can be used (refer to *3-6 Reset Counter*).

● Programmable Output Pulses

The timing characteristics of the Digital Outputs can be modified, depending on the requirements of the application as follows (refer to *3-7-1 Programmable Output Pulses*):

- Output Turn ON Delay [1 ms to 9999 ms], to delay turning ON an Output
- Output Pulse Duration [1 ms to 9999 ms], to generate an Output pulse of the specified duration

● Hysteresis

For Counters in Range Mode a hysteresis can be configured [1 to 255 counts], to prevent Outputs from toggling due to unwanted oscillating of encoding equipment (e.g. rotary incremental encoder) around the upper/lower limits. Refer to *3-7-2 Hysteresis*.

● Noise Filtering

For the purpose of suppressing noise on the signal lines A and B of every Counter and on the Digital Input lines, noise filters can be used.

The cut-off frequencies for the signal lines, A and B can be set to:

- 10 kHz
- 50 kHz (default)
- 500 kHz

For the Digital Inputs, noise filters can be configured to 10 kHz and 50 kHz (default). Refer to 3-7-3 *Noise Filtering*.

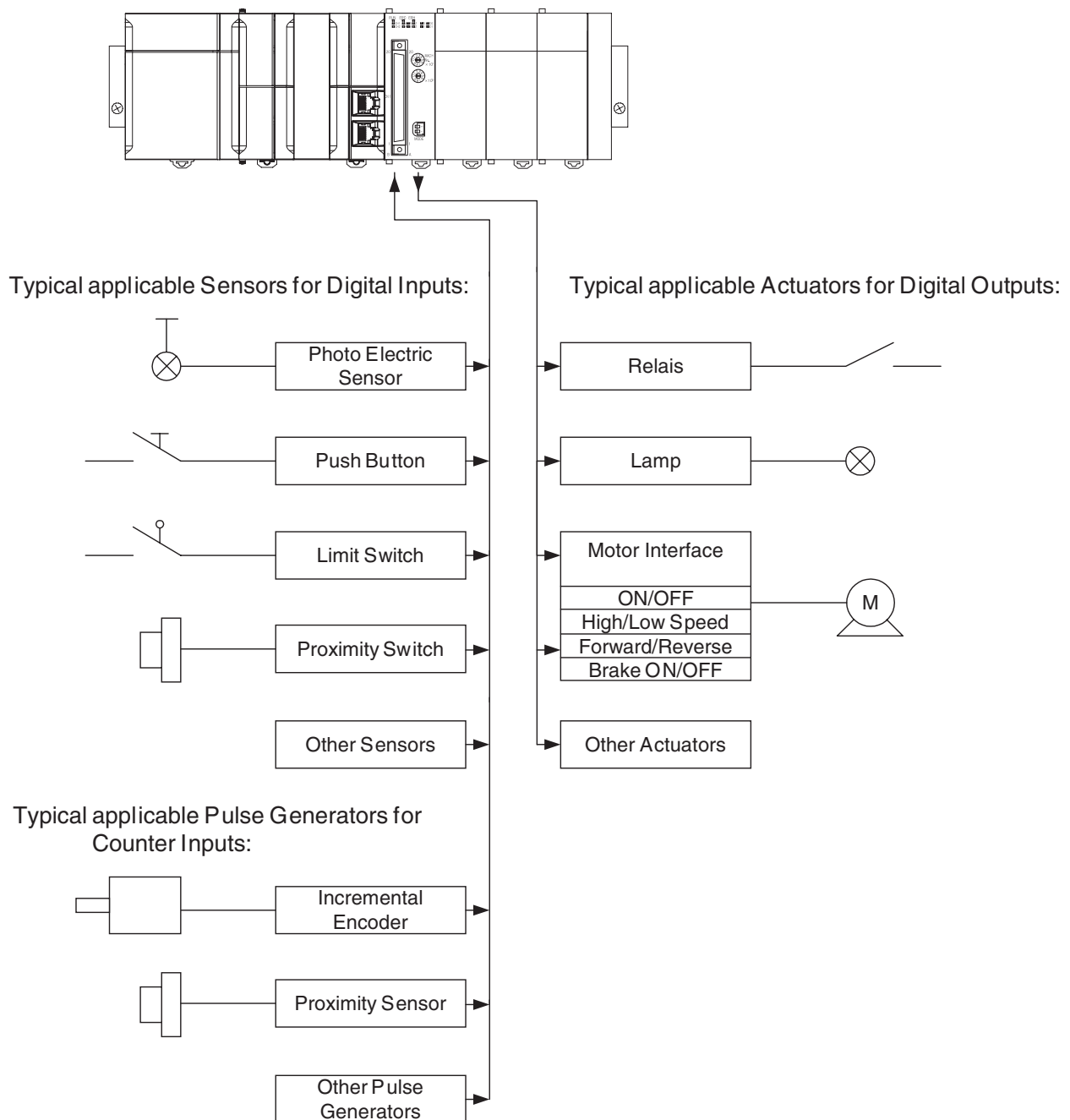
● Support Software

The Unit is set by Sysmac Studio.

● Quick Start Up Reference Guide

For a quick overview of all the features and functions that the High-speed Counter Unit offers you, refer to 1-4 *Quick Start Up Reference Guide*. This section also contains references to the particular section(s) in the Manual where you can read more detailed information about specific features and functions of the High-speed Counter Unit.

1-2 Basic Configuration



● Mounting Restrictions

The CJ1W-CT021 High-speed Counter Unit is a Special I/O Unit that belongs to the CJ Series.

The CJ1W-CT021 High-speed Counter Unit can be mounted in an NJ-series CPU rack or NJ-series Expansion Rack.

Note If you want the CJ1W-CT021 High-speed Counter Unit to generate interrupts to activate external interrupt tasks in a CJ1-H CPU Unit, the Counter Unit must be in one of the five positions immediately to the right of the CJ1-H CPU Unit on the CPU Rack. If you want the High-speed Counter Unit to generate interrupts to activate external interrupt tasks in a CJ1M CPU Unit, the Counter Unit must be in one of the three positions immediately to the right of the CJ1M CPU Unit on the CPU Rack.

No external interrupt tasks can be activated in CJ1-H or CJ1M CPU Units if the CJ1W-CT021

The maximum number of CJ1W-CT021 High-speed Counter Units that can be mounted on all CPU Racks and Expansion Racks is 24.

Furthermore, the number of Units that can be mounted in one NJ-series CPU Rack or NJ-series Expansion Rack is decided by the maximum current that the Power Supply Unit can supply and the amount of current consumed by other Units.

● I/O Connection Methods

To connect the Input and Output signal wires to the Unit, two methods are available:

- 1** Directly connecting the wires by soldering them to the external connector, or
- 2** Indirectly connecting the wires by connecting them to screw terminals on a Terminal Block Unit. Use an Omron Flat Cable (XW2Z-xxxB) to connect an Omron Terminal Block Unit (XW2B-40G4 or XW2B-40G5) to the Counter Unit.

Refer to *2-3-2 Connector Wiring Methods* for more details.

1-3 Specifications and Characteristics

1-3-1 General Specifications

Item	CJ1W-CT021
Unit type	CJ-series Special I/O Unit
General Specifications	Conform to general specifications for Sysmac NJ-series
Ambient Operating Temperature	0 to 55 °C
Ambient Storage Temperature	-20 to 70 °C
Ambient operating Humidity	10% to 90% without condensation
Internal Current Consumption	280 mA (at 5 V)
Dimensions (mm)	31 x 90 x 65 (W x H x D)
Weight	100 g
Mounting Position	NJ-series CPU Rack or NJ-series Expansion Rack
Maximum Number of CT021 Units per Rack	Equal to the number of slots of the Rack*
NJ system (CPU rack and expansion rack)	24
Data Exchange with CPU Unit	Data is exchanged through I/O ports, or as necessary with memory for CJ-series Unit. For details, refer to <i>4-2 Memory Allocation</i> .

* However, the number that can be mounted in one Unit depends on the maximum current that the Power Supply Unit can supply and the current consumption of other Units.

1-3-2 Functional Specifications

Item	CJ1W-CT021
Number of Counters	2
Counter Type	<ul style="list-style-type: none"> • Simple Counter (refer to 3-2-1 Simple Counter) • Circular Counter (refer to 3-2-2 Circular Counter) • Linear Counter (refer to 3-2-3 Linear Counter) <p>The Counter Type can be chosen by DIP switch at the front of the Unit. By default the Counters are set to Simple Counter (refer to 2-1-3 Counter Type Switch).</p>
Maximum Input Frequency	500 kHz, refer to 1-3-3 Input Specifications for details
Maximum Response Time	0.5 ms (refer to A-3 Description of the Response Time)
Signals per Counter	Phase A, B and Z
Digital I/O	<ul style="list-style-type: none"> • 2 Digital Inputs (I0 and I1): Every Digital Input can be assigned to a Counter. In this way one Counter can be controlled by a maximum of 2 Digital Inputs (refer to 3-4 Digital Input Functions) • 2 Digital Outputs (O0 and O1): The Unit Output Pattern represents the 2 Digital Outputs and 30 Soft Outputs (refer to 3-5 Output Control).
Input Signal Types	<ul style="list-style-type: none"> • Phase Differential (multiplication x1), (multiplication x2)* and (multiplication x4)* (refer to 3-3-1 Phase Differential) • Up/Down* (refer to 3-3-2 Up & Down Pulse) • Pulse & Direction* (refer to 3-3-3 Pulse & Direction)
Counter Control using I/O ports	<ul style="list-style-type: none"> • Open Gate/Start Counter: Counter is enabled to count pulses • Close Gate/Stop Counter: Counter is disabled to count pulses • Preset Counter: Preset Value can be saved. • Reset Counter to zero <p>Refer to 3-4 Digital Input Functions.</p>
Digital Input Functionality	<ul style="list-style-type: none"> • Gate* • Reset* • Preset* • Enable Reset* • Disable Reset* <p>For every Function the corresponding action can be triggered on a rising- or on a falling edge (refer to 3-4 Digital Input Functions).</p>
Output Control Mode	<p>Automatic ON/OFF output according to the following three modes:</p> <ul style="list-style-type: none"> • Range Mode * (refer to 3-5-1 Range Mode) • Comparison Mode * (refer to 3-5-2 Comparison Mode) • Manual output control (refer to 3-5-3 Manual Output Control)
Output State Control	<p>You can select the method to control the state of 32 outputs for when the CPU Unit operating mode is changed from RUN to PROGRAM, or when an I/O bus check error or an overflow/underflow error occurs.</p> <ul style="list-style-type: none"> - Continue updating output states automatically. - Hold the output states.* - Bring the pre-defined output state.* <p>Refer to 3-5-4 Output Control Configuration.</p>
Output Driver Configuration	<p>The Output Driver of every Digital Output can be configured as:</p> <ul style="list-style-type: none"> • NPN • PNP* <p>Refer to 3-5-4 Output Control Configuration.</p>

Item	CJ1W-CT021
Reset Signals	<p>Every Counter can be reset to zero by the following sources:</p> <ul style="list-style-type: none"> • Software Counter Reset Bit • Digital Input* • Z-Input* <p>Refer to <i>3-6 Reset Counter</i>.</p>
Extra Functions	<ul style="list-style-type: none"> • Programmable Output Pulse*: To every Digital Output an ON-delay and/or a Pulse Duration [1 to 9999 ms] can be applied (refer to <i>3-7-1 Programmable Output Pulses</i>) • Hysteresis*: To prevent Outputs from being switched On and Off by very small fluctuations in the Counter Value around Range Limits, for every Counter an Hysteresis-value [1 to 255] can be defined (the Unit must in Range Mode). Refer to <i>3-7-2 Hysteresis</i>.
Noise Filtering Counter Inputs and Digital Inputs	<p>To suppress noise on the signal lines of the Counter Inputs (A and B) and the Digital Inputs (I0 and I1) a Noise Filter can be configured to:</p> <ul style="list-style-type: none"> • 10 kHz* • 50 kHz (default) • 500 kHz* <p>For the Digital Inputs the 500 kHz filter can not be selected. The Z-Input Signals of every Counter are filtered with a fixed Noise Filter of 1 kHz. Refer to <i>3-7-3 Noise Filtering</i>.</p>
Initial Counter Value	<ul style="list-style-type: none"> • The initial Counter Values is transferred to the Counter Unit when the Controller is reset or the Counter Unit is restarted.* Refer to <i>3-7-4 Initial Counter Value</i>.
Error History Log Function	<ul style="list-style-type: none"> • Stores up to 30 error log records (refer to <i>5-2 Error codes</i>)

* This specification item is only supported for Circular and Linear Counters (not for Simple Counters). For a complete overview of the differences between Simple and Circular/Linear Counters refer to *1-4 Quick Start Up Reference Guide*.

1-3-3 Input Specifications

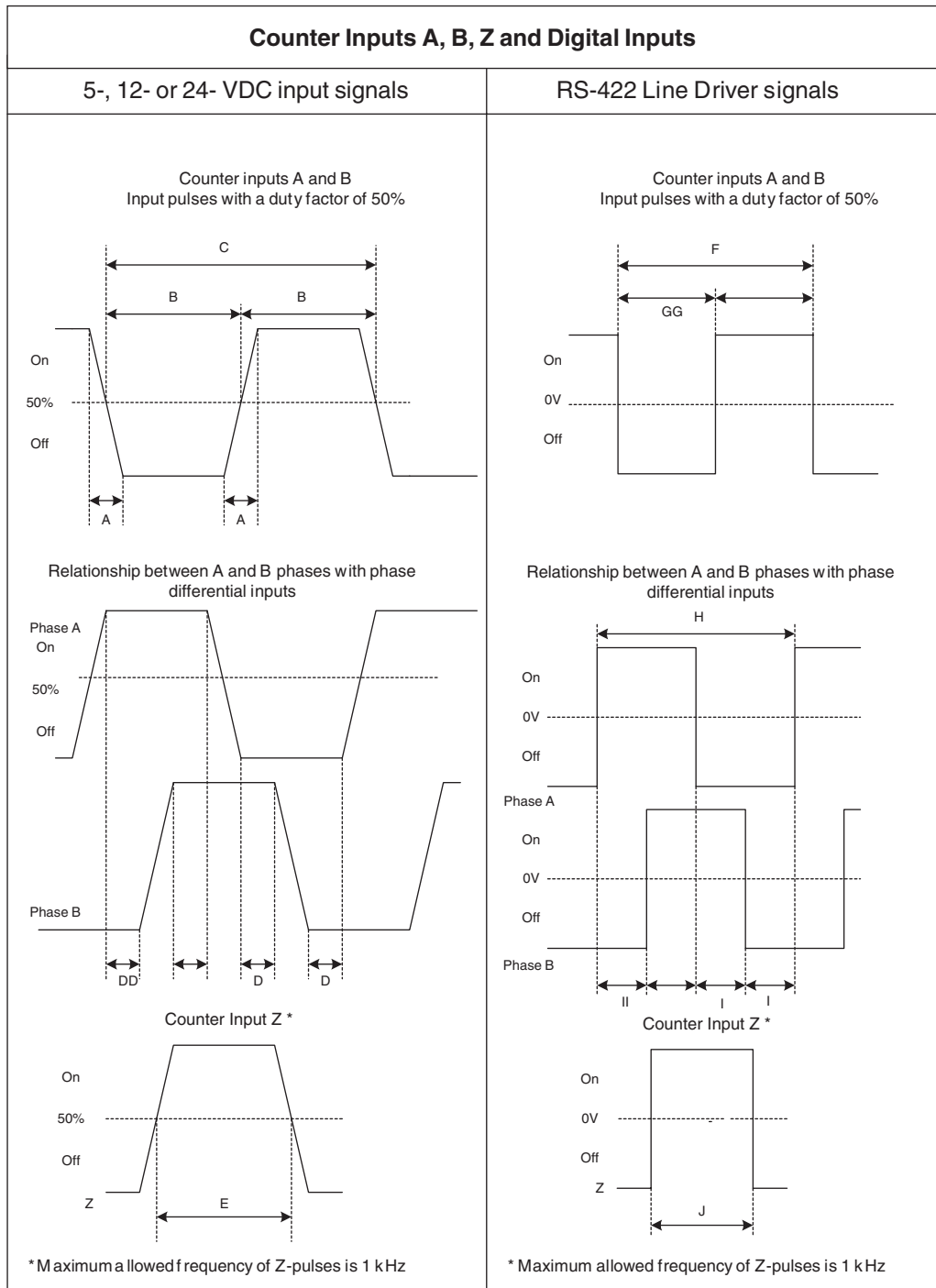
Item	Counter Inputs A and B				Digital Inputs (I0 and I1)
	24 VDC (19.6 to 26.4 V)	12 VDC (9.8 to 13.2 V)	5 VDC (4.5 to 5.5 V)	Line Driver	24 VDC (19.6 to 26.4 V)
Input Current (typical)	8 mA	8 mA	7 mA	11 mA	7.6 mA
ON Voltage (min.)	19.6 V	9.8 V	4.5 V	Connectable to RS-422 compatible Line Drivers.	19.6 V
OFF Voltage (max.)	4 V	2.5 V	1.5 V		4 V

Item	Counter Input Z			
	24 VDC (18.6 to 26.4 V)	12 VDC (9.8 to 13.2 V)	5 VDC (4.5 to 5.5 V)	Line Driver
Input Current (typical)	7.3 mA	6.6 mA	6 mA	11 mA
ON Voltage (min.)	18.6 V	9.8 V	4.5 V	Connectable to RS-422 compatible Line Drivers.
OFF Voltage (max.)	4 V	2.5 V	1.5 V	



Additional Information

- Each Counter Input (A, B, Z) is insulated from the others and from the Digital Inputs. Each Digital Input is also insulated from the others.
- A noise filter can be configured to 10 kHz or 50 kHz (default) for the Digital Inputs. Every Z-Input has a defined noise filter of 1 kHz.
- If the 50-kHz noise filter is configured for Digital Inputs, signals of 10 μ s or longer can be read.



Filter Selection	Timing requirement [μs]									
	A	B	C	D	E	F	G	H	I	J
10 kHz	<3	>50	>100	>23	>10	>100	>50	>100	>23	>10
50 kHz	<3	>10	>20	>4.5	>10	>20	>10	>20	>4.5	>10
500 kHz	<3	>2	>4	>1	>10	>2	>1	>4	>1	>10

**Additional Information**

As a general guideline, to satisfy the above timing specifications, you must pay attention to the type of output driver of the encoder being used, the length of the encoder cable and the frequency of the count pulses generated. For example, if you use an Open Collector encoder (e.g. E6B2-CWZ6C) at 24 V with 10 m cable, you can typically generate count pulses up to 20 kHz. Therefore, if you want to generate count pulses with higher frequencies, you should use a different type of encoder (e.g. E6B2-CWZ1X with Line Driver output or a fast push-pull 24 V encoder, e.g. E6C2-CWZ5GH) or reduce the length of the encoder cable.

1-3-4 Output Specifications

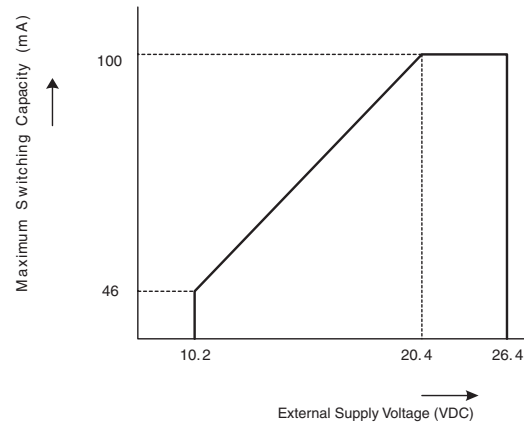
Item	Specification
Driver Type	Open Collector (NPN/PNP selectable)
External Power Supply	12 to 24 VDC (10.2 to 26.4 V), 30 mA max. at 26.4 VDC (for PNP output, without load current)
Maximum Switching Capacity	46 mA at 10.2 V to 100 mA at 26.4 V (200 mA maximum/common) (see picture below)
Minimum Switching Current	5 mA
Output ON-delay	100 μ s max.
Output OFF-delay	100 μ s max.
Leakage Current	0.1 mA max.
Residual Voltage	1.5 V max.
Short Circuit Protection	No

**Additional Information**

- Every Digital Output has 2 Output drivers available: NPN and PNP (available as separate pins on the front connectors). Every Output can be separately configured for NPN or PNP from Edit Special Unit Settings in Sysmac Studio. By default the Outputs are set to NPN-output (refer to *3-5-4 Output Control Configuration*).
- Each Digital Outputs is insulated from the I/O-bus but not from the other Digital Outputs. They are not protected from short circuit.
- The Output current must not exceed 200 mA per common (i.e. per 2 Digital Outputs) Otherwise the unit will be damaged.
- Digital Outputs can be set either to automatic or manual outputs from Edit Special Unit Settings in Sysmac Studio. The manual output control uses the manual output control bit for each I/O port for the output data. (Refer to *3-5 Output Control*)
- You can select the method to control the output states for when the CPU Unit operating mode is changed from RUN to PROGRAM, or when an I/O bus check error or an overflow/underflow error occurs (refer to *3-5-4 Output Control Configuration*).

● Maximum Switching Capacity

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



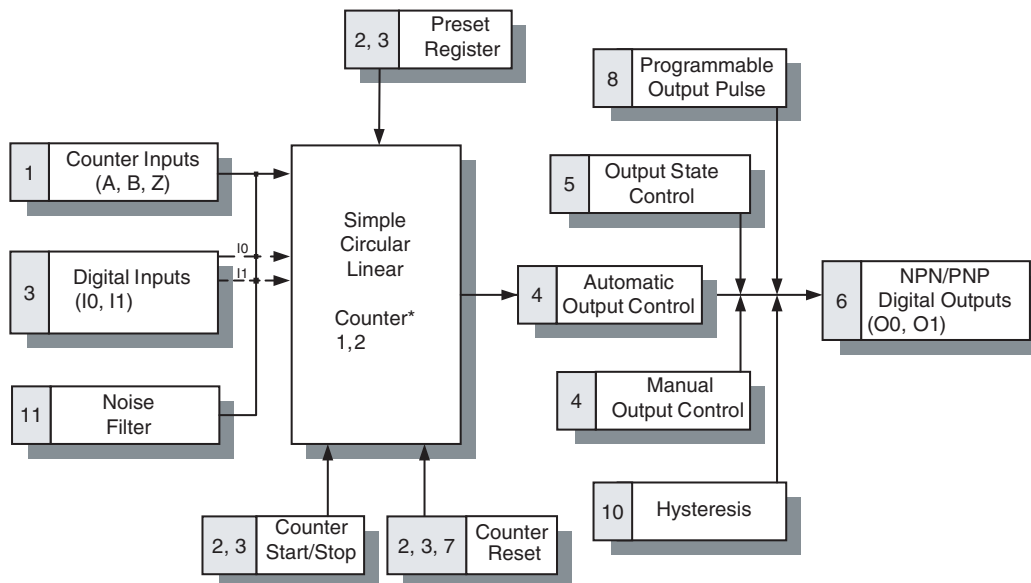
1-4 Quick Start Up Reference Guide

● Operation and Configuration

Every Counter of the High-speed Counter Unit can be set to Simple, Circular or Linear Counter (refer to 1-5 *Operating Procedure Guidelines* for quick start up information).

One CJ1W-CT021 High-speed Counter Unit occupies dedicated areas for four Units. Therefore, the maximum number of Units that can be mounted on all CPU Racks and Expansion Racks is 24.

As a Circular or Linear Counter, all functions of the Unit can be used. As a Simple Counter, however, available functions are restricted. The figure below shows all the function blocks that can be set and used. The tables on Pages 1-14 and 1-15 explain the functions that can be used by a Circular or Linear Counter and by a Simple Counter.



* Diagram is valid for Counter 1 and 2.

	Simple Counter	Circular/Linear Counter	Reference section
1	Input Signal Types		<i>3-3 Input Signal Types</i>
	<ul style="list-style-type: none"> Phase Differential (x1) (=default) 	<ul style="list-style-type: none"> Phase Differential (x1, x2, x4) Up & Down Pulse & Direction 	<i>3-3-1 Phase Differential</i>
			<i>3-3-2 Up & Down Pulse</i>
			<i>3-3-3 Pulse & Direction</i>
2	Counter Control using Device Variables for CJ-series Unit		<i>3-4 Digital Input Functions</i>
	<ul style="list-style-type: none"> Open Gate/Start Counter Close Gate/Stop Counter Preset Counter Reset Counter Capture Counter Value 	<ul style="list-style-type: none"> Open Gate/Start Counter Close Gate/Stop Counter Preset Counter Reset Counter Capture Counter Value 	<i>3-4 Digital Input Functions</i>
3	Digital Input Functions		<i>3-4 Digital Input Functions</i>
	<ul style="list-style-type: none"> No Function (=default) 	<ul style="list-style-type: none"> No Function Gate Positive Gate Negative Preset Rising Edge Preset Falling Edge Reset Rising Edge Reset Falling Edge Reset Enable Reset Disable 	<i>3-4 Digital Input Functions</i>
4	Output Control		<i>3-5 Output Control</i>
		<ul style="list-style-type: none"> Automatic Output Control in: Range Mode Comparison Mode 	<i>3-5-1 Range Mode</i>
			<i>3-5-2 Comparison Mode</i>
	<ul style="list-style-type: none"> Manual Output Control 	<ul style="list-style-type: none"> Manual Output Control 	<i>3-5-3 Manual Output Control</i>
5	Output State Control		<i>3-5-4 Output Control Configuration</i>
	<ul style="list-style-type: none"> No (=default) 	<ul style="list-style-type: none"> Yes 	
6	Output Driver Configuration		<i>3-5-4 Output Control Configuration</i>
	<ul style="list-style-type: none"> NPN (=default) 	<ul style="list-style-type: none"> NPN PNP 	

Simple Counter		Circular/Linear Counter	Reference section
7	Reset Signals		<i>3-6 Reset Counter</i>
	<ul style="list-style-type: none"> • Software Reset Bit 	<ul style="list-style-type: none"> • Software Reset Bit • Digital Input • Z-signal 	
8	Programmable Output Pulses		<i>3-7-1 Programmable Output Pulses</i>
	<ul style="list-style-type: none"> • No (=default) 	<ul style="list-style-type: none"> • Yes 	
9	Hysteresis		<i>3-7-2 Hysteresis</i>
	<ul style="list-style-type: none"> • No (=default) 	<ul style="list-style-type: none"> • Yes 	
10	Noise Filtering Digital Inputs and Counter Inputs		<i>3-7-3 Noise Filtering</i>
	<ul style="list-style-type: none"> • 50 kHz (=default) 	<ul style="list-style-type: none"> • 10 kHz • 50 kHz • 500 kHz * 	
11	Initial Counter Value		<i>3-7-4 Initial Counter Value</i>
	<ul style="list-style-type: none"> • No (=default) 	<ul style="list-style-type: none"> • Yes 	

* The 500 kHz filter can only be configured for the Counter Inputs (not for the Digital Inputs).

1-4-1 Configuring the High-speed Counter Unit

● Configuration

- 1** Configuring every Counter starts with choosing the Counter Type (Simple, Circular or Linear).

Simple Counter

For Simple Counters you do not have to make any Special Unit settings, since for Simple Counters all the default settings are used. Choose Simple Counters when only basic counting functionality is required. (refer to *3-2-1 Simple Counter* and to *1-5 Operating Procedure Guidelines*)

Circular/Linear Counter

If you want to use the full available functionality for a Counter, you must configure it for Circular or Linear Counter (refer to *3-2-2 Circular Counter* and *3-2-3 Linear Counter* for details and to *1-5 Operating Procedure Guidelines* for a quick start up procedure).

- 2** The Input Signal Type (Phase Differential, Up/down pulse, or Pulse & Direction) for every Counter has to be defined.
- 3** Depending on the requirements of the application, one or more (maximum 2) Digital Inputs can be assigned to a Counter. To configure the Digital Input(s) a choice can be made out of 8 available modes (e.g. Gate, Enable Reset or Combination Modes, refer to *3-4 Digital Input Functions*). During operation of the Counter, the Counter can be Started, Stopped, Reset, or Preset by using the Digital Input(s) or the corresponding bits for the I/O port in the CPU Unit.
- 4** Controlling the Outputs is done by choosing the Output Control Mode (Range or Comparison Mode). Furthermore 4 additional control mechanisms are available to control the Outputs (Programmable Output Pulse, Output State Control, Manual Control and Hysteresis). Refer to *3-5 Output Control*.
- 5** In case the Counter Input Signals (A, B, Z) and the Digital Input Signals (I0 to I1) are exposed to electromagnetic noise, a noise filter can be configured (10 kHz, 50 kHz (=default) or 500 kHz) to suppress this noise. The 500 kHz noise filter is only available for the Counter Input Signals and not for the Digital Input Signals. Refer to *3-7-3 Noise Filtering*.
- 6** Specifying indirect addresses for Circular/Linear Counters and Allocating them to user-defined variables

CJ1W-CT021 High-speed Counter Unit are set with the Edit Special Unit Settings of Sysmac Studio. When the contents of the Special Unit settings are transferred to the CPU Unit, they are reflected in the device variables for CJ-series Unit (for setting). When the Controller is reset or the Unit is restarted, the contents of device variables for CJ-series Unit (for setting) are reflected in the High-speed Counter Unit.

With a Counter type other than a Simple Counter, the Output Control Mode can be set either to Range or Comparison Mode. One Counter can be allocated with 32 range data or comparison data. The data is set to free DM or EM Areas.

To make the setting, specify the memory area for the Memory Area, and indirect address for the Memory Address in Edit Special Unit Settings of Sysmac Studio. The indirect addresses point to the actual memory address where the range or comparison data is actually stored.

After that, this area is allocated to user-defined variables.

For details on the data, refer to *3-5-1 Range Mode* or *3-5-2 Comparison Mode*.

For details on device variables for CJ-series Units, refer to *4-2 Memory Allocation*.

- 7** Count operations are started with the gate open/close bit of the device variables for CJ-series Units or Digital Input, depending on the application.

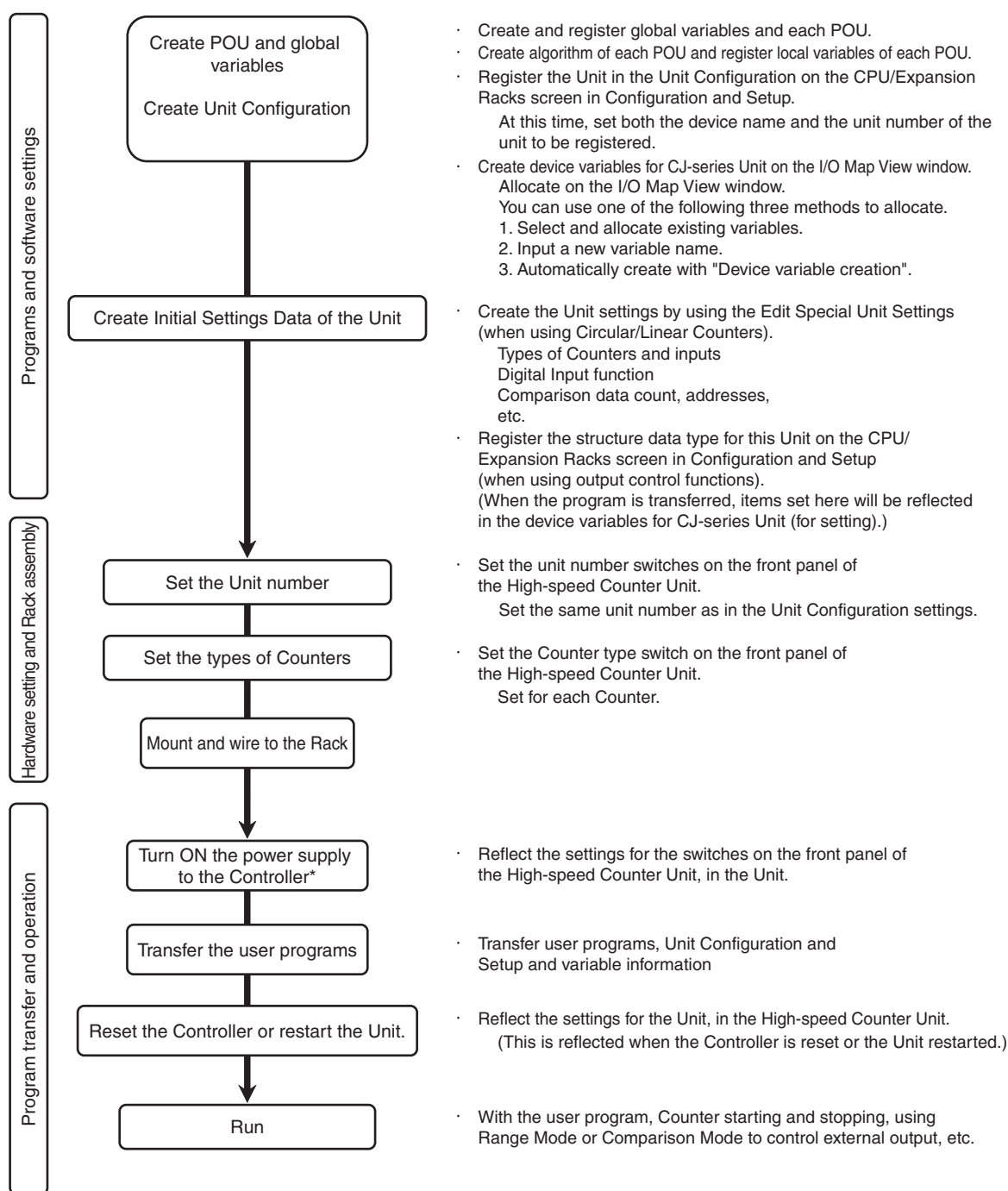
1-5 Operating Procedure Guidelines

The operating procedures for High-speed Counter Units are described here.

There is no restriction regarding the sequence of "Programs and software settings" and "Hardware setting and Rack assembly." These tasks may be carried out concurrently or in the reverse order.

Use Sysmac Studio to create and set programs.

For details on operations of Sysmac Studio, refer to *Sysmac Studio Version 1 Operation Manual* (Cat. No. W504).



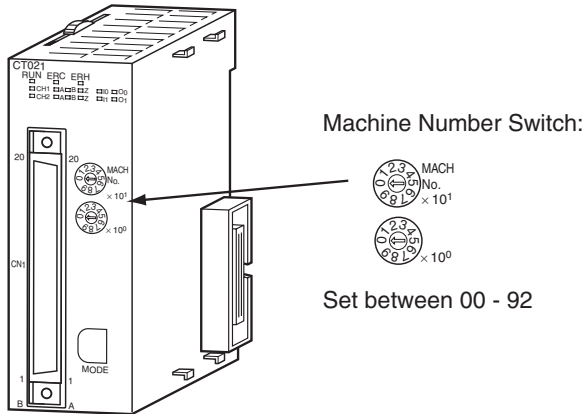
* At this time, an I/O Setting Check Error occurs when there is a Unit Configuration in the CPU Unit which does not match the actual Unit Configuration. In this case, reset the Controller in *Reset the Controller or restart the Unit* process to cancel the error.

Details of Hardware Setting and Rack Assembly

● Set the Unit number

Set the Machine Number. Refer to *2-1-4 Machine Number Switch* for further details.

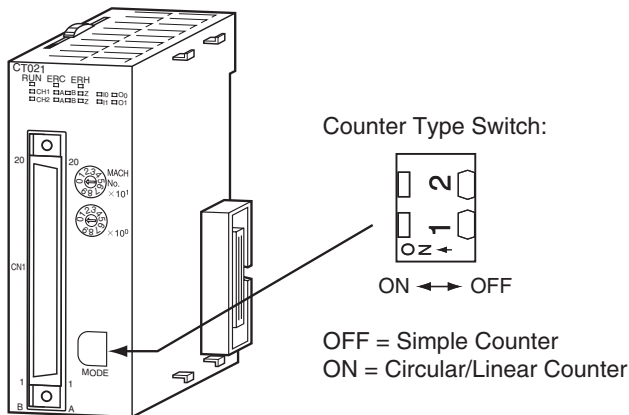
Set the same unit number as in the Unit Configuration settings.



● Set the types of Counters

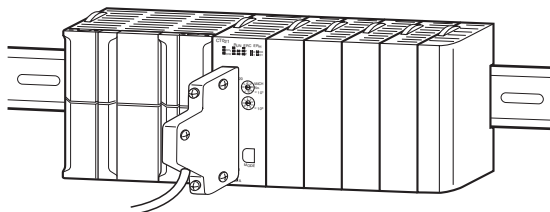
Set the Counter Type for every Counter with the switch at the front of the Unit. Pins 1 and 2 correspond to Counters 1 and 2.

Refer to *2-1-3 Counter Type Switch* for further details.



● Mounting and wiring to the Rack

Install and wire the Unit. Refer to *2-2 Installation* and *2-3 Wiring* for further details.



Create Initial Settings Data of the Unit

Create the initial settings data for the Unit on the Edit Special Unit Settings of Sysmac Studio. When setting in Simple Counters, there is no need to create this data.

When setting in Simple Counters:

No Special Unit settings are necessary. The Unit is ready to count and will use all default settings for the Special Unit settings. All data related to the Simple Counter can be exchanged between the CPU Unit and the Counter Unit through device variables for CJ-series Unit and available for usage in the user Program.

Refer to *3-2-1 Simple Counter* for more details about the Simple Counter.

When setting in Circular/Linear Counters:

The Counter Type (Linear or Circular) can be selected from Edit Special Unit Settings of Sysmac Studio.

Refer to *Section 3 Operation and Configuration* for detailed information about Unit settings.

When using High-speed Counter Unit output control functions, register the structure data type for range or comparison data on the CPU/Expansion Racks screen in Configuration and Setup. Refer to *4-2-2 Allocating Ranges and Comparison Data* for more information about comparison data allocation.

Refer to *3-2-2 Circular Counter* and *3-2-3 Linear Counter* for more details about both Counter Types.

Refer to *4-1-2 Unit Restart* for more information about restarting the Unit.



Additional Information

- For using Simple Counters you do not have to clear the corresponding Special Unit settings to zero (=0000), since the Unit always uses the default (=0000) settings.
- The Settings specified in the Edit Special Unit Settings screen support all of the functions of this Unit. However, when they used with the NJ Series, some functions of this Unit become unavailable. Do not select functions that cannot be used. Errors will not be detected even if these functions are selected or set.

Refer to *A-1 Differences of NJ Series from CJ Series*, for functions that cannot be used with NJ series.

1-6 Application Areas

The main application areas of the High-speed Counter Unit is where signals with high frequencies are counted and high-speed responses have to be triggered at predefined Counter Values. Application areas include:

- Packaging and Sorting plants
- Dosing or proportioning plants
- Process Industry

Typical applications in which the CJ1W-CT021 can be used:

- (CAM)-Positioning
- Position Monitoring
- Flow Control (refer to *6-1 Flow Control*)

Section 6 Application Examples describes typical application examples in which the High-speed Counter can be used, including sample programs.

2

Components, Installation and Wiring

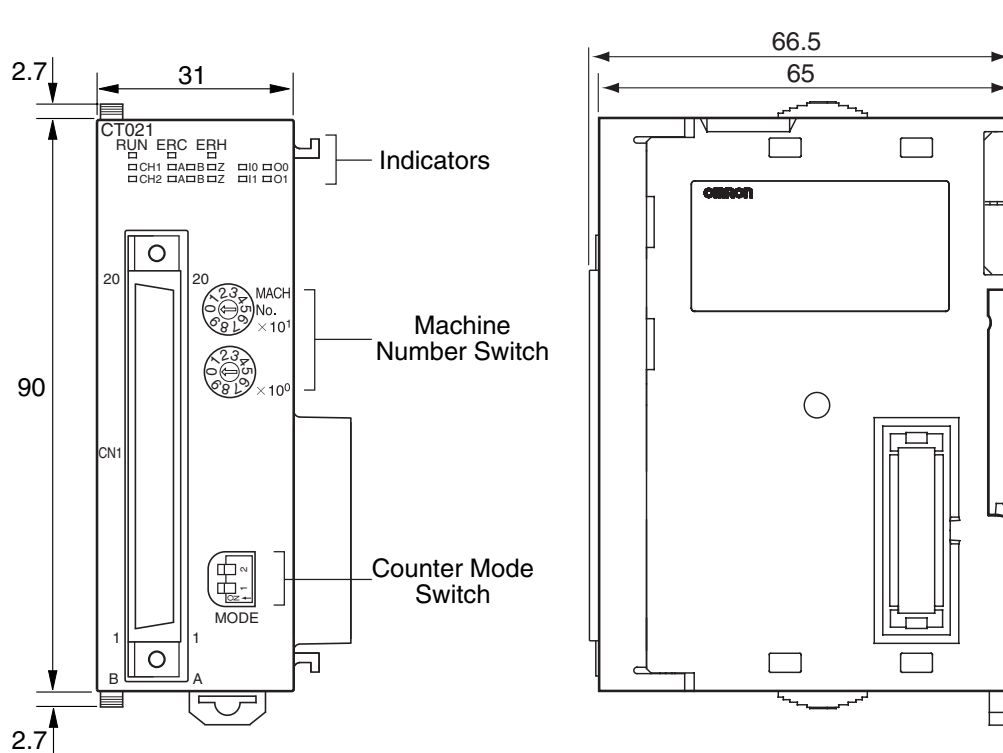
This section provides details of the components, switch settings and other information required to install and operate CJ1W-CT021 High-speed Counter Units.

2-1	Components and Switch Settings	2-2
2-1-1	Components	2-2
2-1-2	Indicators	2-3
2-1-3	Counter Type Switch	2-4
2-1-4	Machine Number Switch	2-5
2-2	Installation	2-6
2-2-1	System Configuration Precautions	2-6
2-2-2	Installing Units	2-6
2-3	Wiring	2-8
2-3-1	Connector Pin-layout	2-8
2-3-2	Connector Wiring Methods	2-9
2-3-3	Important Wiring Considerations	2-13
2-3-4	Internal Circuitry	2-13
2-3-5	Digital I/O Circuit Configurations	2-15
2-3-6	Counter Input Configurations	2-17

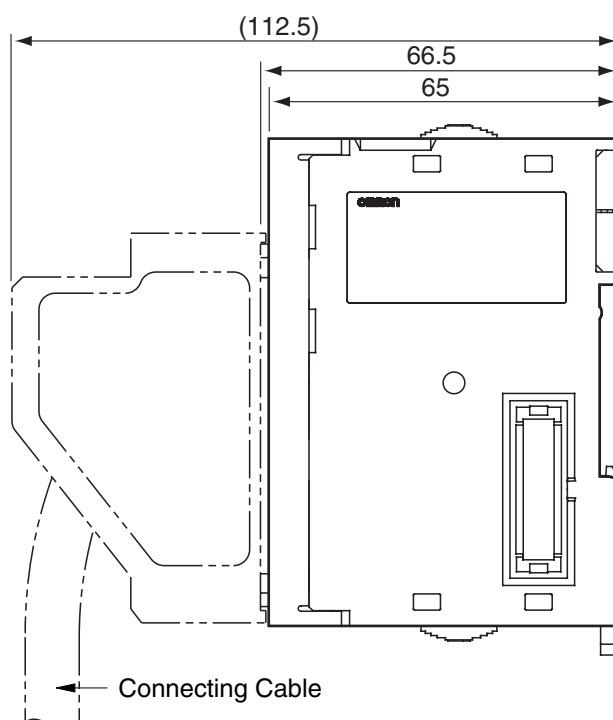
2-1 Components and Switch Settings

2-1-1 Components

● Front and Side View



● Dimensions with Connector



2-1-2 Indicators

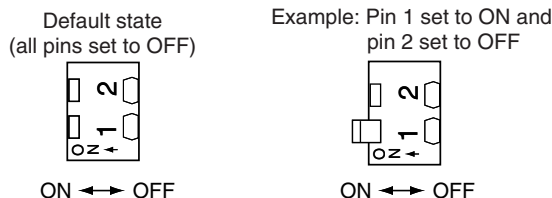
CT021						
RUN	ERC	ERH				
CH1	A	B	Z	I0	O0	
CH2	A	B	Z	I1	O1	

The indicators on the LED-display show the operating status of the Unit. The following table shows the meaning of the indicators.

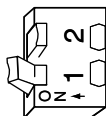
LED	Colour	State	Description
RUN	Green	ON	Unit is in operation (i.e. Unit has initialized normally after the Controller is reset or the Unit is restarted).
		OFF	Any of the following <ul style="list-style-type: none"> No registration in Unit Configuration No power supply from Power Supply Unit Unit WDT error Unit hardware failure
ERC	Red	ON	Unit has operational failure due to a detected error. (For a list of all the errors that can cause an operational failure, see <i>5-2 Error codes</i> .)
		OFF	Unit has no operational failure.
ERH	Red	ON	CPU Unit has operational failure. (For a list of all the errors that can occur at the CPU Unit see <i>5-1 Error Indicators</i>)
		OFF	CPU Unit has no operational failure.
CH1/2	Green	ON	Channel 1/2 (i.e. Counter 1/2) is ready to count (the corresponding counting gate is open).
		OFF	Counter 1/2 is not ready to count (the corresponding counting gate is closed).
A/B/ Z	Yellow	ON	Input A/B/Z has turned ON. (Every Counter is characterised by the signals A/B/Z.)
		OFF	Input A/B/Z is turned OFF.
I0/I1	Yellow	ON	Digital Input (I0/I1) is turned ON.
		OFF	Digital Input (I0/I1) is turned OFF.
O0/O1	Yellow	ON	Digital Output (O0/O1) is turned ON.
		OFF	Digital Output (O0/O1) is turned OFF.

2-1-3 Counter Type Switch

The Counter Type Switch, at the front of the Unit, is used to set the Counter Type for every individual Counter separately. By default all Counters are set to Simple Counter.



Note: Pins are set to ON when they are raised at an angle.



The following table shows how the Counters can be configured:

Pin	Counter	Position	Type
1	#1	ON	Circular/Linear Counter
		OFF	Simple Counter
2	#2	ON	Circular/Linear Counter
		OFF	Simple Counter

After having set the DIP switch of the Counter to ON, select between Circular and Linear Counter from Edit Special Unit Settings of Sysmac Studio. Counters set to Circular/Linear Counter can make use of all the features that the High-speed Counter Unit offers. Refer to 3-2-2 *Circular Counter* and 3-2-3 *Linear Counter*.

The Simple Counter is an extra feature of the High-speed Counter Unit, that enables an easy and fast set-up of the Unit since no Special Unit settings are needed (all default settings are used). Consequently, for Simple Counters, only a reduced subset of all the features that the Unit offers are available. For further details about the Simple Counter and the features supported, see 3-2-1 *Simple Counter*.



Precautions for Safe Use

Always turn OFF the controller power before setting any DIP switches.

2-1-4 Machine Number Switch



Use the unit number switches to set the unit number specific for each Special I/O Unit mounted in a CPU Rack or Expansion Rack. The unit number must be the one registered in Unit Configurations.

Turn OFF the Controller before changing the Unit number setting.

One High-speed Counter Unit occupies areas for four special I/O Units in a CPU Unit.



Precautions for Safe Use

Always turn OFF the controller power before setting the Unit number.



Precautions for Correct Use

- When setting a rotary switch, use a flat-blade screwdriver and be careful not to damage the switch.
- Be sure not to leave the rotary switch midway between numbers.



Additional Information

- If two or more Special I/O Units are set to an identical Unit number or if one Special I/O Unit is set to areas of plural Unit numbers, the CPU Unit has a major fault level error "Duplicate Unit Number" and stops operation.
- After correcting the Unit number setting, cycle the power to the Controller.
- One High-speed Counter Unit occupies allocation areas of four Unit numbers. Be sure that no Unit numbers are duplicated. To avoid duplication, when you set a High-speed Counter Unit to the Unit number "n", set the next Special I/O Unit to the Unit number "n + 4".

2-2 Installation

2-2-1 System Configuration Precautions

The High-speed Counter Units are connectable with CPU Racks and Expansion Racks. A maximum of 10 Units can be mounted on a Rack, and a total of 24 Units on CPU Racks and Expansion Racks altogether.

2-2-2 Installing Units

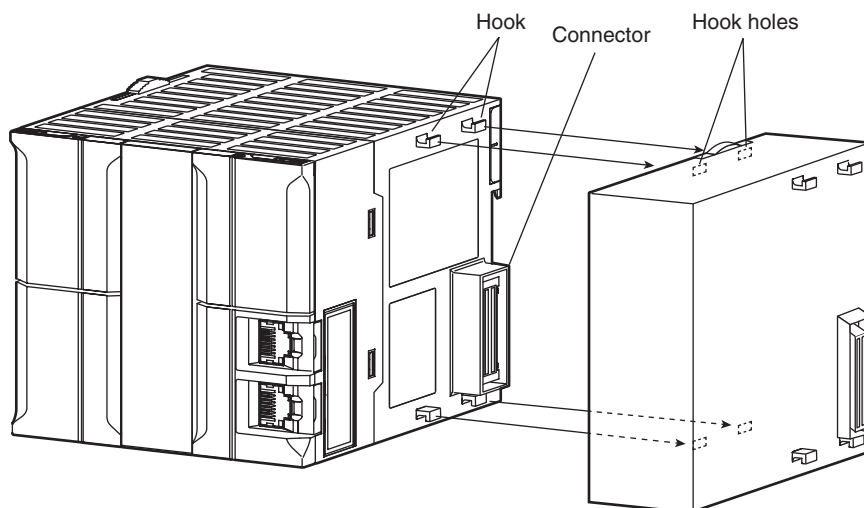


Precautions for Safe Use

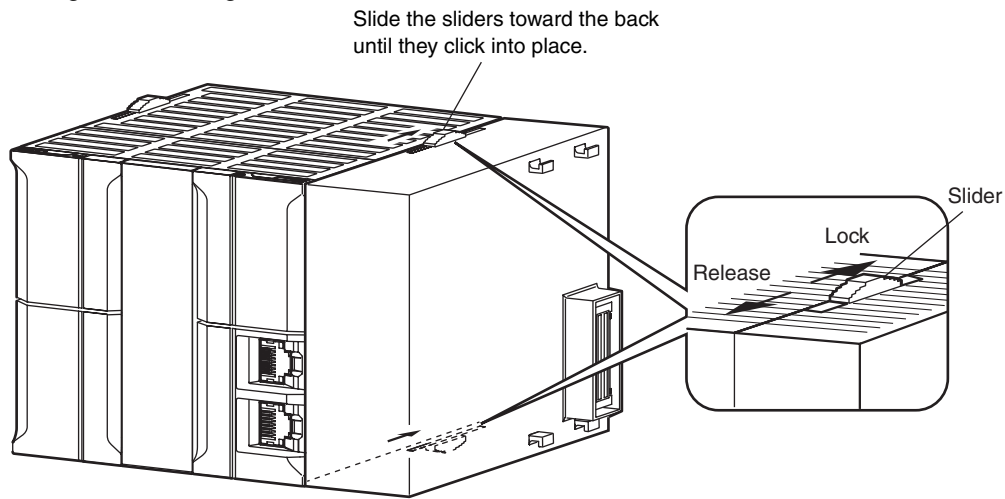
- Prevent wire clippings, cutting chips or other materials from getting inside the Unit. They could cause scorching, failure, and malfunction. Pay particular attention to this during installation and take measures such as covering with a cover.
- If the Unit was shipped from the factory with the dust protection label on top of the unit, be sure to remove that label before switching ON the power. The label prevents heat dissipation and could cause a malfunction.
- Be sure to turn OFF the power of the controller before installing or removing units or connecting or disconnecting connecting lines.

Use the following procedure to install CJ1W-CT021 High-speed Counter Units. Connect the Units before mounting them to DIN-rail.

- 1 Align the connectors and hooks accurately and press the Units together firmly when connecting them.



- 2** Slide the yellow sliders on the top and bottom of the Units until they click into place, firmly locking the Units together.



- 3** Attach an End Plate to the Unit on the right end of the Rack.



Precautions for Safe Use

The Units may not function properly if the sliders are not locked into place. Always connect the End Plate to the rightmost Unit. The NJ-series PLC will not function properly without the End Plate connected. The End Plate is provided with the CPU Unit.

2-3 Wiring

2-3-1 Connector Pin-layout

The 40-pin connector (CN1) on the front of the Unit is divided in Row A and Row B, each row containing 20-pins as indicated on front of the Unit. The Digital Outputs, Digital Inputs and the Counter Inputs of the Unit are logically grouped together and allocated to the pins of connector 1. The following table lists the allocation of the external signals to the respective pins.

Item	Connector 1 (CN1)		Pin No.	
	Row B	Row A		
Counter 2	Z	CH2: 24 V	CH2: 12 V	20
		CH2: LD+	CH2: LD-/0 V	19
	B	CH2: 24 V	CH2: 12 V	18
		CH2: LD+	CH2: LD-/0 V	17
	A	CH2: 24 V	CH2: 12 V	16
		CH2: LD+	CH2: LD-/0 V	15
Spare			14	
Counter 1	Z	CH1: 24 V	CH1: 5 V	13
		CH1: LD+	CH1: LD-/0 V	12
	B	CH1: 24 V	CH1: 5 V	11
		CH1: LD+	CH1: LD-/0 V	10
	A	CH1: 24 V	CH1: 5 V	9
		CH1: LD+	CH1: LD-/0 V	8
Spare			7	
Digital Inputs [0-1]	I1: 24 V	I1: 0 V	6	
	I0: 24 V	I0: 0 V	5	
Spare			4	
Digital Outputs [0-1] (NPN/PNP)	O1: PNP	O1: NPN	3	
	O0: PNP	O0: NPN	2	
Power Supply (to feed the outputs)	+PS:12 to 24 V	-PS: 0 V	1	

● Power Supply

External power has to be applied to the Power Supply pins in order to feed the Digital Outputs. Depending on what your application requires you can apply an external voltage between 12 to 24 VDC. In case the Digital Outputs are not used in your application, no external power has to be supplied.

● Digital Outputs

Every Digital Output (O0 and O1) can be used in a NPN- or PNP-configuration depending on your application needs. This configuration is done with Edit Special Unit Settings screen of Sysmac Studio. (refer to *3-5-4 Output Control Configuration* for more details). After you have configured the Digital Outputs for NPN or PNP you should make sure to use the corresponding NPN or PNP output pin.

● Digital Inputs

The Digital Inputs should be supplied with 24 VDC signals. Every Digital Input (I0 and I1) is equipped with a separate Ground Signal (0V) and has its own electronic input circuitry. This gives you the opportunity to connect sensors either with a NPN- or PNP-output driver. By making the appropriate Special Unit setup it is possible to assign multiple Digital Inputs to single Counters (refer to *3-4 Digital Input Functions* for more details).

● Counter Inputs

To the Counter Inputs of the High-speed Counter Unit signals can be applied originating from one of the following driver types:

- RS-422 Line Driver
- 5, 12 and 24 VDC signals from NPN- or PNP Drivers

The Unit allows you to connect Line Driver signals and 24 VDC signals to any Counter. The following table gives an overview of which driver signals can be applied to which Counters:

	Line Driver	5 VDC	12 VDC	24 VDC
Counter 1	•	•		•
Counter 2	•		•	•

2-3-2 Connector Wiring Methods



Precautions for Safe Use

- Prevent wire clippings, cutting chips or other materials from getting inside the Unit. They could cause scorching, failure, and malfunction. Pay particular attention to this during installation and take measures such as covering with a cover.
- If the Unit was shipped from the factory with the dust protection label on top of the unit, be sure to remove that label before switching ON the power. The label prevents heat dissipation and could cause a malfunction.
- Be sure that all the connectors are wired correctly and properly connected to the High-speed Counter Unit, to prevent the Unit from malfunctioning.

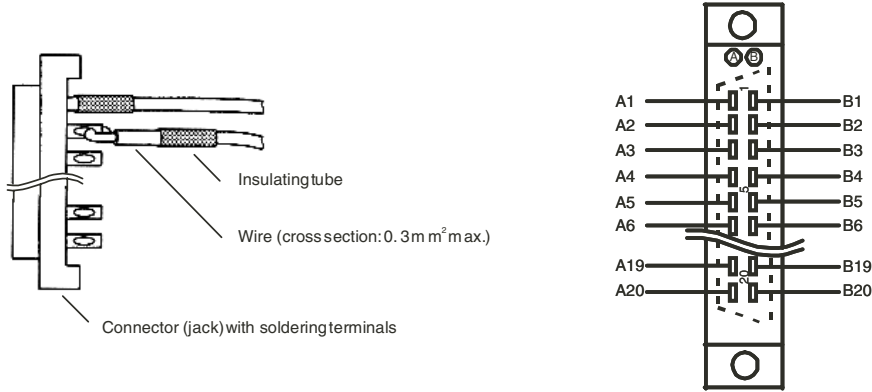
To wire the CJ1W-CT021 in order to connect the external signals (Power Supply, the Digital I/O and the Counter Inputs) two methods are available:

- 1** Directly connecting the wires and cables to the external connector, which is standard delivered with the High-speed Counter Unit
- 2** Indirectly connecting the wires and cables to the screw terminals of a Terminal Block Unit. The Terminal Block Unit is connected to the Unit with a standard (flat-) cable. Both parts can be ordered separately.

● **External Connector**

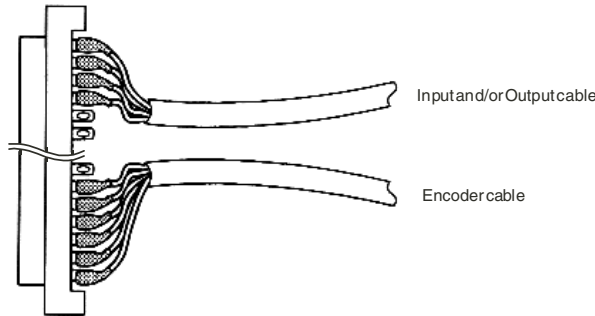
The connector has to be assembled from the separate parts that it exists of and that are supplied together with the Unit. Most important part is the connector jack (FCN-361J040) that contains 40 soldering terminals to which the wires have to be soldered.

● **Wiring the soldering terminals**

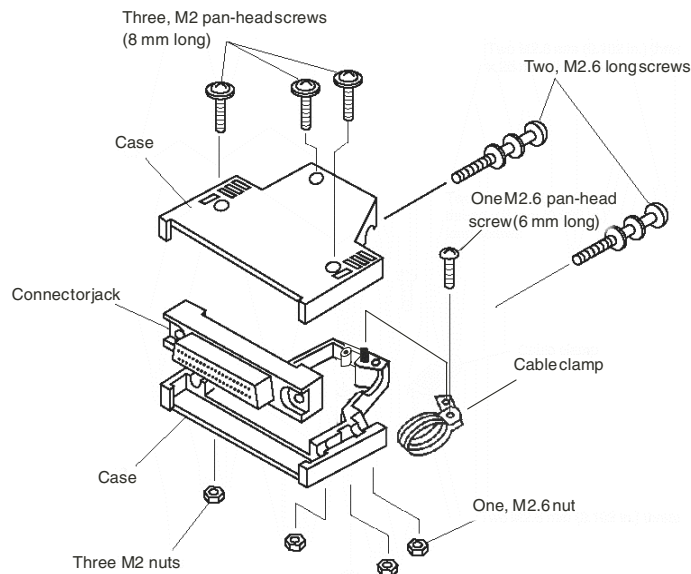


Numbering of the soldering terminals on connector (jack).
For an overview of the connector Pin-layout refer to 2-3-1 "Connector Pin-layout".

● **Cable separation**



● **Assembling Connectors**

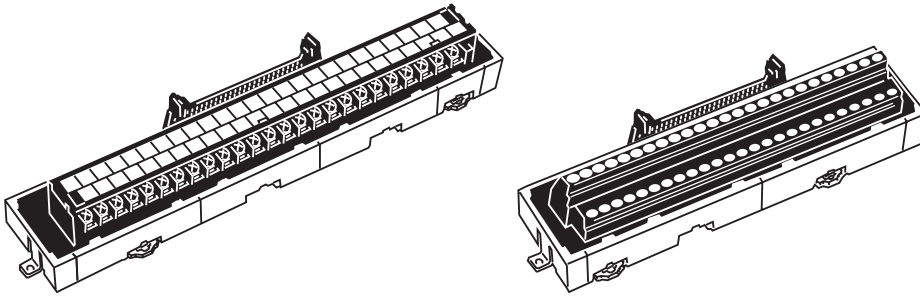




Precautions for Correct Use

- The cross section of the signal wires that can be connected to each soldering terminal must be $\leq 0.3 \text{ mm}^2$
- Do not short circuit any terminals when soldering. Recommended is to cover every soldered wire with an insulated tube.
- When using multi-conductor cables, separate the input- and output cables.

● Terminal Block Unit



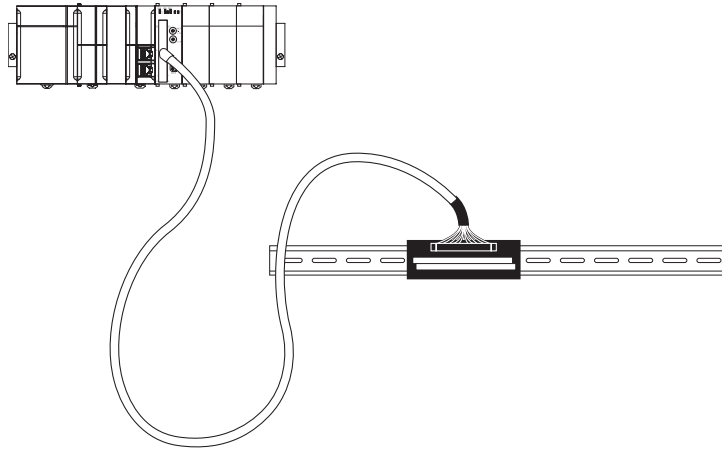
Besides direct connection as described above, it is also possible to make all the connections for the external signals to screw-terminals. This is easier and less time-consuming than soldering the wires to the external connector. For this purpose you should use a Terminal Block Unit. The following Terminal Block Units are recommended for using together with the CJ1W-CT021 High-speed Counter Unit:

- XW2B-40G4, which has 40 screw -terminals (M2.4) available
- XW2B-40G5, which has 40 screw -terminals (M3.5) available

These Terminal Block Units can be mounted to a DIN-rail or can be mounted using screws. The connector on front of the Unit should be connected to a Terminal Block Unit through a standard (40 wire) cable. For this purpose you can use the standard available cables with product-number XW2Z-xxxB. The length of the cable is indicated by 'xxx' in centimetres. The following cables are available:

- XW2Z-050B (0.5 m)
- XW2Z-100B (1 m)
- XW2Z-150B (1.5 m)
- XW2Z-200B (2 m)
- XW2Z-300B (3 m)
- XW2Z-500B (5 m)

The next figure shows how to use the Terminal Block Unit in a typical configuration together with the CJ1W-CT021 High-speed Counter:



Refer to *A-2 Using Terminal Block Units with Screw-terminals* for information on the numbering of the screw-terminals. You need this information in case you want to connect the external signals via Terminal Block Units to the High-speed Counter Unit.

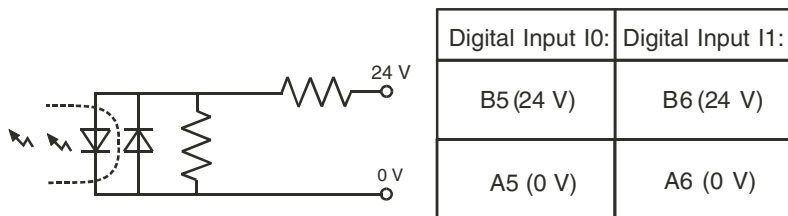
2-3-3 Important Wiring Considerations

Use the following guidelines when planning the system wiring of the Unit:

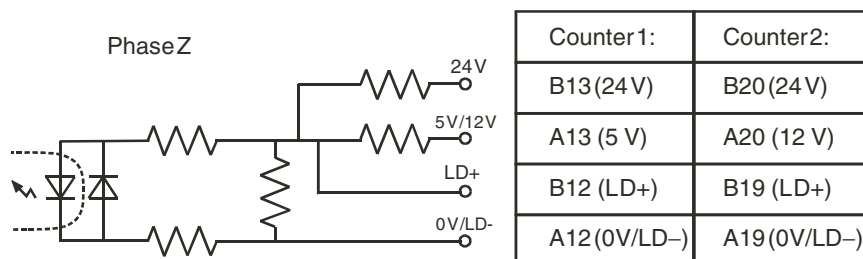
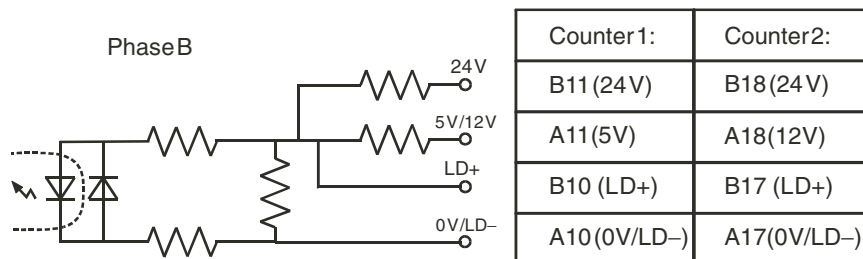
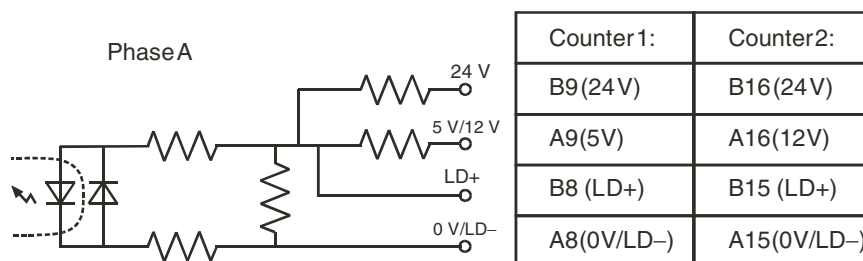
- Disconnect the power to the controller before wiring the unit.
- Make sure the PLC-system is properly grounded.
- Use shielded, twisted pair cables and ground the shield when wiring the Counter Inputs (A, B, Z) and the Digital Inputs. When grounding the shield at the side of the Unit, use the same reference as the ground terminal of the PLC-Power Supply is connected to.
- Make the wiring for the Counter Inputs A, B and Z as short as possible and do not route the wires parallel to lines that produce a lot of noise, such as high-voltage power lines.
- Try to use a separate stabilised Power Supply for the High-speed Counter Unit and another Power Supply for other Units.

2-3-4 Internal Circuitry

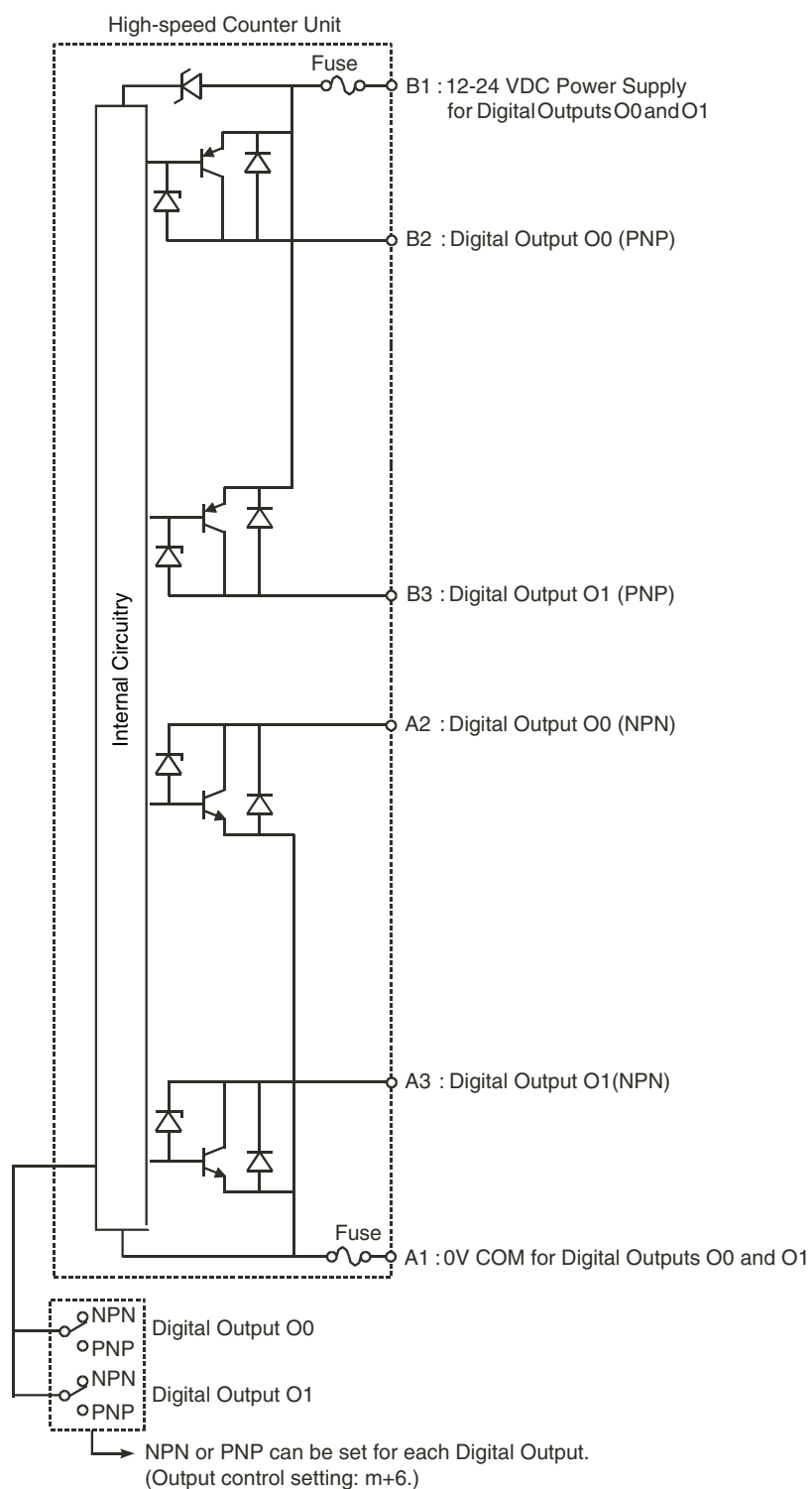
● Digital Input Circuitry



● Counter Input Circuitry



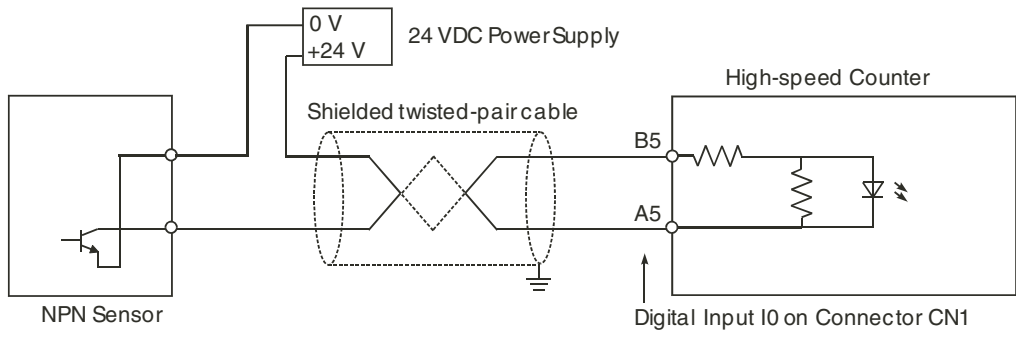
● Digital Output Circuitry



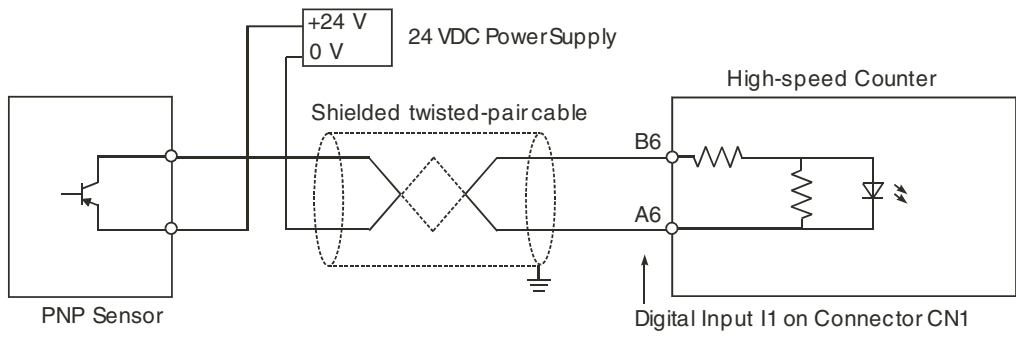
2-3-5 Digital I/O Circuit Configurations

The following examples make clear how to wire the Digital Inputs and the Digital Outputs.

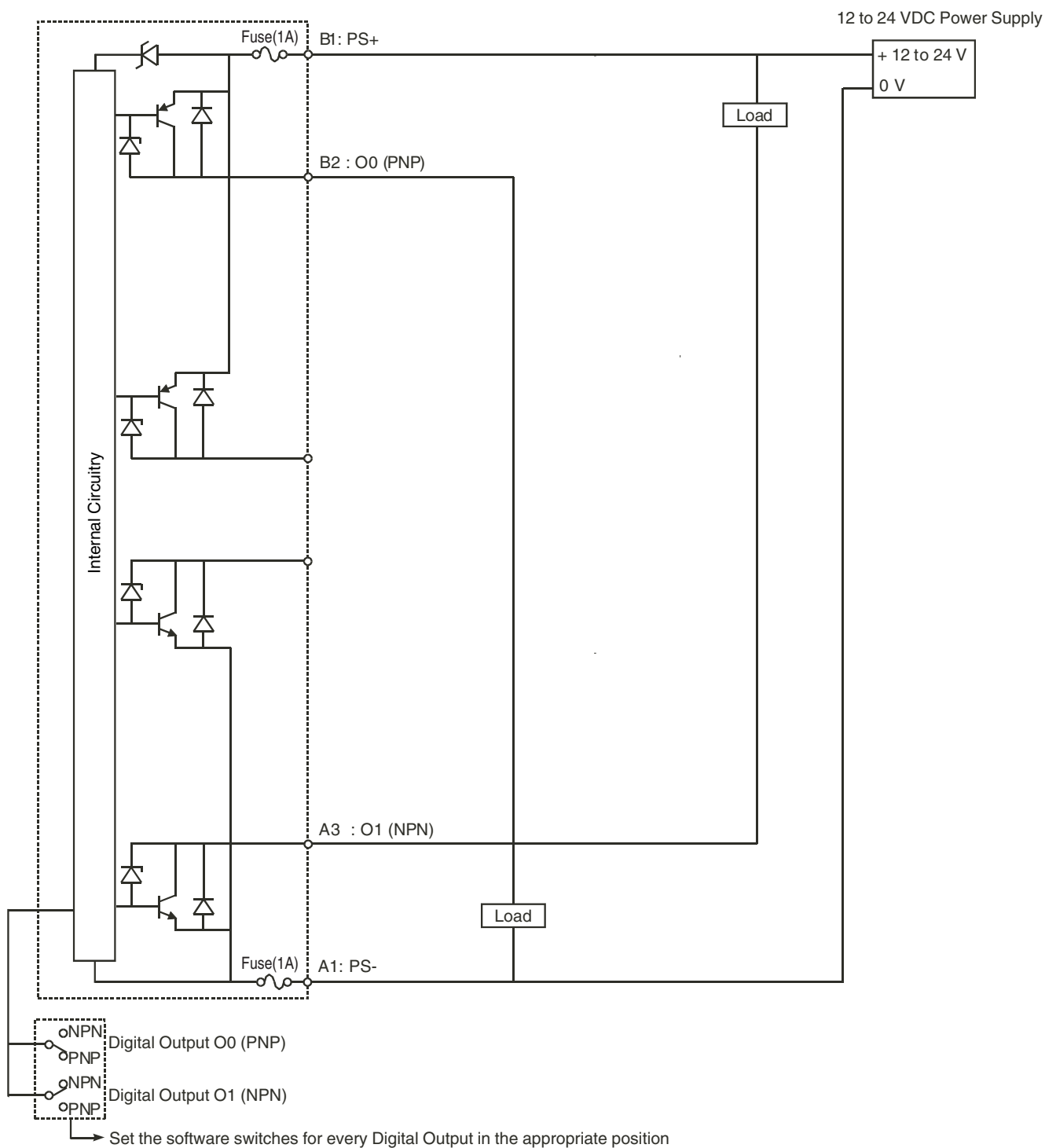
● **24 VDC NPN Sensor**



● **24 VDC PNP Sensor**



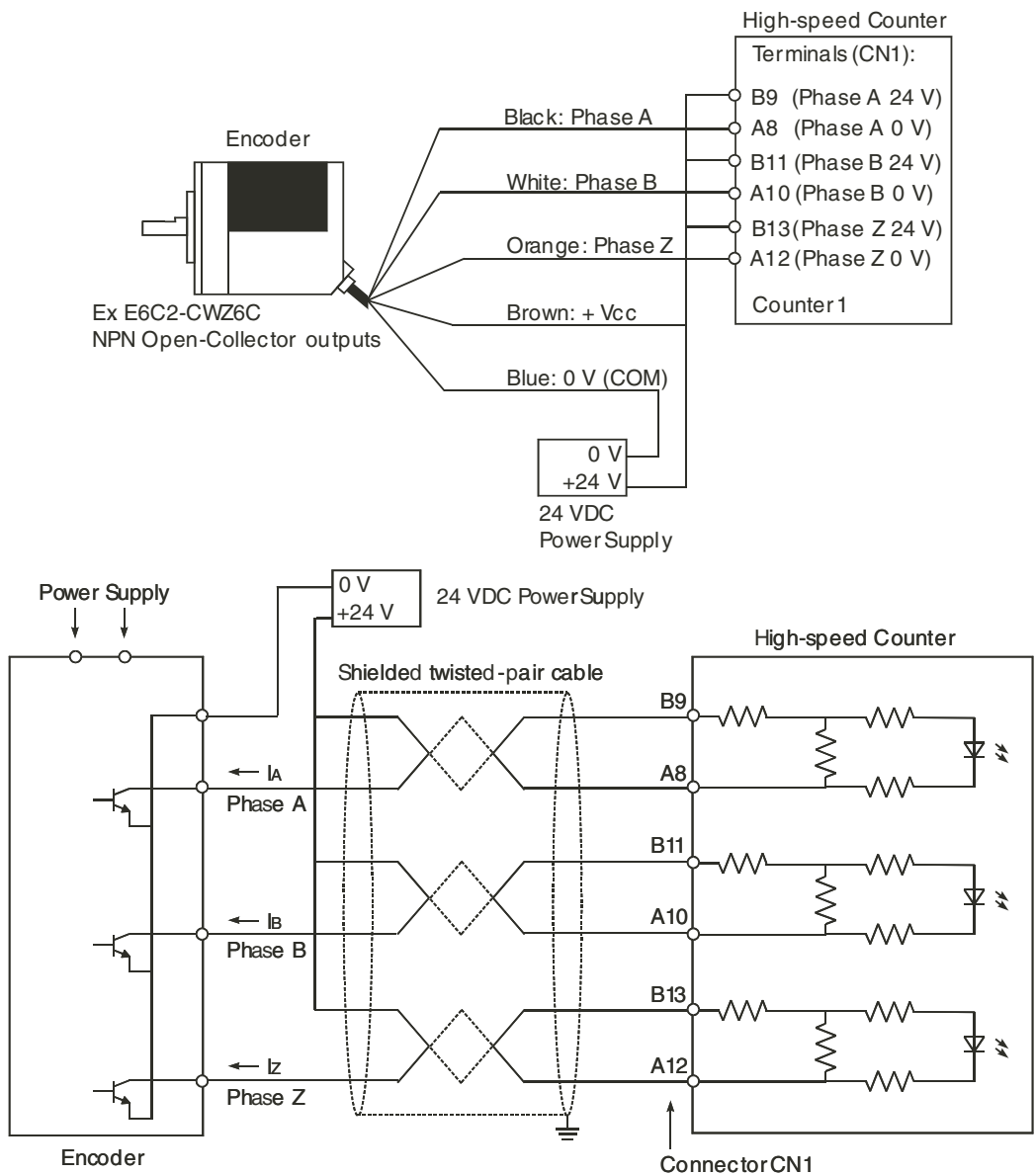
● Wiring example NPN/PNP Digital Output



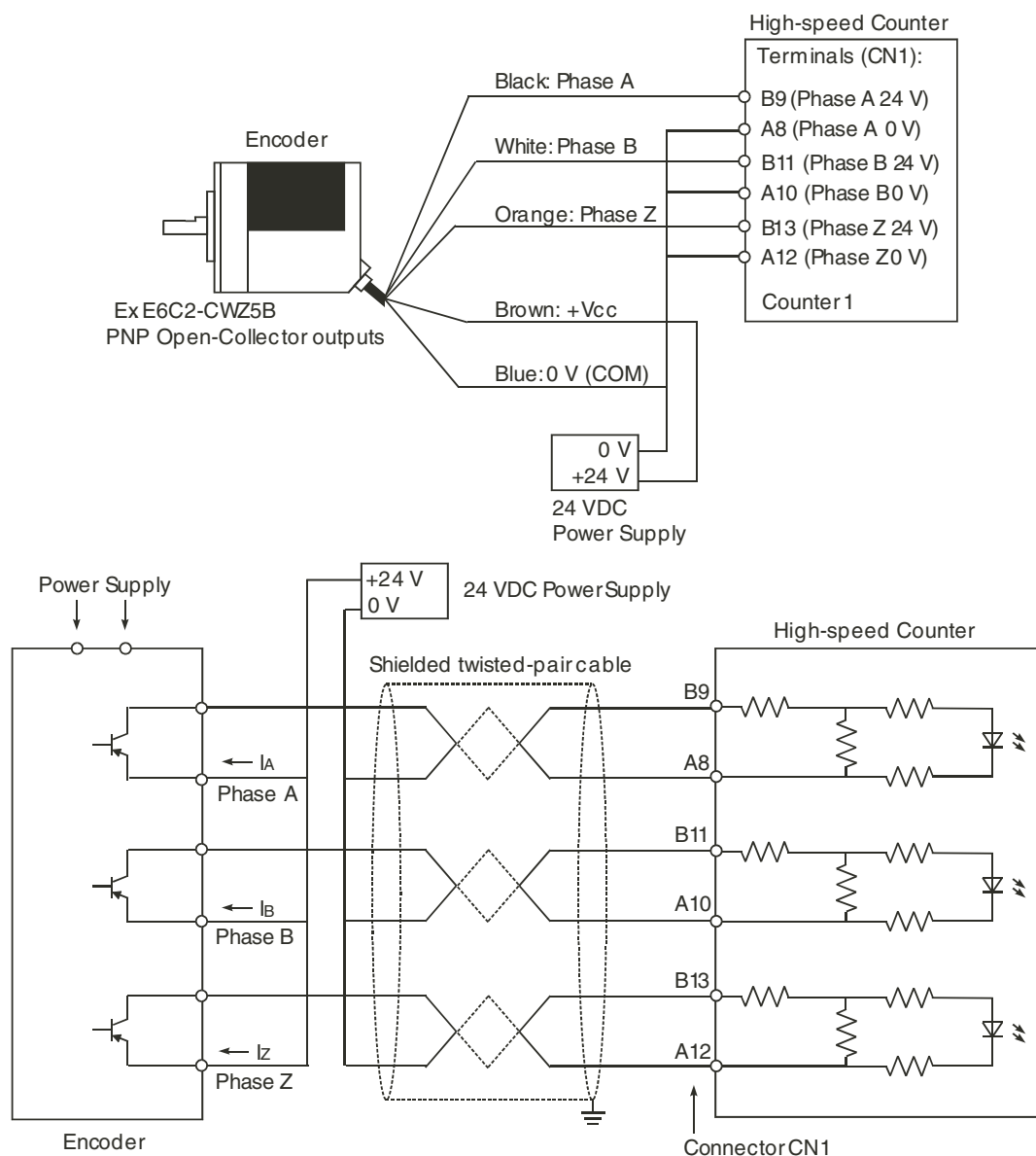
2-3-6 Counter Input Configurations

The following examples make clear how to wire the Counter Inputs in different configurations according to the output-driver of the encoder or proximity switch that you want to use. The configurations that are shown here, related to a specific output-driver, can also be referred to in case you want to use other pulse generating equipment with similar output-drivers.

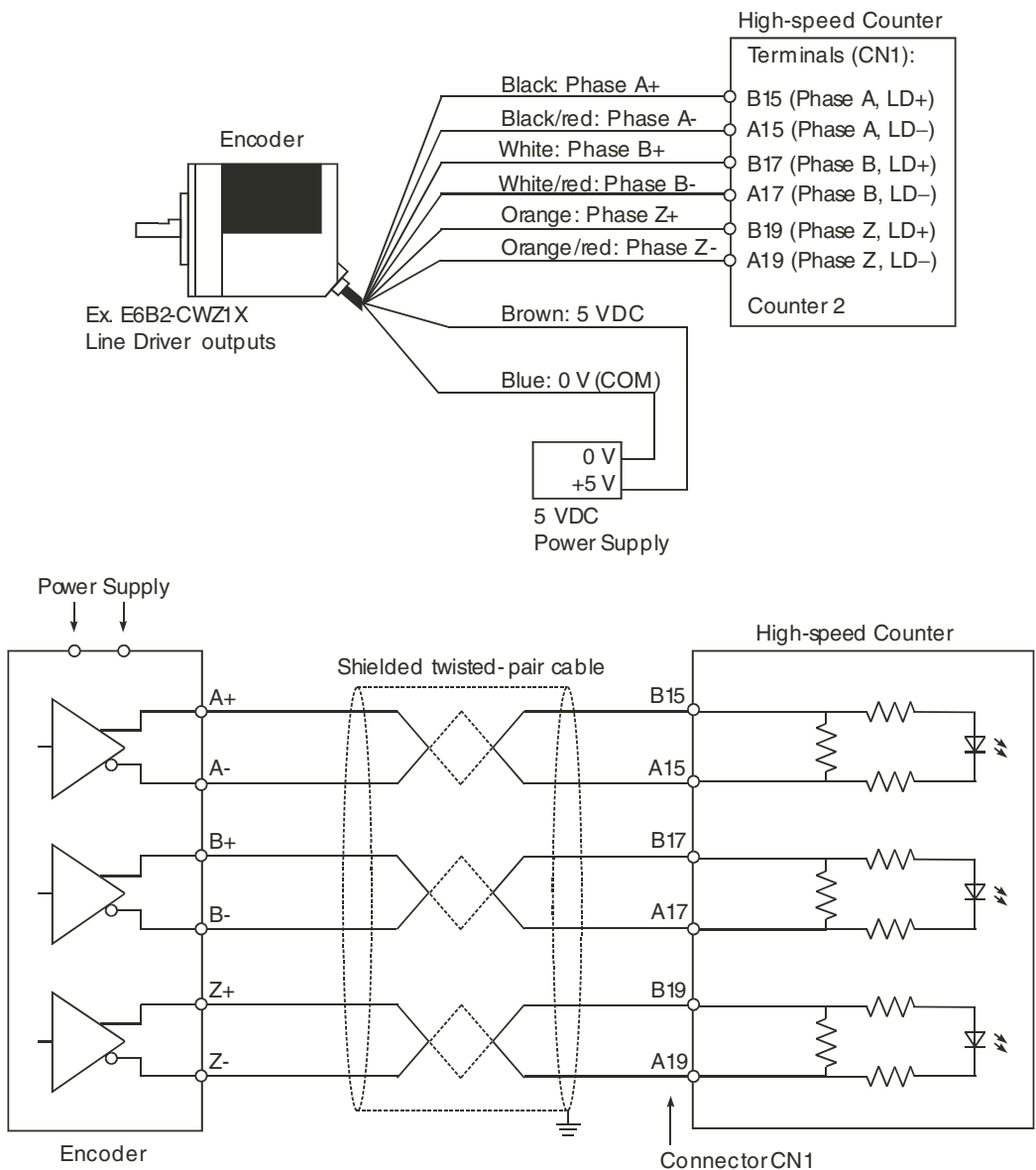
● **5/12/24 VDC NPN Open Collector**



● 5/12/24 VDC PNP Open Collector



● Line Driver (RS-422)



3

Operation and Configuration

This section describes how to configure the CJ1W-CT021 High-speed Counter Unit and how to operate the Unit according to the specific requirements of your application.

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3-1 Overview

3-1-1 Summary

You can make the Unit settings after you complete registration of the CJ1W-CT021 High-speed Counter Unit to the Unit Configuration and registration of device variables for CJ-series Unit.

Unit settings are made with Edit Special Unit Settings of Sysmac Studio. Alternatively, set device variables for CJ-series Unit (for setting) (refer to *4-1 Overview*) in the user program.

The setting by device variables for CJ-series Unit (for setting) is available only with Counters set as Circular/Linear Counters (by the DIP switch on the front face of the Unit). Simple Counters use the default setting and cannot be set by the device variables for CJ-series Unit (for setting).

This section describes how to set the CJ1W-CT021 High-speed Counter Unit to meet the specific needs of the user application. (Refer to *1-4 Quick Start Up Reference Guide* for an overview of the configuration items for every Counter).

Also throughout this section, the device variables for CJ-series Unit that are relevant to operate the Unit from the CPU Unit user program are mentioned. For details on device variables for CJ-series Unit (for input/output), refer to *4-2-3 Details of Device Variables for CJ-series Unit (for input/output)*. For details of device variables for CJ-series Unit (for setting), refer to *4-2-4 Details of Device Variables for CJ-series Unit (for setting)*.

3-1-2 List of Functions/Allocation Areas by Purpose

Refer to Explanation of functions used (reference), Name of device variable for CJ-series Unit (for input/output), and Name of device variable for CJ-series Unit (for setting) shown below according to the purpose for which you will use the High-speed Counter Units.

Determining How the Counter Will Be Used

Purpose	Explanation of functions used (reference)	Name of device variable for CJ-series Unit (for input/output)	Name of device variable for CJ-series Unit (for setting)
To select a pulse input method	<i>3-3 Input Signal Types</i> <ul style="list-style-type: none"> Phase differential Up & down pulse Pulse & direction 	---	<ul style="list-style-type: none"> Counter Types Signal Types Z-reset Mode/Overflow/Underflow error-code generation Upper Count Limit Circular/Linear Lower Count Limit Linear

Purpose	Explanation of functions used (reference)	Name of device variable for CJ-series Unit (for input/output)	Name of device variable for CJ-series Unit (for setting)
To select functions for Digital Inputs	<i>3-4 Digital Input Functions</i> <ul style="list-style-type: none"> • Gate function • Preset function • Reset function • Reset enable/disable function 	<ul style="list-style-type: none"> • Digital Input Status 	<ul style="list-style-type: none"> • Digital Input 0 Selection/ Counter Number • Digital Input 1 Selection/ Counter Number
To select a Digital Output method	<i>3-5-3 Manual Output Control</i> <i>3-5-4 Output Control Configuration</i>	<ul style="list-style-type: none"> • Manual Output Control • Automatic/Manual • Output Status 	<ul style="list-style-type: none"> • Output Driver NPN/PNP/ Output State Control • Predefined Output Pattern
To select a Counter Reset technique	<i>3-6 Reset Counter</i>	<ul style="list-style-type: none"> • Reset • Reset Enable • Reset Activated • Z-signal Activated 	<ul style="list-style-type: none"> • Digital Input 0 Selection/ Counter Number • Digital Input 1 Selection/ Counter Number • Z-reset Mode/Overflow/ Underflow error-code generation

Counter Operations

Purpose	Explanation of functions used (reference)	Name of device variable for CJ-series Unit (for input/output)	Name of device variable for CJ-series Unit (for setting)
When used for Simple Counter operation	<i>3-2-1 Simple Counter</i>	<ul style="list-style-type: none"> • Simple Counter 	Not provided

Purpose	Explanation of functions used (reference)	Name of device variable for CJ-series Unit (for input/output)	Name of device variable for CJ-series Unit (for setting)
When used for Linear Counter operation	<p><i>3-2-3 Linear Counter</i> <i>3-5-1 Range Mode</i> <i>4-2-2 Allocating Ranges and Comparison Data</i> <i>4-2-5 Memory Allocation for Ranges</i></p>	<ul style="list-style-type: none"> • Ranges/Comparison Values active 	<ul style="list-style-type: none"> • Output Control Mode/AND/OR Counter Output Patterns • Counter Type • Upper Count Limit Circular/Linear • Lower Count Limit Linear • Range/Comparison Enable Data • Output Set Pattern • Output Reset Pattern • Number of Ranges/Comparison Values (BCD) • Memory Area • Memory Address (BCD)
When used for Circular Counter operation	<p><i>3-2-2 Circular Counter</i> <i>3-5-1 Range Mode</i> <i>4-2-2 Allocating Ranges and Comparison Data</i> <i>4-2-5 Memory Allocation for Ranges</i></p>	<ul style="list-style-type: none"> • Ranges/Comparison Values active 	<ul style="list-style-type: none"> • Output Control Mode/AND/OR Counter Output Patterns • Counter Type • Upper Count Limit Circular/Linear • Range/Comparison Enable Data • Output Set Pattern • Output Reset Pattern • Number of Ranges/Comparison Values (BCD) • Memory Area • Memory Address (BCD)
When used for Preset Counter operation	<p><i>3-4 Digital Input Functions</i> <i>3-5-2 Comparison Mode</i> <i>3-7-1 Programmable Output Pulses Indirect Address Specification</i> <i>4-2-6 Memory Allocation for Comparison data</i></p>	<ul style="list-style-type: none"> • Preset • Preset Value • Preset Activated 	<ul style="list-style-type: none"> • Output Control Mode/AND/OR Counter Output Patterns • Range/Comparison Enable Data • Output Set Pattern • Output Reset Pattern • Number of Ranges/Comparison Values (BCD) • Memory Area • Memory Address (BCD)

Using Convenient Functions

Purpose	Explanation of functions used (reference)	Name of device variable for CJ-series Unit (for input/output)	Name of device variable for CJ-series Unit (for setting)
To make any desired external output pattern	<i>3-7-1 Programmable Output Pulses</i>	<ul style="list-style-type: none"> Output Status 	<ul style="list-style-type: none"> Output Pulse Turn ON-Delay Time (BCD) Digital Output 0 Output Pulse Duration (BCD) Digital Output 0 Output Pulse Turn ON-Delay Time (BCD) Digital Output 1 Output Pulse Duration (BCD) Digital Output 1
To apply hysteresis to Range conditions	<i>3-7-2 Hysteresis</i>	---	<ul style="list-style-type: none"> Hysteresis
To minimize malfunction due to noise	<i>3-7-3 Noise Filtering</i>	---	<ul style="list-style-type: none"> Input Noise Filter Counters Input Noise Filter Digital Inputs

3-2 Counter Types

Every single Counter of the High-speed Counter Unit can be set independently to one of the following Counter Types (for an overview of the differences between Simple and Circular/Linear Counters refer to *1-4 Quick Start Up Reference Guide*):

- Simple Counter (refer to *3-2-1 Simple Counter*)
- Circular Counter (refer to *3-2-2 Circular Counter*)
- Linear Counter (refer to *3-2-3 Linear Counter*)

The configuration starts by setting each Counter's DIP switch on the front of the Unit.

The factory setting is all DIP switches are set to OFF (for Simple Counters). When you use a Counter as a Circular Counter or Linear Counter, set them to ON, and select circular or linear by using the device variables for CJ-series Unit (for setting) as shown below.

In the description hereafter, each variable name has a prefix "**". This indicates the device name when this Unit is registered in the Unit Configuration. For details, refer to *4-1-3 Access from User Program*.

Name of device variable for CJ-series Unit	Type	Name	Function
*_Ch1_CtTypCfg	UINT	Counter Type	0: Circular Counter
*_Ch2_CtTypCfg			1: Linear Counter

A Circular Counter and a Linear Counter can use all functions provided for a High-speed Counter Unit, and can have various setup. A Simple Counter, however, can only use the default functions.

● Counter Value

For all Counter Types the 32-bit Counter Value is stored in the following device variables for CJ-series Unit (for input): The data range depends on the type of Counter.

Name of device variable for CJ-series Unit	Type	Name	Function
*_Ch1_LinCtVal	DINT	Counter Value	Used for a Simple Counter or Linear Counter. -2,147,483,648 to +2,147,483,647
*_Ch2_LinCtVal			
*_Ch1_RingCtVal	UDINT	Counter Value	Used for a Circular Counter. 0 to +4,294,967,295
*_Ch2_RingCtVal			

3-2-1 Simple Counter

The advantage of using a Counter as a Simple Counter is that you do not have to set any device variables for CJ-series Unit. Instead, all default settings are used. In other words, Simple Counters can only be used in a default configuration. If you intend to use the High-speed Counter Unit only with Simple Counters the information as described in this section "Simple Counter", covers all the default features and functions that are important and available to you.

● Simple Counter Function Outline

Function	Specifications
Counter operation	Linear
Counting range	-2,147,483,648 to +2,147,483,647
Count Mode	Phase difference, multiplication x1
Counting speed	50 kHz
Gate open/close	Device variables for CJ-series Unit are used
External outputs	Manual output control only
Output form	NPN
Reset	Device variables for CJ-series Unit are used

To use all the functions of a High-speed Counter Unit, set the Unit to a Circular Counter or Linear Counter, instead of a Simple Counter. For details on Circular Counters, refer to *3-2-2 Circular Counter*; for details on Linear Counters, refer to *3-2-3 Linear Counter*.

● Simple Counter Configuration

The following features and functions are supported for Simple Counters:

- Simple Counters can count up and down within the 32-bit count range (the same as a Linear Counter can). Refer to *3-2-3 Linear Counter*.
- You can preset or rest the Counter Value of a Simple Counter by using device variables for CJ-series Unit (for input/output) and you can open or close the gate to allow counting pulses or not.
- With Simple Counters, only phase differential signals (multiplication x 1) can be connected. You cannot use the Z signal to trigger a reset, only its status is reported in device variables for CJ-series Unit (for input). (Accordingly, you can trigger a reset indirectly via the user program.)
- The noise filter for Digital Inputs is fixed to 50 kHz. This means that, the maximum frequency of the input pulses up to 50 kHz is guaranteed.
- For High-speed Counter Unit Digital Output, only manual output control is possible by using the corresponding device variables for CJ-series Unit (for output).
- The two Digital Outputs use an NPN-output driver.
- You cannot assign the Digital Inputs to individual Counters and you cannot configure the function of the Digital Inputs. Only the status of the Digital Inputs is reported in device variables for CJ-series Unit (for input). For the method of allocating Digital Inputs to circular or Linear Counters, refer to *3-4 Digital Input Functions*.
- Errors are normally reported in device variables for CJ-series Unit (for input).



Additional Information

- The CPU exchanges data with the Simple Counter via the device variables for CJ-series Unit (for input/output).
- If a Counter is set as a Simple Counter, it is indicated in the device variables for CJ-series Unit (for input).
- The device variables for CJ-series Unit (for setting) that set Counter functions are not used for a Simple Counter.

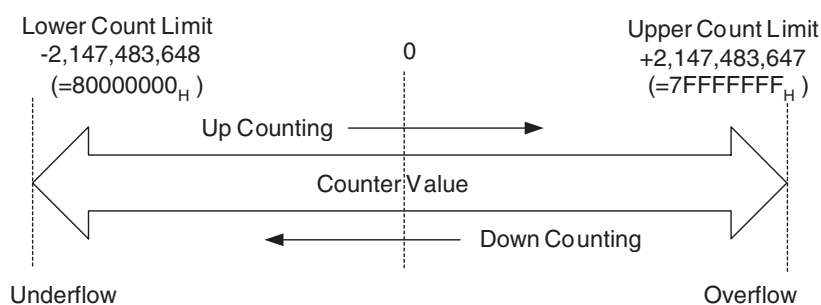
● Controlling Simple Counters via Device Variables for CJ-series Unit (for input/output)

You can control Simple Counters from device variables for CJ-series Unit (for input/output). For details on device variables for CJ-series Unit (for input/output), refer to *4-2-3 Details of Device Variables for CJ-series Unit (for input/output)*.

The following gives a detailed description of all the features and functions for Simple Counters that are available in device variables for CJ-series Unit (for input/output).

● 32 Bits Counting Range

A Simple Counter has the full counting range (=32 bits) available to count up- or downwards over the positive and negative counting range between the Lower Count Limit (-2,147,483,648) and the Upper Count Limit (+2,147,483,647).



● Overflow and Underflow

If a Counter Value exceeds the upper or lower limit, it is reflected to the following device variables for CJ-series Unit (for input) as an overflow or underflow. The Counter Value is retained as the time of overflow or underflow, and subsequent pulses are ignored. You can clear overflow and underflow with a preset or reset.

Name of device variable for CJ-series Unit	Type	Name	Function
*_Ch1_CtOvf	BOOL	Counter Overflow	1: Overflow
*_Ch2_CtOvf			0: Other than the above
*_Ch1_CtUdf	BOOL	Counter Underflow	1: Underflow
*_Ch2_CtUdf			0: Other than the above

● Gating of a Simple Counter

You can start or stop the gate of a Simple Counter by using the following device variables for CJ-series Unit (for output) (Open Gate, Close Gate). A rising edge of the Open Gate or Close Gate triggers the corresponding action in the next I/O refresh.

Name of device variable for CJ-series Unit	Type	Name	Function
_Ch1_Enbl	BOOL	Open Gate	0 to 1: Count start
*_Ch2_Enbl			
*_Ch1_Dsbl	BOOL	Close Gate	0 to 1: Count stop
*_Ch2_Dsbl			

* The system enters the count start state at the rising edge of the Open Gate regardless of the Close Gate state. At a simultaneous rising edge of both variables, the state of the gate is unchanged.

A Simple Counter is stopped when the Unit is restarted or the Controller is reset, including when the power is turned ON. So in order to start a count, it is necessary to first change the open gate (start) to 1.

● Presetting a Simple Counter

The Unit has device variables for CJ-series Unit (for output) which are used to save preset values for Simple Counters. To change preset values, set values to these variables. The rising edge of the preset is the trigger and the Counter Value is overwritten by the preset value at the next I/O refresh.

Name of device variable for CJ-series Unit	Type	Name	Function
*_Ch1_Prst	BOOL	Preset	0 to 1: Counter preset
*_Ch2_Prst			
*_Ch1_PrstLinCtVal	DINT	Preset Value	Used for a Simple Counter or Linear Counter. Set in the range -2,147,483,648 to 2,147,483,647.
*_Ch2_PrstLinCtVal			

● Resetting a Simple Counter

A Counter can be reset by using a Simple Counter reset. The rising edge of the reset is the trigger and the Counter is reset at the next I/O refresh.

Name of device variable for CJ-series Unit	Type	Name	Function
*_Ch1_Rst	BOOL	Reset	0 to 1: Counter reset
*_Ch2_Rst			

● Digital Inputs Status of Simple Counter

The status of the two Digital Inputs is reflected in the devices variables for CJ-series Unit (for input).

Name of device variable for CJ-series Unit	Type	Name	Function
*_In0	BOOL	Digital Input 0 Status	0: OFF 1: ON
*_In1	BOOL	Digital Input 1 Status	0: OFF 1: ON

● Manual Control of Digital Output

If you select 1 for the following device variable Automan, then you can control two Digital Outputs by setting them to either 0 (OFF) or 1 (ON).

Name of device variable for CJ-series Unit	Type	Name	Function
_AutoMan	BOOL	Automatic/Manual	0: Automatic ON/OFF output 1: Manual output control
*_OutCtl0	BOOL	Manual Output Control (Output 0)	0: OFF 1: ON
*_OutCtl1	BOOL	Manual Output Control (Output 1)	0: OFF 1: ON

* Automatic ON/OFF output can only be used with Circular Counters and Linear Counters in Range Mode or Comparison Mode (for details, refer to 3-5 *Output Control*).

● Digital Outputs Status of Simple Counter

The status of the two Digital Outputs is reflected in the devices variables for CJ-series Unit (for input).

Name of device variable for CJ-series Unit	Type	Name	Function
*_OutSta0	BOOL	Digital Output 0 Status	0: OFF 1: ON
*_OutSta1	BOOL	Digital Output 1 Status	0: OFF 1: ON

3-2-2 Circular Counter



Additional Information

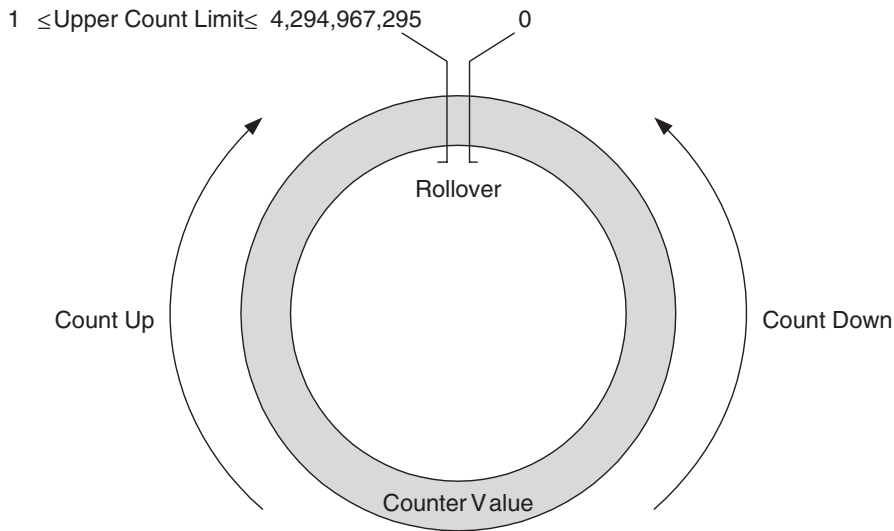
A Circular Counter can uses all functions listed in 1-3-2 *Functional Specifications*.

● Configuring Circular Counters

Circular Counters are set with the following device variables for CJ-series Unit (for setting).

Name of device variable for CJ-series Unit	Type	Name	Function
*_Ch1_CtTypCfg	UINT	Counter Type	0: Circular Counter
*_Ch2_CtTypCfg			1: Linear Counter

A Circular Counter has 32 bits (the full counting range) available to count up- or down over the positive counting range between 0 and the Upper Count Limit.



● **Configuring Upper Count Limit**

The Upper Count Limit can be set to a value between 1 and 4,294,967,295. By default, it is set to the maximum possible count limit of +4,294,967,295.

With Circular Counters, the Counter automatically rolls over to 0 and continues counting, if the Counter Value exceeds the Upper Count Limit. If the Counter Value goes below 0, the Counter rolls over to the Upper Count Limit and continues counting.

Name of device variable for CJ-series Unit	Type	Name	Function
*_Ch1_UpCtLmtCfg	UDINT	Upper Count Limit Circular/Linear	Set the upper count limit in the range of 0 to 4,294,967,295.
*_Ch2_UpCtLmtCfg			When 0 is set, this becomes 4,294,967,295.

3-2-3 Linear Counter



Additional Information

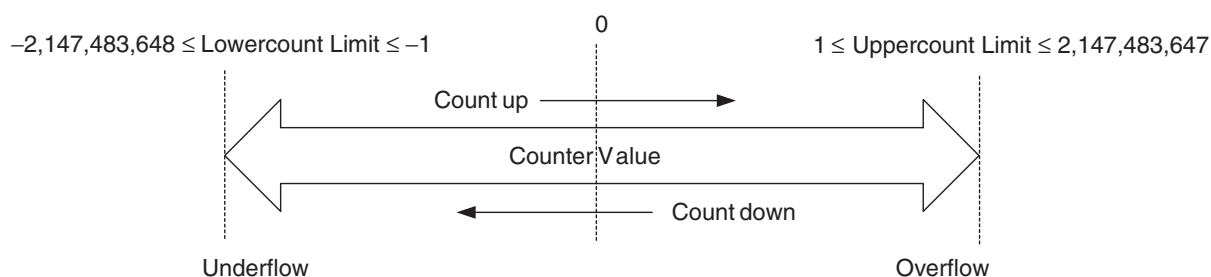
A Linear Counter can use all functions listed in 1-3-2 *Functional Specifications*.

● Configuring Linear Counters

Linear Counters are set with the following device variables for CJ-series Unit (for setting).

Name of device variable for CJ-series Unit	Type	Name	Function
*_Ch1_CtTypCfg	UINT	Counter Type	0: Circular Counter
*_Ch2_CtTypCfg			1: Linear Counter

A Linear Counter has the full counting range (=32 bits) available to count up and down within the range between the Lower Count Limit and the Upper Count Limit. By default the Lower and Upper Count Limits are set to the maximum and minimum counting limits (i.e. -2,147,483,648 and 2,147,483,647 respectively).



If a Counter Value exceeds the Upper Count Limit, an overflow is set in the device variable for CJ-series Units; if a Counter Value is below the Lower Count Limit, an underflow is set.

You can make settings to issue corresponding error codes when an overflow or underflow occurs. If a Z-reset Mode/Overflow/Underflow error-code generation (Bits 04 to 07) is set, the overflow/underflow error can be stored in the Unit EEPROM (refer to 5-2-2 *Overflow/Underflow errors*).

Another feature of overflow/underflow error code is that output states at errors can be predefined. For this purpose you should use the Output State Control function (refer to 3-5-4 *Output Control Configuration* for more information).

● Configuring Upper and Lower Count Limits

The Upper Count Limit must be positive and the Lower Count Limit must be negative. (If either is set to 0, the upper count limit becomes 2,147,483,647 and the lower count limit becomes –2,147,483,648.) To set the Upper and Lower Count Limits, refer to the following.

Name of device variable for CJ-series Unit	Type	Name	Function
*_Ch1_UpCtLmtCfg	UDINT	Upper Count Limit Circular/Linear	Set a value in the range of 0 to 2,147,483,647.
*_Ch2_UpCtLmtCfg			When 0 is set, this becomes 2,147,483,647.
*_Ch1_LowCtLmtCfg	DINT	Lower Count Limit Linear	Set a value in the range of –2,147,483,648 to 0.
*_Ch2_LowCtLmtCfg			When 0 is set, this becomes –2,147,483,648.

● Creating Error Codes

To create an error code with a Linear Counter, set the bits 4 to 7 of the device variable for CJ-series Unit (for setting) to 1.

Name of device variable for CJ-series Unit	Type	Name	Function
*_Ch1_ZOVfUdfCfg	WORD	Z-reset Mode / Overflow/Underflow error-code generation	Bits 00 to 03: Z phase reset
*_Ch2_ZOVfUdfCfg			16#0: No function 16#1: Reset Bits 04 to 07: Overflow/underflow error setting 16#0: Do not generate error codes. 16#1: Generate error codes. Bits 8 to 15: 00

● Overflow and Underflow Flags

An Overflow or Underflow of a Linear Counter is reported in the device variables for CJ-series Unit (for input).

Name of device variable for CJ-series Unit	Type	Name	Function
*_Ch1_CtOvf	BOOL	Counter Overflow	1: Overflow
*_Ch2_CtOvf			0: Other than the above
*_Ch1_CtUdf	BOOL	Counter Underflow	1: Underflow
*_Ch2_CtUdf			0: Other than the above

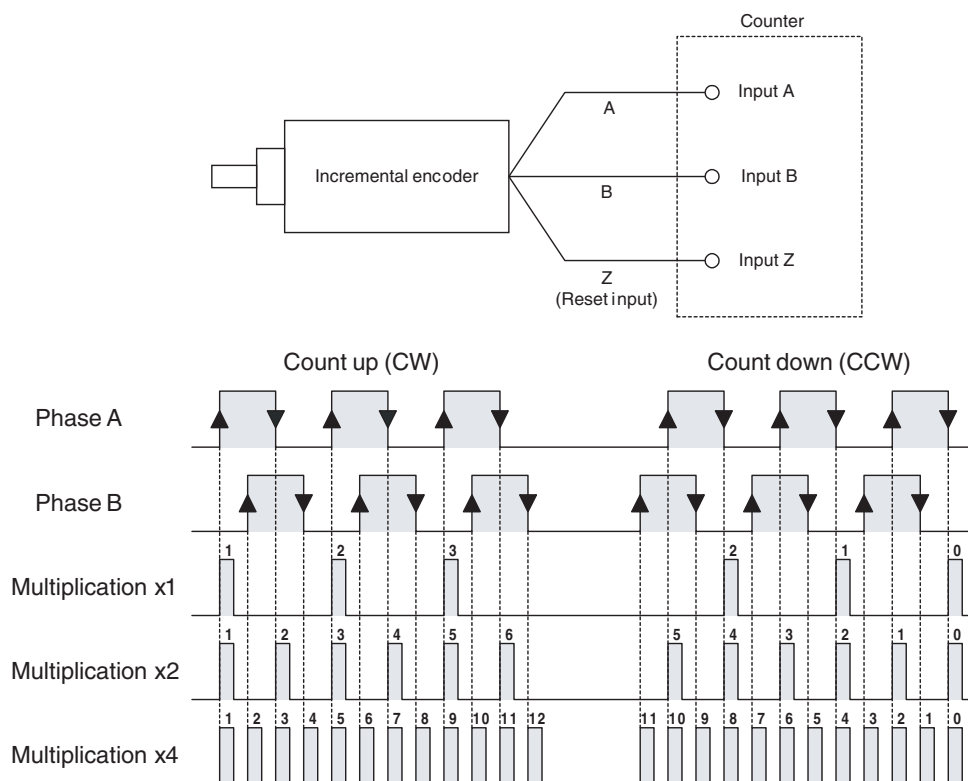
3-3 Input Signal Types

Select the input type using the following device variables for CJ-series Unit (for setting). For every Counter, you can select the Signal Type.

Name of device variable for CJ-series Unit	Type	Name	Function
*_Ch1_SigTypCfg	UINT	Signal Type	This sets the input type.
*_Ch2_SigTypCfg			0: Phase differential (multiplication 1) 1: Phase differential (multiplication 2) 2: Phase differential (multiplication 4) 4: Up & down pulse 8: Pulse & direction

3-3-1 Phase Differential

Phase Differential Signals are connected to the inputs A, B and Z of every Counter. The count direction is determined by the phase angle between input A and input B. If signal A leads to B, the Counter increments. If signal B leads to A, the Counter decrements.



● Multiplication x1

By default the Counter is configured for Multiplication by 1. If the Counter counts up (signal A leads to signal B), pulses are taken into account by the Counter on the rising edges of signal A. If the Counter counts down, pulses are taken into account on the falling edges of input A.

● Multiplication x2

To increase the resolution of the incremental encoder, the Counter can be configured for Multiplication by 2. If the Counter counts up (signal A leads to signal B), pulses are taken into account by the Counter on the rising- and falling edges of signal A. If the Counter counts down, pulses are also taken into account on the rising- and falling edges of signal A.

● Multiplication x4

To further increase the resolution of the incremental encoder, the Multiplication x4 should be selected. If the Counter counts up (signal A leads to signal B), pulses are taken into account by the Counter on the rising- and falling edges of signal A and signal B. If the Counter counts down, pulses are also taken into account on the rising- and falling edges of signal A and B.

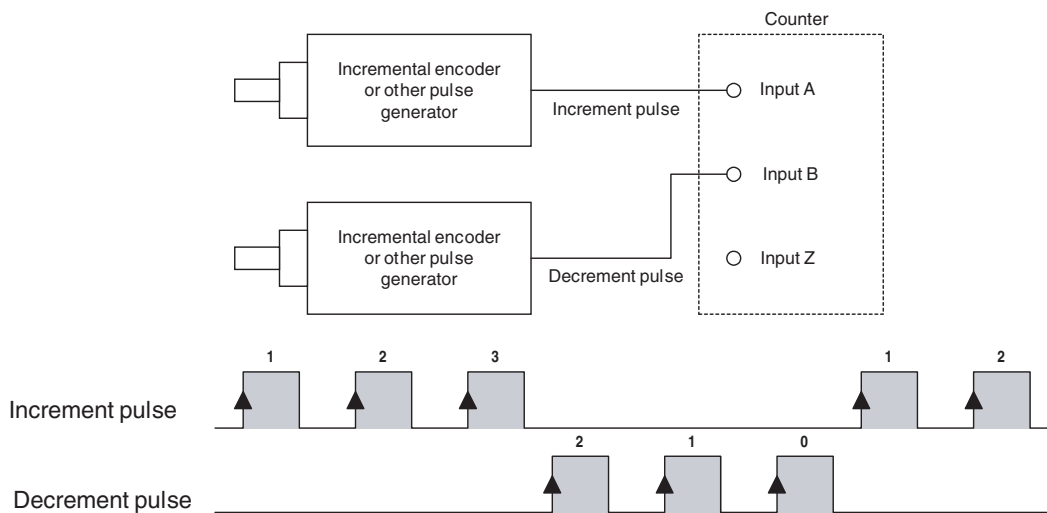


Additional Information

For Counter Reset options (Z-input included) refer to *3-6 Reset Counter*.

3-3-2 Up & Down Pulse

With this Signal Type the Counter increments on the rising edge of pulses applied to input A, and decrements on the rising edge of pulses applied to input B.

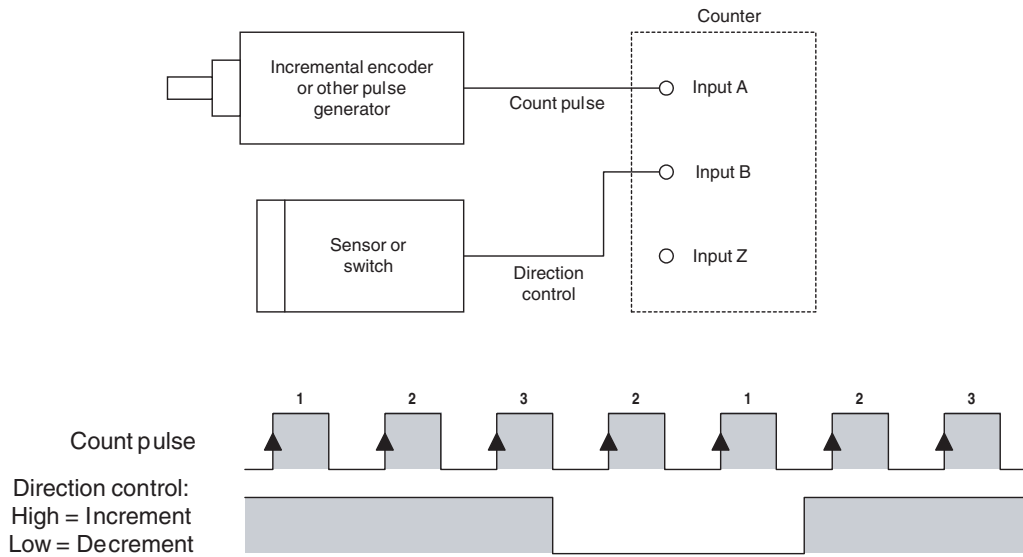


Additional Information

For Counter Reset options refer to *3-6 Reset Counter*.

3-3-3 Pulse & Direction

In this configuration, count pulses are applied to input A. The direction of counting is controlled by the level of the signal applied to input B. If input B is high, the Counter increments on the rising edges of input A. If input B is low, the Counter decrements on the rising edges of input A.



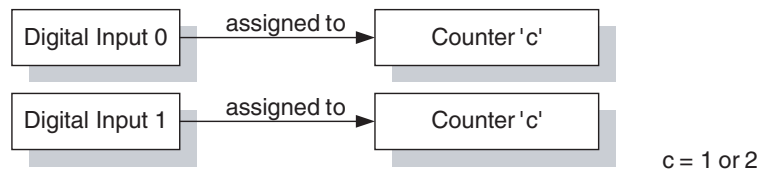
Additional Information

For Counter Reset options refer to *3-6 Reset Counter*.

3-4 Digital Input Functions

● Assigning Plural Digital Inputs to a Single Counter

The High-speed Counter Unit is equipped with two Digital Inputs, each of which can control a different Counter of the Unit. If a Counter has to be controlled by plural Digital Inputs, a maximum of two Digital Inputs can be assigned to the Counter. Be aware if both of the two Digital Inputs are used for one Counter, no other Digital Input is left for other Counters.



● Digital Input Functions

Furthermore, the function of every Digital Input can be selected from one out of 8 available functions. Every function performs its unique action on the Counter to which it is assigned. The action can be performed on the rising or on the falling edge of the Digital Input signal. Depending on the requirements of your application you must select the corresponding Function. By default no function is assigned to the Digital Inputs and no action is performed on a rising or falling edge of the Digital Input signal (Only Digital Input statuses are reflected in device variables for CJ-series Unit (for input).).

Name of device variable for CJ-series Unit	Type	Name	Function
*_DigIn0FunCfg	WORD	Digital Input 0 Function/Counter Number	Bits 07 to 00: Digital input 0 function selection 16#00: No function 16#01: Positive gate (Function 01) 16#02: Negative gate (Function 02)
*_DigIn1FunCfg	WORD	Digital Input 1 Function/Counter Number	16#03: Rising edge preset (Function 03) 16#04: Falling edge preset (Function 04) 16#05: Rising edge reset (Function 05) 16#06: Falling edge reset (Function 06) 16#15: Reset enabled (Function 15) 16#16: Reset disabled (Function 16) Bits 15 to 08 Counter number 16 No. 01: Counter 1 16 No. 02: Counter 2

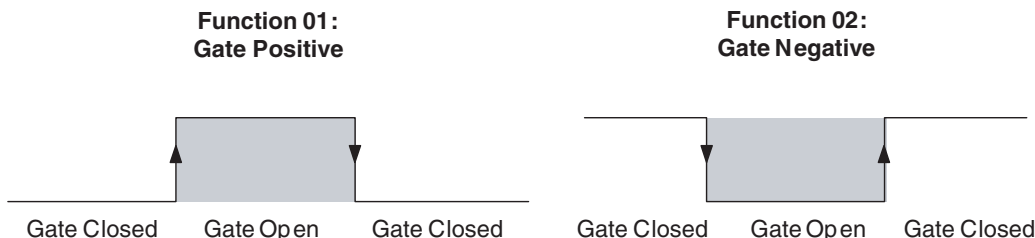


Additional Information

- Unit settings are made with Edit Special Unit Settings of Sysmac Studio. Do not select items that use the capture function from the Digital Input # Function drop down list. When used with the NJ Series, the capture function cannot be used.
- The Settings specified in the Edit Special Unit Settings screen support all of the functions of this Unit. However, when they used with the NJ Series, some functions of this Unit become unavailable. Do not select functions that cannot be used. Errors will not be detected even if these functions are selected or set.
Refer to *A-1 Differences of NJ Series from CJ Series*, for functions that cannot be used with NJ series.

● Gate Function

The Gate Function should be assigned to a Digital Input in case you want to use that Digital Input as a Gate. When the Gate is open, the Counter is able to count pulses. When the Gate is closed, the Counter will not count pulses. The Positive Gate Function (01) results in an open Gate when the level of the signal applied to the Digital Input is high and a closed Gate when the level of the signal applied to the Digital Input is low. For the Negative Gate Function (02) the same functionality is applied to the Counter for inverted signals.



The Counter gate can also be opened or closed with Open Gate/Close Gate of the device variables for CJ-series Unit (for output) as shown below.

Name of device variable for CJ-series Unit	Type	Name	Function
_Ch1_Enbl	BOOL	Open Gate	0 to 1: Count start
*_Ch2_Enbl			
*_Ch1_Dsbl	BOOL	Close Gate	0 to 1: Count stop
*_Ch2_Dsbl			

* The system enters the count start state at the rising edge of the Open Gate regardless of the Close Gate state. If both variables rise at the same time, the gate state of the time is held (is not changed).



Additional Information

Initially, at power up or restart of the Unit, for all Counter types (i.e. Simple-, Circular-, and Linear Counters) the Gate is closed and counting is disabled. In order to enable counting you must open the Gate first.

● Preset Function

A Digital Input configured to have Preset functionality will preset the Counter with the Preset Value on a rising edge (Preset Rising Edge, Function 03) or falling edge (Preset Falling Edge, Function 04) of the Digital Input signal. This will cause the Counter Value to be overwritten with the Preset Value.



This Unit has device variables for CJ-series Unit (for output) to store preset values for Counters. To change a preset value, set a preset value in this variable.

Name of device variable for CJ-series Unit	Type	Name	Function
*_Ch1_Prst	BOOL	Preset	0 to 1: Counter preset
*_Ch2_Prst			
*_Ch1_PrstLinCtVal	DINT	Preset Value	Used for a Simple Counter or Linear Counter. Set it in the range -2,147,483,648 to 2,147,483,647.
*_Ch2_PrstLinCtVal			
*_Ch1_PrstRingCtVal	UDINT	Preset Value	Used for a Circular Counter. Set it in the range 0 to 4,294,967,295.
*_Ch2_PrstRingCtVal			

The Counter Value is overwritten by the preset value at the rising edge of the Preset Counter bit.

● Reset Function

A Digital Input configured to have Reset functionality will reset the Counter to zero on a rising edge (Reset Rising Edge, Function 05) or falling edge (Reset Falling Edge, Function 06) of the Digital Input signal.



To reset a Counter by the Function 05 or 06, it is necessary to set the following variable Reset Enable to 1.

It is also possible to reset a Counter by using the following device variable for CJ-series Unit (for output) Reset.

Name of device variable for CJ-series Unit	Type	Name	Function
*_Ch1_Rst	BOOL	Reset	0 to 1: Counter reset
*_Ch2_Rst			
*_Ch1_RstEnbl	BOOL	Reset Enable	0: Disable 1: Enabled
*_Ch2_RstEnbl			

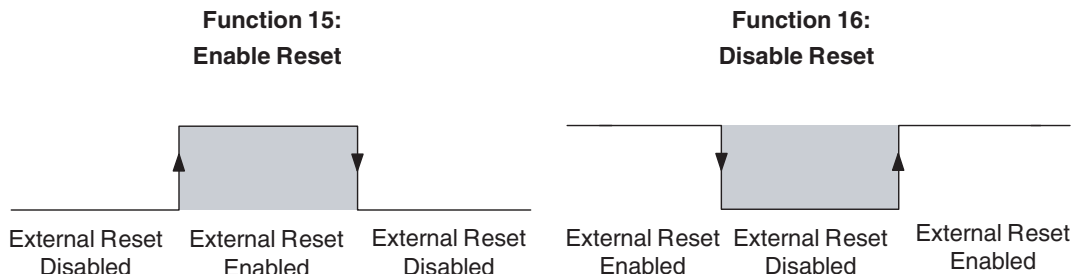


Additional Information

- Resets from an Digital Input signal will be executed within 300 μ s.
- The Open Gate, Close Gate, Preset or Reset in device variables for CJ-series Unit (for output) may not be executed if turned to 1 for only one task period.
Always keep them 1 until the execution status changes in the corresponding flag (Counter Running/Gate Open, Preset Activated, and Reset Activated).

● **Enable, Disable Reset**

A Digital Input configured to have Enable Reset Functionality (Function 15) or Disable Reset Functionality (Function 16) can be used to Enable/Disable resetting a Counter by an external reset signal. The external reset signal can originate from another Digital Input that is configured to have reset functionality (Function 05 or 06) or from the Z-input.



To reset a Counter by the function 05 or function 06, it is necessary for external resets to be in the enabled state and for Reset Enable to be set to 1. For details on Counter resets, refer to *3-6 Reset Counter*.

● **Digital Input Status**

The status of the two Digital Inputs is reflected in the devices variables for CJ-series Unit (for input) shown below.

Name of device variable for CJ-series Unit	Type	Name	Function
*_In0	BOOL	Digital Input 0 Status	0: OFF 1: ON
*_In1	BOOL	Digital Input 1 Status	0: OFF 1: ON

An input with extremely short pulse widths (shorter than the CPU Unit task period) is not always reflected in the above variables.

● **Action Status**

When a preset or reset is allocated to a Digital Input, the status of Digital Inputs is detected via variables (Preset Activated, Reset Activated) of the device variables for CJ-series Unit (for input). When a preset or reset is executed, the corresponding variable changes to ON for 1 task period of the CPU Unit.

Use these variables on the user program when necessary.

● **Z-Input Status**

For each Counter, the Z-input status is reflected in the device variables for CJ-series Unit (for input). The bit is ON for exactly one task period of the CPU Unit after the Z-input is activated.

● **Counting Direction**

For every Counter the (up or down) counting direction is indicated and can be used in the user program.

Name of device variable for CJ-series Unit	Type	Name	Function
*_Ch1_CntDir	BOOL	Counting Direction	0: Count down
*_Ch2_CntDir			1: Count up

3-5 Output Control

● Output Control Mode

The 32 Outputs (2 external and 30 internal) of the High-speed Counter Unit can be controlled automatically in two ways:

- Range Mode. In Range Mode you can define up to a maximum of 32 Ranges per Counter. The Outputs are controlled according to the Counter Value being within Range Limits. For a detailed description about Range Mode refer to 3-5-1 Range Mode.
- Comparison Mode. In Comparison Mode you can define up to a maximum of 32 Comparison data per Counter. The Outputs are controlled according to the direction in which the Counter Value crosses the Comparison Value. For a detailed description about Comparison Mode refer to 3-5-2 Comparison Mode.

If the Unit is configured for Range Mode all two Counters will operate in Range Mode. If the Unit is configured for Comparison Mode all two Counters will operate in Comparison Mode.

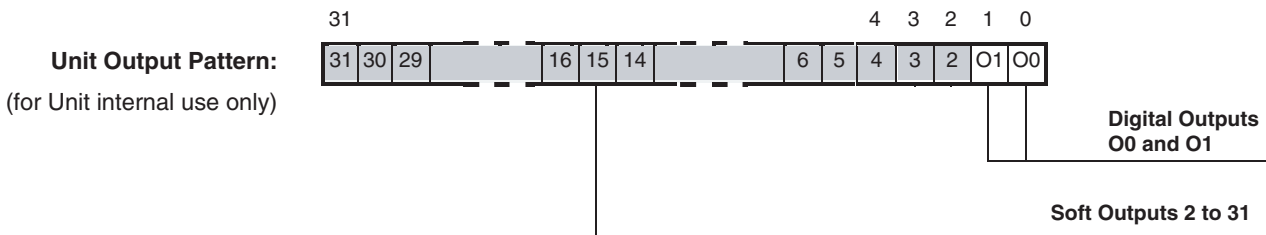
The Output Control Mode is set with bits 0 to 7 of the following device variables for CJ-series Unit (for setting).

Name of device variable for CJ-series Unit	Type	Name	Function
* _OutCtlMdCfg	WORD	Output Control Mode/AND/OR Counter Output Patterns	Bits 0 to 7: Output Control Mode Sets the Output Control Mode. 16#00: Range Mode 16#01: Comparison Mode Bits 8 to 15: Counter output pattern AND/OR selection For Range Mode, selects whether the Counter output pattern is logically OR or AND. 16#00: OR 16#01: AND

Besides automatically, the Digital Outputs can also be controlled manually (refer to 3-5-3 Manual Output Control).

● Unit Output Pattern

Both in Range and Comparison Mode the 32 Outputs of the Unit are represented by the Unit Output Pattern. The Unit uses the Unit Output Pattern internally to control the Outputs. The Unit Output Pattern consists of 30 Soft (internal) Outputs and 2 Digital Outputs. The two Digital Outputs represent the Outputs O0 and O1 of the Unit.



Digital Outputs 0 and 1 correspond with the Digital Outputs O0 and O1.

● Output Status

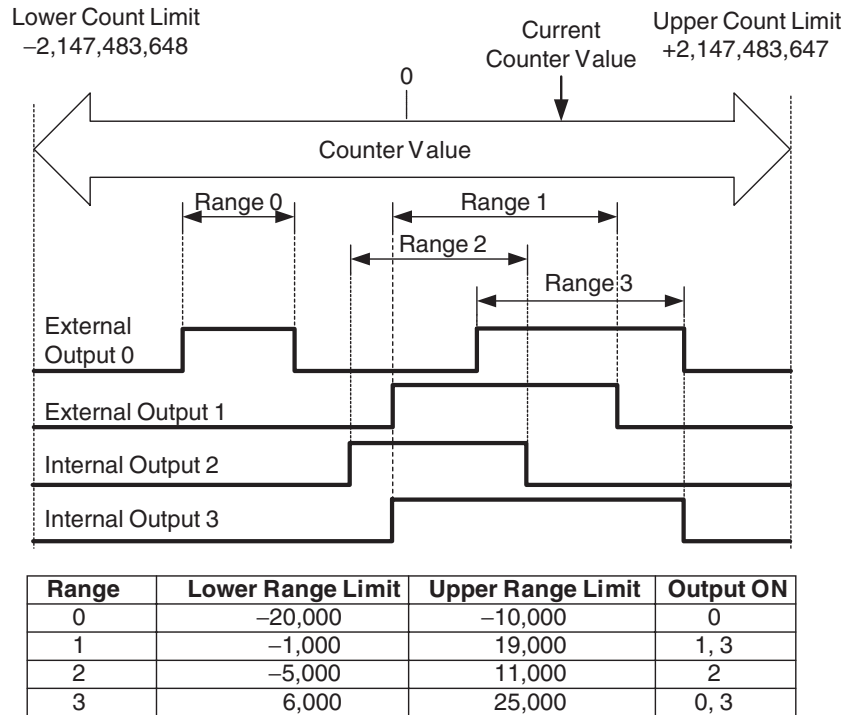
The status of the Digital Outputs is reflected in the device variables for CJ-series Unit (for input). There are two types of variables: one type has one variable for each bit status and the other has one variable that summarizes all 32 bit statuses. The former type of output statuses can be used to control outputs of external basic output units on user programs.

Name of device variable for CJ-series Unit	Type	Name	Function
*_OutStaDat	DWORD	Output Status	The current statuses of digital and internal output (total of 32) are all displayed. 0: OFF 1: ON Bit 00: External output O0 Bit 01: External output O1 Bit 02: Internal output 2 : Bit 31: Internal output 31
*_OutSta0 to *_OutSta31	BOOL	Digital Output 0 to 1 Status Soft Output 2 to 31 Status	0: OFF 1: ON

3-5-1 Range Mode

If the Unit is configured to control the Outputs in Range Mode, this Mode can be applied to Circular Counters or Linear Counters (refer to 3-2-2 *Circular Counter* and 3-2-3 *Linear Counter* for more information).

● Example Range Mode with Linear Counter

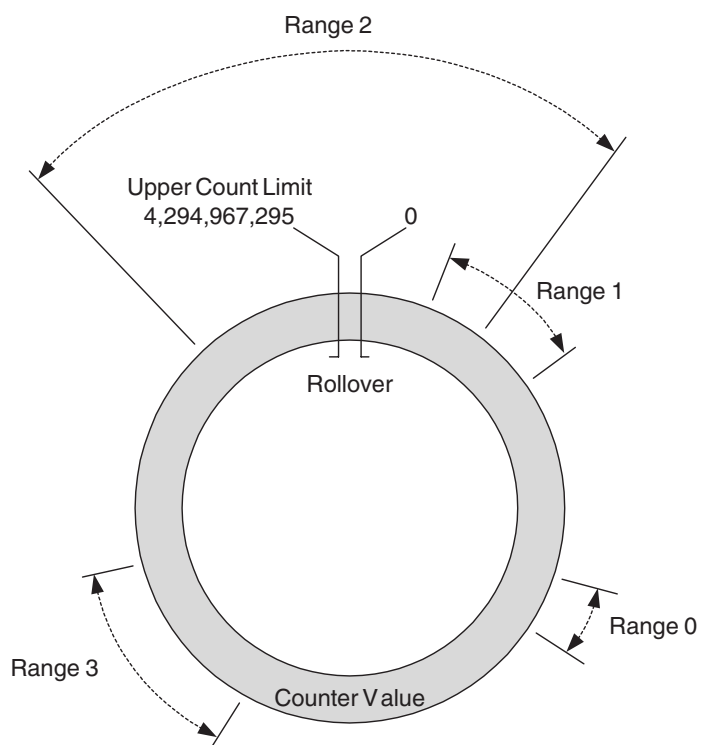


In this example four Ranges are specified. The configuration data of the Counter shows that:

- Output 0 must be ON for Counter Values within Range 0.
- Output 1 and 3 must be ON for Counter Values within Range 1.
- Output 2 must be ON for Counter Values within Range 2.
- Both of the Outputs 0 and 3 must be ON for Counter Values within Range 3.

In the above example the Counter Value is within Range 1 and 3 and consequently the Outputs 0, 1 and 3 are turned ON.

● Example Range Mode with Circular Counter

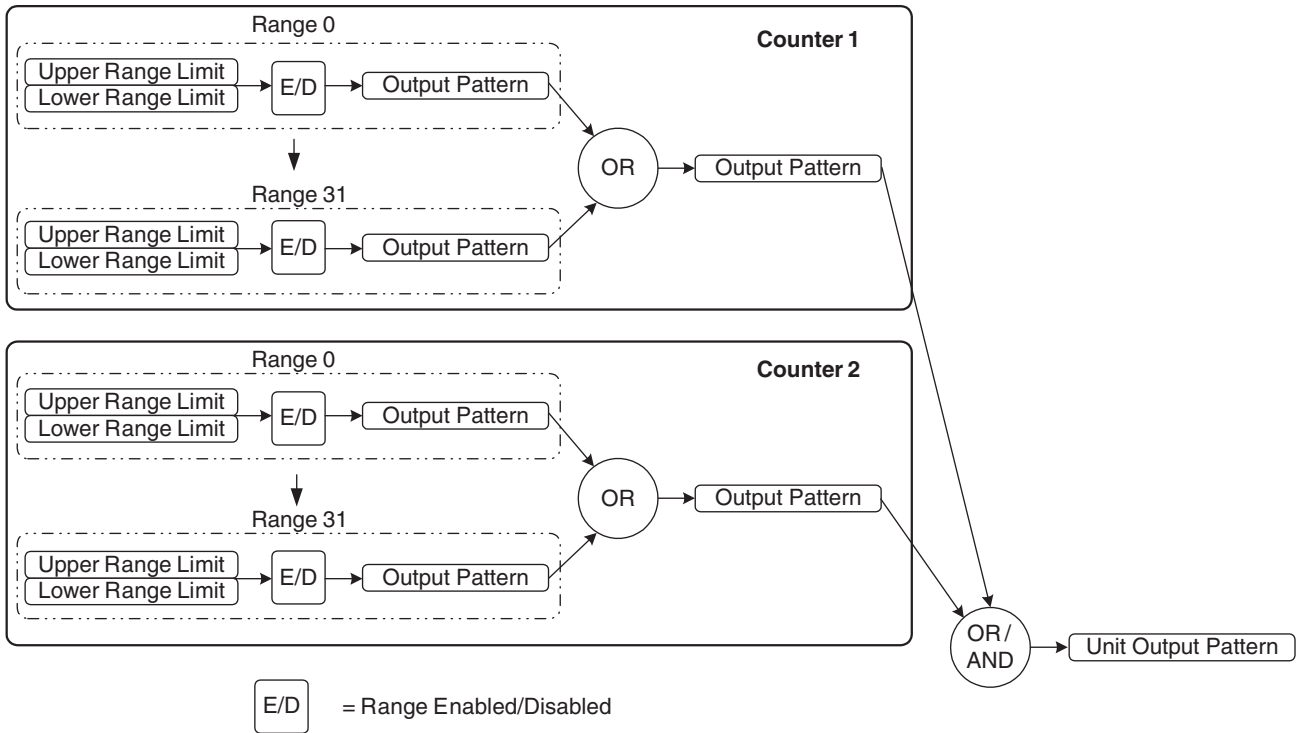


Range	Lower Range Limit	Upper Range Limit	Output ON
0	60,000	80,500	0
1	500	45,000	1, 3
2	37,000,000	6,000	2
3	99,000	150,000	0, 3

This example shows the Range Mode applied to a Circular Counter.

Range Mode Overview

The following figure gives an overview on configuring Counters in Range Mode.



How to configure Counters in Range Mode is described on the next pages.

Configuration and Operation in Range Mode

● Specifying Range Data

In Range Mode every Counter can be assigned up to a maximum of 32 Ranges. The Data of every Range is contained by 3 double words:

- Lower Range Limit, specifying the Lower Limit of the Range
- Upper Range Limit, specifying the Upper Limit of the Range
- Output Pattern, specifying which Outputs have to be activated when that Range is active

The Counter Type (Circular or Linear) determines the range in which the Upper and Lower Limits can be set. For Circular Counters this range is 0 to 4,294,967,295 and for Linear Counters this range is -2,147,483,648 to 2,147,483,647. For Linear Counters the Upper Range Limit must be greater than the Lower Range Limit. The Unit will generate an error if the Upper Range Limit ≤ Lower Range Limit (refer to 5-2 *Error codes* for more details). For Circular Counters, the Upper Range Limit can be set lower than the Lower Range Limit.

To configure a Counter in Range Mode for every Range that you want to use the Range-Data must be set. Each data-item is specified using the structure data type shown next. In order to use structure data types for range data, register the structure data type for High-speed Counter Units beforehand on the CPU/Expansion Racks screen in Configuration and Setup of Sysmac Studio. For the exact memory location to set the Range-Data, refer to 4-2-1 *Memory Mapping*.

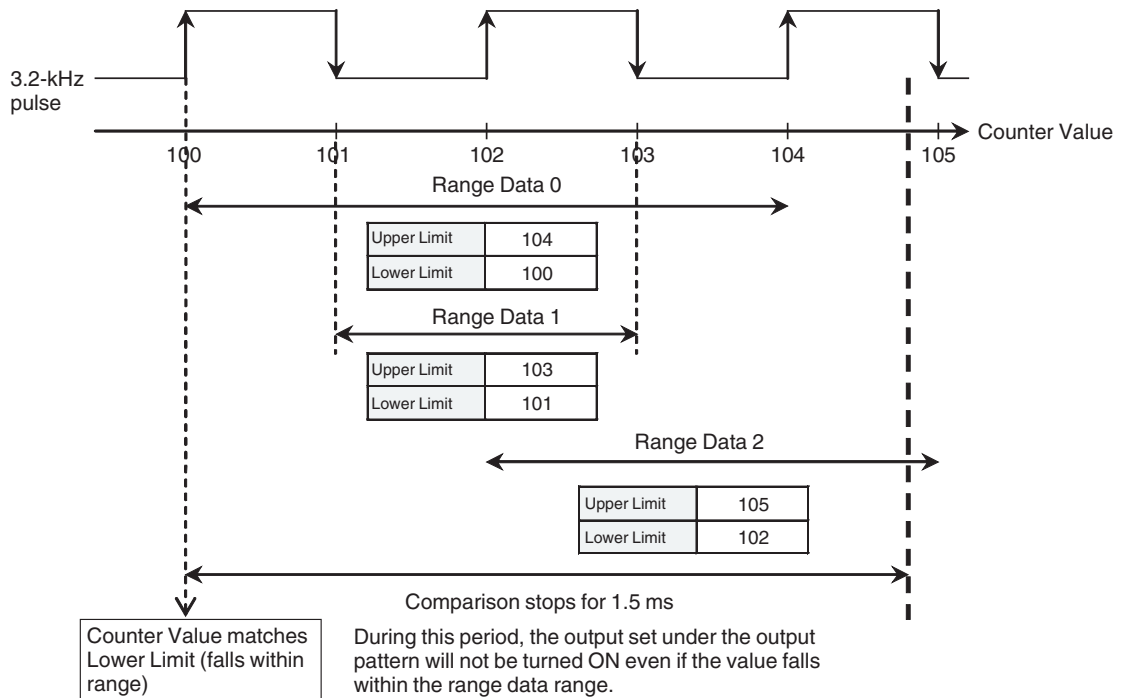
Counter setting	Structure data type name	Member	Name	Data type	Function
Linear Counter	_sCJCT021_Ex_RngLin	LowLmt	Lower Limit Range	DINT	Range data lower limit setting
		UpLmt	Upper Limit Range	DINT	Range data upper limit setting
		OutPat	Output Pattern	DWORD	Output pattern setting for when range conditions are met Bit 00: Digital output 0 Bit 01: Digital output 1 Bit 02 to 31: Internal output 2 to 31
Circular Counter	_sCJCT021_Ex_RngRing	LowLmt	Lower Limit Range	UDINT	Range data lower limit setting
		UpLmt	Upper Limit Range	UDINT	Range data upper limit setting
		OutPat	Output Pattern	DWORD	Output pattern setting for when range conditions are met Bit 00: Digital Output 0 Bit 01: Digital Output 1 Bit 02 to 31: Internal output 2 to 31

In the Output Pattern of the Range every single Output can be configured to turn ON when that Range is active. To configure an Output to turn ON you must set the corresponding bit to 1. If multiple Ranges of a Counter are active at the same time, the Output Patterns of those Ranges are logically OR'ed to become the Output Pattern of that Counter.



Additional Information

- In Range Mode it is possible to apply a hysteresis to ranges in order to prevent Digital Outputs from toggling due to unwanted oscillating of an Encoder. Refer to 3-7-2 *Hysteresis* for detailed information.
- Precautions When Setting Range Data
 - Comparison Stoppage during Comparison of Ranges
The comparison operation stops for 1.5 ms from when the High-speed Counter Value falls within the Upper Range Limit or Lower Range Limit for the range data. The other Counters, however, do not stop comparisons.
Set the range data considering the time when the comparison is stopped.
For example, for the Range table shown in the following diagram, approximately 4.8 counts occur during 1.5 ms when a 3.2 kHz pulse is input. This means that comparison does not occur for Counter Values 101, 102, 103, and 104. During this period, the Output set under the Output Pattern does not turn ON even if the Counter Value is within the range data range.
Comparison starts again after this 1.5 ms has elapsed.



● Reflecting Active/Not Active Ranges

The range conditions are met when $\text{Lower limit} \leq \text{Counter value} \leq \text{Upper limit}$. The state whether the range condition is active or not is reflected in the following device variable for CJ-series Unit (for input) for each Counter.

Name of device variable for CJ-series Unit	Type	Name	Function
*_Ch1_RngCmpDatSta *_Ch2_RngCmpDatSta	DWORD	Ranges / Comparison Values active	The current status of the comparison conditions is shown. Bits 00 to 31 correspond to comparison conditions 0 to 31. Each bit shows 1 when the conditions are met and 0 when they are not.
*_Ch1_RngCmpSta0 *_Ch1_RngCmpSta31 *_Ch2_RngCmpSta0 *_Ch2_RngCmpSta31			BOOL



Additional Information

Lower Range Limit = Upper Range Limit can be set under the Range conditions.

● Enabling and Disabling of Range Conditions

Each range condition can be enabled/disabled separately. When a pair of range conditions is set to disabled (the default setting), that output pattern is ignored when the unit output pattern is calculated. When a pair of range conditions is set to enabled, if conditions are established, that output pattern is applied to the output pattern of the corresponding Counter. The range condition enabled/disabled status for a Counter is set in the device variable for CJ-series Unit (for setting) shown below.

Name of device variable for CJ-series Unit	Type	Name	Function
*_Ch1_RngCmpEnbICfg *_Ch2_RngCmpEnbICfg	DWORD	Range/Comparison Enable Data	Sets whether the range and comparison data is enabled or disabled. Bits 00 to 31 correspond to comparison data 0 to 31. 0: Range conditions disabled 1: Range conditions enabled

● Logically AND/OR Counter Output Patterns

In Range Mode, output patterns of two Counters are logically summed (logical OR) and the result is regarded as the output pattern for the Unit. This is the default setting. If necessary, the operation can be changed from logical OR to logical AND. When it is set to logical AND, output patterns of two Counters are logically multiplied and the result is regarded as the output pattern for the Unit.

When plural Counters are used to control an application, you can select either logical OR or logical AND for the Counter output patterns to decide the output pattern for the Unit. This selection allows to make plural outputs ON when range conditions of plural Counters are met. For instance, it is possible to make one certain output ON when range conditions of both the Counter 1 and 2 are met. To have logical AND of Counter output patterns, use bits 8 to 15 of the device variables for CJ-series Unit (for setting).

Name of device variable for CJ-series Unit	Type	Name	Function
*_OutCtlMdCfg	WORD	Output Control Mode/AND/OR Counter Output Patterns	Bits 0 to 7: Output Control Mode Sets the Output Control Mode. 16#00: Range Mode 16#01: Comparison Mode Bits 8 to 15: Counter output pattern AND/OR selection For Range Mode, selects whether the Counter output pattern is logically OR or AND. 16#00: OR 16#01: AND



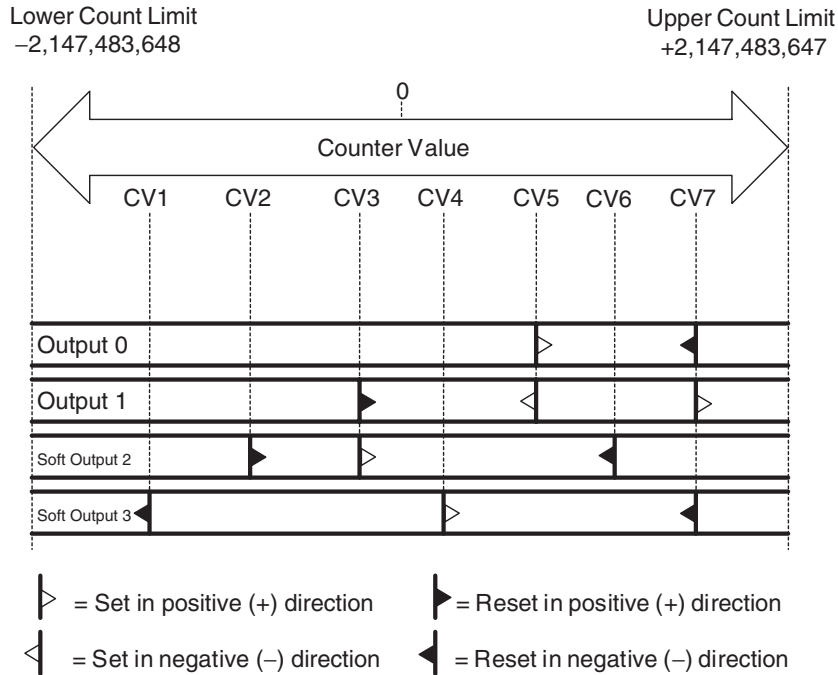
Additional Information

The Counter Output Patterns of Counters which are configured to use no (i.e. zero) Ranges, are ignored in the AND-calculation of the Unit Output Pattern. Like this, Counters that you do not want to use, do not influence the AND-calculation of the Unit Output Pattern. If both the Counters are configured to use no Ranges, the output patterns for both outputs will be all OFF.

3-5-2 Comparison Mode

If the Unit is configured to control the Outputs in Comparison Mode, this Mode can be applied to Circular Counters or Linear Counters (refer to 3-2-2 *Circular Counter* and 3-2-3 *Linear Counter* for more information).

● Example Comparison Mode with Linear Counter

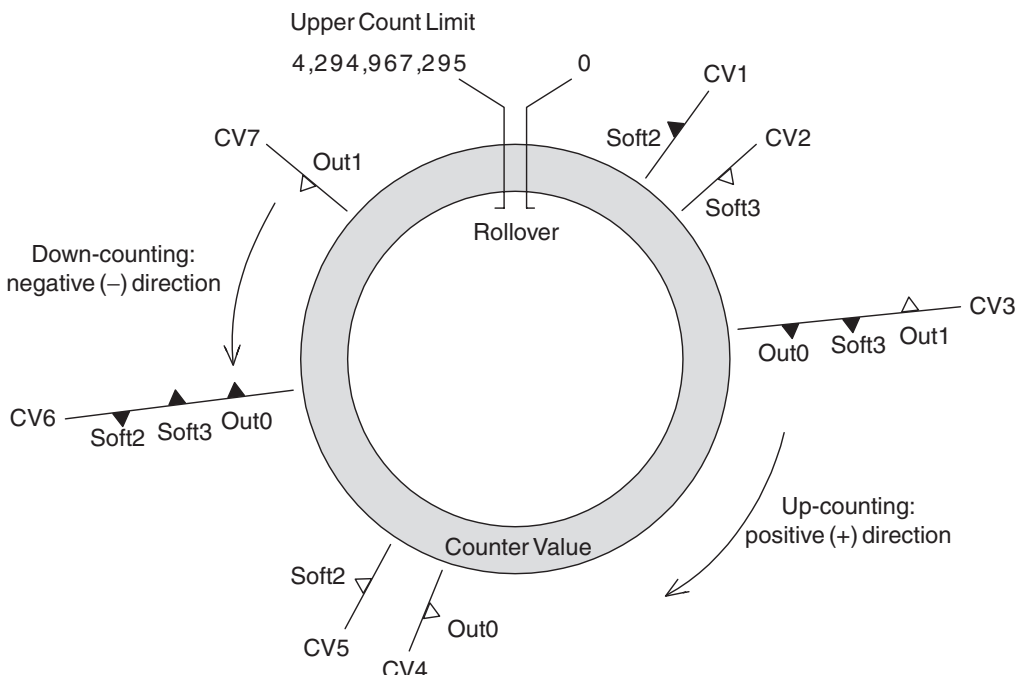


CV	Value	CV Crossing	Out0	Out1	Soft2	Soft3
1	-87,000	+CV crossing				
		-CV crossing				R
2	-56,000	+CV crossing			R	
		-CV crossing				
3	-15,000	+CV crossing		R	S	
		-CV crossing				
4	+18,000	+CV crossing				S
		-CV crossing				
5	+46,000	+CV crossing	S			
		-CV crossing		S		
6	+70,000	+CV crossing				
		-CV crossing			R	
7	+108,000	+CV crossing				
		-CV crossing	R	R		R

In this example 7 Comparison Values are specified. On reaching a Comparison Value an Output can be Set or Reset depending on the crossing direction. If the CV is crossed in the positive counting direction (+CV crossing) or negative counting direction (-CV crossing), one or multiple Outputs can be Set (S) or Reset (R).

For example Output 0 is Set on crossing CV5 in the positive counting direction and Reset on crossing CV7 in the negative counting direction. The crossing of CV3 in the positive counting direction results in the Setting of Output 2 and the Resetting of Output 1.

● Example Comparison Mode with Circular Counter



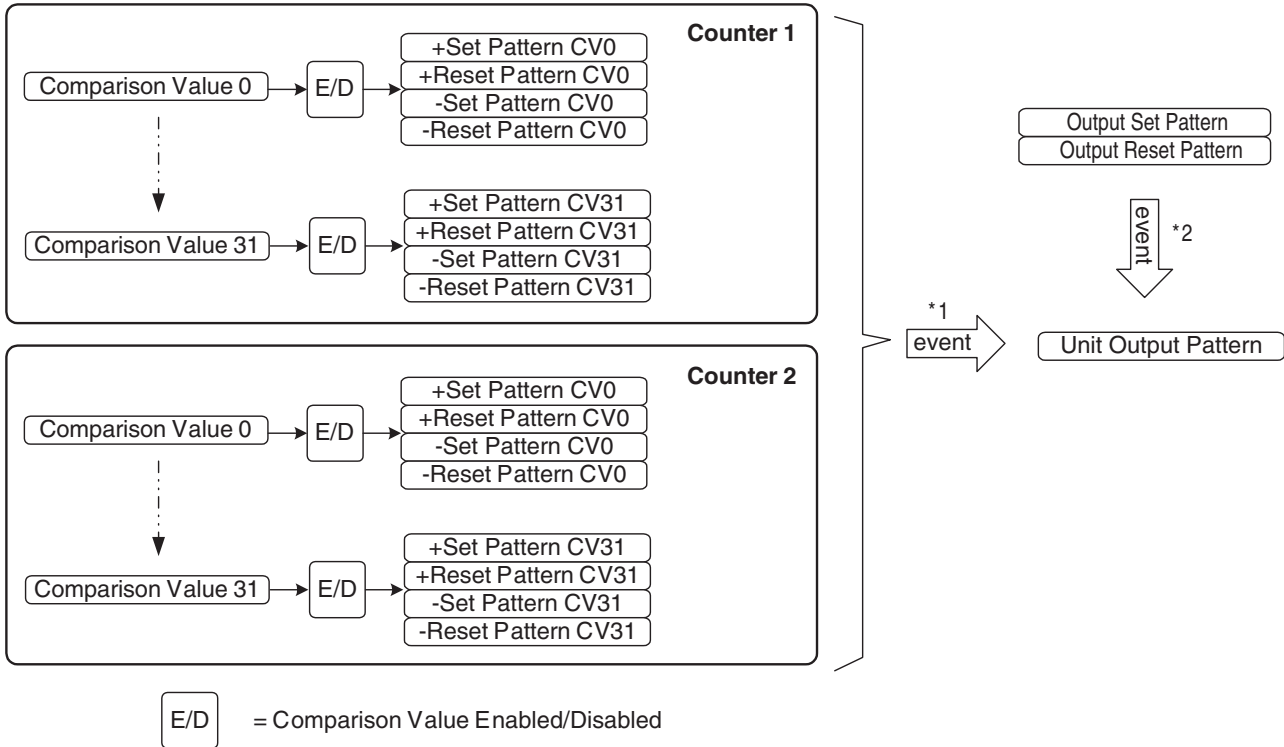
▷ = Set in positive (+) direction ▶ = Reset in positive (+) direction
 ◁ = Set in negative (-) direction ◀ = Reset in negative (-) direction

CV	Value	CV Crossing	Out0	Out1	Soft2	Soft3
1	750	+CV crossing				
		-CV crossing			R	
2	1,800	+CV crossing				S
		-CV crossing				
3	59,000	+CV crossing	R			R
		-CV crossing		S		
4	85,000	+CV crossing				
		-CV crossing	S			
5	90,000	+CV crossing			S	
		-CV crossing				
6	108,000	+CV crossing	R			R
		-CV crossing			R	
7	125,000	+CV crossing				
		-CV crossing		S		

This example shows the Comparison Mode applied to a Circular Counter.

Comparison Mode Overview

The following figure gives an overview on configuring Counters in Comparison Mode.



*1. Event = Crossing of Comparison Value

*2. Event = Preset or Reset Action

How to configure Counters in Comparison Mode is described on the next pages.

Configuration and Operation in Comparison Mode

● Specifying Comparison Data

In Comparison Mode every Counter can be assigned up to a maximum of 32 Comparison data. A comparison data item contains 5 double words:

- Comparison Value (CV) (can be set between $-2,147,483,648$ and $2,147,483,647$ for a Linear Counter and between 0 and $4,294,967,295$ for a Circular Counter)
- Output Set Pattern for the positive counting direction (+Set Pattern CV'n'), specifying which Outputs must be Set on reaching that CV in the positive counting direction (0 = No Change, 1 = Set Output)
- Output Reset Pattern for the positive counting direction (+Reset Pattern CV'n'), specifying which Outputs must be Reset on reaching that CV in the positive counting direction (0 = No Change, 1 = Reset Output)
- Output Set Pattern for the negative counting direction (–Set Pattern CV'n'), specifying which Outputs must be Set on reaching that CV in the negative counting direction (0 = No Change, 1 = Set Output)
- Output Reset Pattern for the negative counting direction (–Reset Pattern CV'n'), specifying which Outputs must be Reset on reaching that CV in the negative counting direction (0 = No Change, 1 = Reset Output)

To configure a Counter in Comparison Mode for every Comparison Value that you want to use the comparison data must be set. Each data-item is specified using the structure data type shown next. In order to use structure data types for comparison data, register the structure data type for High-speed Counter Units beforehand on the CPU/Expansion Racks screen in Configuration and Setup of Sysmac Studio. For the exact memory location of the CV-Data, refer to 4-2-1 *Memory Mapping*.

Counter setting	Structure data type name	Member	Name	Data type	Function
Linear Counter	_sCJCT021_Ex_CmpLin	CmpVal	Comparison Value	DINT	The target value set for comparison
		AddSetPat	+Set Pattern	DWORD	Output pattern setting when comparison conditions are met Bit 00: Digital Output 0 Bit 01: Digital Output 1 Bit 02 to 31: Internal output 2 to 31
		AddRstPat	+Reset Pattern	DWORD	
		SubSetPat	–Set Pattern	DWORD	
		SubRstPat	–Reset Pattern	DWORD	
Circular Counter	_sCJCT021_Ex_CmpRing	CmpVal	Comparison Value	UDINT	The target value set for comparison
		AddSetPat	+Set Pattern	DWORD	Output pattern setting when comparison conditions are met Bit 00: Digital Output 0 Bit 01: Digital Output 1 Bit 02 to 31: Internal output 2 to 31
		AddRstPat	+Reset Pattern	DWORD	
		SubSetPat	–Set Pattern	DWORD	
		SubRstPat	–Reset Pattern	DWORD	



Additional Information

Precautions When Setting Comparison Data

- Comparison Stoppage When Comparison Value Reached

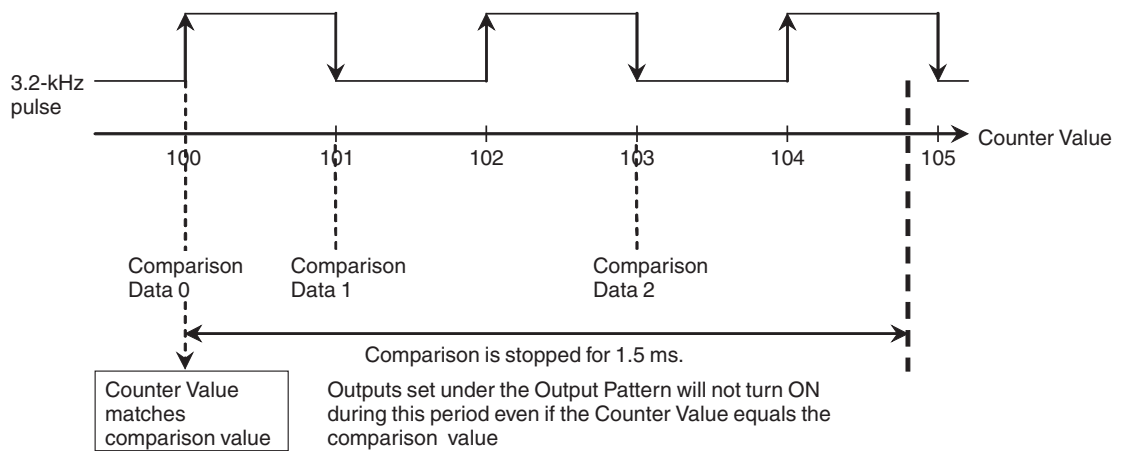
When the High-speed Counter Value reaches a comparison value, comparison stops for 1.5 ms. The other Counters, however, do not stop comparisons.

Set the Comparison Data considering the time when the comparison is stopped.

For example, for the Comparison table shown in the following diagram, approximately 4.8 counts occur during 1.5 ms when a 3.2 kHz pulse is input. This means that comparison does not occur for Counter Values 101, 102, 103, and 104. During this period, the Output set under the Output Pattern does not turn ON.

Comparison starts again after this 1.5 ms has elapsed.

At this time, the processing returns to the stoppage period and Comparison Data 1 and 2 are executed at the same time.



Additional Information

- Multiple Comparison Values of a specific Counter may not have the same value. The Unit will generate an error if multiple CV's have the same value (refer to 5-2 Error codes for more details).
- The Digital Outputs are Set/Reset in the chronological order of reaching the CV's. After reaching a (new) CV the (old) Unit Output Pattern is updated.
- In case for a CV both a Set and a Reset in one and the same counting direction for a specific Output are defined, the Reset has priority.
- The output can be set to Set, Reset, or *No Change* when a CV is reached both for incrementing and decrementing. Each time, the output pattern for both Counters will change in the order CVs are reached.
- Do not change the counting direction quickly near a CV. If the direction is changed near a CV, the direction in which the CV was reached (incrementing or decrementing) may be incorrectly detected.

● Reflecting Active/Not Active Comparison Values

A comparison condition is met when the Counter Value is equal to or larger than the comparison value. The comparison value active/inactive established status is reflected in the following device variable for CJ-series Unit (for input) for each Counter.

Name of device variable for CJ-series Unit	Type	Name	Function
*_Ch1_RngCmpDatSta *_Ch2_RngCmpDatSta	DWORD	Ranges / Comparison Values active	The current status of the comparison conditions is shown. Bits 00 to 31 correspond to comparison conditions 0 to 31. Each bit shows 1 when the conditions are met and 0 when they are not.
*_Ch1_RngCmpSta0 to *_Ch1_RngCmpSta31 *_Ch2_RngCmpSta0 to *_Ch2_RngCmpSta31	BOOL	Ranges 0 to 31 / Comparison Values 0 to 31 active	The numbers after "Sta" correspond to comparison conditions 0 to 31. 0: Range conditions not met 1: Range conditions met



Additional Information

The Ranges/Comparison Active bit indicates whether the current Counter Value is larger than the CV or not. Therefore, if a Counter Value is preset larger than a CV, the bit changes to ON without crossing the CV. If the Counter Value crosses the CV in the reverse (CCW) direction, the bit does not change to ON.

● Enable/Disable Comparison Values

Every single comparison condition can be enabled or disabled. If comparison conditions are disabled (by default), no action will be taken even if the Counter Value reaches the CV. If comparison conditions are enabled, depending on the counting direction, the set or reset pattern is applied to the unit output pattern when the CV is reached. To enable or disable Counter comparison conditions, refer to the following device variables for CJ-series Unit (for setting):

Name of device variable for CJ-series Unit	Type	Name	Function
*_Ch1_RngCmpEnblCfg *_Ch2_RngCmpEnblCfg	DWORD	Range/Comparison Enable Data	Sets whether the range and comparison data is enabled or disabled. Bits 00 to 31 correspond to comparison data 0 to 31. 0: Comparison data disabled 1: Comparison data enabled

● Updating Unit Output Pattern with Preset or Reset Action

Besides by crossing CV's the Unit Output Pattern can also be updated by a Preset or a Reset action. To trigger a Preset or Reset action refer to *3-4 Digital Input Functions* and *3-6 Reset Counter*. Every Preset or Reset Action will then update the Unit Output Pattern according to the predefined Output Set and Output Reset Patterns. You can define an Output to be Set, Reset or remain Unchanged (similar as on reaching a Comparison Value).

Name of device variable for CJ-series Unit	Type	Name	Function
*_Ch1_OutSetPatCfg	DWORD	Output Set Pattern	They decide the set patterns for outputs 0 to 31. Bits 0 to 31 correspond to the outputs 0 to 31. When a bit is ON (1), the pattern is set for the corresponding output. When it is OFF (0), no change is made for the output.
*_Ch2_OutSetPatCfg			
*_Ch1_OutRstPatCfg	DWORD	Output Reset Pattern	They decide the reset patterns for outputs 0 to 31. Bits 0 to 31 correspond to the outputs 0 to 31. When a bit is ON (1), the pattern is reset for the corresponding output. When it is OFF (1), no change is made for the output.
*_Ch2_OutRstPatCfg			



Additional Information

In case for a Preset or Reset action for a specific Output both a Set and a Reset is defined the Reset has priority.

3-5-3 Manual Output Control

● Manual or Automatic Control

The Digital Outputs of the High-speed Counter Unit can be controlled automatically or manually. Automatic control of the Digital Outputs results in the automatic update of the Unit Output Pattern. The Unit Output Pattern will then be updated according to the Mode for which the Unit is configured (Range Mode or Comparison Mode). By default (=0) the Unit is configured for Automatic Output Control.

To control the Outputs (0-1) manually, Manual Output Control must be selected by setting Automatic/Manual Bit to 1. Now it is possible to force ON and OFF the Digital Outputs by setting or resetting the corresponding device variable for CJ-series Units respectively. Manual Output Control can be used for test purposes (wiring check) when the Unit is being installed.

Name of device variable for CJ-series Unit	Type	Name	Function
*_AutoMan	BOOL	Automatic/Manual	0: Automatic ON/OFF output 1: Manual output control
*_OutCtl0	BOOL	Manual Output Control (Output 0)	0: OFF 1: ON
*_OutCtl1	BOOL	Manual Output Control (Output 1)	0: OFF 1: ON

3-5-4 Output Control Configuration

● NPN or PNP Output Driver

NPN output or PNP output can be set for each Digital Output (0, 1) to match the user application. NPN output or PNP output is selected by setting in bit 0 and bit 1 of the following device variable for CJ-series Unit (for setting). The default is that NPN output is selected.

Name of device variable for CJ-series Unit	Type	Name	Function
*_OutStaCtlMdCfg	WORD	Output Driver NPN/PNP/Output State Control	Bits 01 to 00: Digital Output driver (NPN/PNP) selection Bit 00: For output 0 0: NPN (default) 1: PNP Bit 01: For output 1 0: NPN (default) 1: PNP Bits 02 to 11: Use with 0 (default). Bits 12 to 15: Output status control (See below.)

● Output State Control

You can select and control 32-bit output statuses when the CPU Unit operating mode is changed from RUN to PROGRAM mode, when an I/O bus check error occurs, or when an overflow/underflow error occurs.

By default, the Output status control (Bits 12 to 15 of the above device variables for CJ-series Unit (for setting)) is set to 0. The Unit continues refreshing output ON/OFF statuses automatically according to the mode set by the user (i.e. Range or Comparison Mode).

When the output status control is set to 1, the output ON/OFF status is held. In other words, the output ON/OFF status retains the status from just before the CPU Unit Operating Mode was changed, the I/O bus check error occurred, or the overflow/underflow error occurred.

- If the Output status control is set to 2, the predefined output pattern is applied to the output (external output + internal output) when the CPU Unit operating mode is changed, when an I/O bus check error occurs, or when an overflow/underflow error occurs. The output pattern is decided by the following device variable for CJ-series Unit (for setting).

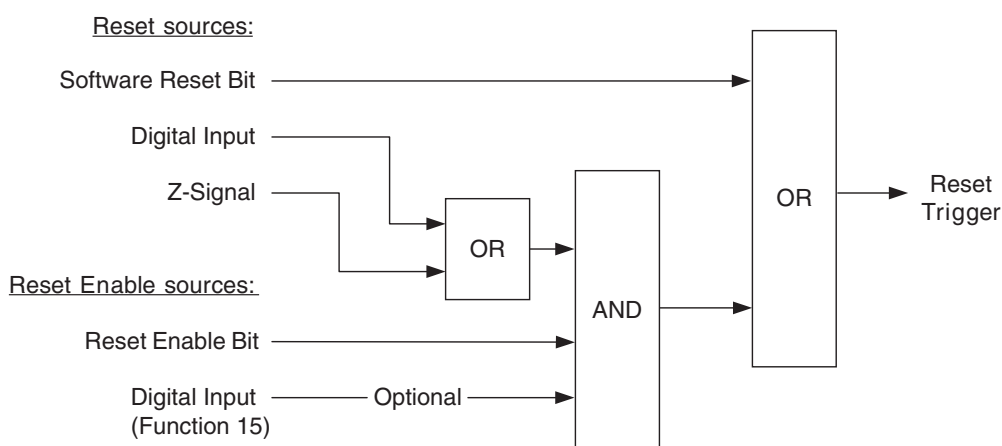
Name of device variable for CJ-series Unit	Type	Name	Function
*_PreOutPatCfg	UDINT	Predefined Output Pattern	Bit 00 corresponds to Digital Output O0. Bit 01 corresponds to Digital Output O1. Bits 02 to 31 correspond to internal outputs 2 to 31. Each bit is 1 for ON or 0 for OFF.

3-6 Reset Counter

For every Counter a reset of the Counter Value to zero can be triggered by the following Sources:

- Software Reset Bit
- Digital Input (Function 05 or 06)
- Z-signal

In order for a Digital Input or the Z-Signal to trigger a reset, the Reset Enable Bit must be set to 1. Additionally a Digital Input can be assigned the function of Reset Enable (Function 15, refer to *3-4 Digital Input Functions*).



● Software Reset Bit as Reset Source

You can reset each Counter by using the device variable for CJ-series Unit (for output) below. These variables take priority over all other reset causes.

Name of device variable for CJ-series Unit	Type	Name	Function
*_Ch1_Rst	BOOL	Reset	0 to 1: Counter reset
*_Ch2_Rst			

● Digital Input as Reset Source

To use Digital Inputs as causes for resetting, it is necessary to allocate function 05 or 06 (reset function) to that Digital Input. For details, refer to *3-4 Digital Input Functions*.

● Z-Input Signal as Reset Source

To use the Z phase signal of an incremental encoder as a reset cause, first it is necessary to enable the Z phase signal resets with bits 03 to 00 of the following device variables for CJ-series Unit (for setting). Resets by Z phase signals can be set separately for each Counter.

Name of device variable for CJ-series Unit	Type	Name	Function
*_Ch1_ZOvfUdfCfg	WORD	Z-reset Mode / Overflow/Underflow error-code generation	Bits 03 to 00: Z phase reset
*_Ch2_ZOvfUdfCfg			16#0: No function 16#1: Reset
			Bits 07 to 04: Overflow/underflow error setting 16#0: Do not generate error codes. 16#1: Generate error codes.
			Bits 15 to 08: 16#00

● Reset Enable Bit as Reset Enable Source

To execute a reset (or preset a Counter Value to 0) by using either Digital Input or a Z phase signal, it is necessary to set the following device variables for CJ-series Unit (for output) to 1.

Name of device variable for CJ-series Unit	Type	Name	Function
*_Ch1_RstEnbl	BOOL	Reset Enable	0: Disable
*_Ch2_RstEnbl			1: Enabled

● Digital Input as Reset Enable Source

In order to use a Digital Input as Reset Enable Source you must assign Function 15 or 16 (= Enable/Disable Reset) to the corresponding Digital Input. Refer to *3-4 Digital Input Functions* for more information.

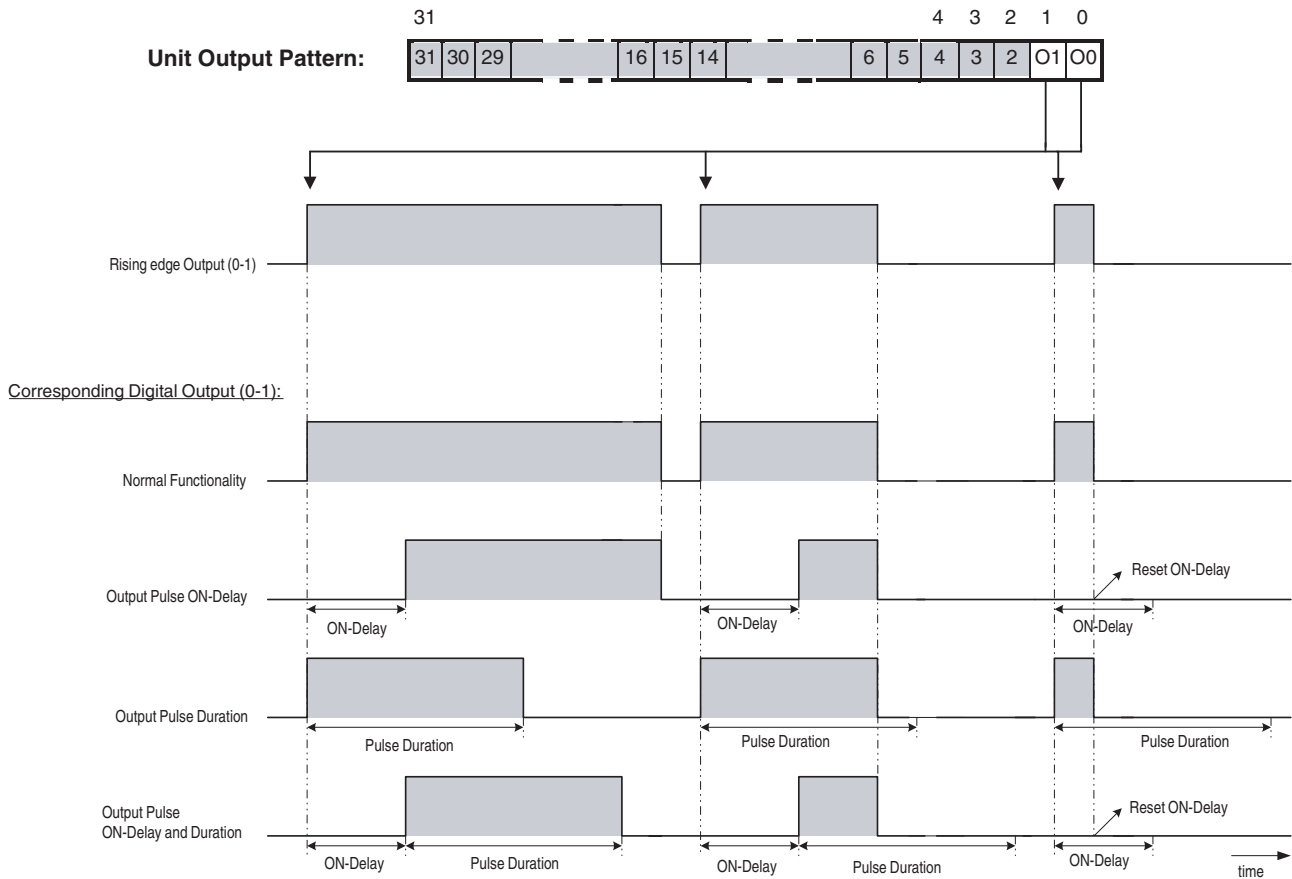
3-7 Extra Functions

3-7-1 Programmable Output Pulses

Depending on the requirements of your application, the timing characteristics of the two Digital Outputs of the High-speed Counter Unit can be modified. The Unit can be either in Range Mode or in Comparison Mode. The following functionality can be assigned to the Digital Outputs:

- Normal Functionality (= default)
- Output Turn ON Delay [1 ms to 9999 ms], to delay turning ON an Output
- Output Pulse Duration [1 ms to 9999 ms], to generate an Output pulse of a specified duration
- Combination of Output Turn ON Delay + Output Pulse Duration

The corresponding action is triggered by a rising edge of the Output (0-1) of the Unit Output Pattern and consequently applied to the corresponding Digital Output.



● Normal Functionality

A Digital Output that is configured to have Normal Functionality will turn ON immediately after the corresponding bit of the Unit Output Pattern turns ON.

● Output Pulse ON-Delay

A Digital Output that is configured to have an Output Pulse ON-Delay will turn ON after the ON-Delay has elapsed.

● Output Pulse Duration

A Digital Output that is configured to have an Output Pulse Duration turns ON immediately and will stay ON for the specified Pulse Duration. After the Pulse Duration has elapsed the Digital Output turns OFF.



Additional Information

The output status is reflected in "*_OutStaDat" (output (external output + internal output) statuses). When the programmable output ON function is allocated to external output, the external output status, including output ON delay and output ON hold, is reflected in Bit 00 and Bit 01 of this variable.

● Configuring Programmable Output Pulses

Name of device variable for CJ-series Unit	Type	Name	Function
*_OutOnDelayTm0Cfg	WORD	Output Pulse Turn ON-Delay Time (BCD) Digital Output 0	Sets the output ON delay time for external output 0. When this is set to 16#0000, the function operates normally. Data range: 16#0000 to 9999 (BCD) Unit: ms
*_OutDur0Cfg	WORD	Output Pulse Duration (BCD) Digital Output 0	Sets the output ON hold time for external output 0. When this is set to 16#0000, the function operates normally. Data range: 16#0000 to 9999 (BCD) Unit: ms
*_OutOnDelayTm1Cfg	WORD	Output Pulse Turn ON-Delay Time (BCD) Digital Output 1	Sets the output ON delay time for external output 1. When this is set to 16#0000, the function operates normally. Data range: 16#0000 to 9999 (BCD) Unit: ms
*_OutDur1Cfg	WORD	Output Pulse Duration (BCD) Digital Output 1	Sets the output ON hold time for external output 1. When this is set to 16#0000, the function operates normally. Data range: 16#0000 to 9999 (BCD) Unit: ms

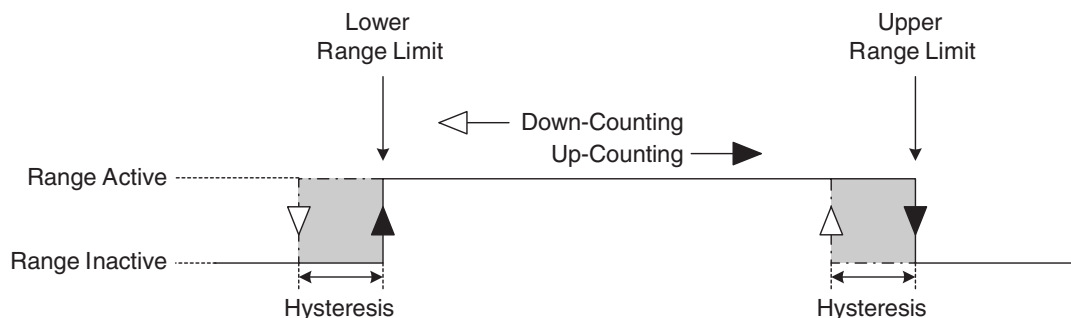


Additional Information

- A Digital Output to which an Output ON-Delay or Output Pulse is applied will turn OFF immediately after the corresponding Output (0-1) of the Output Pattern has turned OFF. An Output Pulse ON-Delay or Output Pulse Duration in progress will be reset immediately and the Digital Output is turned OFF or stays OFF.
- If an Output is switched ON manually (refer to 3-5-3 *Manual Output Control*) and Programmable Output Pulse functionality has been assigned to that Output, then this functionality will not be applied to the Output. Instead, the Output is switched ON immediately.
- When applying an Output Pulse to a turn OFF a Digital Output, the output will appear to be OFF, but internally it will be treated as ON until it is reset when the range conditions are met or target is matched. If an attempt is made to set the output, the system will assume that it is already ON and it will remain OFF. Particularly with target values, configure reset conditions for output carefully.

3-7-2 Hysteresis

An encoder can come to rest at a particular position and then "oscillate" around this position. This state means that the Counter Value fluctuates around a particular value. If, for example, a Range Limit is in this area of fluctuation, the corresponding Range would become active and inactive in the rhythm of these fluctuations. To prevent outputs from being switched ON and OFF by very small fluctuations, the High-speed Counter Unit offers the Hysteresis Function that can be configured for every Counter separately. You can assign Hysteresis in a range from 1 to 255 counts (= 0001_H – 00FF_H) from which the Counter treats the fluctuation in the Counter Input Signal as a real change and outputs can be controlled accordingly.



● Configuring Hysteresis

Name of device variable for CJ-series Unit	Type	Name	Function
*_Ch1_HystrsCfg	UINT	Hysteresis	Sets the hysteresis. For 0, the hysteresis function is disabled. Data range: 0 to 255 Unit: Pulse
*_Ch2_HystrsCfg			



Additional Information

- The Hysteresis can only be applied to Units in Range Mode. If the Unit is in Comparison Mode you are able to configure Hysteresis yourself using Comparison Values.
- Do not set the origin (i.e., an actual value of 0) within the Hysteresis area.
- If the Counter is Preset, turn OFF the Hysteresis. If the Counter is Preset in the Hysteresis area, the Outputs will not be controlled correctly.

3-7-3 Noise Filtering

● Configuring Input Noise Filter Counters

For the purpose of suppressing noise on the signal lines A and B of every Counter a Noise Filter is available. A Noise Filter can be configured for Counter 1 & 2.

Name of device variable for CJ-series Unit	Type	Name	Function
*_NoiseFltCntCfg	UINT	Input Noise Filter Counters	Selects the Counter 1 and 2 noise filter. 0: 50 kHz 1: 500 kHz 2: 10 kHz

● Configuring Noise Filter Digital Inputs

For the purpose of suppressing noise on the control lines of the Digital Inputs also a Noise Filter is available. A Noise Filter can be configured for Digital Input 0 & 1.

Name of device variable for CJ-series Unit	Type	Name	Function
*_NoiseFltInCfg	UINT	Input Noise Filter Digital Inputs	Selects the Digital Input 0 and 1 noise filter. 0: 50 kHz 1: 10 kHz

3-7-4 Initial Counter Value

Every Counter has device variables for CJ-series Unit (for setting) (double word) for the initial Counter Values. The settings for these variables are transferred from the CPU Unit to this unit when the Unit restarts or the Controller is reset, including when the power is turned ON. The initial Counter Values overwrite the Counter Values and become the new Counter Values.

Name of device variable for CJ-series Unit	Type	Name	Function
*_Ch1_InitLinCtCfg	DINT	Initial Counter Value	<ul style="list-style-type: none"> • Sets the initial Counter Value after unit setting data is transferred. • Used for Simple Counter or Linear Counter. • Data range: -2,147,483,648 to 2,147,483,647. • Unit: Pulses
*_Ch2_InitLinCtCfg			
*_Ch1_InitRingCtCfg	UDINT	Initial Counter Value	<ul style="list-style-type: none"> • Sets the initial Counter Value after unit setting data transferred. • Used for Circular Counter. • Data range: 0 to 4,294,967,295 • Unit: Pulses
*_Ch2_InitRingCtCfg			

4

Exchanging Data with CPU

This section provides information on exchanging data between CJ1W-CT021 High Speed Counter Units and CJ-series CPU Units.

4

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4-1 Overview

4-1-1 Data Flow

The CPU Unit and the high-speed Counters exchange data via the I/O port created for the High-speed Counter Unit.

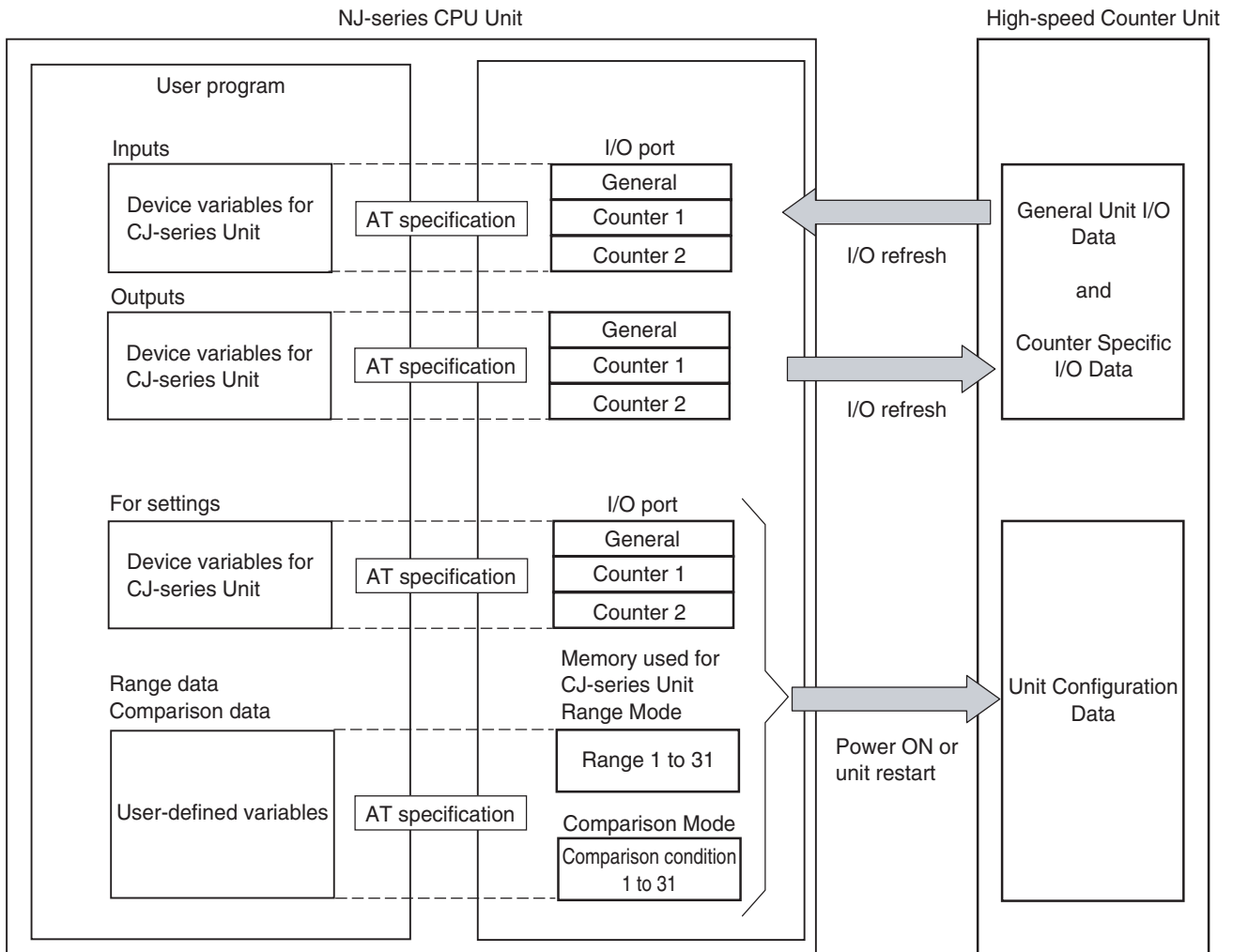
The table and figure below show the data exchange method for each data type.

Data exchange type

Unit data type	Data contents	AT specification destination	How to access from user program	Timing of data exchange
For Inputs For Outputs	Count start and stop, count value, status of each Counter, etc.	I/O port (for Inputs, Outputs)	Device variable for CJ-series Unit	At I/O refreshing *1
For Settings *2	External output control, external input function setting, settings for each Counter, etc.	I/O port (for Settings)		When the Controller is reset or the Unit restarts
Range data *2	Range data	Memory used for CJ-series Unit	User-defined Variable	
Comparison data *2	Comparison data			
Unit Restart Bit, etc.	Unit Restart Bit, etc.	None	System-defined variable	At I/O refreshing

*1 While *_UnitInitSta (Unit Busy) is 1, I/O is not refreshed. (For example, Counter Values are not refreshed during this time.)

*2 The setting data, range data, and comparison data are retained in the CPU Unit by the battery even during power interruptions.



● Device variable for CJ-series Unit

These variables are used to exchange data between the user program and Special I/O Units.

Use device variables for CJ-series Units with AT specification for the I/O port. There are three types of variables: for input, for output, and for settings.

For details on allocation of device variables for CJ-series Units, refer to *4-1-3 Access from User Program*.

● User-defined Variable

When a Counter is used in Range Mode or in Comparison Mode, user-defined variables are used to access, from the user program, the area in which the comparison data is set. An address of the data to be used as comparison data is set with the device variable for CJ-series Unit for setting. Use Sysmac Studio to specify the AT (allocation destination) in which comparison data is stored with user-defined variables.

For details, refer to *4-2-2 Allocating Ranges and Comparison Data*.

AT specification of variables used to access these parameters/data is determined with the following.

Unit data type	AT specification destination	Setting Method
For Inputs For Outputs	I/O port (for Inputs, Outputs)	Created automatically when the Unit is registered to the Unit Configuration.
For Settings	I/O port (for Settings)	
Range data Comparison data	Memory used for CJ-series Unit	Set the allocated address with one of the following methods. (After this setting, reset the Controller or restart the Unit.) <ol style="list-style-type: none"> Set with Memory Area and Memory Address in Edit Special Unit Settings of Sysmac Studio and transfer the data setup file to the Unit. Set using the following device variables for CJ-series Unit: *_Ch#_MemAreaCfg, *_Ch#_MemAdrCfg (in data for Settings)

4-1-2 Unit Restart

To resume Unit operation after the contents of Unit settings are changed or after the cause of an error is eliminated, restart the Unit with the following method.

Any changes in the Unit settings are reflected after the Unit is restarted.

- Reset the Controller from Sysmac Studio.
- Restart from Sysmac Studio when data setup file is transferred from Sysmac Studio.
- Cycle the Controller power to reset the Controller.
- Restart from the program by using a ResetUnit instruction.
- Restart by using a system-defined variable (restart by changing to TRUE).

Variable name

_CJB_SIO**Restart

The asterisks ** mean Unit number 00 to 92.

4-1-3 Access from User Program

Various data is exchanged from the user program using the following variables.

Data type	Access method	Refresh timing
For settings	Device variable for CJ-series Units	When the Controller is reset or the unit restarts
For Outputs		I/O refresh
For Inputs		
Range	User-defined variable	When the Controller is reset or the unit restarts
Comparison data		

Allocating Device Variables for CJ-series Units

Use device variables for CJ-series Units with AT specification for the I/O port, which is explained below.

● I/O port

An "I/O port" is a logical interface for data exchange by a CPU Unit with a High-speed Counter Unit or other Configuration Unit.

An I/O port has a unique pre-defined name for each unit model and function.

An I/O port is automatically created by preparing the Unit Configuration with Sysmac Studio.

● How to specify device variables for CJ-series Units

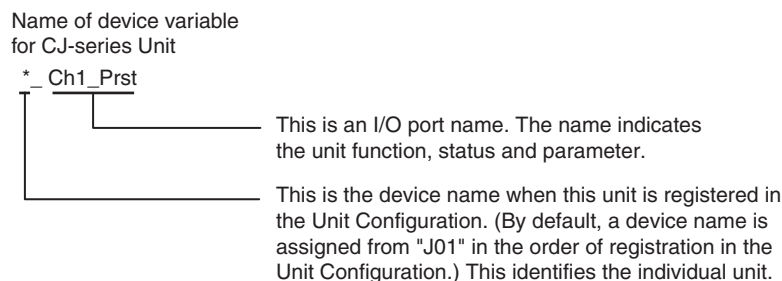
Specify the AT specifications to I/O ports for device variables for CJ-series Units on the I/O Map of Sysmac Studio.

Specify the variable name for the AT specification with the following methods.

- 1** Select a variable already registered in the variable table
- 2** Input a new variable name
- 3** Automatically create a variable name with "Device variable creation"

When a name of device variable for CJ-series Unit is assigned with the method in 2 or 3, the variable input by Sysmac Studio is automatically registered in the variable table.

The following is the configuration of variable names created with automatic creation in step 3.



**Additional Information**

For details on creation of device variables for CJ-series Unit, refer to *Sysmac Studio Version 1 Operation Manual (Cat. No. W504)*.

In the explanations from here on, the device name automatically created is used as the device variable for CJ-series Unit, for example *_Ch1_Prst.

Allocating User-defined Variables

For the data used in Range Mode and Comparison Mode, it is necessary to allocate the variables used by the user (user-defined variables) to memory for CJ-series Unit.

Structure data types are pre-defined for comparison data used in Range Mode and Comparison Mode.

In order to use these data types, register the structure data type for High-speed Counter Units beforehand on the CPU/Expansion Racks screen in Configuration and Setup of Sysmac Studio.

With the Unit selected on the CPU/Expansion Racks screen in Configuration and Setup, right click, then select Register Data Types for Units. The data type is registered and becomes usable.

The user program uses the user-defined variables to control High-speed Counter Units.

With High-speed Counter Units, the following structure data types can be used for each comparison mode and Counter setting.

Comparison mode	Counter setting	Structure data type name
Range Mode	Linear Counter	_sCJCT021_Ex_RngLin
	Circular Counter	_sCJCT021_Ex_RngRing
Comparison Mode	Linear Counter	_sCJCT021_Ex_CmpLin
	Circular Counter	_sCJCT021_Ex_CmpRing

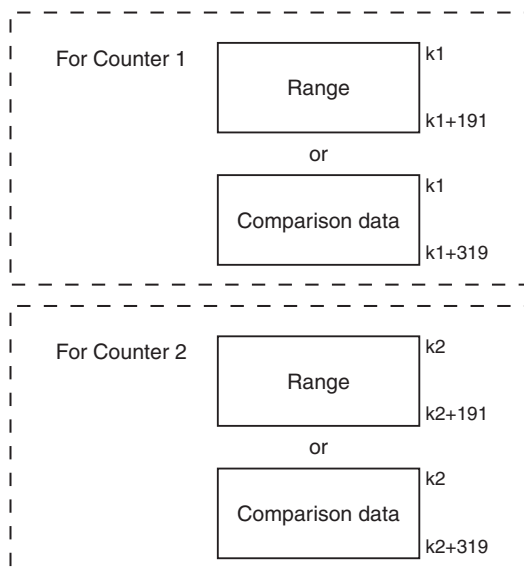
4-2 Memory Allocation

4-2-1 Memory Mapping

When Range Mode and Comparison Mode are used, the data to be used are allocated to any DM or EM Area (bank 0). This allocation method is called extended allocation. For details, refer to 4-2-2 *Allocating Ranges and Comparison Data*.

- For extended allocation

<(DM or EM) Area words allocated to Special I/O Unit>



k_1 , k_2 : Start address for comparison data area for Counter 1 and Counter 2. Specify the allocated address from Memory Address screen in Edit Special Unit Settings of Sysmac Studio.

Data assigned to Counter 1 and Counter 2 can be allocated to any DM or EM address. When this data is overlapped (duplicated), the Unit treats the overlap as a warning and "`*_IABlkOverlapSta`" (IA Blocks overlap) becomes 1. But this is not an error. In other words, by defining one range data or comparison data and setting the same indirect address in two locations ($k_1 = k_2$), that data can be shared by 2 Counters.

4-2-2 Allocating Ranges and Comparison Data

Ranges/Comparison data used in Range Mode or Comparison Mode is allocated in the following two steps.

- 1) Use Sysmac Studio to secure the area for the ranges/comparison data in a DM/EM Area (refer to *Indirect Address Specification*).
- 2) Store the ranges/comparison data in this area. Use user-defined variables to allocate the range/comparison data (refer to *Allocation to User-defined Variable*).

Indirect Address Specification

The High-speed Counter Unit can be used in Range Mode or Comparison Mode (refer to 3-5-1 Range Mode and 3-5-2 Comparison Mode for more information). The range or comparison data is allocated in DM or EM (bank 0). An indirect address that you can set for every Counter with a device variable for CJ-series Unit (for setting) points to the actual memory location in DM or EM where the range or comparison data of that Counter is stored.

● For a Unit in Range Mode

In Range Mode, indirect addresses can be used to define range for each Counter to be used. The number of ranges (M) defines the size of the range data block (size = $M \times 6$ words). When using multiple range items, in order to reserve exclusive memory, it is recommended to save the items consecutively starting from range 0. (For example, when range 0, 1, 2, 3, are set, this becomes $M-1$.)

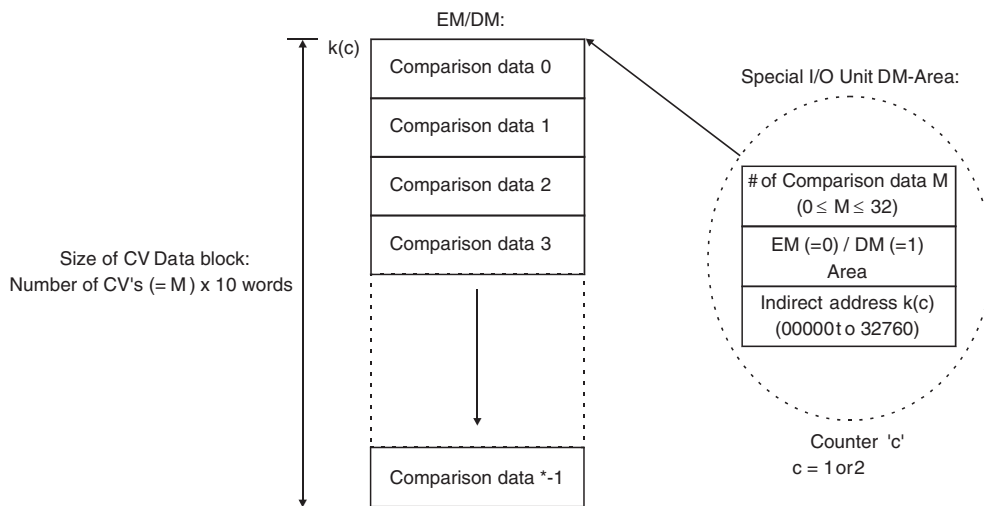


Additional Information

If you do not want to allocate range data items consecutively, for example if you allocate two range data items (Data 0 and 15), the number of range items (M) must be set to 16. This is to avoid a setting error. The range data 1 to 14 must be enabled even if you do not intend to use them.

● For a Unit in Comparison Mode

In Comparison Mode Indirect Addressing can be used to define the comparison data per Counter that you want to use. The number of comparison data (M) defines the size of the Data block (size = $M \times 10$ words). If you want to use multiple CV's you are recommended to use consecutive comparison data starting from comparison data 0 (i.e. CV 0, 1, 2, 3 \rightarrow $M-1$) in order to save memory occupation.



* Assumed that $M \neq 0$. By default $M=0$ which means that no Comparison data will be used.



Additional Information

If you do not want the Comparison data to be consecutive and only intend to use two Comparison data (e.g. Comparison data 0 and Comparison data 15) then you still have to define the number of Comparison data (M) to be 16. In order to prevent configuration errors from happening you should make sure that the Comparison data 1 to 14 is also valid, although you do not intend to use Comparison data 1 to 14.

● **Configuring Indirect Addressing**

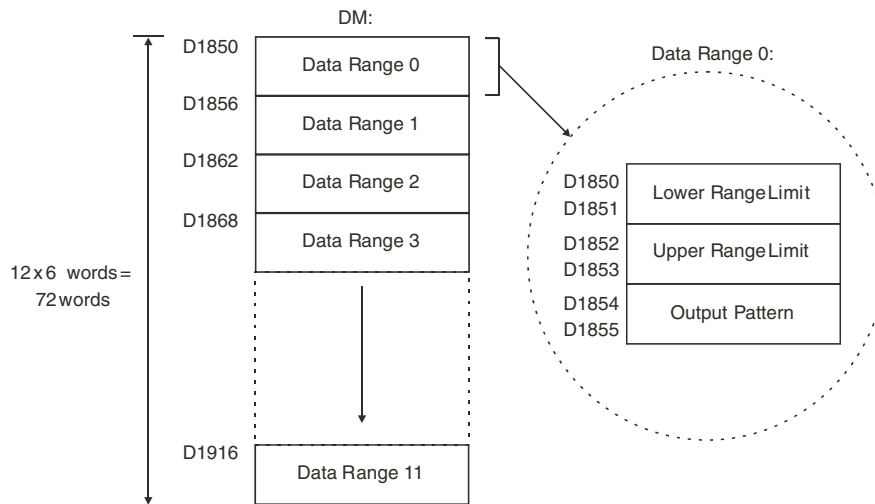
An indirect address for the Unit in Range or Comparison Mode is specified with a device variable for a CJ-series Unit (for setting) for every Counter. You must specify the memory area (EM/DM) and the address (00000 to 32760) of the first word where the Range/Comparison data is to be stored. The size of the comparison data block is determined for every Counter depending on the number of ranges or comparison data. For every Range 6 words and for every Comparison data 10 words are allocated.

Range and comparison data is transferred from the CPU Unit as Unit setting data after the Unit Controller is reset or the Unit is restarted.

● **Example Range Mode**

With the Unit in Range Mode, if 12 range items (0 to 11) are set in Counter 1 and the data is allocated to the area starting with D0185, Sysmac Studio is used to set as follows.

Device variable for CJ-series Unit	Data type	R/W	Name	Set value
*_Ch#_NumRngCmpCfg	WORD	R/W	Number of Ranges/Comparison Values (BCD)	16#0012
*_Ch#_MemAreaCfg	UINT	R/W	Memory Area	1 (DM)
*_Ch#_MemAdrCfg	DWORD	R/W	Memory Address (BCD)	16#00001850

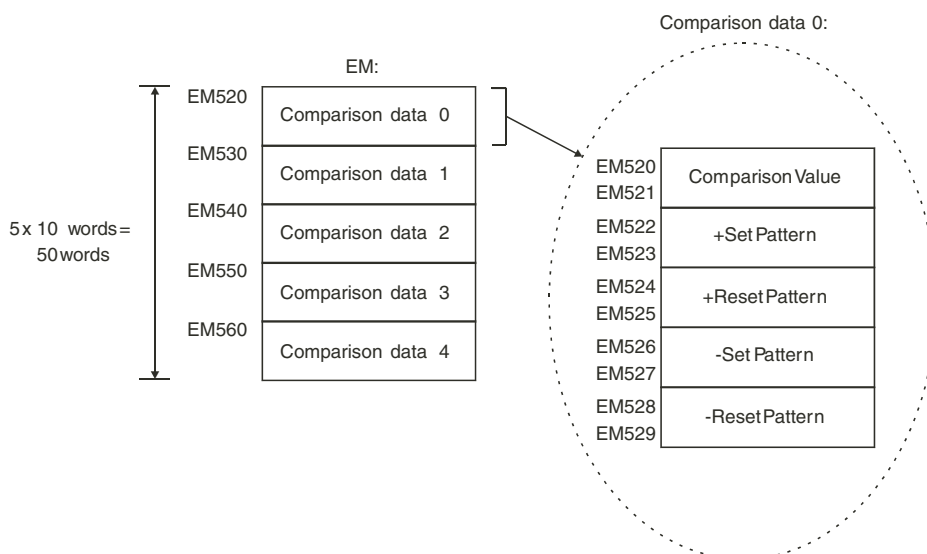


For an overview of all addresses related to range data refer to 4-2-5 Memory Allocation for Ranges.

● **Example Comparison Mode**

With the Unit in Comparison Mode, if 5 comparison data (0 to 4) are set in Counter 1 and allocated to the area starting with EM00520, Sysmac Studio is used to set as follows.

Device variables for CJ-series Unit	Data type	R/W	Name	Setting value
*_Ch#_NumRngCmpCfg	WORD	R/W	Number of Ranges/Comparison Values (BCD)	16#0005
*_Ch#_MemAreaCfg	UINT	R/W	Memory Area	0 (EM (bank 0))
*_Ch#_MemAdrCfg	DWORD	R/W	Memory Address (BCD)	16#00000520



For an overview of all addresses related to Comparison Data refer to 4-2-6 *Memory Allocation for Comparison data*.

Allocation to User-defined Variable

With Sysmac Studio, you can specify an AT (allocation destination) for the DM/EM area that you secured for ranges or comparison data by specifying indirect addresses (see page 4-8). With user-defined variables, it is possible to specify an arbitrary variable name. Once it is allocated, the ranges and comparison data can be read and written from Sysmac Studio or from a user program.

An actual example of allocation to user-defined variables is explained below.

Example: The 12 range data items shown below are allocated for Counter 1 using the structure data type "_sCJCT021_Ex_RngLin" pre-defined for user-defined variable *CmpData*.

Setting the Device Variables for CJ-series Unit (for setting)

Device variable for CJ-series Unit	Data type	Name	Set value
*_Ch1_NumRngCmpCfg	WORD	Number of Ranges/Comparison data (BCD)	16#0012
*_Ch1_MemAreaCfg	UINT	Memory Area	1 (DM)
*_Ch1_MemAdrCfg	DWORD	Memory Address (BCD)	16#00001850

Note After this setting, reset the Controller or restart this Unit.

Data type definition

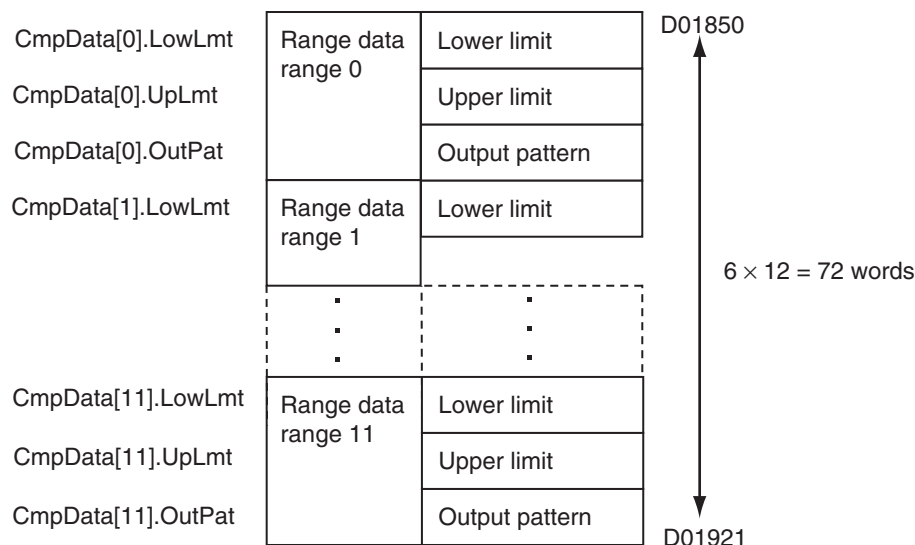
Structure data type name	Member	Data type	Name
_sCJCT021_Ex_RngLin	LowLmt	DINT	Lower Limit Range
	UpLmt	DINT	Upper Limit Range
	OutPat	DWORD	Output Pattern

Register the structure data type for High-speed Counter Units beforehand on the CPU/Expansion Racks screen in Configuration and Setup of Sysmac Studio.

With the Unit selected on the CPU/Expansion Racks screen in Configuration and Setup, right click, then select Register Data Types for Units. The data type is registered and becomes usable.

Variable tables

Variable name	Array	Data type
CmpData	[0..11]	_sCJCT021_Ex_RngLin



4-2-3 Details of Device Variables for CJ-series Unit (for input/output)

● For outputs

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
General				
*_OutCtl0	BOOL	RW	Manual Output Control (Output 0)	0: External output (O0) OFF (factory value) 1: External output (O0) ON
*_OutCtl1	BOOL	RW	Manual Output Control (Output 1)	0: External output (O1) OFF (factory value) 1: External output (O1) ON
*_AutoMan	BOOL	RW	Automatic/Manual	0: Automatic output control (factory value) 1: Manual output control
*_RdNxtErr	BOOL	RW	Read Next Error	If multiple errors occurred at the same time, at the rising edge from 0 to 1, the next error is read out from the error list in this Unit and the error code is stored in *_ErrCode1 (error code 1) and *_ErrCode2 (error code 2). Factory value: 0
Counter 1				
*_Ch1_Enbl	BOOL	RW	Open Gate*1 *3	0 to 1: Opens the gate (starts the count). Factory value: 0
*_Ch1_Dsbl	BOOL	RW	Close Gate*1 *3	0 to 1: Closes the gate (stops the count). Factory value: 0
*_Ch1_Prst	BOOL	RW	Preset*3	0 to 1: Loads preset values. Factory value: 0
*_Ch1_Rst	BOOL	RW	Reset*3	0 to 1: Counter reset (Resets Counter Values to 0) Factory value: 0
*_Ch1_RstEnbl	BOOL	RW	Reset Enable*2	0: Disable (factory value) 1: Enables Z phase input, Digital Input reset

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
*_Ch1_PrstLinCtVal	DINT	RW	Preset Value	Preset value Used for Simple Counter or Linear Counter. Data range: –2,147,483,648 to 2,147,483,647 Unit: Pulse Factory value: 0
*_Ch1_PrstRingCtVal	UDINT	RW	Preset Value	Preset value Used for Circular Counter. Data range: 0 to 4,294,967,295 Unit: Pulse Factory value: 0
Counter 2				
*_Ch2_Enbl	BOOL	RW	Open Gate*1 *3	0 to 1: Opens the gate (starts the count). Factory value: 0
*_Ch2_Dsbl	BOOL	RW	Close Gate*1 *3	0 to 1: Closes the gate (stops the count). Factory value: 0
*_Ch2_Prst	BOOL	RW	Preset*3	0 to 1: Loads preset values. Factory value: 0
*_Ch2_Rst	BOOL	RW	Reset*3	0 to 1: Counter reset (Resets Counter Values to 0) Factory value: 0
*_Ch2_RstEnbl	BOOL	RW	Reset Enable*2	1: Enables Z phase input, and Digital Input reset 0: Disable Factory value: 0
*_Ch2_PrstLinCtVal	DINT	RW	Preset Value	Preset value Used for Simple Counter or Linear Counter. Data range: –2,147,483,648 to 2,147,483,647 Unit: Pulse Factory value: 0
*_Ch2_PrstRingCtVal	UDINT	RW	Preset Value	Preset value Used for Circular Counter. Data range: 0 to 4,294,967,295 Unit: Pulse Factory value: 0

*1 Initially, after the Controller is reset or the Unit is restarted, the Gate is closed. In order to start counting pulses, it is necessary to open the gate by setting Open Gate to 1 for the Counter used.

*2 Bit(s) have no function for Simple Counters.

*3 These bits may not be executed if they are ON for only one task period. Always keep these bits turned ON until the execution status changes in the corresponding bits (refer to the section on device variables for CJ-series Unit for input).

Note The "*" at the head of the device variable name for CJ-series Unit is the device name when this Unit is registered in the Unit Configuration. By default, a device name is assigned from "J01" in the order of registration in the Unit Configuration

● For inputs

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
General				
*_OutStaDat	DWORD	R	Output Status	The current statuses of external and internal output (total of 32) are all displayed. 0: OFF 1: ON Bit 00: External output O0 Bit 01: External output O1 Bit 02: Internal output 2 - Bit 31: Internal output 31 This variable is used to process output signal statuses collectively. Data range: 16#00000000 to 16#FFFFFFFF
*_OutSta0	BOOL	R	Digital Output 0 Status	1: ON, 0: OFF
*_OutSta1	BOOL	R	Digital Output 1 Status	1: ON, 0: OFF
*_OutSta2	BOOL	R	Soft Output 2 Status	1: ON, 0: OFF
~~				
*_OutSta31	BOOL	R	Soft Output 31 Status	1: ON, 0: OFF
*_In0	BOOL	R	Digital Input 0 Status	The Digital Input 0 (I0) status is displayed. 1: ON, 0: OFF
*_In1	BOOL	R	Digital Input 1 Status	The Digital Input 0 (I1) status is displayed. 1: ON, 0: OFF
*_ErrCode1	WORD	R	Error Code 1	For details, refer to 5-2 Error codes. Data range: 16#0000 to 16#FFFF
*_ErrCode2	WORD	R	Error Code 2	For details, refer to 5-2 Error codes. Data range: 16#0000 to 16#FFFF
*_GlbErr	BOOL	R	Global Error	1: Shows that one or more error has occurred. These error codes are stored in the error list in this unit. 0: Normal
*_UnitInitSta	BOOL	R	Unit Busy	1: Unit initialization processing underway*3 0: Other than the above
*_IABlkOverlapSta	BOOL	R	IA Blocks overlap*2	1: Shows that range/comparison data is duplicated in the CPU Unit I/O memory. 0: Other than the above
Counter 1				
*_Ch1_RngCmpDatSta	DWORD	R	Ranges / Comparison Values active*1	Shows the current status of all the comparison conditions. Bits 00 to 31 correspond to comparison conditions 0 to 31. Each bit shows 1 if the condition is met, or 0 if the condition is not met. Data range: 16#00000000 to 16#FFFFFFFF

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
*_Ch1_RngCmpSta0	BOOL	R	Ranges 0 / Comparison Values 0 active	1: Met, 0: Not met
*_Ch1_RngCmpSta1	BOOL	R	Ranges 1 / Comparison Values 1 active	1: Met, 0: Not met
*_Ch1_RngCmpSta2	BOOL	R	Ranges 2 / Comparison Values 2 active	1: Met, 0: Not met
~~				
*_Ch1_RngCmpSta31	BOOL	R	Ranges 31 / Comparison Values 31 active	1: Met, 0: Not met
*_Ch1_LinCtVal	DINT	R	Counter Value	Shows the encoder Counter Value. Used for Simple Counter or Linear Counter. Data range: -2,147,483,648 to 2,147,483,647 Unit: Pulse
*_Ch1_RingCtVal	UDINT	R	Counter Value	Shows the encoder Counter Value. Used for Circular Counter. Data range: 0 to 4,294,967,295 Unit: Pulse
*_Ch1_CtOvf	BOOL	R	Counter Overflow	1: The upper count limit of the Linear Counter is reached.
*_Ch1_CtUdf	BOOL	R	Counter Underflow	1: The lower count limit of the Linear Counter is reached.
*_Ch1_CtRun	BOOL	R	Counter Running/Gate Open	1: During Counter operation/while gate open 0: While Counter stopped/while gate closed
*_Ch1_CntDir	BOOL	R	Counting Direction	1: Count up 0: Count down
*_Ch1_PrstSta	BOOL	R	Preset Activated*2	1: The presets are executed.
*_Ch1_RstSta	BOOL	R	Reset Activated*2	1: A reset is executed.
*_Ch1_ZSig	BOOL	R	Z-signal Activated*2	1: A Z signal is input.
*_Ch1_SmplCntSta	BOOL	R	Simple Counter	1: Simple Counter 0: Circular/Linear Counter
Counter 2				
*_Ch2_RngCmpDatSta	DWORD	R	Ranges / Comparison Values active*1	The current status of all the comparison conditions is shown. Bits 00 to 31 correspond to comparison conditions 0 to 31. Each bit shows 1 if the condition is met, or 0 if the condition is not met. Data range: 16#00000000 to 16#FFFFFFFF
*_Ch2_RngCmpSta0	BOOL	R	Ranges/Comparison Values 0 active	1: Met, 0: Not met
*_Ch2_RngCmpSta1	BOOL	R	Ranges/Comparison Values 1 active	1: Met, 0: Not met
*_Ch2_RngCmpSta2	BOOL	R	Ranges/Comparison Values 2 active	1: Met, 0: Not met

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
~~				
*_Ch2_RngCmpSta31	BOOL	R	Ranges/Comparison Values 31 active	1: Met, 0: Not met
*_Ch2_LinCtVal	DINT	R	Counter Value	Shows the encoder Counter Value. Used for Simple Counter or Linear Counter. Data range: -2,147,483,648 to 2,147,483,647 Unit: Pulse
*_Ch2_RingCtVal	UDINT	R	Counter Value	Shows the encoder Counter Value. Used for Circular Counter. Data range: 0 to 4,294,967,295 Unit: Pulse
*_Ch2_CtOvf	BOOL	R	Counter Overflow	1: The upper count limit of the Linear Counter is reached.
*_Ch2_CtUdf	BOOL	R	Counter Underflow	1: The lower count limit of the Linear Counter is reached.
*_Ch2_CtRun	BOOL	R	Counter Running/Gate Open	1: During Counter operation/while gate open 0: While Counter stopped/while gate closed
*_Ch2_CntDir	BOOL	R	Counting Direction	1: Count up 0: Count down
*_Ch2_PrstSta	BOOL	R	Preset Activated*2	1: The presets are executed.
*_Ch2_RstSta	BOOL	R	Reset Activated*2	1: A reset is executed.
*_Ch2_ZSig	BOOL	R	Z-signal Activated*2	1: A Z signal is input.
*_Ch2_SmplCntSta_CT021	BOOL	R	Simple Counter	1: Simple Counter 0: Circular/Linear Counter

*1 These bits have no function for Simple Counters.

*2 The Reset, Preset, and Z-signal Activated turn ON for at least one CPU Unit task period after the occurrence of a pulse that was detected since the previous I/O refresh.

*3 During initialization, the Unit turns ON for approximately 120 ms.

4-2-4 Details of Device Variables for CJ-series Unit (for setting)

Setting data can be set with the following two methods.

- Set from Edit Special Unit Settings of Sysmac Studio.
- Set the values for device variables for CJ-series Units.

Unit settings are reflected only when the Controller is reset, or when the Unit restarts. The data setup file is retained in the CPU Unit by the battery even during power interruptions.



Precautions for Safe Use

When the data setup file is set in Sysmac Studio and transferred, Sysmac Studio checks whether or not the unit must be restarted. Restart the unit after confirming the safety of the connected destination.

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
General				
*_OutCtlMdCfg	WORD	R/W	Output Control Mode/AND/OR Counter Output Patterns	Bits 00 to 07: Output Control Mode Selects the Output Control Mode. 16#00: Range Mode (factory value) 16#01: Comparison Mode Bits 08 to 15: Counter output pattern AND/OR selection For Range Mode, selects whether the Counter output pattern is logically OR or AND. 16#00: OR (factory value) 16#01: AND
*_OutStaCtlMdCfg	WORD	R/W	Output Driver NPN/PNP/Output State Control	Bits 00 to 01: External output driver (NPN/PNP) selection Bit 00: For output 0 0: NPN (factory value) 1: PNP Bit 01: For output 1 0: NPN (factory value) 1: PNP Bits 02 to 11: Use with 0 (factory value). Bits 12 to 15: Output status control This sets the 32-point output status control method for when the CPU Unit operating mode is changed from RUN mode to PROGRAM mode, when an I/O bus check error occurred, or an overflow/underflow error occurred. 16#00: Output ON/OFF automatic refreshing is continued according to the mode set by the user (Range Mode or Comparison Mode) (factory value). 16#01: Holds the output ON/OFF. 16#02: The pre-defined *_PreOutPatCfg (Pre-defined Output Pattern) is applied to external output.

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
*_NoiseFltCntCfg	UINT	R/W	Input Noise Filter Counters	Selects the Counter 1 and 2 noise filter. 0: 50 kHz (factory value) 1: 500 kHz 2: 10 kHz
*_NoiseFltInCfg	UINT	R/W	Input Noise Filter Digital Inputs	Selects the Digital Input 0 and 1 noise filter. 0: 50 kHz (factory value) 1: 10 kHz
*_OutOnDelayTm0Cfg	WORD	R/W	Output Pulse Turn ON-Delay Time (BCD) Digital Output 0	Sets the output pulse turn ON-delay time for external output 0 as a BCD. When you set this to 16#0000, the status is normal functions. Data range: 16#0000 to 9999 Unit: ms Factory value: 16#0000
*_OutDur0Cfg	WORD	R/W	Output Pulse Duration (BCD) Digital Output 0	Sets the output pulse duration for external output 0 as a BCD. When you set this to 16#0000, the status is normal functions. Setting this to 16#0000 disables this function. Data range: 16#0000 to 9999 Unit: ms Factory value: 16#0000
*_OutOnDelayTm1Cfg	WORD	R/W	Output Pulse Turn ON-Delay Time (BCD) Digital Output 1	Sets the output pulse turn ON-delay time for external output 1 as a BCD. When you set this to 16#0000, the status is normal functions. Data range: 16#0000 to 9999 Unit: ms Factory value: 16#0000
*_OutDur1Cfg	WORD	R/W	Output Pulse Duration (BCD) Digital Output 1	Sets the output pulse duration for external output 1 as a BCD. When you set this to 16#0000, the status is normal functions. Setting this to 16#0000 disables this function. Data range: 16#0000 to 9999 Unit: ms Factory value: 16#0000

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
*_DigIn0FunCfg	WORD	R/W	Digital Input 0 Function/Counter Number	<p>Bits 00 to 07: Sets the function for Digital Input 0.</p> <p>16#00: No function (factory value) 16#01: Positive gate (Function 01) 16#02: Negative gate (Function 02) 16#03: Rising edge preset (Function 03) 16#04: Falling edge preset (Function 04) 16#05: Rising edge reset (Function 05) 16#06: Falling edge reset (Function 06) 16#15: Reset enabled (Function 15) 16#16: Reset disabled (Function 16) (For details, refer to 3-4 Digital Input Functions.)</p> <p>Bits 08 to 15: Sets the Counter connected to the Digital Input 0.</p> <p>16#00: No setting (factory value) 16#01: Counter 1 16#02: Counter 2</p>
*_DigIn1FunCfg	WORD	R/W	Digital Input 1 Function/Counter Number	<p>Bits 00 to 07: Sets the function for Digital Input 1.</p> <p>16#00: No function (factory value) 16#01: Positive gate (Function 01) 16#02: Negative gate (Function 02) 16#03: Rising edge preset (Function 03) 16#04: Falling edge preset (Function 04) 16#05: Rising edge reset (Function 05) 16#06: Falling edge reset (Function 06) 16#15: Reset enabled (Function 15) 16#16: Reset disabled (Function 16) (For details, refer to 3-4 Digital Input Functions.)</p> <p>Bits 08 to 15: Sets the Counter connected to the Digital Input 1.</p> <p>16#00: No setting (factory value) 16#01: Counter 1 16#02: Counter 2</p>
*_PreOutPatCfg	DWORD	R/W	Predefined Output Pattern	<p>When the output status control (Bits 12 to 15) in *_OutStactlMdCfg is set in 16#02, the output pattern set here (external output + internal output) is applied to output.</p> <p>Data range: 16#00000000 to 16#FFFFFFFF Factory value: 16#00000000</p>
Counter 1				
*_Ch1_CtTypCfg	UINT	R/W	Counter Type	<p>Sets the Counter type.</p> <p>0: Circular Counter (factory value) 1: Linear Counter</p>

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
*_Ch1_SigTypCfg	UINT	R/W	Signal Type	Sets the input type. 0: Phase differential (multiplication 1) (factory value) 1: Phase differential (multiplication 2) 2: Phase differential (multiplication 4) 4: Up & down pulse 8: Pulse & direction
*_Ch1_ZOvfUdfCfg	WORD	R/W	Z-reset Mode/Overflow/Underflow error-code generation	Bits 00 to 03: This sets the Z phase input signal function. 16#0: No function (factory value) 16#1: Reset (Z phase input signal rising edge) Bits 04 to 07: Sets whether or not overflow/underflow error codes are created. 16#0: Error codes are not created (The overflow/underflow bit is set and the output retains the previous status.) (factory value) 16#1: Error codes are created. (Error codes are reported and all output is switched OFF.) Bits 08 to 15: Use with 0 (factory value).
*_Ch1_UpCtLmtCfg	UDINT	R/W	Upper Count Limit Circular/Linear	Sets the circular/Linear Counters upper count limit. Data range: 0 to 4,294,967,295 Unit: Pulse Factory value: 0
*_Ch1_LowCtLmtCfg	DINT	R/W	Lower Count Limit Linear	Sets the Linear Counter lower count limit. Data range: -2,147,483,648 to 0 Unit: Pulse Factory value: 0
*_Ch1_InitLinCtCfg	DINT	R/W	Initial Count Value	Sets the initial Counter Value after unit setting data is transferred. Used for Simple Counter or Linear Counter. Data range: -2,147,483,648 to 2,147,483,647 Unit: Pulse Factory value: 0
*_Ch1_InitRingCtCfg	UDINT	R/W	Initial Count Value	Sets the initial Counter Value after unit setting data is transferred. Used for Circular Counter. Data range: 0 to 4,294,967,295 Unit: Pulse Factory value: 0
*_Ch1_RngCmpEnblCfg	DWORD	R/W	Range/Comparison Enable Data	Sets whether the range/comparison data is enabled or disabled. Bits 0 to 31 correspond to comparison data 00 to 31. Each bit is enabled for 1 and disabled for 0. Data range: 16#00000000 to 16#FFFFFFFF Factory value: 0

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
*_Ch1_OutSetPatCfg	DWORD	R/W	Output Set Pattern	Sets the output (0 to 31) set pattern. Bits 0 to 31 correspond to output 00 to 31. Each bit is set for 1 and no change for 0. Data range: 16#00000000 to 16#FFFFFFFF Factory value: 0
*_Ch1_OutRstPatCfg	DWORD	R/W	Output Reset Pattern	Sets the output (0 to 31) reset pattern. Bits 0 to 31 correspond to output 00 to 31. Each bit is reset for 1 and no change for 0. Data range: 16#00000000 to 16#FFFFFFFF Factory value: 0
*_Ch1_HystrsCfg	UINT	R/W	Hysteresis	Sets the hysteresis. For 0, the hysteresis function is disabled.*2 Data range: 0 to 255 Unit: Pulse Factory value: 0
*_Ch1_NumRngCmpCfg	WORD	R/W	Number of Ranges/Comparison Values (BCD)	Sets the number of ranges/comparison values as a BCD. Data range: 16#0000 to 0032 Factory value: 16#0000
*_Ch1_MemAreaCfg	UINT	R/W	Memory Area*3	This sets the area type for storing the range/comparison data. 0: EM (factory value) 1: DM
*_Ch1_MemAdrCfg	DWORD	R/W	Memory Address (BCD)*3	This sets the start address (EM/DM) for storing the range/comparison data as a BCD. Data range: 16#00000000 to 00032760 Factory value: 16#0000
Counter 2				
*_Ch2_CtTypCfg	UINT	R/W	Counter Type	Sets the Counter type. 0: Circular Counter (factory value) 1: Linear Counter
*_Ch2_SigTypCfg	UINT	R/W	Signal Type	Sets the input type. 0: Phase differential (multiplication 1) (factory value) 1: Phase differential (multiplication 2) 2: Phase differential (multiplication 4) 4: Up & down pulse 8: Pulse & direction

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
*_Ch2_ZOvfUdfCfg	WORD	R/W	Z-reset Mode/Overflow/Underflow error-code generation	<p>Bits 00 to 03: This sets the Z phase input signal function.</p> <p>16#0: No function (factory value)</p> <p>16#1: Reset (Z phase input signal rising edge)</p> <p>Bits 04 to 07: Sets whether or not overflow/underflow error codes are created.</p> <p>16#0: Error codes are not created (The overflow/underflow bit is set and the output retains the previous status.) (factory value)</p> <p>16#1: Error codes are created. (Error codes are reported and all output is switched OFF.)</p> <p>Bits 08 to 15: Use with 16#00 (factory value).</p>
*_Ch2_UpCtLmtCfg	UDINT	R/W	Upper Count Limit Circular/Linear	<p>Sets the circular/Linear Counters upper count limit.</p> <p>Data range: 0 to 4,294,967,295</p> <p>Unit: Pulse</p> <p>Factory value: 0</p>
*_Ch2_LowCtLmtCfg	DINT	R/W	Lower Count Limit Linear	<p>Sets the Linear Counter lower count limit.</p> <p>Data range: -2,147,483,648 to 0</p> <p>Unit: Pulse</p> <p>Factory value: 0</p>
*_Ch2_InitLinCtCfg	DINT	R/W	Initial Count Value	<p>Sets the initial Counter Value after unit setting data is transferred.</p> <p>Used for Simple Counter or Linear Counter.</p> <p>Data range: -2,147,483,648 to 2,147,483,647</p> <p>Unit: Pulse</p> <p>Factory value: 0</p>
*_Ch2_InitRingCtCfg	UDINT	R/W	Initial Count Value	<p>Sets the initial Counter Value after unit setting data is transferred.</p> <p>Used for Circular Counter.</p> <p>Data range: 0 to 4,294,967,295</p> <p>Unit: Pulse</p> <p>Factory value: 0</p>
*_Ch2_RngCmpEnblCfg	DWORD	R/W	Range/Comparison Enable Data	<p>Sets whether the range/comparison data is enabled or disabled.</p> <p>Bits 00 to 31 correspond to comparison data 0 to 31.</p> <p>Each bit is enabled for 1 and disabled for 0.</p> <p>Data range: 16#00000000 to 16#FFFFFFFF</p> <p>Factory value: 0</p>
*_Ch2_OutSetPatCfg	DWORD	R/W	Output Set Pattern	<p>Sets the output (0 to 31) set pattern.</p> <p>Bits 00 to 31 correspond to output 0 to 31.</p> <p>Each bit is set for 1 and no change for 0.</p> <p>Data range: 16#00000000 to 16#FFFFFFFF</p> <p>Factory value: 0</p>

Name of device variable for CJ-series Unit	Type	R/W	Name	Function
*_Ch2_OutRstPatCfg	DWORD	R/W	Output Reset Pattern	Sets the output (0 to 31) reset pattern. Bits 00 to 31 correspond to output 0 to 31. Each bit is reset for 1 and no change for 0. Data range: 16#00000000 to 16#FFFFFFF Factory value: 0
*_Ch2_HystrsCfg	UINT	R/W	Hysteresis	Sets the hysteresis. For 0, the hysteresis function is disabled.*2 Data range: 0 to 255 Unit: Pulse Factory value: 0
*_Ch2_NumRngCmpCfg	WORD	R/W	Number of Ranges/Comparison Values (BCD)	Sets the number of ranges/comparison values as a BCD. Data range: 16#0000 to 0032 Factory value: 16#0000
*_Ch2_MemAreaCfg	UINT	R/W	Memory Area	Sets the area type for storing the range/comparison data. 0: EM (factory value) 1: DM
*_Ch2_MemAdrCfg	DWORD	R/W	Memory Address (BCD)	Sets the start address (EM/DM) for storing the range/comparison data as a BCD. Data range: 16#00000000 to 00032760 Factory value: 16#0000

*1 Set to "0" and turn OFF *Hysteresis* to use the Preset Function.

*2 Sets the beginning (k1) of the *Range Data or Comparison Data*.

4-2-5 Memory Allocation for Ranges

Range data are set in the user-defined variable. Refer to *Allocation to User-defined Variable* (P. 4-10) for more information.

Two types of structure data are prepared beforehand for range data user-defined variables: one type for Linear Counters and one type for Circular Counters.

Register the structure data type for High-speed Counter Units beforehand on the CPU/Expansion Racks screen in Configuration and Setup of Sysmac Studio.

With the Unit selected on the CPU/Expansion Racks screen in Configuration and Setup, right click, then select Register Data Types for Units. The data type is registered and becomes usable.

Use these structures to define user-defined variables.

Data type (name)	Member	Data type	Name
_sCJCT021_Ex_RngLin	LowLmt	DINT	Lower Limit Range
	UpLmt	DINT	Upper Limit Range
	OutPat	DWORD	Output Pattern
_sCJCT021_Ex_RngRing	LowLmt	UDINT	Lower Limit Range
	UpLmt	UDINT	Upper Limit Range
	OutPat	DWORD	Output Pattern

The table below shows an example of range allocation when the range data user-defined variables are defined as follows.

c1D for Counter 1 (array[0..31] of _sCJCT021_Ex_RngLin) (Linear Counter, 32 ranges (maximum))

c2D for Counter 2 (array[0..31] of _sCJCT021_Ex_RngRing) (Circular Counter, 32 ranges (maximum))

Variable name	Data type	Item	Function
Counter 1			
c1D[0]	_sCJCT021_Ex_RngLin	Range 0	
	c1D[0].LowLmt	Range 0 Lower Limit	Range 0 lower limit
	c1D[0].UpLmt	Range 0 Upper Limit	Range 0 upper limit
	c1D[0].OutPat	Range 0 Output Pattern	Range 0 output pattern*
c1D[1]	_sCJCT021_Ex_RngLin	Range 1	Range 1 lower limit/upper limit values and output pattern
c1D[2]	_sCJCT021_Ex_RngLin	Range 2	Range 2 lower limit/upper limit values and output pattern
c1D[3]	_sCJCT021_Ex_RngLin	Range 3	Range 3 lower limit/upper limit values and output pattern
c1D[4]	_sCJCT021_Ex_RngLin	Range 4	Range 4 lower limit/upper limit values and output pattern
c1D[5]	_sCJCT021_Ex_RngLin	Range 5	Range 5 lower limit/upper limit values and output pattern
c1D[6]	_sCJCT021_Ex_RngLin	Range 6	Range 6 lower limit/upper limit values and output pattern
c1D[7]	_sCJCT021_Ex_RngLin	Range 7	Range 7 lower limit/upper limit values and output pattern
c1D[8]	_sCJCT021_Ex_RngLin	Range 8	Range 8 lower limit/upper limit values and output pattern
c1D[9]	_sCJCT021_Ex_RngLin	Range 9	Range 9 lower limit/upper limit values and output pattern

Variable name	Data type	Item	Function
c1D[10]	_sCJCT021_Ex_RngLin	Range 10	Range 10 lower limit/upper limit values and output pattern
c1D[11]	_sCJCT021_Ex_RngLin	Range 11	Range 11 lower limit/upper limit values and output pattern
c1D[12]	_sCJCT021_Ex_RngLin	Range 12	Range 12 lower limit/upper limit values and output pattern
c1D[13]	_sCJCT021_Ex_RngLin	Range 13	Range 13 lower limit/upper limit values and output pattern
c1D[14]	_sCJCT021_Ex_RngLin	Range 14	Range 14 lower limit/upper limit values and output pattern
c1D[15]	_sCJCT021_Ex_RngLin	Range 15	Range 15 lower limit/upper limit values and output pattern
c1D[16]	_sCJCT021_Ex_RngLin	Range 16	Range 16 lower limit/upper limit values and output pattern
c1D[17]	_sCJCT021_Ex_RngLin	Range 17	Range 17 lower limit/upper limit values and output pattern
c1D[18]	_sCJCT021_Ex_RngLin	Range 18	Range 18 lower limit/upper limit values and output pattern
c1D[19]	_sCJCT021_Ex_RngLin	Range 19	Range 19 lower limit/upper limit values and output pattern
c1D[20]	_sCJCT021_Ex_RngLin	Range 20	Range 20 lower limit/upper limit values and output pattern
c1D[21]	_sCJCT021_Ex_RngLin	Range 21	Range 21 lower limit/upper limit values and output pattern
c1D[22]	_sCJCT021_Ex_RngLin	Range 22	Range 22 lower limit/upper limit values and output pattern
c1D[23]	_sCJCT021_Ex_RngLin	Range 23	Range 23 lower limit/upper limit values and output pattern
c1D[24]	_sCJCT021_Ex_RngLin	Range 24	Range 24 lower limit/upper limit values and output pattern
c1D[25]	_sCJCT021_Ex_RngLin	Range 25	Range 25 lower limit/upper limit values and output pattern
c1D[26]	_sCJCT021_Ex_RngLin	Range 26	Range 26 lower limit/upper limit values and output pattern
c1D[27]	_sCJCT021_Ex_RngLin	Range 27	Range 27 lower limit/upper limit values and output pattern
c1D[28]	_sCJCT021_Ex_RngLin	Range 28	Range 28 lower limit/upper limit values and output pattern
c1D[29]	_sCJCT021_Ex_RngLin	Range 29	Range 29 lower limit/upper limit values and output pattern
c1D[30]	_sCJCT021_Ex_RngLin	Range 30	Range 30 lower limit/upper limit values and output pattern
c1D[31]	_sCJCT021_Ex_RngLin	Range 31	Range 31 lower limit/upper limit values and output pattern

* For details on output patterns, refer to 3-5-1 Range Mode.

Variable name	Data type	Item	Function
Counter 2			
c2D[0]	_sCJCT021_Ex_RngRing	Range 0	
c2D[0].LowLmt	UDINT	Range 0 Lower Limit	Range 0 lower limit
c2D[0].UpLmt	UDINT	Range 0 Upper Limit	Range 0 upper limit

Variable name	Data type	Item	Function
c2D[0].OutPat	DWORD	Range 0 Output Pattern	Range 0 output pattern*
c2D[1]	_sCJCT021_Ex_RngRing	Range 1	Range 1 lower limit/upper limit values and output pattern
c2D[2]	_sCJCT021_Ex_RngRing	Range 2	Range 2 lower limit/upper limit values and output pattern
c2D[3]	_sCJCT021_Ex_RngRing	Range 3	Range 3 lower limit/upper limit values and output pattern
c2D[4]	_sCJCT021_Ex_RngRing	Range 4	Range 4 lower limit/upper limit values and output pattern
c2D[5]	_sCJCT021_Ex_RngRing	Range 5	Range 5 lower limit/upper limit values and output pattern
c2D[6]	_sCJCT021_Ex_RngRing	Range 6	Range 6 lower limit/upper limit values and output pattern
c2D[7]	_sCJCT021_Ex_RngRing	Range 7	Range 7 lower limit/upper limit values and output pattern
c2D[8]	_sCJCT021_Ex_RngRing	Range 8	Range 8 lower limit/upper limit values and output pattern
c2D[9]	_sCJCT021_Ex_RngRing	Range 9	Range 9 lower limit/upper limit values and output pattern
c2D[10]	_sCJCT021_Ex_RngRing	Range 10	Range 10 lower limit/upper limit values and output pattern
c2D[11]	_sCJCT021_Ex_RngRing	Range 11	Range 11 lower limit/upper limit values and output pattern
c2D[12]	_sCJCT021_Ex_RngRing	Range 12	Range 12 lower limit/upper limit values and output pattern
c2D[13]	_sCJCT021_Ex_RngRing	Range 13	Range 13 lower limit/upper limit values and output pattern
c2D[14]	_sCJCT021_Ex_RngRing	Range 14	Range 14 lower limit/upper limit values and output pattern
c2D[15]	_sCJCT021_Ex_RngRing	Range 15	Range 15 lower limit/upper limit values and output pattern
c2D[16]	_sCJCT021_Ex_RngRing	Range 16	Range 16 lower limit/upper limit values and output pattern
c2D[17]	_sCJCT021_Ex_RngRing	Range 17	Range 17 lower limit/upper limit values and output pattern
c2D[18]	_sCJCT021_Ex_RngRing	Range 18	Range 18 lower limit/upper limit values and output pattern
c2D[19]	_sCJCT021_Ex_RngRing	Range 19	Range 19 lower limit/upper limit values and output pattern
c2D[20]	_sCJCT021_Ex_RngRing	Range 20	Range 20 lower limit/upper limit values and output pattern
c2D[21]	_sCJCT021_Ex_RngRing	Range 21	Range 21 lower limit/upper limit values and output pattern
c2D[22]	_sCJCT021_Ex_RngRing	Range 22	Range 22 lower limit/upper limit values and output pattern
c2D[23]	_sCJCT021_Ex_RngRing	Range 23	Range 23 lower limit/upper limit values and output pattern
c2D[24]	_sCJCT021_Ex_RngRing	Range 24	Range 24 lower limit/upper limit values and output pattern
c2D[25]	_sCJCT021_Ex_RngRing	Range 25	Range 25 lower limit/upper limit values and output pattern
c2D[26]	_sCJCT021_Ex_RngRing	Range 26	Range 26 lower limit/upper limit values and output pattern

Variable name	Data type	Item	Function
c2D[27]	_sCJCT021_Ex_ RngRing	Range 27	Range 27 lower limit/upper limit values and output pattern
c2D[28]	_sCJCT021_Ex_ RngRing	Range 28	Range 28 lower limit/upper limit values and output pattern
c2D[29]	_sCJCT021_Ex_ RngRing	Range 29	Range 29 lower limit/upper limit values and output pattern
c2D[30]	_sCJCT021_Ex_ RngRing	Range 30	Range 30 lower limit/upper limit values and output pattern
c2D[31]	_sCJCT021_Ex_ RngRing	Range 31	Range 31 lower limit/upper limit values and output pattern

* For details on output patterns, refer to 3-5-1 *Range Mode*.

4-2-6 Memory Allocation for Comparison data

Comparison data are set in the user-defined variable. Refer to "Allocation to User-defined Variable" (P. 4-10) for more information.

Two types of structure data are prepared beforehand for comparison data user-defined variables: one type for Linear Counters and one type for Circular Counters.

Register the structure data type for High-speed Counter Units beforehand on the CPU/Expansion Racks screen in Configuration and Setup of Sysmac Studio.

With the Unit selected on the CPU/Expansion Racks screen in Configuration and Setup, right click, then select Register Data Types for Units. The data type is registered and becomes usable.

Use these structures to define user-defined variables.

Data type (name)	Member	Data type	Name
_sCJCT021_Ex_CmpLin	CmpVal	DINT	Comparison value
	AddSetPat	DWORD	+Set pattern
	AddRstPat	DWORD	+Reset pattern
	SubSetPat	DWORD	-Set pattern
	SubRstPat	DWORD	-Reset pattern
_sCJCT021_Ex_CmpRing	CmpVal	UDINT	Comparison value
	AddSetPat	DWORD	+Set pattern
	AddRstPat	DWORD	+Reset pattern
	SubSetPat	DWORD	-Set pattern
	SubRstPat	DWORD	-Reset pattern

The table below shows an example of comparison data allocation when the comparison data user-defined variables are defined as follows.

c1D for Counter 1 (array[0..31] of _sCJCT021_Ex_CmpLin)
(Linear Counter, 32 comparison data (maximum))

c2D for Counter 2 (array[0..31] of _sCJCT021_Ex_CmpRing)
(Circular Counter, 32 comparison data (maximum))

Variable name	Data type	Item	Function
Counter 1			
c1D[0]	_sCJCT021_Ex_CmpLin	Comparison data 0	
c1D[0]	DINT	Comparison data 0 Comparison value	Comparison data 0 Comparison value
c1D[0].CmpVal	DWORD	Comparison data 0 +Set Pattern	Comparison data 0 output +set pattern*
c1D[0].AddSetPat	DWORD	Comparison data 0 +Reset Pattern	Comparison data 0 output +reset pattern*
c1D[0].AddRstPat	DWORD	Comparison data 0 -Set Pattern	Comparison data 0 output -set pattern*
c1D[0].SubSetPat	DWORD	Comparison data 0 -Reset Pattern	Comparison data 0 output -reset pattern*
c1D[1]	_sCJCT021_Ex_CmpLin	Comparison data 1	Comparison value, output (+/-) set/reset pattern
c1D[2]	_sCJCT021_Ex_CmpLin	Comparison data 2	Comparison value, output (+/-) set/reset pattern
c1D[3]	_sCJCT021_Ex_CmpLin	Comparison data 3	Comparison value, output (+/-) set/reset pattern

Variable name	Data type	Item	Function
c1D[4]	_sCJCT021_Ex_CmpLin	Comparison data 4	Comparison value, output (+/-) set/reset pattern
c1D[5]	_sCJCT021_Ex_CmpLin	Comparison data 5	Comparison value, output (+/-) set/reset pattern
c1D[6]	_sCJCT021_Ex_CmpLin	Comparison data 6	Comparison value, output (+/-) set/reset pattern
c1D[7]	_sCJCT021_Ex_CmpLin	Comparison data 7	Comparison value, output (+/-) set/reset pattern
c1D[8]	_sCJCT021_Ex_CmpLin	Comparison data 8	Comparison value, output (+/-) set/reset pattern
c1D[9]	_sCJCT021_Ex_CmpLin	Comparison data 9	Comparison value, output (+/-) set/reset pattern
c1D[10]	_sCJCT021_Ex_CmpLin	Comparison data 10	Comparison value, output (+/-) set/reset pattern
c1D[11]	_sCJCT021_Ex_CmpLin	Comparison data 11	Comparison value, output (+/-) set/reset pattern
c1D[12]	_sCJCT021_Ex_CmpLin	Comparison data 12	Comparison value, output (+/-) set/reset pattern
c1D[13]	_sCJCT021_Ex_CmpLin	Comparison data 13	Comparison value, output (+/-) set/reset pattern
c1D[14]	_sCJCT021_Ex_CmpLin	Comparison data 14	Comparison value, output (+/-) set/reset pattern
c1D[15]	_sCJCT021_Ex_CmpLin	Comparison data 15	Comparison value, output (+/-) set/reset pattern
c1D[16]	_sCJCT021_Ex_CmpLin	Comparison data 16	Comparison value, output (+/-) set/reset pattern
c1D[17]	_sCJCT021_Ex_CmpLin	Comparison data 17	Comparison value, output (+/-) set/reset pattern
c1D[18]	_sCJCT021_Ex_CmpLin	Comparison data 18	Comparison value, output (+/-) set/reset pattern
c1D[19]	_sCJCT021_Ex_CmpLin	Comparison data 19	Comparison value, output (+/-) set/reset pattern
c1D[20]	_sCJCT021_Ex_CmpLin	Comparison data 20	Comparison value, output (+/-) set/reset pattern
c1D[21]	_sCJCT021_Ex_CmpLin	Comparison data 21	Comparison value, output (+/-) set/reset pattern
c1D[22]	_sCJCT021_Ex_CmpLin	Comparison data 22	Comparison value, output (+/-) set/reset pattern
c1D[23]	_sCJCT021_Ex_CmpLin	Comparison data 23	Comparison value, output (+/-) set/reset pattern
c1D[24]	_sCJCT021_Ex_CmpLin	Comparison data 24	Comparison value, output (+/-) set/reset pattern
c1D[25]	_sCJCT021_Ex_CmpLin	Comparison data 25	Comparison value, output (+/-) set/reset pattern
c1D[26]	_sCJCT021_Ex_CmpLin	Comparison data 26	Comparison value, output (+/-) set/reset pattern
c1D[27]	_sCJCT021_Ex_CmpLin	Comparison data 27	Comparison value, output (+/-) set/reset pattern
c1D[28]	_sCJCT021_Ex_CmpLin	Comparison data 28	Comparison value, output (+/-) set/reset pattern

Variable name	Data type	Item	Function
c1D[29]	_sCJCT021_Ex_CmpLin	Comparison data 29	Comparison value, output (+/-) set/reset pattern
c1D[30]	_sCJCT021_Ex_CmpLin	Comparison data 30	Comparison value, output (+/-) set/reset pattern
c1D[31]	_sCJCT021_Ex_CmpLin	Comparison data 31	Comparison value, output (+/-) set/reset pattern

* For details on set and reset patterns, refer to *Configuration and Operation in Comparison Mode*.

Variable name	Data type	Item	Function
Counter 2			
c2D[0]	_sCJCT021_Ex_CmpRing	Comparison data 0	
c2D[0]	UDINT	Comparison data 0 Comparison value	Comparison data 0 Comparison value
c2D[0].CmpVal	DWORD	Comparison data 0 +Set Pattern	Comparison data 0 output +set pattern*
c2D[0].AddSetPat	DWORD	Comparison data 0 +Reset Pattern	Comparison data 0 output +reset pattern*
c2D[0].AddRstPat	DWORD	Comparison data 0 -Set Pattern	Comparison data 0 output -set pattern*
c2D[0].SubSetPat	DWORD	Comparison data 0 -Reset Pattern	Comparison data 0 output -reset pattern*
c2D[1]	_sCJCT021_Ex_CmpRing	Comparison data 1	Comparison value, output (+/-) set/reset pattern
c2D[2]	_sCJCT021_Ex_CmpRing	Comparison data 2	Comparison value, output (+/-) set/reset pattern
c2D[3]	_sCJCT021_Ex_CmpRing	Comparison data	Comparison value, output (+/-) set/reset pattern
c2D[4]	_sCJCT021_Ex_CmpRing	Comparison data 4	Comparison value, output (+/-) set/reset pattern
c2D[5]	_sCJCT021_Ex_CmpRing	Comparison data 5	Comparison value, output (+/-) set/reset pattern
c2D[6]	_sCJCT021_Ex_CmpRing	Comparison data 6	Comparison value, output (+/-) set/reset pattern
c2D[7]	_sCJCT021_Ex_CmpRing	Comparison data 7	Comparison value, output (+/-) set/reset pattern
c2D[8]	_sCJCT021_Ex_CmpRing	Comparison data 8	Comparison value, output (+/-) set/reset pattern
c2D[9]	_sCJCT021_Ex_CmpRing	Comparison data 9	Comparison value, output (+/-) set/reset pattern
c2D[10]	_sCJCT021_Ex_CmpRing	Comparison data 10	Comparison value, output (+/-) set/reset pattern
c2D[11]	_sCJCT021_Ex_CmpRing	Comparison data 11	Comparison value, output (+/-) set/reset pattern
c2D[12]	_sCJCT021_Ex_CmpRing	Comparison data 12	Comparison value, output (+/-) set/reset pattern
c2D[13]	_sCJCT021_Ex_CmpRing	Comparison data 13	Comparison value, output (+/-) set/reset pattern
c2D[14]	_sCJCT021_Ex_CmpRing	Comparison data 14	Comparison value, output (+/-) set/reset pattern
c2D[15]	_sCJCT021_Ex_CmpRing	Comparison data 15	Comparison value, output (+/-) set/reset pattern

Variable name	Data type	Item	Function
c2D[16]	_sCJCT021_Ex_CmpRing	Comparison data 16	Comparison value, output (+/-) set/reset pattern
c2D[17]	_sCJCT021_Ex_CmpRing	Comparison data 17	Comparison value, output (+/-) set/reset pattern
c2D[18]	_sCJCT021_Ex_CmpRing	Comparison data 18	Comparison value, output (+/-) set/reset pattern
c2D[19]	_sCJCT021_Ex_CmpRing	Comparison data 19	Comparison value, output (+/-) set/reset pattern
c2D[20]	_sCJCT021_Ex_CmpRing	Comparison data 20	Comparison value, output (+/-) set/reset pattern
c2D[21]	_sCJCT021_Ex_CmpRing	Comparison data 21	Comparison value, output (+/-) set/reset pattern
c2D[22]	_sCJCT021_Ex_CmpRing	Comparison data 22	Comparison value, output (+/-) set/reset pattern
c2D[23]	_sCJCT021_Ex_CmpRing	Comparison data 23	Comparison value, output (+/-) set/reset pattern
c2D[24]	_sCJCT021_Ex_CmpRing	Comparison data 24	Comparison value, output (+/-) set/reset pattern
c2D[25]	_sCJCT021_Ex_CmpRing	Comparison data 25	Comparison value, output (+/-) set/reset pattern
c2D[26]	_sCJCT021_Ex_CmpRing	Comparison data 26	Comparison value, output (+/-) set/reset pattern
c2D[27]	_sCJCT021_Ex_CmpRing	Comparison data 27	Comparison value, output (+/-) set/reset pattern
c2D[28]	_sCJCT021_Ex_CmpRing	Comparison data 28	Comparison value, output (+/-) set/reset pattern
c2D[29]	_sCJCT021_Ex_CmpRing	Comparison data 29	Comparison value, output (+/-) set/reset pattern
c2D[30]	_sCJCT021_Ex_CmpRing	Comparison data 30	Comparison value, output (+/-) set/reset pattern
c2D[31]	_sCJCT021_Ex_CmpRing	Comparison data 31	Comparison value, output (+/-) set/reset pattern

* For details on set and reset patterns, refer to *Configuration and Operation in Comparison Mode*.

5

Error Processing, Maintenance and Inspection

This section provides details of the CJ1W-CT021 High-speed Counter Unit's error indicators and error codes and guidelines for maintenance and inspection of the Unit.

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5-1 Error Indicators

CT021						
RUN	ERC	ERH				
CH1	A	B	Z	I0	O0	
CH2	A	B	Z	I1	O1	

The RUN-, ERC-, and ERH-LEDs, at the front panel of the High-speed Counter Unit, display the following errors.

5-1-1 Errors during initial processing

RUN	ERC	ERH	Error	Probable cause	Remedy
OFF	OFF	ON	Setup error	Incorrect Unit number Cyclic initial error	Set correct Unit number and turn ON the power again
OFF	ON	OFF	DM-configuration error	Invalid contents of the settings for device variables for CJ-series Unit (for setting)	Check the error code with <i>*_ErrCode1</i> (error code 1) and <i>*_ErrCode2</i> (Error code 2), set the device variables for CJ-series Unit (for setting) (unit setting) again correctly. Restart the Unit or reset the Controller. Refer to <i>5-2 Error codes</i> for more information on error codes and how to clear them.
			Unit error	An error occurred in the Unit's EEPROM, RAM or CPU or a system software error occurred	Restart the Unit or reset the Controller. If errors reoccur, then replace the High-speed Counter Unit.
OFF	ON	ON	Unit classification error	The Unit classification was set incorrectly	Replace the High-speed Counter Unit
OFF	OFF	OFF	Watch Dog Timer time-out error	The Unit's Watch Dog Timer has timed out	Turn OFF and then ON the power again. If errors reoccurs, then replace the High-speed Counter Unit

5-1-2 Errors during normal operation

RUN	ERC	ERH	Error	Probable cause	Remedy
ON	ON	OFF	Unit error	Overflow or underflow of Simple or Linear Counter Preset error	Check the error code with *_ErrCode1 (error code 1), *_ErrCode2 (error code 2), or Sysmac Studio. Apply appropriate remedy according to the cause of the error. Refer to 5-2 Error codes for more information on error codes and how to clear them.
ON	OFF	ON	System error	An error occurred in the CPU Unit. <ul style="list-style-type: none"> • PLC Watch Dog Timer error • Major Fault • Partial Fault • CPU Unit monitoring error • I/O bus check error 	Remove the cause of the major fault or partial fault, then reset the Controller or cycle its power. If the error reoccurs, then replace the CPU Unit. Refer to 5-2-4 System Errors for more information

5-2 Error codes

● Reporting errors

Errors occurring in the High-speed Counter Unit are divided into the following 4 types.

- Allocated DM area setting error
- Overflow/underflow error
- Preset error
- System error

There is an error code for each error. These error codes are made up of error code 1 and error code 2.

If an error occurs, the state becomes as follows.

- The corresponding error code is transferred to the error code 1 and 2 variables below.
- The error code is stored in the error list in the High-speed Counter Unit.
- Global Error variable below changes to ON (1).
- The ERC indicator on the front of the Unit lights up.

Variable names	Type	Name	Function
*_GlbErr	BOOL	Global Error	1: Shows that one or more error has occurred. These error codes are stored in the error list in this Unit. 0: Normal
*_ErrCode1	WORD	Error Code 1	Error code 1
*_ErrCode2	WORD	Error Code 2	Error code 2

When the cause of an error is eliminated, the state becomes as follows.

- The error code 1 and 2 variables are cleared.
- Global Error variable goes OFF (0).
- The ERC indicator on the front of the Unit goes out.

The method for eliminating an error depends on the error type. (The method for eliminating each type of error is given on the pages that follow.)

● Error List File

Up to 30 errors that occurred are recorded in the error list in the high-speed Counter Unit in the order they occurred.

If multiple errors occurred at the same time, the error is stored in "_ErrCode1" (error code1) and "_ErrCode2" (error code 2) when the [*Read Next Error*] variable below is changed from 0 to 1.

When the [*Read Next Error*] variable changes to TRUE (from 0 to 1) again, the next error can be read out.

When an error is read out after the information of the final error is read out, the value 0 is returned to.

When the [*Read Next Error*] bit changes to TRUE (from 0 to 1) again, the same error list can be scrolled through.

Variable names	Type	Name	Function
*_RdNxtErr	BOOL	Read Next Error	When multiple errors occurred at the same time, at the rising edge from 0 to 1, the next error is read out from the error list in this Unit.

5-2-1 DM-configuration errors

An allocated DM area setting error is detected during the initialization processing when the Controller is reset or the Unit is restarted.

When an allocated DM area setting error is detected, the error information is stored into memory and the High-speed Counter Unit stops operation.

You can read the error information with the Read Next Error variable.

For the allocated DM area offset, refer to *A-1-2 Differences in Access Methods from a User Program*.

m in the table indicates the first word allocated in DM. $m = D20000 + (N \times 100)$ (N: Unit number)

Error Code 1	Error Code 2	Error	Description
0300	Offset (BCD)	Out of Range	The DM-setting located at $D20000 + (Nx100) + \text{Offset}$ is Out of Range (N = Machine Number).
0310	Offset (BCD)	Illegal Value	The BCD value of the allocated DM area (m+x (x: offset) words) is invalid. (Any values other than 0 to 9 are invalid.)
0311	Offset (BCD)	Invalid Initial Counter Value	The Initial Counter Value located at $D20000 + (Nx100) + \text{Offset}$ is outside the counting range that is set for that Counter (N = Machine Number).
0320	Counter No.	Range No. (BCD) Invalid Range Limits	Upper limit < Lower limit Bits 00 to 11: Data No. (16#0001 to 16#0032) Bits 12 to 15: Counter No. (16#1, 16#2)
0330	Counter No.	Range No. (BCD)/ CV No. (BCD) Invalid Range Limit(s)/ Comparison Value	If the Unit is in Range Mode: Lower and/or Upper Range Limit is/are outside Counting Range. <u>Counter No.</u> indicates the Counter number and <u>Range No.</u> indicates the Range number. If the Unit is in Comparison Mode: Comparison value is outside Counting Range. <u>Counter No.</u> indicates the Counter number and <u>CV No.</u> indicates the Comparison Value number. (The counting range of Circular and Linear Counters can be specified, refer to <i>3-2-2 Circular Counter</i> and <i>3-2-3 Linear Counter</i> for more information). Bits 00 to 11: Data numbers (16#0001 to 16#0032) Bits 12 to 15: Counter numbers (16#1, 16#2)
0331	Counter No.	CV No. (BCD) Duplicate Target Value	For the Counter, with the <u>Counter Number</u> as reported in Error Code 2, one or more Comparison Values are equal. <u>CV No.</u> indicates the Comparison Value number. Bits 00 to 11: Data numbers (16#0001 to 16#0032) Bits 12 to 15: Counter numbers (16#1, 16#2)

● Clearing DM-configuration Errors

DM-configuration errors can be cleared by correcting the faulty settings in device variables for CJ-series Unit (for setting) and consecutively transferring the new configuration data again to the Unit. To transfer the configuration data you can choose from one out of two possibilities:

- Reset the Controller
- Restart the High-speed Counter Unit (refer to *4-1-2 Unit Restart*).

5-2-2 Overflow/Underflow errors

Over- and underflow errors are reported only for Linear Counters assuming that they have been configured to generate error codes (refer to *3-2-3 Linear Counter*).

Error Code 1	Error Code 2	Error	Description
0450	Counter No.	Overflow	The Linear Counter with the <i>Counter No.</i> as reported in Error Code 2 generated overflow.
0460	Counter No.	Underflow	The Linear Counter with the <i>Counter No.</i> as reported in Error Code 2 generated underflow.

● Clearing overflow/underflow errors

Overflow- and underflow errors can be cleared by resetting or presetting the Counter that generated over- or underflow. To reset a Counter refer to *3-6 Reset Counter*. To preset a Counter refer *3-4 Digital Input Functions*.



Additional Information

At overflow- and underflow errors it is possible to configure Output State Control (refer to *3-5-4 Output Control Configuration*).

5-2-3 Preset Error

A Preset error is generated if a Circular or Linear Counter is preset with an invalid Preset Value (refer to 3-4 *Digital Input Functions* for more information about presetting). The Preset Value is invalid if it is outside the counting range of the Circular or Linear Counter.

Error Code 1	Error Code 2	Error	Description
0470	Counter No.	Illegal Preset Value	The Linear Counter with the <i>Counter No.</i> as reported in Error Code 2 is preset with an invalid Preset Value.

● Clearing Preset error

A Preset error can be cleared by resetting or by presetting the Counter that generated a Preset error, with a valid Preset Value. To reset a Counter refer to 3-6 *Reset Counter*. To preset a Counter refer to 3-4 *Digital Input Functions*.

5-2-4 System Errors

When errors occur in the CPU Unit or on the I/O bus, the ERH-Indicator is turned ON.

At the occurrence of an I/O bus check error, an error code is stored in error codes 1 and 2.

Error Code 1	Error Code 2	Error	Description
0002	Monitoring time (ms)	CPU Unit Monitoring Error	This error occurs when there is no response from the CPU Unit within a specific period of time.
000E	0000	I/O Bus Check Error	An error has occurred on the I/O Bus causing the High-speed Counter Unit to be in an undefined state. On occurrence of an I/O Bus Check Error you can configure the Outputs to keep their last state or to have a predefined state (refer to 3-5-4 <i>Output Control Configuration</i>).

● Clearing System errors

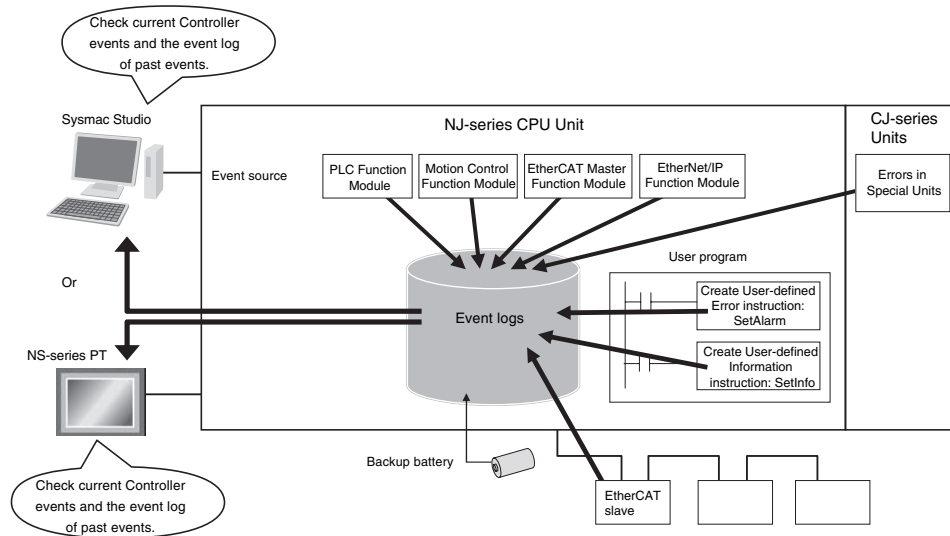
Reset the Controller or turn ON the power supply again. If the error persists, then replace the CJ-series CPU Unit.

5-3 Event Logs

5-3-1 Overview of the Event Logs

You use the same methods to manage all of the events that occur on the NJ-series Controller. (The events include errors and information.) You can use the Sysmac Studio or an NS-series PT to confirm current Controller events and the logs of events that have occurred. These logs are called event logs. Controller errors that occur for this Unit are also reported as events in the NJ-series CPU Unit.

Refer to the *NJ-series CPU Unit Software User's Manual* (Cat. No. W501) for details on the event logs in an *NJ-series CPU Unit*. Refer to the *NJ-series Troubleshooting Manual* (Cat. No. W503) for details on Controller errors, confirmation methods, and corrections.



To use an NS-series PT to check events, connect the PT to the built-in EtherNet/IP port on the CPU Unit.

5-3-2 Error Table

The errors that may occur for this Unit are listed below. Event levels are given in the table as follows:

Maj: Major fault level

Prt: Partial fault level

Min: Minor fault level

Obs: Observation

Info: Information

Refer to the *NJ-series Troubleshooting Manual* (Cat. No. W503) for all of the event codes that may occur in an NJ-series Controller.

Event code	Event name	Meaning	Assumed cause	Level					Reference
				Maj	Prt	Min	Obs	Info	
6801 0000 hex	Unit Error	An error occurred in the High-speed Counter Unit.	<ul style="list-style-type: none"> There is an error in the Special Unit Setup. An overflow or underflow error occurred. An illegal preset value was used. A CPU Unit monitor error or bus error occurred. 			√			page 11

5-3-3 Error Descriptions

This section describes the information that is given for individual errors.

Controller Error Descriptions

The items that are used to describe individual errors (events) are described in the following copy of an error table.

Event name	Gives the name of the error.		Event code	Gives the code of the error.		
Meaning	Gives a short description of the error.					
Source	Gives the source of the error.		Source details	Gives details on the source of the error.	Detection timing	Tells when the error is detected.
Error attributes	Level	Tells the level of influence on control.*1	Recovery	Gives the recovery method.*2	Log category	Tells which log the error is saved in.*3
Effects	User program	Tells what will happen to execution of the user program.*4	Operation	Provides special information on the operation that results from the error (event).		
System-defined variables	Variable	Data type		Name		
	Lists the variable names, data types, and meanings for system-defined variables that provide direct error notification, that are directly affected by the error, or that contain settings that cause the error.					
Cause and correction	Assumed cause		Correction		Prevention	
	Lists the possible causes, corrections, and preventive measures for the error.					
Attached information	This is the attached information that is displayed by the Sysmac Studio or an NS-series PT.					
Precautions/Remarks	Provides precautions, restrictions, and supplemental information.					

*1 One of the following:

Major fault: Major fault level
 Partial fault: Partial fault level
 Minor fault: Minor fault level
 Observation
 Information

*2 One of the following:

Automatic recovery: Normal status is restored automatically when the cause of the error is removed.
 Error reset: Normal status is restored when the error is reset after the cause of the error is removed.
 Cycle the power supply: Normal status is restored when the power supply to the Controller is turned OFF and then back ON after the cause of the error is removed.
 Controller reset: Normal status is restored when the Controller is reset after the cause of the error is removed.
 Depends on cause: The recovery method depends on the cause of the error.

*3 One of the following:

System: System event log
 Access: Access event log

*4 One of the following:

Continues: Execution of the user program will continue.
 Stops: Execution of the user program stops.
 Starts: Execution of the user program starts.

Error Descriptions

Event name	Unit Error		Event code	6801 0000 hex		
Meaning	An error occurred in the High-speed Counter Unit.					
Source	PLC Function Module		Source details	CJ-series Unit	Detection timing	Depends on the nature of the error.
Error attributes	Level	Minor fault	Recovery	Depends on the cause.	Log category	System
Effects	User program	Continues.	Operation	Depends on the nature of the error. Check error information in the operation manual of the High-speed Counter Unit.		
System-defined variables	Variable		Data type		Name	
	None		---		---	
Cause and correction	Assumed cause		Correction		Prevention	
	There is an error in the Special Unit Setup.		Check the attached information with the Sysmac Studio or check error codes 1 and 2 in the error history of the High-speed Counter Unit. Perform corrective actions for system recovery following the descriptions for error codes given in the manual of the High-speed Counter Unit.		Depends on the nature of the error. Check the error information in the operation manual of the High-speed Counter Unit and perform the required corrective actions.	
	An overflow or underflow error occurred.					
	An illegal preset value was used.					
A CPU Unit monitor error or bus error occurred.						
Attached information	Attached information 1: Error code 1 Attached information 2: Error code 2					
Precautions/Remarks	None					

5-4 Maintenance and Inspection

This section describes the routine cleaning and inspection recommended as regular maintenance.

5-4-1 Cleaning

Clean the High-speed Counter Unit regularly as described below in order to keep it in its optimal operating condition.

- Wipe the Unit with a dry, soft cloth for regular cleaning.
- When a spot cannot be removed with a dry cloth, dampen the cloth with a neutral cleanser, wring out the cloth, and wipe the Unit.
- A smudge may remain on the Unit from gum, vinyl, or tape that was left on for a long time. Remove the smudge when cleaning.



Precautions for Correct Use

Never use volatile solvents such as paint thinner or benzene or chemical wipes. These substances could damage the surface of the Unit.

5-4-2 Routine Inspections

In order for your High-speed Counter Unit to continue operating at optimum condition, periodic inspections are necessary. Be sure to inspect the system periodically to keep it in its optimal operating condition. In general, inspect the system once every 6 to 12 months, but inspect more frequently if the system is used with high temperature or humidity or under dirty/dusty conditions.

● **Inspection Equipment**

Prepare the following equipment before inspecting the system.

Required Equipment:

Have a standard and Phillips-head screwdriver, multimeter, alcohol, and a clean cloth.

Equipment that could be needed:

Depending on the system conditions, a synchroscope, oscilloscope, thermometer, gas sensor or hygrometer (to measure humidity) might be needed.

● Inspection Procedure

Check the items in the following table and correct any items that are not according to the criteria.

Item		Criteria	Equipment
Environmental conditions	Ambient temperature	0°C to 55°C	Thermometer
	Ambient humidity	10% to 90%	Hygrometer
	Dust/dirt accumulation	None	---
	Is the Unit exposed to any spray of water, oil, or chemicals?	None	---
	Is the Unit exposed to corrosive or flammable gases?	None	Gas sensor
	Is the Unit exposed to shock or vibration?	None	
Installation	Is the Unit installed securely?	No looseness	---
	Are the external connectors securely mounted?	No looseness	---
	Is all external wiring securely connected?	No looseness	---
	Are the external connectors fully inserted?	No looseness	---
	Are the connecting cables undamaged?	No damage	---



Application Examples

This section gives information about the configuration of the CJ1W-CT021 High-speed Counter Unit and program samples, which can be used to operate the Unit according to five common application examples. At the beginning of each section that describes an application example, all configuration items that are covered in that section are mentioned.

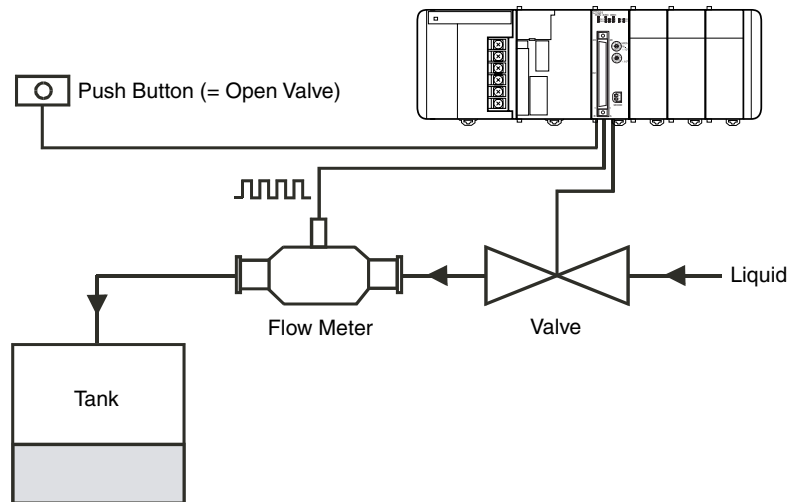
6-1	Flow Control	6-2
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6-1 Flow Control

● Overview

Below is an application example of liquid flow control using a pulse output type flow meter and valve, and using a High-speed Counter Unit Simple Counter.

● Application Description



This is an application that puts a certain amount of liquid in the tank. This application measures the flow of incoming liquid with a flow meter and controls the liquid injection valve.

The application starts filling the liquid into the tank (opens the valve) with the push button switch coming ON as the trigger.

The application measure the flow with the flow meter and when 100 liters have been put into the tank, it closes the valve to end the injection.

The flow meter measures the flow with pulse output. 5,000 pulses are equivalent to 1 liter.

● Unit Settings

The unit settings are as follows.

Name	Setting target	Settings
Counter type	Counter type switch	Set Counter 1 to a Simple Counter. (Set DIP switch 1 to OFF.)
Unit number	Unit number switch and Unit Configuration (CPU/Expansion Racks screen in Configuration and Setup of Sysmac Studio)	Unit number 0 (X10 ¹ :0, X10 ⁰ :0)
Device name of this unit	CPU/Expansion Racks screen in Configuration and Setup of Sysmac Studio	Counter (set with Sysmac Studio.)
Liquid injection start switch	---	Connected to Digital Input (I0)
Liquid injection valve	---	Connected to Digital Output (O0)

● Program Overview

The value counted by the High-speed Counter Unit is compared with the specified value.

When the liquid injection start switch (I0) is changed to ON, the value counted by Counter 1 is reset and the count is started (the gate is opened), and the liquid injection valve output (O0) is changed to ON.

When the value counted by Counter 1 reaches 500,000 or higher, the liquid injection valve output (O0) is changed to OFF and Counter 1 is stopped (the gate is closed).

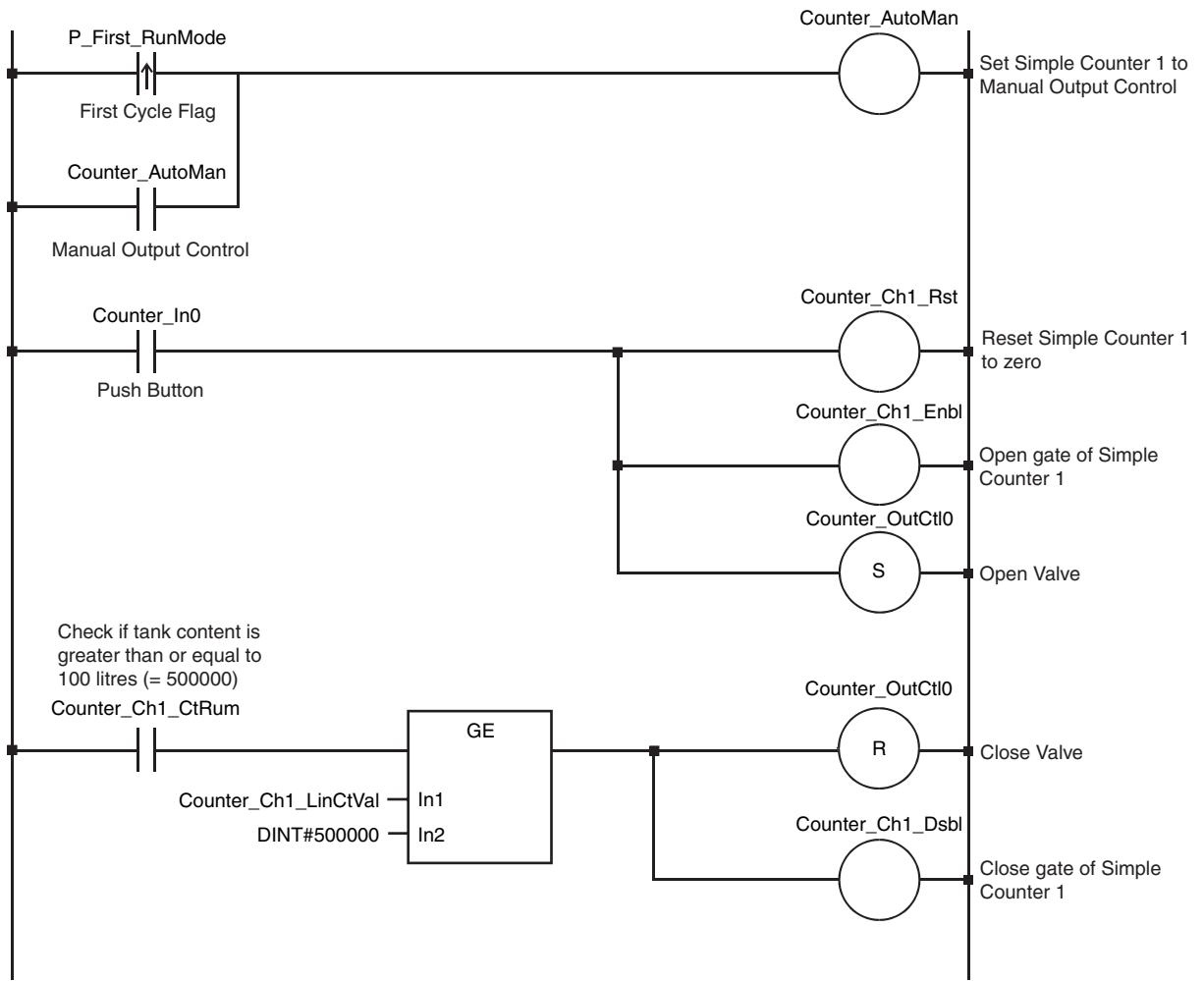
● Defined-variable

The following device variables for CJ-series Unit (for input and output) are relevant to control the application. The program is created using these variables.

Device variables for CJ-series Unit	Type	Name	Function
Counter_AutoMan*	BOOL	Automatic/Manual	0: Automatic output control* 1: Manual output control
Counter_OutCtl0	BOOL	Manual Output Control (Output 0)	0: OFF 1: ON
Counter_Ch1_Enbl	BOOL	Open Gate	0 to 1: Count start*
Counter_Ch1_Dsbl	BOOL	Close Gate	0 to 1: Count stop
Counter_Ch1_Rst	BOOL	Reset	0 to 1: Counter reset
Counter_Ch1_CtRun	BOOL	Counter Running /Gate Open	1: During Counter operation/ while gate open 0: While Counter stopped/while gate closed
Counter_In0	BOOL	Digital Input 0 Status	0: OFF 1: ON
Counter_Ch1_LinCtVal	DINT	Counter Value	-2,147,483,648 to 2,147,483,647 Unit: Pulse

* The above variable prefix (Counter) indicates that it is for the High-speed Counter Units.

● Sample Program





Appendices

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A-1-1 Functional Difference	A-2
A-1-2 Differences in Access Methods from a User Program	A-4
A-2 Using Terminal Block Units with Screw-terminals	A-14
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A-1 Differences of NJ Series from CJ Series

You can use the CJ1W-CT021 High-speed Counter Unit with the NJ-series Units.

If this Unit is used with the NJ Series, some functions become unavailable compared to when it is used with the CJ Series.

The following shows differences between the NJ Series and the CJ-series for each function of this HSC Unit.

A-1-1 Functional Difference

Item	Function in CJ series	Function in NJ series
Number of Counters	2	Same as on the left.
Counter Type	<ul style="list-style-type: none"> • Simple Counters • Circular Counters • Linear Counters 	Same as on the left.
Maximum Input Frequency	500 kHz	Same as on the left.
Maximum Response Time	0.5 ms	Same as on the left.
Input Signal	A phase, B phase, Z phase	Same as on the left.
External Input/Output	<ul style="list-style-type: none"> • External control inputs: 2 • External outputs: 2 (O0, O1) 	Same as on the left.
Types of Inputs	<ul style="list-style-type: none"> • Phase difference pulse input 1, 2, 4x • Addition/subtraction pulse input • Pulse + direction input 	Same as on the left.
Control of Counters using allocation area (CIO)	<ul style="list-style-type: none"> • Open gate (Counter start) • Close gate (Counter stop) • Counter presets • Counter resets • Counter value capture 	Counter value capture cannot be used.
External Control Input Function	<ul style="list-style-type: none"> • Gate function • Reset function • Preset function • Capture function • Stop/capture/continue functions • Stop/capture/reset/continue functions • Capture/reset functions • Reset enable function • Reset disable function 	The capture, Stop/capture/continue, Stop/capture/reset/continue, and Capture/reset functions cannot be used.
Output Control Mode	<ul style="list-style-type: none"> • Automatic ON/OFF output according to the following two modes <ul style="list-style-type: none"> Bandwidth Comparison Mode Target Value Match Comparison Mode • Pulse rate range control • Manual output control 	Pulse rate range control cannot be used.

Item	Function in CJ series	Function in NJ series
Output State Control	Can select the method to control the output states when the CPU operation mode is changed or when an error occurs. <ul style="list-style-type: none"> • Continue updating output states automatically. • Hold the output states. • Bring the pre-defined output state. 	Same as on the left.
External Output Driver Settings	External output drivers can be selected from the two types shown below. <ul style="list-style-type: none"> • NPN • PNP 	Same as on the left.
Counter Reset Conditions	<ul style="list-style-type: none"> • Counter reset bit • External control input • Z signal 	Same as on the left.
Other Functions	<ul style="list-style-type: none"> • Programmable output pulse • Pulse rate measurement functions • Hysteresis 	The pulse rate measurement function cannot be used.
Noise Filter	<ul style="list-style-type: none"> • Encoder noise filter 10 kHz, 50 kHz, 500 kHz • External control input noise filter 10 kHz, 50 kHz 	Same as on the left.
Counter Initial Values	<ul style="list-style-type: none"> • Counter initial values 	Same as at the left. However, because the NJ Series has no power OFF interrupt task, operation cannot be restarted from the position at which the power was interrupted.
IORD Instruction, IOWR Instruction	You can read or write the following data. <ul style="list-style-type: none"> • Allocated DM data • Bandwidth comparison data and target value match comparison data • Captured Counter Value • Pulse rate history log file data • Counter value • High-speed Counter Unit set and reset • Error clear 	The IORD/IOWR instruction cannot be used. Therefore, you cannot read or write the data on the left.
Starting of External Interrupt Task by Output	You can use external output and internal output unit output patterns to start CJ1-H/CJ1M CPU Unit external interrupt tasks.	Cannot use.
Starting of External Interrupt Task by External Control Input	External control input can be used to start CJ1-H/CJ1M CPU Unit external interrupt tasks.	Cannot use.
Error History Log Functions	Up to 30	Same as on the left.

A-1-2 Differences in Access Methods from a User Program

With the NJ Series, device variables for CJ-series Unit are used for the Counter Unit functions.

The following tables show how the words and bits of CJ-series I/O memory or the NJ-series memory used for CJ-series Unit correspond to the NJ-series device variables for CJ-series Unit.

Start address of special I/O Unit area: $n = 2000 \text{ words} + \text{Unit number} \times 10$ (Unit number: 0 to 92)

Start address of the special I/O Unit DM area: $m = D20000 + \text{Unit number} \times 100$ (Unit number: 0 to 92)



The relay number and DM number occupied by the High-speed Counter Unit are set by the Unit number switch on the front panel of the Unit.

One High-speed Counter Unit occupies allocation areas of four Unit numbers.

	Unit Number	CIO Area words allocated to Special I/O Unit	DM Area words allocated to Special I/O Unit
	0	2000 to 2039 words	D20000 to D20399 words
	1	2040 to 2079 words	D20400 to D20799 words
	2	2080 to 2119 words	D20800 to D21199 words
	3	2120 to 2159 words	D21200 to D21599 words
	4	2160 to 2199 words	D21600 to D21999 words
	5	2200 to 2239 words	D22000 to D22399 words
	6	2240 to 2279 words	D22400 to D22799 words
	7	2280 to 2319 words	D22800 to D23199 words
	8	2320 to 2359 words	D23200 to D23599 words
	9	2360 to 2399 words	D23600 to D23999 words
	10	2400 to 2439 words	D24000 to D24399 words
	⋮	⋮	⋮
	n	$2000 + (n \times 10)$ to $2000 + (n \times 10) + 39$	$D20000 + (n \times 100)$ to $D20000 + (n \times 100) + 399$
	⋮	⋮	⋮
	92	2920 to 2959 words	D29200 to D29599 words
	93	(Cannot be set)	---
	94	(Cannot be set)	---
	95	(Cannot be set)	---



Additional Information

- If two or more Special I/O Units are set to an identical Unit number or if one Special I/O Unit is set to areas of plural Unit numbers, the CPU Unit has a major fault level error, a duplicated Unit number error, and stops operation.
- After correcting the Unit number setting, cycle the power to the Controller.
- One High-speed Counter Unit occupies allocation areas of four Unit numbers. Be sure that no Unit numbers are duplicated.
To avoid duplication, when you set a High-speed Counter Unit to the Unit number "n", set the next Special I/O Unit to the Unit number "n + 4".

Special I/O Units Area (Allocated CIO Area words)

● Allocated CIO Area words for outputs

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word	Bit	Variable name	Description
General			
n	00	*_OutCtl0	Manual Output Control (Output 0, 1)
	01	*_OutCtl1	
	02 to 14	Undefined	---
	15	*_AutoMan	Automatic/Manual
n+1	00	*_RdNxtErr	Read Next Error
	01 to 15	Undefined	---
Counter 1			
n+2	00	*_Ch1_Enbl	Open Gate
	01	*_Ch1_Dsbl	Close Gate
	02	*_Ch1_Prst	Preset
	03	*_Ch1_Rst	Reset
	04	Undefined	Capture
	05	*_Ch1_RstEnbl	Reset Enable
	06 to 15	Undefined	---
n+3, n+4	00 to 15	*_Ch1_PrstLinCtVal (Simple Counter or Linear Counter)	Preset Value
		*_Ch1_PrstRingCtVal (Circular Counter)	
Counter 2			
n+5	00	*_Ch2_Enbl	Open Gate
	01	*_Ch2_Dsbl	Close Gate
	02	*_Ch2_Prst	Preset
	03	*_Ch2_Rst	Reset
	04	Undefined	Capture
	05	*_Ch2_RstEnbl	Reset Enable
	06 to 15	Undefined	---
n+6, n+7	00 to 15	*_Ch2_PrstLinCtVal (Simple Counter or Linear Counter)	Preset Value
		*_Ch2_PrstRingCtVal (Circular Counter)	
n+8 to n+13	00 to 15	Undefined	---

● Allocated CIO Area words for inputs

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word	Bit	Variable name	Description
General			
n+14, n+15	00 to 15	32 outputs status (correspond to n+14, n+15) *_OutStaDat	Output Status
n+14	00	*_OutSta0	Digital Output 0 Status
	01	*_OutSta1	Digital Output 1 Status
	02	*_OutSta2	Soft Output 2 Status
		:	:
	15	*_OutSta15	Soft Output 15 Status
n+15	00	*_OutSta16	Soft Output 16 Status
		:	:
	15	*_OutSta31	Soft Output 31 Status
n+16	00	*_In0	Digital Input 0 Status
	01	*_In1	Digital Input 1 Status
	02 to 15	Undefined	---
n+17	00 to 15	*_ErrCode1	Error Code 1
n+18	00 to 15	*_ErrCode2	Error Code 2
n+19	00	*_GlbErr	Global Error
	01	Undefined	External Interrupt Task Start Standby Status
	02	*_UnitInitSta	Unit Busy (Data Transfer Busy*)
	03	Undefined	Data Transfer Complete
	04	*_IABlkOverlapSta	IA Blocks overlap
	05 to 15	Undefined	---
Counter 1			
n+20, n+21	00 to 15	32 outputs status (correspond to n+20, n+21) *_Ch1_RngCmpDatSta	Ranges/Comparison Values active
n+20	00	*_Ch1_RngCmpSta0	Ranges 0/Comparison Values 0 active
		:	:
	15	*_Ch1_RngCmpSta15	Ranges 15/Comparison Values 15 active
n+21	00	*_Ch1_RngCmpSta16	Ranges 16/Comparison Values 16 active
		:	:
	15	*_Ch1_RngCmpSta31	Ranges 31/Comparison Values 31 active
n+22, n+23	00 to 15	*_Ch1_LinCtVal (Simple Counter or Linear Counter)	Counter Value
		*_Ch1_RingCtVal (Circular Counter)	

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word	Bit	Variable name	Description
n+24	00	*_Ch1_CtOvf	Counter Overflow
	01	*_Ch1_CtUdf	Counter Underflow
	02	*_Ch1_CtRun	Counter Running/Gate Open
	03	*_Ch1_CntDir	Counter Direction
	04	*_Ch1_PrstSta	Preset Activated
	05	*_Ch1_RstSta	Reset Activated
	06	Undefined	Capture Activated
	07	*_Ch1_ZSig	Z-signal Activated
	08 to 09	Undefined	---
	10	Undefined	Pulse Rate Range 0 active
	11	Undefined	Pulse Rate Range 1 active
	12 to 14	Undefined	---
	15	*_Ch1_SmplCntSta	Simple Counter
Counter 2			
n+25, n+26	00 to 15	32 outputs status (correspond to n+25, n+26) *_Ch2_RngCmpDatSta	Ranges/Comparison Values active
n+25	00	*_Ch2_RngCmpSta0	Ranges 0/Comparison Values 0 active
	:	:	:
	15	*_Ch2_RngCmpSta15	Ranges 15/Comparison Values 15 active
n+26	00	*_Ch2_RngCmpSta16	Ranges 16/Comparison Values 16 active
	:	:	:
	15	*_Ch2_RngCmpSta31	Ranges 31/Comparison Values 31 active
n+27, n+28	00 to 15	*_Ch2_LinCtVal (Simple Counter or Linear Counter) *_Ch2_RingCtVal (Circular Counter)	Counter Value
n+29	00	*_Ch2_CtOvf	Counter Overflow
	01	*_Ch2_CtUdf	Counter Underflow
	02	*_Ch2_CtRun	Counter Running/Gate Open
	03	*_Ch2_CntDir	Counter Direction
	04	*_Ch2_PrstSta	Preset Activated
	05	*_Ch2_RstSta	Reset Activated
	06	Undefined	Capture Activated
	07	*_Ch2_ZSig	Z-signal Activated
	08 to 09	Undefined	---
	10	Undefined	Pulse Rate Range 0 active
	11	Undefined	Pulse Rate Range 1 active
	12 to 14	Undefined	---
	15	*_Ch2_SmplCntSta	Simple Counter
n+30 to n+39	0015		---

* Names used in CJ-Series

Special I/O Unit DM Area (Allocated DM Area words)

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word	Bit	Variable name	Description
General			
m	00 to 07	*_OutCtlMdCfg	Output Control Mode
	08 to 15	Bits 00 to 07: Output Control Mode Bits 08 to 15: Counter output pattern AND/OR selection	Counter Output Pattern AND/OR Selection
m+1	00 to 15	Undefined	External Interrupt Task No. Offset (Output)
m+2, m+3	00 to 15	Undefined	External Interrupt Task Enable Data (Output)
m+4	00 to 15	Undefined	External Interrupt Task No. Offset (Digital Input)
m+5	00 to 15	Undefined	External Interrupt Task Enable Data (Digital Input)
m+6	00, 01	*_OutStaCtlMdCfg Bit 00: Output 0	Output Driver (NPN/PNP) Selection
	02 to 11	Bit 01: Output 1	---
	12 to 15	Bit 12 to 15: Output state control	Output State Control
m+7	00 to 07	*_NoiseFitCntCfg	Input Noise Filter Digital Inputs
	08 to 15		---
m+8	00 to 07	*_NoiseFitInCfg	Input Noise Filter Digital Inputs
	08 to 15		---
m+9	00 to 15	*_OutOnDelayTm0Cfg	Output Pulse Turn ON-Delay Time (BCD) Digital Output 0
m+10	00 to 15	*_OutDur0Cfg	Output Pulse Duration (BCD) Digital Output 0
m+11	00 to 15	*_OutOnDelayTm1Cfg	Output Pulse Turn ON-Delay Time (BCD) Digital Output 1
m+12	00 to 15	*_OutDur1Cfg	Output Pulse Duration (BCD) Digital Output 1
m+13 to m+16	00 to 15	Undefined	Reserved
m+17	00 to 07	*_DigIn0FunCfg Bits 00 to 07: External control input 0 function selection	Digital Input 0 Function/Counter Number
	08 to 15	Bits 08 to 15: Counter number (external control input 0)	Counter Number (Digital Input 0)
m+18	00 to 07	*_DigIn1FunCfg Bits 00 to 07: External control input 1 function selection	Digital Input 1 Function/Counter Number
	08 to 15	Bits 08 to 15: Counter number (external control input 1)	Counter number (Digital Input 1)
m+19, m+20	00 to 15	Undefined	Reservation
m+21, m+22	00 to 15	*_PreOutPatCfg	Predefined Output Pattern
m+23 to m+29	00 to 15	Undefined	---
Counter 1			
m+30	00 to 15	*_Ch1_CtTypCfg	Counter Type

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word	Bit	Variable name	Description
m+31	00 to 03	*_Ch1_SigTypCfg	Signal Type
	04 to 15		---
m+32	00 to 03	*_Ch1_ZOvfUdfCfg Bits 00 to 03: Reset by Z phase Bits 04 to 07: Overflow/underflow error setting	Z-reset Mode
	04 to 07		Overflow/Underflow error-code generation
	08 to 15		---
m+33, m+34	00 to 15	*_Ch1_UpCtLmtCfg	Upper Count Limit Circular/Linear
m+35, m+36	00 to 15	*_Ch1_LowCtLmtCfg	Lower Count Limit Linear
m+37, m+38	00 to 15	*_Ch1_InitLinCtCfg, *_Ch1_InitRingCtCfg	Initial Count Value
m+39	00 to 15	Undefined	Time Window (Pulse Rate Measurement)
m+40, m+41	00 to 15	Undefined	Pulse Rate Range 0 Lower Limit
m+42, m+43	00 to 15	Undefined	Pulse Rate Range 0 Upper Limit
m+44, m+45	00 to 15	Undefined	Pulse Rate Range 0 Output Set Pattern
m+46, m+47	00 to 15	Undefined	Pulse Rate Range 0 Output Reset Pattern
m+48, m+49	00 to 15	Undefined	Pulse Rate Range 1 Lower Limit
m+50, m+51	00 to 15	Undefined	Pulse Rate Range 1 Upper Limit
m+52, m+53	00 to 15	Undefined	Pulse Rate Range 1 Output Set Pattern
m+54, m+55	00 to 15	Undefined	Pulse Rate Range 1 Output Reset Pattern
m+56	00	Undefined	Pulse Rate Range 0 Enabled
	01		Pulse Rate Range 1 Enabled
	02 to 15		---
m+57, m+58	00 to 15	*_Ch1_RngCmpEnblCfg	Range/Comparison Enable Data
m+59, m+60	00 to 15	*_Ch1_OutSetPatCfg	Output Set Pattern
m+61, m+62	00 to 15	*_Ch1_OutRstPatCfg	Output Reset Pattern
m+63	00 to 15	*_Ch1_HystrsCfg	Hysteresis
m+64	00 to 07	*_Ch1_NumRngCmpCfg	Number of Ranges/Comparison Values (BCD)
	08 to 15		---
m+65	00 to 03	*_Ch1_MemAreaCfg	Memory Area
	04 to 15		---
m+66, m+67	00 to 15	*_Ch1_MemAdrCfg	Memory Address (BCD)

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word	Bit	Variable name	Description
m+68 to m+74	00 to 15	Undefined	---
Counter 2			
m+75	00 to 15	*_Ch2_CtTypCfg	Counter Type
m+76	00 to 03	*_Ch2_SigTypCfg	Signal Type
	04 to 15		---
m+77	00 to 03	*_Ch2_ZOvfUdfCfg	Z-reset Mode
	04 to 07	Bits 00 to 03: Reset by Z phase	Overflow/Underflow error-code generation
	08 to 15	Bits 04 to 07: Overflow/underflow error setting	
m+78, m+79	00 to 15	*_Ch2_UpCtLmtCfg	Upper Count Limit Circular/Linear
m+80, m+81	00 to 15	*_Ch2_LowCtLmtCfg	Lower Count Limit Linear
m+82, m+83	00 to 15	*_Ch2_InitLinCtCfg, *_Ch2_InitRingCtCfg	Initial Count Value
m+84	00 to 15	Undefined	Time Window (Pulse Rate Measurement)
m+85, m+86	00 to 15	Undefined	Pulse Rate Range 0 Lower Limit
m+87, m+88	00 to 15	Undefined	Pulse Rate Range 0 Upper Limit
m+89, m+90	00 to 15	Undefined	Pulse Rate Range 0 Output Set Pattern
m+91, m+92	00 to 15	Undefined	Pulse Rate Range 0 Output Reset Pattern
m+93, m+94	00 to 15	Undefined	Pulse Rate Range 1 Lower Limit
m+95, m+96	00 to 15	Undefined	Pulse Rate Range 1 Upper Limit
m+97, m+98	00 to 15	Undefined	Pulse Rate Range 1 Output Set Pattern
m+99, m+100	00 to 15	Undefined	Pulse Rate Range 1 Output Reset Pattern
m+101	00	Undefined	Pulse Rate Range 0 Enabled
	01		Pulse Rate Range 1 Enabled
	02 to 15		---
m+102, m+103	00 to 15	*_Ch2_RngCmpEnblCfg	Range/Comparison Enable Data
m+104, m+105	00 to 15	*_Ch2_OutSetPatCfg	Output Set Pattern
m+106, m+107	00 to 15	*_Ch2_OutRstPatCfg	Output Reset Pattern
m+108	00 to 15	*_Ch2_HystrsCfg	Hysteresis
m+109	00 to 07	*_Ch2_NumRngCmpCfg	Number of Ranges/Comparison Values (BCD)
	08 to 15		---

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word	Bit	Variable name	Description
m+110	00 to 03	*_Ch2_MemAreaCfg	Memory Area
	04 to 15		---
m+111, m+112	00 to 15	*_Ch2_MemAdrCfg	Memory Address (BCD)
m+113 to m+399	00 to 15	Undefined	---

Range Data

Range data is set in the user-defined variable.

Two types of structure data are prepared beforehand for range data user-defined variables: one type for Linear Counters and one type for Circular Counters.

Use these structures to define user-defined variables.

Data type (name)	Member	Data type	Name
_sCJCT021_Ex_RngLin	LowLmt	DINT	Lower Limit Range 0
	UpLmt	DINT	Upper Limit Range 0
	OutPat	DWORD	Output Pattern Range 0
_sCJCT021_Ex_RngRing	LowLmt	UDINT	Lower Limit Range 0
	UpLmt	UDINT	Upper Limit Range 0
	OutPat	DWORD	Output Pattern Range 0

The table below is an example in which 32 Linear Counter range structure data type (_sCJCT021_Ex_RngLin) are used as user-defined variables and the variable name is defined as "aaaa".

k is set with device variables for CJ-series Unit *_Ch#_MemAreaCfg and *_Ch#_MemAdrCfg.

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word	Bit	Variable name	Description
k to k+5		aaaa[0]	Range 0
k, k+1 k+2, k+3 k+4, k+5	00 to 15	aaaa[0].LowLmt	Lower Limit Range 0
	00 to 15	aaaa[0].UpLmt	Upper Limit Range 0
	00 to 15	aaaa[0].OutPat	Output Pattern Range 0
k+6 to k+11	00 to 15	aaaa[1]	Range 1
k+12 to k+17	00 to 15	aaaa[2]	Range 2
k+18 to k+23	00 to 15	aaaa[3]	Range 3
k+24 to k+29	00 to 15	aaaa[4]	Range 4
k+30 to k+35	00 to 15	aaaa[5]	Range 5
k+36 to k+41	00 to 15	aaaa[6]	Range 6
k+42 to k+47	00 to 15	aaaa[7]	Range 7
k+48 to k+53	00 to 15	aaaa[8]	Range 8
k+54 to k+59	00 to 15	aaaa[9]	Range 9
k+60 to k+65	00 to 15	aaaa[10]	Range 10
k+66 to k+71	00 to 15	aaaa[11]	Range 11
k+72 to k+77	00 to 15	aaaa[12]	Range 12
k+78 to k+83	00 to 15	aaaa[13]	Range 13

CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word	Bit	Variable name	Description
k+84 to k+89	00 to 15	aaaa[14]	Range 14
k+90 to k+95	00 to 15	aaaa[15]	Range 15
k+96 to k+101	00 to 15	aaaa[16]	Range 16
k+102 to k+107	00 to 15	aaaa[17]	Range 17
k+108 to k+113	00 to 15	aaaa[18]	Range 18
k+114 to k+119	00 to 15	aaaa[19]	Range 19
k+120 to k+125	00 to 15	aaaa[20]	Range 20
k+126 to k+131	00 to 15	aaaa[21]	Range 21
k+132 to k+137	00 to 15	aaaa[22]	Range 22
k+138 to k+143	00 to 15	aaaa[23]	Range 23
k+144 to k+149	00 to 15	aaaa[24]	Range 24
k+150 to k+155	00 to 15	aaaa[25]	Range 25
k+156 to k+161	00 to 15	aaaa[26]	Range 26
k+162 to k+167	00 to 15	aaaa[27]	Range 27
k+168 to k+173	00 to 15	aaaa[28]	Range 28
k+174 to k+179	00 to 15	aaaa[29]	Range 29
k+180 to k+185	00 to 15	aaaa[30]	Range 30
k+186 to k+191	00 to 15	aaaa[31]	Range 31

Comparison Data

Comparison data is set in the user-defined variable.

Two types of structure data are prepared beforehand for comparison data user-defined variables: one type for Linear Counters and one type for Circular Counters.

Use these structures to define user-defined variables.

Data type (name)	Member	Data type	Name
_sCJCT021_Ex_CmpLin	CmpVal	DINT	Comparison Value
	AddSetPat	DWORD	+Set Pattern
	AddRstPat	DWORD	+Reset Pattern
	SubSetPat	DWORD	-Set Pattern
	SubRstPat	DWORD	-Reset Pattern
_sCJCT021_Ex_CmpRing	CmpVal	UDINT	Comparison Value
	AddSetPat	DWORD	+Set Pattern
	AddRstPat	DWORD	+Reset Pattern
	SubSetPat	DWORD	-Set Pattern
	SubRstPat	DWORD	-Reset Pattern

The table below is an example in which 32 Circular Counter comparison structure data type (_sCJCT021_Ex_CmpRing) are used as user-defined variables and the variable name is defined as "bbb".

k is set with device variables for CJ-series Unit *_Ch#_MemAreaCfg and *_Ch#_MemAdrCfg.

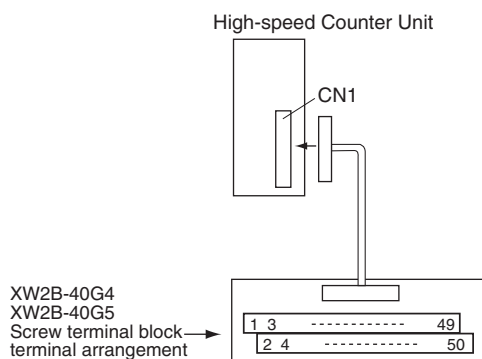
CJ-series I/O memory address		NJ-series device variables for CJ-series Unit	
Word	Bit	Variable name	Description
k to k+9		bbbb[0]	Comparison data 0
k, k+1	00 to 15	bbbb[0].CmpVal	Comparison data 0 Comparison Value
k+2, k+3	00 to 15	bbbb[0].AddSetPat	Comparison data 0 +Set Pattern
k+4, k+5	00 to 15	bbbb[0].AddRstPat	Comparison data 0 +Reset Pattern
k+6, k+7	00 to 15	bbbb[0].SubSetPat	Comparison data 0 –Set Pattern
k+8, k+9	00 to 15	bbbb[0].SubRstPat	Comparison data 0 –Reset Pattern
k+10 to k+19	00 to 15	bbbb[1]	Comparison data 1
k+20 to k+29	00 to 15	bbbb[2]	Comparison data 2
k+30 to k+39	00 to 15	bbbb[3]	Comparison data 3
k+40 to k+49	00 to 15	bbbb[4]	Comparison data 4
k+50 to k+59	00 to 15	bbbb[5]	Comparison data 5
k+60 to k+69	00 to 15	bbbb[6]	Comparison data 6
k+70 to k+79	00 to 15	bbbb[7]	Comparison data 7
k+80 to k+89	00 to 15	bbbb[8]	Comparison data 8
k+90 to k+99	00 to 15	bbbb[9]	Comparison data 9
k+100 to k+109	00 to 15	bbbb[10]	Comparison data 10
k+110 to k+119	00 to 15	bbbb[11]	Comparison data 11
k+120 to k+129	00 to 15	bbbb[12]	Comparison data 12
k+130 to k+139	00 to 15	bbbb[13]	Comparison data 13
k+140 to k+149	00 to 15	bbbb[14]	Comparison data 14
k+150 to k+159	00 to 15	bbbb[15]	Comparison data 15
k+160 to k+169	00 to 15	bbbb[16]	Comparison data 16
k+170 to k+179	00 to 15	bbbb[17]	Comparison data 17
k+180 to k+189	00 to 15	bbbb[18]	Comparison data 18
k+190 to k+199	00 to 15	bbbb[19]	Comparison data 19
k+200 to k+209	00 to 15	bbbb[20]	Comparison data 20
k+210 to k+219	00 to 15	bbbb[21]	Comparison data 21
k+220 to k+229	00 to 15	bbbb[22]	Comparison data 22
k+230 to k+239	00 to 15	bbbb[23]	Comparison data 23
k+240 to k+249	00 to 15	bbbb[24]	Comparison data 24
k+250 to k+259	00 to 15	bbbb[25]	Comparison data 25
k+260 to k+269	00 to 15	bbbb[26]	Comparison data 26
k+270 to k+279	00 to 15	bbbb[27]	Comparison data 27
k+280 to k+289	00 to 15	bbbb[28]	Comparison data 28
k+290 to k+299	00 to 15	bbbb[29]	Comparison data 29
k+300 to k+309	00 to 15	bbbb[30]	Comparison data 30
k+310 to k+319	00 to 15	bbbb[31]	Comparison data 31

A-2 Using Terminal Block Units with Screw-terminals

This section describes the signal layout of the screw terminals on the Connector Terminal Converter Unit (XW2B-40G4 or XW2B-40G5). The Unit is used to connect external signals such as power supply signals, digital I/O signals, and Counter input signals to a CJ1W-CT021 High-speed Counter Unit.

Item	Connector 1 (CN1)				
	Terminal Block Unit 1:Screw-terminal Number				
Power Supply (to feed the outputs)	-PS: 0 V	1	+PS:12 to 24 V	2	
Digital Outputs [0-1] (NPN/PNP)	O0: NPN	3	O0: PNP	4	
	O1: NPN	5	O1: PNP	6	
Spare		7		8	
Digital Inputs [0-1]	I0: 0 V	9	I0: 24 V	10	
	I1: 0 V	11	I1: 24 V	12	
Spare		13		14	
Counter 1	A	CH1: LD-/0 V	15	CH1: LD+	16
		CH1: 5 V	17	CH1: 24 V	18
	B	CH1: LD-/0 V	19	CH1: LD+	20
		CH1: 5 V	21	CH1: 24 V	22
	Z	CH1: LD-/0 V	23	CH1: LD+	24
		CH1: 5 V	25	CH1: 24 V	26
Spare		27		28	
Counter 2	A	CH2: LD-/0 V	29	CH2: LD+	30
		CH2: 12 V	31	CH2: 24 V	32
	B	CH2: LD-/0 V	33	CH2: LD+	34
		CH2: 12 V	35	CH2: 24 V	36
	Z	CH2: LD-/0 V	37	CH2: LD+	38
		CH2: 12 V	39	CH2: 24 V	40

● Connections



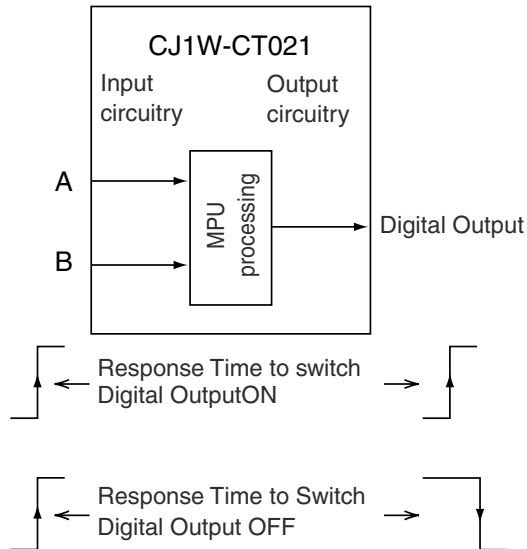


Additional Information

The top row of the Terminal Block Unit (numbered 1 to 39) corresponds to the pins numbered A1 to A20 of the associated connector (CN1) on the High-speed Counter Unit. The bottom row of the Terminal Block Unit (numbered 2 to 40) corresponds to the pins numbered B1 to B20 of the associated connector (CN1) on the Unit.

A-3 Description of the Response Time

The Response Time of the CJ1W-CT021 High-speed Counter Unit is the time between the Unit receiving a count pulse (on one of the Counter inputs A or B) and the switching (ON or OFF) of a corresponding Digital Output.



The Response Time can vary between 0.1 and 0.5 milliseconds, but is guaranteed to be less than 0.5 milliseconds. The following factors cause the Response Time to fluctuate:

- The number of Counters for which the range comparison or target-value comparison condition meets simultaneously

The maximum Response Time of 0.5 milliseconds can no longer be guaranteed and will temporarily become longer than 0.5 milliseconds in case you make use of:

- Programmable output ON
- Digital Inputs or Z-inputs



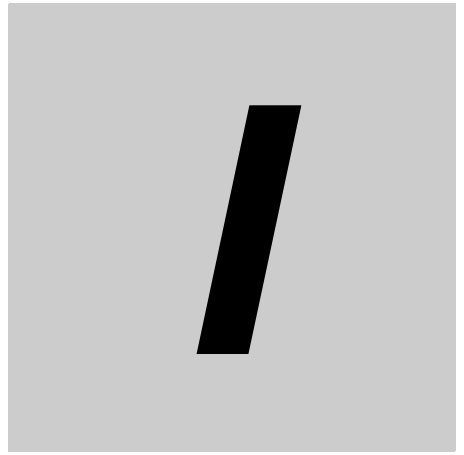
Additional Information

- When one of the above functions is used, the approximate response time will be as follows:
Response time = 0.5 ms + function execution time.
- A Digital Input or Z phase input takes about 300 μ s.

A-4 Application Restrictions

The following restrictions apply when using CJ1W-CT021 High-speed Counter Units.

Restriction	Reference
When a 50-kHz noise filter is configured, External Control Inputs cannot read signals shorter than 10 μ s.	1-3-3 <i>Input Specifications</i>
The time from signal input to resetting for External Control Inputs is 300 μ s max.	3-4 <i>Digital Input Functions</i>
The Open Gate, Close Gate, Preset Counter or Reset in device variables for CJ-series Unit (for output) may not be executed if the CPU Unit is ON for only one task period. Always keep them turned ON until the status changes in the corresponding bit.	3-4 <i>Digital Input Functions</i> 4-2 <i>Memory Allocation</i>
External Control Inputs may not be reflected in the status of External Inputs (n+2, n+5) if the pulse width is extremely short. The following are the main reasons for this: <ul style="list-style-type: none"> The signal is shorter than the CPU Unit task period. 	3-4 <i>Digital Input Functions</i>
The comparison operation stops for 1.5 ms from when the High-speed Counter Value falls within the Upper Range Limit or Lower Range Limit for the range data. However, the comparison does not stop for other Counters. Consider the time that the comparison is stopped when making settings for range data.	3-5-1 <i>Range Mode</i>
When the High-speed Counter Value reaches the comparison value, comparison stops for 1.5 ms. However, comparison for other Counters does not stop. Consider the time the comparison stops when setting Comparison Data.	3-5-2 <i>Comparison Mode</i>
I/O is not refreshed during unit initialization processing (while "_UnitInitSta" is ON). Note that Counter Values are not updated during this time.	4-1-1 <i>Data Flow</i>
At a restart or when the Controller is reset, including when the power is turned ON, the variable "_UnitInitSta" (unit initialization being processed) is ON for about 120 ms.	4-2-3 <i>Details of Device Variables for CJ-series Unit (for input/output)</i>
When any function which cannot guarantee the response time of 0.5 ms is used, the approximate response time will be as follows: Response time = 0.5 ms + function execution time A Digital Input or Z phase input takes about 300 μ s.	A-3 <i>Description of the Response Time</i>



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